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Appendix A: HENs and State-Level Distribution

Hospital Engagement Network (HEN) Acronyms

HEN full and abbreviated names used in this report are listed below in Table A-1.

Table A-1—HEN Acronyms

HEN Name	Acronym
American Hospital Association/Health Research and Educational Trust	AHA/HRET
Ascension Health	Ascension
Carolinas HealthCare System	Carolinas
Dallas-Fort Worth Hospital Council Foundation	DFW
Dignity Health (formerly Catholic Healthcare West)	Dignity
Essential Hospitals Engagement Network	EHEN
Georgia Hospital Association Research and Education Foundation	Georgia
Intermountain Healthcare	Intermountain
Iowa Healthcare Collaborative	Iowa
Joint Commission Resources	JCR
LifePoint Hospitals	LifePoint
Michigan Health & Hospital Association	Michigan
Minnesota Hospital Association	Minnesota
Nevada Hospital Association	Nevada
New Jersey Hospital Association/Health Research and Educational Trust of New Jersey	New Jersey
New York State PfP (Healthcare Association of New York State [HANYS] and Greater New York Hospital Association [GNYHA])	New York
North Carolina Virginia Regional HEN	NoCVA
Ohio Children's Hospitals' Solutions for Patient Safety	Ohio Children's
Ohio Hospital Association	Ohio
Hospital Association of Pennsylvania	Pennsylvania
Premier Healthcare Alliance	Premier
Tennessee Hospital Association	Tennessee
Texas Center for Quality and Patient Safety	TCQPS
University Health System Consortium	UHC
VHA Inc.	VHA
Washington State Hospital Association	Washington

HEN Distribution by State

Table A-2 provides the state-level distribution for Partnership for Patients (PfP) aligned hospitals. The interrupted time series (ITS) results for the state hospital associations (SHAs) that were HENs are provided in Chapter 4 and Chapter 5 of the main body of this report. Additionally, the qualitative results by HEN and SHA can be found in Chapter 3 and Appendix E.

Table A-2—HEN Distribution by State

State	HEN Name	Percentage of PfP-Aligned Hospitals
Alabama	AHA/HRET	49.18%
	Ascension Cohort 1	8.20%
	JCR Cohort 1	3.28%
	LifePoint	8.20%
	Ohio Children's Cohort 2	1.64%
	Premier	6.56%
	UHC	1.64%
	VHA	21.31%
Alaska	AHA/HRET	81.25%
	Premier	6.25%
	VHA	12.50%
Arizona	AHA/HRET	31.37%
	Ascension Cohort 1	5.88%
	Dignity	5.88%
	EHEN	1.96%
	Intermountain	1.96%
	JCR Cohort 1	1.96%
	LifePoint	3.92%
	Ohio Children's Cohort 2	1.96%
	Premier	27.45%
	UHC	1.96%
	VHA	1.96%
Arkansas	AHA/HRET	79.17%
	JCR Cohort 1	2.08%
	Tennessee	2.08%
	VHA	16.67%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
California	AHA/HRET	55.91%
	Dignity	11.81%
	EHEN	3.15%
	Intermountain	7.87%
	Ohio Children's Cohort 1	1.18%
	Ohio Children's Cohort 2	1.97%
	Premier	12.20%
	UHC	3.54%
	VHA	2.36%
Colorado	AHA/HRET	76.19%
	Intermountain	2.38%
	LifePoint	2.38%
	Ohio Children's Cohort 1	2.38%
	Premier	11.90%
	UHC	2.38%
	VHA	2.38%
Connecticut	AHA/HRET	83.33%
	Ascension Cohort 1	3.33%
	JCR Cohort 1	3.33%
	Ohio Children's Cohort 2	6.67%
	VHA	3.33%
District of Columbia	AHA/HRET	28.57%
	Ascension Cohort 1	14.29%
	EHEN	14.29%
	Ohio Children's Cohort 1	14.29%
	Premier	14.29%
	UHC	14.29%
Delaware	Ohio Children's Cohort 1	100.00%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
Florida	AHA/HRET	53.38%
	Ascension Cohort 1	3.76%
	Ascension Cohort 2	0.75%
	Intermountain	0.75%
	JCR Cohort 1	1.50%
	LifePoint	0.75%
	Ohio Children's Cohort 2	2.26%
	Premier	22.56%
	UHC	1.50%
	VHA	12.78%
Georgia	Georgia	83.33%
	LifePoint	0.76%
	Ohio Children's Cohort 1	0.76%
	Premier	7.58%
	VHA	7.58%
Hawaii	Ohio Children's Cohort 2	5.00%
	Premier	95.00%
Idaho	AHA/HRET	71.43%
	Ascension Cohort 1	7.14%
	Intermountain	7.14%
	Premier	7.14%
	VHA	7.14%
Illinois	AHA/HRET	66.21%
	Ascension Cohort 1	1.38%
	EHEN	1.38%
	Iowa	2.76%
	JCR Cohort 1	5.52%
	JCR Cohort 2	4.83%
	Ohio Children's Cohort 2	1.38%
	Premier	8.28%
	UHC	2.76%
	VHA	5.52%

Table A-2—HEN Distribution by State

State	HEN Name	Percentage of PfP-Aligned Hospitals
Indiana	AHA/HRET	77.78%
	Ascension Cohort 1	11.90%
	Ascension Cohort 2	0.79%
	EHEN	0.79%
	LifePoint	0.79%
	Ohio Children's Cohort 1	0.79%
	UHC	2.38%
	VHA	4.76%
Iowa	Iowa	98.28%
	JCR Cohort 1	0.86%
	UHC	0.86%
Kansas	AHA/HRET	89.29%
	Ascension Cohort 2	6.25%
	LifePoint	0.89%
	Premier	0.89%
	UHC	0.89%
	VHA	1.79%
Kentucky	AHA/HRET	79.07%
	LifePoint	10.47%
	Premier	6.98%
	UHC	2.33%
	VHA	1.16%
Louisiana	AHA/HRET	76.04%
	LifePoint	5.21%
	Ohio Children's Cohort 2	1.04%
	Premier	2.08%
	UHC	1.04%
	VHA	14.58%
Maine	VHA	100.00%
Maryland	Ascension Cohort 1	4.35%
	JCR Cohort 2	4.35%
	Premier	52.17%
	UHC	34.78%
	VHA	4.35%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
Massachusetts	AHA/HRET	41.67%
	Ohio Children's Cohort 1	2.78%
	Ohio Children's Cohort 2	2.78%
	Premier	16.67%
	UHC	33.33%
	VHA	2.78%
Michigan	Ascension Cohort 1	10.43%
	JCR Cohort 1	0.87%
	LifePoint	0.87%
	Michigan Cohort 1	59.13%
	Michigan Cohort 2	23.48%
	Ohio Children's Cohort 1	1.74%
	UHC	2.61%
	VHA	0.87%
Minnesota	Ascension Cohort 2	0.79%
	Intermountain	3.97%
	Minnesota	89.68%
	Ohio Children's Cohort 1	0.79%
	Ohio Children's Cohort 2	2.38%
	UHC	0.79%
Mississippi	AHA/HRET	40.00%
	JCR Cohort 1	4.44%
	LifePoint	2.22%
	Premier	24.44%
	Tennessee	11.11%
	UHC	2.22%
	VHA	15.56%
Missouri	AHA/HRET	77.78%
	Ascension Cohort 1	1.85%
	EHEN	1.85%
	JCR Cohort 1	1.85%
	JCR Cohort 2	3.70%
	Ohio Children's Cohort 1	1.85%
	Premier	8.33%
	UHC	2.78%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
Montana	AHA/HRET	74.29%
	Intermountain	8.57%
	Premier	2.86%
	VHA	5.71%
Nebraska	AHA/HRET	73.08%
	Iowa	15.38%
	JCR Cohort 1	1.92%
	Ohio Children's Cohort 2	1.92%
	Premier	1.92%
	UHC	1.92%
	VHA	1.92%
Nevada	Dignity	10.00%
	LifePoint	3.33%
	Nevada	80.00%
	Premier	3.33%
	UHC	3.33%
New Hampshire	AHA/HRET	88.89%
	Intermountain	7.41%
	Ohio Children's Cohort 2	3.70%
New Jersey	NJ	87.32%
	Premier	4.23%
	UHC	5.63%
	VHA	2.82%
New Mexico	AHA/HRET	55.56%
	Intermountain	16.67%
	LifePoint	5.56%
	UHC	2.78%
New York	Ascension Cohort 1	1.75%
	EHEN	0.58%
	New York	88.30%
	Ohio Children's Cohort 1	0.58%
	Ohio Children's Cohort 2	2.34%
	Premier	4.09%
	UHC	2.34%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
North Carolina	Carolinas	20.00%
	LifePoint	2.73%
	NoCVA	70.00%
	Premier	7.27%
North Dakota	AHA/HRET	77.27%
	JCR Cohort 1	6.82%
	VHA	11.36%
Ohio	EHEN	0.78%
	JCR Cohort 1	0.78%
	Ohio	53.13%
	Ohio Children's Cohort 1	6.25%
	Premier	30.47%
	UHC	2.34%
	VHA	6.25%
Oklahoma	AHA/HRET	62.67%
	Ascension Cohort 2	8.00%
	Premier	2.67%
	VHA	24.00%
Oregon	AHA/HRET	64.00%
	Intermountain	16.00%
	Premier	4.00%
	WA	16.00%
Pennsylvania	JCR Cohort 1	0.68%
	Ohio Children's Cohort 1	1.36%
	Ohio Children's Cohort 2	2.04%
	Pennsylvania	76.19%
	Premier	6.12%
	UHC	3.40%
	VHA	10.20%
Puerto Rico	AHA/HRET	100.00%
Rhode Island	AHA/HRET	66.67%
	Ohio Children's Cohort 2	8.33%
	UHC	25.00%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
South Carolina	Carolinas	9.52%
	Ohio Children's Cohort 2	4.76%
	Premier	82.54%
	UHC	3.17%
South Dakota	AHA/HRET	70.83%
	JCR Cohort 1	2.08%
	Premier	14.58%
	VHA	4.17%
Tennessee	Ascension Cohort 1	4.44%
	EHEN	1.11%
	JCR Cohort 1	1.11%
	LifePoint	8.89%
	Ohio Children's Cohort 1	1.11%
	Ohio Children's Cohort 2	4.44%
	Premier	7.78%
	Tennessee	61.11%
	VHA	10.00%
Texas	Ascension Cohort 1	6.18%
	DFW	11.80%
	EHEN	2.81%
	Intermountain	7.30%
	JCR Cohort 1	1.69%
	JCR Cohort 2	1.12%
	LifePoint	1.69%
	Ohio Children's Cohort 1	1.12%
	Ohio Children's Cohort 2	0.56%
	Premier	15.17%
	TCQPS	42.13%
	UHC	3.37%
	VHA	5.06%
Utah	Intermountain	84.00%
	LifePoint	8.00%
	Ohio Children's Cohort 1	4.00%
	UHC	4.00%

Table A-2—HEN Distribution by State		
State	**HEN Name**	**Percentage of PfP-Aligned Hospitals**
Vermont	Intermountain	80.00%
	Ohio Children's Cohort 2	20.00%
Virginia	LifePoint	7.14%
	NoCVA	47.14%
	Ohio Children's Cohort 2	2.86%
	Premier	37.14%
	UHC	2.86%
	VHA	2.86%
Washington	Ascension Cohort 1	1.10%
	Ohio Children's Cohort 1	1.10%
	Ohio Children's Cohort 2	1.10%
	Premier	1.10%
	UHC	2.20%
	WA	93.41%
West Virginia	AHA/HRET	60.00%
	LifePoint	4.44%
	Premier	31.11%
	UHC	2.22%
	VHA	2.22%
Wisconsin	AHA/HRET	75.83%
	Ascension Cohort 1	1.67%
	Ascension Cohort 2	10.83%
	Intermountain	4.17%
	Minnesota	0.83%
	Ohio Children's Cohort 1	0.83%
	Premier	4.17%
	UHC	1.67%
Wyoming	AHA/HRET	81.82%
	Intermountain	4.55%
	LifePoint	4.55%
	Premier	9.09%

Source: HEN-submitted monthly hospital lists.

Appendix B: Secondary Data Sources

This appendix provides detailed information about the Hospital Engagement Network (HEN) data and national data used in the analyses included in the report.

HEN Data

HEN-Level Data (Source: HEN-Submitted Monthly Reports)

HEN-level data were collected for a total of 1,940 distinct measures from several different data sources. This included run chart data the HENs submitted in their November 2014 monthly reports, as well as more than 300 measures obtained by the Evaluation Contractor from national sources, including the Center for Medicare & Medicaid Services (CMS), Medicare, the Centers for Disease Control and Prevention's (CDC's) National Healthcare Safety Network (NHSN), and the National Database of Nursing Quality Indicators® (NDNQI®).[B-1] For further discussion, see Appendix D.

HEN Monthly Z-5 Spreadsheets

HENs submitted monthly spreadsheets that reported each aligned hospital's engagement and harm reduction progress in each of the Partnership for Patients (PfP) focus areas using a "Z-5" scale. In addition, the HEN classified each hospital ("Yes," "No," or "Unknown") on five process metrics for patient and family engagement (PFE) and four metrics for leadership. Twenty-six HENs' data were used in analyses, and any hospital that appeared in the HENs' list of aligned hospitals for any month was included. Changes in HEN-aligned hospital lists over time were incremental and included hospitals dropping off the list (often due to organizational change) or newly appearing (also due to organizational change, or to newly joining PfP). All hospitals nationwide that are not part of a HEN's list are considered "non-aligned," and belong to the pool of potential comparison hospitals. The list of hospitals was merged to the American Hospital Association (AHA) survey at the hospital level to obtain data regarding hospital characteristics.

PfP HEN Major Initiatives and Partnership Timeline (HEN Timeline Data)

In fall 2014, the Evaluation Contractor asked each HEN to list the timing and content of all major initiatives and partnerships the HEN had implemented or created over the course of the campaign in pursuit of the PfP goals. The HENs were provided with an Excel template including instructions on how to select relevant initiatives and partnerships and how to organize their responses. A major initiative was defined as "[T]hose activities or sets of activities that, when viewed as a group over time, represent a significant focus of attention by the HEN on influencing hospital practices and behaviors on a HEN-wide basis." A partnership was defined as "Collaboration between the HEN and another organization in which activity is oriented toward the spread of practices and policies that are expected to have a direct impact on patient harm reduction."

[B-1] NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

All HENs returned completed timeline templates and supporting documents to the Evaluation Contractor. However, the Minnesota HEN's data was incomplete and not used in analyses.

The timeline data were coded, with at least two analytic staff reviewing each coding choice. Each initiative was classified as either "coaching," "education and training," "leadership development," or "tool development and dissemination." Each partnership was classified as "Federal Partner," "National Private Partner," "State and Local Health Organization," "State and Local Private Organization," "State Hospital Association," "Subject Matter Expert," "Other HENs," or "Other." Some initiatives and partnerships were explicitly targeted at specific AEAs or measures, while others, such as those promoting a general culture of safety, were presented as "cross-cutting."

HENs provided begin date, end date, and frequency of activity or involvement for each initiative and partnership. This information was used to calculate the number of activities and partnerships of each type active during each month and quarter for each AEA within each HEN, beginning in January 2012 and ending in December 2014.

Hospital Engagement Network (HEN) Data Validation

Overview of the Data Validation Analyses

The HEN-submitted data were self-reported by Partnership for Patients (PfP) campaign participants. To ensure the quality of the data being analyzed, the Evaluation Contractor examined the quality and consistency of the HENs' data submitted during the PfP campaign against external sources of data. The Evaluation Contractor conducted the following assessments in a two-pronged approach:

- Compared the rates and trends calculated during PfP from data submitted by 12 HENs to those calculated from external HEN-specific data sources.
- Assessed the reasonableness of the HENs' recognition of 527 hospitals as high performing (by giving them Z-5 scores of "4" or "5") by calculating the hospitals' measure rates from an external data source.[B-2]

The Evaluation Contractor submitted two briefs, which presented these analyses.[B-3,B-4] Taken together, the results indicate an encouraging degree of reasonableness and validity in the data reported by the HENs throughout the PfP campaign. This appendix provides a summary of the results submitted to Center for Medicare & Medicaid Services (CMS).

HEN-Reported Measure Rates were Consistent with Rates Calculated from Independent Data Sources

The Evaluation Contractor examined the trends of adverse events and readmissions for PfP-aligned hospitals as reported by 12 of the 26 HENs during the course of PfP, and compared them to the HENs' trends obtained from other national databases. This analysis was not designed to establish the validity or accuracy of the HEN data, but rather to check the reasonableness of the data and to evaluate its quality and consistency against external data sources.

Consistency among various data sources was determined by asking the following research questions:

- Were the slope and direction of the calculated trend lines from the different data sources similar?
- Were the measurement rates consistently reported at approximately the same level?

Data were gathered from the HENs for seven outcome measures representing five core adverse event areas (AEAs), plus 30-day, all-cause readmissions. These measures were selected because they were the same as or similar to measures reported in external databases available to the Evaluation Contractor. The measure rates examined were catheter-associated urinary tract infection (CAUTI) per 1,000 catheter days, central line-associated blood stream infection (CLABSI) per 1,000 medical and surgical discharges, surgical site infection (SSI)-colon surgery standardized infection ratio (SIR), SSI-abdominal hysterectomy SIR, pressure ulcers (Patient Safety Indicators [PSI]-03), venous thromboembolism (VTE) postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT) per 1,000 surgical discharges (PSI-12), and 30-day, all-cause readmissions.

B-2 The July 2014 Hospital List: http://www.healthcarecommunities.org/SearchResults.aspx?sb-search=pfp+July+2014+hospital+list&sb-inst=3_dnn_avtSearch&sb-logid=2542-mdw4k9cwtdyqk1va.

B-3 "*The Data Validation Brief*." Report submitted to CMS. Phoenix: Health Services Advisory Group, Inc. May 2015 (Revised).

B-4 "*Data Validation: An Assessment of Mentor Hospital Designations in the PfP Campaign*." Report submitted to CMS. Phoenix: Health Services Advisory Group, Inc. June 2015.

Results

For all 12 HENs, the slope and direction of trends for the seven outcome measures were consistent regardless of the data source. A different pattern was observed for the 30-day, all-cause readmissions rates, but was similar across all 12 contributing HENs. The readmission rates from the HEN monthly reports and the HEN-submitted hospital-level data were mutually consistent. However, both were lower than the rate calculated from the CMS data. This could be simply explained by the potential differences in measure specifications (e.g., all–payer versus Medicare) and not necessarily an indication that the HEN-submitted rates were not reasonable.[B-5]

Hospitals Identified by the HENs as High-Performing Had Very Low Rates of Patient Harm

The Evaluation Contractor examined the reasonableness of a second type of HEN-submitted data, the Z-5 scores HENs assigned to participating hospitals. HENs were asked to identify those hospitals that were high performing or mentor hospitals (high-performing hospitals) by awarding scores of "4" or "5," respectively, on the Z-5 scale.[B-6] The reasonableness of these scores was assessed by calculating the high-performing hospitals' rates for four specific measures calculated from Medicare claims data, an independent data source. If HENs accurately identified high performing hospitals it should be reflected in low rates of patient harms visible in the Medicare claims data. To allow for the normal lag in processing Medicare claims data, the hospitals scored as high performing in the July 2014 Hospital Lists were used in the analysis.

Four measures, representing adverse event areas (AEAs) addressed in the PfP campaign, were selected for this analysis and were CAUTI hospital-acquired condition (HAC): hospital-acquired urinary tract infections (UTI) in patients with indwelling urinary catheter per 1,000 device days, central venous catheter-related blood stream infections (CRBSI) (PSI-07): hospital-acquired infections due to central venous catheter per 1,000 medical and surgical discharges, pressure ulcers (PSI-03): hospital-acquired stage III or higher pressure ulcer per 1,000 medical and surgical discharges, and VTE PE/DVT (PSI-12): postoperative PE or DVT per 1,000 surgical discharges[B-7,B-8,B-9]

The analysis suggested that the HENs appropriately identified hospitals as high performing, since the Evaluation Contractor confirmed through an independent examination that those hospitals exhibited low rates of patient harm. This was demonstrated by the high number of quarters without any patient harms and the high number of quarters with rates equal to or better than benchmarks.

B-5 All trend graphs were provided in the following brief: "*The Data Validation Brief*." Report submitted to the Centers for Medicare & Medicaid Services. Phoenix: Health Services Advisory Group, Inc. May 2015 (Revised).

B-6 For complete discussion of the Z-5 scoring criteria, see PfP PEC: Hospital List Scoring Criteria and HEN-Wide Performance Benchmarks, April 2014. http://www.healthcarecommunities.org/SearchResults/ViewDocument.aspx?EntryId=78514&CategoryID=45041.

B-7 CRBSI rate, found at: http://www.qualityindicators.ahrq.gov/Downloads/Modules/PSI/V44/TechSpecs/PSI%2007%20Central%20Venous%20Catheter-Related%20Blood%20Stream%20Infection.pdf.

B-8 Pressure ulcer rate, found at: http://www.qualityindicators.ahrq.gov/Downloads/Modules/PSI/V44/TechSpecs/PSI%2003%20Pressure%20Ulcer%20Rate.pdf.

B-9 VTE perioperative PE or DVT rate technical specifications, found at: http://www.qualityindicators.ahrq.gov/Downloads/Modules/PSI/V50/TechSpecs/PSI_12_Perioperative_Pulmonary_Embolism_or_Deep_Vein_Thrombosis_Rate.pdf.

Results

The population of unique hospitals identified as high performing in the four AEAs was 527. The Evaluation Contractor confirmed that the HENs had correctly applied the criteria for awarding a score of "4" or "5." [B-10] Overall, the results indicate a high degree of concordance between the HEN designation as a high-performing hospital and observed rates of patient harm from the Medicare claims data. High-performing hospitals' Z-5 scores were supported by external data sources at 90.00 percent and above for CAUTI, CRBSI, and pressure ulcers (90.55 percent, 93.38 percent, and 96.30 percent, respectively). VTE was supported at 78.61 percent by external data sources.

The analysis confirmed that hospitals identified as high performing had very low rates of patient harms. An overall average of 60 percent of the hospitals were completely free from patient harm related to these four measures throughout the time period studied. Among those hospitals that reported any harm, the number of harm-free quarters greatly exceeded the number of quarters in which harms were reported.

[B-10] Hospitals met the criteria if they met one of two criteria: sustained high performance for an AEA for at least 3 months, or a zero rate for the previous 12 months.

Medicare Data

To conduct analysis of change in readmissions and inpatient harms for Medicare beneficiaries, the Evaluation Contractor used the Inpatient Standard Analytic 100 Percent File (Part A Medicare claims), limiting the file to fee-for-service (FFS) enrollees. Patient characteristics and diagnosis codes were identified using the Agency for Healthcare Research and Quality's (AHRQ's) patient safety indicator (PSI) algorithm, which allowed for integration of risk adjustments in the analyses. Center for Medicare & Medicaid Services (CMS) certification numbers (CCNs) and American Hospital Association (AHA identifiers were used to link the claims data to the AHA survey data set to provide additional details on hospital characteristics.

The Production and Implementation of Hospital Outcome and Efficiency Measures (PIHOEM) contract with CMS created inpatient analytic files, and after receiving permission from CMS, the Evaluation Contractor also used fully and partially constructed PIHOEM data files. To supplement data obtained from PIHOEM and obtain more recent administrative data, the Evaluation Contractor also used the Chronic Condition Warehouse's Virtual Research Data Center (CCW/VRDC).

Medicaid Data

The following sections first provide an overview of the processes that were implemented to determine which states' data to include in Medicaid analyses and to develop analytic files from raw Medicaid inpatient claims and eligibility data, and second, list the outcome measures that were created.

Developing Medicaid Analysis Files and Methods: Overview

State Selection

The Medicaid analyses were developed using individual states' Medicaid Statistical Information System (MSIS) and the Children's Health Insurance Program (CHIP) files. The Evaluation Contractor initially selected 27 states who met either of the following conditions: 1) the state had at least four quarters of 2012 inpatient (IP) and eligibility data available as of October 2013 (states included Alabama [AL], Alaska [AK], Arkansas [AR], California [CA], Connecticut [CT], Delaware [DE], Georgia [GA], Iowa [IA], Kentucky [KY], Maryland [MD], Michigan [MI], Missouri [MO], Mississippi [MS], Montana [MT], Oregon [OR], Pennsylvania [PA], South Dakota [SD], Tennessee [TN], Virginia [VA], and Wyoming [WY]) or 2) the state did not have data through 2012, but contained hospitals that might participate in analyses of obstetric and neonatal care based on medical record abstraction, for whom MSIS claims data were required to facilitate medical record abstraction work (these states included Arizona [AZ], Illinois [IL], Indiana [IN], Louisiana [LA], North Carolina [NC], Vermont [VT], and Washington [WA]).

Ten states were subsequently excluded as follows:

- AK, CA, KY, MS, TN, VA, and WA: In these states, analysts were unable to match at least 75 percent of claims to an AHA identification number (AHA ID) through the National Provider Identification (NPI) or MSIS legacy identification numbers found on the claims. The AHA ID links to data on participation status in Partnership for Patients (PfP) (i.e., Hospital Engagement Network [HEN]-aligned vs. non-aligned), and without this information, a considerable share of claims could not be assigned to the intervention or comparison group.
- AZ and NC: Relatively few IP claims (50 to 75 percent) could be matched to eligibility records over multiple quarters during the analysis period; eligibility data were needed to assign beneficiaries' claims to the correct demographic categories (i.e., age, sex, race and ethnicity, and Medicaid eligibility) for the regression models. In contrast, the match rate of IP claims to eligibility records in other states was 97 to 100 percent for all available quarters.
- DE: This state showed a relatively large decline in the share of IP claims that were fee-for-service (FFS) between 2009 and 2013, and a corresponding increase in encounter claims, suggesting most beneficiaries were moving from fee-for-service into managed care. The encounter claims in this state contained fewer diagnosis codes than the FFS claims in all quarters, suggesting the shift to managed care could bias results because of less complete diagnosis data in the encounter records. In addition, the share of encounter claims that matched to AHA ID varied from 3 to 98 percent over the study period.

The final set of 17 states included in these analyses include: AL, AR, CT, GA, IA, IL, IN, LA, MD, MI, MO, MT, OR, PA, SD, VT, and WY.

State-Specific Analysis Periods and Claim Types Included

To determine each state's analysis period, each IP claim made was matched (from the first calendar quarter of 2009 through the most recent calendar quarter) to eligibility data. The number of IP records that matched to an eligibility record for the month of the hospitalization (or if not eligible during the month of hospitalization to an eligibility record anytime within the preceding or subsequent 12 months) was assessed.[B-11] In addition to Medicaid eligibility status, the eligibility files contain key variables used for many analyses, including date of birth, date of death, sex, race, and ethnicity. State-quarters where fewer than 97 percent of IP records could be matched to an eligibility record at any time during the year before or after hospitalization were excluded from the analyses; in addition, regardless of whether the IP data met the 97 percent match threshold, the Evaluation Contractor excluded the last quarter of IP claims data for each state to account for the fact that there are often delays in IP claims submissions from providers, so that the last quarter may not have complete data.

In the states with Medicaid managed care programs, the Evaluation Contractor reviewed previous research on the quality and completeness of encounter data to determine whether the encounter data could be used.[B-12] The Evaluation Contractor also spoke with one of Mathematica Policy Research's (Mathematica's) experts on state managed care data to better understand potential issues with encounter data in the selected states, as well as any changes in the quality of encounter data since the most recent publication on the topic (personal communication with Vivian Byrd, October 8, 2013).

Table B-1 below summarizes the quarters available for analysis for each of the 17 states. It also denotes whether each state's Medicaid IP files included FFS and/or managed care claims as well as the types of claims included in these analyses.

Table B-1—Quarters of Medicaid Data Available for Analysis in 17 States Included in Study

State	Calendar Quarters Included in Analyses	Percent of Claims: FFS	Percent of Claims: Encounter Records	Claim Type(s) Included in Analyses
Alabama	Q1 2009 - Q1 2013	73	27	FFS Only[a]
Arkansas	Q1 2009 – Q4 2012	100	0	FFS Only
Connecticut	Q1 2009 – Q4 2012	46	54	FFS Only[a]
Georgia	Q1 2010 – Q1 2013[b]	58	42	FFS and Encounter
Iowa	Q1 2009 – Q4 2012	95	5	FFS Only[a]
Illinois	Q1 2009 – Q2 2012	99	1	FFS Only[a]
Indiana	Q1 2009 – Q3 2012	49	51	FFS and Encounter
Louisiana	Q1 2009 – Q1 2012	98	2	FFS Only[a]
Maryland	Q1 2009 – Q2 2012	44	56	FFS Only[c]
Michigan	Q1 2010 – Q4 2012[d]	37	63	FFS and Encounter
Missouri	Q1 2009 – Q4 2012	98	2	FFS Only[e]
Montana	Q1 2009 – Q4 2012	100	0	FFS Only

B-11 The Evaluation Contractor uses the term "claim" in this appendix to encompass both fee-for-service claims and managed care encounter records.

B-12 Byrd VLH and Hedley DA. Assessing the Usability of Encounter Data for Enrollees in Comprehensive Managed Care Across MAX 2007-2009. *MAX Medicaid Policy Brief*; Mathematica Policy Research, Brief 15, December 2012.

Table B-1—Quarters of Medicaid Data Available for Analysis in 17 States Included in Study				
State	**Calendar Quarters Included in Analyses**	**Percent of Claims: FFS**	**Percent of Claims: Encounter Records**	**Claim Type(s) Included in Analyses**
Oregon	Q1 2009 – Q3 2012	37	63	FFS Only[c]
Pennsylvania	Q1 2009 – Q4 2012	100	0	FFS Only
South Dakota	Q1 2009 – Q4 2012	100	0	FFS Only
Vermont	Q1 2009 – Q1 2012	100	0	FFS Only
Wyoming	Q1 2009 – Q3 2012	100	0	FFS Only

[a]Encounter data were excluded from these states' analysis files (AL, CT, IA, IL, and LA) based on previous research and discussions with a Mathematica subject matter expert on the quality of encounter data in these states.
[b]The Evaluation Contractor excluded 2009 data from GA's analysis file, as 23 percent of all claims were encounter records in 2009. The share of encounter records jumped in 2010 and remained relatively stable through the rest of the analysis period, comprising approximately 50 percent in 2010 – 2013. Because the encounter data were generally less complete than the FFS claims in this state (e.g., the median number of diagnoses on encounter records is 4 versus 8 on FFS claims), the Evaluation Contractor did not want to artificially bias results towards fewer adverse events caused by less complete data over time by including incomplete 2009 data.
[c]Encounter data were excluded from MD and OR analysis files because no encounter records matched to an AHA ID.
[d]The Evaluation Contractor excluded 2009 data from MI's analysis file, as 31 percent of all claims were encounter records in 2009. The share of encounter records jumped in 2010 and remained relatively stable through the rest of the analysis period, comprising approximately 67 percent of all claims in 2010-2103. Because the encounter data were generally less complete than the FFS claims in this state (e.g., the median number of diagnoses was 5 on encounter records compared to 7 or 8 on FFS claims, depending on year), the Evaluation Contractor did not want to artificially bias results towards fewer adverse events caused by less complete data over time by including the 2009 data.
[e]The Evaluation Contractor excluded MO encounter data because of variation in the share of encounter records that matched to an AHA ID over the analysis period (range: 0 to 93 percent).

Data Cleaning and Preparation

As described in the sections above, the Evaluation Contractor matched the AHA ID variable to the IP claims by NPI or legacy Medicaid ID to determine whether each claim was associated with a HEN-aligned of non-HEN-aligned hospital. The Evaluation Contractor also matched IP claims to eligibility data to obtain key demographic and Medicaid eligibility data. Both of these steps helped identify the states, timeframes and claim types to include in the analyses. The Evaluation Contractor conducted additional data cleaning and preparation to develop analytic files. Briefly, key steps in this process included the following:

1. *Develop and apply code for business rules to IP data*. The purpose of this step was to correct known problems in state IP files based on state-specific information provided by Mathematica's internal experts who develop Medicaid Analytic eXtract (MAX) files from state MSIS files
2. *Develop and apply code for adjudicating IP data*. The purpose of this step is to adjudicate claims to ensure that the analysis files contain only final-action claims.
3. *Apply Medicare Severity-Diagnosis-related group (MS-DRG) grouper to all claims*. While some states submit DRG data in their IP file, they often use non-MS-DRG groupers. The Evaluation Contractor needed MS-DRGs on all claims in order to run software to flag adverse event outcomes.
4. *Run software to flag adverse events outcomes*. This step included use of patient safety indicators (PSI) software (Agency for Healthcare Research and Quality [AHRQ] version 4.5), pediatric quality indicators (PDI) software (AHRQ version 4.5) and hospital-acquired conditions (HAC) code developed by Mathematica programmers.
5. *Develop and apply code to flag obstetric deliveries and newborn claims, as well as all other control variables.* These flags were developed from diagnosis and procedure codes as well as eligibility data.

6. *Drop specific claims from analysis files*. The Evaluation Contractor deleted any claims for non-inpatient services (e.g., sterilizations, abortions and religious non-medical health care institutions) as well as claims for psychiatric and rehabilitation stays. The Evaluation Contractor also excluded claims for dual-eligible beneficiaries, unless they were related to obstetric hospitalizations, since most dual eligible stays will be included in Medicare analyses.
7. *Develop and apply code to roll-up claims to the stay level.* Some hospitalizations were associated with multiple claims for various reasons (e.g., states allow some hospitals to submit interim claims or due to long length of stay). The Evaluation Contractor rolled these stays up to one claim per hospitalization, including all relevant outcome and control variables on the claim.
8. *Modify existing code for readmissions developed for Medicare analyses, as needed, to flag readmissions in Medicaid claims*. This step involved flagging transfers as well as treating all obstetric-related admissions as planned admissions, effectively excluding care during pregnancy from readmissions analyses.[B-13]

Data Issues and Anomalies

Through the data cleaning and preparation process, the Evaluation Contractor identified some key data anomalies that might affect results. These include the following:

Present on Admission. There are no present on admission variables in Medicaid MSIS files. However, these data are required for a number of outcome measures. The Evaluation Contractor created present on admission variables on the claims data and set all values equal to “not present on admission.” As a result, the Evaluation Contractor flags all claims with diagnoses indicative of an adverse event as an adverse event, regardless of whether the relevant diagnoses were present on admission or not. As long as the rate of present on admission remains constant over the analysis period, any observed declines in outcome variables in the Medicaid data will be driven by reductions in actual in-hospital adverse events. However, readers should be aware that adverse event rates may be over-stated in Medicaid data.

Joint claims for obstetric deliveries and neonates. In several states, claims for both obstetric deliveries and neonates were included on the same claim. This affects all PDI outcome measures that include neonates (e.g., birth trauma rate - injury to neonate (PDI-17) because most joint claims are filed under the mother’s MSIS ID, and the joint claim matches to the mother’s eligibility record, which contains the mother’s age. The injury to neonate algorithm only includes claims for children younger than 29 days or claims for children with age equal to zero years and an admission type or diagnosis code for newborn. Joint claims for neonates who would otherwise meet the inclusion criteria for central venous catheter-related blood stream infections (CRBSI) (PDI-12) may also be excluded, since the software only includes claims for patients ages 17 and under. If joint claims are predominately submitted for deliveries and neonates without complications, the exclusion of these claims from the adverse event denominators may artificially inflate event rates. In addition, the Evaluation Contractor excluded all infants under one year of age from readmissions analyses because of the joint claims; specifically, the Evaluation Contractor cannot identify readmissions for neonates if the initial birth claim is associated with the mother’s MSIS ID and any readmissions are filed under the child’s new MSIS ID.

[B-13] However, all deliveries count as index admissions so a readmission post-delivery could count as a readmission.

State-specific data issues. The Evaluation Contractor also found several issues in individual state files that might affect adverse event rates in these states. In particular:

- ***Claims in AR contained a maximum of two diagnosis codes***. There are nine diagnosis fields on the MSIS claims and many states submitted claims that contained nine diagnoses. In the AR file, only one or two diagnosis fields contained data. Given that many of the adverse events are based on presence of specific diagnoses, there are fewer opportunities for claims in AR to meet the adverse event inclusion criteria, and AR had lower rates of adverse events compared to other states on most measures (data not shown). The lower rate of adverse events in AR may pull down the average adverse event rate across the states included in these analyses.
- ***A larger share of claims in AL and GA were ungroupable.*** In AL and GA, the MS-DRG grouper could not group 19 and 13 percent of claims, respectively. In contrast, the share of claims that was ungroupable in other states ranged between 0.1 and 1.3 percent. This suggests that the data on inpatient claims required by the grouper were less complete than in other states. Claims that were ungroupable and did not get categorized into an MS-DRG were excluded from the denominator of the PSI, PDI and HAC measures by the respective software programs. The direction of any bias from this issue is unknown.
- ***IL, MI and PA had relatively higher share of claims for elderly, non-dual eligible beneficiaries***. As noted above, the Evaluation Contractor excluded all dual-eligible claims, except for those related to obstetric deliveries to avoid double-counting adverse events across Medicare and Medicaid analyses. In most states, this resulted in few to no Medicaid claims for beneficiaries over the age of 65. However, in IL, MI and PA, the Evaluation Contractor found a relatively larger share of claims for beneficiaries over age 65 that did not indicate that the beneficiary was dual-eligible (i.e., that the claim was a cross-over claim). Most of these claims had Medicaid payment amounts that were three to five times greater than claims flagged as cross-over claims, and the Evaluation Contractor believes they are appropriately included in the analyses, although it is possible that these are mislabeled claims for dual eligibles and the Evaluation Contractor potentially double-counted adverse events in these states.

Outcome Measures for HACs and Adverse Event Areas (AEAs): Catheter-Associated Urinary Tract Infection (CAUTI), Hospital-Acquired Urinary Tract Infections (HAUTI), Pressure Ulcers, CRBSI, Other Obstetrical Adverse Events (OB-Other), Venous Thromboembolism (VTE)

The files resulting from the steps above comprise the analytic files used for all Medicaid analyses. Table B-2 below lists the adverse event area outcome measures that were considered for the Medicaid analyses and notes several variables that were extremely rare, causing them to be dropped.

Table B-2—Medicaid Data Measures Considered for the Analyses of Outcome Trends (with Notes on Whether Included or Not)

Measure	Sample Restriction	Notes
HAC AEAs, Adult Discharges		
CAUTI (HAC) events per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Included in analyses
HAUTI (HAC) events per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Included in analyses
Surgical Site Infection (SSI) HAC following certain orthopedic procedures rate, adult discharges	Age ≥18[a]	Omitted from analyses because the event was rare (80 events in 3.3 million at-risk discharges)
SSI HAC mediastinitis following coronary artery bypass graft rate, adult discharges	Age ≥18[a]	Omitted from analyses because the event was rare (3 events in 3.3 million at-risk discharges)
SSI HAC following bariatric surgery for obesity rate, adult discharges	Age ≥18[a]	Omitted from analyses because the event was rare (12 events in 3.3 million at-risk discharges)
SSI HAC Composite Rates rate, adult discharges	Age ≥18[a]	Omitted from analyses because the event was rare (95 events in 3.3 million at-risk discharges)
HAC AEAs, Child Discharges		
CAUTI (HAC) events per 1,000 child discharges, Medicaid claims	Age <18[a]	Omitted from analyses because the event was rare (30 events in 1.6 million at-risk discharges)
HAUTI (HAC) events per 1,000 child discharges, Medicaid claims	Age <18[a]	Included in analyses
SSI HAC following certain orthopedic procedures rate, child discharges	Age <18[a]	Omitted from analyses because the event was rare (7 events in 1.6 million at-risk discharges)
SSI HAC mediastinitis following coronary artery bypass graft rate, child discharges	Age <18[a]	Omitted from analyses because the event was rare (0 events in 1.6 million at-risk discharges)
SSI HAC following bariatric surgery for obesity rate, child discharges	Age <18[a]	Omitted from analyses because the event was rare (0 events in 1.6 million at-risk discharges)
SSI HAC composite rate, child discharges	Age <18[a]	Omitted from analyses because the event was rare (7 events in 1.6 million at-risk discharges)
PSI AEAs, Adult Discharges		
Pressure Ulcers (AHRQ PSI-03) per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Included in analyses
CRBSI (AHRQ PSI-07) per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Included in analyses
Post-operative hip fracture (AHRQ PSI-08) per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Omitted from analyses because the event was rare (40 events in 312 thousand at-risk discharges)

Table B-2—Medicaid Data Measures Considered for the Analyses of Outcome Trends (with Notes on Whether Included or Not)		
Measure	**Sample Restriction**	**Notes**
VTE (AHRQ PSI-12) per 1,000 adult discharges, Medicaid claims	Age ≥18[a]	Included in analyses
OB-related PSIs and PDIs		
Obstetric trauma per 1,000 instrumented deliveries (AHRQ PSI-18), Medicaid claims	Age ≥13[a]	Included in analyses
Obstetric trauma per 1,000 non-instrumented deliveries (AHRQ PSI-19), Medicaid claims	Age ≥13[a]	Included in analyses
Injury to neonate (AHRQ PSI-17) per 1,000 births, Medicaid claims	Age <18[a]	Included in analyses
PDIs, Child Discharges		
Pressure Ulcers (AHRQ PDI-02) per 1,000 child discharges, Medicaid claims	Age <18[a]	Omitted from analyses because the event was rare (77 events in 188 thousand at-risk discharges)
CRBSI (AHRQ PDI-12) per 1,000 child discharges, Medicaid claims	Age <18[a]	Included in analyses

[a]As mentioned in the text, Medicaid-Medicare crossover claims were also excluded

Vital Statistics Data

To analyze the impact of Hospital Engagement Networks (HENs) on obstetrical early elective deliveries (OB-EED) and other birth outcomes, the Evaluation Contractor used data on births from the Centers for Disease Control and Prevention (CDC) National Vital Statistics System (NVSS) natality files for calendar years 2009 through 2013. In order to identify the state and county where the birth occurred, the Evaluation Contractor obtained the restricted-use NVSS files from the CDC. These files do not contain the name of the hospital where the birth occurred and therefore, even though the analyses implement data at the birth level, the level of aggregation to estimate the effect of interest is at the county level.

The United States (U.S.) Standard Birth Certificate was enhanced in 2003 and, for the states that have adopted the new version; the Vital Records data now contain much more information than was previously available. Table B-3 shows the states and U.S. territories using the revised birth certificate in each year, by HEN-alignment status. Thirty states plus Washington, D.C., used the revised birth certificate during the entire period; 5, 4, 1, and 12 states/territories adopted the new birth certificate in 2010, 2011, 2012, and 2013 or later, respectively (Table B-3).

Table B-3—Availability of Revised Birth Certificate 2009–2013

2009 and Earlier	California (CA), Colorado (CO), Delaware (DE), District Columbia (DC)*, Florida (FL), Georgia (GA), Idaho (ID), Indiana (IN), Iowa (IA), Kansas (KS), Kentucky (KY), Michigan (MI), Montana (MT), Nebraska (NE), Nevada (NV)*, New Hampshire (NH), New Mexico (NM), New York (NY), North Dakota (ND), Ohio (OH), Oklahoma (OK)*, Oregon (OR), Pennsylvania (PA), Puerto Rico (PR), South Carolina (SC), South Dakota (SD), Tennessee (TN), Texas (TX), Utah (UT), Vermont (VT), Washington (WA), Wyoming (WY)
2010	Illinois (IL), Louisiana (LA)*, Maryland (MD), Missouri (MO), North Carolina (NC)*
2011	Guam (GU)*, Massachusetts (MA)*, Minnesota (MN)*, Wisconsin (WI)
2012	Virginia (VA)*
2013 or Later	Alaska (AK), Alabama (AL), Arkansas (AR), American Samoan (AS), Connecticut (CT), Hawaii (HI), Maine (ME)*, Mississippi (MS), New Jersey (NJ), Rhode Island (RI), Virgin Islands (VI), West Virginia (WV)

Source: User Guide to the 2013 Natality Public Use File, Documentation Table C and the Evaluation Contractor's Analyses of NVSS natality files for the 50 states, Washington, D.C., and U.S. territories (AS, VI, PR, and GU).

* This state or territory adopted the revised birth certificate after January 1, so data from the 2003 revised birth certificate are only available during the latter part of the year.

Analyses with Medicare Patient Safety Monitoring System (MPSMS) Data

Data Sources and Patient Characteristics

The main data for these analyses were the MPSMS, in which inpatient adverse events, the key outcomes of interest, were identified through abstraction of hospital medical records. The MPSMS data were merged to American Hospital Association (AHA) Annual Survey data to obtain hospital characteristics, and hospitals' Hospital Engagement Network (HEN)-alignment was determined as described above.

MPSMS is a nationwide federal surveillance project sponsored by the Agency for Healthcare Quality Research (AHRQ). MPSMS measures rates of specific adverse events in hospitalized patients by abstracting a national sample of hospital medical charts. The inpatient medical records are those that were sampled as part of the Centers for Medicare & Medicaid Services' (CMS') Inpatient Quality Reporting (IQR) Program for calendar years 2009 through 2013.[B-14]

The MPSMS sample is one of the largest chart abstraction databases of adverse events in the nation. The IQR program sample includes hospitalized patients 18 years of age and older, covered by any insurance plan, who were hospitalized for one or more of four categories of medical conditions: (1) congestive heart failure (HF), (2) acute myocardial infarction (AMI), (3) pneumonia (PN), and (4) a subset of major surgical procedures listed under CMS' Surgical Care Improvement Project (SCIP). Hospitals were selected randomly, as were charts of patient discharged with the four categories; the same hospitals were not necessarily selected year to year. The sample in 2009 included more hospitals (but only about 4 patients per hospital), and the remaining years included fewer hospitals per year with more patients per hospital (about 25 patients per hospital per year). A small fraction of the MPSMS patients (1.1 percent) were dropped from this analysis because they could not be linked to the hospital-level data. The final numbers of patient records and hospitals each year were as follows (see Table B-4):

Table B-4—Numbers of Hospitals and Patient Records in the MPSMS Data Used for this Report, By Year

Calendar Year	Number of Discharges	Number of Hospitals
2009	17,685	4,235
2010	33,372	1,368
2011	33,698	1,372
2012	27,051	1,081
2013	17,526	705
2009-2013 Combined	**129,332**	**4,268**

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Table B-5 provides descriptive statistics for the patients in the MPSMS sample. These variables were also used as control variables in the regression adjusted difference-in-differences impact analyses described later, and in the regression adjusted time trends; however not all control variables were used for each outcome, as explained in the detailed footnotes to Table B-5. The sample reflects the MPSMS sampling design, with approximately one fourth of the sample having each of the four targeted conditions: AMI, CHF, PN, and SCIP. Consequently, about 62 percent of the patients were covered by Medicare and the majority were 65 years or older. Most were admitted for a medical diagnosis related group (DRG), and over 80 percent were admitted for diagnoses related to the circulatory system (44 percent), respiratory system (24 percent), or

[B-14] Analyses are risk-adjusted using patient and hospital characteristics, which allows the inclusion of 2009 data.

musculoskeletal system (13 percent). The MPSMS sampling strategy aims to roughly draw patients from a random sample of *hospitals* each year, not to draw a random sample of *patients*. Therefore smaller hospitals and rural hospitals are over-represented in the data (compared to the analyses with Medicare claims). In the MPSMS data, 78 percent of patients were discharged from HEN-aligned hospitals, and 22 percent from non-aligned hospitals.

Table B-5—Characteristics of Patients and Hospitals in the MPSMS Data (Control Variables)

	Percentage of Patients (Unless Otherwise Noted)				
		Adverse Event		Payer	
	All Patients	Patients with One or More Adverse Events	Patients without an Adverse Event	Medicare Patients	Non-Medicare Patients
Number of discharges	125,896	17,773	108,123	77,838	48,058
Year					
2009	14%	14%	14%	14%	14%
2010	26%	27%	26%	26%	25%
2011	26%	26%	26%	25%	27%
2012	21%	20%	21%	21%	21%
2013	14%	12%	14%	14%	13%
Patient Characteristics					
Payer[a]					
Medicare	62%	72%	60%	100%	0%
Other	38%	28%	40%	0%	100%
Condition[b]					
AMI	21%	24%	20%	20%	21%
CHF	21%	19%	21%	25%	13%
PN	29%	30%	29%	32%	25%
SCIP	29%	27%	30%	22%	41%
Gender[a]					
Male	46%	48%	46%	46%	47%
Female	54%	52%	54%	54%	53%
Age[c]					
18 to 44 years old	9%	4%	10%	2%	21%
45 to 54 years old	12%	8%	13%	4%	26%
55 to 64 years old	18%	16%	18%	8%	34%
65 to 74 years old	22%	24%	22%	30%	9%
75 to 84 years old	22%	28%	21%	32%	7%
85 or older	17%	20%	16%	25%	4%
Race-Ethnicity[d]					
White, non-Hispanic	73%	74%	73%	78%	66%
Minority	20%	21%	19%	16%	25%
Hispanic	6%	6%	5%	4%	8%

Table B-5—Characteristics of Patients and Hospitals in the MPSMS Data (Control Variables)					
	Percentage of Patients (Unless Otherwise Noted)				
		Adverse Event		Payer	
	All Patients	Patients with One or More Adverse Events	Patients without an Adverse Event	Medicare Patients	Non-Medicare Patients
Black, non-Hispanic	11%	12%	11%	9%	14%
Other, non-Hispanic	3%	3%	3%	2%	3%
Unknown	7%	5%	8%	6%	9%
DRG[e]					
Category[b]					
Medical	61%	55%	62%	70%	47%
Surgical	39%	45%	38%	30%	53%
Major Diagnostic Category (MDC)[b,d]					
Respiratory System (MDC 04)	24%	20%	24%	26%	20%
Circulatory System (MDC 05)	44%	49%	43%	48%	37%
Digestive System (MDC 06)	6%	8%	6%	5%	8%
Musculoskeletal System (MDC 08)	13%	10%	13%	12%	14%
Female Reproductive System (MDC 13)	5%	1%	6%	1%	12%
Infectious (MDC 18)	6%	11%	5%	7%	5%
Unknown	2%	2%	2%	1%	4%
Elixhauser comorbidity score (mean)[f]	4.65	6.43	4.36	5.81	2.78
Admission on a weekend[a,g]	33%	36%	32%	34%	30%
Admission on a holiday[a,g]	2%	3%	2%	2%	2%
Hospital Characteristics					
Region/Division[d]					
Northeast	16%	18%	15%	16%	15%
New England	4%	5%	4%	5%	4%
Mid Atlantic	11%	13%	11%	11%	11%
Midwest	25%	24%	25%	26%	23%
East North Central	16%	16%	16%	16%	15%
West North Central	9%	8%	9%	9%	8%
South	41%	41%	40%	41%	40%
South Atlantic	17%	18%	16%	17%	16%
East South Central	9%	9%	9%	10%	8%
West South Central	15%	14%	15%	14%	16%
West	19%	19%	19%	17%	22%
Mountain	7%	6%	7%	6%	8%
Pacific	12%	12%	12%	11%	14%
Metro type[a]					
Metro	46%	50%	45%	44%	50%

Table B-5—Characteristics of Patients and Hospitals in the MPSMS Data (Control Variables)					
	Percentage of Patients (Unless Otherwise Noted)				
		Adverse Event		Payer	
	All Patients	Patients with One or More Adverse Events	Patients without an Adverse Event	Medicare Patients	Non-Medicare Patients
Division	19%	22%	19%	18%	21%
Rural	35%	28%	36%	38%	29%
Rural referral center[a]	10%	10%	10%	11%	8%
AHA member [a]	80%	81%	79%	81%	78%
Hospitals belongs to health care system[a]	64%	66%	63%	63%	64%
Hospitals belongs to a network[a]	32%	34%	32%	32%	32%
Ownership type[a]					
Private	22%	22%	22%	21%	24%
Nonprofit	62%	64%	62%	63%	61%
Government	16%	14%	16%	16%	16%
Hospital size[a]					
>400 beds (non-critical access hospital [CAH])	14%	18%	13%	13%	15%
200-399 beds (non-CAH)	27%	32%	26%	26%	27%
100-199 beds (non-CAH)	28%	27%	28%	28%	28%
<100 beds (non-CAH) or CAH	32%	23%	33%	33%	30%
Teaching hospital[a]	31%	36%	30%	30%	33%
Intensivist, as percentage of total physicians[a]					
Less than 08%	37%	33%	37%	38%	35%
08% to 20%	15%	18%	15%	15%	16%
Greater than 2%	15%	17%	15%	15%	16%
Unknown	32%	31%	33%	32%	33%
Electronic health records (EHR) categories[a]					
No EHR	7%	7%	7%	7%	7%
Has EHR (Partially)	47%	48%	47%	48%	46%
Has EHR (Fully)	20%	21%	20%	19%	20%
Unknown	26%	25%	26%	26%	26%
Hospital Participation in PfP					
HEN-aligned	78%	80%	78%	79%	78%
HEN type					
Complex	27%	26%	27%	27%	26%
Hospital Association	25%	26%	25%	26%	24%
System HEN	5%	5%	5%	5%	5%
Other HEN	22%	23%	22%	21%	23%
HEN size					

Table B-5—Characteristics of Patients and Hospitals in the MPSMS Data (Control Variables)					
	Percentage of Patients (Unless Otherwise Noted)				
		Adverse Event		Payer	
	All Patients	Patients with One or More Adverse Events	Patients without an Adverse Event	Medicare Patients	Non-Medicare Patients
<50 hospitals	5%	5%	4%	4%	5%
50-99 hospitals	17%	18%	17%	17%	17%
100-400 hospitals	30%	31%	30%	30%	30%
>1,000 hospitals	27%	26%	27%	27%	26%
Non-aligned	22%	20%	22%	21%	22%

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Notes: Percentages may not total to 100 percent due to rounding. In addition to these patient characteristics, the regression analyses of composition outcome measures also included an array of dummy variables for being at-risk for each of the measures that contributed to the composite. AMI = acute myocardial infarction, CAH = Critical access hospital, CHF = congestive heart failure, PN = pneumonia, and SCIP = major surgery as defined by CMS' Surgical Care Improvement Project SCIP

[a] Patient or hospital characteristics used as control variables for all outcome measures.

[b] Condition indicators, a surgery flag, and major diagnostic category (MDC) code indicators (for the relatively common MDC codes 4, 5, 6 8, 13, and 18) were used as control variables for all outcome measures except four outcomes where the MPSMS measure's denominators were limited to a select population. Those four conditions were adverse events associated with hip joint replacements, adverse events associated with knee joint replacements, adverse events associated with femoral artery puncture for catheter angiographic procedures, and contrast nephropathy associated with catheter angiography.

[c] Age was used as control variables for all outcome measures, except for one measure (adverse drug events associated with dioxin) where an "over 75 years" dummy was used instead.

[d] Race-ethnicity and census division were used as control variables for all outcome measures except four outcome measures with small sample sizes ([1] adverse drug events associated with digoxin, [2] adverse drug events hospital acquired antibiotic associated clostridium difficile, [3] hospital acquired methicillin-resistant staphylococcus aureus, and [4] hospital acquired vancomycin resistant enterococcus). For those four outcomes, the regressions controlled for minority (instead of a full array of race-ethnicity variables) and for census region (instead of census division), and did not control for MDC codes. Therefore, the percentages of different race-ethnicity variables do not sum to 100 percent. In addition, the South Atlantic division includes a small number of patients from Puerto Rico for these four outcome measures.

[e] All patients in the MPSMS were assigned to diagnosis-related groups (DRG, a classification system that groups patients with similar clinical conditions (diagnoses) and procedures during the hospital stay. The DRGs were created by entering the principal diagnosis code, the eight secondary diagnosis codes, and the six procedure codes from the claims data for each record into DRG the Medicare Severity diagnosis-related groups (MS-DRG) grouping software (version 29). The MPSMS file lacked the present on admission (POA) indicator for the International Classification of Diseases (ICD)-9 diagnosis codes, so all diagnoses were treated as not POA in the DRG grouping software. The DRG codes were in turn grouped into a smaller number of modified DRG (MDRG) codes, and these were then grouped into an even smaller number of MDC codes. Discharges were also classified as surgical or non-surgical.

[f] The evaluation team calculated the continuous comorbidity score developed by van Walraven et al (2009). The score, in turn, relies on a series of 30 different comorbidity indicators, such as congestive heart failure, chronic pulmonary obstructive disease, diabetes, and so on, developed by Elixhauser et al. (1998). SAS software available from AHRQ's Healthcare Cost and Utilization Project (HCUP) website (AHRQ 2015) was used to create the Elixhauser comorbidity indicators. Each of these 30 indicators were then weighted according to van Walraven et al. (2009) and summed to create a single continuous comorbidity score for each patient. For example CHF has a weight of 7, liver disease a weight of 11, and valvular heart disease has a weight of -1. van Walraven and Elixhauser's work was originally aimed at improving risk adjustment in analyses of mortality in administrative data, but the comorbidity indicators and score have since been successfully used for analyses of administrative data on a wide variety of outcomes besides mortality (for example, Farley et al. 2006 and Schneeweiss and Maclure 2000).

[g] A number of studies have demonstrated that weekends and holidays, when hospital staffing is low and there are more handoffs and cross-coverage, are periods of higher risk for adverse events (Klass 2015; Goldstein et al. 2014; Bell et al. 2001; and Peberdy et al. 2008). These two dummy variables indicate whether the patient was admitted on a weekend day or on a holiday.

Outcome Variables

In developing the MPSMS data, trained abstractors from a CMS contractor (the Clinical Data Abstraction Center [CDAC]), performed the chart abstractions using specialized structured abstraction and data entry software. The abstraction process identified twenty-one adverse events in four categories—(1) adverse drug events, (2) post-procedural adverse events, (3) general adverse events, and (4) hospital acquired infections.[B-15] In addition, the evaluation contractor created five binary "any" variables—one for each of the four categories above, plus a fifth for any adverse event at all. Table B-6 lists the 21 adverse events, plus the "any" variables, grouped into the appropriate categories. Finally, a count of the number of adverse events for each patient was calculated (which could potentially range from 0 to 21).

Unadjusted adverse event rates for each of these measures, overall and for select subgroups, are reported in Table B-6. Among all patients in the MPSMS, 14.12 percent experienced one or more of the 21 adverse events. Some discharges had more than one adverse event, so there were 188.93 adverse events per 1,000 cases, on average. A few of the 21 adverse event measures contribute heavily to the overall adverse event rate. Adverse drug events were the most common type of adverse events (34.97 percent of all adverse events), followed by general adverse events (29.71 percent), post procedural adverse events (15.89 percent), and then hospital acquired infections (11.81 percent). Hospital acquired pressure ulcers were the most common of the 21 adverse event measures (25.16 percent of all adverse events), followed by adverse drug event associated with hypoglycemic agent (18.27 percent). Medicare beneficiaries were, on average, more likely to have one or more adverse events than other patients (16.46 versus 10.34 percent). The rate was higher for patients with AMI (16.18 percent) than for the other three conditions.

Table B-6—Prevalence of Adverse Events in the MPSMS Data (Unadjusted)

Measure	Percentage of At-Risk Cases with Adverse Event (Unless Otherwise Noted) Number of Cases At-Risk in Parentheses							Percentage of all Adverse Events
	All Patients	Payer		Condition				
		Medicare	Non-Medicare	AMI	CHF	PN	SCIP	
Any adverse event [a]	14.12 (129,332)	16.46 (79,844)	10.34 (49,488)	16.18 (26,687)	13.27 (26,643)	14.46 (38,063)	12.93 (37,939)	--
Number of adverse events[b] (per 1,000 cases)	188.93 (129,332)	219.32 (79,844)	139.91 (49,488)	220.52 (26,687)	158.32 (26,643)	183.98 (38,063)	193.18 (37,939)	100.0
Adverse Drug Event Measures								
Adverse drug event associated with Digoxin	0.73 (5,590)	0.80 (4,513)	0.46 (1,077)	1.45 (895)	0.43 (2,533)	0.89 (1,683)	0.42 (479)	0.17
Hospital-Acquired Antibiotic-Associated *Clostridium difficile* (*C. difficile*)	0.49 (98,332)	0.59 (60,305)	0.33 (38,027)	0.53 (9,970)	0.38 (13,227)	0.68 (37,662)	0.33 (37,473)	1.98
Adverse drug event associated with Hypoglycemic Agent	9.84 (45,374)	10.60 (30,674)	8.27 (14,700)	9.05 (10,191)	11.57 (11,725)	10.99 (13,805)	6.93 (9,653)	18.27

B-15 Following AHRQ's analyses (AHRQ 2014a, b), the postoperative venous thromboembolic event adverse event measure includes all cases with confirmed deep vein thrombosis.

Table B-6—Prevalence of Adverse Events in the MPSMS Data (Unadjusted)								
Measure	Percentage of At-Risk Cases with Adverse Event (Unless Otherwise Noted) Number of Cases At-Risk in Parentheses							Percentage of all Adverse Events
	All Patients	Payer		Condition				
		Medicare	Non-Medicare	AMI	CHF	PN	SCIP	
Adverse Drug Event associated with intravenous therapy (IV) Heparin	11.57 (11,302)	12.60 (6,707)	10.08 (4,595)	8.93 (8,209)	11.71 (1,076)	19.96 (1,007)	24.55 (1,010)	5.35
Adverse Drug Event associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	4.65 (51,029)	5.03 (32,539)	3.99 (18,490)	4.35 (11,737)	2.45 (9,488)	3.86 (14,627)	7.04 (15,177)	9.72
Adverse Drug Events Associated with Warfarin	5.44 (19,231)	5.81 (13,822)	4.49 (5,409)	6.40 (1,891)	3.59 (5,960)	8.04 (4,205)	5.20 (7,175)	4.28
Any adverse drug event[a]	7.04 (121,307)	8.13 (74,978)	5.30 (46,329)	8.91 (22,761)	8.03 (23,034)	6.72 (37,874)	5.64 (37,638)	34.97
General Adverse Event Measures								
Hospital Acquired Pressure Ulcers	4.75 (129,332)	6.08 (79,844)	2.61 (49,488)	3.48 (26,6487)	4.47 (26,643)	7.30 (38,063)	3.29 (37,939)	25.16
In-hospital Patient Falls	0.98 (129,332)	1.17 (79,844)	0.68 (49,488)	0.75 (26,687)	1.15 (26,643)	1.15 (38,063)	0.86 (37,939)	5.19
Any general adverse event[a]	5.61 (129,332)	7.10 (79,844)	3.21 (49,488)	4.15 (26,687)	5.53 (26,643)	8.25 (38,063)	4.05 (37,939)	29.71
Post Procedural Adverse Event Measures								
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiography	2.16 (14,427)	2.27 (7,276)	2.04 (7,151)	2.34 (11,944)	0.90 (1,227)	1.72 (232)	1.56 (1,024)	1.27
Adverse Events Associated with Hip Joint Replacements	7.09 (6,134)	8.92 (3,845)	4.02 (2,289)	60.00 (5)	0.00 (1)	27.3 (11)	7.01 (6,117)	1.78
Adverse Events Associated with Knee Joint Replacements	4.04 (9,293)	4.57 (5,187)	3.36 (4,106)	-- (0)	-- (0)	-- (0)	4.04 (9,293)	1.53
Contrast Nephropathy Associated with Catheter Angiography	11.92 (15,047)	14.16 (7,336)	9.78 (7,711)	10.60 (12,449)	13.56 (1,246)	21.24 (226)	22.74 (1,126)	7.34
Mechanical Complications Associated with Central Venous Catheters	3.54 (17,336)	3.65 (10,767)	3.35 (6,569)	3.40 (3,647)	4.03 (1,788)	4.15 (5,876)	2.87 (6,025)	2.51
Postoperative Cardiac/Non-cardiac Arrest Events	0.97 (39,492)	1.33 (18,387)	0.66 (21,005)	4.13 (1,648)	1.53 (131)	5.41 (333)	0.79 (37,380)	1.57
Postoperative Venous Thromboembolic Event	0.61 (39,494)	0.77 (18,388)	0.47 (21,106)	1.09 (1,648)	1.53 (131)	1.20 (333)	0.58 (37,382)	0.98

Table B-6—Prevalence of Adverse Events in the MPSMS Data (Unadjusted)								
Measure	Percentage of At-Risk Cases with Adverse Event (Unless Otherwise Noted) Number of Cases At-Risk in Parentheses							Percentage of all Adverse Events
	All Patients	Payer		Condition				
		Medicare	Non-Medicare	AMI	CHF	PN	SCIP	
Any post procedural adverse event [a]	6.41 (60,554)	7.86 (30,379)	4.95 (30,175)	12.05 (14,125)	8.71 (2,881)	5.21 (6,087)	4.31 (37,461)	15.89
Hospital Acquired Infection Measures								
Blood Stream Infection Associated with Central Venous Catheter	1.16 (9,288)	1.20 (5,424)	1.11 (3,864)	0.79 (2,928)	0.70 (1,150)	1.72 (407)	1.46 (4,803)	0.44
Catheter Associated Urinary Tract Infections	3.17 (58,522)	4.09 (34,187)	1.87 (24,335)	5.09 (7,719)	4.99 (8,653)	3.82 (9,876)	2.02 (32,274)	7.58
Hospital Acquired Methicillin-resistant Staphylococcus Aureus	0.06 (125,637)	0.07 (77,102)	0.03 (48,535)	0.04 (26,196)	0.04 (26,002)	0.07 (35,852)	0.06 (37,587)	0.29
Hospital Acquired Vancomycin Resistant Enterococcus	0.03 (128,772)	0.04 (79,420)	0.03 (49,352)	0.00 (26,634)	0.02 (26,534)	0.06 (37,738)	0.05 (37,866)	0.18
Postoperative Pneumonia	2.06 (38,604)	2.93 (17,876)	1.32 (20,740)	5.62 (1,529)	4.67 (107)	31.69 (142)	1.79 (36,826)	3.26
Ventilator Associated Pneumonia	10.83 (2,567)	10.34 (1,577)	11.62 (990)	9.76 (779)	7.10 (183)	13.12 (770)	10.54 (835)	1.14
Any hospital acquired infection[a]	2.23 (129,258)	2.59 (79,794)	1.65 (49,464)	2.05 (26,679)	1.76 (26,631)	1.43 (38,009)	3.50 (37,939)	11.81

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Notes: Adverse event rates are <u>not</u> regression adjusted.

[a] Binary composite measure for having one or more adverse events. Composite measures include cases at-risk for one or more of the contributing measures.

[b] Continuous composite measure with number of adverse events per 1,000 patients.

AMI = acute myocardial infarction, HF = heart failure, PN = pneumonia, and SCIP = major surgery as defined by CMS' Surgical Care Improvement Project

The evaluation team also calculated national time trends for each outcome; these generally aligned with the analysis conducted by AHRQ and its partners, reported elsewhere (AHRQ 2014 a, b; Wang et al. 2014). There was a decline in the regression-adjusted composite adverse event rate from 16.10 percent of discharges in 2009 to 12.74 percent of discharges in 2013, reflecting a decrease in the adverse events rates for 15 of the 21 individual MPSMS outcome measures (data not shown).

The chart-based adverse event measures in the MPSMS data detect adverse events with substantially more sensitivity and specificity than claims-based adverse measures that are used in the Evaluation Contractor's claims-based analyses. To examine the differences between the two sources, the Evaluation Contractor linked the MPSMS data for Medicare FFS patients to their inpatient Medicare claims for the same hospital discharge.[B-16] Then, using traditional 2x2 contingency tables, the chart-based (MPSMS) adverse event measures were compared for each discharge to the corresponding Patient Safety Indicators (PSI) and hospital-acquired condition (HAC) adverse event measure created from diagnostic and procedure codes in the Medicare claims data. As shown in Table B-7, the detection of adverse events through chart abstraction in MPSMS was substantially and significantly more sensitive and specific than detection in Medicare claims data.

[B-16] The MPSMS data were linked to Medicare claims using patients' social security numbers, the dates of patients' hospital stays, Medicare hospital identification numbers (the hospital CMS certification numbers or CCNs) for discharging hospitals, whether the patient was covered by Medicare fee-for-service (FFS), and hospital insurance claim (HIC) numbers for these Medicare patients. The linkage only includes patients from the MPSMS who were covered by FFS Medicare; patients covered by other insurers could not be linked.

Table B-7—Comparison of the MPSMS and Claims-Based Adverse Event Measures													
MPSMS Measure	Claims-Based Measure	Cases At-Risk for Both Measures[a]								Number of Cases			
		Number of True Positives	Number of True Negatives	Number of False Positives	Number of False Negatives	Sensitivity (TP/ (TP+FN))	Specificity (TN/ (FP+TN))	Precision (TP/ (TP+FP))	Kappa[b]	At-Risk for Both Measures	Not At-Risk for MPSMS Measure	Not At-Risk for Claims-Based Measure	Total[c]
CAUTI	CAUTI (HAC) events	9 (0.03%)	27,038 (95.98%)	4 (0.01%)	1,118 (3.97%)	0.80	99.99	69.23	0.0149 (0.001**) Slight agreement	28,169	37,767 [3[d]]	0	65,936
CAUTI	Hospital Acquired Urinary Tract Infection (HAUTI) (HAC) events	338 (1.20%)	26,913 (95.54%)	129 (0.46%)	789 (2.80%)	29.99	99.52	72.38	0.4103 (0.005**) Moderate agreement	28,169	37,767 [308[d]]	0	65,936
CVC-BSI	CRBSI (AHRQ PSI-07)	2 (0.06%)	3,083 (98.78%)	4 (0.13%)	32 (1.03%)	5.88	99.87	33.33	0.0127 (0.012**) Slight agreement	3,121	45,444 [4[d]]	1,219 [22[e]]	49,784
Pressure Ulcers	Pressure Ulcers (AHRQ PSI-03)	2 (0.01%)	21,210 (89.13%)	0	2,585 (10.86%)	0.08	100	100	0.0014 (0.0003**) Slight agreement	23,797	0	42,139 [1,442[e]]	65,936
Falls	Post-operative hip fracture (AHRQ PSI-08)	0	10,091 (98.71%)	0	132 (1.29%)	0	100	-	0 Poor agreement	10,223	0	55,713 [665[e]]	65,936
VTE	VTE (AHRQ PSI-12)	39 (0.26%)	14,816 (99.06%)	61 (0.41%)	41 (0.27%)	59.80	99.74	61.00	0.6013 (0.008**) Moderate agreement	14,957	4,077 [11[d]]	184 [6[e]]	19,218

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data for all patients who were linked to the Medicare 2009-2013 claims data.

[a] These statistics are from a 2x2 contingency table, where the MPSMS measure is treated as the benchmark measure ("gold standard") for comparisons with the claims-based measure (HAC or PSI). The statistics include only the patients at-risk for both the MPSMS measure and the claims-based measure.

[b] The kappa statistic adjusts for agreement that would be observed on the basis of chance. The kappa-statistic measure of agreement is scaled to be 0 when the amount of agreement is what would be expected to be observed by chance and 1 when there is perfect agreement. For intermediate values, Landis and Koch (1977a, 165) suggest the following interpretations: below 0.0 = Poor; 0.00 – 0.20 = Slight; 0.21 – 0.40 = Fair; 0.41 – 0.60 = Moderate; 0.61 – 0.80 = Substantial; 0.81 – 1.00 = Almost perfect. Standard errors for the kappa statistic are in parentheses.

[c] Number of cases at-risk according to the MPSMS measure, the claims-based measure, or both.

[d] Number in brackets is the number of patients not at-risk in the MPSMS measure who had an adverse event according to the claims-based measure.

[e] Number in brackets is the number of patients not at-risk for the claims-based measure who had an adverse event according to the MPSMS measure.

* $p < 0.05$, ** $p < 0.01$

Other National Sources of Measure Rates

The Agency for Healthcare Research and Quality (AHRQ) National Scorecard (Source: AHRQ)

The AHRQ-estimated cost reductions for each hospital-acquired condition (HAC) included in this report are based on AHRQ national scorecard estimates of the incidence of adverse events. The Scorecard data are drawn from a nationwide sample of inpatient charts (the Centers for Medicare & Medicaid Services [CMS] Inpatient Quality Reporting [IQR] sample), from estimates of surgical site infection (SSI) from the Centers for Disease Control and Prevention (CDC) surveillance data, and from all-payer claims data for obstetrical (OB) events and for a number of other HACs that are not focus areas for the Partnership for Patients (PfP).[B-17]

Medicare Claims (Source: CMS)

Central Line-Associated Blood Stream Infections (CLABSI), Pressure Ulcers, Venous Thromboembolism (VTE), and 30-Day All-Cause Readmissions

The Patient Safety Indicator (PSI) measures for CLABSI (PSI-07), pressure ulcers (PSI-03), and VTE (PSI-12) are generated by the Health Policy and Data Analysis Group in the Office of Enterprise Management at CMS, for Medicare fee-for-service (FFS) beneficiaries discharged from Hospital Engagement Network (HEN)-aligned and non-HEN-aligned hospitals, through Q1 2014. All national hospitals (e.g., Inpatient Prospective Payment System [IPPS] hospitals, critical access hospital [CAH], Maryland and Puerto Rico hospitals, and cancer hospitals) are included in these data; however, the data were restricted to those hospitals with adequate present-on-admission (POA) reporting. A hospital's data for a quarter were excluded if more than 5 percent of the hospital's diagnoses that were not exempt from reporting POA codes had inappropriate POA values.[B-18,B-19] The baseline period for the patient safety indicators (PSI) measures excludes Q1 2011. There were problems in that quarter with miscoding of POA indicators, which compromised the integrity of the PSI rates. In Q1 2011, the number of diagnosis codes that IPPS hospitals were required to report changed from 9 to 25; without special adjustment the data prior to Q2 2011 are non-comparable.

Thirty-day all-cause readmissions data are also generated by the Health Policy and Data Analysis Group in the Office of Enterprise Management at CMS, for Medicare FFS beneficiaries discharged from HEN-aligned and non-HEN-aligned hospitals, January 2009 through March 2014. Readmission rates are generated from claims for beneficiaries who were enrolled in FFS Medicare Part A during the month of the index admission and are limited to acute care hospitals. A readmission will also count as a new index admission. A Medicare claim is not final until a few months after it is first received and has undergone processing and adjudication. Thus, results obtained from non-final claims data may vary slightly from those obtained from final data; however, CMS has developed a model that uses non-final data to project the readmission rates (with

B-17 Annual PfP HACs Data, Draft for Presentation January 15, 2014, Noel Eldridge, AHRQ Center for Quality Improvement and Safety. The nature of the MPSMS sample that is the source of most of the 2010-2013 national HACs estimated by AHRQ is described in "Methods To Estimate the Baseline 2010 PFP National Hospital-Acquired Condition Rate," available at http://www.ahrq.gov/professionals/quality-patient-safety/pfp/pfphac.pdf. This document also explains and demonstrates how the national rates were estimated from the available non-representative sample, in combination with other data.

B-18 Every year CMS publishes a list of diagnoses that are exempt from reporting POA codes.

B-19 Inappropriate POA values included blank, invalid, or those wrongly indicating that the diagnosis is exempt from reporting POA values.

associated confidence intervals) that will be seen in the final data, thus, data through March 2014 are included in the analysis.

National Healthcare Safety Network (NHSN) (Source: CDC)

Catheter-Associated Urinary Tract Infections (CAUTI), CLABSI, and Surgical Site Infection (SSI)

The CDC provides quarterly data from the NHSN. The data extend through Q1 2014 and include both HEN-aligned hospitals (including those aligned with Indian Health Services [IHS]) and non-HEN-aligned hospitals.

The data periods vary by measure, corresponding to the periods when hospitals receiving inpatient prospective payment for Medicare services were required by Medicare to report NHSN measures for their ICU. Given hospitals' requirement to report, the NHSN data provide a strong representation of program progress on the measures for the periods available, for PfP as a whole and for most HENs.[B-20] Since CAHs were excluded from the Medicare NHSN reporting requirement, the data for these hospitals are less complete. The data periods are:

- CY 2011 through Q1 2014 for CLABSI standardized infection ratio (SIR).
- Q1 2011 through Q1 2014 for central line utilization ratio (UR) (PfP-aligned hospitals only).
- Q1 2012 through Q1 2014 for facility-wide SSI-colon surgery and SSI-abdominal hysterectomy SIRs.
- Q1 2012 through Q1 2014 for CAUTI SIR.
- Q1 2012 through Q1 2014 for catheter UR (PfP-aligned hospitals only).

Statistical analyses using NHSN data are not presented because the standard errors used to calculate *p*-values do not account for correlation in the probability of infection between patients within a given hospital. Typically, this correlation is addressed by clustering the standard errors at the hospital level. This calculation requires data at either the patient or hospital level, but such data are not available to the Evaluation Contractor. Clustered standard errors are typically substantially larger than their unclustered counterparts. It is possible, therefore, that some of the estimated performance differences between HEN-aligned and non-HEN-aligned hospitals would no longer be statistically significant if clustered standard errors were implemented in the analyses. For example, the clustered standard errors from some of the Evaluation Contractor's difference-in-differences analyses using Medicare data were significantly larger than the unclustered standard errors. The end effect is that results that appear statistically significant when using unclustered standard errors may not be statistically significant if correct standard errors were available and used for analysis.

B-20 In addition, many states also require hospitals to report healthcare associated infections, typically through the NHSN system.

National Database of Nursing Quality Indicators (NDNQI®) (Source: American Nursing Association [ANA])/Collaborative Alliance for Nursing Outcomes (CALNOC) Data (Source: CALNOC)

CAUTI, CLABSI, Falls, Pressure Ulcers, and Ventilator-Associated Pneumonia (VAP)

The NDNQI® is an ANA database that is housed at and administered by the University Of Kansas School Of Nursing. As of November 2013, 1,941 hospitals within the 50 states and the District of Columbia were members of the NDNQI. Hospitals paying a membership fee to NDNQI submit information on nursing-sensitive process, outcome, and structural measures at the hospital unit level on a quarterly basis. CALNOC is a database of nurse-sensitive measures collected from 300 hospitals in the Western Region. Data from a group of about 100 additional hospitals that do not submit data to NDNQI but submit data on the same measures to CALNOC are also included in the analysis for falls and pressure ulcers. Data through Q1 2014 is included in this report, with the exception of VAP where data are presented through Q4 2013. CDC changed the VAP measure definition effective January 2013. Consequently, hospital reporting has declined, and no other sufficiently broad data are currently available for VAP. Reporting on VAP is currently voluntary and less complete, and there is some evidence that reporting hospitals are higher-performing than non-reporting hospitals.

Data received from NDNQI include CAUTI, CLABSI, falls, hospital-acquired pressure ulcers (HAPU), and VAP rates. All measures use a baseline of calendar year 2011 and a follow up period of Q1 2014, with the exception of VAP, which has a follow up period of Q4 2013. To ensure that the trends represent a real change in the measure among reporting hospitals, rather than a change in the mix of hospitals, data include only hospitals reporting both in the current period (Q1 2014) and in at least 80 percent of the nine previous quarters (Q4 2011 through Q4 2013).

Favorable trends among NDNQI-reporting hospitals likely overstate the success achieved nationally, since it is likely that hospitals that have been willing to pay to participate in NDNQI since 2011 are achieving better results than the average hospital not participating in the NDNQI.

American Hospital Association (AHA) Annual Survey

The data source for hospital characteristics for analyses in this report is the 2010 AHA Annual Survey. The survey contains information on 6,334 hospitals, including basic demographics (e.g., type of hospital, geographic location, ownership, number of beds, teaching status, etc.), affiliations and hospital networks, services offered, staffing, and annual utilization. The survey may change slightly over time, but much of the information found at this link will have applied for the 2010 survey as well as the 2013 survey: http://www.ahadataviewer.com/book-cd-products/AHA-Survey/

Limitations of the Measures Constructed From the Data Sources

Obviously, as there is no single data source of adverse events and patient harms that covers all patients, all healthcare payers, all acute care hospitals, and all regions in the entire U.S., the data sources used for the PfP evaluation, and the measures derived from them, all necessarily have limitations, summarized in the Table B-8.

Table B-8—Limitations of Measures Used[a]

Adverse Event Area (AEA)–Measure Name (Source)	Note Here if Only a Subset of Care in the Area is Measured	Length of Trend: Number of Quarters Covered	Claims-Based Measure, Likely to Under-Count Harms	Note if Medicare Only (Otherwise All-Payer)	Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)	Voluntary Subset of Hospitals Subject to Potential Bias?	Stronger Measures for the AEA, Where Multiple Measures Exist	Why Stronger?
CAUTI - CAUTI per 1,000 Catheter Days, All Tracked Units (NDNQI)		13			687	Yes		
CAUTI (HAC) Events per 1,000 Adult Discharges (Medicaid Claims)	Data from 17 states	16						
Hospital Acquired Urinary Tract Infection (HAUTI) Events per 1,000 Adult Discharges (Medicaid Claims)	Data from 17 states	17						
HAUTI Events per 1,000 Pediatric Discharges (Medicaid Claims)	Data from 17 states	17						
CAUTI - CAUTI SIR (Observed/Expected) (ICUs) (NHSN)	ICU only	9			3,106		Stronger	More complete; mandatory for IPPS hospitals

Table B-8—Limitations of Measures Used[a]								
Adverse Event Area (AEA)–Measure Name (Source)	**Note Here if Only a Subset of Care in the Area is Measured**	**Length of Trend: Number of Quarters Covered**	**Claims-Based Measure, Likely to Under-Count Harms**	**Note if Medicare Only (Otherwise All-Payer)**	**Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)**	**Voluntary Subset of Hospitals Subject to Potential Bias?**	**Stronger Measures for the AEA, Where Multiple Measures Exist**	**Why Stronger?**
CLABSI - CLABSI per 1,000 Central Line Days, All Tracked Units (NDNQI)		13			1,181	Yes		
CLABSI - CLABSI SIR, ICUs (NHSN)	ICU only	13			3,081		Stronger	More complete; mandatory for IPPS hospitals
CLABSI – Central Venous Catheter-Related Blood Stream Infections (CRBSI) per 1,000 Discharges (AHRQ PSI-07) (Medicare Claims)	CRBSI narrower diagnosis than CLABSI	12	Yes	Medicare				
CLABSI - CRBSI per 1,000 Discharges (AHRQ PSI-07) (Medicaid Claims)	Data from 17 states	16						
CRBSI (AHRQ PDI-12) per 1,000 Pediatric Discharges (Medicaid Claims)	Data from 17 states	17						
Falls - Falls per 1,000 Patient Days (NDNQI)		13			1,389	Yes		

Table B-8—Limitations of Measures Used[a]									
Adverse Event Area (AEA)–Measure Name (Source)	**Note Here if Only a Subset of Care in the Area is Measured**	**Length of Trend: Number of Quarters Covered**	**Claims-Based Measure, Likely to Under-Count Harms**	**Note if Medicare Only (Otherwise All-Payer)**	**Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)**	**Voluntary Subset of Hospitals Subject to Potential Bias?**	**Stronger Measures for the AEA, Where Multiple Measures Exist**	**Why Stronger?**
Falls - Falls With Injury per 1,000 Patient Days (NDNQI)		13			1,389	Yes	Stronger	More directly associated with harms, broader than hip fracture measure
Falls - Post-Operative Hip Fracture per 1,000 Discharges (AHRQ PSI-08) (Medicare Claims)	Small subset of falls result in hip fracture	12	Yes	Medicare				
Pressure Ulcers - Patients with Hospital-Acquired Pressure Ulcers, Stages 2+, per 1,000 Discharges (NDNQI)		13			1,413	Yes	Equal	
Pressure Ulcers - Pressure Ulcers per 1,000 Discharges (Stages 3+) (AHRQ PSI-03) (Medicare Claims)	Most severe Pressure Ulcers	12	Yes	Medicare			Equal	

Table B-8—Limitations of Measures Used[a]								
Adverse Event Area (AEA)–Measure Name (Source)	**Note Here if Only a Subset of Care in the Area is Measured**	**Length of Trend: Number of Quarters Covered**	**Claims-Based Measure, Likely to Under-Count Harms**	**Note if Medicare Only (Otherwise All-Payer)**	**Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)**	**Voluntary Subset of Hospitals Subject to Potential Bias?**	**Stronger Measures for the AEA, Where Multiple Measures Exist**	**Why Stronger?**
Pressure Ulcers - Pressure Ulcers per 1,000 Discharges (Stages 3+) (AHRQ PSI-03) (Medicaid Claims)	Data from 17 states	16						
Pressure Ulcers - Pressure Ulcers per 1,000 Discharges (Stages 3+) (AHRQ PSI-03) (HENs)	Most severe Pressure Ulcers	Mixed	Yes		1,194	Yes		
Readmissions - Medicare FFS 30-Day All-Cause Readmissions (Medicare Claims)		64 months old data (January 2009 to April 2014)	Yes	Medicare			Stronger	Nearly complete for Medicare so not subject to reporting bias; measure exactly same across hospitals
Readmissions - 30-Day All-Cause Readmissions (HENs)		Mixed			2,634	Yes		
SSI – SSI - Abdominal Hysterectomy SIR (NHSN)	SSI for one procedure	9			3,345		Equal	

Table B-8—Limitations of Measures Used[a]								
Adverse Event Area (AEA)–Measure Name (Source)	**Note Here if Only a Subset of Care in the Area is Measured**	**Length of Trend: Number of Quarters Covered**	**Claims-Based Measure, Likely to Under-Count Harms**	**Note if Medicare Only (Otherwise All-Payer)**	**Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)**	**Voluntary Subset of Hospitals Subject to Potential Bias?**	**Stronger Measures for the AEA, Where Multiple Measures Exist**	**Why Stronger?**
Ventilator Associated Event (VAE) - VAP per 1,000 Ventilator Days (NDNQI)[b]		12			544	Yes		
VTE – Perioperative PE or DVT per 1,000 Surgical Discharges (AHRQ PSI-12) (Medicare Claims)	Only perioperative VTE	12	Yes	Medicare	3,656		Stronger	Nearly complete for Medicare, so not subject to reporting bias; measure exactly same across hospitals
VTE – Perioperative PE or DVT per 1,000 Surgical Discharges (AHRQ PSI-12) (Medicaid Claims)	Data from 17 states Only perioperative VTE	13						
VTE – Perioperative PE or DVT per 1,000 Surgical Discharges (AHRQ PSI-12) (HENs)	Only perioperative VTE	Mixed			2,368	Yes		
OB-EED - Early Elective Delivery Rate (TJC PC-01) (HENs)		Mixed			1,871	Yes		

Table B-8—Limitations of Measures Used[a]								
Adverse Event Area (AEA)–Measure Name (Source)	Note Here if Only a Subset of Care in the Area is Measured	Length of Trend: Number of Quarters Covered	Claims-Based Measure, Likely to Under-Count Harms	Note if Medicare Only (Otherwise All-Payer)	Completeness: Number of Hospitals Included, of 5,196 U.S. Short-Term Acute Care Hospitals (Current Period)	Voluntary Subset of Hospitals Subject to Potential Bias?	Stronger Measures for the AEA, Where Multiple Measures Exist	Why Stronger?
OB-Other - Injury to Neonate (AHRQ PSI-17) (HENs)	Subset of obstetric harms	Mixed	Yes		1,503	Yes	Equal	
OB-Other - Injury to Neonate (AHRQ PSI-17) (Medicaid Claims)	Data from 17 states	17						
OB-Other - Obstetrical Trauma (AHRQ PSI-18) (HENs)	Subset of obstetric harms	Mixed	Yes		1,652	Yes	Equal	
OB-Other - Obstetrical Trauma (AHRQ PSI-18) (Medicaid Claims)	Data from 17 states	16						
OB-Other - Obstetrical Trauma (AHRQ PSI-19) (HENs)	Subset of obstetric harms	Mixed	Yes		1,757	Yes	Equal	
OB-Other - Obstetrical Trauma (AHRQ PSI-19) (Medicaid Claims)	Data from 17 states	16						

Source: Evaluation Contractor.

[a]Measures from the AHRQ National Scorecard are not included in this table; more information on those measures can be obtained by contacting Noel.Eldridge@AHRQ.hhs.gov.

[b]Concerns about the definition of VAP used in this measure resulted in a change in the CDC's definition; however, data for the new definition are not yet available.

Appendix C: PfP Learning Community's Work Toward Reduction in Harms

Research Objectives for Qualitative Analysis of Survey and Interview Data

To examine the learning community structure created by the Partnership for Patients (PfP) and to investigate the implementation strategies Hospital Engagement Networks (HENs) used to carry out harm reduction activities, the Evaluation Contactor examined multiple data sources as described below to address the following research questions:

1. How was the learning community structure of PfP used to spread best practices?
2. What were hospitals' levels of engagement with PfP and perceptions of it?
3. What level and types of operational changes did hospitals make to prevent harm and reduce readmissions?
4. What factors affected the HENs' ability to spread best practices?
5. What unintended consequences did HENs and visited hospitals observe?

Because the AHA/HRET HEN was very large, and operated through 31 state hospital associations (SHAs) which varied in their environments and their approaches to working with their hospitals, the Evaluation Contractor studied both HENs and the SHAs working with the AHA/HRET HEN. The methods discussed below, used to accomplish this purpose, were:

- Interviews and inquiries to HENs to obtain HEN views on the learning community and other PfP design features, summer 2014.
- Interviews with HENs and SHAs working with the AHA/HRET HEN, fall 2014.
- Review and follow-up on written descriptions of federal partner organizations' contributions to PfP.
- Interviews with non-federal partners.
- Site visits to 12 hospitals.
- Survey of HEN-aligned hospitals' participation in patient safety activities.
- Hospital survey on prevention of adverse events and reduction of readmissions.

Prior to discussing each of these methods, the appendix provides an overview of the research-based frameworks used to guide the qualitative analysis. The last section in the appendix discusses how the research question regarding unintended consequences was addressed, using data cutting across sources.

Research-Based Frameworks to Guide Qualitative Analysis of PfP Implementation

The Evaluation Contractor used several research-based frameworks to guide the qualitative analysis of the implementation of PfP. In order to address the complex design of the campaign, the Evaluation Contractor identified theory-based constructs from three frameworks to support a systematic evaluation of the implementation of the PfP learning community model and factors that impacted implementation of the HENs' strategies to spread best practices to reduce patient harm in their aligned hospitals.

PfP Learning Community Model

Developed through a review of factors described in the literature on diffusion of innovations in the healthcare industry, the Blueprint for the Dissemination of Evidence-Based Practices in Health Care provided a framework for evaluation of the implementation of the PfP learning community model.[C-1] Based on the experience of four national quality campaigns (Institute for Healthcare Improvement [IHI] 100,000 Lives Campaign and 5 Million Lives Campaign, the American College of Cardiology's [ACA's] Door to Balloon [D2B] Alliance, and the Medicare Home Health Quality Improvement National Campaign), the Blueprint identifies eight strategies for effective dissemination of evidence-based practices through national quality campaigns. These eight strategies include the following:

1. Highlight the evidence base and relative simplicity of recommended practices.
2. Align the campaign with the strategic goals of the adopting organizations.
3. Increase recruitment by integrating opinion leaders into the enrollment process and employing a nodal organizational structure.
4. Form a coalition of credible campaign sponsors.
5. Generate a threshold of participating organizations that maximizes network exchanges.
6. Develop practical implementation tools and guides for key stakeholder groups.
7. Create networks to foster learning opportunities.
8. Incorporate milestones and monitoring of milestones and goals.

HEN Strategies to Spread Best Practices

To examine the implementation strategies used by HENs and SHAs, the Evaluation Contractor developed an interview protocol that was informed by the Consolidated Framework for Implementation Research (CFIR), which provides a comprehensive taxonomy of constructs that have been shown to influence implementation of complex programs.[C-2] Through the interviews, HENs described their dissemination and implementation strategies to facilitate harm reduction efforts among their hospitals; for example, ranging from efforts to make available evidence-based tools and resources to more hands-on efforts to help hospitals transform processes of care. To compare HENs' implementation strategies with evidence from the literature on implementation science, the Evaluation Contractor incorporated aspects of Yuan et al. (2010, presented above) and the following:

[C-1] Yuan CT, Nembhard IM, Stern MF, et al. Blueprint for the Dissemination of Evidence-Based Practices in Health Care. Commonwealth Fund. 2010: 86.

[C-2] Damschroder LJ, Aron DC, Keith RE, et al. Fostering Implementation of Health Services Research Findings into Practice: A Consolidated Framework for Advancing Implementation Science. Implementation Science. 2009: 4:50.

- A 2004 systematic review of research studies regarding the diffusion of innovations in health services settings, presenting a conceptual model of determinations of diffusion, dissemination, and implementation of innovations in health services settings.[C-3]
- A 2005 literature review of implementation research, presenting best practices in implementation.[C-4]
- The 2005 Dissemination Planning Tool developed on behalf of the Agency for Healthcare Research and Quality (AHRQ).[C-5]
- A 2011 review of the literature on knowledge transfer and exchange in healthcare, presenting evidence-based strategies for effective dissemination.[C-6]
- A 2012 literature review of strategies for implementing clinical innovations in health and mental health.[C-7]
- A 2013 literature scan of large-scale spread efforts in hospitals and healthcare settings to examine the primary drivers of implementation strategy effectiveness.[C-8]

To guide the analysis of facilitators and barriers impacting HEN and SHA harm reduction efforts during PfP, the Evaluation Contractor identified common domains from two research-based frameworks. First, the CFIR, as described above, presents a framework for understanding implementation of evidence-based practices in healthcare settings and describes a number of factors, such as internal organizational characteristics, that may influence implementation effectiveness. Second, Brian Mittman, an implementation science expert, identified a set of key factors that influence the success of scale-up and spread efforts, including characteristics of the innovation, features of target adopters, environmental conditions, innovation champions, and dissemination strategies.[C-9] Applying this research to the PfP model, the Evaluation Contractor identified factors in four domains related to HEN and SHA efforts to disseminate best practices and encourage adoption of harm reduction interventions in their aligned hospitals for analysis. These domains include the following:

- External Factors—payment incentives and policies, mandatory reporting programs, patient needs and expectations.
- Internal Factors (HENs)—organizational resources, history of working with hospitals and partners prior to PfP.
- Target Adopter Factors (Hospitals)—resources/capacity for change, organizational factors.
- Innovation Factors—feasibility, adoptability of harm reduction efforts in adverse event areas (AEAs).

C-3 Greenhalgh T, Robert G, Macfarlane F, et al. Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. Milbank Quarterly. 2004; 4:581–629.

C-4 Fixsen DL, Naoom S, Blase KA, et al. Implementation Research: A Synthesis of the Literature. Tampa, FL: University of South Florida, Louis de la Parte Florida Mental Health Institute, National Implementation Research Network; 2005.

C-5 Carpenter D, Nieva V, Albaghal T, et al. Development of a Planning Tool to Guide Research Dissemination. Advances in Patient Safety: From Research to Implementation. 2005: 4.

C-6 Pentland D, Forsyth D, Maciver M, et al. Key Characteristics of Knowledge Transfer and Exchange in Healthcare: Integrative Literature Review. Journal of Advanced Nursing. 2001:7:1408–1425.

C-7 Powell BJ, McMillen JC, Proctor EK, et al. A Compilation of Strategies for Implementing Clinical Innovations in Health and Mental Health. Medical Care Research and Review. 2012:69:123–157.

C-8 Perla RJ, Bradbury E, Gunther-Murphy C. Large-Scale Improvement Initiatives in Healthcare: A Scan of the Literature. Journal of Healthcare Quality. 2013: 35:30–40.

C-9 Mittman, B. Factors that Influence the Scale Up and Spread of Innovations. Available at: https://innovations.ahrq.gov/perspectives/factors-influence-scale-and-spread-innovations. Accessed on: April 6, 2015.

Interviews and Inquiries to Obtain HEN Views on the Learning Community and Other PfP Design Features, Summer 2014

In summer 2014, the Evaluation Contractor requested that each HEN respond to key questions either through interviews or through submitting a written response to the questions. Of the 26 HENs, 18 HENs chose the telephone interview, and 8 HENs chose to respond via written response. Near-verbatim notes documentation from the interviews was analyzed together with the written responses.

There were five topics for discussion, and the fifth asked HENs to comment on the following features of PfP:

- Goals—The Partnership's ambitious goals.
- Targets—Interim PfP targets.
- Focused Initiatives—Specific "pushes" within the campaign as were done for catheter-associated urinary tract infection (CAUTI), obstetrical early elective delivery (OB-EED), and readmissions.
- National Content Developer's (NCD's) Role—NCD pacing events and other NCD supports.
- Patient and Family Engagement (PFE) Activities—Patient and family engagement master classes, resources, and speakers from the PFE Contractor (PFEC).
- Reporting—Monthly feedback reports including ACT (Alignment of Measures with 40 percent/20 percent Goals, Completeness of Data, and Trend or Benchmark) reports and all-HEN data displays on HENs' progress.
- Measurement Strategies—HENs' and the Partnership's.

HEN responses were grouped by whether the HEN reported that each PfP design feature or support on the above list was beneficial to the HEN's progress and whether it provided minimal or no benefit; themes were noted if cited by three or more HENs.

HEN/SHA Interviews, Fall 2014

Data Collection Approach

The Evaluation Contractor conducted interviews with each of the 26 HENs and 24 of 31 SHAs working as subcontractors to the AHA/HRET HEN between October 2014 and December 2014; the rest of the AHA/HRET SHAs responded to an email request for responses to the interview questions with varying levels of detail. The interviews lasted 90 to 120 minutes. Interviewees provided consent to being audio recorded to ensure accuracy of notes. In total, the Evaluation Contractor had four lead interviewers and seven note takers, and one interviewer and note taker attended each call, along with additional project team members who listened. Interviewers followed a semi-structured interview protocol covering the topics listed below. In addition to participation in the interviews, HENs were asked to complete and submit a workbook listing their initiatives and partnerships in each AEA and overall. All HENs and SHAs participating in interviews submitted these workbooks (referred to as "Intervention Spreadsheets"); interviewers reviewed them prior to the interview, and both HENs/SHAs and interviewers referred to them during the interviews.

Topics covered during the interviews were:

- Timing of emphasis on the AEAs.
- HENs'/SHAs' history working with their hospitals on patient safety.
- HENs'/SHAs' history working with partners on harm reduction.
- Hospital experience working on patient safety prior to PfP.
- Lessons learned about effective partnerships.

- Communication strategies HENs/SHAs used with their hospitals.
- Internal and external factors that may have influenced HEN/SHA progress.
- Unintended consequences of PfP work.
- Detailed discussion of HEN/SHA implementation strategies, highlighting hospital engagement patterns and major milestones in their strategies, for each AEA and overall (across areas, where HENs/SHAs used cross-cutting strategies).
- Detailed discussion of HEN/SHA implementation strategies and implementation processes for readmissions.

Analysis

Note takers completed near-transcript style notes. To prepare for analysis, the Evaluation Contractor qualitatively coded the notes and workbooks using Atlas.ti, a qualitative coding software. Coding is an approach to qualitative data analysis that aids in managing the data and simplifying the data for analysis. Codes are used to both tag text and identify themes. The Atlas database includes all of the interview notes and intervention spreadsheets. It groups documentation based on HEN characteristics, such as geographic spread (single state, multiple states), ownership (hospital association, system, or other), and size (< 50, 50–99, 100+). In this way, the database can aid future analyses examining variation in HEN implementation strategies based on HEN characteristics.

Three researchers collaboratively developed, piloted, and refined a code list to apply to the HEN interview notes and workbooks. The code list was generated subsequent to the HEN interviews and was based on both the protocol questions and emergent themes. The code list was reviewed by other senior researchers on the evaluation team before implementation. The code list is presented in Table C-1. In addition to the codes listed in the table, each protocol question for the readmission section had its own code to facilitate analysis of all of the answers to the same question in this section.

Two lead researchers trained a team of four coders in the code definitions and application of the code list. A lead researcher reviewed and edited each set of coded notes so that each set was reviewed by two people. The coding team met once weekly over the course of the coding process to discuss substantive issues related to coding; for example, discussions of code definitions or conventions for coding, such as length of text to code. Using the coded text, three lead researchers (those who developed the code list) analyzed the data looking for themes and indications of variation across HENs or AEAs in terms of implementation strategies and facilitators and barriers that may have affected progress.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Factors Affecting Progress	
External Factors	• Any indication of factors external to the HEN or its hospitals playing a role in their strategy or harm reduction results achieved. • Examples include incentives and policies, areas of concern in the community or state, public reporting, and so forth.
Readmission Penalties[C-10]	• Captures references to the Centers for Medicare & Medicaid Services (CMS) payment penalties for readmissions for certain conditions.
Hospital-Acquired Condition (HAC) Reduction Program	• Captures references to the CMS HAC reduction program or penalties associated with this program.
Value-Based Purchasing (VBP)	• Captures references to the general movement toward VBP, away from volume-based payment or toward quality of care and away from quantity of care.
Internal Factors	• Any reference to factors internal to the HEN or to its hospitals. • Apply the high-level code when the sub-codes do not apply but the HEN refers to other factors that are specific to the network or network hospitals that may have influenced results achieved.
HEN History Working with Hospitals	• Captures answers to the protocol question about HEN history of working with network hospitals on quality or patient safety issues prior to PfP; this is distinct from "hospital experience in PfP areas," which is about network hospitals' experience working in PfP AEAs (not necessarily in collaboration with the HEN).
HEN History Working with Partners	• Captures references to HENs' history of working with partners on patient safety prior to PfP.
Hospital Experience in PfP Areas	• Captures references to HEN hospitals' experience addressing the 11 adverse event areas addressed in PfP prior to the start of PfP.
HEN Structural Characteristics	• Captures characteristics at the HEN level, such as organizational characteristics.
Hospital Structural Characteristics	• Captures hospital characteristics that are structural in nature, such as pertaining to personnel/staff (including quality improvement staff, leadership, frontline, etc.), organizational characteristics, tools/resources, and infrastructure.
EHR Issues	• Captures references to electronic health record (EHR) issues that are cited as facilitators or barriers or otherwise factors in the HEN harm reduction achievements.
Staff Turnover	• Captures references to staff turnover at the hospital level as a factor in implementation effectiveness.
Intervention Characteristics	• Captures reactions to or descriptions of interventions used within AEAs; higher level code is for more general observations and references that do not pertain to the complexity of the interventions. • May include references to instances where the intervention was well established/already in use and part of routine practice. • Look for mentions of evidence base, availability of clearly defined/nationally recognized measures, clear path forward vs. less clear path forward, nature of care team or involvement of patients.
Complexity	• Captures descriptions of perceived difficulty of implementation—or perceived ease of implementation (absence of difficulty); intended to capture reflections or views on the nature of the interventions in a given AEA and indications that these perceptions influenced progress.

C-10 Indented codes indicate sub-codes to higher-level codes; these codes are conceptually related, where sub-codes are intended to capture more detail or tag particular references.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Lesson Learned/General Insight	• Captures references to general insights or lessons learned, where HEN did not refer specifically to facilitators or barriers/challenges but indicates some learning process or some lessons learned that impacted or would impact how they carry out harm reduction work.
Facilitator	• Captures references to HEN-identified facilitators or factors that made implementation of harm reduction work easier—HEN does not have to use the word "facilitator." • Key words include: "critical," "made a difference," "expedited," "directly impacted," or otherwise enabled change/progress.
Barrier/Challenges	• Captures references to barriers/challenges to harm reduction work identified by the HEN and should capture descriptions of challenges followed by solutions. • HEN does not have to use the words barriers or challenges. • Key words include: "confusion," "difficulty," "lack of buy-in or commitment," "tough nut to crack," or other phrases indicating some sort of challenge or barrier to progress that needed to be overcome or remains a challenge/not yet addressed or resolved.
HEN Implementation Strategies	
Adaptation of Interventions	• Captures descriptions of HEN efforts to aid in hospital adaptation of interventions, such as tools or bundles, or other resources or otherwise encouraging hospitals to adapt or customize interventions or tools based on their local needs.
Alignment with Concurrent Initiatives	• Captures descriptions of HENs' deliberate efforts to align with concurrent initiatives in the local, state, or national environment, or specific efforts to address local problems or priorities.
Collaboratives	• Captures descriptions of intensive workgroups or immersion groups of hospitals working together toward a focused goal convened by the HEN.
Commitment	• Captures references to HENs' requiring hospital or leadership commitments to PfP, at a specifically referenced point in time. • Can also include references to pledges hospitals take; for example, to implement hard stop policies to address EED.
Communication	• Captures HENs' descriptions of their communication strategies, including efforts to target specific hospitals or audiences and customize communications for specific hospitals or audiences; includes references to mode/medium, frequency, messaging, and audience. • Also use for HENs' observations about lessons learned about effective communication.
Customization	• Captures descriptions of HENs' efforts to tailor communication tactics or messages to audiences, such as hospital leadership or frontline staff.
Consultation/Coaching	• Captures descriptions of HENs' coaching or consultation to hospitals on an individual or small group basis on specific processes, measurement issues, opportunities for improvement, and so forth; coaching may be in person or via phone. • Key words include "one-on-one," "face-to-face," or other indications that the HEN staff worked directly with hospitals or a subset of hospitals on issues specific to those hospitals (e.g., after reviewing their data).
Site Visits	• Captures descriptions of HENs' on-site visits to hospitals to support improvement efforts. • Includes who conducted the visits, what was accomplished during the visits.
Cross-cutting Strategy	• Captures references to HENs' overall approaches that affect all or many AEAs.
Culture	• Captures references to efforts to address culture in general.
Patient and Family Engagement	• Captures references to efforts to engage patients and families.
Leadership Engagement	• Captures references to hospital leadership engagement.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Safety Across the Board	• Captures references to cultivating culture of safety across the board within hospitals.
Data-Driven Strategies	• Captures descriptions of HENs' use of data to identify areas of opportunity, areas for improvement, or other potential uses of data that helped to focus the HEN strategy and approach.
Data Monitoring/ Performance Feedback	• Captures HENs' efforts to monitor hospital data on an ongoing basis to continue to identify opportunities or places where there may be promising practices because of reductions in rates. • Captures references to HENs' efforts to provide data back to the hospitals—feedback on patient safety performance—through reporting, dashboards, consultation, or other mechanism, but the key is the feedback loop. Not only is the HEN viewing the data, but it is also reviewing, benchmarking, and reflecting back to individual hospitals or units within hospitals on performance.
Development/Selection of Interventions	• Captures descriptions regarding how HENs developed or selected interventions to promote across their networks within each AEA; examples include HEN not developing tools but making use of other tools/resources such as those provided by the NCD; HEN using an existing tool or bundle off-the-shelf, without modifications; HEN modifying a tool or bundle—for example, based on updated literature or consultation with local experts; HEN developing its own tool or bundle or synthesizing the literature or other resources such as subject matter experts' input to develop an intervention, tool, or resource. • Captures any effort to develop or identify tools that function as part of the actual intervention—such as checklists, bundles, or protocols. • Appropriate to use when HEN encouraged selection of interventions by hospitals (for example, selection of tools based on local factors).
Discover and Spread	• Captures descriptions of HENs leveraging hospital experience to identify a promising practice that the HEN then spreads network-wide; this approach is more bottom-up or hospital-driven, where HEN plays key role in spreading the practice across the network rather than in defining the actual intervention.
Evolution of Implementation Strategy	• Captures HEN indications that their implementation strategies changed or evolved over time, often after identifying better approaches or learning from others. The key is some indication of change—although indications of iterating on the plan or approach are also permissible.
Gap Analysis/Needs Assessment/Root Cause Analysis	• Captures references to efforts to identify gaps, needs, opportunities, or sources of harm at the hospital level. Examples include gap analysis, needs assessment, surveying of hospitals (e.g., Organizational Assessment Tool [OAT] survey), and root cause analysis.
Hospital Engagement	• Captures HENs' descriptions of hospital engagement in AEA or overall; should be applied any time references to hospital engagement are made but in particular during discussion of intervention strategies in each AEA; should also include references to hospital participation in events or interventions and general observations about how engaged hospitals were in a particular AEA. • References to lack of participation or engagement should also be coded. • Should also capture references to hospital take-up or adoption of practices or interventions.
Networking Opportunities	• Captures opportunities for hospitals to share harm reduction experiences and learn from one another, facilitated by the HEN. • Examples of these activities include webinars where HENs explicitly noted that hospitals shared experiences, face-to-face regional meetings to facilitate hospital interaction and ring of practices.
HEN Connects Hospitals to Each Other	• Captures references to HENs' connecting mentor or successful/high-performing hospitals to hospitals with identified room for improvement or hospitals struggling in a particular area.
Other Education/Tools/ Resources	• Captures HENs' provision of education aside from skills training (which has its own code), such as webinars and national speakers; resources, such as tools and bundles; processes to prevent harm or to support outcomes measurement; and tools and resources to support harm reduction work.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Partnerships	• Captures references to partners and partnerships, particularly regarding the role of partnerships in carrying out harm reduction work, and lessons learned regarding effective partnerships.
Association for Professionals in Infection Control and Epidemiology (APIC)	• Intended to flag references to APIC as a partner.
Other HENs	• Intended to flag references to other HENs as partners.
Quality Improvement Organization (QIO)	• Intended to flag references to partnerships with the local QIO.
State Health Department	• Intended to flag references to partnerships with state health departments.
Skills Training	• Captures explicit references to the provision of skills training to hospitals or hospital staff. • Sub-codes are intended to flag specific types of skills training.
TeamSTEPPS	• Specifically references to TeamSTEPPS training.
Comprehensive Unit-based Safety Program (CUSP)	• Specifically references to CUSP training.
Lean	• Specifically references to Lean training.
Six Sigma	• Specifically references to Six Sigma training.
Stakeholder Engagement	• Captures references to efforts to engage relevant stakeholders (e.g., quality staff, preventionists, hospital leadership, patients and families, physicians, nurses, pharmacists, frontline staff, and community organizations) in harm reduction work. • Also includes references to engagement of individuals who could influence others; for example, champions and key opinion leaders. • Also includes references to convening of multidisciplinary councils or workgroups that oversee harm reduction strategies in a given area and help to carry out harm reduction activities.
Standardization	• Captures deliberate HEN efforts to standardize processes or deploy standardized tools network wide.
Targeting	• Captures references to interventions or approaches to specific hospitals; for example, on the basis of hospital characteristics or performance. • Note: Intended to be used in conjunction with codes under Other Descriptive Codes that identify specific types of hospitals, such as Critical Access Hospitals (CAHs)/rural, high impact/high volume, low performers, and high performers, as applicable.
Low Performers	• Flags references to **targeting** low performers or hospitals with opportunity for improvement.
High Performers	• Flags references to **targeting** high performers or hospitals with success.
High Impact/High Volume	• Flags references to **targeting** hospitals that make a significant impact to HEN rates—defer to HEN description of hospitals as high impact or high volume.
Test and Spread	• Captures references to HENs' use of piloting or testing an intervention and then rolling it out network-wide as a strategy. Strategy is more top down or HEN-defined; for example, immersion groups that test an intervention or identify strategies with the intention of spreading network-wide.
Timing/Clustering of AEAs	• Captures descriptions of how the HEN managed the 11 adverse event areas. • May most often come up in response to question in Part I regarding timing of the AEAs but may also come out during discussions of implementation strategies by AEA. • Includes references to areas of top priority or references to how the HEN prioritized areas.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Other Descriptive Codes	
AEA Codes (ADE, CAUTI, Central Line-Associated Blood Stream Infection [CLABSI], Falls, OB-EED, Other Obstetrical Adverse Events [OB-Other] Pressure Ulcers, Surgical Site Infections [SSI], Ventilator-Associated Event [VAE], Venous Thromboembolism [VTE], Readmissions)	• Tags to identify AEAs.
AHA/HRET	• Use for interviews to designate specific interventions or strategies coming from AHA/HRET HEN, rather than from SHA (relevant to coding of AHA/HRET State Hospital Association [SHA] notes).[C-11]
CAH/Rural	• Captures references to small hospitals, CAHs, or rural hospitals using this code.
Disparities	• Captures descriptions of HENs or hospitals identifying different rates of harm or observing different issues for certain patients based on factors related to socio-economic factors, Medicaid or dual-eligible status, income levels, language, race/ethnicity, or other characteristics. HEN does not have to use the word "disparities" but instead could point to differences across subpopulations in rates of patient harm, outcomes, access, or other issues.
Hospital Level	• Use when the HEN is describing hospital-level activities or strategies and the role of the HEN is unclear; in other words, the HEN describes a strategy in use in its network but not its role in prescribing or carrying the strategy out.
Hospital Participation in AHA HEN versus SHA	• Captures answers to the question about hospital participation in AHA/HRET HEN activities as compared to SHA activities.
LEAPT	• Captures references to Leading Edge Advance Practice Topics (LEAPT): – Severe Sepsis and Septic Shock (mandatory) – *Clostridium Difficile* (*C. difficile*) – Hospital Acquired Acute Renal Failure – Airway Safety – Iatrogenic Delirium – Procedural Harm – Undue Exposure to Radiation – Failure to Rescue – Results beyond 40/20 AIMs – Hospital Culture of Safety – Cost Savings Calculations for Hospital Acquired Conditions
Milestone	• Captures HEN-described milestones in implementation strategy, includes references to specific dates and major aspects of their strategy that then led to results achieved.
Spillover Effects	• Captures any indication of the HEN harm reduction efforts reaching or affecting non-aligned hospitals; for example, non-aligned hospitals' attendance at HEN events or use of HEN-provided resources. • References, for example, to "all hospitals in the state" should be coded as spillover effects.

[C-11] Interviews with the AHA/HRET state hospital associations are not included in this report but were coded and will be reported on in the Interim Evaluation Report.

Table C-1—Code List Applied to HEN Interview Data and Intervention Spreadsheets	
Codes	**Definitions**
Unintended Consequences	• Captures answers to the question about unintended consequences associated with HEN participation in PfP; consequences could be positive or negative.

Federal Partners Analysis

The purpose of this analysis was to develop a description of the extent to which federal organizations worked alongside or in partnership with PfP on PfP focus areas, identify any influence PfP had on the organizations and vice versa, and assess the reach of these efforts relative to PfP to the extent we have information.

The evaluation contractor reviewed summaries submitted by the following organizations to the federal partners retreat held in November 2014, in answer to PfP leadership's question "List/Describe your contributions to PfP over the course of the last 3 years:"

- AHRQ
- Centers for Disease Control and Prevention (CDC)
- Human Resources and Services Administration (HRSA)
- Office of the Assistant Secretary for Health(OASH)/Office of Disease Prevention and Health Promotion (ODPHP)
- United States Department of Veterans Affairs (VA)
- QIO program
- The Administration of Community Living (ACL)
- United States Department of Defense (DoD)
- Office of Personnel Management (OPM)

Follow-up contacts (by email or telephone) were used to clarify points in the written summaries.

Non-Federal Partners Interviews

Data Collection Approach

To understand the nature of the shared learning community and the degree of partnership or alignment with private partners at the PfP campaign level, the Evaluation Contractor also conducted a series of interviews with non-federal organizations. Organizations were identified based on their historical work to address patient safety and readmissions or due to recommendations by CMS staff for inclusion. An initial list of interview candidates was based on the list of major initiatives or potential influences presented in the Project Evaluation Activity in Support of Partnership for Patients: Evaluation Progress Report I, December 2014, and identified by a combination of review of HEN monthly reports, input from the NCD, and additions from a sample of members of the affinity groups which included some private partner organizations as well as CMS staff, HENs, and others. CMS reviewed the initial list of interview candidates and suggested several additions.

Between March 19, 2015, and May 4, 2015, 22 interviews representing 19 organizations were conducted. Table C-2 presents a summary of the acceptances, non-responses, and declines. The Evaluation Contractor contacted individuals at those organizations who were affiliated with the PfP campaign, where relevant, or organizational leadership. Many of the contacts were members of the National Quality Forum (NQF) Patient Safety Collaboration, a multi-stakeholder effort convened by the NQF with funding from the Center for

Medicare & Medicaid Innovation (CMMI) to advance the goals of PfP.[C-12] All interviewees were recruited via an email describing the purpose of the interview and topics for discussion.

Table C-2—Non-Federal Partner Contacts, Interviews Conducted, Non-Responses, and Declines			
Number of Organizations Contacted (Number of Individuals)	**Number of Interviews Conducted (Organizations)[C-13]**	**Number of Non-Responses (By Organizations)[C-14]**	**Number of Declines (By Organizations)[C-15]**
22 (33)	22	1	1

Source: The Evaluation Contractor's analysis of non-federal partner interviews.
Note: In some cases, the Evaluation Contractor invited multiple individuals at the same organization to participate, and in a few cases, contacted individuals referred the interview request to others with more relevant knowledge.

Interviews addressed the following topics:

- The organization's activities to address patient harm and readmissions (as relevant) from late 2011 through 2014, and the reach of these activities among hospitals, clinicians, and other stakeholders.
- The nature of the organization's activities related to the PfP campaign and any efforts to deliberately coordinate activities or align with the campaign.
- The degree to which the PfP campaign influenced the organization's activities to address patient harm and readmissions (if at all).
- Any feedback regarding perceived advantages or disadvantages related to PfP.

Interviews were attended by one lead interviewer, a note taker, and 1–2 other team members. Interviews were not recorded, but notes were taken. To ensure accuracy of the notes, the lead interviewer and note taker debriefed after each interview to review key points from the discussion.

Analysis

Interviews were reviewed examining the following:

- The formality of the relationship between the organization and PfP campaign.
- The types of activities the organization participated in as they pertain to PfP (for example, consultation with the HENs).
- The degree to which alignment of activities occurred deliberately versus naturally (as many interviewees cited natural alignment).
- The broader context—for example, other activities going on to address patient harm and readmissions that were either in place prior to the PfP campaign or occurred independently of the PfP campaign, according to interviewees.

C-12 Three action teams addressing OB-EED, readmissions, and PFE were convened to develop best practices and guidance for hospitals in these areas.

C-13 Organizations represented in the interviews included: American Board of Internal Medicine Foundation (2 separate interviews); American Case Management Association; American College of Surgeons; American Nurses Association; American Pharmacist Association; American Society of Health System Pharmacists; Association of State and Territorial Health Officials; Association of Women's Health, Obstetric, and Neonatal Nurses; California Maternal Quality Care Collaborative; Center to Advance Palliative Care; Childbirth Connection; Institute for Healthcare Improvement (2 separate interviews); The Joint Commission (2 separate interviews); The Leapfrog Group; March of Dimes; Pacific Business Group on Health; Planetree; Safe Care Campaign/The Healthcare and Patient Partnership Institute; and Society of Hospital Medicine.

C-14 Two individuals were contacted at a non-federal partner organization via email and did not respond.

C-15 Reason for declining: lack of familiarity with PfP campaign.

The nature of engagement and activities supporting the PfP campaign were categorized, and organizations describing formal partnership, informal partnership, and substantial contributions to the campaign were counted.

Site Visits to 12 Hospitals

Purpose

To understand what changes hospitals made during 2012 through 2014 to improve patient safety and reduce readmissions, why and how they made these changes, and the role PfP and other factors played in these changes.

Research Questions

1. What changes did site visit hospitals make during 2012 to 2014 to improve patient safety and reduce readmissions?
2. How did patient safety culture or infrastructure change in the visited hospitals during this time period? (e.g., leadership involvement, PFE, staff roles and norms in safety, use of data)
3. What role did PfP and other factors, such as market pressures, payment incentives, and public reporting play in influencing hospitals to make changes to improve patient safety?
   a. To improve patient safety culture or infrastructure?
4. Where hospitals were motivated to improve, what role did PfP and other factors play in accelerating change or enabling successful implementation of improvement strategies?
   a. To what extent were the improvement strategies that were used evidence-based vs. developed through other means, such as in-house experience or reported experience from a peer hospital?
5. To what extent have the visited hospitals measured reductions in harm and readmissions during 2011-2014?
   a. Have the hospitals analyzed the relationship between their process changes and outcome trends?
6. What factors, beyond specific process-of-care changes, may have played a role in the hospital's harm reduction outcomes during this period?

Hospital Selection

To support the site visits component of the PfP evaluation, a sample of 12 hospitals was drawn. The pool of hospitals for the study was developed from the analytic file created for the *Hospital Survey on Prevention of Adverse Events and Readmissions*, and included 1,136 hospitals. Table C-3 shows the available, targeted, selected, and visited hospitals, by characteristic as identified by matching the hospital with data from the 2010 AHA Annual Survey. The survey file was used for the frame because of the need to select hospitals at different levels of engagement with PfP, a variable only available for hospitals responding to the survey. The objective was to construct a sample that reflected diversity on the following dimensions of interest:

1. Engagement with a HEN[C-16]
   a. No engagement with a HEN (3 hospitals)
   b. Among those with engagement, different levels of engagement (9 hospitals)
2. Hospital type and size

[C-16] At the time the sample was drawn, only hospitals aligned with a HEN as of June 2012 were considered as HEN-aligned; "late joiner" hospitals were not included as HEN-aligned hospitals. However, we learned from the visits that two of the non-aligned hospitals had joined PfP later, one in 2013 and one in 2014, so they are shown with the HEN-aligned group.

   a. CAH (3 hospitals)
   b. Hospital size (number of beds) (up to 3 levels of hospital size)
3. Geographic variation
   a. Geographic region (4 regions: East, West, South and Midwest)
   b. Urbanicity (rural and non-rural)

Because of the number of dimensions of interest, minimum counts for each of these dimensions were established and an allocation was developed across the dimensions. Not all crosses of the dimensions could be represented in the sample of 12 hospitals, so the sample was randomly allocated to some crosses of the dimensions such that the allocation to a dimension was achieved. For hospitals aligned with a HEN, the requirements were:

1. 3 hospitals from each of 3 levels of engagement with a HEN
2. 2 hospitals were to be CAHs
3. 2 or 3 hospitals from each of 4 levels of hospital size (less than 100, between 100 and 199 beds, between 200 and 299 beds, 300 or more beds)
4. Proportional number of hospitals across geographic region
5. Proportional number of hospitals across urbanicity

The selection process entailed the controlled allocation across the three levels of engagement with a HEN of the sample of 9 hospitals by CAH hospital and among hospitals that were not CAHs, by four hospital size levels. After the sample was allocated across levels of engagement and hospital type and size, the sample was randomly allocated to region and then randomly allocated to urban and rural within the region.

Among HEN-aligned hospitals, the final sample of hospitals (see Table C-3) included:

1. 1 CAH hospital with a low engagement score in a rural area of the Midwest
2. 1 CAH hospital with a high engagement score in a rural area of the South
3. 1 hospital with 100 to 199 beds and a low engagement score in an urban area of the West
4. 1 hospital with 300 or more beds and a low engagement score in an urban area of the South
5. 1 hospital with less than 100 beds and a medium engagement score in a rural area of the Midwest
6. 1 hospital with 100 to 199 beds and a medium engagement score in an urban area of the South
7. 1 hospital with 200 to 299 beds and a medium engagement score in a rural area of the South
8. 1 hospital with 200 to 299 beds and a high engagement score in a rural area of the East
9. 1 hospital with 300 or more beds and a high engagement score in an urban area of the Midwest

For hospitals not engaged with a HEN (242 hospitals), the Evaluation Contractor sought 1 CAH hospital, 1 hospital with less than 100 beds and 1 hospital with more than 100 beds. Only 1 hospital could be selected in any region and a proportional number of hospitals was required across urbanicity.

Among the non-aligned hospitals, the final sample of hospitals included:

1. 1 CAH hospital in a rural area of the Midwest
2. 1 hospital with less than 100 beds in an urban area of the West
3. 1 hospital with 100 or more beds in an urban area of the South

The distribution of the hospitals responding to the survey, the expected sample, and the visited hospitals for the various dimensions are given in Table C-3.

Table C-3—Summary of Hospitals and Selections by Hospital Alignment, Engagement with HEN, Hospital Type and Size, Geographic Region and Urbanicity			
	Available	**Expected Selections**	**Visited**
Aligned Hospitals	**848**	**9**	**11 (2 late joiners)**
Hospital Type and Size			
CAH	253	2.7	3
Not CAH, Less than 100 beds	178	1.9	1
Not CAH, 100 to 199 beds	148	1.6	2
Not CAH, 200 – 399 beds	180	1.9	4
Not CAH, 400 or more beds	79	0.8	1
Engagement Score Tertiles			
First (lowest)	283	3.0	4
Second	284	3.1	4
Third (highest)	271	2.9	3
Region			
Northeast	106	1.1	1
Midwest	328	3.5	4
South	252	3.8	5
West	152	1.6	1
Urbanicity			
Rural	382	4.1	6
Non-rural	456	4.9	5
Non-Aligned Hospitals	**242**	**3**	**1**
Hospital Type and Size			
CAH	70	0.9	
Not CAH, Less than 100 beds	83	1.0	1
Not CAH, 100 to 199 beds	89	1.1	
Region			
Northeast	22	0.3	
Midwest	77	1.0	
South	110	1.4	
West	33	0.4	1

Table C-3—Summary of Hospitals and Selections by Hospital Alignment, Engagement with HEN, Hospital Type and Size, Geographic Region and Urbanicity			
	Available	Expected Selections	Visited
Urbanicity			
Rural	107	1.3	1
Non-rural	122	1.5	
Unknown	13	0.2	

Source: Evaluation Contractor's survey sample file for Survey of Prevention of Adverse Events and Reduction of Readmissions, with characteristics from the AHA Annual Survey (2010).

Participation by Selected Hospitals

Among the 12 initially-selected hospitals, six agreed to participate in the site visits, and six were replaced. Each potential replacement was identified as next on the list from a randomized list of other hospitals meeting the same criteria on the dimensions explained above. For five of the six replacements, the next-approached hospital on the randomized list agreed to participate. For one replacement—whose characteristics were urban, in the south region, 100 beds or larger and non-HEN-aligned, the team had great difficulty finding a hospital willing to cooperate; the visited hospital was the 8th hospital on the list, and although it had appeared on the non-HEN-aligned list for sampling, it was actually a late joiner to the HEN-aligned hospitals, joining beginning in 2013.

Encouragement to Participate

The participating hospitals were assured that their names and other potentially identifying information of the hospitals would be kept confidential, to encourage willingness to participate, and candor.

A $1,000 consulting fee was offered upon successful completion of the visit, to encourage participation and reduce the need for substitution among the originally selected set (where substitution could create actual or perceived bias toward selecting hospitals that want to "show off").

Structure of the Visits

The site visits involved a two-person (senior/junior) team conducting a set of interviews that totaled 4.5 hours on site at the hospital, plus a 45-minute interview prior to the visit. Detailed notes were taken on-site; interviews were also recorded to ensure accuracy of notes, when the participants were comfortable with being recorded (most cases). Table C-4 shows the types of individuals that were interviewed, and time allotment for the interviews:

Table C-4—Interviews Scheduled and Time Allotments		
Individual to be Interviewed	**Time Request**	**Research Questions to be Addressed (Numbers used are those above)**
Chief executive officer (CEO) if possible, or other C-suite representative	30 minutes	All six, high level
Chief medical officer (CMO)	30 minutes	All six, high level
Chief nursing officer (CNO)	30 minutes	All six, high level
Patient safety officer(s)/Quality director(s)/key staff responsible for leading patient safety improvement (overall) and team leads for improvement efforts conducted during 2011-2014	90 minutes	All six, detail except for 5 (measurement), save readmissions for readmission-specific interview
Front-line staff: nurse and aid working in a department affected by changes	30 minutes	1 and 2 (changes in processes and infrastructure), in detail, and a version of 3 and 4 (influencing and supporting factors) specific to the story of changes affecting them
Patient and family engagement lead	20 minutes	1-4, PFE focus (not measurement, not external factors affecting outcomes)
Lead for care transitions work	45 minutes	All six, detail except for 5 (measurement), specific to readmissions
Quality/safety measurement staff	45 minutes (by phone, in advance of the site visit)	5 (measurement), in detail, and 2 in terms of infrastructure changes related to measurement and use of data

Analysis

The analysis consisted of a qualitative synthesis across sites, focused on supplementing and complementing the quantitative information available from other sources, integrated into report sections as appropriate.

Method for Analysis of Unintended Consequences

The primary data source for this analysis was the interviews conducted with 26 HENs and 24 AHA/HRET SHAs in fall 2014, during which we asked participants about unintended consequences – both positive and negative – that they thought hospitals participating in PfP may have experienced ("Have you seen any "unintended consequences" from your work with the hospitals?"). Building on our extensive analyses of this interview data set, we looked for corroborating evidence regarding the potential consequences raised by the HENs and SHAs in other sections of the HEN/SHA interview notes as well as in data from other primary collection efforts, specifically, interviews conducted in winter-spring 2015 with national organizations (referred to as the non-federal partners interviews, interview method described above) and site visits to eleven hospitals participating in PfP. While neither of these other data collection efforts asked explicitly about unintended consequences, the subject was raised in some cases, providing additional insight into the responses given by the HENs and SHAs.

HSAG HEALTH SERVICES ADVISORY GROUP MATHEMATICA Policy Research

Survey of Participation in Patient Safety Activities

The Evaluation Contractor administered a national web-based survey of HEN-aligned hospitals to hospital staff—the Survey of Participation in Activities to Improve Patient Safety—in order to gather information not available through other sources regarding hospitals' participation in different types of patient safety-related activities sponsored by their HENs or the AHA/HRET HEN's SHAs. Respondents were also asked whether participation in patient safety-related activities resulted in changes within specific units, or hospital-wide. The survey collected information about participation in the following activities:

- Skills training
- Value-added—networking with other hospitals
- Virtual consultation or coaching
- On-site visits
- Feedback on patient safety performance data
- Other education and resources

Survey Content

A copy of the Web survey is provided below, with the number of responses to each question annotated. Given that, it was a Web survey, the presentation of the survey to respondents differed from that shown here.

SURVEY OF PARTICIPATION IN ACTIVITIES TO IMPROVE PATIENT SAFETY

NAME: ______________________________

EMAIL: ____________________@______________.com

HOSPITAL NAME: ______________________________

HEN: ______________________________

Your hospital name should replace the red box. This only occurs once in the survey.

The name of the HEN (or state hospital association if aligned with the AHA/HRET).

HSAG HEALTH SERVICES ADVISORY GROUP

MATHEMATICA Policy Research

Survey of Participation in Activities to Improve Patient Safety

Welcome! This survey contains questions about your hospital's participation in and response to patient safety initiatives that were made available as part of the Partnership for Patients campaign (thru your Hospital Engagement Network or state hospital association, for hospitals aligned with the AHA/HRET HEN). The information you provide will allow CMS to better understand how to structure future initiatives focused on patient safety.

The survey contains 11 questions and should take about 5 minutes to complete. Your participation is voluntary. Your responses will be kept confidential. An aggregate report will be provided to CMS, but neither you nor your hospital will be identified.

Thanks in advance for your participation.

This survey is about your hospital's participation in activities and initiatives sponsored by your Hospital Engagement Network (or state hospital association, for hospitals aligned with the AHA/HRET HEN). Your hospital and its HEN are listed below.

Hospital:

HEN: [redacted]

QUESTION 1

SKILLS TRAINING

Skills training: Hospital staff attended training sponsored by the HEN, such as TeamSTEPPS, Lean, CUSP, or another specific curriculum.

In which adverse event area(s) did your hospital staff receive skills training sponsored by the [redacted]?

Check all that apply.

Number of Responses for Question 1	N
CAUTI	1,311
CLABSI	941
SSI	783
VAP	499
VTE	713
Falls	1,179
Pressure Ulcers	856
Early Elective Delivery	654

Number of Responses for Question 1	N
Other Obstetrical Events	370
Adverse Drug Events	882
Readmissions	1,235
Safety-Across-the-Board	798
Hospital did not participate	482

QUESTION 2

VALUE-ADDED NETWORKING WITH OTHER HOSPITALS

Value-added networking with other hospitals: Attended meetings of hospitals where harm reduction experiences were shared, engaged in one-on-one connections with another hospital to share approaches, and/or participated in a collaborative or affinity group sponsored by the HEN to improve patient safety.

Value-added networking with other hospitals, sponsored by the [redacted], focused on which of the following adverse event area(s) in your hospital?

Check all that apply.

Number of Responses for Question 2	N
CAUTI	1,518
CLABSI	1,099
SSI	915
VAP	581
VTE	854
Falls	1,371
Pressure Ulcers	988
Early Elective Delivery	797
Other Obstetrical Events	460
Adverse Drug Events	966
Readmissions	1,492
Safety-Across-the-Board	928
Hospital did not participate	301

QUESTION 3

VIRTUAL CONSULTATION OR COACHING

Virtual consultation or coaching by HEN staff on harm reduction in this hospital's own context: Phone or Internet-based meetings with HEN representative to support/inform patient safety improvement efforts

Virtual consultation or coaching, sponsored by the [redacted], focused on which of the following adverse event area(s) in your hospital?

Check all that apply.

Number of Responses for Question 3	N
CAUTI	1,344
CLABSI	943
SSI	826
VAP	565
VTE	815
Falls	1,234
Pressure Ulcers	893
Early Elective Delivery	680
Other Obstetrical Events	423
Adverse Drug Events	951
Readmissions	1,281
Safety-Across-the-Board	887
Hospital did not participate	484

QUESTION 4

ON-SITE VISITS

On-Site Visits: In-person, on-site visits from HEN staff to support/inform the hospital's improvement efforts

On-site visits, sponsored by the [redacted], focused on which of the following adverse event area(s) in your hospital?

Check all that apply.

Number of Responses for Question 4	N
CAUTI	1,044
CLABSI	747
SSI	693

Number of Responses for Question 4	N
VAP	489
VTE	680
Falls	1,003
Pressure Ulcers	725
Early Elective Delivery	537
Other Obstetrical Events	334
Adverse Drug Events	737
Readmissions	1,071
Safety-Across-the-Board	869
Hospital did not participate	676

QUESTION 5

FEEDBACK ON PATIENT SAFETY PERFORMANCE DATA

Feedback on patient safety performance data: Examples include monthly or quarterly data feedback report with comparisons

In which adverse event area(s) did your hospital receive feedback on safety performance data from the [redacted]?

Check all that apply.

Number of Responses for Question 5	N
CAUTI	1,836
CLABSI	1,561
SSI	1,380
VAP	1,063
VTE	1,422
Falls	1,815
Pressure Ulcers	1,556
Early Elective Delivery	1,149
Other Obstetrical Events	673
Adverse Drug Events	1,367
Readmissions	1,781
Safety-Across-the-Board	952
Hospital did not participate	177

QUESTION 6

OTHER EDUCATION AND RESOURCES

Other education and resources: Received information about processes to prevent harm or outcomes measurement and/or accessed tools and resources to support improvement.

In which adverse event area(s) did your hospital staff receive other education and resources sponsored by the [redacted]?

Check all that apply.

Number of Responses for Question 6	N
CAUTI	1,387
CLABSI	1,063
SSI	958
VAP	724
VTE	996
Falls	1,369
Pressure Ulcers	1,076
Early Elective Delivery	813
Other Obstetrical Events	569
Adverse Drug Events	1,114
Readmissions	1,421
Safety-Across-the-Board	1,032
Hospital did not participate	451

QUESTION 7

When answering the following questions, please think about ALL of the activities that your hospital participated in that were sponsored by the [redacted]

In which of the following areas did your hospital take hospital-wide action or change policies to improve patient safety as a result of participating in activities sponsored by the [redacted]?

Check all that apply.

Number of Responses for Question 7	N
CAUTI	1,420
CLABSI	912
SSI	721
VAP	424
VTE	815

Number of Responses for Question 7	N
Falls	1,368
Pressure Ulcers	830
Early Elective Delivery	672
Other Obstetrical Events	304
Adverse Drug Events	853
Readmissions	1,341
Safety-Across-the-Board	755

QUESTION 8

In which of the following areas did your hospital take unit-specific action or change policies to improve patient safety as a result of participating in activities sponsored by the [redacted]?

Check all that apply.

Number of Responses for Question 8	N
CAUTI	1,151
CLABSI	726
SSI	564
VAP	432
VTE	579
Falls	1,101
Pressure Ulcers	649
Early Elective Delivery	807
Other Obstetrical Events	426
Adverse Drug Events	553
Readmissions	885
Safety-Across-the-Board	493

QUESTION 9

In which of the following areas did your hospital make changes to improve patient safety, but those changes were NOT due to your hospital's participation in activities sponsored by the [redacted]?

Check all that apply.

Number of Responses for Question 9	N
CAUTI	572
CLABSI	502
SSI	554
VAP	341
VTE	569
Falls	711
Pressure Ulcers	524
Early Elective Delivery	379
Other Obstetrical Events	269
Adverse Drug Events	451
Readmissions	649
Safety-Across-the-Board	426

QUESTION 10

In what areas were changes NOT needed because harm in the area was so low in your hospital already due to work prior to 2012.

Check all that apply.

Number of Responses for Question 10	N
CAUTI	403
CLABSI	650
SSI	412
VAP	789
VTE	321
Falls	198
Pressure Ulcers	615
Early Elective Delivery	311
Other Obstetrical Events	231
Adverse Drug Events	289
Readmissions	160

Number of Responses for Question 10	N
Safety-Across-the-Board	83

QUESTION 11

Use the space provided to add any comments about your hospital's experiences working with the [redacted].

Sample and Survey Administration

HENs and AHA/HRET's SHAs were asked to provide, for each participating hospital, the name, email address, and phone number for the person who could answer questions about the hospital's participation in HEN-sponsored activities. The Evaluation Contractor received lists from 17 HENs and 26 AHA/HRET's SHAs, containing the names of 1,672 and 1,317 individuals, respectively. An additional 5 HENs and 1 AHA/HRET SHA opted to administer the survey anonymously to 400 individuals. The total sample across all HENs and AHA/HRET's SHAs included 3,389 individuals.

The Web survey was administered between January 2015 and March 2015. An invitation email was sent to each sample member for whom contact information had been provided. Seven reminder emails were sent to non-responders. During the last four weeks of data collection, reminder phone calls were made to non-responders.

For those for whom contact information was lacking, the HENs and AHA/HRET's SHAs sent an invitation email on behalf of the Evaluation Contractor. Two reminder emails were sent to hospitals upon the Evaluation Contractor's request.

Response Rate

Among hospitals through which contact information was made available, the response rate was 75 percent. Among the 400 hospitals that received the Web survey for participation anonymously, the response rate was 50 percent. The response rate across all hospitals was 72 percent. There was no significant difference between HEN and AHA/HRET SHA hospitals with regard to response rate (71 percent and 72 percent, respectively) (Table C-5).

Table C-5—Survey of Participation in Patient Safety Activities

Contact Information	Total Number of Surveys Sent	Number of Responses	Response Rate
Hospitals with Contact Information	2,989	2,231	75.0%
Hospitals without Contact Information	400	201	50.0%
Total	**3,389**	**2,432**	**72.0%**

Source: Evaluation Contractor's Survey Database.

Analysis

The Evaluation Contractor used the survey data to conduct several statistical analyses regarding HEN characteristics, hospital participation, and hospital operational changes in response to PfP. Prior to descriptive and statistical analyses, the analytic file was cleaned to eliminate a small number of duplicates and ensure only eligible hospitals remained, such that the final number of hospitals in the analytic file was 2,355.[C-17] These analyses address the following research questions:

- Does hospital participation in HEN activities vary based on HEN characteristics?
- Are hospitals in certain types of HENs more likely to have made changes due to PfP than others?
- Are hospitals that participated in certain types of HEN activities more likely to have made changes due to PfP than others?

For these analyses, at the hospital level, adverse event areas were marked as not applicable, or treated as missing data, for the following two reasons:

- The hospital did not provide relevant healthcare services (e.g., obstetrics or central lines).
- The hospital marked the AEA in response to the following survey question: "In what areas were changes NOT needed because harm in the area was so low in your hospital already due to work prior to 2012;" removing these areas from analysis helps to ensure that participation and indications of making changes due to PfP are in areas where changes were still needed during the PfP campaign time period.

Hospitals from HENs with less than 70 percent response rates were dropped, to ensure adequate representation of HENs in the survey analysis of HEN characteristics.

To explore whether hospital participation varied based on characteristics of HENs and SHAs participating through AHA/HRET, the Evaluation Contractor conducted a one-way ANOVA analysis of variance in HEN characteristics (ownership, size, and rural composition) compared to the average number of HEN activities hospitals participated in. HEN characteristics were defined as follows:

- Ownership (system, state hospital association, and other): based on publicly available descriptions of HENs and the Evaluation Contractor's knowledge of the HENs.
- Size (<50, 50-99, 100+): based on the November 2014 hospital list of eligible HEN participating hospitals reported by each HEN and each SHA participating through AHA/HRET.
- Rural composition (0-30 percent, more than 30 percent): based on the November 2014 hospital list of eligible HEN participating hospitals reported by each HEN and each SHA participating through AHA/HRET.

C-17 Ineligible hospitals are hospitals other than CAHs, acute care, and children's hospitals, including long-term care and psychiatric hospitals that were permitted to attend HEN activities, but were not included in evaluation analyses. The qualitative analysis of hospitals' open-ended comments was done prior to the data cleaning and was not re-considered after cleaning due to the likelihood of little change and the time necessary to repeat this analysis.

The HEN and SHA characteristics are provided in Table C-6.

Table C-6—HEN Characteristics by HEN or AHA/HRET SHA

HEN/SHA	Ownership Type	Size (Number of Eligible Hospitals)	Rural Composition
AHA/HRET	Hospital Association	100+ hospitals	>30% of hospitals
Ascension	System	50 - 99 hospitals	>30% of hospitals
Carolinas	System	<50 hospitals	>30% of hospitals
DFW	Other	<50 hospitals	0% - 30% of hospitals
Dignity	System	<50 hospitals	0% - 30% of hospitals
EHEN	Other	<50 hospitals	0% - 30% of hospitals
Georgia	Hospital Association	100+ hospitals	>30% of hospitals
Intermountain	Other	50 - 99 hospitals	>30% of hospitals
Iowa	Hospital Association	100+ hospitals	>30% of hospitals
JCR	Other	<50 hospitals	>30% of hospitals
LifePoint	System	50 - 99 hospitals	>30% of hospitals
Michigan	Hospital Association	50 - 99 hospitals	>30% of hospitals
Minnesota	Hospital Association	100+ hospitals	>30% of hospitals
Nevada	Hospital Association	<50 hospitals	0% - 30% of hospitals
New York	Hospital Association	100+ hospitals	>30% of hospitals
NJ	Hospital Association	50 - 99 hospitals	0% - 30% of hospitals
NoCVA	Hospital Association	100+ hospitals	>30% of hospitals
Ohio	Hospital Association	50 - 99 hospitals	>30% of hospitals
Ohio Children's	Other	50 - 99 hospitals	0% - 30% of hospitals
Pennsylvania	Hospital Association	100+ hospitals	>30% of hospitals
Premier	Other	100+ hospitals	>30% of hospitals
TCQPS	Other	50 - 99 hospitals	>30% of hospitals
Tennessee	Hospital Association	50 - 99 hospitals	>30% of hospitals
UHC	Other	50 - 99 hospitals	0% - 30% of hospitals
VHA	Other	100+ hospitals	>30% of hospitals
WA	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Alaska	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Alabama	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Arkansas	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Arizona	Hospital Association	<50 hospitals	>30% of hospitals
AHA-California	Hospital Association	100+ hospitals	0% - 30% of hospitals
AHA-Colorado	Hospital Association	<50 hospitals	>30% of hospitals

Table C-6—HEN Characteristics by HEN or AHA/HRET SHA			
HEN/SHA	**Ownership Type**	**Size (Number of Eligible Hospitals)**	**Rural Composition**
AHA-Connecticut	Hospital Association	<50 hospitals	0% - 30% of hospitals
AHA-District of Columbia	Hospital Association	<50 hospitals	0% - 30% of hospitals
AHA-Florida	Hospital Association	50 - 99 hospitals	0% - 30% of hospitals
AHA-Idaho	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Illinois	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Indiana	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Kansas	Hospital Association	100+ hospitals	>30% of hospitals
AHA-Kentucky	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Louisiana	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Massachusetts	Hospital Association	<50 hospitals	0% - 30% of hospitals
AHA-Missouri	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-Mississippi	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Montana	Hospital Association	<50 hospitals	>30% of hospitals
AHA-North Dakota	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Nebraska	Hospital Association	<50 hospitals	>30% of hospitals
AHA-New Hampshire	Hospital Association	<50 hospitals	>30% of hospitals
AHA-New Mexico	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Oklahoma	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Oregon	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Puerto Rico	Hospital Association	50 - 99 hospitals	0% - 30% of hospitals
AHA-Rhode Island	Hospital Association	<50 hospitals	0% - 30% of hospitals
AHA-South Dakota	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Wisconsin	Hospital Association	50 - 99 hospitals	>30% of hospitals
AHA-West Virginia	Hospital Association	<50 hospitals	>30% of hospitals
AHA-Wyoming	Hospital Association	<50 hospitals	>30% of hospitals

Source: HEN monthly reports submitted to CMS, November, 2014.

To investigate any associations between HEN characteristics and hospitals' indications that they made changes due to PfP (either hospital wide or unit-specific), the Evaluation Contractor conducted a simple logistical regression. The independent variable was each HEN characteristic outlined above, analyzed separately, and the dependent variable was defined as "hospitals made changes due to PfP overall," where hospital made changes in at least three adverse event areas. Three areas were required, because descriptive statistics pointed to this threshold as capturing the majority of hospital respondents (68 and 60 percent of hospital respondents made changes in at least three adverse event areas in one unit or hospital wide, respectively).

To explore whether there was variation in hospitals' operational response to PfP due to participation in certain HEN activities, the Evaluation Contractor conducted a simple logistical regression. For all applicable adverse event areas at the hospital level, the independent variable was defined as hospital participation in each of six HEN activities in each adverse event area, and the dependent variable was defined as hospitals' indication of making changes (hospital wide or unit specific) due to PfP in the same area, resulting in 11 sets of results. The reference group for each comparison was hospitals that did not receive the HEN activity either because the HEN did not offer the activity or because the HEN offered the activity but the hospital did not participate in it.

Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions

The Evaluation Contractor administered a national web-based survey to hospital staff—the *Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions*—in order to gather information not available through other sources on hospitals' efforts and capacity to track and improve outcomes focused on by PfP. The survey collected information on the following:

- Hospital participation in PfP
- Improvement efforts
- Influences, beyond PfP, on hospitals' efforts to reduce or prevent adverse events
- Care transitions
- Sufficiency of resources and knowledge to reduce or prevent adverse events
- Hospital culture and patient care practices related to specific adverse events

The first round of the survey was administered in spring 2012 and the second round in spring 2014.[C-18] For round 1, a random sample of 2,570 hospitals from a pool of 5,078 acute care hospitals—including critical access and children's hospitals—was identified using the 2009 AHA survey database.[C-19] Most specialty facilities, including long-term care, rehabilitation, and psychiatric hospitals, were excluded. After drawing the sample, an additional 118 hospitals were determined to be ineligible because they had closed, were Veteran Affairs hospitals, or were military hospitals, leaving 2,452 in the survey sample. Among the 2,452 sample members invited to participate, 1,719 completed it, yielding a response rate of 70 percent. For round 2, all 1,719 respondents to round 1 were asked to complete the survey. During data collection, 13 hospitals were identified as having closed or merged since 2012. These hospitals were excluded from the sample resulting in a final eligible round 2 sample of 1,706. A total of 1,136 of the 1,706 eligible hospitals completed the survey, yielding a response rate of 67 percent. Overall, 1,136 individuals among 2,439 eligible cases completed both rounds of the survey, yielding a combined round 1-round 2 response rate of 47 percent.

Sampling weights and non-response adjustment weights were used in the survey analysis as follows:

Sampling Weights: The survey sample was drawn using a stratified random sampling design. The sample frame file contained a total of 5,078 hospitals. The strata were defined by hospital type, children's hospitals and non-children's hospitals. There were 88 children's hospitals and 4,990 non-children's hospitals. The Evaluation Contractor selected all 88 children's hospitals and 2,482 non-children's hospitals for a total of

C-18 The survey was fielded by Mathematica Policy Research, subcontractor to Health Services Advisory Group, which together comprise the PfP Evaluation Contractor.

C-19 Although the analyses use 2010 AHA data, the sample frame was created using the 2009 data because the 2010 data had not become available to the evaluation contractor by the time of the creation of the frame.

2,570 hospitals. The probability of selection is equal for all hospitals within each stratum. Therefore, the sampling weights for the selected hospitals were calculated as follows.

- If hospital h is a children's hospital, $W_h = 1$
- If hospital h is a non-children's hospital, $W_h = 4{,}990/2{,}482 = 2.0105$

Non-Response Adjustment: Sampling weights were adjusted for HEN-aligned and non-HEN-aligned hospitals (separately) to obtain non-response adjusted weights. The purpose of this adjustment was to reduce the bias that would result if analyses incorporated no weights or only the sampling weights. After adjusting the sample weights for non-response, a non-response bias analysis was performed to compare the estimates before and after non-response adjustment (Table C-7 through Table C-9). Consistent with the goal, non-response bias was greatly reduced after the Evaluation Contractor did the non-response adjustment. For the full sample, when comparing sample frame variables using only the sampling weights, 7 out of the 19 comparisons were significant, indicating potentially severe bias. When using the non-response adjusted weights, only one out of the 19 comparisons was significant.

Table C-7—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: Overall

	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
Bed Size/Type											
CAH	650	26.98	337	30.11	313	24.28	3.12*	11.56	27.55	0.56	2.08
<100 Beds, Non-CAH	627	25.28	281	24.56	346	25.90	-0.72	-2.83	25.37	0.09	0.37
100-199 Beds, Non-CAH	478	19.45	198	17.37	280	21.25	-2.07*	-10.67	18.67	-0.78	-4.00
200-399 Beds, Non-CAH	459	18.53	222	19.34	237	17.84	0.80	4.34	19.31	0.77	4.18
400+ Beds, Non-CAH	238	9.76	98	8.62	140	10.74	-1.14	-11.64	9.11	-0.65	-6.67
Ownership Type											
Government	543	22.52	267	23.85	276	21.37	1.33	5.91	23.33	0.81	3.58
Non-Profit	1,448	58.42	708	61.86	740	55.44	3.43*	5.87	58.16	-0.26	-0.45
For-Profit	447	18.47	154	13.67	293	22.65	-4.81*	-26.02	17.75	-0.73	-3.94
Missing	14	0.58	7	0.63	7	0.54	0.04	7.59	0.77	0.18	31.72
Region											
East	281	11.48	138	12.10	143	10.93	0.63	5.45	11.12	-0.36	-3.13
West	566	23.14	281	24.79	285	21.71	1.65	7.11	23.24	0.09	0.41
Midwest	1,114	45.41	520	45.73	594	45.13	0.32	0.71	47.14	1.73*	3.81
South	491	19.97	197	17.37	294	22.22	-2.59*	-12.98	18.50	-1.47	-7.35

Table C-7—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: Overall											
	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
System Member											
Yes	1,331	54.40	582	51.32	749	57.08	-3.08*	-5.67	55.11	0.71	1.31
No	1,121	45.60	554	48.68	567	42.92	3.08*	6.76	44.89	-0.71	-1.56
Children's Hospital											
Yes	86	1.78	33	1.47	53	2.04	-0.31	-17.43	1.78	0.00	0.00
No	2,366	98.22	1,103	98.53	1,263	97.96	0.31	0.32	98.22	0.00	0.00
Teaching Hospital											
Yes	599	23.47	271	23.09	328	23.80	-0.38	-1.63	23.27	-0.20	-0.84
No	1,853	76.53	865	76.91	988	76.20	0.38	0.50	76.73	0.20	0.26
Alignment Status											
Aligned Hospitals	1,738	71.32	894	79.01	844	64.64	7.69*	10.79	71.32	0.00	0.00
Non-Aligned Hospitals	714	28.68	242	20.99	472	35.36	-7.69*	-26.82	28.68	0.00	0.00

Source: Evaluation Contractor's analysis of response data from the Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions and hospital characteristics from the AHA Annual Survey of Hospitals, 2010.

Note: [a]Estimates were calculated with the sampling weights.

[b]Estimates were calculated with respondent sample using non-response adjusted weights.

[c]Estimated bias is calculated as the weighted non-response rate times the difference in the weighted respondent and non-respondent means. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.

[d]The relative bias is calculated as the estimated bias divided by the (before adjustments) overall mean.

[e]Estimated bias is calculated as the difference in the weighted overall mean before adjustment and the respondent sample mean calculated using the non-response adjusted weight. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.

Table C-8—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: HEN-Aligned Hospitals											
	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
Bed Size/Type											
CAH	448	26.08	267	30.19	181	21.72	4.11*	15.76	26.91	0.84	3.21
<100 Beds, Non-CAH	358	20.58	198	22.05	160	19.02	1.47	7.14	20.87	0.30	1.44
100-199 Beds, Non-CAH	355	20.40	157	17.58	198	23.39	-2.82*	-13.83	19.44	-0.97	-4.73
200-399 Beds, Non-CAH	370	21.04	187	20.69	183	21.41	-0.35	-1.67	22.03	0.99	4.68
400+ Beds, Non-CAH	207	11.90	85	9.50	122	14.46	-2.41*	-20.22	10.75	-1.15	-9.68
Ownership Type											
Government	368	21.42	213	24.08	155	18.60	2.66*	12.42	22.39	0.97	4.53
Non-Profit	1,160	66.38	594	66.14	566	66.64	-0.25	-0.37	66.25	-0.13	-0.20
For-Profit	210	12.2	87	9.78	123	14.76	-2.42*	-19.8	11.36	-0.84	-6.88
Missing	0	0	0	0	0	0	0	0	0	0	0
Region											
East	223	12.86	116	13.06	107	12.66	0.19	1.51	12.75	-0.11	-0.88
West	433	24.94	236	26.46	197	23.34	1.51	6.07	24.66	-0.28	-1.14
Midwest	706	40.63	378	42.17	328	38.99	1.54	3.79	41.94	1.31	3.22
South	376	21.57	164	18.32	212	25.01	-3.25*	-15.07	20.65	-0.91	-4.23
System Member											
Yes	992	57.22	462	51.72	530	63.05	-5.49*	-9.60	57.25	0.03	0.05
No	746	42.78	432	48.28	314	36.95	5.49*	12.84	42.75	-0.03	-0.06
Children's Hospital											
Yes	40	1.16	19	1.07	21	1.25	-0.09	-7.74	1.16	0.00	0.00
No	1,698	98.84	875	98.93	823	98.75	0.09	0.09	98.84	0.00	0.00

Table C-8—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: HEN-Aligned Hospitals											
	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
Teaching Hospital											
Yes	475	26.63	228	24.87	247	28.49	-1.76	-6.60	26.59	-0.04	-0.13
No	1,263	73.37	666	75.13	597	71.51	1.76	2.39	73.41	0.04	0.05

Source: Evaluation Contractor's analysis of response data from the Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions and hospital characteristics from the AHA Annual Survey of Hospitals, 2010.
Note: [a]Estimates were calculated with the sampling weights.
[b]Estimates were calculated with respondent sample using non-response adjusted weights.
[c]Estimated bias is calculated as the weighted non-response rate times the difference in the weighted respondent and non-respondent means. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.
[d]The relative bias is calculated as the estimated bias divided by the (before adjustments) overall mean.
[e]Estimated bias is calculated as the difference in the weighted overall mean before adjustment and the respondent sample mean calculated using the non-response adjusted weight. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.

Table C-9—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: Non-HEN-Aligned Hospitals											
	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
Bed Size/Type											
CAH	202	29.24	70	29.79	132	28.95	0.55	1.89	29.12	-0.12	-0.42
<100 Beds, Non-CAH	269	36.97	83	34.04	186	38.48	-2.93	-7.93	36.56	-0.42	-1.13
100-199 Beds, Non-CAH	123	17.08	41	16.59	82	17.32	-0.48	-2.82	16.77	-0.31	-1.82
200-399 Beds, Non-CAH	89	12.30	35	14.25	54	11.29	1.95	15.89	12.55	0.25	2.03
400+ Beds, Non-CAH	31	4.41	13	5.32	18	3.95	0.90	20.49	5.01	0.60	13.58
Ownership Type											
Government	175	25.26	54	22.98	121	26.43	-2.27	-9.01	25.66	0.40	1.58
Non-Profit	288	38.63	114	45.74	174	34.97	7.11*	18.40	38.04	-0.59	-1.53
For-Profit	237	34.09	67	28.3	170	37.07	-5.78*	-16.97	33.63	-0.45	-1.32
Missing	14	2.03	7	2.98	7	1.54	0.95	47.02	2.67	0.64	31.72

Table C-9—Non-Response Bias Analysis for Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions: Non-HEN-Aligned Hospitals											
	Before Adjustments to the Weight (Sampling Weight[a])								After Adjustments to the Weight (Non-Response Adjusted Weight[b])		
	Full Sample		Respondent		Non-Respondent		Estimated Bias[c]	Relative Bias[d]	Respondent Sample Mean	Estimated Bias[e]	Relative Bias[d]
Data Item (Unit)	N	Mean	N	Mean	N	Mean					
Region											
East	58	8.03	22	8.51	36	7.79	0.48	5.93	7.06	-0.97	-12.06
West	133	18.67	45	18.51	88	18.75	-0.16	-0.85	19.70	1.03	5.54
Midwest	408	57.31	142	59.15	266	56.36	1.84	3.21	60.09	2.78	4.85
South	115	15.99	33	13.83	82	17.10	-2.16	-13.51	13.15	-2.85	-17.79
System Member											
Yes	339	47.39	120	49.79	219	46.16	2.39	5.05	49.81	2.41	5.10
No	375	52.61	122	50.21	253	53.84	-2.39	-4.55	50.19	-2.41	-4.59
Children's Hospital											
Yes	46	3.31	14	2.96	32	3.49	-0.35	-10.51	3.31	0.00	0.00
No	668	96.69	228	97.04	440	96.51	0.35	0.36	96.69	0.00	0.00
Teaching Hospital											
Yes	124	15.62	43	16.38	81	15.23	0.76	4.84	15.02	-0.60	-3.82
No	590	84.38	199	83.62	391	84.77	-0.76	-0.90	84.98	0.60	0.71

Source: Evaluation Contractor's analysis of response data from the Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions and hospital characteristics from the AHA Annual Survey of Hospitals, 2010.
Note: [a]Estimates were calculated with the sampling weights.
[b]Estimates were calculated with respondent sample using non-response adjusted weights.
[c]Estimated bias is calculated as the weighted non-response rate times the difference in the weighted respondent and non-respondent means. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.
[d]The relative bias is calculated as the estimated bias divided by the (before adjustments) overall mean.
[e]Estimated bias is calculated as the difference in the weighted overall mean before adjustment and the respondent sample mean calculated using the non-response adjusted weight. A value marked with an asterisk (*) identifies a bias that is significantly different from zero with statistical significance ≤ 0.05. Bias estimates without an asterisk are labeled as negligible.

The survey instrument, with annotations, is included below.

Hospital Survey on Prevention of Adverse Events and the Reduction of Readmissions

INSTRUMENT WITH FREQUENCY COUNTS

Section I: Participation in the Partnership for Patients Campaign

ALL

4_1. **Please indicate which (if any) types of organizations this hospital worked with or learned from to improve patient safety and reduce readmissions during any or all of 2012-2013. (Q4_1_1_1 through Q4_9_1)**

Check all that apply.

Eligible = 1,136

- ☐ Hospital Engagement Network (HEN) [*Click here to see list of HENs*] 1
  .... n=886
- ☐ A state hospital association 2
  .... n=714
- ☐ American Hospital Association (AHA) 3
  .... n=322
- ☐ Medicare Quality Improvement Organization (QIO) 4
  .... n=651
- ☐ Institute for Health Improvement (IHI) 5
  .... n=496
- ☐ Agency for Healthcare Research and Quality Comprehensive Unit-Based Safety Program (AHRQ CUSP) project 6
  .... n=382
- ☐ Professional organizations such as Association of Professionals in Infection Control (APIC) 7
  .... n=542
- ☐ Consulting firm 8
  .... n=90
- ☐ Other (specify) 9
  .... n=122

4. **Did your hospital work with a hospital engagement network (HEN) or state hospital association on patient safety improvement during any or all of 2012-2013? (Q4_1)**

Eligible = 1,136

- ❍ Yes 1 Q5a
  .... n=978
- ❍ No .... 0 Programmer not before 4a.
  .... n=111
- ❍ Don't know .... 3 Programmer not before 4a.
  .... n=47

PROGRAMMER NOTE: IF Q4=NO and HENFLAG=0, GO TO Q5; IF Q4= D and HENFLAG=0, GO TO Q9; IF Q4=NO, D and HENFLAG=1, GO TO Q4a

4a. Our records indicate that this hospital was on the roster as working with [HEN name or AHA/HRET/state hosp association name] as of June 2012. Please help us reconcile your answer with our records, if possible, by indicating if any of these are true: (Q4a_1)

ELIGIBLE = 9

- ☐ This hospital stopped participating with [HEN name or state hospital association name] .... 1 Q4b n=0
- ☐ This hospital never participated in patient safety activities with [HEN name or state hospital association name], and you believe you would know if they did .... 2 Q5 n=1
- ☐ "No" was your best guess, but you are not really sure. .... 3 Q4c n=8

Q4b. What month and year did this hospital stop participating with [HEN name or AHA/HRET/state hosp association name]? (q4b_1_1, q4b_year_1)

ELIGIBLE = 0

Month: Jan thru Dec **Year:** 2014, 2013, 2012, 2011, Not sure

Q4c. Is there someone else who may be able to complete the survey? This would be someone who is aware of patient safety activities the hospital participated in with [HEN name or AHA/HRET/state hosp association name] (Q4c_1)

ELIGIBLE = 8

- ❍ Yes .... 1 Q4c_contact n=0
- ❍ No .... 0 Q5a n=5
- ❍ Don't know .... 3 Q5a n=3

(Q4=0 & HENFLAG=0) OR Q4A=2 OR Q4C=0, 3

5. Why did this hospital <u>not</u> work with a hospital engagement network (HEN) or state hospital association as part of Partnership for Patients during 2012-2013? (Q5_1)

ELIGIBLE = 105

- ❍ No such opportunity presented .... 1 Q9 n=32
- ❍ Seemed redundant with other efforts we are involved in .... 2 Q9 n=27
- ❍ No resources to participate in another effort .... 3 Q9 n=29
- ❍ Other (specify) .... 4 Q9 n=5
- ❍ High-level decision .... 5 Q9 n=4
- ❍ Piggyback .... 6 Q9 n=2
- ❍ No need .... 7 Q9 n=6

Q4=1 or Q4a

5a. What hospital engagement network (HEN) and/or state hospital association did this hospital work with in any or all of 2012-2013? (Q5a_1)

PROGRAMMER NOTE: Fill hospital association name based on sample data.

Eligible = 978

1 American Hospital Association (AHA/HRET/HOSP ASSOC NAME)	397
2 Ascension Health	23
3 Carolinas Health Care System	10
5 Catholic Healthcare West	11
4 Dallas-Fort Worth Hospital Council Foundation	3
14 Essential Hospitals Engagement Network (EHEN), formerly National Public Health and Hospital Institute (NPHHI)	7
6 Georgia Hospital Association Research and Education Foundation	27
7 Hospital Association of Pennsylvania	27
8 Intermountain Healthcare	18
9 Iowa Healthcare Collaborative	36
10 Joint Commission Resources	19
11 LifePoint Hospitals	14
12 Michigan Health & Hospital Association (MHA)	24
13 Minnesota Hospital Association	27
15 Nevada Hospital Association	7
16 New Jersey Hospital Association/ Health Research and Educational Trust of NJ	13
17 North Carolina Virginia Regional HEC (NoCVA)	18
18 New York State PfP (HANYS and GNYHA)	41
19 Ohio Children's Hospitals' Solutions for Patient Safety (OCHSPS)	19
20 Ohio Hospital Association (OHA)	17
21 Premier Healthcare Alliance	75
22 Tennessee Hospital Association	12
23 Texas Hospital Association Foundation/ Texas Center for Quality & Patient Safety	27
24 University HealthSystem Consortium (UHC)	17
25 VHA Inc	38
26 Washington State Hospital Association	22
27 Some other HEN or state hospital association (specify)	17
28 State Hospital Association not affiliated with HEN	9
29 Indian Health Service	3

Q4 = 1 OR Q4A=1

6. **Which of the following types of assistance did this hospital receive from [HEN name or AHA/HRET/state hosp association name] in 2012-2013? (Q6_1_1 through Q6_7_1)**

Check all that apply.

ELIGIBLE = 978

1 ☐ Someone from this hospital attended in-person or virtual collaborative meetings of hospitals to share progress and lessons learned on patient safety topics .... n=835

2 ☐ Received information about effective measurement approaches, tools, or processes to prevent harms .... n=875

3 ☐ Worked with a [HEN name or AHA/HRET/state hosp association name] improvement advisor to plan improvements in patient safety........ n=608

4 ☐ Because of a connection made through someone from the [HEN name or AHA/HRET/state hosp association name], this hospital shared information on patient safety processes or measurement with another hospital that needed this. .... n=544

5 ☐ Because of a connection made through someone from the [HEN name or AHA/HRET/state hosp association name], this hospital, received information on patient safety processes or measurement from another hospital. .... n=634

6 ☐ Received feedback on patient safety performance data for this hospital .... n=736

7 ☐ Other (specify) .... n=9

8 ☐ Skills training .... n=3

9 ☐ Received information........ n=10

10 ☐ Access to resources .... n=3

Q4 = 1 OR Q4A=1

6a. In each of the following areas, please mark the response that best describes your hospital's level of engagement in patient safety activities sponsored or led by [HEN name or AHA/HRET/state hosp association name] in 2012-2013. (Q6a_1 through Q6a_12)

ELIGIBLE = 978

	Missing	Fully Engaged	Moderately Engaged	Minimally Engaged	Not at all Engaged
1. Adverse drug events	50	401	217	204	106
2. Catheter-associated urinary tract infections (CAUTI)	28	645	167	96	42
3. Central line-associated blood stream infections (CLABSI)	42	571	160	91	114
4. Injuries from falls and immobility	34	621	178	105	40
5. Early elective deliveries	85	424	104	63	302
6. Other obstetrical (OB) adverse events	99	270	155	109	345
7. Pressure ulcers	46	488	188	166	90
8. Surgical site infections	46	557	148	99	128
9. Venous thromboembolism (VTE)	52	476	199	146	105
10. Ventilator-associated events	70	391	146	118	253
11. All cause harm	77	414	204	142	141
12. Readmissions	30	598	210	102	38

Any item at 6a in (2, 3 4)

6b. Which best describes the reason(s) why this hospital was not fully engaged in the patient safety work with [HEN name or AHA/HRET/state hosp association name]? (Q6b_1_1 through Q6_9_1)

Check all that apply.

ELIGIBLE=791

- ☐ The hospital did not need the support of HEN name or AHA/HRET/state hosp association name] .... 1 n=118
- ☐ The areas are not applicable to this hospital .... 2 n=326
- ☐ The areas do not need improvement because the hospital sustains zero rates of harm in these areas .... 3 n=129
- ☐ We had all the improvement support needed within this hospital or health system .... 4 n=182
- ☐ We preferred to work with another organization outside the hospital .... 5 n=41
- ☐ Management decision .... 6 n=78
- ☐ Sub-optimal quality of resources or programming by [HEN name or AHA/HRET/state hosp association name] .... 7 n=21
- ☐ Inconvenient scheduling of learning events by [HEN name or AHA/HRET/state hosp association name] .... 8 n=48
- ☐ Other (specify) .... 9 n=44

Programmer note: If Q6b=3 and more than one item is Q6 is marked as low engagement or not at all engaged, then Q6b_other_1. Else, programmer note after Q6b_other_1.

Q6B=3

6b_other_1. In which area(s) did this hospital sustain zero rates of harm?

(Q6b_1_1_1 through Q6b_1_11_1)

Check all that apply.

ELIGIBLE = 124

☐	Adverse drug events	1	n=14
☐	Catheter-associated urinary tract infections (CAUTI)	2	n=35
☐	Central line-associated blood stream infections (CLABSI)	3	n=65
☐	Injuries from falls and immobility	4	n=11
☐	Early elective deliveries	5	n=31
☐	Other obstetrical (OB) adverse events	6	n=27
☐	Pressure ulcers	7	n=56
☐	Surgical site infections	8	n=24
☐	Venous thromboembolism (VTE)	9	n=23
☐	Ventilator-associated events	10	n=69
☐	All cause harm	11	n=2
☐	Readmissions	12	n=3

Q4=1 OR Q4A=1

7. As a result of assistance received from [HEN name or AHA/HRET/state hosp association name] in 2012-2013, did this hospital make changes to care processes aimed at reducing the rate of preventable adverse events in any of the following areas? (Q7_1_1 through Q7_12_1)

Check all that apply.

ELIGIBLE = 978

☐	Adverse drug events	1	n=356
☐	Catheter-associated urinary tract infections (CAUTI)	2	n=605
☐	Central line-associated blood stream infections (CLABSI)	3	n=412
☐	Injuries from falls and immobility	4	n=547
☐	Early elective deliveries	5	n=370
☐	Other obstetrical (OB) adverse events	6	n=187
☐	Pressure ulcers	7	n=332
☐	Surgical site infections	8	n=364
☐	Venous thromboembolism (VTE)	9	n=405
☐	Ventilator-associated events	10	n=225
☐	All cause harm	11	n=261
☐	Readmissions	12	n=621

Q4=1 OR Q4A=1

8. Please indicate the extent to which you agree with the following statements about the hospital's patient safety work with [HEN name or AHA/HRET/state hosp association name].

(Q8_1 through Q8_8)

Select one per row.

ELIGIBLE = 978

	Missing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. The work with [HEN name or AHA/HRET/state hosp association name] has been a major opportunity for the hospital to improve patient safety and readmissions with the support of outside resources	10	416	388	123	37	4
2. The topic areas covered by the work were well-aligned with other patient safety and readmission initiatives I'm familiar with	11	500	405	53	8	1
3. Meaningful measures of patient safety and readmissions were used in the work	27	411	433	90	11	6
4. [HEN name or AHA/HRET/state hosp association name] provided the right expertise to assist us to improve patient safety and readmissions	17	401	402	132	20	6
5. Important patient safety and readmissions learning opportunities were made available to us	22	474	398	70	11	3

	Missing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
6. Opportunities to convene with and learn from other hospitals were highly valuable to our improvement effort	19	408	372	150	23	6
7. The ambitious goals of the work with [HEN name or AHA/HRET/state hosp association name] helped further our success	20	365	387	171	28	7
8. The work with [HEN name or AHA/HRET/state hosp association name] was well-tailored to the needs of this hospital	18	347	365	196	40	12

ALL

9. To what extent were Partnership for Patients (PfP) adverse event focus areas among this hospital's top priorities for quality and safety improvement in 2012-2013? (Q9_1)

'PfP adverse events' are as follows: Adverse drug events, catheter-associated urinary tract infections (CAUTI), central line-associated blood stream infections (CLABSI), injuries from falls and immobility, early elective deliveries, other OB events, pressure ulcers, surgical site infections, venous thromboembolism, ventilator-associated events, all-cause harm, and readmissions

. **Eligible = 1,136**

- All or almost all the focus areas of the Partnership for Patients were among this hospital's top priorities for quality and safety improvement ....1 n=589
- Several of the focus areas of Partnership for Patients were among this hospital's top priorities for quality and safety improvement ....2 n=469
- There were other clinical areas we needed to focus on and so the Partnership for Patients focus areas, although important, were not among the top priorities for quality and safety improvement ....3 n=69

NO RESPONSE ....M n=9

ALL

10. Did the existence of Partnership for Patients (PfP) as a national effort influence this hospital's decision to pursue changes in the PfP adverse event focus areas or the intensity with which it pursued or is pursuing them? (Q10_1)

Eligible=1,136

❍ Yes	1		n=561
❍ No	0	Q12	n=387
❍ Don't know	3	Q12	n=183
NO RESPONSE	M	Q12	n=5

Q10=1

10a. When did this hospital begin to pursue change as a result of the existence of Partnership for Patients? (Q10a_1_1)

ELIGIBLE = 561

2011 ....n=87
2012 ....n=226
2013 ....n=98
2014 ....n=11
Not Sure..................n=128
Missing....................n=11

Q4=1 OR Q4A=1

12. When answering the following, think about all the times you have accessed [HEN name or AHA/HRET/state hosp association name] or other Partnership for Patients (PfP) patient safety or readmissions learning resources to date—including any that the [HEN name or AHA/HRET/state hosp association name] (if applicable) may have pointed you to, even if they were not developed by the Partnership for Patients (PfP)or [HEN name or AHA/HRET/state hosp association name]. (Q12_1 through Q12_3)

Taken together, how useful have the resources been in:

PROGRAMMER: CODE ONE PER ROW

ELIGIBLE = 978

	Missing	Very Useful	Somewhat Useful	Not very Useful	Not at all Useful
1. increasing knowledge of how to reduce harms in this hospital?	12	515	409	38	4
2. reinforcing or enhancing commitment to reduce harms in this hospital?	16	542	372	43	5
3. enabling this hospital to take new or different action to reduce adverse events?	17	466	423	66	6

Q4=1 or Q4a=1

13. Were the resources easy to access at the time you needed them? (Q13)

ELIGIBLE = 978

❍ Yes	1	n=909
❍ No	0	n=47
NO RESPONSE	M	n=22

Q4=1 or Q4a=1

14. Have others in this hospital accessed [HEN name or AHA/HRET/state hosp association name] or other Partnership for Patients learning resources? (Q14)

ELIGIBLE = 978

❍ Yes	1	n=698
❍ No	0	n=65
❍ Don't know	3	n=208
NO RESPONSE	M	n=7

Q4=1

15. Please provide any further comments on the Partnership for Patients Campaign or patient safety activities of [HEN name or AHA/HRET/state hosp association name] in the space provided. (Q15_1_1)

(STRING 400)

Section II: Improvement Efforts

ALL

16. During the past 12 months, how much effort has been made in each of the following aspects of quality improvement (QI) / patient safety? (Q16_1 through Q16_6)

PROGRAMMER: CODE ONE PER ROW **Eligible= 1,136**

	Missing	Major Effort 1	2	3	4	No Effort 5
1. Training front-line staff in patient safety skills or specific safe practices.	10	423	463	203	34	3
2. Development of QI leadership or staff in more advanced QI and patient safety improvement techniques.	6	408	462	185	59	16
3. Measuring or gathering data to measure the adverse event types that are the focus of the Partnership for Patients.	7	556	416	123	25	9
4 Addressing the adverse event types that are the focus of the Partnership for Patients.	8	490	447	148	27	16
5. Working with information system support personnel to improve QI and patient safety measurement capability.	14	387	398	229	81	27
6 Working with information system support personnel to improve clinical decision supports or to "hard-wire" important care guidelines.	12	413	375	214	81	41

ALL

17. For each of the following, please indicate if you provide the service in your hospital. (Q17_1 through Q17_4)

PROGRAMMER: Require a response on each row.

Eligible, 1,136

Service	Yes	No
a. Obstetrical services	n=711	n=425
b. Central line placement	n=983	n=153
c. Inpatient surgery	n=978	n=158
d. Ventilator support	n=845	n=291

Section III: Progress

ALL

17_4. Did your hospital implement process improvement efforts in 2012-2013 aimed at any of the following adverse event areas? (Q17_4_1 through Q17_4_12)

Some rows may be grayscaled based on responses to prior questions.

	Eligible	Missing	Yes	No
1. Adverse drug events	1,136	39	811	286
2. Catheter-associated urinary tract infections (CAUTI)	1,136	16	968	152
3. Central line-associated blood stream infections (CLABSI)	983	21	751	211
4. Injuries from falls and immobility	1,136	22	993	121
5. Early elective deliveries	711	24	592	95
6. Other obstetrical (OB) adverse events	711	35	445	231
7. Pressure ulcers	1,136	48	746	342
8. Surgical site infections	978	30	812	136
9. Venous thromboembolism (VTE)	1,136	30	873	233
10. Ventilator-associated events	845	35	563	247
11. All cause harm	1,136	71	681	384
12. Readmissions	1,136	25	974	137

PROGRAMMER: If Q17_4 all 0 or all blank, go to Q17_6.

Q17_4 = 1 for at least one item.

17_5. Was the process improvement effort implemented in 2012-2013 focused on specific units or was it focused on all applicable units hospital-wide? (Q17_5_1 through Q17_5_12)

Some rows may be grayscaled based on responses to prior questions.

PROGRAMMER: GRAYSCALE ROWS WHERE 17_4=0 or blank.

	Eligible	Missing	Focused on specific units	Focused on all applicable units hospital-wide
1. Adverse drug events	811	17	81	713
2. Catheter-associated urinary tract infections (CAUTI)	968	12	222	734
3. Central line-associated blood stream infections (CLABSI)	751	10	191	550
4. Injuries from falls and immobility	993	13	128	852
5. Early elective deliveries	592	8	465	119
6. Other obstetrical (OB) adverse events	445	7	345	93
7. Pressure ulcers	746	9	100	637
8. Surgical site infections	812	12	237	563
9. Venous thromboembolism (VTE)	873	12	102	759
10. Ventilator-associated events	563	6	347	210
11. All cause harm	681	13	38	630
12. Readmissions	974	13	181	780

ALL

17_9. For those adverse event areas with initiatives implemented in 2012-2013, please indicate if your hospital achieved a small (<10% reduction), moderate (10% to 39% reduction), or large (40% or more reduction) degree of improvement in 2012-2013. (Q17_9_1_1 through Q17_9_12_1)

Some rows may be grayscaled based on responses to prior questions.

			Degree of Improvement Achieved			
	Eligible	**Missing**	**Small to None** (e.g. <10% reduction)	**Moderate** (e.g. 10-39% reduction)	**Large** (e.g. 40% or more reduction)	**Don't Track/ Don't Know**
1. Adverse drug events	811	53	378	234	61	85
2. Catheter-associated urinary tract infections (CAUTI)	968	57	437	271	162	41
3. Central line-associated blood stream infections (CLABSI)	751	45	311	207	154	34
4. Injuries from falls and immobility	993	44	425	346	130	48
5. Early elective deliveries	592	41	149	157	219	26
6. Other obstetrical (OB) adverse events	445	34	144	141	63	63
7. Pressure ulcers	746	32	355	195	116	48
8. Surgical site infections	812	55	389	226	108	34
9. Venous thromboembolism (VTE)	873	55	392	240	106	80
10. Ventilator-associated events	563	34	235	154	109	31
11. All cause harm	681	45	250	221	79	86
12. Readmissions	974	45	432	361	89	47

Q4=1 AND Q17_9 IN (1, 2, OR 3) FOR AT LEAST ONE ROW; FILL [HEN] FROM Q5A.

23. **You indicated improvement occurred in the following adverse event areas. For each, please indicate if assistance from [HEN name or AHA/HRET/state hosp association name] was important to achieving the level of improvement that was accomplished. (Q23_1_1 through Q23_12_1)**

Some rows may be grayscaled based on responses to prior questions.

		Assistance was important to improvement in this area?	
	Missing	Yes	No
1. Adverse drug events	18	350	305
2. Catheter-associated urinary tract infections (CAUTI)	18	559	293
3. Central line-associated blood stream infections (CLABSI)	15	383	274
4. Injuries from falls and immobility	23	532	346
5. Early elective deliveries	10	319	196
6. Other obstetrical (OB) adverse events	14	187	147
7. Pressure ulcers	14	328	324
8. Surgical site infections	22	363	338
9. Venous thromboembolism (VTE)	24	393	321
10. Ventilator-associated events	17	224	257
11. All cause harm	15	345	190
12. Readmissions	18	626	238

ALL

26. **Has the hospital publicly released improvement goals in the following areas? (Q26_1 through Q26_2)**

Select one per row.

Eligible = 1,136

	Missing	Yes	No	Don't know
1. Patient safety (adverse events)	85	219	599	233
2. Readmissions	43	238	615	240

Section IV: Influences on Hospital Activity beyond PfP

ALL

27. better- During the past 12 months, have any of the following influenced your hospital to take shaped or more aggressive action to prevent harms in any of the PfP adverse event areas (including readmissions)? (Q27_1_1 through Q27_14_1)

Check all that apply.

Eligible = 1,136

- ☐ Reporting to NHSN..1
n=689
- ☐ Other reporting requirements 2
n=509
- ☐ Payment policies - Medicare 3
n=667
- ☐ Payment policies - Medicaid..4
n=429
- ☐ Payment policies – private sector insurance..................................5
n=359
- ☐ Joint Commission 6
n=550
- ☐ Quality Improvement Organizations' work 7
n=558
- ☐ Institute for Healthcare Improvement 8
n=321
- ☐ Community-Based Care Transitions Program 9
n=223
- ☐ State hospital association-sponsored effort 10
n=467
- ☐ VHA Health Care Safety Network 11
n=69
- ☐ NAPH-NPSF Patient Safety Initiative 12
n=73
- ☐ Other regional, state, or local initiative 13
n=232
- ☐ Hospital system-level initiative 14
n=708

Q27=1 for any item

28. You indicated that the following has/have influenced your hospital: (Q28_1_1 through Q28_12_1)

[LIST ITEMS CHECKED AT Q27]

Which of the following adverse event areas have been impacted by one or more of these policies, entities, or associations?

- ☐ Adverse drug events .... 1 n=464
- ☐ Catheter-associated urinary tract infections (CAUTI) .... 2 n=836
- ☐ Central line-associated blood stream infections (CLABSI) .... 3 n=669
- ☐ Injuries from falls and immobility .... 4 n=703
- ☐ Early elective deliveries .... 5 n=486
- ☐ Other obstetrical (OB) adverse events .... 6 n=245
- ☐ Pressure ulcers .... 7 n=512
- ☐ Surgical site infections .... 8 n=626
- ☐ Venous thromboembolism (VTE) .... 9 n=627
- ☐ Ventilator-associated events .... 10 n=406
- ☐ All cause harm .... 11 n=410
- ☐ Readmissions .... 12 n=861

Section V: Care Transitions

ALL

29. Is your hospital participating in the Community-Based Care Transitions Program (CCTP)? (Q29_1)

ELIGIBLE = 1,136

- ❍ Yes .... 1 n=230
- ❍ No .... 0 n=567
- ❍ Don't know .... 3 n=334

NO RESPONSE .... M n=5

32. How often does your hospital provide a summary of care record for the next provider when a patient is discharged? (Q32_1)

ELIGIBLE = 1,136

- ❍ None of the time .... 1 n=39
- ❍ Less than 50% of the time .... 2 n=87
- ❍ 50% or more but less than 75% of the time .... 3 n=118
- ❍ 75% or more of the time .... 4 n=691
- ❍ Don't know .... 5 n=191

NO RESPONSE .... M n=10

ALL

32a. Do all patients undergo standardized medication reconciliation at the time of discharge to home or transfer to another facility? (Q32a_1)

ELIGIBLE = 1,136

❍ Yes	1	n=1084
❍ No	0	n=30
❍ Don't know	3	n=13
NO RESPONSE	M	n=9

ALL

32b. Prior to discharge, do all patients undergo a risk assessment for readmission? (Q32b_1)

ELIGIBLE = 1,136

❍ Yes	1		n=316
❍ No	0	Q33	n=659
❍ Don't know	3	Q33	n=153
NO RESPONSE	M	Q33	n=8

IF 32B=1

32c. Prior to discharging a patient at high risk of readmission, is a <u>face-to-face</u> follow-up visit scheduled within 48 hours of discharge? (Q32c_1)

ELIGIBLE = 316

❍ Yes	1	n=126
❍ No	0	n=149
❍ Don't know	3	n=41

IF 32B=1

32d. Prior to discharging a patient at moderate risk of readmission, is a follow-up <u>phone call</u> scheduled within 48 hours of discharge? (Q32d_1)

ELIGIBLE = 316

❍ Yes	1	n=209
❍ No	0	n=74
❍ Don't know	3	n=33

ALL

33. During the <u>past 12 months</u>, how often have hospital staff communicated with other hospitals and other care settings (such as skilled nursing facilities [SNFs], home health agencies, physician practices, etc.) about care transition initiatives for purposes of information sharing and improving care transition for patients? (Q33_1)

ELIGIBLE = 1,136

- ❍ Four or more times during the past year .... 1 n=659
- ❍ Two or three times during the past year .... 2 n=290
- ❍ Once during the past year .... 3 n=82
- ❍ Not at all during the past year .... 4 n=71

NO RESPONSE .... M n=34

ALL

34. During the <u>past 12 months</u>, how often have hospital staff communicated with other hospitals about patient safety initiatives for purposes of information sharing and improving each other's initiatives? (Q34_1)

ELIGIBLE = 1,136

- ❍ Four or more times during the past year .... 1 n=580
- ❍ Two or three times during the past year .... 2 n=312
- ❍ Once during the past year .... 3 n=85
- ❍ Not at all during the past year .... 4 n=125

NO RESPONSE .... M n=34

Section VI: Sufficiency of Resources and Knowledge

ALL

35. Do you know what your hospital can do to improve patient safety in all 10 PfP adverse event areas? (Q35)

ELIGIBLE = 1,136

- ❍ Yes .... 1 n=801
- ❍ No .... 0 n=314

NO RESPONSE .... M n=21

ALL

36. Please indicate the extent to which you agree with the following statement. (Q36_1)

ELIGIBLE = 1,136

	Missing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. This hospital's information system supports measuring progress on key patient safety indicators associated with the focus areas	12	163	443	265	195	58

ALL

37. Did your hospital have enough staff, time, and financial resources to make major improvements in patient safety in 2012-2013 in the PfP adverse event areas? (Q37_1)

ELIGIBLE = 1,136

- ❍ Yes, for all or most of the PfP adverse event areas................ 1 n=387
- ❍ Yes, for less than half of the PfP adverse event areas........... 2 n=447
- ❍ No.. 3 n=280

NO RESPONSE .... M n=22

Section VII: Unmet Needs

ALL

39. What tools and resources is your hospital lacking that would be helpful in pursuing reductions in adverse events and readmissions? (Q39_1_1 through Q39_3_1)

Please list up to three.

Section VIII: Hospital Culture

ALL

40. **Is your hospital owned by or affiliated with a larger hospital system? (Q40)**

Eligible = 1,136

- Yes .... 1 n=628
- No .... 0 n=508

ALL

41. **Please indicate the extent to which you agree with each of the following statements. (Q41_1 through Q41_11)**

Some rows may be grayscaled based on responses to prior questions.

PROGRAMMER: CODE ONE PER ROW
PROGRAMMER NOTE: GRAYSCALE ROW C and D IF Q40=0, blank

Eligible = 1,136

	Missing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. The hospital's board has identified reductions in adverse events and hospital readmission rates as a priority, and often discusses hospital performance on these topics.	15	495	381	179	56	10
2. The hospital devotes resources to improvement and safety consistent with achieving national benchmark performance and it is clear from the support that achieving these benchmarks is a key part of the hospital's strategic plan.	11	448	467	158	47	5

	Missing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
3. [If Q40=1] Patient safety activities at this hospital are largely determined by system-level priorities and programs.	11	199	294	85	34	5
4. [If Q40=1] System-level quality improvement staff frequently provides learning opportunities, resources and information that are used to improve our patient safety efforts.	12	211	260	92	43	10
5. All hospital employees in clinical positions understand and embrace their important role in improving and ensuring patient safety and quality.	17	263	581	195	75	5
6. All hospital employees in non-clinical positions understand and embrace their important role in improving and ensuring patient safety and quality.	13	153	509	335	117	9
7. Reporting an adverse event or a near miss will not result in negative repercussions for the person reporting it.	11	660	400	47	16	2
8. The hospital's focus on safety makes it easy for staff to learn from others' mistakes.	10	319	551	214	38	4
9. Top clinical managers know where each department is in terms of key quality and safety measures.	15	354	501	173	84	9
10. Clinical leaders communicate messages of urgency to improve in targeted areas of quality and patient safety.	11	350	543	182	43	7
11. Top clinical managers lead or actively support improvement efforts.	16	413	544	116	41	6

41_a1. **Does this hospital have a master TeamSTEPPs trainer? (Q41_a1_1)**

Information on TeamSTEPPs can be found here: http://teamstepps.ahrq.gov/

ELIGIBLE = 1,136

❍ Yes	1		n=206
❍ No	0		n=849
❍ Don't know	2		n=73
NO RESPONSE	M		n=8

ALL

41a. **Which of the following is true about patients in your hospital and their families? (Q41a_1_1 through Q41a_6_1)**

Check all that apply.

ELIGIBLE = 1,136

☐ They take part in advisory councils	1	n=367
☐ They are invited to take part in multidisciplinary rounds	2	n=290
☐ They are partners in monitoring compliance with safety practices	3	n=250
☐ They actively participate on patient safety committees	4	n=165
☐ They participate in root cause analysis	5	n=46
☐ They serve as members on the hospital's board	6	n=558

41b. **As compared to two years ago, has there been improvement in the extent to which patients and families' perspectives are heard and considered in ways important to the safety of patient care? (Q41b_1)**

ELIGIBLE = 1,136

☐ Yes, greatly improved	1	n=220
☐ Yes, somewhat improved	2	n=438
☐ Yes, slightly improved	3	n=337
☐ No, not improved	4	n=124
NO RESPONSE	M	n=17

We would like to highlight hospitals that have strong patient and family engagement strategies and/or patient advocates so that other hospitals can improve their patient and family engagement strategies.

41c. **In your opinion, does this hospital have strong engagement strategies and/or patient advocates? (Q41c_1)**

ELIGIBLE = 1,136

❍ Yes	1		n=480
❍ No	0	Q43	n=492
❍ Don't know	3	Q43	n=146
NO RESPONSE	M	Q43	n=18

41d. Are you willing to discuss your hospital's patient and family engagement strategies and/or patient advocates with the Partnership for Patients' Patient and Family Engagement Contractor? (Q41d)

ELIGIBLE = 480

❍ Yes	1	
❍ No	0	
NO RESPONSE	M	

Section VIII: Patient Safety Practices

ADVERSE DRUG EVENTS

ALL

43. To minimize errors, has your hospital limited the variety of insulin products on its formulary? (Q43_1)

ELIGIBLE = 1,136

❍ Yes	1	n=944
❍ No	0	n=46
❍ Don't know	3	n=139
NO RESPONSE	M	n=7

ALL

44. Does your hospital require standardized protocols and formats for prescribing insulin for all units? (Q44_1)

ELIGIBLE = 1,136

❍ Yes	1	n=840
❍ No	0	n=180
❍ Don't know	3	n=109
NO RESPONSE	M	n=7

ALL

45. How often are patients on all units who are on hypoglycemic drugs monitored for hypoglycemia? (Q45_1)

ELIGIBLE = 1,136

❍ At least four times a day	1	n=540
❍ 1 – 3 times a day	2	n=305
❍ Less than once per day	3	n=4
❍ Monitoring varies across units or there is no routine monitoring	4	n=217
NO RESPONSE	M	n=70

ALL

46. How long would it take to obtain a list of patients hospitalized over a certain time period who had an International Normalized Ratio (INR) greater than some threshold (for example, an INR>5)? (Q46_1)

By 'over a certain time period' we mean within the past 3-months, within past 6-months, etc.

ELIGIBLE = 1,136

- ❍ Within minutes electronically .... 1 n=635
- ❍ Within 1-2 weeks from lab electronic data .... 2 n=308
- ❍ Would have to be obtained from chart review .... 3 n=123
- ❍ No feasible way to find this data .... 4 n=23

NO RESPONSE .... M n=47

ALL

47. In what year did your hospital last complete the ISMP Medication Safety Self-Assessment for Hospitals? (Q47_1_1)

ELIGIBLE = 1,136

1 Never completed .... n=50
2 Prior to 2007 .... n=253
3 2007 .... n=155
4 2008 .... n=66
5 2009 .... n=44
6 2010 .... n=16
7 2011 .... n=13
8 2012 .... n=12
9 2013 .... n=50
10 2014 .... n=252
Missing .... n=225

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS (CAUTI)

ALL

48. Please respond yes or no to each of the following questions about practices related to patient catheter use and catheterization-related activities. (Q48_1 through Q48_8)

ELIGIBLE = 1,136

	Missing	Yes	No
1. Does your hospital require specialized training for nurses on the appropriate placement and management of urinary catheters *and* keep records on those who have and have not received training?	37	674	425
2. Does your hospital require documentation of the indications for the indwelling urinary catheter at the time of insertion?	30	847	259
3. In your hospital, are there routine automatic stop orders or nurse protocols for urinary catheter removal for all patients on all units?	27	542	567

	Missing	Yes	No
4. In surgical patients, are all urinary catheters removed post-operatively within 24-48 hours unless there are appropriate indications for continued use?	76	935	125
5. Do nurses on all units routinely use bladder ultrasound scanners (e.g. to guide intermittent catheterization or catheter irrigation)?	46	552	538
6. Are all patients with catheters reviewed daily for continued need for a catheter?	25	944	167
7. Does your hospital monitor urinary catheter days?	31	102	83
8. Does your hospital monitor CAUTI rates per 1000 catheter days using NHSN definitions?	22	104 3	71

FALLS

ALL

49. Please respond yes or no to each of the following questions about activities focused on determination of fall risk and fall reduction. (Q49_1 through Q49_3)

ELIGIBLE = 1,136

	Missing	Yes	No
1. Do all newly admitted patients undergo a standardized fall assessment?	6	1123	7
2. Do all patients at risk of fall or injury routinely have visual indicators (e.g. colorful socks, colored wrist bands and/or blankets, or stickers or signs outside and inside the room) to quickly communicate their fall risk with the care team?	12	1074	50
3. Are patients who have fallen while hospitalized always offered facilitated environmental home assessments upon discharge?	35	173	928

ALL

**50. How often does staff perform comfort rounds to assess and address patient needs for pain relief,
toileting, and positioning? (Q50_1)**

ELIGIBLE = 1,136

- Hourly .... 1 n=849
- Every two hours .... 2 n=236
- During shift changes .... 3 n=15
- Only when patients call for assistance .... 4 n=21

NO RESPONSE .... M n=15

OBSTETRICAL ADVERSE EVENTS

If Q17_a=1, missing

51. Please respond yes or no to each of the following questions about obstetrical care in your hospital. (Q51_1 through Q51_4)

ELIGIBLE = 711

	Missing	Yes	No
1. Does your hospital require the use of a checklist-driven protocol or bundle for the *induction* of labor (e.g. Hospital Corporation of America's Pre-Oxytocin checklist)?	53	437	221
2. Does your hospital require the use of a checklist-driven protocol or bundle for the *augmentation* of labor (e.g. Hospital Corporation of America's Pre-Oxytocin checklist)?	61	394	256
3. Does your hospital allow scheduling C-section or other elective delivery **prior to 39 weeks**?	31	92	588
4. Does your hospital have an active program to track and reduce elective deliveries **prior to 39 weeks**?	21	656	34

If Q17_a=1, missing

52. Does your hospital have a protocol governing the timing of and conditions for elective deliveries? (Q52)

ELIGIBLE = 711

- Yes .... 1 n=624
- No .... 0 n=87

Q52=1

52a. How often is adherence to the elective delivery protocol monitored? (Q52a_1)

ELIGIBLE = 624

- Monthly .... 1 n=507
- Quarterly .... 2 n=84
- Semi-annually .... 3 n=4
- Annually .... 4 n=8
- Less than annually .... 5 n=6

NO RESPONSE .... M n=15

Q52=1

52b. Is compliance with the elective delivery protocol considered as part of re-granting privileges for physicians? (Q52b)

ELIGIBLE = 624

❍ Yes	1	n=210
❍ No	0	n=383
NO RESPONSE	M	n=31

If Q17_a=1, missing

53. Which of the following is available in your hospital to ensure a uniform team management of shoulder dystocia? (Q53_1_1 through Q53_5_1)

Check all that apply.

ELIGIBLE = 711

☐ Drills	1	n=353
☐ Continuing medical education	2	n=355
☐ Interactive online courses and protocols that clarify the duties of each team member	3	n=151
☐ A system (e.g. checklist) to ensure appropriate documentation of the maneuvers utilized and avoided in the management of shoulder dystocia	4	n=262
☐ None of the above	5	n=111

PRESSURE ULCERS

ALL

54. Please respond yes or no to each of the following questions about the prevention of pressure ulcers among your hospitalized patients. (Q54_1 through Q54_4)

ELIGIBLE = 1,136

		Missing	Yes	No
1.	Does your hospital require a system (e.g. checklists) to ensure that pressure ulcer risk assessment is conducted within 4 hours of admission for all patients?	31	852	253
2.	Do nurses use a standard pressure ulcer risk assessment tool (e.g. Braden scale)?	13	1093	30
3.	Are patients and families routinely educated about pressure ulcer prevention <u>and</u> is the education documented in the chart?	51	616	469
4.	Does your hospital routinely monitor rates of patients at-risk for pressure ulcers who are receiving full pressure ulcer preventive care?	33	773	330

SURGICAL SITE INFECTION

Q17_c=1 or missing

55. How soon are failures to meet the targets for the following measures communicated back to the responsible physicians? (Q55_1 through Q55_3)

ELIGIBLE = 978

		Missing	Within 24 hours	After 24 hours	Not communicated
1.	Recommended timing of initiation of perioperative prophylactic antibiotic (that is, administration within 1 hour of surgical incision)	23	375	532	48
2.	Perioperative antibiotic selection	27	348	553	50
3.	Discontinuation of prophylactic antibiotic (that is, discontinuation within 24 hours after end of surgery or 48 hours after end of cardiac surgery)	30	355	544	49

POST-SURGICAL VENOUS THROMBOEMBOLISM (VTE)

ALL

56. Does your organization have a hospital-wide written thromboprophylaxis policy? (Q56)

ELIGIBLE = 1,136

- Yes .... 1 n=804
- No .... 0 n=281

NO RESPONSE .... M n=51

ALL

57. How often does this hospital provide information about the risk of VTE and its prevention to patients? (Q57_1)

ELIGIBLE = 1,136

- To almost all admitted patients (80% or more) .... 1 n=530
- To at least 50% of patients .... 2 n=247
- Patients do not receive information on VTE risk and prevention .... 3 n=274

NO RESPONSE .... M n=85

VENTILATOR ASSOCIATED EVENTS

Q17_d=1 or missing

58. Please respond yes or no to each of the following questions about patients on mechanical ventilation, in your hospital. (Q58_1 through Q58_4)

ELIGIBLE = 845

		Missing	Yes	No
1.	Is there always a bedside visual cue (e.g. tape on the wall or bed frame) to identify when the head of the bed is elevated at 30 to 45 degrees?	65	518	262
2.	Do patients undergo daily “sedative interruption” and assessment of readiness to extubate?	70	685	90
3.	Do patients have their teeth brushed every 12 hours?	72	684	89
4.	Do patients undergo oral suctioning as needed?	53	785	7
5.	Do patients have at least daily oral application of chlorhexidine?	83	603	159

HAND HYGIENE

ALL

59. Does this hospital routinely monitor workers' hand-hygiene adherence (as the number of hand-hygiene episodes performed by personnel/number of hand-hygiene opportunities) by ward or service and provide feedback to personnel? (Q59)

ELIGIBLE = 1,136

- ❍ Yes .... 1 n=1402
- ❍ No .... 0 n=85
- NO RESPONSE .... M n=79

ALL

60. Does this hospital routinely assess that direct patient care staff are not wearing artificial nails? (Q60)

- ❍ Yes .... 1 n=850
- ❍ No .... 0 n=263
- NO RESPONSE .... M n=23

Section XI: Demographics and Contact Information

This next section gathers information about you and your training and experience.

Question 61 through 65 removed for confidentiality reasons.

66. Did you complete the 2012 Hospital Survey on Prevention of Adverse Events and Reduction of Readmissions? (Q66_1)

	ELIGIBLE = 1,136
❍ Yes, I completed it 1	n=599
❍ No, someone else at this hospital completed it ...2	n=227
❍ Don't know 3	n=288
NO RESPONSE ....M	n=22

67. When did you begin working at this hospital? (Q67_year_1)

	ELIGIBLE = 227
Before 2010....	n=128
2010 to 2012	n=38
After 2012....	n=58
Missing	n=3

Appendix D: Detailed Methodologies

The results in the report are based on the following topics and analytic approaches:

- Difference-in-Differences Comparison Group Analyses Methodology
- Bayesian Difference-In-Difference Analysis Methodology
- Estimates of Averted Costs from National Reduction in Adverse Events Methodology
- Estimation of Costs Averted Due to Hospital Engagement Networks (HENs) Methodology
- Interrupted Time Series (ITS) Methodology
- Statistical Process Control (SPC) Chart Methodology
- Vital Records Analysis Methodology
- Hospital Engagement Analysis Methodology
- Dose-Response Analysis Methodology
- Analysis of Medicare Patient Safety Monitoring System (MPSMS) Methodology
- Survey Analysis Removing Spillover Methodology
- ITS Cluster Analysis Methodology
- HEN-Level Data File Methodology
- Repeated Measures Analysis of the Association between HEN Activities and Partnerships and Common Measure Outcomes Methodology

The sections below provide detail on each of the analytic approaches used.

Difference-in-Differences Comparison Group Analyses

Overview of Difference-in-Differences Comparison Group Analyses

Impact Analyses of Hospital Engagement Network (HEN)-Aligned and Non-HEN-aligned Hospitals

In order to compare the amount of improvement that occurred in HEN-aligned hospitals to the amount of improvement that might have been expected had those hospitals not worked with a HEN, the Evaluation Contractor constructed a comparison group of non-HEN-aligned hospitals and compared change in the outcomes between the two groups before and after the Partnership for Patients (PfP). The HEN-aligned hospitals were those reported by HENs as HEN-aligned in their June 2012 monthly report. These hospitals are considered to be “treated,” while non-HEN-aligned hospitals form the untreated “comparison” group. The comparison group excludes hospitals that were “late joiners” to PfP between June 2012 and December 2013. The comparison group was created using propensity score reweighting, where non-HEN-aligned hospitals with observable characteristics more similar to HEN-aligned hospitals are given higher weights. Regression-based difference-in-differences analyses were used to compare changes between the groups. The sections below describe the propensity score reweighting and difference-in-differences approaches used by the Evaluation Contractor.

There are two caveats to the comparison group analyses. First, as discussed in the report, the HENs’ work is only one of the elements used to achieve PfP goals; thus the comparison group analyses only address the HEN component of PfP. Second, to the extent that non-HEN-aligned as well as HEN-aligned hospitals received benefits from PfP, the comparison method may underestimate the true impact of PfP.

Propensity Score Reweighting

Calculation of Propensity Scores

For purposes of understanding the effect of HENs’ efforts, it is important to assemble a comparison group that is similar to the group of HEN-aligned hospitals in order to understand how different HEN-aligned hospitals would have been had the hospitals not worked with a HEN. A simple comparison of observed improvement in HEN-aligned versus non-HEN-aligned hospitals will not serve that purpose because hospitals that elected to work with a HEN differ in important ways from those that did not, and differences in outcomes might result from underlying differences in hospital mix rather than from the effects of PfP.

Using a statistical technique called propensity score reweighting, the Evaluation Contractor created a comparison group from the pool of non-HEN-aligned hospitals. Propensity score reweighting produces a comparison group of non-HEN-aligned hospitals that are similar to HEN-aligned hospitals on observable characteristics of hospitals and their patients, by assigning different weights to non-HEN-aligned hospitals depending on their similarity to HEN-aligned hospitals, giving more weight to non-HEN-aligned hospitals that are more similar to HEN-aligned hospitals and less weight to non-HEN-aligned hospitals that are less similar.

The propensity score reweighting approach used in this evaluation consisted of two steps. First, the approach called for estimating a propensity score model in which participation in PfP is a function of relevant hospital characteristics. Second, weights were constructed from the estimated propensity scores to weight the non-HEN-aligned (comparison group) hospitals in order to make the hospitals similar to treatment (HEN-aligned) hospitals on observable characteristics (Hirano and Imbens 2001; Guo and Fraser 2010; Busso et al. 2014).

The Evaluation Contractor estimated a logistic (logit) regression model using the predictor variables described in detail in Chen et al. 2014. The baseline hospital characteristics used to create the weights were drawn from data from the 2010 American Hospital Association (AHA) Annual Survey and Medicare claims from the pre-campaign years (2009 and 2010). The claims data provided data on level and trend in the adverse event and readmission rates before the start of PfP, as well as the demographic composition of the patients served. Other variables drawn from the AHA survey, such as region, urbanicity, and hospital size were characteristics included as broad differentiators of hospitals and their contexts. A further set of items was included based on having been found to predict HEN alignment in the Evaluation Contractor's baseline analysis. Examples include teaching hospitals or the percentage of physicians who are intensivists. The predictor variables were entered into the logit model as predictors of treatment status, defined as a binary dependent variable that equaled one for HEN-aligned (treatment) hospitals and zero for non-HEN-aligned hospitals. Separate propensity models were estimated for each adverse event area (AEA) and for readmissions. To maintain continuity with the impact regressions (in which discharges are the unit of analysis and thus hospitals implicitly are weighted by the number of relevant discharges), hospitals were weighted by the number of discharges in the measure denominator in 2010.

The estimated coefficients from the logit model were used to calculate a propensity score for each hospital, which was the predicted probability that a hospital with its characteristics would choose to participate in the program. These propensity scores were then used to construct a weight for each hospital. HEN-aligned hospitals received a weight of one, and non-HEN-aligned hospitals (the comparison group) received a weight equal to $p/(1-p)$, where p is the estimated propensity score (Busso et al. 2014; Guo and Fraser 2010; Nichols 2008). This formula assigns greater weight to comparison group hospitals that are similar to the treatment group hospitals and lower weights to comparison group hospitals that are not similar to treatment hospitals.

The Centers for Medicare & Medicaid Services (CMS) has expressed a preference for using propensity score reweighting rather than propensity score matching to create the comparison group for the impact analysis of HEN activities under PfP. Propensity score reweighting differs from propensity score matching in that (1) all non-treatment observations are retained in the comparison group (though possibly with weights approaching zero), and (2) those non-treatment observations are not matched to particular treated observations. Propensity score reweighting offers some advantages over matching. First, reweighting is simpler to implement, not requiring subjective analytic decisions about how to create matches. Second, standard errors are easily calculated, which is not always the case for matching estimators. Third, the power to detect impacts can be higher than with matching (Busso et al. 2014). Earlier work has found, however, that reweighting may perform worse than matching in creating well-balanced treatment and comparison groups if the pool of non-treatment observations differs greatly from treatment group observations (Busso et al. 2014).

Balance Testing

The Evaluation Contractor examined the similarity between the HEN-aligned and non-HEN-aligned groups before and after propensity score reweighting. In order for the propensity score reweighting to perform well, the two groups should demonstrate some degree of balance before reweighting. That is, a substantial subset of non-HEN-aligned hospitals should exist that possess characteristics similar to those of treatment group hospitals—though the two groups as a whole may differ on average. For example, although the aligned and non-HEN-aligned groups may differ in the proportion of hospitals that are large, concern would be warranted if all or nearly all large hospitals were HEN-aligned and very few or no large hospitals were available in the non-HEN-aligned group as potential comparisons. After creating the propensity score reweighted comparison group, the Evaluation Contractor assessed the extent to which reweighting improved the balance between the groups.

The Evaluation Contractor assessed balance between the groups in several ways. First, the propensity score distributions were graphically analyzed, both before and after weighting (figures not displayed). For each propensity score model, the Evaluation Contractor examined histograms of the distribution of propensity scores for the HEN and non-HEN-aligned hospitals before and after reweighting. If the two groups were identical in their distribution of propensity scores, the histograms would be mirror images of one another. For each outcome, the Evaluation Contractor found that before reweighting the comparison group typically had a much longer tail to the left (more low propensity scores), whereas the treatment group has scores more densely concentrated at the upper end (more high propensity scores). However, there were comparison group hospitals that had high propensity scores, and those hospitals received larger weights when the comparison group was created. After reweighting, the Evaluation Contractor found that the dissimilarities between the groups were greatly reduced in all cases.

A second analysis examined the improvement in balance (treatment/comparison similarity) achieved between groups through reweighting on individual characteristics included as predictors in the model. The Evaluation Contractor examined the degree of similarity between the HEN-aligned hospitals and the pool of nonaligned hospitals on those characteristics before and after reweighting. The analysis measured similarity by using standardized difference (SD)—a measure of the number of standard deviations by which groups differ.[D-1] A difference of greater than 0.25 standard deviations is commonly considered meaningfully large.[D-2]

The balance tables below, show in greater detail how the groups compared on individual characteristics of interest after reweighting for each of the separate analyses where propensity score reweighting was used. There is one table for the analysis sample for each propensity score model. Each table shows mean values of each variable for non-HEN-aligned hospitals (before and after matching), mean values of each variable for HEN-aligned hospitals, the difference between the matched non-HEN-aligned and HEN-aligned hospitals, the *p*-value of the difference, and the standardized difference. A dagger (†) identifies variables whose absolute value of the SD (the absolute standardized difference [ASD]) exceeds the 0.25 threshold. Given the large sample size, even small differences will be statistically significant and, given the large number of

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[D-1] The SD statistic compares means of covariates (x) between treatment and comparison hospitals, standardized by the pooled standard deviation of the treated and comparison hospitals. For the standardized difference before matching, the difference is computed between the sample means in the full sample of HEN-aligned and non-HEN-aligned hospitals. The SD after reweighting is the difference between the sample means in the matched treated hospitals and reweighted comparisons.

SD (before) $= \dfrac{\bar{x}_A - \bar{x}_N}{\sqrt{(V_A\,(x) - V_N\,(x))/2}}$ and

SD (after) $= \dfrac{\bar{x}_{AM} - \bar{x}_{NM}}{\sqrt{(V_A\,(x) - V_N\,(x))/2}}$

[D-2] For instance, the standard used by the U.S. Department of Education's What Works Clearinghouse systematic evidence review for considering groups to be equivalent is a standardized difference less than 0.25 standard deviations (What Works Clearinghouse 2010).

variables, some statistically significant differences will emerge just by chance. Consequently, the Evaluation Contractor views the ASD as a more meaningful indicator than statistical significance of whether the dissimilarities in the last columns of the tables raise concerns for the validity of the analyses. The tables show that it is rare for the groups to differ by more than a quarter of a standard deviation on any measure, and differences between groups in pre-intervention level and trend for the outcome measures never exceed that threshold for most analyses.

Another gauge of covariate balance involves examining the goodness of fit of the propensity score regression before and after reweighting by re-estimating the propensity score model with the propensity score weights. Before reweighting, the variables in the model predict participation; as would be expected given that the variables were selected in part for their ability to predict participation. A low pseudo-R^2 and/or failure to reject the hypothesis that the variables do not (jointly) predict participation using a log-likelihood ratio test obtained after reweighting would indicate success of the propensity score reweighting in balancing the characteristics of the HEN-aligned and non-HEN-aligned hospitals. That is, if the covariates in the model no longer predict participation after reweighting, the HEN-aligned and constructed (reweighted or matched) comparison group hospitals do not differ statistically on those characteristics.

The Evaluation Contractor also checked for covariate balance across the treatment and matched comparison beneficiaries in each hospital by using a single "omnibus" test statistic. The omnibus test is based on the t-tests for the difference in means between treatment and matched comparison beneficiaries across the set of covariates. After performing each *t*-test (using a linear regression of the covariate on a treatment dummy), the estimation results—parameter estimates and associated covariance matrices—are combined into a one parameter vector and simultaneous covariance matrix of the sandwich/robust type. After estimating the covariance matrix of the multivariate normal distribution of the estimators of the models, the Evaluation Contractor checks that the treatment dummies are jointly equal to zero. The advantage of the omnibus test is that it generates a single probability statement through one *p*-value capturing whether or not the groups differ statistically across all of the variables as a whole.

The measures that assess differences across the full distribution of covariates—mean ASD, median ASD, pseudo-R^2, the chi^2 *p*-value from the likelihood ratio test, and the chi^2 and *p*-value from the omnibus test—all show improvement in balance of the covariates after propensity score reweighting relative to the balance before reweighting; however, the pseudo-R^2 and the chi^2 are statistically significant in several cases. The low ASD indicates that the magnitude of the differences between groups is small, and that the pseudo-R^2 and the chi^2 and results are attributable to the large sample sizes, which allow even small differences to be statistically significant. Nonetheless, readers should be aware that propensity score reweighting, though successful in greatly improving similarity between the groups, does not eliminate all differences.

Difference-in-Differences Comparison Group Analyses Methodology

The Evaluation Contractor compared change over time among HEN-aligned and comparison group hospitals using a regression-based difference-in-differences approach. This approach removes biases in estimated impacts that could result from any time-invariant differences between the treatment and comparison groups that remain after propensity score reweighting or from any factors unrelated to the HENs' work with hospitals that affect changes in patient safety and readmissions for both groups (such as other CMS quality improvement efforts underway at the same time as PfP).[D-3]

The difference-in-differences analyses using adverse event measures from Medicare claims were conducted with patient discharges as the unit of analysis. For each outcome, the sample was limited to hospital discharges that were applicable ("at risk") for the given adverse event—that is, the "denominator" for estimating a particular adverse event rate. For analyses with Medicare claims, discharges in HEN-aligned hospitals received a weight of one, and discharges in comparison group hospitals received the propensity score–based weight assigned to the hospital where the discharge occurred.

Medicare Analyses—Difference-in-Differences Regression Specification for Adverse Event Outcomes

For adverse event outcomes, the difference-in-differences regression specification for the Medicare analyses has the following form:

$$y_i = \sum_{yr=2009}^{2013} \delta_{yr} \left(PFP_h * 1(yr = Y)\right) + \gamma t_t + \varphi w_i + \theta x_i + \beta z_h + \varepsilon_i \qquad (1)$$

where the outcome variable, y_i, is measured for a hospital discharge (i) occurring in quarter t in hospital h. The variable PFP_h is a dummy variable for whether or not the hospital where the discharge occurred was aligned with a HEN as of June 2012; Y is the year of the hospital discharge and "$1(yr = Y)$" is an indicator function that is used to allow the incremental effect of PfP interventions to vary over each year; t_t is a vector of quarterly dummy variables indicating the quarter in which the observation took place; and the estimated coefficients ($\gamma = [\gamma_1,\gamma_2,\ldots,\gamma_T]$) control for secular trends in the outcome variable. The regression model also includes patient-level covariates that control for demographics, patient risk factors, and characteristics of the hospital where the discharge occurred. The patient demographics (w_i) are age, gender, and race/ethnicity. The patient risk factors (x_i) are comorbidities specific for each outcome variable and were chosen in accordance with the risk factors used by the patient safety indicators (PSI) algorithm for calculating risk-adjusted adverse event rates.[D-4]

The regression model also includes hospital-level characteristics as a vector of hospital dummies (z_h)—also known as hospital fixed effects—to control for all hospital-specific observed and unobserved factors that are stable over time. Finally, ε_i is an error term with the usual properties. Equation (1) was estimated with linear probability models. Compared to nonlinear models, the linear probability model offers three advantages:

D-3 Time-invariant characteristics include factors such as region or ownership type. To the extent that patient populations served by hospitals tend to remain relatively stable over time, those differences in those populations will also be adjusted for.

D-4 Controls do not include variables that are potentially endogenous. For example, the Evaluation Contractor did not include large arrays of dummy variables for diagnosis or procedure codes because an adverse event may cause the need for a "cascade" of diagnoses or follow-up procedures to reduce harm or sustain life. Thus, the Evaluation Contractor used patient-specific control variables that (1) are present on admission, (2) represent procedures originally planned or the cause of the admission, and/or (3) otherwise are not added to the claim in the case of an adverse event.

permitting the use of hospital fixed effects, allowing the marginal effect of the interaction terms to be interpreted without making distributional assumptions, and reducing the computational run times.[D-5]

The estimated coefficient reported in difference-in-differences impact results tables is given by δ_{2013}.[D-6] This is the regression-adjusted difference between the HEN-aligned and non-HEN-aligned hospitals in 2013 compared to the baseline of 2011. It captures how the change in an outcome among hospitals that signed up to work with a HEN differs from the change in that outcome among non-HEN-aligned hospitals in 2013 relative to 2011, while holding constant differences between hospitals' outcomes at baseline, differences in the characteristics of patients served, and differences in hospital characteristics. For the subgroup analyses, the $PFP_h * 1(Y = yr)$) indicators are being interacted with a variable denoting each subgroup category.

Medicare Analyses—Difference-in-Differences Regression Specification for Readmission Outcomes

The difference-in-differences Medicare readmission measure used hospital-level data constructed from claims but was otherwise similar to the adverse event analyses. The sample consisted of one observation for each hospital for each year. Observations for HEN-aligned hospitals received a weight of one, and comparison group hospitals received the propensity score–based weight. The difference-in-differences regression specification had the following form:

$$y_{ht} = \sum_{t=2009}^{2013} \delta_t (PFP_h * 1(t = \tau)) + \alpha yr_t + \varphi \bar{w}_{ht} + \theta \bar{x}_{ht} + \beta z_h + \varepsilon_{ht} \qquad (2)$$

where the outcome variable, y_{ht}, is measured for a hospital (h) in each year (t). The variable PFP_h is a dummy variable denoting whether a hospital was aligned with a HEN as of June 2012, as defined previously and yr_t is an indicator for the year of the hospital discharge. The Evaluation Contractor controlled for patient demographics and comorbidities by aggregating them to the hospital-level each year ($\bar{w}_{ht}$ and $\bar{x}_{ht}$ respectively). The Evaluation Contractor continued to include a vector of hospital dummies (z_h). ε_{ht} is an error term with the usual properties.

As with the Medicare analysis for adverse events discussed above, the coefficient δ_{2013} is the impact estimate for the PfP campaign in 2013 and is presented in the tables of the difference-in-differences estimates.

Balance Tables

This section provides the tables showing the results of the balance tests described above, comparing characteristics of the HEN-aligned and reweighted comparison groups for each analysis: Bayesian analysis, survey analysis removing spillover, analysis of the relationship between hospital engagement (survey) and outcomes (Medicare fee-for-service [FFS] claims), and analysis of costs averted due to HENs.

[D-5] The Evaluation Contractor used Stata's robust standard errors (SEs) in all models to account for repeated measures within hospitals and heteroskedasticity.

[D-6] There is no uninteracted HEN-alignment indicator, PFP_h, because it would be collinear with the hospital fixed effects.

Bayesian Analysis

Table D-1–Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began–PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*P*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean (n=977)	Matched Comparison Group Mean (n=977)	Treatment Group Mean (n=3,269)			
Hospital is a Critical Access Hospital (CAH)	4.9	2.8	2.7	0.1	0.796	-0.01
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.9	9.5	7.4	2.0	0.002	-0.07
100–199 beds (non-CAH)	24.7	22.1	18.6	3.5	0.000	-0.09
200–399 beds (non-CAH)	34.5	36.5	36.5	0.0	0.978	0.00
400 beds or more (non-CAH)	19.0	29.1	34.7	-5.6	0.000	0.12
Ownership (Percent)						
Government, federal	0.0	0.1	0.0	0.1	0.031	-0.05
Government, nonfederal	9.3	14.9	12.4	2.6	0.002	-0.07
Nongovernment for-profit	42.4	11.3	9.8	1.4	0.050	-0.05
Nongovernment not-for-profit	48.3	73.6	77.8	-4.1	0.000	0.10
Region (Percent)						
New England	9.0	5.5	5.0	0.5	0.368	-0.02
Mid Atlantic	1.5	11.4	16.4	-5.0	0.000	0.14
South Atlantic	32.6	16.4	20.1	-3.6	0.000	0.09
East North Central	14.7	19.8	17.2	2.6	0.005	-0.07
East South Central	6.7	8.0	8.8	-0.8	0.203	0.03
West North Central	3.2	5.1	7.9	-2.8	0.000	0.11
West South Central	20.6	10.8	9.4	1.4	0.055	-0.05
Mountain	3.5	4.9	4.9	0.0	0.991	-0.00
Pacific	8.1	16.9	9.9	7.0	0.000	-0.21
Associated areas	0.0	1.2	0.4	0.8	0.000	-0.09
Race/Ethnicity[a]						
Hispanic	3.3	2.3	2.1	0.2	0.057	-0.05
White (non-Hispanic)	80.5	81.9	82.5	-0.6	0.168	0.03
Black (non-Hispanic)	13.5	11	12.4	-1.4	0.000	0.09
Other (non-Hispanic)	2.7	4.8	3.1	1.7	0.000	-0.19
Other Hospital Characteristics						
Rural	20.8	23.4	18.3	5.1	0.000	-0.13

Table D-1–Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began–PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)							
Panel A—Comparison of Groups on Basic Hospital Characteristics							
Characteristics		**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***P*-Value of Difference**	**Standardized Difference**
		Pre-Matching Comparison Group Mean (n=977)	**Matched Comparison Group Mean (n=977)**	**Treatment Group Mean (n=3,269)**			
Member of hospital system		67.4	60.9	66.5	-5.6	0.000	0.12
Member of hospital network		25.7	30.6	41.3	-10.6	0.000	0.22
Teaching hospital		33.7	45.4	50.2	-4.7	0.000	0.10
Hospital part of Inpatient Prospective Payment Systems (IPPS)		86.2	88.8	96.3	-7.5	0.000	0.29
Other Case Mix Characteristics							
Female[a]		44.1	44.7	44.3	0.4	0.000	-0.09
Age[b]		72.7	72.5	72.7	-0.3	0.001	0.08
ASD		**Logit Model**				**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**		***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.09	0.09	0.083	810.6		0.000	74.0 (26)	0.000
Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level and Change							
Variable		**Mean (or percent)**			**Difference Between Treatment and Matched Comparison Means**	***P*-Value of Difference**	**Standardized Difference**
		Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=977)**	**Treatment Group Mean (n=3,269)**			
2011 CRBSI rate (events per 1,000 at risk)[c]		0.119	0.214	0.247	-0.033	0.000	0.11
2010 CRBSI rate minus 2009 CRBSI rate (events per 1,000 at risk)[c]		-0.057	-0.100	-0.136	0.036	0.000	-0.08
2011 CRBSI rate minus 2010 CRBSI rate (events per 1,000 at risk)[c]		-0.034	-0.035	0.044	-0.080	0.000	0.17
ASD		**Logit Model**				**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**		***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.12	0.11	0.008	74.7		0.000	7.4 (3)	0.061

Source: Analysis of hospital rosters, AHA Survey (fiscal year [FY] 2010), and Medicare claims, 2009–2012.
Note: Means (or percentages) are weighted by the product of the number of patients at risk for CRBSI and the weight obtained from a propensity score model with 2009, 2010, and 2011 rates and change in the rates for CRBSI from Medicare claims as independent variables. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.
[a]Weighted mean of the percentage of at-risk patients across hospitals.
[b]Weighted mean of the average age of at-risk Medicare patients across hospitals.
[c]The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

Table D-2–Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began–PSI-03: Pressure Ulcers (Stage III, IV, and Unstageable)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=949)**	**Treatment Group Mean (n=3,246)**			
Hospital is a CAH	4.1	1.7	1.6	0.2	-0.574	-0.01
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	18.0	8.2	5.7	2.4	0.00	-0.10
100–199 beds (non-CAH)	23.0	20.6	17.4	3.2	0.001	-0.08
200–399 beds (non-CAH)	33.7	35.1	36.6	-1.5	0.187	0.03
400 beds or more (non-CAH)	21.2	34.4	38.7	-4.3	0.000	0.09
Ownership (Percent)						
Government, federal	0.0	0.1	0.0	0.1	0.116	-0.04
Government, nonfederal	8.5	12.8	12.3	0.5	0.514	-0.02
Nongovernment for-profit	45.1	11.0	9.6	1.3	0.070	-0.04
Nongovernment not-for-profit	46.4	76.2	78.1	-1.9	0.058	0.05
Region (Percent)						
New England	7.6	5.5	4.8	0.7	0.185	-0.03
Mid Atlantic	1.4	10.5	18.3	-7.7	0.000	0.22
South Atlantic	32.3	19.5	21.1	-1.6	0.089	0.04
East North Central	13.1	21	16.1	4.9	0.000	-0.13
East South Central	5.9	8.9	8.6	0.3	0.622	-0.01
West North Central	8.4	4.3	6.7	-2.4	0.000	0.11
West South Central	20.5	10.7	10.0	0.7	0.34	-0.02
Mountain	2.8	4.8	4.3	0.5	0.334	-0.02
Pacific	8.0	12.7	9.5	3.1	0.000	-0.10
Associated areas	0.0	2.1	0.5	1.6	0.000	-0.14
Race/Ethnicity[a]						
Hispanic	3.4	2.6	2.3	0.3	0.034	-0.05
White (non-Hispanic)	79.9	80.9	81	-0.1	0.772	0.01
Black (non-Hispanic)	14.0	12.8	13.5	-0.7	0.054	0.05
Other (non-Hispanic)	2.7	3.7	3.2	0.6	0.001	-0.08
Other Hospital Characteristics						
Rural	22.2	19.9	15.3	4.6	0.000	-0.12

Table D-2–Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began–PSI-03: Pressure Ulcers (Stage III, IV, and Unstageable)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=949)**	**Treatment Group Mean (n=3,246)**			
Member of hospital system	65.1	64.7	66.3	-1.6	0.166	0.03
Member of hospital network	24.6	34.3	42.3	-8.0	0.000	0.17
Teaching hospital	33.9	47.8	53.0	-5.2	0.000	0.10
Hospital part of IPPS	87.2	87.1	97.2	-10.1	0.000	0.38
Other Case Mix Characteristics						
Female[a]	43.5	44.8	44.5	0.3	0.004	-0.07
Age[b]	72.4	72.2	72.6	-0.4	0.000	0.11

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2(d.f)**	***p*-value**
0.08	0.06	0.091	876.0	0.000	76.4 (26)	0.00

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level and Change						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***P*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=949)**	**Treatment Group Mean (n=3,246)**			
2011 pressure ulcer rate (events per 1,000 at risk)[c]	0.055	0.076	0.136	-0.060	0.000	0.25
2010 pressure ulcer rate minus 2009 pressure ulcer rate (events per 1,000 at risk)[c]	-0.017	-0.011	-0.011	-0.000	1.000	-0.00
2011 pressure ulcer rate minus 2010 pressure ulcer rate (events per 1,000 at risk)[c]	0.002	-0.030	0.018	-0.048	0.360	0.17

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f.)**	***p*-value**
0.14	0.17	0.020	191.2	0.000	25.6 (3)	0.00

Source: Analysis of hospital rosters, AHA Survey (FY 2010), and Medicare claims, 2009–2012.

Note: Means (or percentages) are weighted by the product of the number of patients at risk for pressure ulcers and the weight obtained from a propensity score model with 2009, 2010, and 2011 rates and change in the rates for pressure ulcers from Medicare claims as independent variables. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

Table D-3—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=809)**	**Treatment Group Mean (n=3,063)**			
Hospital is a CAH	37.9	8.3	13.9	-5.6	0.000	0.18
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	20.6	6.4	6.6	-0.2	0.718	0.01
100–199 beds (non-CAH)	10.6	25.8	12.9	12.9	0.000	-0.33
200–399 beds (non-CAH)	18.3	32.9	30.5	2.3	0.019	-0.05
400 beds or more (non-CAH)	12.7	26.7	36.1	-9.5	0.000	0.21
Ownership (Percent)						
Government, federal	0.0	0.1	0.0	0.1	0.104	-0.04
Government, nonfederal	15.9	16.5	15.5	1.0	0.207	-0.03
Nongovernment for-profit	32.2	9.5	11.2	-1.6	0.014	0.05
Nongovernment not-for-profit	51.9	73.9	73.4	0.5	0.567	-0.01
Region (Percent)						
New England	4.2	3.7	4.0	-0.3	0.534	0.01
Mid Atlantic	0.5	13.5	13.2	0.3	0.702	-0.01
South Atlantic	26.3	18.9	20.3	-1.4	0.108	0.03
East North Central	11.8	18.9	14.1	4.8	0.000	-0.13
East South Central	14.5	6.0	9.9	-3.9	0.000	0.14
West North Central	11.7	10.2	12.4	-2.1	0.002	0.07
West South Central	17.6	14.4	11.4	3	0.000	-0.09
Mountain	4.9	2.9	5.0	-2.1	0.000	0.11
Pacific	8.5	8.3	9.2	-0.8	0.161	0.03
Associated areas	0.0	3.1	0.6	2.5	0.000	-0.18
Race/Ethnicity[a]						
Hispanic	1.8	2.6	1.8	0.8	0.000	-0.17
White (non-Hispanic)	83.9	76.1	82.4	-6.2	0.000	0.32
Black (non-Hispanic)	12.0	18	12.9	5.1	0.000	-0.27
Other (non-Hispanic)	2.3	3.3	3.0	0.3	0.013	-0.05
Other Hospital Characteristics						
Rural	50.7	18.4	23.0	-4.7	0.000	0.12
Member of hospital system	41.7	68.6	64.7	3.9	0.000	0.08
Member of hospital network	19.7	38.5	41.7	-3.2	0.003	0.06

Table D-3—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent): Pre-Matching Comparison Group Mean	Mean (or Percent): Matched Comparison Group Mean (n=809)	Mean (or Percent): Treatment Group Mean (n=3,063)	Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
Teaching hospital	24.0	49.1	50.4	-1.3	0.228	0.03
Hospital part of IPPS	57.9	81.5	85.1	-3.6	0.000	0.10
Other Case Mix Characteristics						
Female[a]	41.9	44.7	44.5	0.2	0.015	-0.05
Age[b]	74.2	72.7	73.2	-0.4	0.000	0.12

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f.)	*p*-value
0.10	0.08	0.101	1215.6	0.000	57.8 (26)	0.00

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level and Change

Variable	Mean (or percent): Pre-Matching Comparison Group Mean	Mean (or percent): Matched Comparison Group Mean (n=809)	Mean (or percent): Treatment Group Mean (n=3,063)	Difference Between Treatment and Matched Comparison Means	*P*-Value of Difference	Standardized Difference
2011 VTE rate (events per 1,000 at risk)[c]	0.219	0.221	0.246	-0.026	0.003	0.06
2010 VTE rate minus 2009 VTE rate (events per 1,000 at risk)[c]	-0.012	0.028	-0.028	0.056	0.000	-0.13
2011 VTE rate minus 2010 VTE rate (events per 1,000 at risk)[c]	0.030	-0.067	0.011	-0.079	0.000	0.18

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f.)	*p*-value
0.13	0.13	0.010	114.4	0.000	7.3 (3)	0.06

Source: Analysis of hospital rosters, AHA Survey (FY 2010), and Medicare claims, 2009–2012.

Note: Means (or percentages) are weighted by the product of the number of patients at risk for VTE and the weight obtained from a propensity score model with 2009, 2010, and 2011 rates and change in the rates for VTE from Medicare claims as independent variables. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.

[a]Weighted mean of the percentage of at-risk patients across hospitals.

[b]Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c]The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

Table D-4—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=1,051)**	**Treatment Group Mean (n=3,463)**			
Hospital is a CAH	5.5	3.4	2.9	0.5	0.213	-0.03
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.1	8.7	6.8	1.9	0.003	-0.07
100–199 beds (non-CAH)	23.6	21.1	17.6	3.5	0.000	-0.09
200–399 beds (non-CAH)	35.1	35.5	36.0	-0.5	0.649	0.01
400 beds or more (non-CAH)	19.7	31.4	36.7	-5.4	0.000	0.11
Ownership (Percent)						
Government, federal	0.0	0.1	0.0	0.1	0.150	-0.03
Government, nonfederal	9.5	12.6	12.6	0.1	0.940	0.00
Nongovernment for-profit	41.8	10.8	9.4	1.3	0.058	-0.04
Nongovernment not-for-profit	48.7	76.5	78.0	-1.4	0.138	0.03
Region (Percent)						
New England	8.8	6.1	4.9	1.2	0.019	-0.05
Mid Atlantic	1.4	12.9	16.1	-3.2	0.000	0.09
South Atlantic	32.1	17.0	19.9	-2.9	0.001	0.08
East North Central	15.2	20.9	17.3	3.6	0.000	-0.09
East South Central	6.6	8.1	8.5	-0.5	0.468	0.02
West North Central	3.4	5.7	8.3	-2.6	0.000	0.10
West South Central	20.7	10.9	9.6	1.3	0.061	-0.04
Mountain	3.6	4.7	5.0	-0.3	0.534	0.01
Pacific	8.3	12.9	10.1	2.8	0.000	-0.09
Associated areas	0.0	0.8	0.3	0.5	0.001	-0.07
Race/Ethnicity[a]						
Hispanic	0.6	0.8	0.6	0.2	0.057	-0.04
White (non-Hispanic)	80.7	82.7	82.1	0.6	0.105	-0.04
Black (non-Hispanic)	13.4	12.0	12.7	-0.7	0.047	0.05
Other (non-Hispanic)	5.3	4.5	4.6	-0.1	0.575	0.01
Other Hospital Characteristics						
Rural	20.5	24.3	17.6	6.7	0.000	-0.17
Member of hospital system	67.2	62.0	66.6	-4.7	0.000	0.10

Table D-4—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=1,051)**	**Treatment Group Mean (n=3,463)**			
Member of hospital network	26.0	33.2	41.9	-8.7	0.000	0.18
Teaching hospital	34.6	43.9	52.1	-8.2	0.000	0.16
Hospital participates in Community-based Care Transitions Program (CCTP)	11.2	16.1	19.8	-3.7	0.000	0.10
Hospital part of IPPS	85.5	87.3	95.8	-8.5	0.000	0.31
Other Case Mix Characteristics						
Female (2011)[a]	44.1	44.9	44.5	0.4	0.000	-0.09
Age (2011)[b]	72.7	72.3	72.7	-0.3	0.000	0.09

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f.)**	***p*-value**
0.08	0.07	0.079	808.0	0.000	86.9 (27)	0.00

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level and Change						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***P*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=1,051)**	**Treatment Group Mean (n=3,463)**			
30-day all-cause readmission rate (2010)	16.9	19.0	19.1	-0.2	0.031	0.05
30-day all-cause readmission rate (2011)	16.7	18.8	19.0	-0.2	0.005	0.07
Change from 30-day all-cause readmission rate from 2010 to 2011	-0.3	-0.2	-0.1	-0.2	0.185	0.03
30-day readmission rate for Myocardial Infarction (MI) patients (2010)	15.2	20.8	21.3	-0.5	0.040	0.05
30-day readmission rate for MI patients (2011)	13.2	20.9	20.9	-0.0	0.922	0.00
Change from 30-day readmission rate for MI patients from 2010 to 2011	-2.1	0.2	-0.3	0.5	0.088	-0.04
30-day readmission rate for Heart Failure (HF) patients (2010)	20.7	25.6	26.3	-0.7	0.000	0.11

Table D-4—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=1,051)**	**Treatment Group Mean (n=3,463)**			
30-day readmission rate for HF patients (2011)	21.2	25.7	25.7	-0.0	0.802	-0.01
Change from 30-day readmission rate for HF patients from 2010 to 2011	0.2	0.1	-0.6	0.7	0.000	-0.11
30-day readmission rate for Pneumonia (PN) patients (2010)	15.9	18.8	19.4	-0.6	0.000	0.11
30-day readmission rate for PN patients (2011)	14.7	18.9	19.1	-0.2	0.039	0.05
Change from 30-day readmission rate for PN patients from 2010 to 2011	-1.0	0.1	-0.2	0.3	0.006	-0.06

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f.)**	***p*-value**
0.06	0.05	0.005	51.0	0.000	5.4 (12)	0.94

Source: Analysis of hospital rosters, AHA Survey (FY 2010), and Medicare claims, 2009–2012.

Note: Means (or percentages) are weighted by the product of the number of patients at risk for readmission and the weight obtained from a propensity score model with 2009, 2010, and 2011 rates and change in the rates for readmission from Medicare claims as independent variables. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.

[a]Weighted mean of the percentage of at-risk patients across hospitals.

[b]Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c]The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

Survey Analysis Removing Spillover

Table D-5—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=119)	Treatment Group Mean (n=813)			
Hospital is a CAH	7.5	8.4	3.0	5.5	0.000	0.24
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.7	14.8	7.2	7.6	0.000	0.24
100–199 beds (non-CAH)	18.6	21.1	17.3	3.8	0.127	0.10
200–399 beds (non-CAH)	27.8	30.7	41.2	-10.5	0.001	-0.22
400 beds or more (non-CAH)	29.4	25.0	31.4	-6.3	0.036	-0.14
Ownership (Percent)						
Government, federal	0.0	0.0	0.1	-0.1	0.592	-0.05
Government, nonfederal	5.1	7.3	15.1	-7.9	0.001	-0.25
Nongovernment for-profit	44.0	33.9	9.6	24.3	0.000	0.62†
Nongovernment not-for-profit	50.9	58.9	75.2	-16.3	0.000	-0.35†
Region (Percent)						
New England	2.8	3.3	4.6	-1.3	0.335	-0.07
Mid Atlantic	0.2	0.4	16.3	-15.9	0.000	-0.60†
South Atlantic	40.1	36.3	17.4	18.8	0.000	0.43†
East North Central	17.6	18.8	20.4	-1.6	0.532	-0.04
East South Central	7.6	8.7	9.5	-0.8	0.660	-0.03
West North Central	4.3	4.6	7.4	-2.8	0.094	-0.12
West South Central	21.9	19.8	9.0	10.8	0.000	0.31†
Mountain	3.9	5.0	4.9	0.1	0.930	0.01
Pacific	1.6	3.2	10.3	-7.1	0.000	-0.29†
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.7	1.9	1.7	0.2	0.433	0.04
White (non-Hispanic)	79.4	80.5	81.7	-1.2	0.277	-0.07
Black (non-Hispanic)	16.6	15.1	13.3	1.8	0.070	0.11
Other (non-Hispanic)	2.2	2.5	3.3	-0.8	0.066	-0.15
Other Hospital Characteristics						

Table D-5—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=119)	Treatment Group Mean (n=813)			
Rural	27.2	29.5	18.8	10.7	0.000	0.25
Member of hospital system	72.4	71.2	65.9	5.3	0.088	0.11
Member of hospital network	23.1	25.2	41.5	-16.2	0.000	-0.35[†]
Teaching hospital	21.0	24.3	50.1	-25.8	0.000	-0.55[†]
Other Case Mix Characteristics						
Female[a]	43.8	43.6	44.4	-0.8	0.001	-0.21
Age[b]	73.1	72.9	72.6	0.3	0.176	0.09

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.22	0.18	0.184	344.9	0.000	168.8 (24)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 CRBSI rate (events per 1,000 at risk) [c]	0.397	0.383	0.468	-0.085	0.013	-0.18

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for CRBSI and the weight obtained from a propensity score model with the 2011 CRBSI rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The 2011 adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-6—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-03: Pressure Ulcers (Stage III, IV, and Unstageable)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=113)**	**Treatment Group Mean (n=913)**			
Hospital is a CAH	3.3	5.8	2.2	3.5	0.001	0.18
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	32.0	12.2	5.5	6.7	0.000	0.24
100–199 beds (non-CAH)	13.4	20.4	15.4	4.9	0.050	0.13
200–399 beds (non-CAH)	23.2	33.1	40.5	-7.4	0.029	-0.15
400 beds or more (non-CAH)	28.1	28.6	36.3	-7.8	0.019	-0.17
Ownership (Percent)						
Government, federal	0.0	0.0	0.1	-0.1	0.637	-0.04
Government, nonfederal	2.6	5.5	14.7	-9.2	0.000	-0.31[†]
Nongovernment for-profit	51.4	34.0	8.9	25.1	0.000	0.64[†]
Nongovernment not-for-profit	46.0	60.5	76.3	-15.8	0.000	-0.34[†]
Region (Percent)						
New England	1.6	2.7	4.4	-1.7	0.224	-0.09
Mid Atlantic	0.1	0.4	18.8	-18.4	0.000	-0.66[†]
South Atlantic	34.6	39.1	18.7	20.4	0.000	0.46[†]
East North Central	14.6	17.2	20.2	-3.0	0.281	-0.08
East South Central	6.1	9.0	8.4	0.6	0.768	0.02
West North Central	9.0	3.6	6.4	-2.9	0.089	-0.13
West South Central	30.8	21.7	9.1	12.6	0.000	0.35[†]
Mountain	2.0	3.6	4.4	-0.9	0.535	-0.04
Pacific	1.0	2.8	9.5	-6.7	0.001	-0.28[†]
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.7	2.0	1.8	0.2	0.483	0.04
White (non-Hispanic)	78.8	79.2	80.4	-1.2	0.310	-0.07
Black (non-Hispanic)	17.6	16.2	14.4	1.8	0.104	0.11
Other (non-Hispanic)	1.8	2.6	3.4	-0.8	0.103	-0.14
Other Hospital Characteristics						
Rural	24.2	26.2	15.4	10.8	0.000	0.27[†]
Member of hospital system	73.6	73.2	65.8	7.4	0.023	0.16

Table D-6—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-03: Pressure Ulcers (Stage III, IV, and Unstageable)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=113)	Treatment Group Mean (n=913)			
Member of hospital network	17.1	24.3	43.6	-19.3	0.000	-0.42[†]
Teaching hospital	17.6	25.3	53.4	-28.2	0.000	-0.60[†]
Other Case Mix Characteristics						
Female[a]	42.6	43.8	44.5	-0.8	0.003	-0.20
Age[b]	71.5	72.8	72.5	0.2	0.299	0.07

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.23	0.16	0.213	365.6	0.000	185.5 (24)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 pressure ulcer rate (events per 1,000 at risk)[c]	0.181	0.228	0.264	-0.035	0.248	-0.09

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for pressure ulcers and the weight obtained from a propensity score model with the 2011 pressure ulcer rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The 2011 adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-7—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=103)**	**Treatment Group Mean (n=827)**			
Hospital is a CAH	40.3	29.2	32.9	-3.7	0.209	-0.08
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	40.4	15.9	5.0	10.8	0.000	0.36[†]
100–199 beds (non-CAH)	4.6	14.2	15.8	-1.6	0.478	-0.05
200–399 beds (non-CAH)	6.7	19.4	23.8	-4.4	0.099	-0.11
400 beds or more (non-CAH)	8.1	21.4	22.5	-1.2	0.653	-0.03
Ownership (Percent)						
Government, federal	0.0	0.0	0.0	0.0	0.839	-0.02
Government, nonfederal	33.6	23.6	21.4	2.2	0.381	0.05
Nongovernment for-profit	12.1	21.7	6.3	15.4	0.000	0.46[†]
Nongovernment not-for-profit	54.4	54.7	72.3	-17.7	0.000	-0.37[†]
Region (Percent)						
New England	0.2	0.9	4.2	-3.3	0.007	-0.21
Mid Atlantic	0.0	0.0	9.5	-9.4	0.000	-0.46[†]
South Atlantic	9.8	24.9	16.4	8.5	0.000	0.21
East North Central	3.5	10.0	13.6	-3.6	0.092	-0.11
East South Central	38.0	13.8	12.1	1.7	0.408	0.05
West North Central	4.2	13.5	22.7	-9.1	0.000	-0.24
West South Central	42.7	30.5	10.7	19.8	0.000	0.50[†]
Mountain	1.3	5.0	4.5	0.6	0.664	0.03
Pacific	0.2	1.3	6.3	-5.1	0.001	-0.27[†]
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.9	1.6	1.1	0.5	0.007	0.13
White (non-Hispanic)	88.8	86.4	86.4	0.1	0.947	0.00
Black (non-Hispanic)	9.4	10.0	10.1	-0.0	0.954	-0.00
Other (non-Hispanic)	0.9	1.9	2.4	-0.5	0.086	-0.13
Other Hospital Characteristics						
Rural	79.6	48.4	48.9	-0.5	0.881	-0.01
Member of hospital system	26.9	61.7	51.0	10.6	0.001	0.21

Table D-7—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent): Pre-Matching Comparison Group Mean	Mean (or Percent): Matched Comparison Group Mean (n=103)	Mean (or Percent): Treatment Group Mean (n=827)	Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
Member of hospital network	7.9	28.2	41.5	-13.3	0.000	-0.28†
Teaching hospital	4.6	15.2	34.8	-19.7	0.000	-0.47†
Other Case Mix Characteristics						
Female[a]	39.5	43.5	43.8	-0.4	0.208	-0.07
Age[b]	76.5	75.8	74.2	1.6	0.000	0.37†

ASD: Mean	ASD: Median	Logit Model: Pseudo R^2	Logit Model: Chi^2	Logit Model: *p*-value	Omnibus Test: Chi^2 (d.f)	Omnibus Test: *p*-value
0.19	0.13	0.244	544.2	0.000	162.8 (24)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent): Pre-Matching Comparison Group Mean	Mean (or Percent): Matched Comparison Group Mean	Mean (or Percent): Treatment Group Mean	Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
2011 VTE rate (event per 1,000 at risk) [c]	0.044	0.124	0.184	-0.059	0.004	-0.20

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for VTE and the weight obtained from a propensity score model with the 2011 VTE rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The 2011 adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-8—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=168)**	**Treatment Group Mean (n=857)**			
Hospital is a CAH	5.0	5.0	3.2	1.8	0.095	0.09
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	12.5	9.0	6.6	2.4	0.108	0.09
100–199 beds (non-CAH)	21.1	21.8	16.1	5.8	0.009	0.15
200–399 beds (non-CAH)	41.9	40.6	39.1	1.5	0.617	0.03
400 beds or more (non-CAH)	19.5	23.7	35.1	-11.4	0.000	-0.25
Ownership (Percent)						
Government, federal	0.1	0.0	0.0	0.0	0.218	0.03
Government, nonfederal	6.9	6.1	16.1	-10.0	0.000	-0.32
Nongovernment for-profit	30.0	19.5	8.6	10.9	0.000	0.32
Nongovernment not-for-profit	63.0	74.3	75.3	-1.0	0.694	-0.02
Region (Percent)						
New England	8.4	11.0	3.5	7.4	0.000	0.29
Mid Atlantic	0.1	0.3	17.9	-17.6	0.000	-0.64
South Atlantic	32.0	31.6	16.8	14.8	0.000	0.35
East North Central	22.3	17.3	20.7	-3.4	0.154	-0.09
East South Central	6.7	5.0	9.9	-4.9	0.005	-0.19
West North Central	2.6	2.7	8.3	-5.5	0.001	-0.24
West South Central	17.7	16.8	7.9	8.9	0.000	0.27
Mountain	5.8	8.0	4.8	3.2	0.015	0.13
Pacific	4.4	7.4	10.2	-2.8	0.117	-0.10
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.0	1.0	0.7	0.4	0.021	0.11
White (non-Hispanic)	77.8	80.8	82.5	-1.7	0.081	-0.10
Black (non-Hispanic)	18.1	14.7	13.0	1.8	0.042	0.11
Other (non-Hispanic)	3.1	3.5	3.9	-0.5	0.274	-0.07
Other Hospital Characteristics						
Rural	20.4	18.2	18.3	-0.1	0.958	-0.00
Member of hospital system	65.0	69.3	65.5	3.8	0.177	0.08

Table D-8—Comparison of HEN-Aligned and Non-HEN-Aligned Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=168)**	**Treatment Group Mean (n=857)**			
Member of hospital network	25.7	34.1	42.2	-8.1	0.006	-0.17
Teaching hospital	23.9	30.7	53.3	-22.6	0.000	-0.47
Hospital part of IPPS	83.9	81.2	95.0	-13.8	0.000	-0.44
Other Case Mix Characteristics						
Female[a]	43.9	44.0	44.4	-0.4	0.070	-0.11
Age[b]	72.7	72.9	72.6	0.3	0.112	0.10

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.18	0.11	0.196	416.6	0.000	196.9 (26)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level and Change						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
30-day all-cause readmission rate, 2010[c]	19.4	18.7	19.1	-0.5	0.014	-0.13
30-day all-cause readmission rate, 2009 [c]	19.7	18.8	19.2	-0.4	0.035	-0.11
Change in 30-day all-cause readmission rate from 2009 to 2010[c]	-0.3	-0.2	-0.1	-0.1	0.420	-0.04

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.12	0.11	0.006	12.8	0.005	2.5 (3)	0.473

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).
Note: Means (or percentages) are weighted by the product of the number of patients at risk for readmission and the weight obtained from a propensity score model with the 2009 and 2010 readmission rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.
[†] SD is larger than 0.25 standard deviations.
[a] Weighted mean of the percentage of at-risk patients across hospitals.
[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.
[c] The 2009 and 2010 adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.
N/A = not applicable

Analysis of Relationship Between Hospital Engagement (Survey Data) and Outcomes (Medicare FFS Claims)

Table D-9—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=146)	Treatment Group Mean (n=784)			
Hospital is a CAH	5.6	5.6	5.5	0.1	0.989	0.00
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.7	11.7	7.0	4.7	0.363	0.16
100–199 beds (non-CAH)	18.3	26.4	30.7	-4.4	0.577	-0.10
200–399 beds (non-CAH)	38.6	25.3	32.3	-7.0	0.373	-0.15
400 beds or more (non-CAH)	27.9	31.1	24.5	6.6	0.399	0.15
Ownership (Percent)						
Government, federal/non-federal	9.5	8.7	20.3	-11.5	0.052	-0.33†
Nongovernment for-profit	19.0	6.1	2.5	3.6	0.321	0.18
Nongovernment not-for-profit	71.5	85.1	77.2	7.9	0.239	0.20
Region (Percent)						
New England	6.3	5.7	0.9	4.8	0.145	0.27†
Mid Atlantic	15.9	3.5	5.7	-2.2	0.536	-0.11
South Atlantic	23.3	16.1	10.5	5.6	0.351	0.16
East North Central	20.3	22.9	31.2	-8.3	0.282	-0.19
East South Central	5.0	2.7	1.4	1.3	0.608	0.09
West North Central	4.8	15.4	23.9	-8.5	0.212	-0.21
West South Central	12.2	10.8	2.1	8.7	0.052	0.36†
Mountain	6.9	7.5	3.8	3.7	0.374	0.16
Pacific	5.4	15.4	20.5	-5.0	0.448	-0.13
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.6	1.6	1.2	0.3	0.529	0.11
White (non-Hispanic)	79.1	85.5	87.3	-1.8	0.455	-0.13
Black (non-Hispanic)	16.5	9.1	8.1	1.0	0.628	0.09
Other (non-Hispanic)	2.8	3.8	3.3	0.5	0.545	0.10
Other Hospital Characteristics						

Table D-9—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=146)**	**Treatment Group Mean (n=784)**			
Rural	20.2	29.5	29.0	0.5	0.954	0.01
Member of hospital system	66.0	70.2	51.8	18.4	0.028	0.38[†]
Member of hospital network	33.4	31.7	32.2	-0.5	0.949	-0.01
Teaching hospital	34.6	43.2	49.7	-6.5	0.458	-0.13
Other Case Mix Characteristics						
Female[a]	44.3	44.6	44.9	-0.3	0.641	-0.08
Age[b]	72.7	72.6	72.4	0.12	0.838	0.04

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.15	0.13	0.15	27.89	0.220	34.36 (23)	0.060

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2011 CRBSI rate (events per 1,000 at risk)[c]	0.400	0.459	0.484	-0.02	0.842	-0.03

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for CRBSI and the weight obtained from a propensity score model with the 2011 CRBSI rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-10—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=146)**	**Treatment Group Mean (n=784)**			
Hospital is a CAH	5.6	3.9	4.8	-0.9	0.680	-0.04
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.7	9.8	5.8	4.0	0.171	0.15
100–199 beds (non-CAH)	18.3	23.1	23.4	-0.3	0.943	-0.01
200–399 beds (non-CAH)	38.6	32.4	46.1	-13.8	0.008	-0.28†
400 beds or more (non-CAH)	27.9	30.9	19.9	11.0	0.020	0.25
Ownership (Percent)						
Government, federal/non-federal	9.5	17.9	13.8	4.1	0.299	0.11
Nongovernment for-profit	19.0	10.5	5.7	4.7	0.114	0.17
Nongovernment not-for-profit	71.5	71.6	80.4	-8.8	0.056	-0.21
Region (Percent)						
New England	6.3	5.2	1.7	3.4	0.096	0.19
Mid Atlantic	15.9	12.2	17.3	-5.1	0.171	-0.14
South Atlantic	23.3	16.7	15.5	1.2	0.762	0.03
East North Central	20.3	18.2	40.1	-21.9	0.000	-0.50†
East South Central	5.0	8.7	2.3	6.4	0.012	0.28†
West North Central	4.8	8.2	9.5	-1.3	0.674	-0.04
West South Central	12.2	19.2	6.2	13.0	0.000	0.40†
Mountain	6.9	4.5	3.9	0.6	0.776	0.03
Pacific	5.4	7.1	3.5	3.6	0.146	0.16
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.6	1.3	1.1	0.2	0.555	0.06
White (non-Hispanic)	79.1	81.3	82.3	-1.0	0.594	-0.06
Black (non-Hispanic)	16.5	13.8	14.0	-0.2	0.902	-0.01
Other (non-Hispanic)	2.8	3.6	2.6	1.0	0.029	0.24
Other Hospital Characteristics						
Rural	20.2	19.2	25.1	-6.0	0.173	-0.14
Member of hospital system	66.0	75.6	64.0	11.6	0.017	0.25

Table D-10—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=146)	Treatment Group Mean (n=784)			
Member of hospital network	33.4	32.0	48.8	-16.8	0.001	-0.35†
Teaching hospital	34.6	41.1	41.0	0.1	0.983	0.00
Other Case Mix Characteristics						
Female[a]	44.3	45.1	45.2	-0.1	0.921	-0.01
Age[b]	72.7	72.3	72.2	0.04	0.932	0.09

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.15	0.14	0.129	64.09	0.000	26.23 (23)	0.290

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 CRBSI rate (events per 1,000 at risk)[c]	0.400	0.310	0.452	-0.142	0.007	-0.29†

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for CRBSI and the weight obtained from a propensity score model with the 2011 CRBSI rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-11—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=146)**	**Treatment Group Mean (n=784)**			
Hospital is a CAH	5.6	3.6	4.5	-0.9	0.389	-0.04
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.7	9.2	12.1	-2.9	0.068	-0.09
100–199 beds (non-CAH)	18.3	19.2	17.9	1.3	0.536	0.03
200–399 beds (non-CAH)	38.6	30.9	36.9	-6.0	0.015	-0.13
400 beds or more (non-CAH)	27.9	37.1	28.5	8.6	0.001	0.18
Ownership (Percent)						
Government, federal/non-federal	9.5	13.2	13.5	-0.3	0.849	-0.01
Nongovernment for-profit	19.0	17.2	9.1	8.1	0.000	0.24
Nongovernment not-for-profit	71.5	69.7	77.4	-7.7	0.001	-0.18
Region (Percent)						
New England	6.3	5.7	8.2	-2.4	0.067	-0.09
Mid Atlantic	15.9	10.0	16.1	-6.1	0.000	-0.18
South Atlantic	23.3	16.4	21.1	-4.7	0.021	-0.12
East North Central	20.3	13.5	17.4	-3.9	0.037	-0.11
East South Central	5.0	8.8	10.5	-1.8	0.253	-0.06
West North Central	4.8	7.7	5.8	1.9	0.163	0.07
West South Central	12.2	22.9	8.3	14.5	0.000	0.41[†]
Mountain	6.9	5.6	3.6	2.0	0.078	0.09
Pacific	5.4	9.4	9.0	0.5	0.758	0.02
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.6	2.1	1.3	0.7	0.001	0.18
White (non-Hispanic)	79.1	80.0	84.0	-3.9	0.000	-0.24
Black (non-Hispanic)	16.5	13.0	11.1	1.9	0.013	0.13
Other (non-Hispanic)	2.8	4.8	3.6	1.3	0.001	0.17
Other Hospital Characteristics						
Rural	20.2	17.7	25.7	-8.0	0.000	-0.19
Member of hospital system	66.0	75.4	54.8	20.6	0.000	0.44[†]

Table D-11—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-07: Central Venous Catheter-Related Blood Stream Infection (CRBSI)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=146)	Treatment Group Mean (n=784)			
Member of hospital network	33.4	29.0	44.4	-15.4	0.000	-0.32†
Teaching hospital	34.6	55.2	43.3	12.0	0.000	0.24
Other Case Mix Characteristics						
Female[a]	44.3	44.5	43.5	1.1	0.000	0.29
Age[b]	72.7	72.1	73.4	-1.2	0.000	-0.40†

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.17	0.17	0.102	205.89	0.000	28.47 (23)	0.198

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 CRBSI rate (events per 1,000 at risk)[c]	0.400	0.321	0.371	-0.05	0.031	-0.11

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).
Note: Means (or percentages) are weighted by the product of the number of patients at risk for CRBSI and the weight obtained from a propensity score model with the 2011 CRBSI rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.
† SD is larger than 0.25 standard deviations.
[a] Weighted mean of the percentage of at-risk patients across hospitals.
[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.
[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.
N/A = not applicable

Table D-12—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=142)**	**Treatment Group Mean (n=876)**			
Hospital is a CAH	3.1	3.3	2.7	0.6	0.786	0.03
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	15.0	5.8	5.8	0.0	0.981	0.00
100–199 beds (non-CAH)	15.1	13.7	18.7	-5.0	0.263	-0.14
200–399 beds (non-CAH)	36.3	45.6	49.5	-3.9	0.528	-0.08
400 beds or more (non-CAH)	30.6	31.6	23.3	8.3	0.140	0.19
Ownership (Percent)						
Government, federal/non-federal	8.5	12.2	19.0	-6.8	0.118	-0.19
Nongovernment for-profit	23.1	7.6	10.7	-3.1	0.375	-0.11
Nongovernment not-for-profit	68.4	80.2	70.3	9.9	0.058	0.23
Region (Percent)						
New England	4.7	2.4	1.8	0.6	0.739	0.04
Mid Atlantic	17.6	20.5	4.6	15.9	0.000	0.49[†]
South Atlantic	22.9	19.5	15.8	3.7	0.437	0.10
East North Central	19.0	21.3	22.0	-0.6	0.901	-0.02
East South Central	4.4	5.8	9.6	-3.8	0.229	-0.14
West North Central	5.7	4.6	14.9	-10.3	0.002	-0.35[†]
West South Central	15.8	15.0	15.2	-0.2	0.960	-0.01
Mountain	4.7	4.4	2.4	2.0	0.384	0.11
Pacific	5.1	6.6	13.9	-7.3	0.040	-0.24
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.7	1.4	1.8	-0.4	0.416	-0.10
White (non-Hispanic)	77.6	74.6	84.0	-9.4	0.000	-0.52[†]
Black (non-Hispanic)	18.1	20.9	11.6	9.3	0.000	0.52[†]
Other (non-Hispanic)	2.6	3.1	2.6	0.5	0.361	0.12
Other Hospital Characteristics						
Rural	17.3	15.3	13.9	1.4	0.755	0.04
Member of hospital system	66.1	72.5	56.8	15.7	0.007	0.33[†]

Table D-12—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=142)	Treatment Group Mean (n=876)			
Member of hospital network	30.3	37.7	42.1	-4.4	0.465	-0.09
Teaching hospital	33.6	53.5	43.3	10.1	0.102	0.20
Other Case Mix Characteristics						
Female[a]	44.1	44.9	45.1	-0.1	0.757	-0.04
Age[b]	72.1	72.2	72.2	0.04	0.917	0.01

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.16	0.11	0.20	74.0	0.000	42.7 (23)	0.007

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 Pressure Ulcer rate (events per 1,000 at risk)[c]	0.247	0.273	0.263	0.01	0.842	-0.02

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for pressure ulcer and the weight obtained from a propensity score model with the 2011 pressure ulcer rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-13—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=142)**	**Treatment Group Mean (n=876)**			
Hospital is a CAH	3.1	3.5	2.5	1.0	0.571	0.06
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	15.0	7.0	5.4	1.6	0.495	0.07
100–199 beds (non-CAH)	15.1	19.6	24.7	-5.2	0.203	-0.12
200–399 beds (non-CAH)	36.3	55.9	46.2	9.7	0.048	0.19
400 beds or more (non-CAH)	30.6	14.0	21.1	-7.1	0.055	-0.19
Ownership (Percent)						
Government, federal/non-federal	8.5	27.0	15.9	11.1	0.006	0.27[†]
Nongovernment for-profit	23.1	9.1	7.8	1.3	0.640	0.05
Nongovernment not-for-profit	68.4	63.9	76.3	-12.4	0.006	-0.27[†]
Region (Percent)						
New England	4.7	2.9	6.3	-3.4	0.091	-0.16
Mid Atlantic	17.6	22.1	23.4	-1.2	0.762	-0.03
South Atlantic	22.9	17.1	13.8	3.3	0.362	0.09
East North Central	19.0	19.0	33.2	-14.2	0.001	-0.33[†]
East South Central	4.4	5.1	1.1	4.0	0.024	0.23
West North Central	5.7	4.1	8.0	-3.9	0.087	-0.17
West South Central	15.8	13.7	7.3	6.4	0.036	0.21
Mountain	4.7	11.7	5.2	6.5	0.019	0.24
Pacific	5.1	4.3	1.7	2.6	0.131	0.15
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.7	1.5	2.1	-0.6	0.218	-0.12
White (non-Hispanic)	77.6	76.0	82.6	-6.6	0.000	-0.35[†]
Black (non-Hispanic)	18.1	19.9	12.8	7.1	0.000	0.40[†]
Other (non-Hispanic)	2.6	2.6	2.5	0.1	0.842	0.02
Other Hospital Characteristics						
Rural	17.3	16.6	21.4	-4.8	0.208	-0.12
Member of hospital system	66.1	67.2	64.0	3.2	0.493	0.07

Table D-13—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=142)	Treatment Group Mean (n=876)			
Member of hospital network	30.3	44.0	56.4	-12.4	0.012	-0.25
Teaching hospital	33.6	53.5	50.8	2.8	0.575	0.06
Other Case Mix Characteristics						
Female[a]	44.1	45.3	44.8	0.5	0.242	0.12
Age[b]	72.1	71.7	72.3	-0.6	0.102	-0.16

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.17	0.16	0.13	73.6	0.000	33.6 (23)	0.070

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 Pressure Ulcer rate (events per 1,000 at risk)[c]	0.247	0.347	0.396	-0.049	0.410	-0.08

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).
Note: Means (or percentages) are weighted by the product of the number of patients at risk for pressure ulcer and the weight obtained from a propensity score model with the 2011 pressure ulcer rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.
[†] SD is larger than 0.25 standard deviations.
[a] Weighted mean of the percentage of at-risk patients across hospitals.
[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.
[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.
N/A = not applicable

Table D-14—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=142)**	**Treatment Group Mean (n=876)**			
Hospital is a CAH	3.1	3.1	2.6	0.4	0.642	0.03
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	15.0	7.2	8.6	-1.4	0.355	-0.05
100–199 beds (non-CAH)	15.1	12.2	15.5	-3.3	0.076	-0.10
200–399 beds (non-CAH)	36.3	49.1	35.5	13.6	0.000	0.28[†]
400 beds or more (non-CAH)	30.6	28.4	37.7	-9.3	0.000	-0.20
Ownership (Percent)						
Government, federal/non-federal	8.5	14.5	14.6	-0.1	0.955	-0.00
Nongovernment for-profit	23.1	5.9	9.1	-3.2	0.027	-0.12
Nongovernment not-for-profit	68.4	79.6	76.4	3.3	0.148	0.08
Region (Percent)						
New England	4.7	6.3	4.7	1.6	0.206	0.07
Mid Atlantic	17.6	33.1	21.2	11.9	0.000	0.27[†]
South Atlantic	22.9	12.3	21.4	-9.1	0.000	-0.25
East North Central	19.0	13.5	16.2	-2.7	0.170	-0.08
East South Central	4.4	4.1	9.7	-5.6	0.000	-0.22
West North Central	5.7	3.7	7.0	-3.3	0.007	-0.15
West South Central	15.8	11.2	7.3	4.0	0.013	0.14
Mountain	4.7	8.7	3.5	5.2	0.000	0.22
Pacific	5.1	7.1	9.0	-1.9	0.202	-0.07
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	1.7	1.5	1.4	0.1	0.571	0.03
White (non-Hispanic)	77.6	71.7	82.9	-11.2	0.000	-0.55[†]
Black (non-Hispanic)	18.1	23.6	12.6	11.1	0.000	0.56[†]
Other (non-Hispanic)	2.6	3.2	3.2	0.0	0.957	0.00
Other Hospital Characteristics						
Rural	17.3	13.9	22.1	-8.2	0.000	-0.22
Member of hospital system	66.1	74.6	63.9	10.7	0.000	0.23

Table D-14—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-03: Stage III, IV, and Unstageable Pressure Ulcers						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=142)**	**Treatment Group Mean (n=876)**			
Member of hospital network	30.3	42.2	43.3	-1.1	0.698	-0.02
Teaching hospital	33.6	62.9	54.3	8.7	0.001	0.18
Other Case Mix Characteristics						
Female[a]	44.1	45.6	44.0	1.6	0.000	0.42[†]
Age[b]	72.1	72.0	73.1	-1.1	0.000	-0.33[†]

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.18	0.15	0.16	289.7	0.000	39.1 (23)	0.019

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2011 Pressure Ulcer rate (events per 1,000 at risk)[c]	0.247	0.310	0.216	0.095	0.000	0.24

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for pressure ulcer and the weight obtained from a propensity score model with the 2011 pressure ulcer rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-15—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=126)	Treatment Group Mean (n=788)			
Hospital is a CAH	51.1	11.8	40.0	-28.2	0.000	-0.68†
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.6	11.8	22.9	-11.1	0.000	-0.30†
100–199 beds (non-CAH)	6.1	27.3	7.9	19.4	0.000	0.53†
200–399 beds (non-CAH)	13.9	22.9	17.1	5.8	0.068	0.15
400 beds or more (non-CAH)	12.3	26.2	12.1	14.1	0.000	0.36†
Ownership (Percent)						
Government, federal/non-federal	39.7	9.4	35.3	-26.2	0.000	-0.66†
Nongovernment for-profit	6.9	23.5	13.2	10.3	0.001	0.27†
Nongovernment not-for-profit	53.4	67.2	51.3	15.9	0.000	0.33†
Region (Percent)						
New England	2.3	20.0	13.4	6.6	0.027	0.18
Mid Atlantic	7.4	0.7	1.2	-0.5	0.514	-0.05
South Atlantic	10.9	12.0	6.1	5.9	0.010	0.21
East North Central	28.4	6.3	8.5	-2.2	0.297	-0.08
East South Central	15.3	2.4	3.5	-1.2	0.376	-0.07
West North Central	12.6	23.9	37.3	-13.4	0.000	-0.29†
West South Central	18.3	17.6	14.3	3.3	0.262	0.09
Mountain	3.3	5.3	10.7	-5.4	0.012	-0.20
Pacific	1.6	11.9	5.1	6.8	0.002	0.35†
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.9	2.9	1.9	1.0	0.021	0.19
White (non-Hispanic)	89.0	86.5	91.5	-5.0	0.000	-0.44†
Black (non-Hispanic)	8.2	6.7	4.9	1.8	0.024	0.18
Other (non-Hispanic)	1.9	4.0	1.7	2.2	0.000	0.61†
Other Hospital Characteristics						
Rural	68.2	32.9	65.2	-32.3	0.000	-0.68†
Member of hospital system	31.8	67.6	33.7	33.9	0.000	0.72†

Table D-15—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=126)**	**Treatment Group Mean (n=788)**			
Member of hospital network	22.1	64.2	56.6	7.7	0.049	0.16
Teaching hospital	18.6	41.0	20.6	20.4	0.000	0.45†
Other Case Mix Characteristics						
Female[a]	40.5	42.7	44.9	-2.2	0.000	-0.64†
Age[b]	75.8	74.3	75.6	-1.3	0.000	-0.34†

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.34	0.29	0.405	354.78	0.000	77.3 (23)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2011 VTE rate (events per 1,000 at risk)[c]	0.110	0.273	0.102	0.171	0.000	0.57†

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for VTE and the weight obtained from a propensity score model with the 2011 VTE rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

a Weighted mean of the percentage of at-risk patients across hospitals.

b Weighted mean of the average age of at-risk Medicare patients across hospitals.

c The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable.

Table D-16—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=126)**	**Treatment Group Mean (n=788)**			
Hospital is a CAH	51.1	33.5	38.2	-4.7	0.165	-0.10
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.6	1.8	2.5	-0.8	0.433	-0.05
100–199 beds (non-CAH)	6.1	27.0	9.0	18.0	0.000	0.48†
200–399 beds (non-CAH)	13.9	18.2	25.3	-7.1	0.014	-0.17
400 beds or more (non-CAH)	12.3	19.5	24.9	-5.4	0.068	-0.13
Ownership (Percent)						
Government, federal/non-federal	39.7	20.7	29.4	-8.7	0.004	-0.20
Nongovernment for-profit	6.9	8.3	3.9	4.4	0.015	0.18
Nongovernment not-for-profit	53.4	71.0	66.7	4.3	0.188	0.09
Region (Percent)						
New England	2.3	4.6	1.4	3.2	0.015	0.19
Mid Atlantic	7.4	9.4	12.3	-2.9	0.180	-0.09
South Atlantic	10.9	9.6	8.9	0.6	0.757	0.02
East North Central	28.4	20.8	24.3	-3.4	0.245	-0.08
East South Central	15.3	0.4	0.9	-0.5	0.327	-0.07
West North Central	12.6	44.4	43.1	1.3	0.722	0.03
West South Central	18.3	5.9	4.3	1.6	0.320	0.07
Mountain	3.3	2.1	2.4	-0.3	0.749	-0.02
Pacific	1.6	2.8	2.3	0.5	0.651	0.03
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.9	0.7	1.0	-0.2	0.229	-0.08
White (non-Hispanic)	89.0	85.1	87.7	-2.7	0.025	-0.17
Black (non-Hispanic)	8.2	10.3	8.7	1.5	0.179	0.10
Other (non-Hispanic)	1.9	3.9	2.6	1.4	0.000	0.32†
Other Hospital Characteristics						
Rural	68.2	54.8	45.5	9.3	0.009	0.19
Member of hospital system	31.8	73.6	71.6	2.0	0.535	0.04

Table D-16—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=126)	Treatment Group Mean (n=788)			
Member of hospital network	22.1	59.4	56.1	3.3	0.353	0.07
Teaching hospital	18.6	39.6	40.3	-0.8	0.829	-0.02
Other Case Mix Characteristics						
Female[a]	40.5	43.0	45.3	-2.2	0.000	-0.63[†]
Age[b]	75.8	75.0	75.6	-0.6	0.071	-0.12

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.14	0.09	0.250	278.2	0.000	54.9 (23)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 VTE rate (events per 1,000 at risk)[c]	0.110	0.252	0.204	0.047	0.077	0.13

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for VTE and the weight obtained from a propensity score model with the 2011 VTE rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-17—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=126)**	**Treatment Group Mean (n=788)**			
Hospital is a CAH	51.1	23.8	41.2	-17.3	0.000	-0.38†
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	16.6	3.0	3.1	-0.1	0.889	-0.01
100–199 beds (non-CAH)	6.1	29.8	19.0	10.8	0.000	0.25
200–399 beds (non-CAH)	13.9	12.8	19.2	-6.4	0.000	-0.17
400 beds or more (non-CAH)	12.3	30.6	17.5	13.0	0.000	0.31†
Ownership (Percent)						
Government, federal/non-federal	39.7	7.9	18.0	-10.1	0.000	-0.31†
Nongovernment for-profit	6.9	4.3	4.5	-0.2	0.805	-0.01
Nongovernment not-for-profit	53.4	87.8	77.5	10.4	0.000	0.28†
Region (Percent)						
New England	2.3	4.7	2.6	2.1	0.012	0.11
Mid Atlantic	7.4	5.5	6.8	-1.3	0.207	-0.05
South Atlantic	10.9	23.7	18.0	5.8	0.001	0.14
East North Central	28.4	10.9	12.8	-1.9	0.171	-0.06
East South Central	15.3	12.5	18.3	-5.8	0.000	-0.16
West North Central	12.6	17.8	19.6	-1.8	0.289	-0.05
West South Central	18.3	12.2	14.3	-2.1	0.160	-0.06
Mountain	3.3	1.8	2.1	-0.3	0.607	-0.02
Pacific	1.6	10.8	5.5	5.4	0.000	0.20
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.9	1.2	0.7	0.5	0.000	0.22
White (non-Hispanic)	89.0	83.9	87.5	-3.6	0.000	-0.24
Black (non-Hispanic)	8.2	10.8	9.9	0.9	0.137	0.06
Other (non-Hispanic)	1.9	4.0	1.9	2.1	0.000	0.42†
Other Hospital Characteristics						
Rural	68.2	48.8	60.2	-11.5	0.000	-0.23
Member of hospital system	31.8	63.5	40.4	23.1	0.000	0.48†

Table D-17—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—PSI-12: Venous Thromboembolism (VTE)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=126)	Treatment Group Mean (n=788)			
Member of hospital network	22.1	40.5	29.3	11.2	0.000	0.24
Teaching hospital	18.6	40.5	26.5	14.0	0.000	0.30†
Other Case Mix Characteristics						
Female[a]	40.5	42.3	42.6	-0.3	0.219	-0.05
Age[b]	75.8	74.3	74.3	0.0	0.992	0.00

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.18	0.17	0.191	563.7	0.000	56.7 (23)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2011 VTE rate (events per 1,000 at risk)[c]	0.110	0.155	0.150	0.004	0.734	0.01

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for VTE and the weight obtained from a propensity score model with the 2011 VTE rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-18—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=139)**	**Treatment Group Mean (n=863)**			
Hospital is a CAH	3.9	7.6	4.6	3.0	0.407	0.12
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.0	10.3	6.2	4.0	0.328	0.15
100–199 beds (non-CAH)	19.9	27.0	21.7	5.3	0.412	0.12
200–399 beds (non-CAH)	40.7	26.6	43.3	-16.7	0.017	-0.35†
400 beds or more (non-CAH)	26.5	28.5	24.1	4.4	0.503	0.10
Ownership (Percent)						
Government, federal/non-federal	5.9	15.5	15.5	0.0	0.998	-0.00
Nongovernment for-profit	21.8	9.7	10.5	-0.8	0.859	-0.03
Nongovernment not-for-profit	72.2	74.8	74.0	0.8	0.901	0.02
Region (Percent)						
New England	3.8	12.2	8.0	4.2	0.352	0.14
Mid Atlantic	17.9	16.4	19.6	-3.2	0.572	-0.08
South Atlantic	21.7	5.6	14.9	-9.3	0.034	-0.31†
East North Central	20.4	7.3	10.6	-3.3	0.437	-0.11
East South Central	7.0	7.9	7.7	0.1	0.975	0.00
West North Central	2.0	4.9	12.3	-7.4	0.069	-0.26†
West South Central	12.5	32.6	13.5	19.1	0.002	0.46†
Mountain	9.6	8.5	5.0	3.5	0.354	0.14
Pacific	5.2	4.5	8.3	-3.8	0.284	-0.16
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.8	2.8	1.1	1.7	0.012	0.38†
White (non-Hispanic)	79.4	85.8	79.7	6.1	0.012	0.36†
Black (non-Hispanic)	16.1	9.2	14.8	-5.7	0.012	-0.37†
Other (non-Hispanic)	3.7	2.3	4.4	-2.1	0.005	-0.40†
Other Hospital Characteristics						
Rural	17.8	28.1	23.4	4.7	0.469	0.11
Member of hospital system	65.6	58.2	51.2	7.0	0.343	0.14

Table D-18—Comparison of Minimally Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=139)**	**Treatment Group Mean (n=863)**			
Member of hospital network	27.4	38.4	39.9	-1.5	0.838	-0.03
Teaching hospital	36.7	49.3	36.2	13.2	0.073	0.27[†]
Other Case Mix Characteristics						
Female[a]	44.1	42.4	44.9	-2.5	0.000	-0.62[†]
Age[b]	73.1	73.8	71.9	1.9	0.000	0.62[†]

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.22	0.14	0.36	92.46	0.000	77.68 (24)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2010 30-day readmission rate [c]	19.3	18.3	19.2	0.9	0.134	0.22

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for readmissions and the weight obtained from a propensity score model with the 2010 readmission rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-19—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=139)**	**Treatment Group Mean (n=863)**			
Hospital is a CAH	3.9	9.5	2.8	6.8	0.002	0.28†
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.0	9.2	5.6	3.7	0.138	0.14
100–199 beds (non-CAH)	19.9	22.9	10.7	12.3	0.000	0.33†
200–399 beds (non-CAH)	40.7	29.7	38.4	-8.7	0.055	-0.18
400 beds or more (non-CAH)	26.5	28.6	42.6	-14.0	0.002	-0.30†
Ownership (Percent)						
Government, federal/non-federal	5.9	17.0	14.6	2.3	0.502	0.06
Nongovernment for-profit	21.8	10.3	5.7	4.5	0.076	0.17
Nongovernment not-for-profit	72.2	72.8	79.6	-6.9	0.089	-0.16
Region (Percent)						
New England	3.8	7.2	2.3	4.9	0.014	0.23
Mid Atlantic	17.9	9.2	23.9	-14.7	0.000	-0.40†
South Atlantic	21.7	12.3	12.6	-0.3	0.931	-0.01
East North Central	20.4	14.6	29.3	-14.7	0.000	-0.36†
East South Central	7.0	11.6	6.1	5.5	0.040	0.19
West North Central	2.0	5.0	9.7	-4.7	0.060	-0.18
West South Central	12.5	21.1	4.2	16.8	0.000	0.52†
Mountain	9.6	10.2	3.7	6.5	0.006	0.26†
Pacific	5.2	8.8	8.2	0.7	0.801	0.02
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.8	2.2	0.7	1.5	0.001	0.32†
White (non-Hispanic)	79.4	85.2	82.4	2.8	0.043	0.19
Black (non-Hispanic)	16.1	9.9	13.2	-3.3	0.013	-0.24
Other (non-Hispanic)	3.7	2.8	3.8	-1.0	0.014	-0.24
Other Hospital Characteristics						
Rural	17.8	27.7	12.4	15.3	0.000	0.39†
Member of hospital system	65.6	61.8	65.1	-3.3	0.466	-0.07

Table D-19—Comparison of Moderately Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=139)**	**Treatment Group Mean (n=863)**			
Member of hospital network	27.4	32.3	45.1	-12.8	0.006	-0.26†
Teaching hospital	36.7	52.2	61.8	-9.6	0.041	-0.20
Other Case Mix Characteristics						
Female[a]	44.1	42.8	44.9	-2.1	0.000	-0.60†
Age[b]	73.1	73.7	72.6	1.1	0.000	0.35†

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.25	0.24	0.24	149.88	0.000	59.67 (24)	0.000

Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2010 30-day readmission rate [c]	19.3	17.9	19.4	-1.4	0.000	-0.40†

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for readmissions and the weight obtained from a propensity score model with the 2010 readmission rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

† SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Table D-20—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean (n=139)**	**Treatment Group Mean (n=863)**			
Hospital is a CAH	3.9	9.5	4.3	5.1	0.001	0.20
Hospital Size (Percent)						
Fewer than 100 beds (non-CAH)	9.0	13.6	9.2	4.4	0.018	0.14
100–199 beds (non-CAH)	19.9	25.7	27.5	8.2	0.001	0.20
200–399 beds (non-CAH)	40.7	21.1	39.5	-18.3	0.000	-0.41†
400 beds or more (non-CAH)	26.5	30.2	29.6	0.006	0.818	0.01
Ownership (Percent)						
Government, federal/non-federal	5.9	18.8	16.4	2.4	0.281	0.06
Nongovernment for-profit	21.8	8.5	9.3	-0.8	0.620	-0.03
Nongovernment not-for-profit	72.2	72.7	74.2	-1.6	0.540	-0.04
Region (Percent)						
New England	3.8	9.2	5.8	3.4	0.030	0.13
Mid Atlantic	17.9	5.6	11.4	-5.9	0.000	-0.21
South Atlantic	21.7	11.8	20.2	-8.4	0.000	-0.23
East North Central	20.4	10.6	22.8	-12.2	0.000	-0.33†
East South Central	7.0	13.5	8.7	4.8	0.010	0.15
West North Central	2.0	4.8	9.5	-4.7	0.002	-0.18
West South Central	12.5	29.5	9.0	20.5	0.000	0.54†
Mountain	9.6	5.8	3.6	2.2	0.080	0.10
Pacific	5.2	9.3	9.0	0.3	0.856	0.01
Associated areas	0.0	0.0	0.0	0.0	N/A	N/A
Race/Ethnicity[a]						
Hispanic	0.8	2.7	0.7	2.0	0.000	0.42†
White (non-Hispanic)	79.4	84.3	83.2	1.1	0.215	0.07
Black (non-Hispanic)	16.1	10.3	12.2	-1.9	0.023	-0.13
Other (non-Hispanic)	3.7	2.6	3.8	-1.2	0.001	-0.19
Other Hospital Characteristics						
Rural	17.8	34.0	22.7	11.3	0.000	0.25
Member of hospital system	65.6	61.2	62.9	-1.7	0.542	-0.04

Table D-20—Comparison of Fully Engaged HEN-Aligned and Non-HEN-Aligned/Non-Engaged Hospitals Before the PfP Intervention Began—Readmissions

Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean (n=139)	Treatment Group Mean (n=863)			
Member of hospital network	27.4	30.2	41.5	-11.4	0.000	-0.24
Teaching hospital	36.7	51.5	46.4	5.1	0.080	0.10
Other Case Mix Characteristics						
Female[a]	44.1	42.6	44.2	-1.6	0.000	-0.40[†]
Age[b]	73.1	73.6	72.8	0.8	0.000	0.25
ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.19	0.19	0.18	286.2	0.000	65.1 (24)	0.000
Panel B—Comparison of Groups on Pre-Intervention Outcome Measure Level						
Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean	Matched Comparison Group Mean	Treatment Group Mean			
2010 30-day readmission rate [c]	19.3	18.2	19.0	-0.7	0.000	-0.22

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims (2011–2012).

Note: Means (or percentages) are weighted by the product of the number of patients at risk for readmissions and the weight obtained from a propensity score model with the 2010 readmission rate from Medicare claims as independent variables. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of at-risk patients across hospitals.

[b] Weighted mean of the average age of at-risk Medicare patients across hospitals.

[c] The adverse event rates were Winsorized at the 95th percentile of the distribution of adverse event rates among hospitals with positive rates.

N/A = not applicable

Analysis of Costs Averted Due to HEN

Table D-21—Balance Test Results for the Total Expenditures Analysis (90 Days)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean (n=546)	**Matched Comparison Group Mean (n=546)**	**Treatment Group Mean (n= 2,298)**			
Hospital Size (Percent)						
Fewer than 100 beds	18.2	11.8	9.1	2.7	0.000	-0.09
100–199 beds (non-CAH)	20.4	20.2	16.5	3.7	0.000	-0.10
200–399 beds (non-CAH)	37.7	36.9	35.7	1.1	0.000	-0.02
400 beds or more (non-CAH)	23.7	31.1	38.7	-7.6	0.000	0.16
Ownership (Percent)						
Government, federal	0.0	0.0	0.0	0.0	0.000	0.01
Government, non-federal	9.3	13.8	12.6	1.2	0.000	-0.04
Nongovernment for-profit	31.1	9.2	6.5	2.7	0.00	-0.10
Nongovernment not-for-profit	59.6	77.0	80.9	-3.8	0.00	0.09
Electronic Health Record (EHR) (Percent)						
Has Full EHR	25.4	35.4	35.2	0.2	0.000	0.00
Has Partial EHR	59.2	53.0	57.1	-4.1	0.000	0.08
Has No EHR	12.2	8.2	4.7	3.5	0.000	0.14
Missing	3.2	3.4	3.0	0.4	0.000	-0.2
Region (Percent)						
New England	10.1	6.7	5.2	1.5	0.000	-0.07
Mid Atlantic	0.4	4.6	15.2	-10.5	0.000	0.36[†]
South Atlantic	25.0	14.6	19.9	-5.3	0.000	0.14
East North Central	18.7	28.3	19.3	9.0	0.000	-0.21
East South Central	4.3	7.3	7.1	0.2	0.000	-0.01
West North Central	3.0	10.4	8.9	1.5	0.000	-0.05
West South Central	27.7	11.0	11.1	-0.1	0.004	0.00
Mountain	3.4	3.9	4.5	-0.6	0.000	0.03
Pacific	7.4	13.0	8.7	4.3	0.000	-0.14
Associated areas	0.0	0.1	0.0	0.0	0.000	-0.02
Race/Ethnicity[a]						
Hispanic	3.1	1.7	1.7	0.1	0.000	-0.02
White (non-Hispanic)	82.0	83.3	84.0	-0.7	0.000	0.04

Table D-21—Balance Test Results for the Total Expenditures Analysis (90 Days)

Panel A—Comparison of Groups on Basic Hospital Characteristics

Characteristics	Mean (or Percent)			Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean (n=546)	Matched Comparison Group Mean (n=546)	Treatment Group Mean (n= 2,298)			
Black (non-Hispanic)	12.3	12.0	11.5	0.5	0.000	-0.03
Other (non-Hispanic)	2.6	3.0	2.8	0.2	0.000	-0.03
Obstetrical (OB) Care Beds as Percent of Total						
Discrete Group 1	21.4	13.1	11.0	2.0	0.000	-0.06
Discrete Group 2	48.2	54.5	58.8	-4.3	0.000	0.09
Discrete Group 3	30.4	32.5	30.2	2.3	0.000	-0.05
Intensivist as Percent of Total						
Discrete Group 1	51.7	39.2	34.1	5.2	0.000	-0.11
Discrete Group 2	28.3	27.1	34.3	-7.1	0.000	0.16
Discrete Group 3	20.0	33.6	31.7	2.0	0.000	-0.04
Other Hospital Characteristics						
Rural	18.5	19.5	17.0	2.5	0.000	-0.06
Member of hospital system	67.2	61.3	65.4	-4.1	0.000	0.09
Member of hospital network	34.1	33.9	45.9	-12.1	0.000	0.25
Teaching hospital	43.1	53.7	56.0	-2.3	0.000	0.05
Rural Referral Center	2.7	8.9	10.8	-1.9	0.000	0.07
Maryland Hospital (Not IPPS/CAH)	11.3	1.8	1.1	0.7	0.000	-0.06
AHA Member	85.4	88.3	91.7	-3.4	0.000	0.11
Other Case Mix Characteristics						
Female[a]	56.9	56.5	56.2	0.3	0.000	-0.07
Age[b]	73.5	73.2	73.4	-0.2	0.000	0.06

ASD		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.08	0.06	0.074	800,605.9	0.000	132.1 (34)	0.000

Table D-21—Balance Test Results for the Total Expenditures Analysis (90 Days)

Panel B—Baseline Values

Variable	Mean (or Percent)			Difference Between Treatment and Matched Comparison Means	*p*-Value of Difference	Standardized Difference
	Pre-Matching Comparison Group Mean (n=546)	Matched Comparison Group Mean (n=546)	Treatment Group Mean (n=2,298)			
2010 Average Total Expenditures	19,992.9	20,970.7	20,766.9	203.9	0.000	-0.04
Difference from 2009 to 2010 in Average Total Expenditures	129.5	-127.2	9.6	-136.8	0.000	0.13

Standardized Difference		Logit Model			Omnibus Test	
Mean	Median	Pseudo R^2	Chi^2	*p*-value	Chi^2 (d.f)	*p*-value
0.09	0.059	0.003	37,464.3	0.000	2.2 (2)	0.328

Source: Analysis of hospital rosters submitted by HENs in June 2012, AHA Survey (FY 2010), and Medicare claims, 2009–2010.

Note: Means (or percentages) are weighted by the product of the number of index discharges and the weight obtained from a propensity score model with 2009 and 2010 average expenditures and change in the average expenditures from Medicare claims as independent variables. The variables listed in Panel A are a subset of all the hospital characteristics included in the propensity score model. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.

[†] SD is larger than 0.25 standard deviations.

[a] Weighted mean of the percentage of Medicare patients across hospitals.

[b] Weighted mean of the average age of Medicare patients across hospitals.

Characteristics	Pre-Matching Comparison Group Mean (n=546)	Matched Comparison Group Mean (n=546)	Treatment Group Mean (n= 2,298)	Difference Between Comparison and Treatment	*p*-Value of Difference	Standardized Difference
Table D-22—Balance Test Results for Index Discharge Expenditures Analysis (90 days)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
	Mean (or Percent)					
Hospital Size (Percent)						
Fewer than 100 beds	18.2	12.0	9.1	3.0	0.000	-0.10
100–199 beds (non-CAH)	20.4	20.3	16.5	3.7	0.000	-0.10
200–399 beds (non-CAH)	37.7	35.5	35.7	-0.2	0.000	0.00
400 beds or more (non-CAH)	23.7	32.2	38.7	-6.5	0.000	0.14
Ownership (Percent)						
Government, federal	0.0	0.0	0.0	0.0	0.000	0.01
Government, nonfederal	9.3	13.8	12.6	1.2	0.000	-0.04
Nongovernment for-profit	31.1	8.7	6.5	2.2	0.000	-0.08
Nongovernment not-for-profit	59.6	77.5	80.9	-3.4	0.000	0.08
Electronic Health Record (Percent)						
Has Full EHR	25.4	31.1	35.2	-4.1	0.000	0.09
Has Partial EHR	59.2	57.8	57.1	0.7	0.000	-0.01
Has No EHR	12.2	7.8	4.7	3.1	0.000	-0.13
Missing	3.2	3.3	3.0	-0.3	0.000	-0.02
Region (Percent)						
New England	10.1	6.2	5.2	1.0	0.000	-0.04
Mid Atlantic	0.4	4.6	15.2	-10.6	0.000	0.36[†]
South Atlantic	25.0	16.8	19.9	-3.1	0.000	0.08
East North Central	18.7	25.9	19.3	6.6	0.000	-0.16
East South Central	4.3	7.1	7.1	-0.1	0.000	0.00
West North Central	3.0	11.7	8.9	2.8	0.000	-0.09
West South Central	27.7	10.5	11.1	-0.6	0.000	0.02
Mountain	3.4	3.7	4.5	-0.8	0.000	0.04
Pacific	7.4	13.5	8.7	4.8	0.000	-0.15
Associated areas	0.0	0.0	0.0	0.0	0.000	-0.01
Race/Ethnicity[a]						
Hispanic	3.1	1.8	1.7	0.1	0.000	-0.03
White (non-Hispanic)	82.0	82.7	84.0	-1.3	0.000	-0.08
Black (non-Hispanic)	12.3	12.4	11.5	-0.9	0.000	-0.06

Table D-22—Balance Test Results for Index Discharge Expenditures Analysis (90 days)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean (n=546)	**Matched Comparison Group Mean (n=546)**	**Treatment Group Mean (n= 2,298)**			
Other (non-Hispanic)	2.6	3.1	2.8	-0.3	0.000	-0.06
OB Care Beds as Percent of Total						
Discrete Group 1	21.4	12.4	11.0	1.4	0.000	-0.04
Discrete Group 2	48.2	55.1	58.8	-3.7	0.000	0.07
Discrete Group 3	30.4	32.5	30.2	2.3	0.000	-0.05
Intensivist as Percent of Total						
Discrete Group 1	51.7	37.8	34.1	3.8	0.000	-0.08
Discrete Group 2	28.3	27.1	34.3	-7.2	0.000	0.16
Discrete Group 3	20.0	35.1	31.7	3.4	0.000	-0.07
Other Hospital Characteristics						
Rural	18.5	19.1	17.0	2.1	0.000	-0.05
Member of hospital system	67.2	61.5	65.4	-3.9	0.000	0.08
Member of hospital network	34.1	33.3	45.9	-12.6	0.000	0.26[†]
Teaching hospital	43.1	53.6	56.0	-2.4	0.000	0.05
Rural Reference Center	2.7	8.6	10.8	-2.2	0.000	0.07
Maryland Hospital (Not IPPS/CAH)	11.3	1.5	1.1	0.4	0.000	-0.04
AHA Member	85.4	88.0	91.7	-3.8	0.000	0.13
Other Case Mix Characteristics						
Female[a]	56.9	56.5	56.2	0.3	0.000	-0.07
Age[b]	73.5	73.2	73.4	-0.2	0.000	0.07

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.08	0.07	0.071	778,359.0	0.000	126.9 (34)	0.000

Table D-22—Balance Test Results for Index Discharge Expenditures Analysis (90 days)						
Panel B—Baseline Values						
Variable	**Mean (or Percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean	**Matched Comparison Group Mean**	**Treatment Group Mean**			
2010 Average Index Discharge Expenditures	8,207.7	9,404.5	9,340.7	63.8	0.000	-0.02
Difference from 2009 to 2010 in Average Index Discharge Expenditures	-7.2	-110.9	-60.9	-50.1	0.000	0.10

Standardized Difference		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.06	0.06	0.002	20,390.9	0.000	1.0 (2)	0.594

Source: Analysis of hospital rosters submitted by HENs in June 2012, AHA Survey (FY 2010), and Medicare claims, 2009–2010.
Note: Means (or percentages) are weighted by the product of the number of index discharges and the weight obtained from a propensity score model with 2009 and 2010 average expenditures and change in the average expenditures from Medicare claims as independent variables. The variables listed in Panel A are a subset of all the hospital characteristics included in the propensity score model. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.
[†] SD is larger than 0.25 standard deviations.
[a] Weighted mean of the percentage of Medicare patients across hospitals.
[b] Weighted mean of the average age of Medicare patients across hospitals.

Table D-23—Balance Test Results for the Post-Discharge Expenditures Analysis (90 days)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean (n=546)	**Matched Comparison Group Mean (n=546)**	**Treatment Group Mean (n= 2,298)**			
Hospital Size (Percent)						
Fewer than 100 beds	18.2	13.4	9.1	4.4	0.000	-0.14
100–199 beds (non-CAH)	20.4	20.3	16.5	3.7	0.000	-0.10
200–399 beds (non-CAH)	37.7	35.8	35.7	0.0	0.454	0.00
400 beds or more (non-CAH)	23.7	30.5	38.7	-8.1	0.000	0.17
Ownership (Percent)						
Government, federal	0.0	0.0	0.0	0.0	0.000	0.01
Government, nonfederal	9.3	12.7	12.6	-0.1	0.000	0.00
Nongovernment for-profit	31.1	9.6	6.5	3.1	0.000	-0.11
Nongovernment not-for-profit	59.6	77.6	80.9	-3.3	0.000	0.08
Electronic Health Record (Percent)						
Has Full EHR	25.4	31.1	35.2	-4.1	0.000	0.09
Has Partial EHR	59.2	57.5	57.1	0.4	0.000	-0.01
Has No EHR	12.2	8.7	4.7	4.0	0.000	-0.16
Missing	3.2	2.7	3.0	-0.3	0.000	0.02
Region (Percent)						
New England	10.1	6.7	5.2	1.5	0.000	-0.06
Mid Atlantic	0.4	5.5	15.2	-9.7	0.000	0.32
South Atlantic	25.0	16.7	19.9	-3.2	0.000	0.08
East North Central	18.7	25.0	19.3	5.7	0.000	-0.14
East South Central	4.3	8.0	7.1	0.9	0.000	-0.03
West North Central	3.0	10.1	8.9	1.2	0.000	-0.04
West South Central	27.7	11.1	11.1	0.0	0.112	0.00
Mountain	3.4	4.1	4.5	-0.4	0.000	0.02
Pacific	7.4	12.9	8.7	4.1	0.000	-0.13
Associated areas	0.0	0.0	0.0	0.0	0.641	0.0
Race/ Ethnicity[a]						
Hispanic	3.1	1.8	1.7	0.1	0.000	-0.02
White (non-Hispanic)	82.0	82.3	84.0	-1.7	0.000	-0.10
Black (non-Hispanic)	12.3	12.6	11.5	1.1	0.000	-0.07

Table D-23—Balance Test Results for the Post-Discharge Expenditures Analysis (90 days)						
Panel A—Comparison of Groups on Basic Hospital Characteristics						
Characteristics	**Mean (or Percent)**			**Difference Between Comparison and Treatment**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean (n=546)	**Matched Comparison Group Mean (n=546)**	**Treatment Group Mean (n= 2,298)**			
Other (non-Hispanic)	2.6	3.3	2.8	0.5	0.000	-0.08
OB Care Beds as Percent of Total						
Discrete Group 1	21.4	13.9	11.0	2.9	0.000	-0.08
Discrete Group 2	48.2	54.0	58.8	-4.8	0.000	0.10
Discrete Group 3	30.4	32.1	30.2	1.9	0.000	-0.04
Intensivist as Percent of Total						
Discrete Group 1	51.7	40.1	34.1	6.0	0.000	-0.13
Discrete Group 2	28.3	26.1	34.3	-8.2	0.000	0.18
Discrete Group 3	20.0	33.8	31.7	2.1	0.000	0.05
Other Hospital Characteristics						
Rural	18.5	20.7	17.0	3.7	0.000	-0.09
Member of hospital system	67.2	61.3	65.4	-4.1	0.000	0.09
Member of hospital network	34.1	32.0	45.9	-14.0	0.000	0.29[†]
Teaching hospital	43.1	52.7	56.0	-3.2	0.000	0.07
Rural Reference Center	2.7	9.6	10.8	-1.2	0.000	0.04
Maryland Hospital (Not IPPS/CAH)	11.3	1.6	1.1	-0.5	0.000	-0.04
AHA Member	85.4	87.5	91.7	-4.3	0.000	0.14
Other Case Mix Characteristics						
Female[a]	56.9	56.8	56.2	0.6	0.000	-0.14
Age[b]	73.5	73.3	73.4	-0.1	0.000	0.04

ASD		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.09	0.08	0.075	817,859.5	0.000	129.0 (34)	0.000

Table D-23—Balance Test Results for the Post-Discharge Expenditures Analysis (90 days)						
Panel B—Baseline Values						
Variable	**Mean (or percent)**			**Difference Between Treatment and Matched Comparison Means**	***p*-Value of Difference**	**Standardized Difference**
	Pre-Matching Comparison Group Mean (n=546)	**Matched Comparison Group Mean (n=546)**	**Treatment Group Mean (n= 2,298)**			
2010 Average Post-Discharge Expenditures	11,785.3	11,604.9	11,426.2	178.7	0.000	-0.08
Difference from 2009 to 2010 in Average Post-Discharge Expenditures	136.7	4.0	70.4	-66.4	0.000	0.09

Standardized Difference		**Logit Model**			**Omnibus Test**	
Mean	**Median**	**Pseudo R^2**	**Chi^2**	***p*-value**	**Chi^2 (d.f)**	***p*-value**
0.08	0.08	0.002	27.1	0.000	1.4 (2)	0.506

Source: Analysis of hospital rosters submitted by HENs in June 2012, AHA Survey (FY 2010), and Medicare claims, 2009–2010.
Note: Means (or percentages) are weighted by the product of the number of index discharges and the weight obtained from a propensity score model with 2009 and 2010 average expenditures and change in the average expenditures from Medicare claims as independent variables. The variables listed in Panel A are a subset of all the hospital characteristics included in the propensity score model. The variables listed in Panel B were not included in the propensity score model as listed, but hospital categories, and various interaction terms were included in the models. Any discrepancies between the sample means and the difference column are due to rounding.
[†] SD is larger than 0.25 standard deviations.
[a] Weighted mean of the percentage of Medicare patients across hospitals.
[b] Weighted mean of the average age of Medicare patients across hospitals.

Bayesian Difference-In-Differences Analysis Methodology

The Evaluation Contractor estimated the impact of the Hospital Engagement Network (HEN) component of the Partnership for Patients (PfP) campaign with a Bayesian difference-in-differences model. The Bayesian model is analogous to a traditional difference-in-differences linear probability model but deviates from the conventional approach in several key ways. This appendix focuses on the methods used for the Bayesian difference-in-differences model.

Bayesian Difference-in-Differences Estimation of the Effect of the HEN Component of the PfP on Adverse Event Outcomes and Readmissions

Using a Bayesian framework, the Evaluation Contractor estimated the impacts of HEN alignment on three adverse event outcomes—venous thromboembolisms (VTE), pressure ulcers, central venous catheter-related blood stream infection (CRBSI)—as well as 30-day hospital readmissions. The Bayesian analysis diverges from a traditional difference-in-differences regression in three ways:

- The model estimates not only a PfP-wide impact of HEN alignment, but also investigates heterogeneity in that impact across groups defined by HEN and by hospital characteristics. In particular, the Bayesian model allows variation in the impact of HEN activities by categorizing HENs based on their intensity (high/low), use of collaboratives (yes/no), and organization type (hospital association, health care system, or other). For more details on the classification of HENs into groups, please see Appendix E. The model also takes into account several hospital characteristics that might influence the impact of participation in the HEN campaign, defining hospital groups by critical access hospital (CAH) status, ownership (private for-profit, private non-profit, or government), and number of beds (< 100, 100-199, 200-399, 400+). To enable the incorporation of these hospital-specific covariates, The Evaluation Contractor used random rather fixed hospital-specific intercepts. As shown in Cheh et al. (2015), the results are functionally equivalent to those obtained using fixed effects.
- Assigning a “prior distribution” to each model parameter translates the model into the Bayesian framework. A prior distribution describes the analyst’s beliefs about a parameter before any data are taken into account.
  - In this model, most priors assign equal probability to all possible values of a parameter, equivalent to making no prior assumptions at all. Doing so reaps the benefits of the Bayesian framework without compromising objectivity, allowing the data, rather than subjective assumptions, to drive inference. In particular, and most importantly, the parameter describing the PfP-wide impact of the HEN component of the campaign is given a flat prior.
  - Not all priors were non-informative though. Consider, for example, the effect of HEN alignment in each of the groups defined by hospital characteristics. These effects are assumed to derive from a common normal distribution. This assumption, called a “shrinkage” prior, allows the model to “borrow strength” from other types of hospitals when calculating HEN alignment’s impact in any given type of hospital. Another recommendation of the shrinkage prior for these parameters is that it generates the natural Bayesian correction for multiple comparisons, facilitating the study of heterogeneity of treatment effects that requires analyses of many types of hospitals. Analogous to the normal prior that induces shrinkage across types of hospitals, The Evaluation Contractor also specified a normal prior that induces shrinkage across types of HENs. This produces the same benefits of (a) allowing the model to borrow strength across types of HENs and (b) obviating the need for a post-hoc multiple comparisons correction, despite estimating the impact of HEN alignment in many types of HENs. The intuition behind these two advantages of the Bayesian approach is described more fully in Chapter 4.

- The Evaluation Contractor further modified the traditional difference-in-differences model to make Bayesian computation feasible. These modifications were adopted purely as a computational convenience and are not inherently Bayesian; a traditional impact estimation framework could also adopt this approach.
  - Rather than fitting a single, unified model at the discharge level as in the frequentist analysis, the model was fit using a two-stage formulation. The first-stage model is a discharge-level propensity-score-weighted risk adjustment fit using linear regression. The goal of the first stage analysis is to (a) aggregate discharges to the hospital-quarter level and (b) risk adjust outcomes to enable comparisons across hospitals and quarters that differ in their case mix. The risk-adjusted hospital-quarter-level output from stage 1 is used as data in stage 2, which estimates the impact of HEN alignment in a Bayesian difference-in-differences framework.
  - Prior to analysis, discharges were divided at random into subsamples until all observations were allocated to a subsample, with all discharges from a given hospital-quarter included in the same subsample. The stage-1 regression models were then fit separately to each subsample. Since the observations in each subsample were selected at random, the relationships between the outcome variable and the risk-adjustment covariates should be comparable across subsamples. For example, age and race should have the same relationship with the likelihood of 30-day readmission in all subsamples. As a result, risk adjusting in this way is expected to produce comparable results to a risk-adjustment model estimated on the entire data set, the strategy adopted in the frequentist analyses presented in Cheh et al. (2015).

The Bayesian Model

Additional details about the computationally feasible two-stage procedure are given below. This procedure is equivalent to a unified model that accomplishes impact estimation and risk adjustment simultaneously through a linear probability model of the following form.

$$y_{ihq} = \beta^D X_i^D + \beta^H X_{hq}^H + \gamma_q + \omega_h + \omega_{k[h]}^K + \alpha_{hq} + \alpha_{k[h]q}^K + z_h(\phi + \phi_{j[h]}^J + \phi_{k[h]}^K + \theta_{y[q]} + \theta_{j[h]y[q]}^J + \theta_{k[h]y[q]}^K) + \varepsilon_{ihq} \tag{1}$$

In this model, the subscripts and superscripts are many, but their meaning is easy to intuit: i indexes discharges, h hospitals, and q quarters. Superscripts D and H denote discharge- and hospital-level terms, respectively. The groups defined by HEN and by hospital characteristics are denoted by subscripts j and k, respectively, and by superscripts J and K. Square brackets are used to indicate group membership such that *y[q]* is the year *y* to which quarter q belongs, *j[h]* is the group of HENs j to which hospital h belongs, and *k[h]* is the group of hospitals *k* to which hospital *h* belongs.

Each of the terms in the model will now be described in turn. First, y_{ihq}=1 denotes an occurrence of the adverse event outcome or readmission; y_{ihq}=0 denotes no adverse event or readmission.

The parameters β^D describe the effects of X_i^D, the risk-adjustment characteristics of discharge i. Similarly, β^H describe the effects of X_{hq}^H, the covariates describing hospital h in quarter q. These include binary variables describing electronic health record use, bed size, teaching status, participation in a health care delivery system, participation in the Community Care Transitions Program (CCTP), geographic region, rural status, whether the hospital treats solely patients with cancer, and whether the hospital treats a high proportion of Medicaid patients. Not all covariates appear in the analysis for all outcomes; covariates correlated with other variables present in the model with a correlation coefficient of 0.55 or greater are dropped to avoid redundancy. Covariate coefficients that could not be defined in a linear regression framework because of high correlations were also removed from the model.

The parameters γ_t control for PfP-wide secular time trends. The random effects ω_h and ω_k^K are specific to hospital h and to hospital type k, respectively; they control for consistent differences between the PfP-wide outcome and the outcome at each hospital and each hospital type. The random effects α_{hq} and α_{kq}^K are specific to hospital h in quarter q and to hospital type k in quarter q, respectively; they allow secular time trends to vary by hospital and hospital type. Apart from the error term, ε_{ihq}, all remaining model parameters are multiplied by z_h, a binary variable indicating whether hospital h is affiliated with a HEN. This implies that all remaining model parameters only apply to discharges from HEN-aligned hospitals. The parameters ϕ, ϕ_j^J, and ϕ_k^K describe the baseline (time-invariant, main-effect) association with HEN alignment at the PfP-wide level, for HEN type j, and for hospital type k, respectively. Analogous to a traditional difference-in-differences model, the intervention's impact is captured by an interaction term between HEN alignment and time. These parameters of interest, describing the impact of HEN alignment in year y at the PfP-wide level, for HEN type j, and for hospital type k, are θ_y, θ_{jy}^J, and θ_{ky}^K.

Each set of random effects is assumed to come from a normal distribution with mean zero and with its own variance. As described above, it is the normal priors for the θ_{jy}^J and θ_{ky}^K impact parameters that induce shrinkage in the estimates of HEN alignment's impact across types of HENs and types of hospitals, respectively. This allows the model to borrow strength across HEN and hospital types and also obviates the need for post-hoc multiple comparisons corrections, despite estimating the impact of HEN alignment in many types of HENs and hospitals. All other parameters, including the square root of each variance parameter, have flat, uninformative priors.

The Data

The analysis used Medicare claims data for acute care hospitals in the country (except pediatric and psychiatric) that were targeted by HENs and (1) that consistently reported present-on-admission indicators, and (2) for which data on hospital characteristics were available for propensity score matching. For these hospitals, all discharges for Medicare fee-for-service (FFS) beneficiaries were included in the analysis. The HEN aligned hospitals include those that have joined the program through June 2012. Hospitals that joined late (after June 2012) are excluded, that is, they a not regarded as either HEN-aligned or not HEN-aligned. Hospitals that did not join the intervention are used as comparisons.

The data set included Medicare claims from Q1 2009 through Q1 2014, with the start of the intervention in Q1 2012. For the analysis presented in this report, the Evaluation Contractor estimated impacts of the HEN component from Q1 2012 through Q1 2014 on VTE, pressure ulcers stages 3 and higher (Patient Safety Indicator [PSI]-03) rates, CRBSI (PSI-07) rates, and 30-day readmission rates, using Q1 2011 through Q4 2011 as a baseline. Discharges associated with hospitals that had more than 5 percent invalid present on admission (POA) indicators in a given quarter were excluded from the sample in that quarter. Creation of adverse event outcomes followed the Agency for Healthcare Research and Quality (AHRQ) PSI algorithm, using the first nine diagnosis codes recorded on the inpatient claims. Adverse event outcomes were constructed using the first 9 diagnosis codes available on the claim. Even though 25 diagnoses codes were available starting in 2011, the Evaluation Contractor chose to use 9 diagnosis codes to enable both a closer propensity score match and the use of two additional years of pre-intervention data (2009 and 2010) to improve estimation of the variability in these outcomes over time and across hospitals. Impact analyses using outcomes based on 25 diagnosis codes were conducted and showed no meaningful difference between impact estimates when using outcomes based on 9 diagnosis codes. The availability of additional pre-intervention data strengthened the analysis by allowing the model to account for more detailed, long-term trends in outcomes and the corresponding impacts. Additional detail about Medicare data used for this and other analyses is presented in Appendix B.

Stage 1—Risk-Adjustment to Estimate a Hospital-Level File

The first stage took as input a discharge-level data set and ran linear regressions that produce risk-adjusted estimates of the three adverse events and readmission rates and their standard errors for each hospital and quarter. The model included hospital-level propensity score weights, which are essential at this stage to ensure that the standard errors around the stage 1 estimates reflect the relationship between patient mix and risk of adverse events at HEN-aligned hospitals and the most similar comparison hospitals.

The Evaluation Contractor fit stage-1 regressions separately for 16 random subsamples of each discharge-level data set, ensuring that all observations from a given hospital-quarter appear in the same subsample. The 16 random subsamples included all the observations in the data set; that is, even though random subsampling was used, every observation in the dataset appeared in one of the 16 subsamples. By properties of random sampling, the relationship between the outcome variable and each risk-adjustment covariate is expected to remain consistent across samples, analogous to the AHRQ risk-adjustment approach.

For each subsample, the stage 1 regression has the form:

$$y_{ihq} = \beta^D X_i^D + \alpha_{hq} + \varepsilon_{ihq}, \tag{2}$$

All notation is as described for equation (1). Recall that the outcome y_{ihq} is a binary event indicator for discharge i from hospital h in quarter q. The parameters β^D describe the effects of X_i^D, the risk-adjustment characteristics of discharge i. The X_i^D are centered so that the mean of each covariate is 0.This facilitates computation and allows interpretation of regression coefficients as effects relative to the mean of each covariate. The hospital-quarter-specific effect α_{hq} is treated as fixed in this stage because its random-effects variance will be estimated in stage 2.

The Evaluation Contractor then estimated an "offset" for each hospital h in quarter q, denoted R_{hq}. The offset is calculated as:

$$R_{hq} = \hat{\alpha}_{hq} \tag{3}$$

where $\hat{\alpha}_{hq}$ represents the estimated fixed effect for hospital h in quarter q. Because the stage-1 model was a linear probability model and the subsamples were random, R_{hq} represents the expected probability of an adverse event or readmission at hospital h in quarter q if the patients it treated were as risky as the national average. These estimated offsets were used as the dependent variable in the stage-2 Bayesian model. Their squared standard errors were used as inverse weights. This allows the propensity score weight and the uncertainty of stage-1 estimation to propagate through to the final inference on the impact of HEN alignment. Furthermore, it reflects the uncertainty associated with the sample size in each hospital; that is, hospitals with fewer discharges have larger estimated standard errors and thus contribute less to the final impact estimates.

Stage 2—Bayesian Estimation Using a Difference-in-Differences Regression Model

In stage 2, the R_{hq} offset for hospital *h* in quarter q (output from the stage 1 risk-adjustment model) becomes the outcome variable of a fully Bayesian difference-in differences impact estimation model:

$$R_{hq} = \beta^H X_{hq}^H + \gamma_q + \omega_h + \omega_{k[h]}^K + \alpha_{k[h]q}^K + z_h(\phi + \phi_{j[h]}^J + \phi_{k[h]}^K + \theta_{y[q]} + \theta_{j[h]y[q]}^J + \theta_{k[h]y[q]}^K) + e_{hq} \tag{4}$$

All notation is again as described for equation (1). Recall that β^H describe the effects of X_{hq}^H, the covariates describing hospital *h* in quarter *q*. The parameters γ_t control for global secular time trends. The random effects ω_h and ω_k^K are specific to hospital *h* and to hospital type *k*, respectively. The random effects α_{hq} and α_{kq}^K are specific to hospital *h* in quarter *q* and to hospital type *k* in quarter *q*, respectively. The parameters ϕ, ϕ_j^J, and ϕ_k^K describe the baseline association with HEN alignment at the PfP-wide level, for HEN type *j*, and for hospital type *k*, respectively. The parameters describing the impact of HEN alignment in year *y* at the PfP-wide level, for HEN type *j*, and for hospital type *k*, are θ_y, θ_{jy}^J, and θ_{ky}^K.

Applying a Bayesian model in the second stage reaps all the benefits of a difference-in-differences approach while simultaneously permitting probabilistic statements about the impact of HEN alignment. As in the frequentist paradigm, the difference-in-differences impact estimate captures the magnitude and direction of any change in an outcome among hospitals that signed up to work with a HEN compared to the magnitude and direction of changes in that outcome among non-HEN-aligned hospitals—holding constant differences between hospitals' outcomes at baseline, differences in the characteristics of patients served, differences in potentially time-varying observed hospital characteristics, and external factors that might influence changes over time in outcomes across hospitals in both groups.

Impact Estimation

Consider hospitals of type *k* in post-intervention year *y*. The impact of alignment with a HEN of type *j* is denoted Θ_{jky}. This impact is the difference in differences between outcomes at hospitals of type *k* that were aligned with a HEN of type *j* and those that were not aligned with a HEN, in year *y*, compared to the year 2011:

$$\Theta_{jky} = \theta_y + \theta_{jy}^J + \theta_{ky}^K - (\theta_{2011} + \theta_{j\,2011}^J + \theta_{k\,2011}^K) \tag{5}$$

The PfP-wide impact of HEN alignment in year *y*, denoted Θ_y^*, is a weighted average of the impact estimates Θ_{jky}'s across hospital and HEN types:

$$\Theta_y^* = \sum_{j,k} p_{jk} \Theta_{jky} \tag{6}$$

So that hospitals with more discharges contribute more to the final impact estimates, the weights *p* are determined not by the number of hospitals in each group, but rather by the standard errors of the hospital-quarter offsets estimated in stage 1. In particular, p_{jk} is proportional to the inverse of the sum of the squared standard errors of all hospital-quarter offsets ascribed to a hospital belonging to HEN type *j* and hospital type *k*.

Impacts of HEN alignment for a particular type of HEN or in a particular type of hospital are calculated analogously, as weighted averages of the Θ_{jky}'s of that type.

Estimation of Costs Averted from National Trend in Harms

The methods used by the Agency for Healthcare Research and Quality (AHRQ) and the Evaluation Contractor for estimating costs averted from the national decrease in harm were explained in Chapter 6. The tables below provide additional details related to the two estimates:

- Table D-24 shows AHRQ's sources for the cost per event estimates.
- Table D-25 through Table D-27 show AHRQ's estimates of events averted and costs averted broken down by year.
- Table D-28 shows the Evaluation Contractor's sources for the cost per event estimates.

The tables are followed by a description of the methods used to create original cost estimates for the Evaluation Contractor's cost per event estimates for obstetrical (OB) adverse events and venous thromboembolism (VTE) from Healthcare Cost Utilization Project (HCUP) data, and the use literatures to derive a per-event cost estimate for OB-early elective delivery (OB-EED) neonatal intensive care unit (NICU) stays.

Tables with Additional Details on the Costs Averted Estimate

Table D-24—Sources for Cost per Event Used in AHRQ Estimate of Cost Savings		
Condition	**Cost per Adverse Event**	**Source**
Central Line-Associated Bloodstream Infection (CLABSI)	$17,000	The Centers for Disease Control and Prevention (CDC) Vital Signs-CLABSI-United States (U.S.) 2001, 2008, 2009. March 3, 2011 MMWR (e-release March 1, 2011). http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6008a4.htm?s_cid=mm6008a4_w
VTE (post-surgery)	$8,000	Spyropoulos AC, Lin J. Direct medical costs of venous thromboembolism and subsequent hospital readmission rates: an administrative claims analysis from 30 managed care organizations. J Manag Care Pharm. 2007 Jul-Aug; 13(6):475-86. http://www.ncbi.nlm.nih.gov/pubmed/17672809 Maynard G, Stein J. Preventing hospital-acquired venous thromboembolism: A guide for effective quality improvement. Prepared by the Society of Hospital Medicine. AHRQ Publication No. 08-0075. Rockville, MD: Agency for Healthcare Research and Quality. August 2008. http://www.ahrq.gov/qual/vtguide/
Pressure Ulcer	$17,000	Kandilov A, Dalton K, Coomer N. Analysis Report: Estimating the Incremental Costs of Hospital-Acquired Conditions (HACs). Final Report. Research Triangle Park, NC: RTI International. October 2011.

Table D-24—Sources for Cost per Event Used in AHRQ Estimate of Cost Savings		
Condition	**Cost per Adverse Event**	**Source**
Surgical Site Infection (SSI)	$21,000	CDC (Scott, RD), The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospital and the Benefits of Prevention. March 2009. Available at http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf
Ventilator-Associated Pneumonia (VAP)	$21,000	CDC (Scott, RD), The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospital and the Benefits of Prevention. March 2009. Available at http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf
Catheter-Associated Urinary Tract Infection (CAUTI)	$1,000	CDC (Scott, RD), The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospital and the Benefits of Prevention. March 2009. Available at http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf
Adverse Drug Event (ADE)	$5,000	Bates DW, Cullen DJ, Laird N, et al. Incidence of adverse drug events and potential adverse drug events. JAMA 1995; 274:29-34. http://www.ncbi.nlm.nih.gov/pubmed/7791255
OB Adverse Event	$3,000	AHRQ estimate after consultation with researcher Dr. Stanley Davis of Fairview Health System
Injury from Fall	$7,234	Kandilov A, Dalton K, Coomer N. Analysis Report: Estimating the Incremental Costs of Hospital-Acquired Conditions (HACs). Final Report. Research Triangle Park, NC: RTI International. October 2011.
All Other HACs	$17,000	Health and Human Services (HHS) computation based on costs above

Source: See column 3.

Table D-25—AHRQ's Calculation of Cost Savings for 2011					
PfP HAC	**Estimated Cost per HAC**	**2010 Count of HACs (Rounded)**	**2011 Normalized Count of HACs (Rounded)**	**Reduction in HACs (2010 to 2011) (Rounded)**	**Estimated Cost Savings (2010-2011) (Not-Rounded)**
ADE	$5,000	1,621,000	1,594,000	27,000	$135,000,000
CAUTI	$1,000	400,000	370,000	30,000	$30,000,000
CLABSI	$17,000	18,000	17,000	1,000	$17,000,000
Falls	$7,234	260,000	260,000	0	0
OB Adverse Events	$3,000	82,000	82,000	0	0
Pressure Ulcers	$17,000	1,320,000	1,320,000	0	0
SSI	$21,000	96,000	82,000	14,000	$294,000,000
VAP	$21,000	38,000	35,000	3,000	$63,000,000
VTE	$8,000	28,000	24,000	4,000	$32,000,000
All Other HACs	$17,000	894,000	875,000	19,000	$323,000,000
Totals (based on unrounded numbers)		**4,757,000**	**4,659,000**	**98,000**	**$894,000,000**

Source: AHRQ publications found at http://www.ahrq.gov/professionals/quality-patient-safety/pfp/index.html#methods and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/hacrate2011-12.html and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/interimhacrate2013.html.

Table D-26—AHRQ's Calculation of Cost Savings for 2012					
PFP HAC	**PFP Cost per HAC**	**2010 Count of HACs (Rounded)**	**2012 Normalized Count of HACs (Rounded)**	**Reduction in HACs (2010 to 2012 Rounded)**	**Reduction in Costs (2010 to 2012 not rounded)**
ADE	$5,000	1,621,000	1,372,000	249,000	$1,245,000,000
CAUTI	$1,000	400,000	350,000	50,000	$50,000,000
CLABSI	$17,000	18,000	17,000	1,000	$17,000,000
Falls	$7,234	260,000	230,000	30,000	$217,020,000
OB Adverse Events	$3,000	82,000	77,000	5,000	$15,000,000
Pressure Ulcers	$17,000	1,320,000	1,300,000	20,000	$340,000,000
SSI	$21,000	96,000	82,000	14,000	$294,000,000
VAP	$21,000	38,000	34,000	4,000	$84,000,000

Table D-26—AHRQ's Calculation of Cost Savings for 2012					
PFP HAC	**PFP Cost per HAC**	**2010 Count of HACs (Rounded)**	**2012 Normalized Count of HACs (Rounded)**	**Reduction in HACs (2010 to 2012 Rounded)**	**Reduction in Costs (2010 to 2012 not rounded)**
VTE	$8,000	28,000	32,000	-4,000	-$32,000,000
All Other HACs	$17,000	894,000	843,000	51,000	$867,000,000
Totals (based on unrounded numbers)		**4,757,000**	**4,337,000**	**420,000**	**$3,097,020,000**

Source: AHRQ publications found at http://www.ahrq.gov/professionals/quality-patient-safety/pfp/index.html#methods and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/hacrate2011-12.html and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/interimhacrate2013.html.

Table D-27—AHRQ's Calculation of Cost Savings for 2013					
PFP HAC	**PFP Cost per HAC**	**2010 Count of HACs (Rounded)**	**2013 Normalized Count of HACs (Rounded)**	**Reduction in HACs (2010 to 2013 Rounded)**	**Reduction in Costs (2010 to 2013 not rounded)**
ADE	$5,000	1,621,000	1,320,000	301,000	$1,505,000,000
CAUTI	$1,000	400,000	290,000	110,000	$110,000,000
CLABSI	$17,000	18,000	9,200	8,800	$149,600,000
Falls	$7,234	260,000	240,000	20,000	$144,680,000
OB Adverse Events	$3,000	82,000	77,000	5,000	$15,000,000
Pressure Ulcers	$17,000	1,320,000	1,060,000	260,000	$4,420,000,000
SSI	$21,000	96,000	79,000	17,000	357,000,000
VAP	$21,000	38,000	37,000	1,000	$21,000,000
VTE	$8,000	28,000	23,000	5,000	$40,000,000
All Other HACs	$17,000	894,000	822,000	72,000	$1,224,000,000
Totals (based on unrounded numbers)		**4,757,000**	**3,957,200**	**799,800**	**$7,986,280,000**

Source: AHRQ publications found at http://www.ahrq.gov/professionals/quality-patient-safety/pfp/index.html#methods and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/hacrate2011-12.html and http://www.ahrq.gov/professionals/quality-patient-safety/pfp/interimhacrate2013.html, and data provided by Noel Eldridge. Center for Quality Improvement and Patient Safety, AHRQ.

Table D-28—Estimated Cost per Event Used by Evaluation Contractor to Estimate Cost Savings from Averting Adverse Events		
Adverse Event Area	**Estimated Cost per Event (In 2014 Dollars)***	**Source**
CAUTI	$989	Zimlichman ED, Henderson O, Tamir C, et al. Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Intern Med*. 2013; 173:2039-2046.
CLABSI	$50,568	Zimlichman ED, Henderson O, Tamir C, et al. Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Intern Med*. 2013; 173:2039-2046.
OB-EED	$9,762 for OB-EEDs resulting in NICU; number of NICU stays estimated to equal 0.0996 x number of OB-EEDs	1. Bailit JL, Gregory KD. Maternal and neonatal outcomes by labor onset type and gestational age. *American Journal of Obstetrics and Gynecology*, 202: 245.e1-12. (Average NICU length of stay [LOS] for all early deliveries at 37 to 38 weeks gestational age) 2. March of Dimes. “Special Care Nursery Admissions.” http://www.marchofdimes.com/peristats/ pdfdocs/nicu_summary_final.pdf. Accessed April 17, 2013 (Average charge for a NICU stay for babies 37 to 38 gestational weeks) 3. Anderson GF. From ‘Soak The Rich’ To ‘Soak The Poor’: Recent Trends in Hospital Pricing. *Health Affairs*, 2007; 26, 3; 780-789. (Cost-to-charge ratio) 4. Ehrenthal DB, Hoffman MK, Jiang X, et al. Neonatal Outcomes After Implementation of Guidelines Limiting Elective Delivery Before 39 Weeks of Gestation. *Obstetrics and Gynecology*, 2011; 118: 5, 1047-1055. (Estimated fraction of OB-EEDs that lead to a NICU stay) 5. Friedman B, La Mare J, Andrews R, et al. “Practical options for estimating cost of hospital inpatient stays. *Journal of Health Care Finance*. 2002; 29, 1, 1-13. 6. Zhan C, Miller MR. Excess Length of Stay, Charges, and Mortality Attributable to Medical Injuries During Hospitalization. *JAMA*. 2003; 290: 14, 1868-1874.
Falls with Fracture	$12,965	Kandilov, AM, NM Coomer, and K Dalton. “The Impact of Hospital-Acquired Conditions on Medicare Program Payments.” Medicare & Medicaid Research Review, 2014, vol. 4, no. 4. pp. E1-E23.
Pressure Ulcers	$12,565	Jon Shreve et al., “The Economic Measurement of Medical Errors,” Milliman, June 2010.
PSI-12—VTE	$17,666 (Medicare) $27,691 (Non-Medicare)	Analysis by the Evaluation Contractor of the difference in Medicare and Non-Medicare hospital costs during the index stay between those with and without an adverse event, using a matched sample from the 2009 to 2011 HCUP data that were available at the time of analysis for 12 states. Note: HCUP data include only hospital cost, not physician cost. It is likely that the cost implications of this event would be greater if physician costs were included.

Table D-28—Estimated Cost per Event Used by Evaluation Contractor to Estimate Cost Savings from Averting Adverse Events		
Adverse Event Area	**Estimated Cost per Event (In 2014 Dollars)***	**Source**
PSI-17—Injuries to Neonate	$1,145	Analysis by the Evaluation Contractor of the difference in all-payer hospital costs during the index stay between those with and without an adverse event, using a matched sample from the 2009 to 2011 HCUP data that were available at the time of analysis for 12 states. Note: HCUP data include only hospital cost, not physician cost or costs incurred outside the hospital setting. It is likely that the cost implications of this event would be greater if these other costs were included.
PSI-18—Obstetric Trauma-Vaginal Delivery with Instrument	$114	Analysis by the Evaluation Contractor of the difference in all-payer hospital costs during the index stay between those with and without an adverse event, using a matched sample from the 2009 to 2011 HCUP data that were available at the time of analysis for 12 states. Note: HCUP data include only hospital cost, not physician cost. It is likely that the cost implications of this event would be greater if physician costs were included.
PSI-19—Obstetric Trauma-Vaginal Delivery without Instrument	$197	Analysis by the Evaluation Contractor of the difference in all-payer hospital costs during the index stay between those with and without an adverse event, using a matched sample from the 2009 to 2011 HCUP data that were available at the time of analysis for 12 states. Note: HCUP data include only hospital cost, not physician cost. It is likely that the cost implications of this event would be greater if physician costs were included.
Readmissions	$15,477 (Medicare) $13,311 (Non-Medicare)	Hines, Al, Barrett ML, Jiang J, Steiner C., "Conditions With the Largest Number of Adult Hospital Readmissions by Payer, 2011." Healthcare Cost and Utilization Project, AHRQ, Statistical Brief, April 2014.
SSI	$22,942	Zimlichman ED, Henderson O, Tamir C, et al. Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Intern Med*. 2013; 173:2039-2046.
VAP	$44,310	Zimlichman ED, Henderson O, Tamir C, et al. Health Care–Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Intern Med*. 2013; 173:2039-2046.

Source: See column 3 for the source.

Method for Deriving Evaluation Contractor's Per-Event Cost Estimates for OB Trauma, Birth Trauma, and VTE

Using the HCUP's State Inpatient Databases (SID), the cost of hospital stays for patients who experience medical harms was compared to the costs of similar stays where a medical harm did not occur. The cost figures derived from the method described below were adjusted for inflation to 2014 dollars using the CPI-U.

Data

All analyses were conducted using the HCUP SID, a group of health care databases that are available through a Federal-State-Industry partnership. The SID is composed of inpatient discharge abstracts that, in total, encompass almost 90 percent of all U.S. hospital discharges. The SID contains clinical and nonclinical information on all patients regardless of payer. Forty-eight organizations submit annual data to HCUP on state specific timelines. Given this, there is variation in the data lag experienced by each of the states' datasets. While most of the variables are uniform across all datasets, there are state-specific data elements such as hospital identifiers and present on admission variables. Given the need for the state-specific data elements and desire for a minimal data lag, data from 12 states from 2009 to 2011 were used. (Data for 2011 were unavailable for 2 of the 12 states. See Table D-29 for a list of all of the states and years). Using a subsample of states limits the generalizability of our results; however, the population of states used includes at least one state from eight of the ten United States' Department of Health and Human Services regions (there are no data from regions five and eight). The Evaluation Contractor also linked the HCUP SID datasets to the American Hospital Association's (AHA's) 2010 hospital survey to obtain hospital characteristics.

Table D-29—States Included in The Analysis, By Year

State	HHS Region	2009	2010	2011
Arkansas	6	Yes	Yes	Yes
Arizona	9	Yes	Yes	Yes
California	9	Yes	Yes	Yes
Florida	4	Yes	Yes	Yes
Iowa	7	Yes	Yes	Yes
Kentucky	4	Yes	Yes	Yes
Massachusetts	1	Yes	Yes	
Maryland	3	Yes	Yes	Yes
New Jersey	2	Yes	Yes	Yes
Nevada	9	Yes	Yes	
New York	2	Yes	Yes	Yes
Washington	10	Yes	Yes	Yes

Source: Analysis of HCUP-SID data.
Note: There are no states from HHS regions five and eight. States included in region five include: Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin. States included in region eight include: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.
HHS = United States' Department of Health and Human Services.

The sample was limited according to the criteria listed in Table D-30.

Table D-30—Included Discharges, by Criteria				
Inclusion Criteria	**VTE**	**Birth Trauma**	**OB Trauma – No Instrument**	**OB Trauma – With Instrument**
In HCUP Data	44,006,083	44,006,083	44,006,083	44,006,083
From acute care hospitals with a length of stay between 0 and 365 days[a]	42,759,458	42,759,458	42,759,458	42,759,458
Were not duplicates	42,755,614	42,755,614	42,755,614	42,755,614
Primary diagnosis was not for rehabilitation or mental health[b]	41,561,653	41,561,653	41,561,653	41,561,653
Not overlapping with another discharge	41,530,210	41,530,210	41,530,210	41,530,210
Not part of a transfer bundle or a transfer discharge that extended less than 0 or more than 365 days, or did not die more than once[c]	41,036,160	41,036,160	41,036,160	41,036,160
Not missing all diagnosis codes	41,035,639	41,035,639	41,035,639	41,035,639
Between ages 18 and 123	34,158,661	N/A	N/A	N/A
Not missing cost data for any part of their index stay[d]	33,058,111	39,649,322	39,649,322	39,649,322
At risk for the harm, didn't have the harm present on admission, and did not have a missing or invalid POA indicator for an influential diagnosis code	8,342,952	4,131,006	197,371	2,530,941
Had non-missing index stay costs over $100	8,342,499	4,126,023	197,370	2,530,904

Source: Analysis of HCUP-SID data.

Note: See Table D-31 for measure definitions.

[a]Discharges from (1) hospitals in the Inpatient Prospective Payment System, (2) Critical Access Hospitals, (3) Children's hospitals, and (4) Maryland hospitals were included in the analysis. Hospitals not included in the AHA survey were excluded from the dataset as information from the AHA survey was needed to complete the analysis.

[b]Discharges were excluded that had a primary diagnosis for a mental or behavioral health issue that were transferred to a non-hospital health care facility. Discharges with a primary diagnosis for rehabilitation were also excluded from the data.

[c]Discharges that were part of a transfer string were rolled up into one discharge, therefore the individual discharges that were rolled up into one complete discharge were excluded from the dataset.

[d]Discharges that were missing cost information for any segment of their transfer or overlapping stay were excluded.

Measures

AHRQ's PSI-12, -17, -18, and -19 were the measures of inpatient harms (Table D-31). The first 9 diagnosis codes, the first 6 procedure codes, and all available E-codes were used to produce the measures.[D-7] The analysis accounted for inconsistent reporting of the POA indicators in SID data when developing the medical harm indicators.

Table D-31—Measures Used of Inpatient Harms

Inpatient Harm	Description	PSI
VTE	Perioperative Pulmonary Embolism (PE) or Deep Vein Thrombosis (DVT)	PSI-12
Birth Trauma	Birth Trauma – Injury to Neonate	PSI-17
Obstetric Trauma (with instrument)	Obstetric Trauma Rate – Vaginal Delivery with Instrument	PSI-18
Obstetric Trauma (without instrument)	Obstetric Trauma Rate – Vaginal Delivery without Instrument	PSI-19

Source: AHRQ's website provides more detailed definitions. http://www.qualityindicators.ahrq.gov/modules/PSI_TechSpec.aspx.

Cost Measures

This study focuses on the costs of the hospital index stay, which include total charges reported in the HCUP-SID data. These charges generally do not include professional fees or non-covered charges. Emergency department charges incurred prior to admission to the hospital may be included—Medicare requires a bundled bill and other payers may or may not have similar billing preferences. The cost variables were created by multiplying the charges by hospital-specific cost-to-charge ratios.[D-8] These cost-to-charge ratios were obtained from HCUP. Additional state-specific details on the cost variables can be found on the HCUP-SID website. The Evaluation Contractor analyzed Perioperative PE or DVT (PSI-12) separately for Medicare patients and patients with other payers besides Medicare; the Evaluation Contractor examined costs for the other inpatient harms for all payers together.

Hospital stays were excluded from the analyses if charges were missing or were less than $100, as these data were believed to be inaccurate. Stays for patients that transferred among facilities were bundled into one single stay. If cost information for any piece of the transfer process was missing, the bundled stay was not included in the analyses.

Comparison Group Selection

In order to estimate the cost of each medical harm, it is necessary to have a counterfactual measure of what the hospital costs would have been had the patients not experienced the harm. In this study, a comparison group of hospital stays was constructed where the patients who did not experience a harm but had observed characteristics similar to those of patients who experienced a medical harm. The comparison group was created using coarsened exact matching on pre-selected criteria (Iacus, King, and Porro 2011).[D-9]

The matching process was done separately for each type of medical harm. VTE was also done separately for Medicare and non-Medicare patients. During the first round of matching, the Evaluation Contractor exact-matched on the year of hospitalization, hospital, base diagnosis related group (DRG), age categories, gender,

D-7 In the first quarter of 2011, Medicare regulations were revised to allow 25 rather than 9 diagnoses to be recorded on a claim. To maintain consistency, the first 9 diagnosis codes were used to construct outcome measures for all analyses.

D-8 Group-specific cost-to-charge ratios where used when hospital-specific ratios were not available.

D-9 A HAC CAUTI is a particular type of hospital-acquired urinary tract infection (HAUTI). For the CAUTI analyses the potential comparison pool consisted only of patients who did not experience any type of HAUTI.

race categories, whether the patient died, payer type, and admission source.[D-10] Any stays without a medical harm were selected as a comparison unit for a stay with a medical harm if they matched exactly on all these variables (that is, if they fell into the same matching "cell"). If the Evaluation Contractor was unable to find a match in the first round, another round of matching was conducted in which the criteria were relaxed— one or more criterion were either loosened or dropped. This iterative process continued, with the matching criteria being relaxed in each subsequent round. Comparison observations were matched with replacement. The criteria used in each round is shown in Table D-32. The matching was completed in nine rounds for each type of medical harms, and in each case matches were found for virtually all discharges who experienced a medical harm. Depending on the medical harm measure, between 66 and 98 percent of the discharges who experienced a medical harm were matched in the first round, when matching criteria were most strict, and over 99 percent of the discharges who experienced a medical harm were matched to discharges in the same hospital (Table D-33).

Table D-32—Criteria Used for Matching in Each Round

Characteristic	Round								
	1	2	3	4	5	6	7	8	9
Individual Characteristics									
Year	X	X	X	X	X	X	X	X	X
Base DRG code	X	X	X	X	X	X	X	X	X
Age category	X	X	X		X	X	X	X	X
Female	X	X	X		X	X	X	X	X
Race (all categories)	X	X			X	X	X	X	
Race (white/not white)			X						X
Died	X				X				
Payer type	X				X				
Admission source	X				X				
Hospital Characteristics									
Hospital identification	X	X	X	X					
Teaching hospital					X	X	X		
State					X	X	X	X	X
Metro type					X	X	X		
Ownership type					X	X	X		
Critical access hospital (CAH)					X	X	X		
Number of beds					X	X	X		
AHA member					X	X			
Rural referral center					X	X			

D-10 The base DRG code is the DRG code that has been collapsed to remove distinctions of conditions that occurred with or without a complication. For example, a "seizure with complications" and a "seizure without complications" is treated as one diagnosis. This process collapses the original 746 DRG codes into 335 base codes. Base codes were used instead of DRG codes due to the concern that an adverse event may cause a discharge to be marked as having a complication when no complications would have been noted if the adverse event had not occurred. However, the Evaluation Contractor may have missed cases where a medical harm causes a stay to be assigned to a different DRG altogether.

Table D-32—Criteria Used for Matching in Each Round									
Characteristic	Round								
	1	2	3	4	5	6	7	8	9
Individual Characteristics									
Inpatient Prospective Payment Systems (IPPS) hospital					X	X			
Belongs to health care system					X	X			
Belongs to network					X	X			
Electronic health records (EHR)					X	X			
Percent intensivists (dummy variables)					X	X			

Source: The Evaluation Contractor's analysis.
Note: The base DRG code is the DRG code that has been collapsed to get rid of distinctions of conditions that occurred with or without a complication. For example, a seizure with complications and a seizure without complications is treated as one diagnosis. This process collapses the original 746 DRG codes into 335 new codes.

Table D-33—Matching Results of Discharges with Inpatient Harm												
Inpatient Harm	Number of Discharges with Inpatient Harm											Average Matching Ratio
	Number Matched to One or More Comparison Group Discharges										Number Not Matched	
	Matching Round									Total		
	1	2	3	4	5	6	7	8	9			
VTE (Medicare)	15,748	1,703	630	2,323	12	2	115	176	10	20,719	46	1:30
VTE (non-Medicare)	8,896	3,489	969	3,050	6	7	39	174	18	16,648	79	1:13
Birth Trauma	8,307	311	75	45	0	0	8	1	0	8,747	7	1:64.6
Obstetric Trauma (with instrument)	21,372	1,653	782	868	22	8	54	45	1	24,805	5	1:18.8
Obstetric Trauma (without instrument)	53,922	766	234	135	0	1	1	1	0	55,060	1	1:213

Source: Analysis of HCUP-SID data.
Note: See Table D-29for list of included states and years. See Table D-31 for inpatient harm measure definitions.

Once the Evaluation Contractor selected patients for the comparison group, the Evaluation Contractor conducted balance tests to assess whether the characteristics of patients who experience a medical harm were similar to those of the comparison group in the matched sampled. Standardized biases—the number of standard deviations by which the two sample means differ—decreased for all patient characteristics and hospital characteristics after matching. After matching, for each type of medical harm and cost measure, the standardized bias was less than 25 percent of one standard deviation for all of the characteristics included in the matching process (the 0.25 target is an industry standard). Due to the large number of covariates used in the matching process, the Evaluation Contractor was unable to present the change in the standardized bias for each covariate; however, Table D-34 shows the mean standardized bias across covariates for each type of medical harm. The Evaluation Contractor observed that the matching process substantially decreased the mean standardized bias across covariates. For example, the first row of the table shows that the mean standardized bias was 5 percent of one standard deviation before matching for the index stay sample for birth trauma, but after matching the imbalance was reduced by over 90 percent to less than 1 percent of one standard deviation on average.

Table D-34—Balance Test for Matching

Inpatient Harm	Mean Standardized Bias Across Covariates (Percent of One Standard Deviation)	
	Before Matching	After Matching
Birth Trauma	5.21	0.28
Obstetric Trauma (with Instrument)	5.51	0.53
Obstetric Trauma (without Instrument)	4.09	0.26
VTE (Medicare)	7.49	1.17
VTE (non-Medicare)	9.11	1.35

Source: Analysis of HCUP-SID data.
Note: See Table D-29 for list of included states and years. See Table D-31 for inpatient harm measure definitions.

Regression Models

The Evaluation Contractor used linear regression models to estimate the relationship between experiencing a medical harm and the cost of hospital care. The dependent variable in the regression models is the cost of the index hospital stay. The main independent variable was a dummy variable that indicated whether a medical harm occurred. The Evaluation Contractor estimated the model separately for each type of medical harm and separately for Medicare and non-Medicare for VTE. The regression models also control for comorbidity measures affiliated with the medical harm of interest (listed in Table D-35), and dummies indicating the matching cell (or cells) the patient fell into, and other medical harms that occurred for some patients in the sample (that is, medical harms other than the medical harm of interest). By including dummy variables for each matching cell, the Evaluation Contractor controlled for all variables that were used during the matching process as well as all interactions between those variables. Weighted regression analysis was used to account for variation in the size of a matching cells; the matched comparison discharges were normalized to have the same net weight as the discharges who experienced medical harms in the same matching cell. Standard errors (SEs) were calculated using non-nested two-way clustering (Cameron, Gelbach, and Miller 2011) to accounts for a hospital stay's matching cell and, if a stay was matched in multiple rounds, repeated observations.

Table D-35—Comorbidity Measures Associated with Inpatient Harm

VTE	Birth Trauma	Obstetric Trauma
• Transfer from acute care facility • Congestive heart failure • Valvular disease • Pulmonary circulation disease • Peripheral vascular disease • Hypertension • Paralysis • Other neurological disorders • Chronic pulmonary disease • Diabetes without chronic complications • Hypothyroidism • Renal failure • Acquired immune deficiency syndrome • Lymphoma • Metastatic cancer • Solid tumor without metastasis • Obesity • Weight loss • Chronic blood loss anemia • Deficiency Anemias • Alcohol abuse • Drug abuse • Psychoses • Depression	• Alcohol abuse • Drug abuse • Depression • Other neurological disorders • Hypertension	• Alcohol abuse • Drug abuse • Psychoses • Depression • Other neurological disorders • Hypertension • Pregestational or gestational diabetes • Preeclampsia • Chronic hypertension • Gestational hypertension • Preeclampsia or eclampsia superimposed on pre-existing hypertension • Preterm labor or delivery

Source: The Evaluation Contractor's analysis.
Note: The majority of the comorbidity measures are created in the PSI algorithm. The Evaluation Contractor developed six extra measures (gestational hypertension, hypertension, preeclampsia, preeclampsia or eclampsia superimposed on pre-existing hypertension, pregestational or gestational diabetes, and preterm labor or delivery) using diagnosis and present on admission codes in the dataset to serve as additional controls in the analysis.

Method for Deriving Literature-Based Estimate of OB-EED NICU Stays

The Evaluation Contractor's method for deriving a per-event cost estimate for OB-EED-related NICU stay costs relies on existing research literature on:

- How NICU rates change when efforts are made to reduce OB-EEDs.
- Costs of NICU stays for early term births (as opposed to the many NICU stays that follow births at other gestational ages, including pre-term births).
- Relative length of NICU stays for elective early term births compared to NICU stays for all early term births.

- Ratios of hospital charges to hospital costs.[D-11]

Since the estimate was for NICU stays, to complete the calculation of costs averted from OB-EEDs, the number of OB-EED-related NICU stays must be estimated. This was done by multiplying the number of OB-EEDs averted by .0996, a value derived from Ehrenthal et al. (2011).[D-12]

Note that the resulting estimate is very rough. Even if the Evaluation Contractor assumes that the results of existing studies are internally valid (that is, results are not biased or erroneous because of some design flaw), they may lack external validity because the particular samples used in those studies may not be representative of the Partnership for Patients (PfP) hospitals that are reporting data, so the relationships found in those studies may not hold exactly in other hospitals.

Table D-36—Steps in OB-EED-Related NICU Stays Cost-Per-Event Calculation

Item	Amount	Source
(1)Hospital charge per NICU stay, 37-38 weeks births	$37,137	March of Dimes[a]
(2) Cost per NICU stay, 37-38 weeks elective	$7,875	Adjust (1) by the ratio of average length of NICU stay for elective 37-38 week deliveries to those of all 37-38 week deliveries ($23,865),[b] and multiply by a 0.33 hospital cost-to-charge ratio[c]

Source: See third column.

Note: This calculation assumes that the cost of NICU stays among births in which an OB-EED was averted remain the same as they would have been if the birth had ended in an OB-EED and been followed by a NICU stay.

[a]March of Dimes. “Special Care Nursery Admissions.” http://www.marchofdimes.com/peristats/pdfdocs/nicu_summary_final.pdf. Accessed April 17, 2013. This document presents hospital *charges*.

[b]Average length of stay by gestational age and labor onset type is taken from: Bailit, J. L., Gregory, K. D., Reddy, U. M., Gonzalez-Quintero, V. H., Hibbard, J. U., Ramirez, M. M., ... & Zhang, J. (2010). Maternal and neonatal outcomes by labor onset type and gestational age. *American Journal of Obstetrics and Gynecology*, 202(3), 245-e1.

[c]In the absence of detailed data on the ratio of hospital costs to charges specifically for NICU services, a preliminary ratio of 0.33 is used. This ratio may understate the costs averted, since using 2004 data, Anderson et al. report a charge to cost ratio of 3.07 for all hospitals for all “Medicare-allowable costs” (or a cost to charge ratio of slightly less than 0.33) (Medicare-allowable costs are costs determined by CMS to be the costs associated with care for *all* patients, not just Medicare patients; Anderson, G.F. “From ‘Soak the Rich’ to ‘Soak the Poor’: Recent Trends in Hospital Pricing.” *Health Affairs,* vol. 36, no. 3, May/June 2007, pp. 780-789), and using 2010 data, MedPAC reports a charge to cost ratio of 3.18 (or a cost to charge ratio of 0.315) for “Medicare services” (not otherwise specified; MedPAC. “A Data Book: Health Care Spending and the Medicare Program.” chart 6-23, June 2012, http://www.medpac.gov/chapters/Jun12DataBookSec6.pdf).

The resulting estimate for cost savings per OB-EED-related NICU stay averted ($7,875) is then update for inflation to 2014 dollars, using the CPI-U, to provide the $9,762 figure shown in Table D-28.

[D-11] Hospital charges—what hospitals charge—are typically higher than the costs actually expended by hospitals for patient care, and higher than what health care payers generally pay hospitals.

[D-12] Ehrenthal, D. B., Hoffman, M. K., Jiang, X., & Ostrum, G. (2011). Neonatal outcomes after implementation of guidelines limiting elective delivery before 39 weeks of gestation. *Obstetrics & Gynecology*, 118(5), 1047-1055. This evaluation of a policy limiting elective deliveries prior to 39 weeks gestation at a large academic center found that “early term” deliveries (those at 37 or 38 weeks gestation) fell from 33.1 percent to 26.4 percent of all births. In turn, the percent of term births (all births at 37 weeks gestation or later) with NICU stays fell from 9.29 percent to 8.55 percent, which translates to a reduction in NICU stays as a percentage of all births falling from 8.38 percent to 7.71 percent. From that, changes in NICU stays per OB-EED averted is calculated as: (0.0771-0.0838)/(0.264-0.331) = 0.0996. Roughly one NICU stay is averted for every 10 OB-EEDs averted. Note that because of the particular sample, there may be concerns with generalizing the results to PfP hospitals.

Estimation of Costs Averted Due to Hospital Engagement Networks (HENs) Methodology

This section provides details about the methods used to analyze the HENs' role in cost reduction.

Data

Medicare claims data (January 2009 through March 2014) from the inpatient Research Identifiable Files (RIFs), the carrier RIFs, the Home Health Agency (HHA) RIFs, Hospice RIFs, outpatient RIFs, Skilled Nursing Facility (SNF) RIFs, and the Durable Medical Equipment (DME) RIFs were used to construct the Medicare expenditure variables. Duplicate claims were removed and overlapping claims were identified based on the dates of care, the diagnosis codes, and the provider. The following table (Table D-37) provides a detailed description of the components that make up each expenditure category as well as the Medicare RIFs used.

Table D-37—Definitions of Expenditure Measures

Measure	Source	Expenditure Components
Total expenditures	All RIF files	The sum of expenditures from the inpatient index discharge and the post-discharge expenditures.
Index discharges	Inpatient and Carrier RIF files	The sum of expenditures from the inpatient acute hospital stay amount and the carrier amount during the index stay.
Post-discharge	All RIF files	The sum of expenditures from the post-discharge inpatient amount; the post-discharge carrier amount; the home health amount; the hospice amount; the outpatient amount; the SNF amount; and the DME amount.
Post-discharge Inpatient (IP)	Inpatient RIF files	The sum of expenditures from the post-discharge acute care hospital amount; long term care hospital amount; rehabilitation hospital amount; psychiatric hospital amount; and other inpatient hospital amount.
Outpatient	Outpatient RIF files	The sum of all outpatient expenditures in the post-discharge period. This includes payment amounts for Emergency Department (ED) visits, observations stays, and other outpatient amounts.
DME	DME RIF files	The sum of all DME expenditures in the post-discharge period.
HHA	HHA RIF files	The sum of HHA expenditures in the post-discharge period.
SNF	SNF RIF files	The sum of all SNF expenditures in the post-discharge period.
Hospice	Hospice RIF files	The sum of Hospice expenditures in the post-discharge period.
Professionals (i.e., carrier)	Carrier RIF Files	The sum of all Professional (i.e., carrier) expenditures in the post-discharge period.

Notes: These expenditures breakdowns are derived from Medicare fee-for-service (FFS) claims. In the analyses, all expenditures are deflated to adjust for price inflation unless otherwise noted.

Sample

The analysis sample consists of all index discharges that took place between 1/1/2009 and 12/31/2013 at short-term acute-care hospitals.[D-13] Medicare beneficiaries must have FFS Part A during the index stay to be included in the analysis, as well as FFS Parts A and B throughout the entire post-discharge period.

Identifying Index Discharge Admissions

As noted above, only admissions to short-term acute care hospitals were considered as an index discharge. That is, inpatient admissions to other types of hospitals were never considered as index discharges in this analysis (e.g., long term care; rehabilitation; psychiatric).

Although Medicare claims data are available from January 2009 through March 2014, the Evaluation Contractor restricted the analysis to individuals whose index discharge occurred early enough to allow a complete lookout period to be covered. For example, to construct the 90 day expenditure variables, a beneficiary must have had an index discharge at a short-term acute-care hospital before January 1st 2014; to construct the 180 day expenditure variables, the index discharge must have occurred 180 days prior to March 31st 2014.

Two sets of index discharges were identified, one defined with a 90-day post-discharge lookout period and one with a 180-day post-discharge lookout period. The first discharge for any beneficiary during the sample period was considered an index discharge for both the 90-day definition and the 180-day definition. Inpatient discharges that took place within the lookout period of an index discharge were not considered as index discharges themselves and these inpatient expenditures were allocated to the post-discharge period.

Variable Construction

Index admission expenditures were calculated using payment information from the inpatient RIFs and the carrier RIF claims that overlap the index stay period. To calculate post-discharge expenditures, payment information from all RIF files above was used. All inpatient discharges at short-term acute care hospitals were included in the analysis, either as an index discharge or as part of the expenditures in the lookout period following an index discharge. Admissions to all hospital types are included in the calculation of post-discharge inpatient expenditures if they fell in the post-discharge period.[D-14] Similarly, all outpatient, SNF, Hospice, HHA, DME, and carrier claims were allocated to the post-discharge period if they fell within the window of 90 or 180 days following the index discharge date.

Since claims show the total payment amounts over the entire service period of the claim, if care extended beyond the post-discharge period, then the payment amounts were pro-rated to only include the lookout period. For example, if a beneficiary had a Hospice visit that took place from days 80 to 100 after the index discharge, then the total amount for this claim was divided by two for the 90 day look out period (since half the days fell in the 90 day lookout period and half fell outside of it) and only half of the total payment amount was allocated to the post-discharge period.

[D-13] Hospitalizations with length of stay longer than 365 were excluded from the analysis.

[D-14] For example, admissions to long-term care providers, rehab hospitals, psychiatric hospitals are all considered for calculating post-discharge expenditures.

Methods

Generating Propensity Score Weights

Baseline hospital characteristics were selected from the Medicare claims data and the American Hospital Association (AHA) survey data for potential inclusion in the propensity score analyses: (1) hospital demographic information, (2) hospital characteristics information, and (3) baseline measures of Medicare expenditure outcomes. Propensity score analyses should include all available traits that predict participation in an intervention, particularly if they are also likely to be related to the outcomes of interest. This may include a large number of characteristics. The trade-off for including many, rather than few, characteristics is that although the matching may produce a comparison group that is more similar to the treatment group broadly speaking, the average balance between the treatment group and the reweighted comparison group across the characteristics included in the particular model will be lower than if only a few characteristics are included.[D-15]

To select relevant variables to be used in the model, a two-step selection procedure was used:

1. The Evaluation Contractor used a method from Hirano and Imbens (2001) to assess whether each variable was independently correlated with PfP participation. Using a *t*-test, any variables that were not associated with program participation at the 95 percent confidence level were dropped. Continuous variables were transformed into four quartiles with the raw score cut at the 25th, 50th, and 75th percentiles and represented as dummy variables.[D-16] For categorical variables and continuous variables, variables were kept if at least one of the categories/quartiles was associated with participation.
2. Some hospital characteristics were highly correlated and it was possible that some hospital characteristics under consideration would be unrelated to HEN alignment after controlling for other hospital characteristics. Thus, the Evaluation Contractor estimated a logit model in which all the candidate variables were used to predict treatment status. A variable was selected if the null hypothesis of no association between the variable and HEN alignment could not be rejected (conditional on other hospital characteristics) at the 20 percent confidence level for a two-tailed test. Tests of joint significance (Wald tests) were used for measures with multiple mutually exclusive categories (categorical variables and the quartiles of continuous variables) in order to capture whether the concept measured by these variables was statistically significantly associated with HEN alignment.

Liberal variable inclusion criteria allowed a broad understanding of the factors that influenced participation and permited the identification of potential challenges to creating a comparison group from the non-HEN-aligned pool of hospitals that was comparable to those that were HEN-aligned. See Table D-38 for a full list of the variables included in the propensity score analysis. These variables were included in matching for all expenditure outcomes.

[D-15] At the extreme, if the propensity model includes only one independent variable, perfect balance can be achieved on that characteristic, though the groups will likely be poorly balanced on the characteristics not included in the model. As more measures are added to the model, it improves balance across the wider range of characteristics as a whole, but achieving perfect balance on any given measure is no longer likely.

[D-16] In some cases, the distribution of a continuous variable was highly skewed or multimodal and thus alternate cutoff points were used to create the dummies for each category (e.g., zero, low, or high).

The estimated propensity scores were then used to construct the sampling weights (i.e., inverse propensity score weights) which were employed in the impact regression analysis. In the difference-in-differences analysis, observations from HEN-aligned hospitals received a weight of one, and observations from non-HEN-aligned hospitals received the propensity score-based weight for each outcome.

Table D-38—Variables Included in the Propensity Score Models for Inverse Weight Calculation

Hospital Characteristics
Bed Size
Bed size: <100 beds; 100-199; 200-399; 400+
Ownership Type
Investor-owned (for-profit); Public; Nonprofit nongovernmental
Has Electronic Health System (EHR)
Fully has EHR; partially has EHR; no EHR; EHR indicator missing
Census Region
New England; Mid-Atlantic; South Atlantic; East North Central; East South Central; West North Central; West South Central; Mountain; Pacific; Associated areas
Rural Indicator
Hospital Does Belong to a Network
Hospital Does Belong to a System
Other Hospital Characteristics
AHA member; teaching hospital; rural referral center
Obstetric Care Beds, as a Percent of Total
Obstetric care beds: Tercile 1; Tercile 2; Tercile 3
Intensivists, as a Percent of Total Physicians
Intensivists: Tercile 1; Tercile 2; Tercile 3
Patient Case Mix Characteristics (Hospital Level)
Mean patient age; percentage of patients who are female
Race/Ethnic Composition of Inpatient Population, Percent of Beneficiaries
White (non-Hispanic); black (non-Hispanic); Hispanic; other (non-Hispanic)
Pre-Intervention Outcomes
2010 Expenditures; Difference in expenditures between 2009 and 2010; Quantiles of 2010 expenditures; Quantile of difference in expenditures between 2009 and 2010

Source: Medicare Claims, AHA Hospital Files.

Balance Tests

The similarity between the HEN-aligned and non-HEN-aligned groups before reweighting was analyzed. The Evaluation Contractor assessed the balance between the groups in several ways. First, the propensity score distributions were graphically analyzed, looking for overlap in the propensity scores for the HEN-aligned and non-HEN-aligned hospitals. Second, the Evaluation Contractor examined the improvement in balance achieved between groups through reweighting; the similarity between the HEN-aligned hospitals and the pool of non-HEN-aligned hospitals on characteristics in the propensity score model was examined. The extent that the similarity is greater after implementing propensity score reweighting was assessed by comparing HEN-aligned hospitals to the reweighted comparison group of non-HEN-aligned hospitals. Tables showing results of this analysis were provided in the balance tables (Table D-21 through Table D-23), above.

The Difference-in-Differences Analysis of Cost Averted Due to HENs

An overview of the analytic approach was provided in Chapter 6. A more detailed description of the difference-in-differences model for the expenditure analysis is discussed here. For each expenditure outcome, a difference-in-differences model was fit relating individual discharge outcomes (e.g., total expenditures; index discharge expenditures; post-discharge expenditures) to HEN alignment and a set of demographic and other control variables. The Evaluation Contractor estimated difference-in-differences models as follows:

$$y_{iht} = \delta_t \, PFP_h * \, t_t + \gamma \, t_t + \phi \, w_i + \theta \, x_i + \beta \, z_h + \varepsilon_{iht}, \qquad (1)$$

where the outcome variable, y_{iht}, is measured for a hospital discharge ($_i$) occurring in hospital h in year t. The variable PFP_h is a dummy variable for whether or not the hospital where the discharge occurred was HEN-aligned as reported in the June 2012 roster. The coefficient δ_t estimates the effect in year t of hospital alignment with a HEN. t_t is a vector of yearly dummy variables indicating the year in which the index discharge took place, and the estimated coefficients ($\gamma = [\gamma_1, \gamma_2, \ldots, \gamma_T]$) control for secular trends in the outcome variable. The regression model also includes patient-level covariates that control for demographics, patient medical factors, and characteristics of the hospital where the index discharge occurred. The patient demographics (w_i) are age, gender, and race/ethnicity. The patient risk factors (x_i) are indicators for the 30 chronic condition flags outlined in Elixhauser (1998), as well as an index derived from each of these flags. The regression model also includes hospital-level characteristics as a vector of hospital dummies (z_h)—also known as hospital fixed effects—to control for all hospital-specific observed and unobserved factors that are stable over time.[D-17] Finally, ε_{iht} is an error term. The same covariates were included for all expenditure categories and for both 90 and 180 days. Equation 1 follows the approach used for the difference-in-differences comparison group analyses, lookout periods described in detail above. In addition to examining results separately for 2012 and 2013, results for 2012 and 2013 combined were also examined.

As a reminder, in the difference-in-differences models, observations from HEN-aligned hospitals received a weight of one, and observations from non-HEN-aligned hospitals received the propensity score-based weight for each outcome.

To assess the robustness of the results, the Evaluation Contractor also performed the analysis on finer expenditure categories; using nominal expenditures (rather than inflation-adjusted); using a different baseline year (2010 rather than 2011); and collapsing the years into pre versus post intervention periods.

[D-17] It should be noted that since all difference-in-differences regression-adjusted models include hospital fixed effects, individual hospital characteristics (e.g., ownership; beds; rural indicator; hospital type) drop out of the analysis and are only included for the adjusted trend graphs shown in Appendix E, Figures E-11 through E-16.

Using 2010 as the Baseline Year

The Evaluation Contractor repeated the main analysis using 2010 as the baseline year rather than 2011. While no significant impact of HEN alignment was found when 2011 was the baseline year, the Evaluation Contractor considered the possibility HEN activities had already begun in 2011. This analysis investigates this possibility. Table D-39 and Table D-40 provide the difference-in-differences results using 2010 as the baseline year rather than 2011 for the 90 and 180 day look-out periods, respectively. The layout of these tables is the same as in the main tables in Chapter 6 of the report. As can be seen in the last column, no statistically significant effects were found across different expenditures, demonstrating that the main estimates are robust to the baseline used.

Table D-39—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 Day Lookout Period, 2010 and 2013; n = 24,253,498

Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN				
	2010	2013	Difference (SE)	2010	2013	Difference (SE)	Difference-in-Differences (SE)	Difference-in-Differences Impact Estimate (SE)
Total Expenditures	20,766.86	20,899.09	132.23** (50.01)	20,970.74	21,403.88	433.14 (240.16)	-300.91 (245.31)	-124.91 (132.00)
Index Discharges	9,340.67	9,544.89	204.22** (31.93)	9,404.47	9,860.45	455.98** (138.55)	-251.76 (142.18)	-107.83 (90.74)
Post-Discharge	11,426.19	11,354.21	-71.98** (25.38)	11,604.93	11,522.79	-82.13 (145.58)	10.15 (147.77)	31.46 (91.46)
Post-Discharge IP	5,556.59	5,437.31	-119.27** (16.96)	5,580.88	5,458.42	-122.46 (79.09)	3.19 (80.89)	26.24 (59.81)
Outpatient	1,205.02	1,341.54	136.52** (5.05)	1,228.14	1,396.96	168.83** (20.30)	-32.31 (20.92)	-6.28 (14.38)
DME	250.80	204.45	-46.35** (1.28)	253.06	206.78	-46.28** (3.95)	-0.07 (4.15)	3.27 (4.36)
Home Health	1,070.51	983.89	-86.61** (4.68)	1,061.55	980.99	-80.55** (16.69)	-6.06 (17.33)	-0.51 (17.59)
SNF	3,073.50	3,113.61	40.11** (12.35)	3,268.74	3,293.21	24.47 (88.99)	15.64 (89.84)	-41.74 (48.64)
Hospice	169.38	175.97	6.58** (1.33)	179.10	182.63	3.54 (7.55)	3.04 (7.66)	4.13 (8.45)
Professionals (i.e., Carrier)	100.39	97.43	-2.96** (0.25)	98.54	96.62	-1.92 (1.29)	-1.03 (1.31)	-0.79 (1.29)

Table D-39—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 Day Lookout Period, 2010 and 2013; n = 24,253,498								
Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN				
	2010	2013	Difference (SE)	2010	2013	Difference (SE)	Difference-in-Differences (SE)	Difference-in-Differences Impact Estimate (SE)

Source: Mathematica Policy Research analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted using propensity-score based weights. For all 10 outcomes, expenditures are price-adjusted and are expressed in January 2010 dollars. The first six columns of estimates present mean expenditures in 2010 and 2013, as well as the change from 2010 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2010 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D provides the full list of controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

*Difference-in-differences treatment-comparison impact estimate significantly different from zero at the .05 level, two-tailed test.

**Difference-in-differences treatment-comparison impact estimate significantly different from zero at the .01 level, two-tailed test.

Table D-40—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 Day Lookout Period, 2010 and 2013, n = 19,441,206								
	Unadjusted							Regression-Adjusted
Expenditure Type	HEN			Non-HEN			Difference-in-Differences (SE)	Difference-in-Differences Impact Estimate (SE)
	2010	2013	Difference (SE)	2010	2013	Difference (SE)		
Total Expenditures	24,748.40	24,528.03	-220.36** (56.49)	25,001.13	25,192.16	191.03 (256.35)	-411.39 (262.50)	-205.10 (175.30)
Index Discharges	9,299.33	9,383.65	84.32** (30.93)	9,357.85	9,720.60	362.75* (147.70)	-278.43 (150.90)	-119.13 (106.73)
Post-Discharge	15,449.07	15,144.38	-304.69** (34.91)	15,884.70	15,594.91	-289.79 (181.58)	-14.89 (184.91)	6.81 (126.80)
Post-Discharge IP	7,506.46	7,241.61	-264.84** (22.86)	7,533.76	7,317.43	-216.33* (109.75)	-48.52 (112.10)	-10.28 (92.23)
Outpatient	2,040.09	2,264.48	224.38** (8.10)	2,062.96	2,348.30	285.34** (35.19)	-60.96 (36.11)	-21.24 (26.47)
DME	430.27	350.87	-79.40** (2.16)	440.17	358.14	-82.03** (7.56)	2.63 (7.86)	6.31 (8.15)
Home Health	1,516.32	1,375.48	-140.84** (6.79)	1,523.65	1,404.88	-118.77** (23.77)	-22.07 (24.73)	-15.40 (26.12)
SNF	3,584.51	3,531.45	-53.06** (14.28)	3,847.63	3,750.62	-97.01 (123.34)	43.94 (124.16)	-51.48 (49.87)

Table D-40—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 Day Lookout Period, 2010 and 2013, n = 19,441,206								
	Unadjusted							Regression-Adjusted
Expenditure Type	HEN			Non-HEN			Difference-in-Differences (SE)	Difference-in-Differences Impact Estimate (SE)
	2010	2013	Difference (SE)	2010	2013	Difference (SE)		
Hospice	268.63	281.05	12.42** (2.42)	294.82	288.23	-6.60 (13.72)	19.02 (13.93)	21.60 (15.11)
Professionals (i.e., Carrier)	102.78	99.44	-3.34** (0.29)	100.43	97.91	-2.52 (1.68)	-0.82 (1.70)	-0.70 (1.78)

Source: Mathematica Policy Research analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted using propensity-score based weights. For all 10 outcomes, expenditures are price-adjusted and are expressed in January 2010 dollars. The first six columns of estimates present mean expenditures in 2010 and 2013, as well as the change from 2010 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2010 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D provides the full list of controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

*Difference-in-differences treatment-comparison impact estimate significantly different from zero at the .05 level, two-tailed test.

**Difference-in-differences treatment-comparison impact estimate significantly different from zero at the .01 level, two-tailed test.

Other Expenditure Categories

The Evaluation Contractor repeated the main analysis on a set of finer expenditures which all contribute to the larger expenditure categories presented in the main tables. While no significant impact of HEN alignment was found on the broader categories, the Evaluation Contractor considered the possibility that a component of an individual category might have been affected but was masked by the broader results. This analysis investigates this possibility. Table D-41 and Table D-42 provide the difference-in-differences results for these expenditure subgroups for the 90 and 180 day look-out periods, respectively. The layout of these tables is the same as in the main tables in Chapter 6 of the report. As can be seen in the last column, no statistically significant effects were found across different expenditures, suggesting that the more aggregated groupings were not masking significant effects in the finer categories.

Table D-41—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 days Lookout Period, 2011 and 2013, n = 24,253,498								
Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN			Difference-in-Difference	Difference-in-Differences Impact Estimate
	2011	2013	Difference	2011	2013	Difference		
IP Acute Hospital Stay Expenditure	8,970.88	9,379.76	408.88** (26.54)	9,151.14	9,701.46	550.32** (114.94)	-141.44 (117.96)	-30.79 (77.40)
Professional (Carrier) Index Discharge Expenditure	170.25	165.13	-5.13** (0.57)	167.82	163.21	-4.61* (2.18)	-0.51 (2.25)	-1.05 (2.21)
IP Acute Hospital Post Expenditure	4,083.18	3,994.63	-88.55** (11.49)	4,119.15	4,049.42	-69.73 (57.41)	-18.82 (58.55)	24.33 (44.36)
IP Rehab Post Expenditure	808.72	846.20	37.48** (6.59)	757.10	768.87	11.77 (43.63)	25.71 (44.13)	40.87 (58.51)
IP Long Term Care (LTC) Hospital Post Expenditure	468.52	469.37	0.86 (5.83)	526.38	516.43	-9.95 (29.24)	10.81 (29.81)	26.36 (27.15)
Psych Post Discharge Expenditure	127.93	126.52	-1.40 (1.52)	138.15	127.75	-10.40 (7.67)	9.00 (7.82)	6.23 (6.90)
Other Hospital Post Discharge Expenditure	0.98	0.59	-0.39* (0.19)	0.44	1.67	1.23 (1.02)	-1.61 (1.04)	-1.56 (1.04)
Outpatient (OP) Emergency Room (ER) Post Expenditure	87.17	103.97	16.80** (0.42)	95.76	115.02	19.26** (1.65)	-2.46 (1.70)	-0.83 (1.46)
OP Other Post Expenditure	1,146.35	1,235.54	89.19** (3.86)	1,172.35	1,276.42	104.07** (15.70)	-14.88 (16.17)	4.60 (12.73)

Source: The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all nine outcomes, expenditures are price-adjusted and are expressed in Jan 2010 dollars. The first six columns of estimates present mean expenditures in 2011 and 2013, as well as the change from 2011 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2011 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Table D-42—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 days Lookout Period, 2011 and 2013, n = 19,441,206								
Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN				
	2011	2013	Difference	2011	2013	Difference	Difference-in-Differences	Difference-in-Differences Impact Estimate
IP Acute Hospital Stay Expenditure	8,926.20	9,213.11	286.91** (25.67)	9,100.37	9,549.79	449.42** (125.16)	-162.51 (127.76)	-37.37 (92.12)
Professional (carrier) Index Discharge Expenditure	176.69	170.54	-6.14** (0.61)	174.21	169.72	-4.48 (2.32)	-1.66 (2.40)	-1.89 (2.30)
IP Acute Hospital Post Expenditure	5,762.09	5,589.23	-172.86** (16.50)	5,749.41	5,637.83	-111.59 (97.92)	-61.28 (99.30)	3.00 (85.05)
IP Rehab Post Expenditure	942.30	959.68	17.38* (7.48)	890.00	870.75	-19.25 (55.86)	36.63 (56.36)	42.21 (62.45)
IP LTC Hospital Post Expenditure	510.21	505.39	-4.82 (6.18)	576.43	566.25	-10.19 (32.69)	5.36 (33.27)	15.33 (30.51)
Psych Post Discharge Expenditure	187.18	186.27	-0.91 (2.23)	211.41	197.86	-13.55 (10.49)	12.64 (10.73)	7.62 (8.81)
Other Hospital Post Discharge Expenditure	1.47	1.05	-0.42 (0.27)	0.51	2.50	2.00 (1.20)*	-2.41 (1.23)	-2.36 (1.22)
OP ER Post Expenditure	134.19	157.21	23.02** (0.60)	144.05	169.02	24.97** (2.12)	-1.95 (2.20)	-0.29 (1.97)
OP Other Post Expenditure	1,982.24	2,104.12	121.88** (6.42)	2,051.01	2,181.14	130.13** (23.60)	-8.25 (24.46)	25.72 (23.17)

Source: The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all nine outcomes, expenditures are price-adjusted and are expressed in Jan 2010 dollars. The first six columns of estimates present mean expenditures in 2011 and 2013, as well as the change from 2011 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2011 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. It shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Using Nominal Expenditures

The Evaluation Contractor also repeated the main analysis using nominal expenditures rather than price-adjusted expenditures. To do this, propensity weights for each nominal expenditure outcome for each hospital were generated in the same manner as the main analysis. The difference-in-differences analysis on the nominal expenditures was performed using these propensity weights. In Table D-43 and Table D-44, the difference-in-differences estimates are shown for the same expenditure categories as in Chapter 6, Table 6-2 and Table 6-3. As can be seen, the estimates are fairly similar to the estimates derived using the real expenditures, and, again, there are no statistically significant effects.

Table D-43—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 days Lookout Period, 2011 and 2013 (Nominal), n=24,253,498

Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN			Difference-in-Differences	Difference-in-Differences Impact Estimate
	2011	2013	Difference	2011	2013	Difference		
Total Expenditures	21,392.54	22,473.86	1,081.33** (45.93)	21,818.61	23,018.27	1,199.66** (242.98)	-118.33 (247.28)	27.86 (141.38)
Index Discharges	9,492.74	10,263.88	771.13** (30.03)	9,675.57	10,606.94	931.37** (131.66)	-160.24 (135.05)	-45.62 (89.69)
Post-Discharge	11,899.80	12,209.99	310.19** (22.51)	12,195.41	12,402.30	206.89 (150.21)	103.30 (151.89)	130.73 (95.77)
Post-Discharge IP	5,701.10	5,847.59	146.49 (15.56)	5,744.03	5,872.47	128.44 (75.65)	18.05 (77.24)	44.85 (56.47)
Outpatient	1,282.74	1,442.94	160.19** (4.43)	1,318.19	1,502.11	183.93** (19.15)	-23.73 (19.65)	1.78 (14.21)
DME	243.80	219.92	-23.88** (1.23)	247.45	222.19	-25.26** (3.16)	1.38 (3.39)	4.82 (3.48)
HHA	1,029.87	1,058.14	28.26** (3.76)	1,021.99	1,054.69	32.70 (17.12)	-4.44 (17.53)	1.30 (16.51)
SNF	3,355.83	3,347.32	-8.51 (11.14)	3,665.33	3,540.29	-125.04 (106.21)	116.53 (106.79)	63.79 (56.45)

Table D-43—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 days Lookout Period, 2011 and 2013 (Nominal), n=24,253,498								
Expenditure Type	**Unadjusted**							**Regression-Adjusted**
	HEN			**Non-HEN**			**Difference-in-Differences**	**Difference-in-Differences Impact Estimate**
	2011	**2013**	**Difference**	**2011**	**2013**	**Difference**		
Hospice	182.17	189.28	7.12** (1.30)	193.69	196.49	2.80 (7.21)	4.32 (7.33)	6.97 (8.32)
Professionals (i.e., Carrier)	104.28	104.80	0.52* (0.24)	101.40	103.91	2.51 (1.40)	-1.99 (1.42)	-1.64 (1.38)

Source: The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all ten outcomes, expenditures are not price-adjusted (i.e. nominal dollars). The first six columns of estimates present mean expenditures in 2011 and 2013, as well as the change from 2011 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2011 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Table D-44—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 days Lookout Period, 2011 and 2013 (Nominal), n=19,441,206								
Expenditure Type	**Unadjusted**							**Regression-Adjusted**
	HEN			**Non-HEN**			**Difference-in-Differences**	**Difference-in-Differences Impact Estimate**
	2011	**2013**	**Difference**	**2011**	**2013**	**Difference**		
Total Expenditures	25,485.77	26,367.49	881.72** (52.67)	26,035.19	27,091.51	1,056.32** (274.41)	-174.60 (279.42)	-20.99 (189.93)
Index Discharges	9,452.45	10,086.92	634.47** (28.77)	9,626.50	10,450.06	823.56** (140.03)	-189.08 (142.95)	-64.62 (103.31)
Post-discharge	16,033.33	16,280.58	247.25** (32.02)	16,614.82	16,774.04	159.21 (195.68)	88.04 (198.29)	105.73 (125.18)
Post-Discharge IP	7,688.76	7,785.21	96.45 (21.60)	7,689.47	7,875.99	186.52 (123.32)	-90.08 (125.20)	-49.66 (103.55)
Outpatient	2,200.63	2,434.93	234.29** (7.26)	2,273.00	2,526.88	253.88** (26.31)	-19.58 (27.29)	17.74 (22.45)
DME	422.21	377.24	-44.97** (2.14)	429.11	385.35	-43.76** (9.68)	-1.21 (9.91)	2.91 (10.24)
HHA	1,459.80	1,478.81	19.01** (5.16)	1,475.78	1,510.61	34.83 (23.00)	-15.82 (23.57)	-8.32 (23.06)

Table D-44—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 days Lookout Period, 2011 and 2013 (Nominal), n=19,441,206								
Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN			Difference-in-Differences	Difference-in-Differences Impact Estimate
	2011	2013	Difference	2011	2013	Difference		
SNF	3,860.95	3,795.29	-65.66** (12.76)	4,240.18	4,036.59	-203.58 (136.42)	137.93 (137.02)	54.75 (59.38)
Hospice	294.87	302.18	7.31** (2.39)	316.50	309.96	-6.54 (16.83)	13.85 (17.00)	18.90 (18.83)
Professionals (i.e., Carrier)	106.10	106.92	0.82** (0.27)	103.37	105.30	1.93 (1.32)	-1.11 (1.34)	-0.84 (1.32)

Source: The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all ten outcomes, expenditures are not price-adjusted (i.e. nominal dollars). The first six columns of estimates present mean expenditures in 2011 and 2013, as well as the change from 2011 to 2013 for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from 2011 to 2013 between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Using Pre and Post Periods

An additional robustness check collapsed the years into either the pre or post Partnership for Patients (PfP) period. In particular, index discharges in calendar years 2009 to 2011 are grouped into the pre-period, while discharges in calendar years 2012 and 2013 are grouped into the post period. This analysis detects the average impact of HEN alignment after PfP was initiated. In Table D-45 and Table D-46, the difference-in-differences estimates for the same expenditure categories as shown in Chapter 6, Table 6-2 and Table 6-3. Again, across all types of expenditures, no significant effects are found, though the coefficients change slightly compared to the main analysis.

Table D-45—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 days Lookout Period, Pre and Post, n=24,253,498

Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN			Difference-in-Differences	Difference-in-Differences Impact Estimate
	Pre	Post	Difference	Pre	Post	Difference		
Total Expenditures	20,698.61	20,657.05	-41.56 (37.11)	21,004.92	21,109.18	104.26 (217.80)	-145.83 (220.94)	-52.37 (105.68)
Index Discharges	9,285.26	9,358.04	72.78** (23.75)	9,387.02	9,637.01	249.99* (109.75)	-177.21 (112.30)	-54.60 (72.53)
Post-Discharge	11,413.35	11,299.01	-114.34** (18.96)	11,636.84	11,474.35	-162.50 (136.85)	48.15 (138.16)	31.44 (68.22)
Post-Discharge IP	5,575.55	5,448.78	-126.76** (12.82)	5,617.66	5,459.72	-157.93* (71.15)	31.17 (72.29)	32.80 (46.17)
Outpatient	1,205.71	1,318.42	112.72** (3.80)	1,240.11	1,372.15	132.04** (17.20)	-19.33 (17.62)	-2.34 (12.73)
DME	246.41	217.45	-28.95** (0.93)	249.94	221.66	-28.28** (3.17)	-0.68 (3.30)	1.77 (3.32)
HHA	1,038.91	984.12	-54.79** (3.69)	1,028.29	977.25	-51.05** (13.23)	-3.74 (13.73)	2.35 (13.70)
SNF	3,077.00	3,054.72	-22.29* (9.27)	3,314.30	3,238.34	-75.96 (84.68)	53.67 (85.18)	-17.88 (33.55)

Table D-45—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 90 days Lookout Period, Pre and Post, n=24,253,498								
Expenditure Type	**Unadjusted**							**Regression-Adjusted**
	HEN			**Non-HEN**			**Difference-in-Differences**	**Difference-in-Differences Impact Estimate**
	Pre	**Post**	**Difference**	**Pre**	**Post**	**Difference**		
Hospice	170.24	177.10	6.87** (0.94)	178.64	182.81	4.18 (4.94)	2.69 (5.03)	2.22 (5.67)
Professionals (i.e., Carrier)	99.53	98.40	-1.13** (0.19)	97.52	96.57	-0.96 (1.01)	-0.17 (1.03)	0.04 (1.02)

Source: The Evaluation Contractor's The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all ten outcomes, expenditures are price-adjusted and are expressed in Jan 2010 dollars. The first six columns of estimates present mean expenditures in the pre and post PfP period, as well as the change from the pre-PfP period to the post-PfP period for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from the pre-PfP to the post-PfP periods between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2012 - 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Table D-46—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 days Lookout Period, Pre and Post, n=19,441,206								
Expenditure Type	**Unadjusted**							**Regression-Adjusted**
	HEN			**Non-HEN**			**Difference-in-Differences**	**Difference-in-Differences Impact Estimate**
	Pre	**Post**	**Difference**	**Pre**	**Post**	**Difference**		
Total Expenditures	24,729.94	24,422.22	-307.72** (41.56)	25,106.27	25,014.64	-91.63 (222.69)	-216.09 (226.54)	-101.03 (132.44)
Index Discharges	9,245.28	9,244.53	-0.76 (22.88)	9,336.50	9,531.84	195.33 (113.79)	-196.09 (116.07)	-58.99 (79.27)
Post-Discharge	15,484.65	15,177.69	-306.96** (25.65)	15,977.96	15,630.58	-347.37* (163.72)	40.41 (165.72)	11.58 (87.04)
Post-Discharge IP	7,572.61	7,311.19	-261.42** (16.87)	7,592.41	7,359.65	-232.76** (85.63)	-28.67 (87.28)	-20.12 (66.50)
Outpatient	2,058.93	2,231.87	172.94** (6.10)	2,105.95	2,317.30	211.35** (26.79)	-38.42 (27.47)	-14.73 (22.23)
DME	428.88	376.29	-52.58** (1.51)	439.83	380.33	-59.50** (4.15)	6.92 (4.42)	9.73* (4.96)

Table D-46—Mean Medicare Expenditures per Discharge and Differences, by Expenditure Type and 180 days Lookout Period, Pre and Post, n=19,441,206

Expenditure Type	Unadjusted							Regression-Adjusted
	HEN			Non-HEN			Difference-in-Differences	Difference-in-Differences Impact Estimate
	Pre	Post	Difference	Pre	Post	Difference		
HHA	1,484.27	1,383.59	-100.69** (5.45)	1,491.85	1,401.07	-90.77** (17.79)	-9.91 (18.61)	-2.35 (19.23)
SNF	3,564.65	3,492.02	-72.63** (10.47)	3,858.75	3,702.34	-156.41 (112.64)	83.78 (113.12)	-21.59 (37.32)
Hospice	274.09	282.57	8.48** (1.69)	295.96	294.06	-1.90 (9.06)	10.38 (9.22)	10.06 (9.86)
Professionals (i.e., Carrier)	101.22	100.17	-1.05** (0.19)	99.05	98.33	-0.73 (1.14)	-0.32 (1.16)	-0.12 (1.21)

Source: The Evaluation Contractor's analyses of Medicare claims data.

Notes: Each row corresponds to a separate difference-in-differences regression model using index discharge-level data, with discharges weighted by propensity-score based weights. For all ten outcomes, expenditures are price-adjusted and are expressed in Jan 2010 dollars. The first six columns of estimates present mean expenditures in the pre and post PfP period, as well as the change from the pre-PfP period to the post-PfP period for HEN-aligned and comparison hospitals using raw, or unadjusted, expenditures. The next column provides the difference in the change from the pre-PfP to the post-PfP periods between HEN-aligned and comparison hospitals using raw, unadjusted, expenditures. The top number in the final column presents the main impact estimate, adjusting for patient characteristics, patient risk factors, and hospital fixed effects. The coefficient shows the average effect of HEN alignment in the 2012 - 2013 period. The main impact estimates were calculated by using linear regression models. Appendix D describes the controls included in the regression. Robust SEs, clustered by hospital, are provided in parentheses.

* Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.05 level, two-tailed test.

** Difference-in-differences treatment-comparison impact estimate significantly different from 0 at the 0.01 level, two-tailed test.

Interrupted Time Series (ITS) Methodology

Introduction

Every measure collected by the 26 Hospital Engagement Networks (HENs) which met inclusion criteria for the various analyses was assessed for the significance of the magnitude and timing of changes in trends in order to fully characterize the changes which occurred over the course of the Partnership for Patients (PfP) campaign. The subset of measures that had significant changes in trends during the campaign was identified. Additionally, the HEN activities were catalogued and organized to characterize the number and type of initiatives that were ongoing at every point of the campaign. Preliminary results are presented in the May 2015 Evaluation Progress Report, and the complete analysis of the relationship between trend changes and HEN activities is presented in this Interim Evaluation Report.

Criteria for Categorizing Measures as Widely Reported

With a total of 1,940 measures reported in PfP, measures were grouped into different subsets for analysis. Chapter 4, of the report presents a summary of campaign achievements for those measures deemed to have the most consistent and strongest data sets.

Measures were classified into widely-reported or less widely-reported based on the percentage of hospitals within the HEN contributing data to the measure. If 60 percent of the eligible hospitals reported the measure in at least 50 percent of the observations for the series, then the measure is deemed to be a widely-reported measure. If not, the measure is deemed to be a less widely-reported measure.

Measures were classified into consistently-reported or inconsistently-reported based upon the variations in the number of hospitals contributing data to the measure. If the reporting hospital count did not vary by more than 15 percent from the maximum hospital count during the series, then the measure is deemed to be a consistently-reported measure.

In the event that a measure had an observation where the hospital count fluctuated by more than 15 percent of the maximum hospital count during the series, the measure was evaluated to determine if the changes in hospital counts were systematically related to the measure rate. To decide if the rate had been affected due to fluctuating hospital counts, an ordinary least square (OLS) regression was performed that included a dummy variable for observations with a suspect hospital count. If the dummy variable for hospital counts greater than 15 percent was significant ($p < .05$), then this was evidence that the hospital count was systematically related to the measure rate, and the measure was declared an inconsistently-reported measure. In contrast, if the hospital count was not significant, then the measure was placed in the consistently-reported group because the hospital counts did not exhibit any systematic relationship to the measure rate.

Measuring Reductions in Patient Harms

The first step in assessing the relationship between HEN activities and harms reduction was to quantify which measures improved, and by how much. Overall improvement was assessed by comparing the baseline value with the measure rate across the last 3 reporting months using a *z*-test for the difference in two sample proportions. In cases where no data were collected prior to January 2012 (the first full month of HEN activities), the baseline was defined as either the HEN-reported baseline, if it was reported as an annual or semi-annual rate, or as the rate for the first 3 months of the series. Data were categorized such that measures were defined as improved if the change in rates were statistically significant in the desired direction (generally, rates for outcome measures were expected to decrease and rates for process measures were expected to increase, with some exceptions). In contrast, measures that changed significantly in the undesired direction were defined as worsened. Measures were defined as unchanged if there was no significant difference between the baseline value and the rate over the final 3 months of data collected. The significance threshold used in the analysis was $\alpha < .05$.

$$z = \frac{\mathrm{Last3} - \mathrm{BL}}{\sqrt{\left(\frac{\mathrm{p}(1-\mathrm{p})}{\mathrm{Last3_{Dr}}}\right) + \left(\frac{\mathrm{p}(1-\mathrm{p})}{\mathrm{BL_{Dr}}}\right)}} \tag{1}$$

$$\mathrm{p} = \frac{\mathrm{Last3_{Nr}} + BL_{Nr}}{\mathrm{Last3_{Dr}} + BL_{Dr}}$$

where

BL = baseline rate
Last3 = average rate over the final 3 months of data collection
BL_{Nr}= aggregated baseline numerator
BL_{Dr}= aggregated baseline denominator
$\mathrm{Last3_{Nr}}$= aggregated numerator over the final 3 months of data collection
$\mathrm{Last3_{Dr}}$= aggregated denominator over the final 3 months of data collection

There were several types of measures for which the z-test described above could not be estimated. These measures included:

- Standardized infection ratios (SIRs)
- Average days, lengths of stay, etc.
- Count measures
- Device Utilization Ratios
- Measures that do not have denominators

For those measures that could not be assessed using the z-test, an OLS regression was estimated to determine if the overall trend (slope) of the series was in the expected direction (negative for outcome measures and positive for process measures) and if the parameter estimate of slope was significant ($p < 0.05$)

The general form of the OLS model is the following:

$$Rate = \beta_0 + \beta_1(Time) + \varepsilon \qquad (2)$$

where

Rate = the measure value
β_0 = the intercept of the line
β_1 = the slope of the line
Time = a linear trend variable
ε = random error

Measures that exhibited slope coefficients (β1) in the expected direction of change, that were statistically significant were defined as improved measures. Measures that exhibited significant trends in the direction opposite of improvement were defined as worsening. Measures that did not exhibit a statistically significant slope in the above equation were defined as not changing.

Measuring Changes in Trends

The ITS design is a strong quasi-experimental research design and has been widely used in assessing the effects of health services and policy interventions.[D-18] The ITS design has two parameters of interest: the intercept (i.e., level change) and slope (i.e., trend change and/or month-to-month variation.) Given these parameters, one can quantify and/or assess the effect of an intervention by testing the change in either the intercept and/or the slope. To distinguish intervention effects from effects of other co-interventions requires use of a comparison group that is not exposed to the intervention.

The ITS regression is a method for determining whether a time series is described better by a single regression line or by two (or more) separate regression lines. Briefly, two linear regression lines are calculated corresponding to the time periods (a) before the event at time *t*, and (b) after the event. Two parameters, the level and the trend, define each segment of the time series. The level is the value of the series at the beginning of the interval and the trend is the slope of the segment. A change in level after the intervention indicates an abrupt effect, while a change in the slope represents a gradual change in outcomes during the segment. The general form of the model is in the following formula:

$$\text{Rate}_t = \beta_0 + \beta_1 * \text{time}_t + \beta_2 * \text{segment}_t + \beta_3 * \text{time}_t * \text{segment}_t + AR(1)_t + \varepsilon_t, \qquad (3)$$

where

Rate$_t$ is the measure value at time *t*,
β_0 is the intercept of the first segment,
β_1 is the slope of the first segment,
β_2 is the intercept of the second segment,
β_3 is the incremental change in the slope for the second segment relative to the first, segment$_t$ is a dummy variable with value of 0 when *t* is before intervention and 1 when *t* is on or after the intervention,
$AR(1)_t$ is the first-order autocorrelation term, and
ε_t is random error.

D-18 See, e.g., Penfold, Robert B. PhD and Fang Zhang, PhD 2013; Use of Interrupted Time Series Analysis in Evaluating Health Care Quality Improvements. *Academic Pediatrics*, 2013 13: No. 6S. S38—S44; Wagner, A. K., S. B. Soumerai, Zhang and D. Ross-DegnanSegmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics* 2002; 27: 299–309.

Traditionally, a break point analysis would be done by testing whether an intervention is associated with a change in the intercept or trend when the intervention occurred. However, this was not possible due to the multiplicity and contemporaneity of interventions. The HENs reported multiple ongoing activities that covered time frames from a single month up to the entire 3 years of the campaign. During most months, these overlapped with one-time events, introduction of tools, and "as-needed" interventions such as coaching with individual hospitals. In most cases, there was at least one activity going on during every potential break point. Therefore, the Evaluation Contractor utilized a two-stage approach to ITS. In the first step, every potential break point (each separate month or quarter of data) between January 2012 and December 2014 was assessed using a Chow test. Significant change points were identified for future comparison with the pattern of the number and type of concurrent HEN activities (see the cluster analysis and repeated measures analysis in this report).

The Chow test has a null hypothesis that the two trend lines have the same slope and intercept (level). Rejecting the Chow test is evidence that the event at time *t* is associated with a change in the trend and identified as a change point. The general form of the Chow test is as follows:

$$F = \frac{RSS_c - (RSS_1 + RSS_2)/k}{RSS_1 + RSS_2 / n - 2k}, \tag{4}$$

where

RSS = Residual Sum of Squares for the linear regression models
c = the complete model over all time points,
1 = time points in segment 1, and
2 = time points in segment 2
n = total number of time points
k = number of time points in segment 1
F follows the *F*-distribution with *(n, n*-2*k)* degrees of freedom.

Effect of Monthly versus Quarterly Reporting

Although monthly reporting of measure data has been described as a burden by many hospitals, there are significant advantages to retaining the level of detail inherent in monthly reporting. A statistically robust ITS model should have at least 25 data points (time periods) per time segment tested, although researchers have argued that having at least eight points before and eight points after an intervention can provide a viable analysis.[D-19,D-20,D-21] For this analysis, the Evaluation Contractor relaxed that requirement considerably in order to allow for the short baseline and follow-up periods demanded by the PfP campaign design, setting the minimum number of required data points for this analysis at eight, or four data points for pre-intervention and four for post-intervention performance. Many of the quarterly reported measures could not be analyzed with ITS since the measures had fewer than eight data points, or at least two years of data. In contrast, if data are reported monthly, only eight months would be sufficient to support the ITS analysis. Additionally, a minimum segment length of four data points is equivalent to 12 months of quarterly reporting, such that break points within the first or last year of the PfP campaign could not be evaluated for measures with rates

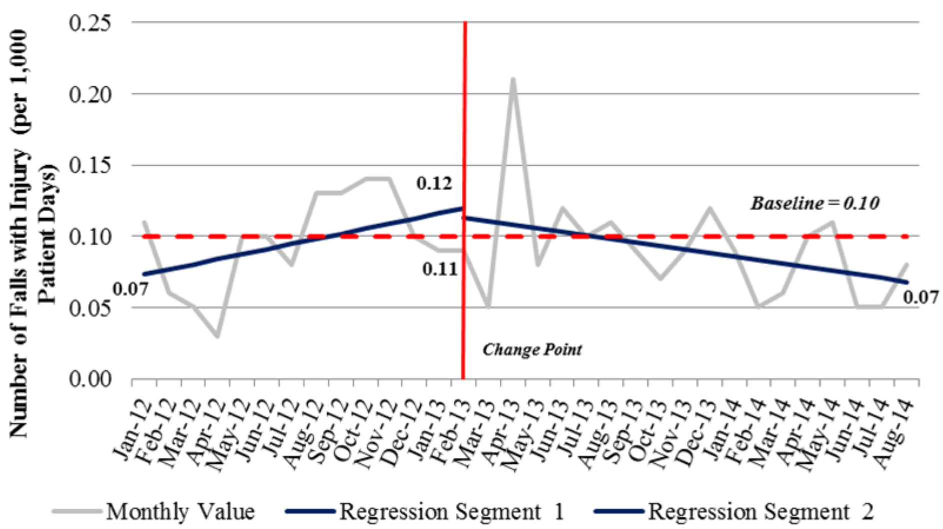
D-19 Wagner AK, Soumerai SB, Zhang, F, et al. Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics*. 2002; 27:299-309.
D-20 Zhang F, Wagner AK, Ross-Degnan D. Simulation-based power calculation for designing interrupted time series analyses of health policy interventions. *Journal of Clinical Epidemiology*. 2011; 64(11):1252-1261.
D-21 Penfold RB, Zhang F. Use of interrupted time series analysis in evaluating healthcare quality improvements. *Academic Pediatrics*. 2013. 13(6S):S38 – S44.

reported on a quarterly basis. A final consideration is that monthly reporting allows for more precise estimates of error terms, leading to increased statistical power to detect existing differences.

Quarterly measures were more likely to be excluded from the analysis due to having an insufficient number of data points, and were less likely to have significant break points. Of all the measures reported by the HENs, 6.60 percent of the quarterly measures were excluded for having fewer than eight data points, while only 6.08 percent of the measures reported monthly were excluded for having too few data points.

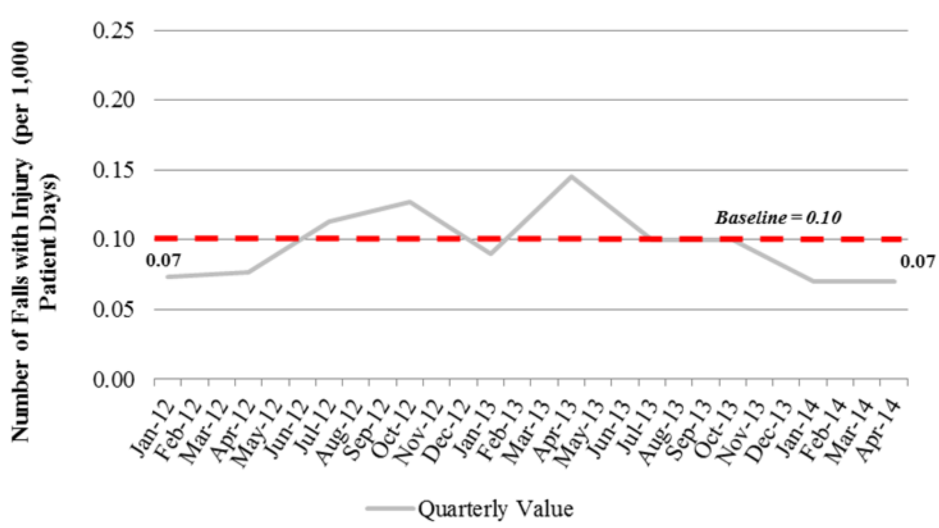
The impact of quarterly reporting can be illustrated by converting monthly data points into quarterly rates. In many cases, a significant change point could not be detected from quarterly data due to the inability to test for change points in the first or last measurement year with quarterly data. Figure D-1 and Figure D-2 illustrate a measure with a significant change point when analyzed using monthly data (top panel), compared to result obtained if data were reported quarterly (bottom panel). In this case, the change point was in the middle of the run chart so it could be tested using both monthly and quarterly rates. However, the significant change point identified using monthly data was no longer significant when the data were aggregated to quarterly rates due to the loss of precision and power. The Chow test *p*-value was $p = .077$ for quarterly data, indicating that no significant change in trend was detected.

Figure D-1—Number of Falls with Injury (per 1,000 Patient Days), Monthly Reporting



Source: The Evaluation Contractor's calculations based on results obtained from the ITS analysis of HEN-submitted run chart data from November 2014.

Figure D-2—Number of Falls with Injury (per 1,000 Patient Days), Quarterly Reporting



Source: The Evaluation Contractor's calculations based on results obtained from the ITS analysis of HEN-submitted run chart data from November 2014.

Statistical Process Control (SPC) Chart Methodology

The trend charts presented in several sections of the report include characteristics of SPC charts, such as estimated center lines and upper and lower control limits. The SPC charts provide a method for assessing whether the processes generating the data share common cause variation (i.e., rates that share similar underlying characteristics), or exhibit special cause variation, a range of variation so different, it is likely the result of a different cause, suggesting a change in the underlying process. For example, if all the data points in a given measure randomly straddle the center line without extremely high or low data points, then the data share common cause variation. However, if some of the data points exhibit certain characteristics, such as eight or more data points falling above or below the center line or points that fall above or below the defined control limits, then there is evidence of special cause variation. Further detail of what constitutes special cause variation is provided below in the 35BCriteria for Special Cause Variation section.

Center lines represent calculations of the average rate over time, and the control limits represent boundaries driven by variation in the rate over time. Center lines and control limits were calculated differently depending on the number of data points available in the series. For measures with fewer than 20 data points, center lines and control limits were derived using all of the available data. For measures with 20 or more data points, center lines and control limits were derived using the first 15 data points.[D-22] SPC charts for measures with fewer than eight data points were not generated.[D-23]

The control limits and data series were then examined for evidence indicating that a phase shift was necessary. A phase shift is warranted if 8 or more consecutive data points fall either above or below the center line of the original control chart. The point of the shift is identified as the first point in the run of data above or below the center line. If evidence of a phase shift was observed, the center lines and control limits were recalculated for both phases of the series. The rule of using the first 15 data points as opposed to the full series was applied to each phase. Overdispersion – a parameter comparing observed variation in the rate to expected variation on the *U* or *U'* chart type – was also reassessed once a phase shift was observed.

Importantly, Shewhart charts are an effective tool for assessing changes in trends that are unlikely to be due to random fluctuations in the data generating processes. However, Shewhart charts alone are not capable of providing attribution of changes to specific interventions in a complex environment such as a healthcare system, unless careful attention is paid to control the influence of other interventions and external factors on the data series under examination. Instead, Shewhart charts are most effective in providing a method for assessing when non-random variation occurs, and determining the timeframes that researchers should focus on for identifying the sources of special cause variation.

The SPC charts take one of three forms. *U* charts are used to present control limits for rates in which the underlying data are represented as a proportion, and have denominator values that vary over time. *U′* charts

D-22 For the Medicare 30-Day All-Cause fee-for-service (FFS) Readmissions rate there was more data available, and the initial center line was calculated using data from January 2009 to December 2011.

D-23 The SPC methodology for calculating center lines and control limits requires the assumptions that there are sufficient data points to reliably estimate the mean level of performance (represented by the center line) and the natural variability in the process (represented by the control limits). As the number of data points available in a series is reduced, the reliability of the estimates becomes less stable and the addition of one or more future data points may have a substantive impact on the overall estimates. In contrast, with a longer data series, the reliability of the estimate and additional data points are less likely to change the estimates substantively unless special cause variation exists. In situations where data collection is expensive, long periods exist between data points, or large effects are anticipated, then data series may contain fewer than 10 data points. However, if the analysis is attempting to identify quality improvements of a moderate scale in data that is collected with some regularity, having 11 – 50 data points is desirable (Provost, Lloyd P., and Sandra Murray. 2011. The Health Care Data Guide: Learning from Data for Improvement. San Francisco: Jossey-Bass). To balance these desires with monthly or quarterly data, the Evaluation Contractor chose a minimum criteria of 8 observations for graphing with SPC chart methodology.

extend *U* charts by also accounting for overdispersion when detected in the data. *XmR* charts are used for measures in which the underlying data are represented as an average or a ratio that is not bounded by 0 and 1.[D-24] *XmR* charts are used for measures such as National Healthcare Safety Network (NHSN) catheter-associated urinary tract infection (CAUTI) and central line-associated blood stream infection (CLABSI) standardized infection ratios (SIRs), while *U* and *U'* charts are used for measures such as the Centers for Medicare & Medicaid Services (CMS) pressure ulcers and National Database of Nursing Quality Indicators® (NDNQI®) falls.[D-25] Additionally, an *XmR* chart may be used in instances where numerator and denominator data are unavailable for a *U* or *U'* chart (e.g., SIRs, or average lengths of stay).

XmR Chart

The average and moving range chart (*XmR*) was used to generate control limits for SIRs obtained through the NHSN and other measures not suitable for use with a *U* chart.

Where *XmR* charts are used, the value of the center line (CL) is the average of the measure over the data points used for the control limits. These time frames vary by measure, and are noted in the footnote for each chart.

$$\overline{X} = \sum x_t \Big/ \sum n_t \qquad (1)$$

In Equation 1, x_t is an observation of an adverse event occurring during a baseline time period t, and n_t is the sample size during a baseline time period t. For SIRs obtained through NHSN, an average value of individual cases was not calculated first. Rather the SIRs were used directly to calculate the center line and control limits. The upper control limit (UCL) and lower control limit (LCL) then take the following form for the NHSN data:

$$\overline{X} \pm 2.66\left(\overline{MR}\right) \qquad (2)$$

In Equation 2, the average moving range ($\overline{MR}$) is calculated as the average difference between pairs of values used to compute the center line of the measure:

$$\overline{MR} = \frac{\sum_{t=2}^{T} \left| x_t - x_{t-1} \right|}{T-1} \qquad (3)$$

D-24 Provost, Lloyd P., and Sandra Murray. 2011. The Health Care Data Guide: Learning from Data for Improvement. San Francisco: Jossey-Bass; Wheeler, Donald J., and David S. Chambers. 2010. Understanding Statistical Process Control, 3rd Edition. Knoxville, TN: SPC Press; Laney, David B. 2002. Improved Control Charts for Attributes. Quality Engineering 14(4):531-537.

D-25 NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

U and U′ Chart

Charts based on other data sources aside from NHSN were generated using either *U* or *U′* charts. *U* charts are appropriate when the data follow a Poisson process (i.e., counts) and have unequal sample sizes over time. CL for a *U* chart is calculated as follows:

$$\overline{U} = \sum x_t \Big/ \sum n_t \tag{4}$$

Where x_t is an observation of an adverse event occurring during a baseline time period *t*, and n_t is the sample size during a baseline time period *t*. For The UCL and LCL are then calculated with the following formula:

$$\overline{U} \pm 3\sqrt{\frac{\overline{U}}{n_t}} \tag{5}$$

Count data often exhibit overdispersion, or a state in which the variation is greater than would be expected given the average count over time. When a process exhibits overdispersion, it is necessary to adjust the control limits to take into account this additional variability from one period to the next. To do so, counts are transformed into *z*-scores by the following formula:

$$z_t = \frac{u_t - \overline{U}}{\sqrt{\overline{U} \big/ n_t}} \tag{6}$$

After transforming the counts into *z*-scores, the average moving range of the *z*-scores is divided by 1.128 to estimate the degree of overdispersion, using the following formula:

$$\sigma_z = \frac{MR_z}{1.128} \tag{7}$$

To obtain the UCL and LCLs of the overdispersion-adjusted *U* chart, equation 6 is multiplied by the result of equation 8. This generates the *U′* chart:

$$\overline{U} \pm 3\left(\sqrt{\frac{\overline{U}}{n_t}}\right)\sigma_z \tag{8}$$

The *U′* chart is used when the estimate of σ_z is greater than 1. Otherwise, a *U* chart is used.

Medicaid-Based U Charts

Charts developed from Medicaid claims are *U* or *U'* charts, for which the data series rates undergo a regression-adjustment procedure prior to inclusion in the control chart. Specifically, a logistic regression model is used to predict the number of hospital-acquired conditions (HAC) events, controlling for differences in the states contributing data over time, and the populations included in the sample (e.g., fee-for-service [FFS] only, or all encounters) for each quarter. The regression-adjusted rates were then used to generate either *U* or *U'* charts, with control limits based on the sample sizes used in the regression equation.

Center Lines and Shifts

For all charts, center lines were first calculated assuming a single center line. After reviewing the charts, the presence of a shift was determined by assessing the trend for a series of 6 or more data points above or below the center line for series with fewer than 20 data points. For series with 20 or more data points, a shift was observed when there are 8 or more data points above or below the center line. The presence of a shift required recalculating the center line for multiple phases of the control chart, using the data points that were associated with each phase.

Criteria for Special Cause Variation

After constructing the Shewhart charts, the Evaluation Contractor examined the data to determine if there was evidence of special cause variation, specifically, whether evidence suggested that the process generating the measure rates changed in substantively meaningful ways. There are four criteria used to determine whether special cause variation was evident:

1. One or more points occur outside the upper or lower control limits.
2. With 20 or more data points, a run containing 8 or more data points above or below the center line is evidence of a shift. With less than 20 data points, a run containing 6 or 7 data points suggests a shift.
3. Six or more consecutive points increase or decrease.
4. Two or more data points fall between the +/-2σ line and the upper or lower control limit, respectively.

A chart meeting any of these criteria is declared to exhibit evidence of non-random variation in the rate. Therefore, common cause variation is ruled out as being a likely cause of the changes, and special cause variation is the more likely cause.

Vital Records Analysis Methodology

The data sources for the vital records analysis were (1) the Centers for Disease Control and Prevention (CDC) National Vital Statistics System (NVSS) natality files for calendar years 2009 through 2013, and (2) the American Hospital Association (AHA) Annual Survey data for 2010 (See Appendix B).

The AHA survey provides a critical link between the roster of aligned hospitals and the Vital Records data because it contains two key data fields:

- The state and county of the hospital.[D-26]
- The number of births per year per hospital.

Rosters of Aligned Hospitals

The Evaluation Contractor used rosters that identify the hospitals that were aligned with a Hospital Engagement Network (HEN) as of June 2012 to calculate the level of HEN penetration in counties. Specifically, the treatment group was comprised of counties where 90 percent or more of births occurred in HEN-aligned hospitals (as of June 2012). The comparison group was comprised of counties where 50 percent or less of births occurred in HEN-aligned hospitals (as of January 2014).

Analytic Sample

The analyses excluded 147 counties with births that appeared in the NVSS or AHA data, but not both. In the sample, 104 counties with births in the NVSS files that do not have any eligible hospitals listed in the AHA survey were dropped (0.40 percent of NVSS births dropped), as well as 23 counties where all hospitals in the county reported having zero births in the 2010 AHA survey but had both non-HEN-aligned and HEN-aligned hospitals, making it impossible to calculate the fraction of births occurring in HEN-aligned counties (0.02 percent of NVSS births dropped). There were also 15 counties that appeared in the AHA with more than one birth reported, but because no births were found in the NVSS, these counties are not included in the analyses. Finally, there were five counties that appeared in both AHA and NVSS data; however, in the AHA data, these counties were marked as ineligible and had zero births, so these counties were excluded from the final analysis (0.038 percent of NVSS births dropped). A description of the analytic sample is included in Table D-47.

[D-26] The modified county code from the AHA survey was used. This variable was created by the survey administrators in order to account for independent cities (e.g., St. Louis and Baltimore).

Table D-47—Number of Counties and Births Included in The Analysis with NVSS Data, 2009-2013		
Description	**Number of Counties[a]**	**Number of Births[b]**
Treatment and Comparison Groups Included in The Main Analysis		
Included in the analysis	2,133	18,265,786
Greater than (or equal to) 90 percent of births in HEN-aligned hospitals	1,635	11,860,740
Less than (or equal to) 50 percent of births in HEN-aligned hospitals	398	2,014,319
Between 50 and 90 percent of births in HEN-aligned hospitals	100	4,390,727

Source: Evaluation Contractor's calculations from Vital Records data merged with hospital data
[a] Counties with any hospitals eligible for Partnership for Patients (PfP) (including those that are aligned or not aligned with a HEN).
[b] Births in the NVSS occurring in hospitals.

Without individual hospital identification in the NVSS files, the Evaluation Contractor was able to estimate the fraction of births that occurred in a HEN-aligned hospital only when a county has only one hospital, all the hospitals in the county are HEN-aligned, or all hospitals are non-HEN-aligned.[D-27] In counties where a subset of hospitals are aligned with a HEN, the Evaluation Contractor estimated the fraction of births occurring in HEN-aligned hospitals in the county by dividing the sum of births occurring in HEN-aligned hospitals in the county by the total number of hospital births in the county. That is, the Evaluation Contractor calculated the fraction of births in each county that occurred in a HEN-aligned hospital as follows:

$$\text{Percent Aligned}=\frac{(\text{\# births in HEN-aligned hospitals})}{(\text{\# births in HEN-aligned hospitals})+(\text{\# births in non-HEN-aligned hospitals})} \tag{1}$$

Using this calculation, counties were classified into treatment counties—those with 90 percent or more of births in HEN-aligned hospitals—and comparison counties—those with 50 percent or fewer of births in HEN-aligned hospitals (Table D-47). The Evaluation Contractor did not limit comparison of counties to counties with no births in HEN-aligned hospitals because the proportion of hospitals working with HENs is so high that few such counties exist.[D-28]

Substantial variation in the number of births occurring in HEN-aligned hospitals was found across states/territories, suggesting that there was substantial room for Partnership for Patients (PfP) interventions to assist states and healthcare providers in reducing the occurrence of obstetrical early elective deliveries (OB-EEDs), particularly in states that had high rates and/or did not experience improvements prior to the beginning of PfP's focus on OB-EED. Table D-48 provides the distribution of births in counties by the percentage of births in the county in a HEN-aligned hospital and total number of births per year by state.

D-27 The Evaluation Contractor excluded hospitals ineligible for PfP (reported to have had zero births), most of which are specialty facilities such as long-term care, rehabilitation, and psychiatric hospitals.

D-28 The definition of PfP participation, based on HEN alignment at the beginning of the PfP initiative, is analogous to an "intent to treat" analysis in a randomized trial. This approach has the advantage that it is likely to be less prone to selection bias than a definition of PfP participation status based on actual participation behavior. It is also clearer to define than other potential indicators. This definition is conservative because it does not exclude hospitals from the treatment group that may have not been exposed to a HEN's OB-EED-related efforts.

Table D-48—Number of Counties by The Number of Births Occurring in HEN-Aligned Hospitals and The Number of Births Per State (or Territory), 2009-2013												
State	Number of Counties with More Than One Birth[a]						Percentage of Births in HEN-Aligned Hospitals[a]	Number of Births in The Analyses[b]				
	Percentage of Birth in The County That Occur in a HEN-Aligned Hospital											
	0 Percent	0.1 Percent-50 Percent	50.1 Percent-89.9 Percent	90 Percent-99.9 Percent	100 Percent	Total		2009	2010	2011	2012	2013
AK	2	0	2	1	9	14	82.1%	7,991	7,582	7,168	6532	8424
AL	13	1	1	0	39	54	74.0%	41,892	40,389	40,755	39441	38729
AR	9	2	0	0	40	51	79.8%	31,207	29,892	30,398	29810	29675
AS	1	0	0	0	0	1	0.0%	0	0	0	0	0
AZ	1	2	5	0	5	13	71.7%	71,372	65,436	70,949	72102	71477
CA	2	2	11	3	35	53	87.9%	376,034	367,038	368,910	373546	374132
CO	3	0	0	1	38	42	92.6%	55,820	54,410	53,067	52219	52262
CT	0	0	0	0	8	8	100.0%	33,494	32,489	31,276	30576	30590
DC	0	0	1	0	0	1	86.4%	10,105	10,000	10,398	10959	10851
DE	2	0	1	0	0	3	17.0%	9,514	9,235	9,360	8922	8809
FL	17	6	9	2	19	53	56.2%	146,701	139,669	141,662	146228	149240
GA	1	0	2	0	92	95	98.6%	52,131	53,907	59,072	64263	63988
GU	1	0	0	0	0	1	0.0%	2,088	2,113	0	0	0
HI	0	0	1	0	3	4	88.8%	13,061	13,881	14,169	14518	14543
IA	0	0	0	0	80	80	100.0%	33,890	32,647	32,281	32038	31933
ID	16	1	1	0	10	28	39.7%	19,105	18,774	18,120	18647	18249
IL	21	5	5	0	26	57	55.3%	113,574	113,255	113,964	112062	109737
IN	0	0	0	0	74	74	100.0%	71,023	69,402	69,645	69993	69847
KS	10	2	1	1	51	65	81.9%	25,940	25,497	25,358	25986	25228
KY	0	1	1	0	70	72	98.8%	41,352	39,886	41,206	41632	41823
LA	4	0	4	4	26	38	85.6%	47,988	44,998	48,896	49108	49162
MA	1	1	6	2	4	14	78.7%	62,095	60,904	58,992	59521	58311
MD	13	2	0	1	5	21	32.3%	59,101	56,802	55,263	55500	52097

Table D-48—Number of Counties by The Number of Births Occurring in HEN-Aligned Hospitals and The Number of Births Per State (or Territory), 2009-2013												
State	Number of Counties with More Than One Birth[a]						Percentage of Births in HEN-Aligned Hospitals[a]	Number of Births in The Analyses[b]				
	Percentage of Birth in The County That Occur in a HEN-Aligned Hospital											
	0 Percent	0.1 Percent-50 Percent	50.1 Percent-89.9 Percent	90 Percent-99.9 Percent	100 Percent	Total		2009	2010	2011	2012	2013
ME	10	0	2	0	3	15	29.9%	10,817	10,475	10,096	10137	10221
MI	19	2	3	0	39	63	66.8%	52,010	50,600	50,921	50,784	50,924
MN	1	0	1	0	59	61	97.6%	52,506	52,384	52,544	54,905	55,231
MO	6	0	2	0	58	66	89.7%	57,275	57,454	55,881	55,589	56,514
MS	20	1	3	0	34	58	62.6%	29,523	27,851	28,092	26,981	26,970
MT	6	0	0	0	21	27	77.8%	8,103	8,546	8,837	8,568	9,072
NC	2	1	2	0	71	76	95.8%	87,827	87,605	92,705	92,753	93,858
ND	2	0	0	0	17	19	89.5%	7,626	7,581	7,929	8,126	8,770
NE	16	0	2	0	34	52	67.5%	21,604	20,730	20,488	20,029	19,828
NH	0	0	0	0	10	10	100.0%	10,270	9,822	9,858	9,769	9,956
NJ	0	0	0	0	21	21	100.0%	89,790	87,246	96,057	85,830	85,252
NM	2	0	0	0	18	20	90.0%	7,674	7,232	7,177	7,090	6,820
NV	2	0	0	1	6	9	77.3%	21,066	20,641	20,791	20,752	21,153
NY	0	0	3	2	49	54	99.0%	201,865	201,813	199,718	201,224	197,379
OH	13	0	3	3	47	66	79.0%	96,949	94,099	96,297	96,116	99,746
OK	13	0	3	2	39	57	75.6%	41,195	38,815	37,345	37,307	37,482
OR	2	1	2	0	24	29	89.6%	36,014	34,851	34,478	34,116	34,537
PA	3	0	1	1	53	58	94.4%	96,602	94,292	94,792	93,890	93,173
PR	0	0	2	1	17	20	97.8%	35,347	33,167	0	0	0
RI	0	0	0	0	4	4	100.0%	8,749	8,560	8,247	8,180	8,353
SC	2	0	0	1	35	038	94.7%	45,112	43,324	42,368	41,330	41,035
SD	4	0	0	0	26	30	86.7%	9,984	9,831	10,160	10,355	10,451
TN	20	0	3	0	47	70	70.3%	55,876	53,216	51,168	51,963	52,470
TX	66	8	9	1	52	136	45.9%	270,186	258,787	253,566	25,7715	261,137

Table D-48—Number of Counties by The Number of Births Occurring in HEN-Aligned Hospitals and The Number of Births Per State (or Territory), 2009-2013												
State	Number of Counties with More Than One Birth[a]						Percentage of Births in HEN-Aligned Hospitals[a]	Number of Births in The Analyses[b]				
	Percentage of Birth in The County That Occur in a HEN-Aligned Hospital											
	0 Percent	0.1 Percent-50 Percent	50.1 Percent-89.9 Percent	90 Percent-99.9 Percent	100 Percent	Total		2009	2010	2011	2012	2013
UT	8	1	4	0	10	23	57.0%	44,212	42,863	42,487	43,090	42,522
VA	7	2	1	0	48	58	85.1%	81,194	77,850	76,483	75,580	75,803
VI	2	0	0	0	0	2	0.0%	955	884	0	0	0
VT	8	0	0	0	3	11	27.3%	2,839	2,790	2,725	2,745	2,750
WA	0	0	3	0	28	31	96.9%	66,527	65,009	64,931	67,042	66,463
WI	2	1	0	0	57	60	95.5%	54,071	52,988	51,796	50,337	50,234
WV	0	0	0	0	31	31	100.0%	16,481	16,132	16,026	16,244	16,315
WY	3	0	0	0	13	16	81.3%	5,110	4,864	5,238	5,168	5,230
Total	**356**	**42**	**100**	**27**	**1,608**	**2,133**	**41.28%**	**2,950,837**	**2,870,508**	**2,850,110**	**2,857,318**	**2,858,756**

Source: Evaluation Contractor's analysis of 2010 AHA survey and NVSS Vital Records data.
[a] Number of births from the 2010 AHA hospital survey that were included in the data set.
[b] Number of births from the 2009–2013 NVSS natality files that were not excluded from the "early induction or early Cesarean section (C-section)" outcome measure.

Definitions of Outcome Variables and Control Variables

The outcome measures were constructed using different fields from the birth certificate; some birth certificates, however, have missing data for some fields. Analyses were conducted with birth certificates where the data for each particular outcome variable were not missing. Thus, a birth certificate may be included in the analyses for some outcome variables but not others, depending on whether the particular birth certificate is missing certain fields. Certain outcomes are unavailable for counties in states that have not adopted the new revision of the birth certificate. Those include the OB-EED, NICU admissions, and assisted ventilation rates, but early induction or early C-section, low birth weight, and low APGAR score measures are available for counties in all states.

Table D-49 lists the six key birth outcome measures implemented in the analyses. The definition of each measure is provided in the second column and the third column defines the sample included in analyses with the measures. Table D-50 lists all independent variables that were included in the regression models (indicated with check marks in the last two columns). The table also defines each variable and indicates the data source.

Table D-49—Definitions of Perinatal Delivery and Health Outcomes

Outcome	Definition	Inclusion Criteria
Early Induction or Early C-Section	Births with induction of labor or C-section, and gestational age less than 39 weeks	Births (1) where gestational age is non-missing and greater than 36 weeks,[a] (2) that are singleton births, (3) that occur in a hospital, (4) where birth weight is consistent with the gestational age[b] or is missing, and (5) where induction and delivery method are non-missing.
Non-Medically Indicated Early Term Singleton Birth (OB-EEDs; Based on The Medicaid Medical Directors Network [MMDN] Measure)	Births with the following three conditions: (1) gestational age is 37 or 38 weeks. (2) one of the following: Induction of labor *and* not medically indicated. C-section *and* not medically indicated *and* no trial of labor. Induction of labor *and* not medically indicated *and* C-section Note: In (2), "medically indicated" is one or more of the following: Prolonged labor Fetal intolerance Premature rupture of membrane Chorioamnionitis	Births (1) where gestational age is non-missing and greater than 36 weeks,[a] (2) that are singleton births, (3) that occur in a hospital, (4) where birth weight is consistent with the gestational age[b] or is non-missing, (5) have data based on the revised birth certificate and (6) have none of the following: Hypertension Pre-pregnancy Gestational Hypertension Hypertension/Eclampsia Pre-pregnancy Diabetes Gestational Diabetes Non-Vertex Presentation Other - Fetal Presentation at Birth Anencephaly Meningomyelocele/Spina Bifida Down Syndrome Suspected Chromosomal Disorder Cyanotic Congenital Heart Disease Diaphragmatic Hernia Omphalocele Gastroschisis Other Previous Poor Pregnancy Outcome

Table D-49—Definitions of Perinatal Delivery and Health Outcomes		
Outcome	**Definition**	**Inclusion Criteria**
APGAR Score 0–6	Births with APGAR score 0–6 assessed at 5 minutes.	In denominator for early induction or early C-section (row 3) and APGAR score is non-missing.
Assisted Ventilation Required Immediately Following Delivery[c]	Births with assisted ventilation required immediately following delivery.	In denominator for early induction or early C-section (row 3) and assisted ventilation is non-missing.
Admission to NICU[c]	Births with admission to NICU.	In denominator for early induction or early C-section (row 3) and NICU admission is non-missing.
Low Birth Weight at 37+ Weeks (< 2,500g)	Birth weight less than 2,500g.	Births (1) where gestational age is non-missing and greater than 36 weeks,[a] (2) that are singleton births, (3) that occur in a hospital, (4) where birth weight is non-missing and consistent with the gestational age[c].

Source: Definitions developed by the Evaluation Contractor, based on the data available in 2009 Birth Data Files from the CDC, National Center for Health Statistics, Division of Vital Statistics, User Guide to the 2009 Natality Public Use File, available at [http://www.cdc.gov/nchs/data_access/Vitalstatsonline.htm]. National rates for 2009 were calculated with the 2009 U.S. births public-use file.

[a] Gestational age is measured as the interval between the first day of the mother's last normal menstrual period and the date of birth. Births where gestational age is missing (imputed) are excluded, even if a clinical estimate is provided, except in Arizona in 2011 where there was a data anomaly with the flag that identified imputed gestational ages.

[b] Very high (implausible) birth weight–gestational age combinations are not uncommon in Vital Records data; they are believed to be caused by miscoding of gestational age. Births are excluded that have inconsistent weight for gestational age according to the criteria published by Alexander et al. (1996, Table 1).

[c] Rate can be calculated only in states that have adopted the 2003 Revision of the U.S. Standard Certificate of Live Birth (33 states as of January 1, 2010).

Table D-50—Definitions of Control Variables from the NVSS Files Used in the Regression Analyses			
Variable	**Definition**	**Rolled Up to County Level**	**Included as Birth-Level Covariate**
Hospital Characteristics (Variables from the 2010 AHA Survey)			
Bed size or critical access hospitals (CAH)	CAHs; fewer than 100 beds (non-CAH); 100–199 beds (non-CAH), 200–399 beds (non-CAH); or 400 or more beds (non-CAH).	✓	✓
Ownership type	Ownership types included investor-owned (for-profit), non-government not-for-profit, federal government, and non-federal government. Given the smaller hospital samples included in the analyses, the variable for federal government ownership was not included in the falls models.	✓	✓
Has electronic health record (EHR) system	Full, partial, or no adoption of electronic health records. This variable was missing for a substantial portion of the sample. A "missing data" indicator was used in the model to avoid dropping the entire case from the regression model.	✓	✓
Census region	Census regions and their component states are: Pacific (CA, OR, WA), Mountain (AZ, CO, ID, MT, NM, NV, UT, WY), West South Central (AR, LA, OK, TX), East South Central (AL, KY, MS, TN), South Atlantic (DE, DC, FL, GA, MD, NC, SC, VA, WV), West North Central (IA, KS, MN, MI, NE, ND, SD), East North Central (IN, IL, MI, OH, WI), Mid Atlantic (NJ, NY, PA), and New England (CT, MA, ME, NH, RI, VT). U.S. territories located outside the 50 U.S. states and DC are categorized as "Associated Areas."	✓	✓

Table D-50—Definitions of Control Variables from the NVSS Files Used in the Regression Analyses			
Variable	**Definition**	**Rolled Up to County Level**	**Included as Birth-Level Covariate**
Urban/rural type	Whether the hospital was located in a rural county was determined by the Rural-Urban Commuting Area (RUCA) code. For hospitals not in rural areas, the type (size) of urban area was determined by the Core Based Statistical Area (CBSA) code (found in the AHA survey). With that approach, hospital location was identified as rural, metropolitan, micropolitan, or division.	✓	✓
Teaching hospital	Race/ethnicity was categorized into four mutually exclusive, collectively exhaustive categories: Hispanic, black non-Hispanic, white non-Hispanic, and other non-Hispanic.	✓	✓
Hospital belongs to a network	Binary indicators for yes; no†	✓	✓
Hospital belongs to healthcare system	Binary indicators for yes; no†	✓	✓
Rural referral center	Binary indicators for yes; no†	✓	✓
Intensivist, as percentage of total physicians	Binary indicators for yes; no†	✓	✓
Birth-Level Characteristics (Variables from the NVSS Natality File)			
Age of mother	Binary indicators for ≤ 17 Years, 18–19 Years, 20–34 Years†, and ≥ 35 Years.		✓
Race of mother	Binary indicators for White†, Black, American Indian/Alaskan Native, Asian/Pacific Islander, other (PR only), or Unknown/other.		✓
Mother's Hispanic origin	Binary indicators for Non-Hispanic†, Hispanic, or unknown.		✓
Mother's marital status	Binary indicators for Yes†, No, or unknown.		✓
Mother's education	Less than 12th grade with no diploma; high school graduate or GED completed; some college or associate degree; bachelor's degree or higher; or unknown.		✓
Adequacy of prenatal care—APNCU-2M index	Binary indicators if the VanderWeele et al (2009) Adequacy of Prenatal Care Utilization (APNCU) modified measure APNCU-2M index is "adequate" or "adequate plus" †; "inadequate" and "intermediate" categories; or Unknown or missing.		✓
Any cigarette smoking during pregnancy	Binary indicators for yes; no†; or unknown.		✓

Table D-50—Definitions of Control Variables from the NVSS Files Used in the Regression Analyses			
Variable	**Definition**	**Rolled Up to County Level**	**Included as Birth-Level Covariate**
Diabetes	Binary indicators for yes; no†; or unknown.		✓
Chronic Hypertension	Binary indicators for yes; no†; or unknown.		✓
Pregnancy Associated Hypertension	Binary indicators for yes; no†; or unknown.		✓
Eclampsia	Binary indicators for yes; no†; or unknown.		✓
Plurality	Binary indicators for Singleton†; Twin; Other multiple; unknown.		✓
Revised/Unrevised Birth Certificate	Binary indicators for data based on the 2003 revision of the U.S. Standard Birth Certificate (Revised)†; or Data based on the 1989 revision of the U.S. Standard Birth Certificate (Unrevised).		✓
Quarter in year	Quarter in year (1†/2/3/4).		✓
Pre-Intervention Outcomes			
Early induction or early C-section	2011 rate[a]	✓	
Early induction of labor or C-section	2011 rate[a]	✓	
Non-Medically Indicated Early Term Singleton Birth	2011 rate[a]	✓	
Early term singleton delivery	2011 rate[a]	✓	
APGAR score 0–6	2011 rate[a]	✓	
Assisted ventilation required immediately following delivery	Trend between 2009 and 2013[a]	✓	
Admission to NICU	Trend between 2009 and 2013[a]	✓	
Low birth weight at 37+ weeks	Trend between 2009 and 2013[a]	✓	

Table D-50—Definitions of Control Variables from the NVSS Files Used in the Regression Analyses			
Variable	**Definition**	**Rolled Up to County Level**	**Included as Birth-Level Covariate**
Early induction or early C-section	Trend between 2009 and 2013[a]	✓	
Early induction of labor or C-section	Trend between 2009 and 2013[a]	✓	
Non-Medically indicated early term singleton birth	Trend between 2009 and 2013[a]	✓	
Early term singleton delivery	Trend between 2009 and 2013[a]	✓	
Assisted ventilation required immediately following delivery	Trend between 2009 and 2013[a]	✓	
Admission to NICU	Trend between 2009 and 2013[a]	✓	
Low birth weight at 37+ weeks	Trend between 2009 and 2013[a]	✓	

Source: Developed by the Evaluation Contractor based on 2010 AHA survey and 2009–2013 NVSS Vital Records data.
† The "base" category for indicator variables in the birth-level analyses.
[a] For each measure, counties were categorized into one group based on their quartile. A dummy variable for each of these categories was entered into the model and interacted with the 2011 rate. In addition, the trend slope for each county between 2009 and 2013 was calculated and the counties were divided into four categories.

Methods

Estimating Trends

Regressions were used to estimate national time trends of the outcome measures that adjusted for patient demographics, risk factors, seasonality, measurement variation, and hospital characteristics (see Table D-50) for a complete list of variables and definitions). The regression-adjusted rates in each period were standardized based on demographics of the births in 2011 using linear probability regression models. The models were fitted to the data using ordinary least squares (OLS) estimation, with standard errors corrected for heteroskedasticity and clustered at the county level to correct for possible between-patient associations related to shared factors at the county level.

A difference-in-differences model was used for the impact evaluation. The difference-in-differences general econometric specification was of the following form (equation 1):

$$y_i = \delta\,(PFP_c * Post_t) + \gamma\,t_t + \theta\,x_i + \beta\,z_c + \varepsilon_i \quad (1)$$

where y_i is the outcome of interest for a birth occurring in county c in quarter t; the variable PFP_c is a dummy variable indicating the treatment group; $Post_t$ is a dummy variable indicating if the observation took place after PfP's Strong Start efforts began; t_t is a vector of quarterly dummy variables indicating the quarter in which the birth took place and that controls for seasonality effects; x_i is a vector of birth-level control variables that adjust for patient demographics, risk factors, and measurement variation; z_c is a vector of county fixed effects to control for all county-specific observed and unobserved factors that are stable over time; and e_{ct} is the error term. The coefficient δ is the coefficient of interest—the difference-in-differences estimate, which provides a statistical test for the differential effect of the PfP intervention on y_i between pre- and post-periods of PfP initiation.

Hospital Engagement Analysis Methodology

Relationship Between Hospital Engagement with Their Hospital Engagement Network (HEN) and Outcomes (Survey Data and Medicare Claims)

This appendix section provides more detail about the sample, propensity score reweighting, and analytic method used in the analysis of the relationship between hospitals' engagement with Partnership for Patients (PfP) and outcomes as measured using survey data (for engagement) and Medicare fee-for-service (FFS) claims (for outcomes). The results of the analysis were presented in Chapter 5.

Sample

In spring 2012 and spring 2014, the Evaluation Contractor administered a national web-based survey to hospital staff—the *Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions*—in order to gather information not available through other sources on hospitals' efforts to improve outcomes focused on by PfP(see Appendix C for details).

For the engagement analysis, several exclusions were applied to the 2014 Survey sample prior to merging the sample with the Medicare claims. All children's hospitals that responded to the 2014 Survey were excluded from the sample because there are no (or negligible) Medicare claims data for these hospitals. For the central venous catheter-related blood stream infection (CRBSI) outcome, hospitals were excluded if they reported that they do not provide central line placement. Hospitals that responded to the survey but could not be merged to Medicare claims were also excluded from this analysis. The total number of hospitals, and associated discharges for the Patient Safety Indicators (PSI) outcomes, that were included in the analysis for each outcome are displayed in Chapter 5.

All HEN-aligned hospitals responded to the following question separately for relevant adverse event areas:

> *"In each of the following areas, please mark the response that best describes your hospital's level of engagement in patient safety activities sponsored or led by [auto-filled with HEN name or AHA/HRET/state hosp association name] in 2012-2013."*

HEN-aligned hospitals were characterized based on their responses to the question for readmissions and each of the three adverse event outcome areas examined in this analysis. A 4-category engagement variable was created and included the following categories: (0) not at all engaged; (1) minimally engaged; (2) moderately engaged; (3) fully engaged. Non-HEN-aligned hospitals were coded as "0-Not at all engaged." Separate dummy variables for each category of engagement were also created: "Fully engaged" was equal to 1 if the hospital was fully engaged and equal to 0 otherwise; "Moderately engaged" was equal to 1 if the hospital was moderately engaged and equal to 0 otherwise; and "Minimally engaged" was equal to 1 if the hospital was minimally engaged and equal to 0 otherwise.

Propensity Score Reweighting

The propensity score reweighting approach used for the analysis consisted of two steps. The first step was to estimate a propensity score model in which a hospital's level of engagement in HEN activities was a function of relevant hospital characteristics. Second, weights were constructed from the estimated propensity scores.

For the propensity score model, the Evaluation Contractor estimated the probability *p* (generalized propensity score) of a hospital's level of engagement (full, moderate, minimal, or none) in HEN activities as a function of observable hospital characteristics measured during the pre-PfP period using a multinomial logit model.[D-29] The pre-PfP characteristics included hospital characteristics from the 2010 American Hospital Association (AHA) Annual Survey such as urbanicity, size, ownership type, and teaching status, as well as patient demographics and baseline rates in the outcome measures from 2011 Medicare claims data. These characteristics are the same as those that were used for the main Medicare impact analyses and are described above in this appendix. Because the sample used for this engagement analysis was based on the 2014 Survey sample, the survey non-response adjusted weight was also included in the propensity score model (DuGoff et al. 2014). All of these predictor variables were entered into the multinomial logit model as predictors of the level of engagement. Separate propensity score models were estimated for each of the four outcomes (FFS 30-day all-cause readmissions, CRBSI [PSI-07], pressure ulcer [PSI-03], and venous thromboembolism (VTE) [PSI-12]) examined in this analysis. To maintain continuity with the impact regressions for the PSI outcomes (in which discharges are the unit of analysis and thus hospitals implicitly are weighted by the number of relevant discharges), hospitals were weighted by the number of discharges in the measure denominator in 2011.

The estimated coefficients from the multinomial logit model are used to calculate propensity scores for each hospital, which are the predicted probabilities that a hospital with its characteristics chooses a particular level of engagement. The inverse of the generalized propensity scores are then used as weights. In the multi-treatment model, the inverse of the generalized propensity score p for the actual treatment is defined as a sampling weight. Each hospital is assigned a weight for full, moderate, and minimal engagement.

Difference-in-Differences Analyses

The Evaluation Contractor compared change over time among hospitals with different levels of engagement in HEN activities using a regression-based difference-in-differences approach. This approach removes biases in estimated impacts that could result from any time-invariant differences between the treatment and comparison groups that remain after propensity score reweighting or from any factors unrelated to the HENs' activities that affect changes in patient safety and readmissions for both groups.

After creating the propensity score weights for each hospital in the sample, the Evaluation Contractor estimated difference-in-differences models as follows:

$$y_i = \omega_1\,(Full_h * Postyear_t) + \tau_1(Moderate_h * Postyear_t) + \sigma_1\,(Minimal_h * Postyear_t) + \gamma\, t_t + \phi\, w_i + \theta x_i + \beta z_h + \varepsilon_i \tag{1}$$

where the outcome variable, y_i, is measured for a hospital discharge ($_i$) occurring in quarter t in hospital h. The variable $Full_h$ is a dummy variable for whether the hospital where the discharge occurred reported being fully engaged in HEN activities for the outcome area on the 2014 Survey on Prevention of Adverse Events and Readmissions; $Moderate_h$ is a dummy variable for whether the hospital where the discharge occurred reported being moderately engaged in HEN activities for the outcome area; $Minimal_h$ is a dummy variable for whether the hospital where the discharge occurred reported being minimally engaged in HEN activities

D-29 The propensity score reweighting technique is designed for interventions that have various doses (or levels) of interventions that include multiple treatment arms (Imbens 2000, Cattaneo 2010).

for the outcome area; $Postyear_t$ is a dummy variable for whether or not the discharge occurred in 2012 or 2013 which allowed separate estimates for 2012 and 2013; t_t is a vector of quarterly dummy variables indicating the quarter in which the observation took place; and the estimated coefficients ($\gamma = [\gamma_1,\gamma_2,\ldots,\gamma_T]$) control for secular trends in the outcome variable. The regression model also includes patient-level covariates that control for demographics, patient risk factors, and characteristics of the hospital where the discharge occurred. The patient demographics (w_i) are age, gender, race/ethnicity. The patient risk factors (x_i) are comorbidities specific for each outcome variable and were chosen in accordance with the risk factors used by the PSI algorithms. The regression model also includes hospital-level characteristics as a vector of hospital dummies (z_h)—also known as hospital fixed effects—to control for all hospital-specific observed and unobserved factors that are stable over time. Finally, ε_i is an error term. The equation above is specified for the multi-treatment model, but it follows the approach used for the main Medicare impact analyses described in detail in this appendix.

The equation above is specified for the discharge-level outcomes (CRBSI, pressure ulcer, and VTE), but the Evaluation Contractor used a hospital-level model for the readmissions outcome. In this hospital-level model, there was one observation for each hospital for each year and the outcome variable ranged from zero to one. The patient demographics and comorbidities were aggregated to the hospital-level for each year, but otherwise the analyses were similar to those for the discharge-level outcomes.

The difference-in-differences model was estimated three times for each outcome to weight for full, moderate, and minimal engagement. Because the hospitals responding to the Evaluation Contractor's survey were used for these analyses, the survey non-response adjusted weights were also used as weights in the regression models (DuGoff et al. 2014).

The coefficient on the interaction term ($Full_h$*$Postyear$) from the equation above from the model weighting for full engagement captures the estimated effect of HEN activities for fully engaged hospitals, relative to non-engaged/non-HEN-aligned hospitals, for each outcome, after controlling for fixed differences between groups and secular trends. The coefficient on the interaction term ($Moderate_h$*$Postyear$) from the equation above from the model weighting for moderate engagement captures the estimated effect of HEN activities for moderately engaged hospitals, relative to non-engaged/non-HEN-aligned hospitals. Likewise, the coefficient on the interaction term ($Minimal_h$*$Postyear$) from the model weighting for minimal engagement captures any relative effect of minimal engagement.

Dose-Response Methodology

Over the course of the Partnership for Patients (PfP) campaign, the Hospital Engagement Networks (HENs) strove to deliver resources, services, connections, and support to aligned hospitals in order to increase patient safety and reduce harms. The efforts of the HENs, however, could only have an impact on patient outcomes if aligned hospitals participated in the intervention activities the HENs provided. Chapter 5 uses a dose-response metaphor to conceptualize the relationship between hospital participation in HEN-sponsored patient safety activities (the "dose") and HEN-level patient outcomes (the "response"). More specifically, the report section addresses the question: "Were higher levels of hospital participation associated with larger or faster reductions in adverse events?"

Reductions in adverse events were assessed using three metrics:

- The percentage of PfP outcome measures that met campaign harm reduction goals
- The average percentage improvement in PfP outcome measures
- The time required to meet campaign goals

This appendix section provides details on the research methods used to assess the relationship between hospital participation and these three metrics of improvement.

Data Sources

The primary data sources for this section were the Survey of Hospital Participation in Patient Safety Activities and the Evaluation Contractor's cross-sectional and longitudinal HEN-level data files. See Appendix B for background information on these data sources.

The "Dose": Calculating the Proportion of Hospitals Participating in Patient Safety Activities

The "dose" portion of the Dose-Response analyses—the percentage of hospitals in a HEN participating in each of six types of patient safety activities with respect to an adverse event area (AEA)—was computed from the responses of aligned hospitals to the Survey of Hospital Participation in Patient Safety Activities. The percentages of hospitals participating in patient safety activities in each HEN cohort/AEA combination were calculated for the following activities:[D-30]

- Skills training
- Value-added networking with other hospitals
- Virtual consultation or coaching
- On-site visits
- Feedback on patient safety performance data
- Other education and resources

To ensure that analyses were conducted with reliable measures of dosage, a minimum HEN/cohort response rate threshold of 65 percent was adopted.

[D-30] These survey items were administered in a checklist format. If a hospital respondent did not check at least one AEA or supplementary list item (where "Hospital did not participate in skills training or no such activity or resource was offered" was included as a response option), they were regarded as having "skipped the page," an indicator of nonresponse.

The overall survey response rate is discussed in Appendix C. For the Dose-Response analyses, response rates were calculated at the cohort level for the HENs that reported their data by cohort (Ascension, JCR, Michigan, and Ohio Children's HENs), and at the HEN level for all others. The hospital list compiled by the Evaluation Contractor for November 2014 was used to determine the number of PfP-eligible hospitals in each HEN and cohort and to determine the PfP eligibility of all responding hospitals. Hospitals with unknown PfP eligibility were included in response rate calculations.

As shown in Table D-51, 21 of 30 HENs and cohorts were included in the Dose-Response analyses. Of the remaining 9 HENs and cohorts, 4 were excluded because of low response rates and 5 were excluded because the HENs chose not to participate in the survey. Because 9 of 30 HENs and cohorts were excluded from the analyses described below, the corresponding results may not be representative of the PfP campaign as a whole.

Table D-51—Survey Response Rate, Inclusion in Dose-Response Analyses, and AEAs with Unknown Eligibility, By HEN

HEN	Response Rate	Included in Analyses	AEAs with Unknown Eligibility
AHA/HRET	69.37		(See Notes)
Ascension Cohort 1	78.26		
Ascension Cohort 2	82.76		
Carolinas	82.14		
DFW	57.14	No	
Dignity	69.44		
EHEN	95.65		Central Line-Associated Blood Stream Infection (CLABSI)
Georgia	82.73		
Iowa	76.98		
JCR Cohort 1	75.00		
JCR Cohort 2	92.86		
Intermountain	-	No	
LifePoint	72.22		CLABSI
Michigan Cohort 1	75.00		
Michigan Cohort 2	-	No	
Minnesota	73.68		CLABSI, obstetrical early elective deliveries (OB-EED), other obstetrical adverse events (OB-Other), surgical site infections (SSI), ventilator-associated pneumonia (VAP)/ventilator-associated event (VAE)

Table D-51—Survey Response Rate, Inclusion in Dose-Response Analyses, and AEAs with Unknown Eligibility, By HEN			
HEN	**Response Rate**	**Included in Analyses**	**AEAs with Unknown Eligibility**
Nevada	75.00		
New Jersey	67.74		
New York	70.86		CLABSI
NoCVA	-	No	
Ohio	73.53		CLABSI, OB-EED, OB-Other, SSI, VAP/VAE
Ohio Children's Cohort 1	-	No	
Ohio Children's Cohort 2	-	No	
Pennsylvania	26.61	No	
Premier	72.24		
TCQPS	17.33	No	
Tennessee	60.66	No	
UHC	69.89		
VHA	72.47		
Washington	73.12		

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015.
Notes: The response rate for HENs that did not participate in the survey was listed as "-". The percentage base for AHA/HRET was the full count of aligned hospitals without respect to state hospital association (SHA) membership. Hospitals aligned with the Alaska State Hospital & Nursing Home Association responded (n = 13) but did not provide hospital identifiers, so eligibility was unknown for CLABSI, OB-EED, OB-Other, SSI, and VAP/VAE. Hospitals from the Alaska SHA did not contribute to estimates in that set of AEAs.

The hospital list maintained by the Evaluation Contractor included information about hospital eligibility to contribute data for each AEA.[D-31] A small number of HENs administered the survey on behalf of the Evaluation Contractor to protect the confidentiality of aligned hospitals and limited the ability of the Evaluation Contractor to link responding hospitals to their information in the hospital list. When this occurred, it was not possible to determine hospital eligibility to contribute data to certain AEAs. Survey responses regarding hospital participation in activities with respect to a specific AEA were disregarded if the hospital's eligibility for the AEA was unknown.

All PfP-eligible hospitals in the November 2014 list were eligible to contribute data on adverse drug events (ADEs), catheter-associated urinary tract infection (CAUTI), falls, pressure ulcers, and readmissions. However, the EHEN, LifePoint, and New York HENs regularly submitted deidentified hospital lists that prevented determination of their hospitals' eligibility to submit data on infection CLABSI. Because aligned

[D-31] A hospital with a Z-5 score of 0 or above for an AEA was considered eligible to contribute data for that AEA.

hospitals' eligibility to contribute data on CLABSI was unknown, their survey responses on activities respecting CLABSI were disregarded.

Two additional HENs—Minnesota and Ohio—administered the survey on behalf of the Evaluation Contractor, resulting in data submissions without the hospital identifiers necessary to determine eligibility. Aligned hospitals' eligibility to contribute to CLABSI, OB-EED, OB-Other, SSI, and VAP/VAE could not be determined, and therefore their survey responses regarding activities for those AEAs were disregarded. As noted in Table D-51, eligibility for these AEAs could not be determined for a small number of AHA hospitals as well.

While the percentages of hospitals participating in HEN activities represents one measure of dosage with respect to the administration of a "treatment", another possible dosage measure is the percentage of hospitals that made changes to the process of delivering health care. This measure captures the dosage of the treatment that makes it to the patient. The percentages of hospitals that reported taking action or changing policies in order to improve patient safety were also calculated from the Survey of Hospital Participation in Patient Safety Activities. These survey items, however, were not constructed in a way that allowed detection of nonresponse, so no nonresponse adjustments were made to the denominators. [D-32]

The "Response": Improvement Metrics

As mentioned previously, reductions in adverse events for calculating the response were assessed using three metrics:

- The percentage of PfP outcome measures that met campaign harm reduction goals
- The average percentage improvement in PfP outcome measures
- The time required to meet campaign goals

These metrics of improvement were computed as detailed below.

Note that, as described in Appendix B, all measures were classified into one of two reporting statuses: widely reported and consistent, and less-widely-reported or inconsistent. All analyses were conducted separately for each reporting status; only the results for widely-reported and consistent measures were presented in detail in that section.

Improvement Metrics Computed at the HEN/AEA Level

The HEN-level cross-sectional file described in Appendix B was used for the analyses of the first two improvement metrics: the percentage of PfP outcome measures that met campaign harm reduction goals and the average percentage improvement in PfP outcome measures.

The percentage of measures meeting goal was calculated for two different sets of goals: the 17.6 percent/10 percent goals of 17.6 percent reduction in inpatient adverse events and a 10 percent reduction in readmissions, and the 40 percent/20 percent goals of a 40 percent reduction in inpatient adverse events and a 20 percent reduction in readmissions. To calculate the percentage of measures meeting 17.6 percent/10 percent or 40 percent/20 percent goals, target rates for each measure were calculated relative to the baseline rates provided in the cross-sectional file. For all PfP outcome measures, the direction of improvement is negative, so

[D-32] Failure to check any items is interpreted as "no changes were made."

$$target\ rate = \frac{(100 - reduction\ target)}{100} \times baseline\ rate \qquad (1)$$

where the reduction target is 17.6 percent or 40 percent for inpatient adverse event measures and 10 percent or 20 percent for readmission measures. If the current rate for a measure as defined in the cross-sectional file was less than or equal to the target rate, the measure met the goal.[D-33] For example, a readmissions measure met the 40 percent/20 percent goals if $current\ rate \leq (.80 \times baseline\ rate)$.

The percentage of measures meeting goal was then calculated within groups of measures defined by HEN cohorts, AEA, and reporting status. For example, if 3 of 6 widely-reported ADE measures and 1 of 3 less-widely-reported ADE measures from the AHA/HRET HEN had met 17.6 percent/10 percent goals, the percentage meeting goal for the former would be 50.00 percent and the percentage meeting goal for the latter would be 33.33 percent.

The percentage improvement in a single measure was calculated as

$$percentage\ improvement = 100 \times \frac{current\ rate}{baseline\ rate} \qquad (2)$$

The average percentage improvement in measures was calculated by averaging the individual measures by HEN, AEA, and reporting status.

Improvement Metrics Computed at the Measure Level

The HEN-level longitudinal file was used to calculate the third improvement metric: time to goal. Time to goal in months was established using a regression method described below. As with the percentage of measures meeting goal, time to goal was computed for both 17.6 percent /10 percent goals and 40 percent /20 percent goals.

The longitudinal file contain fewer measures than the cross-sectional file because the longitudinal file includes only measures with at least 8 current observations.

Using ordinary least squares (OLS) regression, the measure rate for each measure was individually regressed on time (in months) with the first current month = 1, using the regression equation

$$rate_i = \beta_0 + \beta_1 time_i + e_i \qquad (3)$$

where *i* is the individual measure. The target rate for each measure was calculated using equation 1 above.

If the predicted measure rate for the end of the measure series was at or below the target rate, the measure was considered to have met goal. Time to goal for measures that met goal was calculated by rearranging equation 3 and setting *rate* = *target rate*:

$$time\ to\ goal = \frac{target\ rate - \beta_0}{\beta_1} \qquad (4)$$

Equation 4 was solved and time to goal was rounded up to the next full month.

D-33 For historical reasons, the post-baseline period is referred to as the "current period" and the calculated rate for the final 60-90 days of the measure series is referred to as the "current rate."

Two special cases were identified and handled as follows: First, if the measure rate was improving over time (decreasing) and the predicted time to goal was less than 1 month, the time to goal was set to 1 month. Second, if the measure rate began below the goal rate calculated from the baseline, was worsening over time but the predicted rate never exceeded the target rate, the measure was considered to have met goal and the time to goal was set to 1 month.

Measures and Observations

The analyses of the percentage of measures meeting goal and the average percentage change in measures were based on summaries for all measures in an AEA within a HEN, calculated separately by reporting status. While there are 330 possible HEN-AEA combinations for each reporting status (with 26 HENs and 4 additional cohorts and with 11 AEAs, there are $30 \times 11 = 330$ combinations), a number of combinations do not appear in the data because not all HENs reported PfP outcome measures for all AEAs, and even for those HENs that did report measures in all AEAs, some reported only measures that fell in one reporting status or the other. As can be seen in Table D-52, there were only 274 HEN/AEA combinations representing 844 widely-reported measures in the cross-sectional data. After dropping measures due to HEN-level nonresponse and the unknown eligibility of hospitals for specific AEAs, only 175 HEN/AEA combinations representing 564 widely-reported measures were analyzed for percentage of measures meeting goals.

For the analyses of time to goal, longitudinal data were used and analyzed at the measure level rather than the HEN/AEA level. Of 740 widely-reported PfP outcome measures in the longitudinal data, 519 were analyzed for time to goal. The 29.86 percent drop in measures between the available data and those analyzed was, as above, due to survey nonresponse and unknown eligibility of hospitals for certain AEAs.

Table D-52—Measures and HEN/AEA Summary Observations

	Widely Reported and Consistent Measures		Less-Widely Reported or Inconsistent Measures	
	HEN/AEA Combinations	Measures	HEN/AEA Combinations	Measures
Possible HEN/AEA Combinations	330		330	
Cross-Sectional Data	274	844	202	639
Analyzed for Percentage Meeting Goal	175	564	132	463
Longitudinal Data		740		525
Analyzed for Time to Goal		519		417

Source: Evaluation Contractor analysis of HEN-level data submitted by HENs, Centers for Medicare & Medicaid (CMS)/Medicare, National Healthcare Safety Network (NHSN), and National Database of Nursing Quality Indicators® (NDNQI®).[D-34]

Notes: Longitudinal data were not summarized at the HEN/AEA level for the time to goal analyses and therefore the number of HEN/AEA combinations are not reported.

[D-34] NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

Regression Analyses: Improvement Metrics Computed at the HEN/AEA Level

For the analyses of the percentage of measures meeting goals, generalized least squares (GLS) regression was used. GLS allows adjustment of standard errors to account for clustering of observations. Adjustments were made for clustering at the HEN level. In addition, observations were weighted by the number of PfP outcome measures reported by the HEN for the AEA in the reporting status. Each observation was an AEA within a HEN for a reporting status. For the percentage of measures meeting goals, the regression model takes the following form:

$$y_{ij} = \beta_0 + \beta_p X_{pij} + \sum_{a=1}^{A-1} \beta_a X_a + \sum_{h=1}^{H-1} \beta_h X_h + \varepsilon_{ij} \qquad (5)$$

where

y_{ij} is the percentage of outcome measures meeting the goals (17.6 percent/10 percent or 40 percent/20 percent) for AEA *i* and HEN *j*.

β_0 is the percentage of measures meeting the goals for the Georgia HEN in the OB-Other AEA (these reference categories were selected because they were consistently near the middle of the distribution across outcome variables and reporting statuses) when the percentage of hospitals participating in activity *p* equals 0.

β_p is the change in the percentage of measures meeting the goals associated with a 1 percentage point change in hospitals participating in activity *p* .

β_a is the difference in the percentage of measures meeting the goals associated with AEA *a* relative to OB-Other AEA.

β_h is the difference in the percentage of measures meeting the goals for HEN *h* relative to the Georgia HEN.

X_{pij} is the percentage of eligible hospitals that reported participating in activity *p* in HEN *i* and AEA *j*.

X_a is a dummy variable indicating the observation is associated with AEA *i*.

X_h is a dummy variable indicating the observation is associated with HEN *j*.

ε_{ij} is an error term distributed N ~ (0, σ).

The model presented in Equation 4 allows for estimation of the association between HEN activities (*p*) and the proportion of measures exhibiting reductions that meet goals. The key coefficients from Equation 1 are the βp, which represent the elasticity between hospital participation rates and the percentage of measures meeting interim goals.

For each model specification, DFBETAs were computed in order to identify highly influential outliers for the percentage of hospitals participating in activity *p*. These were computed using Weighted Least Squares (WLS) regression with weights for the number of measures included but without clustering adjustments. A threshold of ±0.2 was used to identify highly influential observations (slightly more conservative than the conventional threshold for DFBETAS of $\pm 2/\sqrt{n}$). Roughly 5-7 observations were removed per model, which was then refit with GLS as described above.

The same procedures were used for the average percentage improvement in measures metric. The interpretation of regression coefficients is equivalent.

Multicollinearity

In initial bivariate analyses, the Evaluation Contractor found that most of the measures of measures of hospital participation in patient safety activities were at least moderately correlated with each other. Plans to test the joint association of these variables with outcome improvement metrics hinged on tests of multicollinearity among these predictors. The variance inflation factor (VIF) diagnostic was used as an indicator of multicollinearity in models with two or more indicators of hospital activity p using specifications similar to equation (4) above. VIFs for these variables in tested models were high. For example, in a model with percentage meeting 17.6 percent/10 percent goals as the dependent variable, controlling for HEN and AEA and examining widely-reported measures only, the VIFs ranged from 13.84 for other education and resources to 25.90 for virtual consultation or coaching. Levels of VIF higher than 3.0 are typically seen as needing attention and levels higher than 10.0 are interpreted as indicating problematic levels of multicollinearity. In addition, when included in a single regression model, multiple measures of hospital participation in patient safety activities showed marked indications of multicollinearity such as reversed signs relative to models with single predictors. Given the high degree of multicollinearity, the Evaluation Contractor decided to fit models separately with each individual measure of hospital participation in patient safety activities.

Regression Analyses: Time to Goal

For the time to goal improvement metric, Cox proportional hazards models were fit. Robust standard errors were computed using a "sandwich" estimator for the covariance matrix. These models were of the form:

$$h_i(t) = \lambda_0(t)\exp\left(\beta_p X_{pi} + \sum_{a=1}^{A-1}\beta_a X_a + \sum_{h=1}^{H-1}\beta_h X_h\right) \tag{6}$$

where

$h_i(t)$ is the hazard of meeting goal at time *t* for measure *i*.

$\lambda_0(t)$ is the baseline hazard function for the time-to-goal.

β_p is the log hazard ratio associated with a 1 percentage point change in hospitals participating in activity *p*. Because this is a continuous covariate, the estimated percentage change in the hazard of meeting goal associated with a 1 percentage point change in hospitals participating in activity p is $100 \times \left(e^{\beta_p} - 1\right)$.

β_a is the log hazard ratio associated with a measure in AEA a relative to the OB-Other AEA reference category. That is, e^{β_a} is the ratio of the estimated hazard of meeting for a measure in AEA a to the estimated hazard of meeting goal for a measure in the OB-Other AEA.

β_h is the log hazard ratio associated with a measure in HEN h relative to the Georgia HEN reference category.

X_{pi} is the percentage of eligible hospitals that reported participating in activity p in the HEN and AEA associated with measure i.

X_a is a dummy variable indicating the observation is associated with AEA a.

X_h is a dummy variable indicating the observation is associated with HEN h.

There is no intercept or error term. All other terms are as described in the previous section.

For each model fit, DFBETAS diagnostics were computed in order to identify highly influential outliers for the percentage of hospitals participating in activity p. Using the conventional threshold for DFBETAS of $\pm 2/\sqrt{n}$, none were found.

To test for violations of the proportional hazards assumption with regard to the percentage of hospitals participating in activity p, the models shown in equation 5 were fit, separately for each reporting status, and Schoenfeld residuals were computed for the percentage of hospitals participating in activity p. The correlation of the residuals with linear term t and quadratic term t^2 were computed and tested for statistical significance (α = .05). When a significant result was found for an activity p for a specific reporting status, two additional models were fit; one with a linear interaction term and one with both a linear and a quadratic interaction term. Terms for linear and quadratic time t and t^2 were not entered into the models. The full model with linear and quadratic interaction terms is:

$$h_i(t) = \lambda_0(t)\exp\left(\beta_p X_{pi} + \beta_{pt} t X_{pi} + \beta_{pt^2} t^2 X_{pi} + \sum_{a=1}^{A-1} \beta_a X_a + \sum_{h=1}^{H-1} \beta_h X_h\right) \quad (7)$$

where β_p, β_{pt}, and β_{pt^2} are each components of the implicit time-dependent function *P(t)*.

The coefficients cannot be interpreted independently or each other or time; rather, the estimated change in the hazard of reaching goal associated with an X percentage point increase in the proportion of hospitals participating in activity p at time t is:

$$100 \times \left(\exp(\beta_p X + \beta_{pt} t + \beta_{pt^2} t^2 X) - 1\right) \quad (8)$$

Models were only fit for instances where the correlation test indicated a significant interaction. Quadratic terms were only retained if the corresponding coefficient was statistically significant (α = .05) and Schwartz's Bayesian Criterion (SBC) was at least 2 points lower for the full model than the models with only a linear term and the model without interaction terms. If the Quadratic term was not significant but the linear term was, the linear term was retained if the SBC for the model with the linear interaction was at least 2 points lower than for the model without interactions.

All measures analyzed were reported either monthly or quarterly throughout the current period. This analysis was conducted in terms of months to goal, regardless of the periodicity of the underlying measure.

Limitations

The analyses reported in Chapter 5 have a number of limitations that may affect interpretation of their results. First, although the "dose"—the participation of each hospital in six types of activities—was measured in the Survey of Hospital Participation in Patient Safety Activities at the hospital level, the improvement metrics were measured at the HEN level. If the metrics had been available at the hospital level, it would have been possible to directly assess the relationship between the hospital's behaviors and its outcomes. Instead, using aggregate activity data, these analyses assess the relationship between the overall activity of the HEN and overall outcomes for the HEN in a given AEA.

Second, the way the "dose" was measured placed additional limits on the types of analyses that could be conducted. One of the primary limitations regarded timing: hospitals identified only whether they participated in six types of activities, not when they began or stopped participating. Omission of the time element precluded analyses linking timing of activities to timing of outcomes.

Information about timing could have made multicollinearity less of a problem. The multicollinearity detected among the "dose" variables is a result of the tendency of the hospitals within a HEN as a whole to engage in multiple activities in an AEA if they engaged in any activities in that AEA at all. That there were moderate-to-high correlations between the percentages of hospitals participating in each type of activity is positive from the perspective that aligned hospitals should use all available resources to make patient safety improvements. On the other hand, when there are statistically significant associations between participation in two or more activity types and an improvement metric, the multicollinearity precludes an assessment of whether the association is accounted for mainly by one of the activity types or by all of them together. If the hospitals had engaged in these activities at different times, however, and if the timing was known, a time series analysis would be better suited to disentangled the relationships of the variables to improvement metric.

As noted above, because reliable survey data were not available for 9 of 30 HENs and cohorts and because difficulties with determining eligibility prevented the use of measures from specific AEAs within certain HENs, the results of the Dose-Response analyses may not be representative of the PfP campaign as a whole. Whether the lack of data for these HENs and AEAs biases results in any particular direction is unknown. It is known, however, that had data been available for all HENs and AEAs, the power of these analyses to detect associations between hospital participation in patient safety activities and improvement metrics would have been higher.

As discussed above and in Chapter 5, the regression models fit for this section were sensitive to model specification and to the particular observations included in the analysis. For some of the models, the difference between a moderately large coefficient with a significant *p*-value and a smaller coefficient with a non-significant *p*-value was a handful of influential observations. The sensitivity of the models and the small degree of consistency between results for widely-reported measures and results for other measures suggest that measurement problems have reduced the extent to which it is possible to draw conclusions about the relationship between dose and response.

Analysis of Medicare Patient Safety Monitoring System (MPSMS) Data Methodology

The Evaluation Contractor compared change over time among Hospital Engagement Network (HEN)-aligned and comparison group hospitals using a regression-based difference-in-differences approach. The difference-in-differences analyses with MPSMS data were conducted with patient discharges as the unit of analysis. For each outcome, the sample was limited to hospital discharges that were applicable ("at risk") for the given adverse event—that is, the "denominator" for estimating a particular adverse event rate varied from outcome to outcome.

For adverse event outcomes, the difference-in-differences (logit) regression specification for the MPSMS analysis has the following form:

$$\Pr(y_i = 1) = F(\delta(PFP_h * Post_t) + \mu\, PFP_h + \gamma\, t_t + \theta\, x_i + \beta\, z_h) \qquad (1)$$

where the outcome variable, y_i, is measured for a hospital discharge (i) occurring in quarter t in hospital h. The variable PFP_h is a dummy variable for whether or not the hospital where the discharge occurred was aligned with a HEN as of June 2012 ; $Post_t$ is a dummy for whether or not the discharge occurred after December 31, 2011; t_t is a vector of quarterly dummy variables indicating the quarter in which the observation took place; and the estimated coefficients ($\gamma = [\gamma_1, \gamma_2, \ldots, \gamma_T]$) control for secular trends in the outcome variable.[D-35] The remaining variables (x_i and z_h) are control variables, which are listed in Appendix B, Table B-5. It was important to control for patient and hospital characteristics because the sample of hospitals and patients varies from year to year—MPSMS includes a different set of hospitals in each year, and a small sample of patients are then randomly selected within each hospital. Patient–level control variables used in the analysis (x_i) included basic patient demographics (age, gender, race, and ethnicity), insurance (Medicare or other), and the date of discharge. Other variables characterizing the hospital stay included indicators for which of the four categories of conditions (Acute Myocardial Infarction [AMI], Heart Failure [HF], Pneumonia [PN], or Surgical Care Improvement Project [SCIP]) the hospital chart was sampled for MPSMS, medical or surgical stay, major diagnostic category, comorbidities (through the Elixhauser comorbidity score), and the date of admission (see the footnotes to Appendix B, Table B-5 for further details). For the composite outcome measures, the patient-level controls (x_i) also included an array of dummy variables that indicated whether a patient was considered "at-risk" for each of the contributing adverse event measures. Several hospital characteristics (z_h), such as region in the country, urban or rural location, membership in a health care system, and so on, were used as control variables in the analysis. This hospital-level information was obtained by merging the American Hospital Association (AHA) survey data (Appendix B).

Because the hospitals included in the MPSMS varied from year-to-year, there are two major differences between the MPSMS analyses and the (frequentist) analyses with Medicare claims. First, the Evaluation Contractor did not employ inverse propensity weighting for the analyses with MPSMS. Each discharge received a weight of one. Second, hospital fixed effects were not included in the primary regression model (although they were included in one of the robustness checks). Because fixed effects were not included in the

[D-35] Due to the rare occurrence four outcome variables, annual dummies were used instead of quarterly dummies, for the corresponding four outcome variables. Of these four variables were adverse drug events associated with digoxin, adverse drug events hospital acquired antibiotic associated clostridium difficile, hospital acquired methicillin-resistant staphylococcus aureus, and hospital acquired vancomycin resistant enterococcus.

regression and because the MPSMS sample sizes were relatively small, the Evaluation Contractor was able to use logit models to fit these regression models.[D-36]

The coefficient on the first interaction term ($PFP_h * Post_t$) leads to the impact estimate. This coefficient, δ, captures how the change in an outcome among hospitals that signed up to work with a HEN differs from the change in that outcome among non-HEN-aligned hospitals—holding constant differences between hospitals' outcomes at baseline, differences in the characteristics of patients served, differences in stable hospital characteristics that could influence change in outcomes, and external factors that could influence changes over time in outcomes across hospitals in both groups. To present the main findings, the Evaluation Contractor calculated mean marginal effects by averaging each patient's difference-in-differences estimate across the patients with $PFP_h = Post_t = 1$ (that is, an average treatment effect on the treated patients was calculated). To account for repeated measures within hospitals and heteroskedasticity, the Delta Method was used to calculate robust standard errors, clustered by hospital. Subgroup analyses were conducted by introducing interaction terms.

[D-36] In a logit model, $F(u) = \exp(u)/(1 - exp(u))$. For the outcome "number of adverse events," a linear model was used instead $(F(u) = u)$.

Survey Analysis Removing Spillover Methodology

This appendix section provides more detail about the sample, propensity score reweighting, and analytic method used in the analysis of survey data removing spillover, whose results were presented in Chapter 4.

Sample

Appendix C provided details about the *Hospital Survey on the Prevention of Adverse Events and Reduction of Readmissions*, and Appendix B provided information about the Medicare fee-for-service (FFS) claims data, the two data sources used in this analysis. For the spillover analysis, a number of exclusions were applied to the 2014 Survey sample prior to merging the sample with the Medicare claims. All children's hospitals that responded to the 2014 Survey were excluded from the sample because there are no (or negligible) Medicare claims data for these hospitals. For all outcomes, non- Hospital Engagement Network (HEN)-aligned survey respondents were excluded from the comparison group if they responded that they were influenced by the Partnership for Patients (PfP) campaign. For the central venous catheter-related blood stream infection (CRBSI) outcome, hospitals were excluded if they reported that they do not provide central line placement. Hospitals that responded to the survey but could not be merged to Medicare claims were also excluded from this analysis. Chapter 4, Table 4-7, displayed the total number of hospitals, and associated discharges for the patient safety indicator (PSI) outcomes, which were included in the analysis for each outcome.

Propensity Score Reweighting

The propensity score reweighting approach used for the analysis consisted of two steps. The first step was to estimate a propensity score model in which being HEN-aligned was a function of relevant hospital characteristics. Second, weights were constructed from the estimated propensity scores to weight the non-HEN-aligned (comparison group) hospitals in order to make the hospitals similar to treatment (HEN-aligned) hospitals on observable characteristics.

For the propensity score model, the Evaluation Contractor estimated a logistic (logit) regression model to predict HEN-alignment as a function of observable hospital characteristics measured during the pre-PfP period. The pre-PfP characteristics included hospital characteristics from the 2010 American Hospital Association (AHA) Annual Survey such as urbanicity, size, ownership type, and teaching status, as well as patient demographics and baseline rates in the outcome measures from 2011 Medicare claims data. These characteristics are the same as those that were used for the main Medicare impact analyses and are described above in this appendix, Section 1. Because the sample used for the spillover analysis was based on the 2014 Survey sample, the survey non-response adjusted weight was also included in the propensity score model (DuGoff et al. 2014). All of these predictor variables were entered into the logit model as predictors of HEN-alignment, defined as a binary dependent variable that equals one for HEN-aligned hospitals and zero for non-HEN-aligned hospitals. Separate propensity score models were estimated for each of the four outcomes examined in the spillover analysis. To maintain continuity with the impact regressions for the PSI outcomes (in which discharges are the unit of analysis and thus hospitals implicitly are weighted by the number of relevant discharges), hospitals were weighted by the number of discharges in the measure denominator in 2011.

The estimated coefficients from the logit model are used to calculate a propensity score for each hospital, which is the predicted probability that a hospital with its characteristics chooses to participate in the program. These propensity scores are then used to construct a weight for each hospital. HEN-aligned hospitals receive a weight of one, and non-HEN-aligned hospitals (the comparison group) receive a weight equal to $p/(1-p)$, where *p* is the estimated propensity score. This formula assigns greater weight to comparison group hospitals that are similar to the treatment group hospitals and lower weights to comparison group hospitals that are not similar to treatment hospitals.

Difference-in-Differences Analyses

The Evaluation Contractor compared change over time among HEN-aligned and non-HEN-aligned hospitals using a regression-based difference-in-differences approach. This approach removes biases in estimated impacts that could result from any time-invariant differences between the treatment and comparison groups that remain after propensity score reweighting or from any factors unrelated to the HENs' work with hospitals that affect changes in patient safety and readmissions for both groups.

After creating the propensity score weights for each hospital in the sample, the Evaluation Contractor estimated difference-in-differences models as follows:

$$y_i = \delta\,(PFP_h * Postyear_t) + \gamma\, t_t + \phi\, w_i + \theta x_i + \beta z_h + \varepsilon_i \qquad (1)$$

where the outcome variable, y_i, is measured for a hospital discharge (i) occurring in quarter t in hospital h. The variable PFP_h is a dummy variable for whether or not the hospital where the discharge occurred was HEN-aligned as reported on the 2014 Survey on Prevention of Adverse Events and Readmissions; $Postyear_t$ is a dummy for whether or not the discharge occurred in 2012 or 2013 which allowed separate estimates for 2012 and 2013; t_t is a vector of quarterly dummy variables indicating the quarter in which the observation took place; and the estimated coefficients ($\gamma = [\gamma_1,\gamma_2,\ldots,\gamma_T]$) control for secular trends in the outcome variable. The regression model also includes patient-level covariates that control for demographics, patient risk factors, and characteristics of the hospital where the discharge occurred. The patient demographics (w_i) are age, gender, race/ethnicity. The patient risk factors (x_i) are comorbidities specific for each outcome variable and were chosen in accordance with the risk factors used by the PSI algorithms. The regression model also includes hospital-level characteristics as a vector of hospital dummies (z_h)—also known as hospital fixed effects—to control for all hospital-specific observed and unobserved factors that are stable over time. Finally, ε_i is an error term.

The equation above is specified for the discharge-level outcomes (CRBSI, pressure ulcer, and venous thromboembolism [VTE]), but the Evaluation Contractor used a hospital-level model for the readmissions outcome. In this hospital-level model, there was one observation for each hospital for each year and the outcome variable ranged from zero to one. The patient demographics and comorbidities were aggregated to the hospital-level for each year, but otherwise the analyses were similar to those for the discharge-level outcomes.

In the difference-in-differences models, observations from HEN-aligned hospitals received a weight of one, and observations from non-HEN-aligned hospitals received the propensity score–based weight for each outcome. Because the hospitals responding to the Evaluation Contractor's survey were used for these analyses, the survey non-response adjusted weights were also used as weights in the regression models (DuGoff et al. 2014).

The coefficient on the interaction term ($PFP_h*Postyear_t$) from the equation above captures the estimated effect of PfP interventions by year for HEN-aligned hospitals, relative to non-HEN-aligned hospitals, for each outcome, after controlling for fixed differences between groups and secular trends.

Quality Improvement Organization (QIO)/Partnership for Patients (PfP) Trends Data Sources

The data used in the analyses comparing PfP data to QIO data were derived from three sources. The quality improvement organization (QIO) participation data were obtained from Health Services Advisory Group (HSAG), the QIO for the states of California, Arizona, Florida, and Ohio. The measure rates used in the analysis were obtained through calculations from Medicare claims data. Finally, the Partnership for Patients (PfP) participation list was obtained from the November 2014 hospital list developed by the Evaluation Contractor, and based on the Hospital Engagement Networks (HENs) identification of hospitals participating in the PfP campaign.

Methodology

The methodology used by the Evaluation Contractor would ideally examine hospital-level trends in rates of patient harms, and allow for differentiation based on facility-level characteristics. In the current research, the analysis focuses on the quality improvement program affiliation of the hospitals in the sample: PfP-only, QIO-only, or both or neither. The section below describes the analytic strategy used for the analyses.

Hierarchical Generalized Linear Model (HGLM)

The descriptive analyses presented in Chapter 2 are based on a comparison of the weighted average rates for each outcome across the relevant group of hospitals. The rates are implicitly weighted, in that the rate for each group in each period is constructed by summing the numerators and denominators across hospitals first, and then calculating the rate from the summations. However, further analyses comparing the rates across groups would suffer from two drawbacks. First, comparison based on the group averages alone effectively assumes that all hospitals within each group exhibited the same trends. This assumption may not be true, but can be empirically verified. Second, if the analysis were restricted to only using the average group trends, then the amount of data for analysis would be very limited (i.e., in this case between 12 and 16 data points for each group depending on the measure). By focusing on the hospital-level trends, the Evaluation Contractor is able to increase the statistical power of the analysis by using all of the data for each individual hospital.

The analyses were optimized to make use of all of the available data, capture all of the variability in hospital-level outcome trends, and test for differences in group-level trends. Additionally, given the rarity of the outcome events (i.e., as low as 0.31 per 1,000 discharges) the analytic strategy should be capable of modeling outcomes based on counts of discrete events over time. For this reason, the analytic strategy chosen was a two-level hierarchical generalized linear growth-curve model using a negative binomial sampling distribution.[D-37] Formally the model for the HGLM is:

$$\ln(\lambda_{it}) = \beta_{0i} + \beta_{1i}(PfP_{it}) + \beta_{2i}(Time_{it}) + \beta_{3i}(PfP * Time_{it}) + \sum_{k=4}^{6}\beta_k\delta_{kit} + u_{0i} + u_{2i}(Time_{it}) + e_{it} \quad (1)$$

where the outcome count, y_{it} is distributed: $y_{it} \mid e_{it} \sim Negative\ Binomial(\lambda_{it}, \phi)$ (2)

and the error term is distributed: e_{it} i.i.d. $N(0, \sigma_e^2)$ (3)

[D-37] Raudenbush, Stephen W. and Anthony S. Bryk. 2002. Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage.

In Equation 1, the count of events is modeled using the denominator number of cases as an offset variable, with its coefficient constrained equal to 1. The variable PfP_{it} is a dummy variable indicating that a hospital participated in the PfP campaign only, and participation with a QIO only is the reference category. The Evaluation Contractor restricted analyses to these two groups initially in order to assess whether the group trends differed absent any potential confounding of treatment effects. The variable $Time_{it}$ is a linear trend used to estimate the trend in the outcome for hospitals that worked only with a QIO. The interaction term $PfP{*}Time_{it}$ is used to assess the difference in trends exhibited by hospitals that only participated in *PfP* relative to those that only worked with a QIO. The vector of δ variables represents a series of dummy variables controlling for the state where the hospital is located, with California serving as the reference category. The error term is decomposed into three parts: u_{0i} is the deviation of hospital *i* from the grand mean outcome rate for California hospitals working with the QIO, u_{2i} is the hospital-specific deviation from the average time trend associated with QIO hospitals, and e_{it} is the usual normally distributed error term.

After estimating the model presented in Equation 1, the intercept β_{0i} represents the natural log of the average measure rate, λ_{it}, for hospitals that worked only with a QIO. The coefficients β_{4i} through β_{6i} represent the change in the logged rates associated with a 1-unit change in the relevant covariate. Thus, the coefficient β_{1i} represents the increment or decrement to the log of the average rate associated with a hospital's participation with the PfP campaign. Therefore, hospitals participating in the PfP campaign will be estimated to have average measure rate [exp(β_{1i} – 1)*100] percentage points higher or lower than those working with the QIO program.

In addition to estimating the average level and trend in measure rates for PfP hospitals relative to QIO hospitals, the model estimated in Equation 1 also contains a random intercept for each hospital, u0i, and a random slope for the time trend for each hospital, u2i. The random intercept is assumed N(0, τ00), and the random Time slope is assumed N(0, τ11). The variance of the random effects is examined to determine whether or not there is significant variation in either the initial level of the measure or the trend in the measure across hospitals.

Interrupted Time Series (ITS) Cluster Analysis Methodology

Overview

Clustering refers to a broad set of techniques used for identifying patterns or subgroups in a data set. Observations are clustered into groups such that the observations within each cluster are similar across a number of metrics. Observations in different clusters are quite different from each other.[D-38] For this analysis, a bottom-up hierarchical algorithm was used to cluster observations into similar groups.

In this analysis, hospital engagement network (HEN)-level measures are treated as the observations. Data provided by each HEN on the timing and nature of activities it engaged in during the Partnership for Patients (PfP) campaign were merged with the outcome variables in their respective adverse event areas (AEAs). Because the time period for each activity was provided, the Evaluation Contractor was able to align the HEN activities with the observations for each outcome, and calculate how many activities occurred in a given month or quarter reported for an outcome. To further refine the analysis, trained reviewers with backgrounds in clinical quality improvement examined the HEN activity data and classified the activities each into one of 4 categories: tool dissemination, education, one-on-one coaching, and leadership transformation.

The outcome measures used for this analysis are the number of structural breaks identified by the interrupted time series (ITS) analysis, and the overall percentage improvement in patient safety indicators. The hierarchical clustering algorithm used for this analysis – Ward's Method – is described below.

Data

The data used in this analysis consist of a listing of activities that each HEN engaged in for a given AEA and when the HEN engaged in the activity. The lists of activities were provided by the HENs and varied in nature. For instance, a one-time webinar or call may be classified under coaching as an activity. Similarly, a monthly review of protocols over a 2 year time span may also be counted at the same level as daily feedback to physicians. These data were aggregated to provide a snapshot of the number of activities that each HEN engaged in at a given point in time for a specific AEA. An activity that took place monthly over a 2 year time period would count as one activity for each data point during that 2 year time period. In addition to the HEN submitted activity data, results from the ITS analysis were used as outcomes in order to help identify any association between number of activities and outcomes. Specifically, the Evaluation Contractor used the number of breaks found in the ITS and the overall percentage change in the rate from the baseline period to an average of the last three data points.

Bottom-Up Hierarchical Clustering – Ward's Method:

The algorithm proceeds as follows:

- Each of the n measures is treated as its own cluster and the distance between each cluster is calculated. Note: There are n clusters at this stage.
- This analysis uses the sum of squares between clusters as the distance metric (Ward's method), where the distance is calculated using the HEN activity measures described below.
- The two clusters that have the smallest distance (minimum sum of squares) are merged into a single cluster so that there are now $n – 1$ clusters.

[D-38] Aldenderfer, Mark S., and Roger K. Blashfield. 1988. Cluster Analysis. Thousand Oaks, CA: Sage Publications.

- The distance between each of the *n – 1* clusters is calculated.
- The two clusters that have the smallest distance are merged into a cluster so that there are now *n – 2* clusters.

The algorithm continues this process until all observations belong to a single cluster.

For purposes of this analysis, the Evaluation Contractor chose an R-squared threshold of 0.7 to define clusters. This threshold was chosen because many of the measures exhibited a fair amount of separation near that threshold and defined a low number of clusters.

Variables Used in Clustering

The Evaluation Contractor used eight variables to define clusters. Two variables for each of four broad activities (Tools, Education, Coaching, and Leadership) were computed for each HEN-measure combination. For each activity, the Evaluation Contractor computed the number of months a HEN engaged in the activity, and the percentage of data points that each HEN engaged the activity relative to the total number of data points. Table D-53 presents the descriptive statistics across all HENs and measures.

Table D-53—Descriptive Statistics for HEN Activity Exposure Variables

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Tools (Percent of Data Points)	1,557	46.6	37.5	0.0	97.1
Education (Percent of Data Points)	1,557	51.6	32.9	0.0	97.1
Coaching (Percent of Data Points)	1,557	36.9	37.1	0.0	97.1
Leadership (Percent of Data Points)	1,557	24.7	30.9	0.0	97.1
Tools (Number of Months)	1,557	14.0	13.4	0.0	53.0
Education (Number of Months)	1,557	16.4	11.9	0.0	54.0
Coaching (Number of Months)	1,557	12.5	13.2	0.0	51.0
Leadership (Number of Months)	1,557	11.1	14.4	0.0	50.0

Source: The Evaluation Contractor's Analysis of HEN Monthly Report Data, November 2014 and HEN timeline data, fall 2014.

HENs were grouped, or clustered, together using these eight metrics of activity exposure for each common measure. After the clustering algorithm is implemented, the Evaluation Contractor examined two metrics of outcomes: (1) the total number of breakpoints from the interrupted time series model, and (2) the change in rates from the baseline period (first 3 months) to the ending period (last 3 months). For each group of measures identified as a cluster due to their similarity in exposure to HEN activities, the two outcome metrics were averaged to form the cluster average number of breaks, and average improvement. By examining these two outcome metrics both within and across clusters, it was possible to identify any associations between outcomes and exposure to HEN activities. Associations between the HEN activity exposure and outcome metrics would be observed if the relative levels of activity exposure and outcome metrics could be ordered from largest to smallest in the same pattern across clusters.

Hospital Engagement Network (HEN)-Level Data File Methodology

Constructing the HEN-Level Data File

HEN-level data were collected for a total of 1,940 distinct measures from several different data sources. This included data the HENs submitted in their November 2014 monthly reports, as well as more than 300 measures extracted by the Evaluation Contractor from national sources, including the Centers for Medicare & Medicaid Services (CMS)/Medicare, National Healthcare Safety Network (NHSN), and National Database of Nursing Quality Indicators® (NDNQI®).[D-39]

The Evaluation Contractor constructed a common analytic data set for use in multiple analyses based on the following basic criteria:

- Definition of baseline and current data: The measure baseline was defined as a 90 day minimum period of data collection, usually prior to January 2012. If no data prior to that date was provided, the first 90 day time period reported was counted as the baseline period, and the remaining data points were treated as current (HEN-era) data. Measures without at least 60 days of current data were excluded. One baseline rate was calculated for the entire baseline period regardless of its length, and a final rate was calculated for the final 60-90 days of the current period, depending on data availability.[D-40]
- Periodicity corrections: Where necessary, monthly data were aggregated to quarterly data to allow for appropriate comparison over time.
- Overlapping data periods: 26 measures were identified that had a single lengthy baseline observation including periods that overlapped with other current data (i.e., 2012 or later). For example, a single baseline may cover the period from January 2011 through March 2012, while monthly data reporting starting with January 2012. The portion of the data that overlapped the baseline was identified, where possible, and excluded to prevent double counting. Special procedures were applied to 19 measures reported by the TCQPS HEN, for which a single baseline data point overlapped a single current data point. Since overlapping data could not be identified and removed, the Evaluation Contractor elected to err on the side of including the HEN's data in the analysis despite some indeterminable amount of temporal overlap.
- Duplicate measure data were identified and excluded to prevent double counting.

The data for the analysis were cleaned and used to generate two analytical data sets. The first data set did not include the time series aspects of each measure, including only the baseline and more recent 90 day period. This data set was used to calculate overall percentage change scores and determine whether improvements were significant or not. The second data set consisted of the subset of measures that had at least 8 post-baseline data points available for analysis. This longitudinal data set was used for constructing HEN-level statistical process control (SPC) charts and performing interrupted time series (ITS) analyses.

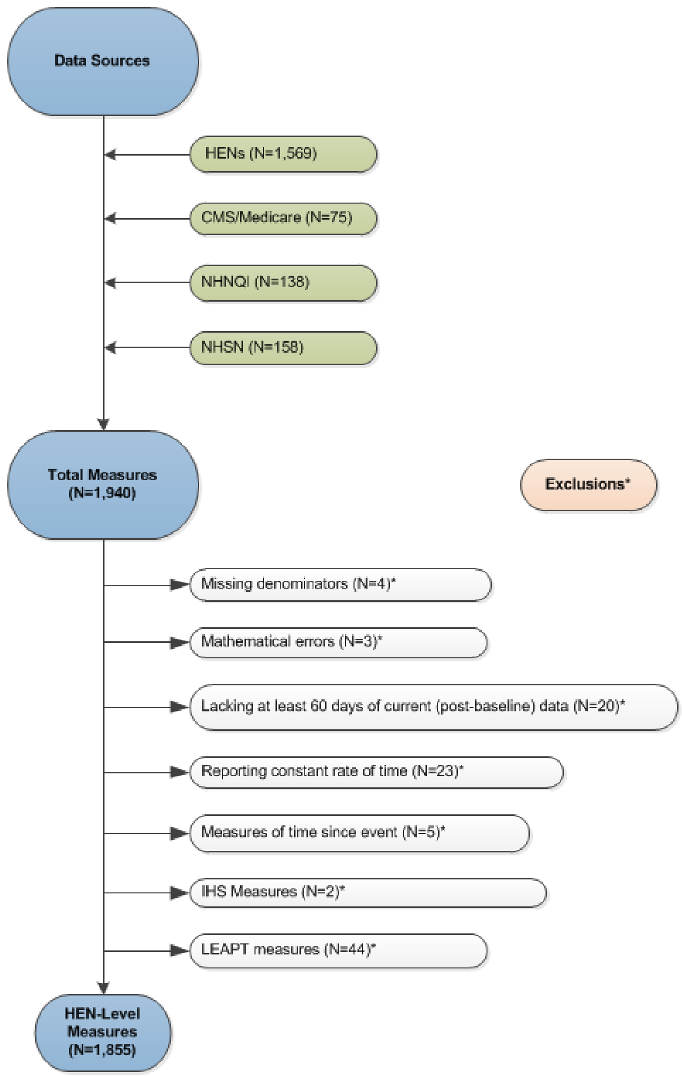
During the data cleaning process, several measures were excluded for a variety of reasons related to the quality of the data. Figure D-3 provides a description of exclusions and the number of measures excluded from the analysis for these reasons. Measures were excluded for the following reasons: missing denominators

D-39 NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

D-40 For some measures, 2 years or more of baseline data were supplied. To calculate raw baseline and final rates, the sum of all numerators were divided by the sum of all denominators for all included observations. Where denominators were not available, numerators were summed and then divided by the number of observations. These rates were then adjusted to the selected reporting scale for the measure, if necessary.

that would allow proper calculation of rates and many statistical tests (n = 4); mathematical discrepancies between the reported numerators, denominators, and rates such that the evaluation contractor was unable to identify the proper rate (n = 3); measures lacking at least 60 days of post-baseline data that would allow a comparison of baseline rates to current periods for reliable assessment of improvement (n = 20); measures that remained at a constant rate across reporting periods (often a rate of zero) and preventing any assessment based on within measure variation (n = 23); measures capturing time since last that were not amenable to the analyses performed for this evaluation (n = 5); measures specified for the Leading Edge Advance Practice topics (LEAPT) program (n = 44); and measures reported by the Indian Health Services (IHS) HEN (n = 2).[D-41] Some measures were excluded for multiple reasons listed above. The resulting data set included 1,855 measures for the cross-sectional file.

Figure D-3—Construction of the Cross-Sectional Data Set



Source: The Evaluation Contractor's analysis of HEN monthly reports, November 2014 and other national sources: CMS/Medicare, NHSN, and NDNQI.

[D-41] IHS was contracted as a HEN with the PfP campaign. However, due to a lack of data reporting, IHS was not included in any analyses.

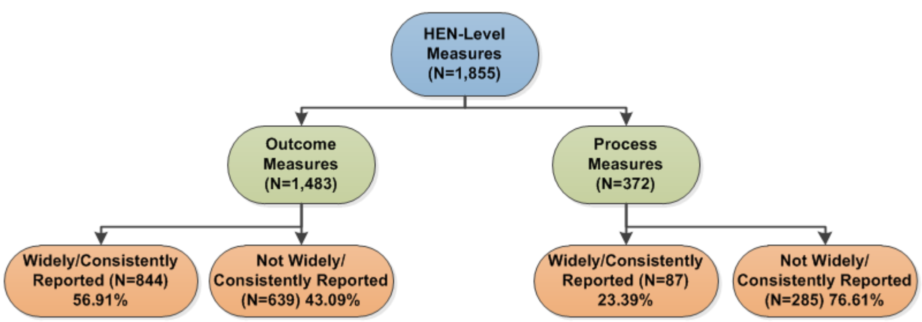
Identification of Widely and Consistently Reported Measures

With 1,855 measures, the Evaluation Contractor identified a subset of the measures with the most robust data for independent analysis. Two criteria were used to identify the most reliable measures:

- Measures were classified as widely reported or less widely reported based on the proportion of eligible hospitals in the HEN/AEA that supplied data for the measure. If 60 percent or more of the eligible hospitals reported the measure at least 50 percent of the time in the measure series, the measure is deemed to be a widely reported measure. The remaining measures are deemed less-widely reported measures.
- Measures were classified as consistently reported or inconsistently reported based upon the existence of large fluctuations in hospital counts. If the reported hospital count did not differ by more than 15 percent from the maximum hospital count reported during the series, the measure was deemed to be consistently reported. Measures where any hospital count differed by more than 15 percent from the maximum were subjected to a regression test to assess whether the fluctuations in the series affected the measure rate over time. If there were at least 4 current observations in the measure series, the measure rate was regressed on time and an indicator variable for observations that differed from the maximum hospital count by more than 15 percent. If the *p*-value for the indicator variable was statistically significant ($p < .05$), the measure was deemed inconsistent. Measures with fewer than 4 current observations were also deemed inconsistent (n = 12).

Figure D-4 illustrates the proportions of outcome and process measures that met (or did not meet) these standards for reporting and consistency.

Figure D-4—Defining Widely-Reported and Consistent Measures



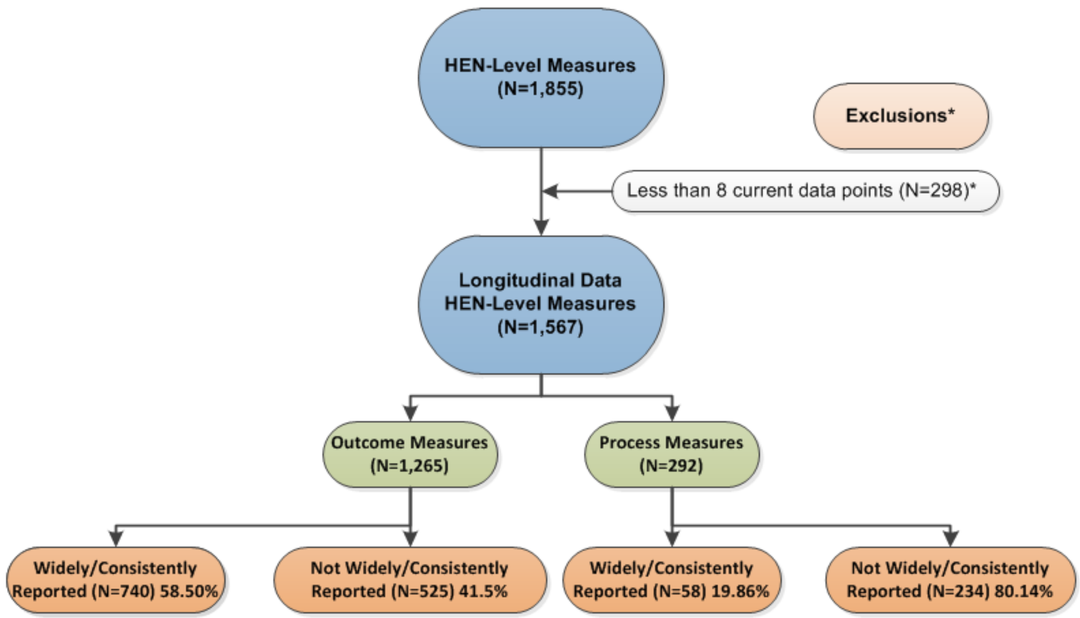
Source: The Evaluation Contractor's analysis of HEN monthly reports, November 2014 and other national sources: CMS/Medicare, NHSN, and NDNQI.

Construction of Longitudinal Data Set

Beginning with the 1,855 measures identified for inclusion in the cross-sectional data set described above, a longitudinal data set was created for use in many of the time series-based analyses. Any measures with less than 8 current data points were excluded. The longitudinal file was used to prepare SPC charts, and ITS models by AEA, by HEN, and stratified by HEN activity level. It was used in the cluster analysis of outcomes, substantial portions of the dose response time to goal analysis, and the repeated measures regression of common measures.

For some analyses, these measures were also divided into those that were widely and consistently reported and those that were not, as displayed in Figure D-5.

Figure D-5—Construction of the Longitudinal Data Set



Source: The Evaluation Contractor's analysis of HEN monthly reports, November 2014 and other national sources: CMS/Medicare, NHSN, and NDNQI.

Application of the exclusions resulted in a longitudinal data set including 1,567 measures; 740 of those measures were widely and consistently reported outcome measures.

Repeated Measures Analysis of the Association between HEN Activities and Partnerships and Common Measure Outcomes Methodology

In the effort to attribute reductions in patient harms among HEN-aligned hospitals to the PfP campaign, an association between HEN activities and partnerships (hereafter referred to as HEN activities) and patient harm outcome measures must exist. To establish this relationship, the Evaluation Contractor examined the relationship over time between HEN activities and patient harms. For any single HEN, the number of outcome observations is frequently too few (i.e., less than 50) for reliable assessment of the independent relationships between the 4 activity and 8 partnership types measured. Therefore, it is desirable to pool the data together where HENs reported measures with the same or highly consistent specifications, also known as common measures.

For each common measure and data source, the Evaluation Contractor used the pooled data to estimate a repeated measures mixed model. The repeated measures aspect of the analysis acknowledges that the data represent repeated observations on the outcome from specific HEN cohorts. The formula for the mixed model takes the following form:

$$y_{it} = \beta_{0i} + \beta_1(Time_t) + \sum_{j=1}^{12} \beta_j\left(Activity_{ijt}\right) + \beta_k\left(Hospitals_{it}\right) + u_{0i} + u_{1i}(Time_i) + \varepsilon_{it} \tag{1}$$

where, y_{it} is the outcome rate of harm for HEN-cohort *i* in time *t*, β_{0i} is a random intercept for HEN-cohort *i* with a residual HEN-cohort specific deviation from the grand mean u_{0i} distributed N(0,τ_{00}), β_1 is a random average quarterly change in outcome rates across all HEN-cohorts with a residual HEN-cohort specific deviation from the grand mean u_{1i} distributed N(0,τ_{10}), β_k is the average change in outcome rates associated with a 1 unit change in reporting hospital counts, β_j represents the average change in outcome rates associated with a 1 unit increase in 1 of 4 types of HEN activities or 8 types of partnerships, and ε_{it} is a residual error term for HEN-cohort *i* in time *t* distributed N(0, σ^2).

Equation 1 estimates and average level and trend for the common measure outcome y_{it}, across the HEN-cohorts submitting data. The model captures variation across HEN-cohorts in their average levels and trends of patient harms through the use of random intercepts and slopes (u_{0i} and u_{1i}) that represent HEN-cohort specific variations from the average.[D-42] Thus, the model effectively estimated the level and trend in patient harm for each contributing HEN-cohort. The most important coefficients estimated in Equation X are the β_j, which represent the relationship between HEN activities and rate of patient harms. For each mixed model, 12 coefficients are estimated for which the expected sign is negative, representing a reduction in patient harms associated with a 1 unit increase in the specific HEN activity. If the β_j is not significant, the activity is not interpreted to have an association with the patient harm captured by the common measure. Finally, positive and significant coefficients for β_j are not expected, but would imply that additional HEN activities are related to increase in patient harms over time.

D-42 Raudenbush, Stephen W. and Anthony S. Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods, 2nd Edition.* Thousand Oaks, CA: Sage.

Appendix E: Supplemental Tables and Results

This appendix provides supplemental tables and results for several of the chapters found in the main body of the report. The following sections are included in this appendix:

- National trends in inpatient harms (Chapter 2)
  - Context tables for each of the Partnership for Patients (PfP) focus areas
  - Quality Improvement Organization (QIO)/PfP trend supplemental results
- PfP learning community's work toward reductions in harms (Chapter 3)
  - Qualitative learning supplemental results
- Quantitative analysis of the overall Hospital Engagement Network (HEN) component impact on observed outcomes (Chapter 4)
  - Bayesian difference-in-differences estimation of the effect of the HEN component of PfP on adverse event outcomes
  - Interrupted Time Series (ITS) detailed results and supplementary analyses
  - Difference-in-Differences Analysis of Composite Measure of Harms from Medicare Patient Safety Monitoring System (MPSMS)
  - Repeated Measures Analysis of the Association between HEN Activities and Partnerships and Common Measure Outcomes
- Harm among different subgroups of HENs and hospitals (Chapter 5)
  - Additional details on the survey data analyses
- Estimation of costs averted as a result of the HEN component of PfP (Chapter 6)
  - Two different estimates of healthcare cost savings and the number of adverse events averted

Partnership for Patients (PfP) Focus Area Context Tables (Chapter 2)

Table E-1 through Table E-11 present a list of the key actions by the "three engines" of the Partnership: the Center for Medicare & Medicaid Innovation (CMMI) investment engine, federal partners, and the private sector, that may have contributed to the reduction in patient harms.

Table E-1—Summary of Strategies to Reduce Harm Used by PfP and Partners–Obstetrical Early Elective Deliveries (OB-EED)

CMMI Investment	Federal Partners	Private Partners
Hospital Engagement Networks (HENs) • Sought commitments from hospital chief executive officers (CEOs) for "hard-stop" policies. • Highlighted strategies of successful hospitals and celebrated their success. • Provided hospitals with tools and information in partnership with private and federal partners. • Provided comparative feedback on OB-EED rates. CMMI with PfP support contractors • Facilitated sharing of best practices among HENs. • Actively recognized HENs and hospitals with large, early decreases. • Mapped progress, highlighting areas of success and those needing improvement. CMMI funded National Quality Forum (NQF) to convene "maternal action team," which developed a "Playbook" to assist late adopters in reducing OB-EED.	Aligned Medicaid program payment policies in many states. Strong Start public communications campaign (with the American Congress of Obstetricians and Gynecologists [ACOG], the March of Dimes, and other partners). The Centers for Medicare & Medicaid Services' (CMS') requirement to report OB-EED rates publicly beginning 2013 with payment implications for 2015.	March of Dimes' "Less than 39 Weeks Toolkit" and banner recognition programs for hospitals adopting hard stop policies. Joint Commission included OB-EED rate (PC-01) as a core measure for hospital accreditation beginning 2013. Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) conducted "Don't Rush Me!" Reducing Early Elective Deliveries and Go the Full 40 consumer education campaigns. Leapfrog included hospital reporting of OB-EED rates in its annual hospital safety survey, beginning 2010, and reports results publicly. Public-private collaborations including goal of reduced OB-EED were identified in at least 21 states in 2012. ACOG conducted educational efforts to support reduction of early elective delivery. California Maternal Quality Care Collaborative (CMQCC) developed PC-01 toolkit, provided consultation to hospitals on OB-EED reduction. NQF Maternity Action Team developed the *Playbook for Successful Elimination of Early Elective Deliveries*, 2014.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the National Content Developer (NCD); input from federal partners including the Agency for Healthcare Research & Quality (AHRQ), the Centers for Disease Control & Prevention's (CDC), and the Administration for Community Living (ACL); and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HENs, and others. Veterans' administration partnership efforts may have existed but are not listed here because Veterans Affairs (VA) hospitals are not included in the data trends analyzed.

Table E-2—Summary of Strategies to Reduce Harm Used by PfP and Partners–Readmissions		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Working with their hospitals and community partners to implement numerous intervention strategies to prevent readmissions, including risk assessments, care coordination and case management, discharge planning, and medication reconciliation. Community-based Care Transitions Program (CCTP) • Funded 101 Community-Based Organizations (CBOs), involving around 475 hospitals, to implement innovative models for care transitions to prevent readmissions. Readmissions affinity group • The affinity group (convened by the NCD) collaborated with the medication safety and rural affinity groups to identify ways to improve medication management in care transitions and is currently working to identify readmission prevention strategies used by high-performing hospitals to share with other HENs and hospitals. Patient and Family Engagement Contractor (PFEC) • Worked to bring the patient voice into all PfP pacing events, and to encourage HENs to include patient engagement in efforts to prevent readmissions.	CMS Readmissions Reduction Program financial penalties. ACL funding for local care transitions partnerships between hospitals and Aging and Disability Resource Centers (ADRC) (2010) (about 386 hospitals involved). AHRQ Project RED (Re-Engineered Discharge) toolkit and technical assistance. Quality Improvement Organizations' (QIOs') work with hospitals and other healthcare facilities to improve care coordination and prevent readmissions. NQF-led patient and family engagement (PFE) Action Team and Readmissions Action Team" (2014).	The American Case Management Association (ACMA) educates case managers in INTERACT and other strategies The Society of Hospital Medicine (SHM) worked with hospitals and the readmissions affinity group to reduce readmissions related to glycemic management. Medication Management in Care Transitions Initiative, a collaboration between the American Pharmacists Association and the American Society of Health-System Pharmacists, published a list of best practices in medication management during care transitions to prevent readmissions (2013). Planetree regional and national-level education and consultation strategies for hospitals on patient and family engagement to reduce readmissions The Joint Commission's (TJC) Center for Transforming Healthcare project to improve caregiver hand-off communications and related toolkit (2009). American Nurses Association (ANA) collaborated with PfP leadership to spread awareness among nurses of national care transition goals.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-3—Summary of Strategies to Reduce Harm Used by PfP and Partners–Adverse Drug Events (ADE)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Data feedback to increase awareness. • Engaging pharmacists. • Developing and sharing prevention tools and resources. CMMI staff organized a session at a national conference of the American Society of Health-System Pharmacists on use of International Normalized Ratio (INR) and glucose lab values to help prevent inpatient adverse drug events (December 2011). NCD • Convened a medication safety affinity group, which hosted webinars and "office hours" for hospitals to help accelerate sharing of best practices related to prevention of adverse drug events (2012). • Supported readmissions and rural hospital affinity groups in collaboration to develop crosscutting harm strategies related to care transitions and medication management (2012). PfP policy • CMS clarified that all HENs were expected to be tracking and working on three specific areas of inpatient ADE: hypoglycemia, glucose control, and opioids; the NCD hosted a series of webinars and "office hours" specifically on ADE topics.	AHRQ Medications at Transitions and Clinical Handoffs (MATCH) Toolkit for Medication Reconciliation. CMS requirement that Inpatient Prospective Payments Systems (IPPS) hospitals report *Clostridium difficile* (*C. difficile)* to the National Healthcare Safety Network (NHSN) (2013). Health and Human Services (HHS) draft National Action Plan for ADE Prevention (2013).	TJC • Center for Transforming Healthcare project to identify and spread practices to promote the safe and effective use of insulin (2012) • National Patient Safety Goals for hospitals include the safe use of medications. The Medication Management in Care Transitions Initiative (a collaboration between the American Pharmacists Association and the American Society of Health-System Pharmacists): a published list of best practices for hospitals to use to prevent ADEs. ANA collaboration with PfP leadership to spread awareness of hospital-acquired conditions (HAC) reduction goals among nurses.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-4—Summary of Strategies to Reduce Harm Used by PfP and Partners–Venous Thromboembolism (VTE)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Assisting their hospitals to implement best practice bundles, standardized risk assessments and order sets, process of care audits, inclusion of medical as well as surgical patients in measurement and prevention, and establishing mentor connections between better and worse performing hospitals. NCD • Convened a procedural harm affinity group to educate HENs on best practices to prevent surgical harm including VTE and provides opportunities for HENs to share prevention strategies.	CMS HAC reduction program financial penalties (2014). AHRQ resources including a guide to preventing VTEs, a safe surgery toolkit, and a guide to the safe use of anticoagulants. The CDC data analysis and VTE prevention webinars	The National Blood Clot Alliance (an advocacy organization) educational events and resources on VTE prevention. Leapfrog's hospital safety scorecard presenting a composite outcome measure including PSI 12, starting in 2012. The Society of Hospital Medicine promoted resources including an AHRQ toolkit (2008) and guidelines from the American College of Chest Physicians released between 2004 and 2012. ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-5—Summary of Strategies to Reduce Harm Used by PfP and Partners–Ventilator-Associated Pneumonia/Ventilator-Associated Events (VAP/VAE)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Worked with hospitals to implement VAP prevention bundles. • Tracking process measures to monitor compliance with interventions. The NCD convened a healthcare-associated infections (HAI) affinity group to promote sharing among HENs and hospitals of strategies to prevent infections including VAP.	CDC new measure definitions to encourage broader measurement of VAE to improve surveillance compared to the narrower VAP measure (2013). HHS 2013 National Action Plan to Prevent Health Care-Associated Infections roadmap for preventing HAIs (including VAP) in acute care hospitals as well as other settings. QIOs' work with hospitals to prevent HAIs and collaborate with the CDC to use data to target VAE prevention activities. The CDC funding for state health departments to hire and train staff for HAI prevention, increase reporting for HAI, and participate in collaborative projects focused on preventing HAIs including VAP (2010). AHRQ Comprehensive Unit-based Safety Program (CUSP) for Mechanically Ventilated Patients and VAP program, which includes toolkits for hospitals to use to reduce VAE (2013-2014).	ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-6—Summary of Strategies to Reduce Harm Used by PfP and Partners–Catheter-Associated Urinary Tract Infections (CAUTI)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Working with hospitals to implement interventions aligned with Institute for Healthcare Improvement (IHI) guidelines for preventing CAUTI • Leveraging safety culture and PFE for prevention. The NCD convened a HAI affinity group to provide opportunities for HENs and hospitals to share strategies to prevent infections including CAUTI. CMMI in response to national data from NHSN that showed little improvement in CAUTI rates in intensive care units (ICUs), CMMI with PfP support contractors convened several educational events in 2013 focused on "reversing the trend" in CAUTI. • Facilitated sharing of best practices among HENs. • Actively recognized HENs and hospitals with large, early decreases. • Mapped progress, highlighting areas of success and those needing improvement.	CMS HAC reduction program financial penalties (2014). CMS mandated reporting of HAIs, including CAUTI, to the CDC's NHSN (2012). QIOs' work with hospitals to prevent CAUTI, including linking hospitals with AHRQ's CUSP for CAUTI, and technical assistance with data reporting. AHRQ's CUSP for CAUTI, which involves over 850 hospitals across 37 states. QIOs and the CDC collaboration to help QIOs use data to target CAUTI prevention activities. CDC technical assistance to hospitals and HENs to analyze their HAI data and implement best practices. HAI prevention programs through state health departments include CDC funding	Wound, Ostomy, and Continence Nurses (WOCN) fact sheet to increase awareness and knowledge of CAUTI prevention strategies to prevent CAUTI and encouragement of members to adopt these evidence-based practices (2009). Leapfrog's hospital safety scorecard presenting a composite outcome measure including CAUTI, starting in 2012. ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses with explicit focus on CAUTI and developed and piloted in partnership with two HENs a streamlined evidence-based tool for CAUTI reduction.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-7—Summary of Strategies to Reduce Harm Used by PfP and Partners–Central Line-Associated Blood Stream Infections (CLABSI)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Assisting their hospitals to consistently use insertion and maintenance bundles in accordance with IHI guidelines. • Tracking and data feedback. The NCD convened an HAI affinity group to provide opportunities for HENs and hospitals to share strategies to prevent infections including CLABSI (2012).	CMS HAC reduction program financial penalties (2014). Hospitals are not reimbursed for instances of the CMS HAC for central venous catheter-related blood stream infections (CRBSI). CMS-mandated reporting of HAIs, including CLABSI-ICU, to the CDC's NHSN database (2011). QIOs' work with hospitals to implement evidence-based guidelines, such as AHRQ's CUSP and to assist with data reporting. AHRQ's CUSP for CLABSI: Includes over 1,000 hospitals across 44 states. The CDC technical assistance to hospitals and HENs to analyze their HAI data and implement best practices.	ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses (2012). Leapfrog's hospital safety scorecard presenting a composite outcome measure including CLABSI, starting in 2012.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-8—Summary of Strategies to Reduce Harm Used by PfP and Partners–Falls

CMMI Investment	Federal Partners	Private Partners
HENs • Working with hospitals to implement numerous interventions to avoid falls, including risk assessments and ensuring communication between members of patient care teams, patients, and families. The Pennsylvania HEN convenes a group of HENs specifically around the topic of falls, to share lessons learned and generate improved effectiveness in falls prevention (2014).	CMS HAC reduction program financial penalties on hospitals with high rates of PSI-08, post-operative hip fracture (2014). IPPS hospitals are not reimbursed for the CMS HAC for falls and trauma. AHRQ "Preventing Falls in Hospitals" toolkit (shared with HENs via webinar in 2012 and publicly released January 2013).	TJC launched a project focused on preventing falls with injury (2011). TJC requires accredited hospitals to conduct fall risk assessments for hospitalized patients to identify risk for falls in order to implemented prevention measures in the plan of care (2013) Leapfrog's hospital safety scorecard presenting a composite outcome measure including falls, starting in 2012. ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses, with explicit focus on falls. ANA's National Database of Nursing Quality Indicators® (NDNQI®) includes measures of falls and fall-related injuries, and reports provide comparisons of rates for facilities with similar bed size, teaching status, and other characteristics.[E-1]

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

[E-1] NDNQI® is a registered trademark of the ANA. NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

Table E-9—Summary of Strategies to Reduce Harm Used by PfP and Partners–Other Obstetrical Adverse Events (OB-Other)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Many HENs have focused on reducing injury to neonates and OB trauma. • In 2013, at CMS' request, HENs expanded their harm reduction focus to include preeclampsia and OB hemorrhage. The NCD convened a maternal affinity group (2012), which invites speakers to share prevention strategies with affinity group members and engages with national organizations to encourage national dialog. The group also did a deep-dive into the PC-02 cesarean section (C-section) measure required by TJC beginning in 2014. CMMI funded the NQF to convene a "maternal action team" focused on reducing EED and C-section rates (2011).	AHRQ shared OB safety resources with HENs and hospitals, including the Perinatal Safety Intervention Program (PSIP). CDC supports State Perinatal Quality Collaboratives (PQCs) to promote perinatal safety, including hemorrhage and C-section prevention.	TJC expanded mandatory reporting requirements for accreditation to perinatal care core measure set for all hospitals with at least 1,100 births annually (2014). AWHONN several perinatal safety toolkits, national and local education seminars, and support to nurses leading local improvement efforts. The Pacific Business Group on Health (PBGH), in partnership with the CMQCC and California Maternal Data Center: coaching and technical assistance to reduce C-section rates in commercially insured populations. CMQCC national advocacy on focusing on preeclampsia and hemorrhage as two highest causes of maternal mortality The National Partnership for Maternal Safety: developing Patient Safety Bundles to prevent obstetric hemorrhage, hypertension, and VTE prevention. The hemorrhage bundle is currently available, and the Partnership's goal is to have all birthing facilities to have all three bundles in place by 2016. ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses (2012).

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-10—Summary of Strategies to Reduce Harm Used by PfP and Partners–Pressure Ulcers		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Assist their hospitals to implement many interventions recommended by the IHI, including pressure ulcer risk assessments, skin inspections, nutrition management, and minimizing pressure. Evaluation Contractor's point-scoring method encouraged HENs to expand measurement of pressure ulcers to include pressure ulcers stage 2 or higher, not just those that are most severe (2013).	CMS HAC reduction program financial penalties (2014). IPPS hospitals are not reimbursed for instances of the CMS HAC for pressure ulcers. AHRQ pressure ulcer prevention toolkit (presented to HENs via webinar in 2012).	ANA's NDNQI includes measures of pressure ulcers incidence and prevalence, and reports provide comparisons of rates for facilities with similar bed size, teaching statues, and other characteristics. ANA collaborated with PfP leadership to spread awareness among nurses of HAC reduction goals, with explicit focus on pressure ulcers. Leapfrog's hospital safety scorecard presenting a composite outcome measure including pressure ulcers, starting in 2012. WOCN Society and Sage Products Partners in Prevention program, which provides nurses with the tools they need to prevent HACs through various initiatives, including a webinar series, designed to help WOCN nurses further their knowledge in advancing and supporting the prevention of pressure ulcers (2014). The National Pressure Ulcer Advisory Panel (NPUAP) hosted webinars and conferences focused on pressure ulcer measurement and prevention during 2011-2014.

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Table E-11—Summary of Strategies to Reduce Harm Used by PfP and Partners–Surgical Site Infections (SSIs)		
CMMI Investment	**Federal Partners**	**Private Partners**
HENs • Assisting their hospitals with numerous interventions such as use of surgical safety checklists, full and reliable/audited implementation of all surgical care improvement project (SCIP) processes, focusing on perioperative normothermia, improving surgical team culture (such as with TeamSTEPPs training), and targeting deep-dive assistance to hospitals with higher rates of SSIs. HAI and procedural harm affinity group: NCD convened HAI and procedural harm affinity groups to help HENs and hospitals share strategies to prevent infections, including SSI. The affinity groups invite experts to speak to participants and present prevention strategies. The procedural harm affinity group also created a matrix of tools to prevent SSIs across the care continuum, and hosted a series of workshops on sustaining results.	CMS-mandated reporting of abdominal hysterectomy and colon surgery SSIs to NHSN (maintained by the CDC) (2012). HHS project JOINTS (Joining Organizations IN Tackling SSIs), through which the IHI provided participating hospitals with free tools, resources and supports to reduce SSIs (2011-2013). HHS 2013 National Action Plan to Prevent Health Care-Associated Infections roadmap for preventing HAIs in acute care hospitals, ambulatory surgical centers, end-stage renal disease facilities, and long-term care facilities. The CDC funding for state health departments to hire and train staff for HAI prevention, to increase reporting for HAI, and to participate in collaborative projects focused on preventing HAIs (2010). The CDC technical assistance to hospitals and HENs to analyze their HAI data and implement best practices. AHRQ's Surgical Unit-Based Safety Program (SUSP), which was also shared with HENs through webinars in 2012 (around 250 hospitals in 37 states have participated since 2011). QIOs' work to assist hospitals to implement evidence-based guidelines to prevent HAIs.	American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP), which manages data feedback to about 400 hospitals, based on their chart-review data, provides tools, analyses, and reports to prevent surgery-related infection including SSI. Leapfrog's hospital safety scorecard presenting a composite outcome measure including SSI for colon surgery, starting in 2012. TJC's National Patient Safety Goals include goals for SSI prevention activities. TJC implementation guide with best practices to reduce SSIs. ANA collaborated with PfP leadership to spread awareness of HAC reduction goals among nurses (2012).

Source: Evaluation Contractor's list of major initiatives or potential influences, as identified by a combination of review of HEN monthly reports; input from the NCD; input from federal partners including AHRQ, the CDC, and the ACL; and additions from a convenience sample of members of the affinity groups which include some private partner organizations as well as CMS staff, HEN staff, and others. Veterans' administration partnership efforts may have existed but are not listed here because VA hospitals are not included in the data trends analyzed.

Quality Improvement Organization (QIO)/Partnership for Patients (PfP) Trend Analysis Supplemental Tables (Chapter 2)

As Table E-12 shows, results for the selected measures vary widely, indicating a highly skewed distribution in the average hospital rates for the three Patient Safety Indicators (PSIs) in all treatment groups. For instance, the average pressure ulcer rate for hospitals participating in PfP-only was 0.68, with some hospitals exhibiting rates as high as 19.23 per 1,000 discharges. Readmissions rates were substantially less skewed than the PSI rates, with a tighter range of variability in all four treatment groups. Table E-12 summarizes the corresponding descriptive statistics for each area assessed.

Table E-12—Descriptive Statistics of Hospital Rates, Q1 2010 – Q1 2014[a]

Measure	Treatment Group	Average	Standard Deviation	Minimum	Maximum
Central Venous Catheter (CVC) Infection Rates (per 1,000 discharges)	PfP-Only	0.38	0.39	0.00	6.41
	QIO-Only	0.50	0.42	0.00	2.77
	PfP and QIO	0.56	0.52	0.00	4.69
	Neither PfP nor QIO	0.31	0.45	0.00	5.59
	Total	**0.44**	**0.47**	**0.00**	**6.41**
Postoperative Pulmonary Embolism (PE)/Deep Vein Thrombosis (DVT) Rates (per 1,000 discharges)	PfP-Only	5.86	3.48	0.00	28.37
	QIO-Only	5.25	2.80	0.00	19.23
	PfP and QIO	6.76	3.56	0.00	17.18
	Neither PfP nor QIO	4.98	3.48	0.00	23.81
	Total	**5.99**	**3.51**	**0.00**	**28.37**
Pressure Ulcer Rates (per 1,000 discharges)	PfP-Only	0.68	1.23	0.00	19.23
	QIO-Only	0.45	0.65	0.00	12.74
	PfP and QIO	0.47	0.79	0.00	7.94
	Neither PfP nor QIO	0.46	1.08	0.00	12.50
	Total	**0.54**	**1.01**	**0.00**	**19.23**
30-Day All-Cause Readmissions Rates	PfP-Only	0.18	0.03	0.04	0.40
	QIO-Only	0.19	0.05	0.04	0.38
	PfP and QIO	0.20	0.03	0.06	0.32
	Neither PfP nor QIO	0.19	0.04	0.00	0.41
	Total	**0.19**	**0.04**	**0.00**	**0.41**

Source: Health Services Advisory Group (HSAG) analysis of QIO participation and Medicare claims data.

[a] The time period for the 30-day, all-cause readmissions rate extends quarterly from Q1 2010 through Q1 2014. For the remaining measures, the time periods extend quarterly from Q2 2011 through Q1 2014.

Note: The full regression model results tables can be found in Appendix E.

Table E-13 provides the hierarchical generalized linear model (HGLM) model results for the four measures in this analysis. The upper panel of the model presents the fixed effects, or the estimated coefficients describing the observed levels and trends across the two groups of hospitals and controlling for unobserved state effects. The lower panel in the table presents the random effects or the variability across hospitals in their initial levels and trends over time. The intercept is the log of the expected count in the first quarter for a hospital in California (CA) that worked only with the QIO. The intercepts can be converted into predicted rates by using the average denominator count for this group of hospitals, resulting in predicted rates of 1.06 CVC-related blood stream infections per 1,000 discharges, 0.67 pressure ulcers per 1,000 discharges, 4.49 PE/DVT per 1,000 discharges, and a 20.01 percent readmission rate.[E-2] The coefficients for the states represent the increment or decrement to the intercept value for QIO hospitals in those states. Thus, in Florida (FL) the average QIO hospital has a CVC infection rate per 1,000 discharges that is [exp(.306) – 1]*100 = 35.80 percent higher than in CA (approximately 1.44 per 1,000), while the non-significant coefficients for Arizona (AZ) and Ohio (OH) indicate that QIO hospitals in these states have statistically equivalent CVC infection rates to those in CA.

The coefficient for the Time variable represents the average quarterly change from the initial point of the intercept. For CVC infections, the average quarterly change among QIO hospitals in CA is [exp(-.093) – 1]*100 = -8.88 percent. The only other measure exhibiting a significant trend, either upward or downward, is readmissions. The Time coefficient of -0.006 for readmissions indicates that on average, QIO hospitals in CA saw their readmission rates change by [exp(-0.006) – 1]*100 = -0.60 percent each quarter.

The estimate for the PfP-only indicator represents the average rate compared to QIO-only hospitals at the beginning of the time period. For example, the estimate of -0.114 for readmissions suggests that, on average, PfP-only hospitals started with a rate that was [exp(-0.114) – 1]*100 = -10.77 percent lower than QIO-only hospitals in Q1 2010. For CVC infection rates, PfP-only hospitals began the series on average, 43.39 percent lower than QIO-only hospitals. No significant differences were found between the PfP-only hospitals and QIO-only hospitals at the beginning of the series for pressure ulcers or PE/DVT rates.

Table E-13—HGLM Solution for Fixed and Random Effects Among PfP-Only and QIO-Only Hospitals

Estimate (Standard Error)	CVC Infection Count	PE/DVT Count	Pressure Ulcer Count	30-Day All-Cause Readmissions Count
Fixed Effects				
Intercept	-6.846*** (0.294)	-5.405*** (0.158)	-7.311*** (0.451)	-1.609*** (0.031)
PfP-Only Indicator	-0.569* (0.331)	0.110 (0.171)	-0.336 (0.496)	-0.114*** (0.032)
Time	-0.093*** (0.025)	-0.005 (0.011)	-0.037 (0.038)	-0.006*** (0.001)
PfP-Only Indicator x Time	0.023 (0.029)	-0.016 (0.012)	0.050 (0.042)	0.001 (0.001)
AZ	-0.042 (0.279)	0.022 (0.174)	-0.455 (0.427)	-0.180*** (0.049)

E-2 The formula to convert the intercept into a predicted rate is [exp(β_{0i} + ln(n))/n], multiplied by 1,000 for each of the PSIs and by 100 for the readmissions rate. As an example, the intercept for readmissions is converted into a predicted rate using the average quarterly denominator observed in CA hospitals of 641.96: [exp(-1.609 + ln(641.96))/641.96]*100 = 20.01 percent. For CVC infections, pressure ulcers, and PE/DVT the relevant denominators are 372.50, 197.69, and 158.02.

Table E-13—HGLM Solution for Fixed and Random Effects Among PfP-Only and QIO-Only Hospitals				
Estimate (Standard Error)	**CVC Infection Count**	**PE/DVT Count**	**Pressure Ulcer Count**	**30-Day All-Cause Readmissions Count**
FL	0.306** (0.147)	0.147 (0.101)	-0.538** (0.222)	0.052 (0.034)
OH	-0.141 (0.148)	0.230** (0.093)	-1.104*** (0.234)	0.064** (0.030)
Random Effects				
Intercept Variance	0.323***	0.267***	0.681***	0.053***
Time Variance	0.000455	0.000000	0.002558***	0.000024***

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table E-14 through Table E-16 provides the full results for models to identify differences in trends for hospitals aligned with both PfP and QIO. Each table presents the fixed effects, which are the estimated coefficient estimates describing the observed levels and trends across the two groups of hospitals and controlling for unobserved state effects. The lower panel in each table presents the random effects or the variability across hospitals in their initial levels and trends over time. These results are interpreted the same way that the results presented in Table E-13 are interpreted. The intercept is the log of the expected count in the first quarter for a hospital in CA that was a member of the PfP and QIO group.

The intercepts can be converted into predicted rates by using the average denominator count for the reference group.[E-3] The coefficients for the states represent the increment or decrement to the intercept value for QIO hospitals in those states.

[E-3] The formula to convert the intercept into a predicted rate is $[\exp(\beta_{0i} + \ln(n))/n]$, multiplied by 1,000 for each of the PSIs and by 100 for the readmissions rate. As an example for Table E-14, the intercept for readmissions is converted into a predicted rate using the average quarterly denominator observed in PfP or QIO California hospitals of 878.49: $[\exp(-1.614 + \ln(878.49))/ 878.49]*100 =$ 19.90 percent. The relevant denominators include the following: CVC Infections = 482.38, pressure ulcers = 264.82, PE/DVT = 227.77, and readmissions = 878.49.

Table E-14—HGLM Solution for Fixed Effects Among Neither PfP Nor QIO Compared to PfP and QIO				
Estimate (Standard Error)	**CVC Infection Count (per 1,000 Discharges)**	**PE/DVT Count (per 1,000 Discharges)**	**Pressure Ulcer Count (per 1,000 Discharges)**	**30-Day All-Cause Readmissions Count**
Fixed Effects				
Intercept	-6.558^{***} (0.182)	-5.195^{***} (0.090)	-7.362^{***} (0.299)	-1.614^{***} (0.024)
Neither PfP nor QIO	-1.027^{***} (0.289)	-0.315^{**} (0.137)	-0.738^{*} (0.409)	-0.031 (0.025)
Time	-0.111^{***} (0.015)	-0.009 (0.006)	-0.071^{***} (0.026)	-0.005^{***} (0.001)
Neither PfP nor QIO x Time	0.039 (0.025)	0.001 (0.010)	0.063^{*} (0.034)	0.001 (0.001)
AZ	-0.222 (0.202)	0.003 (0.113)	0.092 (0.291)	-0.092^{**} (0.038)
FL	0.141 (0.136)	0.136 (0.084)	-0.346 (0.212)	0.059^{**} (0.029)
OH	-0.723^{***} (0.203)	0.003 (0.109)	-0.224 (0.276)	-0.097^{***} (0.034)
Random Effects				
Intercept Variance	0.466^{***}	0.236^{***}	0.757^{***}	0.063^{***}
Time Variance	0.000851^{*}	0.000061	0.003983^{***}	0.000035^{***}

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E-15—HGLM Solution for Fixed Effects Among PfP-Only Compared to PfP and QIO				
Estimate (Standard Error)	**Estimate (Standard Error)**	**Estimate (Standard Error)**	**Estimate (Standard Error)**	**Estimate (Standard Error)**
Fixed Effects				
Intercept	-6.611^{***} (0.172)	-5.250^{***} (0.084)	-7.391^{***} (0.277)	-1.630^{***} (0.019)
PfP Indicator	-0.751^{***} (0.230)	-0.019 (0.107)	-0.426 (0.331)	-0.090^{***} (0.020)
Time	-0.107^{***} (0.014)	-0.008 (0.005)	-0.066^{***} (0.023)	-0.005^{***} (0.001)
PfP Indicator x Time	0.039^{**} (0.020)	-0.014^{*} (0.008)	0.074^{***} (0.027)	0.000 (0.001)
AZ	-0.267 (0.201)	0.052 (0.121)	0.031 (0.314)	-0.120^{***} (0.035)

Table E-15—HGLM Solution for Fixed Effects Among PfP-Only Compared to PfP and QIO				
Estimate (Standard Error)	**Estimate (Standard Error)**	**Estimate (Standard Error)**	**Estimate (Standard Error)**	**Estimate (Standard Error)**
FL	0.193 (0.120)	0.181** (0.079)	-0.206 (0.195)	0.064*** (0.024)
OH	-0.381*** (0.136)	0.136* (0.081)	-0.835*** (0.223)	0.046* (0.024)
Random Effects				
Intercept Variance	0.396***	0.263***	0.854***	0.038***
Time Variance	0.000306	0.000000	0.003357***	0.000027***

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E-16—HGLM Solution for Fixed Effects Among QIO-Only Compared to Non-PfP/QIO				
Estimate (Standard Error)	**CVC Infection Count (per 1,000 Discharges)**	**PE/DVT Count (per 1,000 Discharges)**	**Pressure Ulcer Count (per 1,000 Discharges)**	**30-Day All-Cause Readmissions Count**
Fixed Effects				
Intercept	-6.491*** (0.217)	-5.207*** (0.091)	-7.528*** (0.296)	-1.605*** (0.021)
QIO Indicator	-0.231 (0.327)	-0.171 (0.165)	-0.030 (0.505)	0.009 (0.029)
Time	-0.119*** (0.021)	-0.009 (0.006)	-0.053** (0.024)	-0.005*** (0.001)
QIO Indicator x Time	0.019 (0.029)	0.003 (0.012)	0.019 (0.042)	-0.001 (0.001)
AZ	-0.413* (0.217)	0.085 (0.113)	0.084 (0.298)	-0.117*** (0.038)
FL	0.192 (0.155)	0.203** (0.089)	-0.203 (0.233)	0.022 (0.032)
OH	-0.750*** (0.240)	-0.133 (0.127)	-0.581 (0.356)	-0.050 (0.039)
Random Effects				
Intercept Variance	0.426***	0.217***	0.893***	0.039***
Time Variance	0.001710	0.000044	0.001761*	0.000027***

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E-17 through Table E-19 provide the full results for models to identify differences in trends for hospitals aligned with neither PfP nor QIO. Each table presents the fixed effects, which are the estimated coefficient estimates describing the observed levels and trends across the two groups of hospitals and controlling for unobserved state effects. The lower panel in each table presents the random effects or the variability across hospitals in their initial levels and trends over time. These results are interpreted the same way that the results presented in Table E-13 are interpreted. The intercept is the log of the expected count in the first quarter for a hospital in CA that was a member of the neither PfP nor QIO group.

Table E-17—HGLM Solution for Fixed Effects Among PfP and QIO Compared to Non-PfP/QIO

Estimate (Standard Error)	CVC Infection Count (per 1,000 Discharges)	PE/DVT Count (per 1,000 Discharges)	Pressure Ulcer Count (per 1,000 Discharges)	30-Day All-Cause Readmissions Count
Fixed Effects				
Intercept	-7.585*** (0.278)	-5.510*** (0.132)	-8.100*** (0.384)	-1.645*** (0.022)
PfP and QIO Indicator	1.027*** (0.289)	0.315** (0.137)	0.738* (0.409)	0.031 (0.025)
Time	-0.072*** (0.023)	-0.008 (0.009)	-0.008 (0.032)	-0.005*** (0.001)
PfP and QIO Indicator x Time	-0.039 (0.025)	-0.001 (0.010)	-0.063* (0.034)	-0.001 (0.001)
AZ	-0.222 (0.202)	0.003 (0.113)	0.093 (0.291)	-0.092** (0.038)
FL	0.141 (0.136)	0.136 (0.084)	-0.345 (0.212)	0.059** (0.029)
OH	-0.723*** (0.203)	0.003 (0.109)	-0.224 (0.276)	-0.097*** (0.034)
Random Effects				
Intercept Variance	0.443***	0.236***	0.756***	0.063***
Time Variance	0.000851*	0.000061	0.003987***	0.000035

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E-18—HGLM Solution for Fixed Effects Among PfP-Only Compared to Non-PfP/QIO				
Estimate (Standard Error)	**CVC Infection Count (per 1,000 Discharges)**	**PE/DVT Count (per 1,000 Discharges)**	**Pressure Ulcer Count (per 1,000 Discharges)**	**30-Day All-Cause Readmissions Count**
Fixed Effects				
Intercept	-7.662*** (0.287)	-5.551*** (0.129)	-7.793*** (0.364)	-1.670*** (0.022)
PfP Indicator	0.327 (0.295)	0.269* (0.140)	0.199 (0.398)	-0.045* (0.024)
Time	-0.080*** (0.024)	-0.007 (0.009)	-0.008 (0.030)	-0.005*** (0.001)
PfP Indicator x Time	-0.002 (0.026)	-0.015 (0.010)	0.008 (0.033)	-0.001 (0.001)
AZ	0.309 (0.262)	-0.146 (0.167)	-0.357 (0.390)	-0.117*** (0.042)
FL	0.269* (0.144)	0.096 (0.091)	-0.663*** (0.199)	0.081*** (0.029)
OH	-0.245 (0.151)	0.223*** (0.086)	-0.806*** (0.209)	0.001 (0.029)
Random Effects				
Intercept Variance	0.443***	0.277***	0.618***	0.070***
Time Variance	0.001447**	0.000000	0.004048***	0.000034***

Source: HSAG's analysis of QIO participation and Medicare claims data.
Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E-19—HGLM Solution for Fixed Effects Among QIO-Only Compared to Non-PfP/QIO				
Estimate (Standard Error)	**CVC Infection Count (per 1,000 Discharges)**	**PE/DVT Count (per 1,000 Discharges)**	**Pressure Ulcer Count (per 1,000 Discharges)**	**30-Day All-Cause Readmissions Count**
Fixed Effects				
Intercept	-7.670*** (0.314)	-5.508*** (0.147)	-7.651*** (0.411)	-1.643*** (0.028)
QIO Indicator	0.829** (0.385)	0.152 (0.191)	0.486 (0.556)	0.044 (0.041)
Time	-0.080*** (0.026)	-0.008 (0.010)	-0.003 (0.034)	-0.004*** (0.001)
QIO Indicator x Time	-0.019 (0.034)	0.003 (0.014)	-0.038 (0.048)	-0.002 (0.001)

Table E-19—HGLM Solution for Fixed Effects Among QIO-Only Compared to Non-PfP/QIO				
Estimate (Standard Error)	**CVC Infection Count (per 1,000 Discharges)**	**PE/DVT Count (per 1,000 Discharges)**	**Pressure Ulcer Count (per 1,000 Discharges)**	**30-Day All-Cause Readmissions Count**
AZ	0.070 (0.272)	-0.019 (0.152)	-0.351 (0.336)	-0.117** (0.052)
FL	0.307* (0.183)	0.088 (0.112)	-0.924*** (0.233)	0.052 (0.040)
OH	-0.420 (0.264)	0.145 (0.141)	-0.508* (0.297)	-0.113** (0.045)
Random Effects				
Intercept Variance	0.443***	0.223***	0.333	0.091***
Time Variance	0.001416*	0.000081	0.003202***	0.000035***

Source: HSAG's analysis of QIO participation and Medicare claims data.

Note: Estimates are solutions for fixed effects. Standard errors are displayed in parenthesis and italicized.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Learning Community Design and Support for Hospital-Level Changes (Chapter 3)

Design of Partnership for Patients (PfP)

In a brief published by The Commonwealth Fund, Yuan et al. identified best practices based on a review of published literature regarding large-scale quality improvement campaigns and developed a blueprint for future campaigns. Table E-20 shows how design features of PfP align with the blueprint.

Table E-20—Alignment of PfP Campaign Strategy with Best Practices Blueprint

Healthcare Blueprint for Dissemination of Best Practices	PfP Campaign Strategy
Align campaign goals with strategic goals of adopting organizations	The Centers for Medicare & Medicaid Services (CMS) aligned PfP harm reduction goals with financial incentives/other programs, which gave PfP a good chance to align with hospitals' strategic goals. Survey data from a national sample of hospitals early in the campaign confirmed a high degree of alignment.[a]
Highlight evidence base and relative simplicity of recommended practices	Ten focus areas were selected for PfP based on the existence of evidence-based practices for improvement that could be spread. CMS chose not to recommend specific interventions, and the degree to which the evidence-based practices are simple varied.
Develop practical implementation tools and guides for key stakeholder groups	CMS used two support contractors, the National Content Developer (NCD) and the Patient and Family Engagement Contractor (PFEC), to help share existing practical tools and resources and address emerging needs within the learning network, and to facilitate Hospital Engagement Networks (HENs) sharing additional tools and guides with each other. There was no single recommended set of tools and guides.
Increase recruitment and engagement by integrating opinion leaders and local organizations into enrollment process and employing a nodal organizational structure	CMS contracted with HENs, organizations with existing ties to large groups of hospitals, opinion leaders, and local partners, to recruit hospitals to PfP and serve as a nodal structure for implementation.
Form coalition of credible campaign sponsors	Selection of HENs to be organizations with existing ties, often hospital associations and including the American Hospital Association (AHA), was one way to achieve credible sponsorship. A second way was to work with well-respected federal and non-federal partner organizations such as the Centers for Disease Control and Prevention (CDC), the American Nurses Association (ANA), and the March of Dimes, and to support the National Quality Forum (NQF) to reach out to private-sector organizations that could align their efforts.
Generate threshold of participating organizations that maximizes network exchanges	CMS allowed measurement flexibility to encourage participation by many hospitals not willing or able to devote resources to produce standardized measures; CMS also emphasized to HENs the importance of recruiting all possible hospitals to join HENs and participate in PfP, including a second try in year 3 to add any willing hospitals from the list of non-aligned hospitals. Organizing the learning community to operate at both the national and local levels was another means to maximize network exchanges.
Create networks to foster learning opportunities	Using a support contractor at the national level and HENs at the local level, CMS sponsored networks that engaged in virtual events, in-person events, affinity groups, listservs, and assistance making peer-to-peer connections to foster learning opportunities.

Table E-20—Alignment of PfP Campaign Strategy with Best Practices Blueprint	
Healthcare Blueprint for Dissemination of Best Practices	**PfP Campaign Strategy**
Incorporate monitoring and evaluation of milestones and goals	Through the Evaluation Contractor, CMS performed monthly monitoring with formative evaluation reports and related presentations. CMS also directly monitored progress, including "leadership huddles" between PfP leaders and each HEN's leadership, and by conducting formal interim HEN assessments in the summers of 2013 and 2014.

Sources: Yuan et al., "Blueprint for the Dissemination of Evidence-Based Practices in Health Care." Commonwealth Fund Issue Brief, May 2010; Evaluation Contractor's ongoing observation and documentation of PfP implementation, recorded in monthly formative feedback reports submitted to CMS February 2012 through December 2014.

[a]Based on a survey fielded by the Evaluation Contractor in summer 2012, over 90 percent of HEN-aligned hospitals agreed or strongly agreed that PfP was well-aligned with their hospital's strategic goals. "Project Evaluation Activity in Support of PfP: Formative Evaluation First Annual Report," September 2012.

Two summary tables (Table E-21 and Table E-22) show the views of HENs that (1) found each aspect of the PfP learning community and design had a positive influence, and (2) reported each aspect had no positive influence.

Table E-21—HEN-Reported Positive Influence of PfP Learning Community and Design Features on HEN Progress		
Learning Community or Design Feature	**Number of HENs Reporting This Positively Affected Their Progress (Of Number Commenting)**	**Common Themes (Each Bullet Point Paraphrases Comments Made by at Least 3 HENs, and Are the Most Common Types of Statements Made by the Group)**
Support Contractors' Work		
NCD learning events and personalized assistance	21 (of 26)	• High-quality content and speakers for the learning events. • Content was shared with hospitals and committees. • NCD provided support when requested. • Wished for more support early in the contract. • Would tweak some aspects of the learning events—wished they were not so packed with speakers, had more practical detail and time for questions.
PFEC master classes and materials	21 (of 25)	• High-quality master classes, speakers, and depth of content. • Support increased as PfP continued.
Evaluation Contractor monthly feedback reports	21 (of 26)	• Used to compare their progress against other HENs. • Used to identify which HENs were meeting targets in specific areas so they could reach out to them for assistance. • Used the reports and data visuals to update internal and external stakeholders on their program's status.
PfP Design Features		
Bold aims	20 (of 25)	• Source of motivation, creating urgency and focus around efforts to improve patient safety. • Critical to generating engagement from hospitals and hospital leadership.

Table E-21—HEN-Reported Positive Influence of PfP Learning Community and Design Features on HEN Progress		
Learning Community or Design Feature	**Number of HENs Reporting This Positively Affected Their Progress (Of Number Commenting)**	**Common Themes (Each Bullet Point Paraphrases Comments Made by at Least 3 HENs, and Are the Most Common Types of Statements Made by the Group)**
Interim targets and related assessments	18 (of 25)	• Allowed them to gauge their progress toward the overall 40 percent/20 percent goals, keeping hospitals on track in their improvement efforts. • Generated greater hospital engagement than the 40/20 goals due to their greater feasibility.
Focused "pushes" on early elective delivery (OB-EED), readmissions, and catheter-associated urinary tract infection (CAUTI) within the overall campaign	18 (of 25)	• Helped them to focus on high-priority areas and added a sense of urgency that resulted in more intensive programs for OB-EED, readmissions, and CAUTI.
Measurement flexibility	5 (of 16)	• Allowed HENs and hospitals to use measures that best suited their needs and helped to encourage hospitals' participation and data submission.

Source: HEN interviews conducted by the Evaluation Contractor, summer 2014.

Table E-22—HENs Reporting No Positive Influence of PfP Learning Community and Design Features on HEN Progress		
Learning Community or Design Feature	**Number of HENs Reporting This Did NOT Affect Their Progress**	**Common Themes (Each Bullet Point Paraphrases Comments Made by at Least 1 HEN)**
Support Contractors' Work		
NCD learning events and personalized assistance	5 (of 26)	• Significant time commitment for events was drain on resources. • Low attendance from hospitals although the HEN encouraged their participation.
PFEC master classes and materials	4 (of 25)	• Low attendance from hospitals within the HEN. • Desire for more detailed explanations of how successes were achieved.
Evaluation Contractor monthly feedback reports	5 (of 26)	• Reports viewed as too complicated. • Quarterly rather than monthly would have sufficed.
PfP Design Features		
Bold aims	5 (of 25)	• Discouraged the participation of hospitals that did not have the resources necessary to achieve the targets. • Infeasible to achieve for those high-performing hospitals already sustaining low rates in the adverse event areas.
Interim targets and related assessments	7 (of 25)	• Distracted focus from their work toward the overall goals of the Partnership.

Table E-22—HENs Reporting No Positive Influence of PfP Learning Community and Design Features on HEN Progress		
Learning Community or Design Feature	**Number of HENs Reporting This Did NOT Affect Their Progress**	**Common Themes (Each Bullet Point Paraphrases Comments Made by at Least 1 HEN)**
Focused "pushes" on OB-EED, readmissions, and CAUTI within the overall campaign	7 (of 25)	• Interrupted their flow of work. • Not naturally aligned with their HEN activities. • Already had robust activities planned for the areas targeted by the pushes.
Measurement flexibility	11 (of 16)	• Noted that the later shift to encourage reporting on common measures was frustrating and caused additional work.

Source: HEN interviews conducted by the Evaluation Contractor, summer 2014.

The Composition of the National-Level Learning Community

The national-level PfP learning community involved federal partners, non-federal partners, patients and families, and HENs and hospitals. This section provides more detail than in the body of the report about how each of these groups played an important role in PfP.

Federal Partners

PfP leadership convened weekly meetings of federal partners and several in-person, full-day meetings. The in-person meetings were well-attended, while attendance varied on the weekly meetings. Table E-23 highlights the main contributions of the federal partners.

Table E-23—Main Contributions of PfP Federal Partners to PfP at the National Level	
Federal Partner	**Main Contributions to PfP**
Agency for Healthcare Research and Quality (AHRQ)	• Developed a way to measure the national rate of hospital-acquired conditions, which served to articulate and mark progress toward PfP goals; then provided updated data on the measure and its components as data became available. • Provided connections to practical tools and methods for preventing harm, developed by AHRQ, including Comprehensive Unit-Based Safety Program (CUSP) and TeamSTEPPS, which were widely promoted by HENs.
Health Resources and Services Administration (HRSA), Office of Rural Health Policy	• Conducted outreach using existing relationships and networks to recruit over 900 rural hospitals (including critical access hospitals [CAHs]) into PfP. • Worked with support contractor to form and support a Rural Affinity Group within PfP, including an in-person and multiple virtual events. • Shared best practice models, patient safety toolkits, and other relevant materials developed by HRSA.
Office of the Assistant Secretary for Health, Office of Disease Prevention and Health Promotion	• Development of the National Action Plan for adverse drug events (ADEs) prompted PfP's year 3 focus within adverse drug events on three critical topic areas: anticoagulants, hypoglycemic agents, and opioids.
CMS—Office of Clinical Standards and Quality (CCSQ) (Quality Improvement Organization [QIO] Program)	• HEN and QIO contracts included overlap in topic areas, with the expectation that the two types of healthcare improvement organizations would work together to avoid duplication of effort while maximizing national-scale harm reduction. • Three annual QualityNet conferences convened the QIOs and HENs together with shared programming and encouraged additional partnering and strategizing.

Table E-23—Main Contributions of PfP Federal Partners to PfP at the National Level	
Federal Partner	**Main Contributions to PfP**
CDC	• Provided subject matter expertise on healthcare-associated infections (HAIs) and medication safety through faculty for learning events. • Provided assistance to the HENs to access and use National Healthcare Safety Network (NHSN) data with their hospitals for tracking and promoting progress. • Provided national and HEN-level data to the Evaluation Contractor for rapid-cycle feedback reports and presentations. • In year 3, worked with several HENs to use NHSN data to target facilities and units where there appears to be greatest opportunity for prevention ("Targeted Assessment for Prevention").
U.S. Department of Veterans Affairs (VA)	• Provided faculty for PfP learning events. • Involvement of one VA expert extensively shaped HEN strategies regarding falls prevention.
Office of Personnel Management	• Encouraged hard stop policies and other contractual measures to reduce OB-EED by insurance carriers covering federal employees.
Administration for Community Living, Office of Policy Analysis and Development, Center for Disability and Aging Policy	• Provided care transitions-focused faculty for the readmissions affinity group and other PfP meetings. • Provided resources and information to the PFEC.

Source: "Federal Partners Retreat Pre-Work," provided by the NCD in November 2014, containing federal partner organization representatives' responses to the question "List/describe your contributions to PfP over the course of the last 3 years;" Federal partner representatives' responses to Evaluation Contractor follow-up emails for clarity and completeness.

Other federal efforts, while not part of PfP, were well-aligned with and complemented PfP. These include:

- CMS financial incentive policies, including the Readmissions Reduction, Value-Based Purchasing (VBP), and Hospital-Acquired Condition (HAC) Reduction Programs.
- United States (U.S.) Department of Defense (DoD) and VA patient safety programs, which targeted many of the same harm areas within those health systems.

Non-Federal Partners

A key component of the shared learning community led by the Center for Medicare & Medicaid Innovation (CMMI) was the engagement of national organizations and stakeholders addressing patient harm and readmissions ("non-federal partners"). Organizations were identified based on their historical work to address patient safety and readmissions, prior affiliations with the PfP campaign, or due to recommendations by CMS staff for inclusion. To get a better understanding of the nature of these partnerships and alignment of focus, the team interviewed 22 representatives from 19 national-level organizations in March and May 2015 (see Appendix C for methodology).

- Overall, representatives from 13 national-level organizations described activities to contribute to the PfP campaign.[E-4] Such activities included disseminating information with constituents about the

[E-4] This count is based on organizations who engaged directly with HENs or their organizational constituents, such as hospitals and clinicians. This count does not include those individuals involved in the NQF Patient Safety Collaboration, although there is some overlap between individuals who participated in that work and who contributed to campaign-related activities.

campaign, partnering with HENs to carry out dissemination campaigns and pilot interventions, and functioning as consultants to HENs.[E-5]

Natural alignment was more common than deliberate alignment and formal collaboration.

- Overall, one organization—a health professional association with large-scale, national-level reach—characterized its involvement in PfP as a formal partnership with CMMI leadership, describing standing meetings and strategizing with leadership on paths to take.
- Several (7) organizations participated in informal partnership activities, such as meetings and information-sharing with CMMI leadership. Some of these involved multiple touch-points over time, while one involved early period meetings only.
- Many (11) of the organizations have partnered with or provided expertise and consultation to the HENs. Two organizations deliberately aligned with the campaign in carrying out their activities, while over half of the organizations (14) had a natural alignment with the PfP campaign due to shared goals.

The majority of organizations included in the interviews (16 of 19) participated in the NQF Patient Safety Collaboration. The collaboration, funded by PfP, was a multi-stakeholder activity to develop best practices and guidance for hospitals addressing OB-EED, readmissions, and patient and family engagement (PFE).

Table E-24 presents the ways in which the organizations reported contributing toward PfP goals.

Table E-24—Contributions of National-Level Non-Federal Partner Organizations toward PfP Goals, December 2011 Through December 2014

Focus of Organizations' Activities	Ways Organizations Contributed toward PfP Goals (Natural or Deliberate Alignment)
ADEs and HAIs	• Developed intervention tools • Disseminated information about the campaign and the adverse event areas (AEAs) to constituents • Advocated direct engagement of constituents in harm reduction as campaign strategy • Collaborated with HENs on venous thromboembolism (VTE) and anticoagulation • Collaborated with HENs on CAUTI, focusing on promoting culture of safety • Participated in PfP pacing events • Reported on hospital safety • Provided consultation and education on ADEs • Consulted on the role of pharmacists • Developed and disseminated patient safety and quality measures, tools, bundles, and other resources

[E-5] The Evaluation Contractor interviewed representatives from the following 19 organizations who were identified as working on patient safety improvement during the time of PfP. Due to confidentiality, the scope and substance of contributions are not identified in the report: American Board of Internal Medicine Foundation (ABIM) (2 separate interviews); American Case Management Association (ACMA); American College of Surgeons (ACS); American Nurses Association (ANA); American Pharmacist Association (APhA); American Society of Health System Pharmacists (ASHP); Association of State and Territorial Health Officials (ASTHO); Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN); California Maternal Quality Care Collaborative (CMQCC); Center to Advance Palliative Care (CAPC); Childbirth Connection; Institute for Healthcare Improvement (IHI) (2 separate interviews); The Joint Commission (TJC) (2 separate interviews); The Leapfrog Group; March of Dimes; Pacific Business Group on Health (PBGH); Planetree; Safe Care Campaign/The Healthcare and Patient Partnership Institute (H2Pi); and Society of Hospital Medicine (SHM).

Table E-24—Contributions of National-Level Non-Federal Partner Organizations toward PfP Goals, December 2011 Through December 2014	
Focus of Organizations' Activities	**Ways Organizations Contributed toward PfP Goals (Natural or Deliberate Alignment)**
OB-EED and Other Obstetrical Adverse Events (OB-Other)	• Influenced focus on OB-EED, hemorrhage, and preeclampsia by providing evidence of harm, position statements, and recommendations • Engaged constituents and other stakeholders in eliminating non-medically necessary OB-EEDs (including hospitals and clinicians) • Provided patient education campaign and materials • Partnered with HENs and other organizations to carry out public awareness raising campaigns and pilot bundles and other tools • Consulted with HENs on implementing interventions to address OB-EED and OB and neonatal harms • Developed and disseminated patient safety and quality measures, tools, bundles, and other resources • Reported on OB-EED rates among hospitals • Built partnerships and multi-stakeholder collaborations • Participated in PfP pacing events
Readmissions and Care Transitions	• Piloted readmissions interventions in three states with HEN presence • Partnered with HEN to convene collaborative to address readmissions • Pushed for the involvement of patient advocates at hospitals participating in PfP • Provided evidence-based tools around palliative care and care transitions
PFE	• Developed and disseminated PFE guides for various target audiences • Partnered with HENs to pilot process for establishing a patient and family advisory committee in hospitals • Disseminated patient and consumer brochures about unnecessary treatments • Disseminated patient education materials specific to AEAs; for example, OB-EED and surgical site infections (SSI) • Garnered public attention through public reporting of patient safety measures or developed quality measures to enhance quality improvement efforts
Safety-Across-the-Board and Leadership Engagement	• Partnered with HENs to conduct leadership training • Provided consultation on measurement

Source: Evaluation Contractor interviews with 20 individuals from 18 organizations in spring 2015 (see Appendix C for method).

Non-federal partners interviewed by the Evaluation Contractor in winter 2015 expressed the following opinions about PfP. Most non-federal partner participants perceived that the PfP campaign provided momentum and energy toward reducing patient harm and readmissions. Representatives from nine (of 19) organizations pointed to the visibility of the campaign, and two of these representatives noted the value of having the national campaign and federal alignment with their agenda as they worked to engage their members or constituents. As one participant said, "How else do you get that kind of synergy to focus on the same thing no matter what else is going on in the environment?" Five representatives said that the campaign increased their reach to their constituents and members (including hospitals) and helped to propel their work (e.g., distribution of their toolkits and protocols, use of their patient safety measures).

Two interviewees noted that bringing national attention to OB-Other was novel, and PfP played a substantial role in doing so: "From the national OB perspective, what was really great was the fact that for the first time on a national level, hospital leadership saw OB harm as something that needed to be addressed. People recognized this need for the first time. There wasn't significant attention or resources devoted to this before."

Another participant perceived PfP as being equitable through the availability of resources so that small and critical access hospitals, which previously may have been unable to afford hands-on technical assistance, now had access to quality improvement (QI) resources through HENs. Another noted that PfP has resulted in significant collaboration among providers.

Many saw value in the multi-stakeholder collaboration through the NQF Patient Safety Collaboration and action teams, and those involved in developing the OB-EED *Playbook* viewed it favorably. However, two people involved in the NQF work viewed it as ineffective and only a starting point.

One person characterized PfP as disruptive to their work as they were running a pilot in one of the targeted AEAs and had built regional collaborations that were then fragmented due to participation in different HENs. This person also noted that readmissions greatly differed from the other AEAs due to the complexity of the problem—that reducing readmissions requires efforts beyond individual hospitals' control. One organization would have liked to have seen more public reporting in PfP, and several participants noted disappointment in the lack of standardized measurement across the HENs.

Regarding the future of PfP, two participants noted the need to hardwire changes, continue to address cultural issues, and move into other focus areas of harm.

Patients and Families

Patients and families of patients who had been harmed in the hospital were active advisers to the PfP learning network. Individuals willing to play this role were identified and supported by the PFEC and a patient-focused consultant to the NCD. They were invited and encouraged to share their stories as motivation for the group, and to listen to the learning sessions and meetings and share their perspectives with the group in order to keep the focus of the campaign on the patient. Nearly every national-level learning event, including in-person meetings, from December 2012 forward included a patient perspective.

HENs and Hospitals[E-6]

HENs, as the organizations funded to provide critical assistance to hospitals, and hospitals themselves routinely participated in the national-level learning community as both faculty and audience, due to the "all-teach, all-learn" core tenet of PfP. Learning community events occurred on an approximately weekly schedule. During April 2013 through April 2014, for example, a total of 31 weekly pacing events (virtual learning events) occurred. Of these, over three-fourths had attendance of at least 100 telephone lines.[E-7] Nineteen of the 26 HENs attended at least 75 percent of the events.

Although the weekly events were open to both HENs and hospitals, events designed specifically for hospitals were scheduled approximately monthly. During the period April 2013 through April 2014, for example, 10 hospital events each drew between 400 and 818 participating lines. The topics included ADEs, readmissions, medication reconciliation post-discharge, generating physician and leadership engagement, reversing the CAUTI trend, and ensuring pediatric safety in general hospitals.

The weekly pacing events were only one part of HENs' participation in the national-level learning community. Three other components of the learning community that involved person-to-person networking by HENs were affinity groups, HEN house calls, and office hours.

E-6 The source for participation data cited in this section is NCD, "Pacing Attendance_HEN_2013_2014_v2," spreadsheet providing attendance detail for pacing events from April 1, 2013, through April 1, 2014.

E-7 The method available for tracking participation does not allow for separation of hospital versus HEN or other participants, nor does it provide the ability to determine whether one telephone line included multiple individuals.

- ***Affinity Groups.*** Affinity groups were led by HEN staff and supported by the NCD, and were composed of a mix of HENs, advocacy and professional organizations interested in the topic, and hospitals interested in the topic. Affinity groups held meetings approximately monthly and worked to identify leaders in their areas to highlight key issues and potential solutions for the broader group.
- ***HEN House Calls.*** HENs set up a routine communication vehicle for the learning community that included only HEN staff (no CMMI, no support contractors)—weekly "HEN house" calls that, anecdotally, appear to have been well-attended and were valued by the HENs enough that they made plans to continue these after PfP ended.
- ***Office Hours.*** PfP leadership hosted weekly office hours, where HENs called in at the scheduled time for open and informal communication with PfP leadership (no agenda). Most HENs attended the office hours, this is apparent because CMS took attendance. Although line interference was not uncommon due to the large attendance and open mic policy, often PfP leadership was able to respond to questions from the HENs and/or generate discussion around a point of interest to them.

HENs and hospitals also participated in the learning community through the Community of Practice (CoP) website and listservs, both supported by the NCD. The CoP website allowed for sharing of tools and resources within the group, and housed archived webinars and slide sets from the learning events. The NCD used listservs to push out links and resources to individuals who had signed up for specific topic areas or for general information from PfP.

HENs also received routine, monthly feedback on their progress from the Evaluation Contractor, in formats that evolved over PfP but always provided full transparency at the HEN level, with data displays showing progress HEN-by-HEN in ways that visually identified the leaders.

Spread of Best Practices Through HEN-Led Learning Communities

Overview of HENs' Major Activities as Reported to the Evaluation Contractor

HENs conducted a wide range of activities to spread best practices and provide support to hospitals in harm reduction. These activities broadly fall into several major categories, presented in Table E-25.

Table E-25—HEN Activity Types

Activity	Timing	Examples	Number reported
Education	One-time, Quarterly, Monthly, Weekly, Continuous, As needed	Training; Materials on HEN websites; Conference calls; Webinars	2,227
Tools	One-time (dissemination of tool to hospitals), As needed	Common scheduling forms; Hard Stop Policy; Protocols; Checklists; Materials (hemorrhage carts, disinfection caps)	944
Coaching	One-time, As needed	Data collection on-site training; Tools training; Site visits	417
Leadership	One-time, Quarterly, Monthly, Weekly, Continuous	Review of campaign results; Regional meetings of hospital leadership; Clinical leaders meetings	525
Partnerships	One-time, Monthly, Quarterly, Annually, As needed	Collaboration with outside agencies such as AHRQ, State hospital associations, QIOs, State health departments, Physician practices, etc.	1,271
Total			**5,384**

Source: Analysis conducted by Evolution Contractor of the 26 intervention spreadsheets submitted by HENs to the Evaluation Contractor as part of the fall 2014 interviews

Note: The HEN-reported activities were reviewed by two independent reviewers to assign each activity to one of five categories. The HENs reported 109 activities that they considered as "cross-cutting," meaning that they applied to all of the PfP focus areas. Other HENs reported these kinds of activities separately, by focus area. Therefore, items reported as cross-cutting were included as an activity in each focus area for those HENs.

HEN Implementation Strategies

For PfP to achieve its goals, HENs, as facilitators of change, needed to implement effective strategies. The Evaluation Contractor conducted interviews with the HENs in fall 2014 to understand the nature of the implementation strategies they used and to assess concordance with key elements of implementation strategies identified in the literature on implementation and quality improvement in health service settings (see Appendix C for details). This section examines how HENs worked with hospitals to carry out harm reduction efforts based on HENs' descriptions of their implementation strategies.

Based on a synthesis of the evidence regarding quality improvement initiatives and the adoption of evidence-based practices in health services settings, derived from eight reviews or syntheses of the literature, the Evaluation Contractor examined the HEN strategies for the following characteristics:[E-8]

- Multi-faceted strategies; for example, addressing cultural and infrastructure-related issues as well as changes to processes of care.

[E-8] A larger literature review of dissemination and implementation in health and healthcare informed the identification of these references as being most relevant.

- Attention to context; for example, by encouraging adaptation of interventions to local patient population needs, organizational settings, and other environmental factors, and tailoring strategies given contextual factors and organizational characteristics.
- Planning and management of the implementation process.
- Capacity building, including skills training and education.
- Engagement of key influencers such as prominent organizations, champions, and subject matter experts who could motivate participation of key stakeholders.
- Engagement of leadership that can commit to the goals of the initiative.
- Engagement of stakeholders, particularly frontline staff and clinicians.
- Facilitation of peer-to-peer learning.
- Provision of technical assistance and consultation with use of interventions and in process changes.
- Use of data to drive process improvement and to evaluate and refine strategies.
- Partnership with organizations that can expand reach and align efforts.

Other key points in this section include:

- The variation in the intensity and breadth of work carried out by the HENs becomes apparent when their strategies and tactics are arrayed.
- Beyond high-level similarities, HEN strategies varied substantially by HEN and by focus area.
- Prior experiences and partnerships were an important factor shaping HEN strategies.
- HEN implementation strategies frequently evolved, in a cycle of improvement based on experience and data.

Concordance with Literature-Based Principles of Effective Implementation

HENs' approaches were generally consistent with several principles of effective implementation identified in the literature, as summarized in Table E-26.

In addition to the literature-based elements in the table below and the HEN interview data that are summarized, the literature also highlights the importance of the quality of facilitation and support provided during large-scale quality improvement initiatives. The Evaluation Contractor's national survey of hospitals in summer 2014 (reported in Chen et al. 2014) found that hospitals self-reported high usefulness of the HENs' support, perhaps the best indication of quality. Specifically, they reported the resources they were provided or linked to because of the HENs were useful in:

- Reinforcing or enhancing their commitment to harm reduction (57 percent very useful, 95 percent somewhat or very useful).
- Increasing their knowledge of how to reduce harms (53 percent very useful, 95 percent somewhat or very useful).
- Enabling new or different actions to reduce adverse events (49 percent very useful, 92 percent somewhat or very useful).

Table E-26—Alignment of HENs' Implementation Strategies with Key Elements of Implementation	
Key Elements of Implementation	**Description of HENs' Implementation Strategies**
Use of multi-faceted strategies (Fixsen et al. 2005; Powell et al. 2012; Damschroder et al. 2009)	• All HENs provided education (accompanied by tools and resources), skills training, coaching and consultation, and monitoring and data feedback. • Communications from the HENs to hospitals were also multipronged, including weekly emails pushed to the main contacts; printed data reports sent directly to chief executive officers (CEOs); listservs; interactive dashboards, group and individual telephone meetings; and webinars. • HENs also described strategies to address hospital patient safety culture, such as conducting culture surveys, providing educational and training offerings focused on culture, and engendering accountability across the hospital for harm reduction.
Attention to context through adaptation and tailoring of strategies (Damschroder et al. 2009; Greenhalgh et al. 2004; Fixsen et al. 2005)	• More than half of HENs (16) aided hospitals in adapting interventions, most often through engagement of local leadership or on-the-ground consultation. • Most of the rest (8 additional HENs) recognized the need for adaptation and expected or allowed for it.
Planning and management of the process (Damschroder et al. 2009; Perla et al. 2013)[E-9]	• Most HENs (25) used data-driven strategies, conducting gap analyses or surveys of hospitals at various points in the campaign to assess needs, current practices, and opportunities for improvement. • Most HENs (21) also described mining data or used assessment tools such as Plan-Do-Study-Act to drive strategies and focus efforts—engaging in a rapid cycle, continuous quality improvement cycle. • HENs also described refining their strategies over the course of the campaign.
Capacity building, including skills training and education (Perla et al. 2013; Greenhalgh et al. 2004)	• All HENs provided education, skills training, and consultation or coaching. HENs used various modes for education and conducted varied types of skills training for different target audiences, including leadership, clinicians, frontline staff, and patients and families.
Engagement of key influencers (Perla et al. 2013; Greenhalgh et al. 2004; Fixsen et al. 2005; Damschroder et al. 2009)	• Almost all HENs engaged subject matter experts (SMEs) and champions to encourage engagement of others. • In some cases, SMEs or champions provided on-site consultation and feedback to hospitals. • Many HENs held up a subset of influential entities that adopted an intervention to encourage others to adopt in some way—some through intensive collaborative work with a small subset of hospitals, which then shared their experience with the broader group. Many HENs described leveraging data to identify pockets of success and then asking those hospitals what they were doing, and sharing that information with the group.
Engagement of leadership (Greenhalgh et al. 2004; Perla et al. 2013)	• All HENs engaged hospital leadership, although they used different tactics; for example, direct communications and data feedback reports targeted to hospital leadership. • HENs also described engagement of leaders at multiple levels; for example, hospital boards, the C-suite, clinician leadership, and nurse leadership.

[E-9] This element includes efforts to plan the implementation strategy, carry out the implementation strategy, and monitor and refine the strategy. The literature discusses use of a theory or model of change to inform strategies; however, this element was not explored in the HEN interviews.

Table E-26—Alignment of HENs' Implementation Strategies with Key Elements of Implementation	
Key Elements of Implementation	**Description of HENs' Implementation Strategies**
Engagement of stakeholders (Greenhalgh et al. 2004; Pentland et al. 2011)	• All HENs engaged multiple stakeholders, including leadership, clinicians and staff, and patients and families, among others. • Most HENs targeted communications and performance feedback reports to hospital leadership. • Most HENs required an explicit commitment from their hospital leadership, sometimes including chief medical and chief nursing officers, related to participation in PfP or to reduction in patient harm and readmissions. • HENs engaged clinicians through physician champions and clinician advisory committees. HENs also developed or promoted the development of multidisciplinary care teams, for example to address ADE and readmissions. • HENs also engaged frontline staff, which consisted of skills training such as TeamSTEPPS and nurse-driven protocols, and by making safety-across-the-board everyone's goal and responsibility.
Facilitation of peer-to-peer learning (Yuan et al. 2010; Perla et al. 2013; Greenhalgh et al. 2004)	• All HENs served in a convener and facilitator role, linking hospitals for shared learning opportunities and using their networks to spread promising practices, frequently featuring hospital representatives as faculty in the learning sessions. • Half (13) indicated that they linked hospitals, such as those struggling in a particular area, to high performing hospitals or hospitals with similar characteristics; for example, linking more advanced small or critical access hospitals with similar hospitals that were less advanced.
Provision of technical assistance and consultation with use of interventions and in process changes (Yuan et al. 2010; Greenhalgh et al. 2004; Perla et al. 2013)	• All HENs provided some form of consultation and coaching. Most HENs (22) provided on-site consultation and in many cases this consultation consisted of hands-on support with use of a tool or intervention.
Use of data to drive process improvement and to evaluate and refine strategies (Yuan et al. 2010; Perla et al. 2013)	• All HENs worked with hospitals to develop data-monitoring capabilities and to collect data for monitoring patient safety and readmissions at the HEN level. • Most HENs described using audit tools, gap analysis, and root cause analysis to drive performance improvements and identify areas needing improvement. • Most HENs similarly targeted their approaches to areas of high need; for example, by working more directly with low-performing hospitals.
Partnership with organizations that can expand reach and align efforts (Greenhalgh et al. 2004; Fixsen et al. 2005; Carpenter et al. 2005)	• All HENs partnered with organizations to help carry out the work of harm reduction or to engage key stakeholder groups.

Source: Fall 2014 HEN interview data and HEN self-reported intervention spreadsheets describing cross-cutting and area-specific interventions, strategies, and partnerships and cited literature.

Variation in HEN Implementation Strategies

Consistent with the design of PfP (Figure 1-1 in the main body of the report), HENs' implementation strategies for spreading best practices consisted of the primary mechanisms foundational to the campaign: capacity building, shared learning, coaching and consultation, rapid-cycle feedback, and alignment of focus through stakeholder engagement, including leadership and patient and family engagement. In addition, many HENs sought to meet hospitals where they were in their progress toward addressing patient safety and in doing so provided a variety of educational offerings and evidence-based tools and resources that the hospitals could participate in or adopt as appropriate. Beyond these basic commonalities, HENs varied substantially in the configuration and nature of their strategies. Key points regarding this variation include the following:

- Most but not all HENs conducted site visits (22) in addition to virtual learning events and other activities. The visits varied in frequency and protocol, but variously included observation of care processes and feedback, working with hospital staff to address barriers to change, review of data and opportunities for improvement, and engaging with hospital leadership.
- A smaller subset of HENs (9) developed individualized plans with hospitals, typically beginning with a systematic needs assessment.
- HENs varied their emphasis on adaptation and standardization. While nearly all HENs recognized the need for adaptation of at least some interventions, and for standardization of at least some processes, 16 actually provided hands-on assistance to hospitals working to adapt better care processes, and many HENs (19)—often those that were also health delivery systems—emphasized more than others the need for standardized adoption of practices across staff or units within hospitals or across hospitals.
- While nearly all HENs targeted their assistance to some degree (25), the nature and extent of targeted assistance varied. For example, many but not all HENs specifically identified low performers, or "high-impact hospitals" (hospitals with high numbers of harms, often larger hospitals), and offered more intensive outreach and assistance to those hospitals.

How HENs Chose Strategies and How They Evolved

PfP differed from most tests of implementation in that there was not a single, defined set of interventions that the campaign pushed in order to achieve results. Due to this flexibility, along with the variation in HEN strategies described above, it is important to understand what drove the differences in implementation strategies and interventions that the HENs undertook.

Building on prior experience and partner activities where possible. Many HENs (21) built their efforts onto previous experience and momentum within their network as well as partner activities or state policies. Since HENs had varying levels of experience and partner activities, some began PfP further ahead than others both in terms of hospitals' readiness to work on specific areas of harm reduction, and the HEN's own readiness to provide quickly appropriate resources to support the next step in harm reduction. For example, one HEN (NY) described:

> *"In 2012, the Department of Health had planned to expand their work and spread lessons learned in an EED Collaborative throughout the state. It was very fortuitous that the partnership was gearing up at this time, and [the HEN] worked with Department of Health to align their work. Together, we formed the [state] Perinatal Collaborative across the state. I think it's because of that partnership that we've had such tremendous success. It has helped create statewide focus and reduced other distractions from the perspective of our hospitals. We've been able to work together as one unit moving forward."*

In another example, a HEN noted that it had been working on falls for a number of years:

> *"It started statewide in 2007. We already had an established policy in place. Due to statewide reporting laws, we have detailed data. We were able to bring that data back to our initiative to know what to focus on."*

On the other hand, HENs did not have experience or partners to build on in every area. One HEN expressed disappointment that the national learning community did not provide neat packages of interventions selected as best, right at the start of PfP. Many HENs spent considerable time and effort during 2012 reviewing existing interventions, working with their advisory groups, and conducting needs assessments with their hospitals, before recommending or strongly highlighting particular interventions for some of the PfP focus areas. Seeing this need, several HENs built change packages for each area; for example, AHA/HRET change packages were released in 2013 and 2014.[E-10]

Using data to drive evolution of strategies. Most HENs (21) described mining data or using assessment tools, for example Plan-Do-Study-Act, to drive strategies and focus efforts—engaging in a rapid-cycle, continuous quality improvement cycle. Some HENs described a process of allowing for more flexibility among hospitals up front in the selection and use of interventions locally, but then moved to standardization—specifying the interventions to use for the hospitals—or to hands-on support in adaptation. External factors also drove the evolution of HENs' implementation strategies, such as emerging evidence or measurement changes. As one HEN described how the change from ventilator-associated pneumonia (VAP) to ventilator-associated event (VAE) motivated movement toward an interdisciplinary team approach:

> *"[The definition change] was a good thing to happen because it defined the way we were measuring VAEs. It wasn't so subjective, but based more on data and trending of patients' physiologic function. That was one of best things that could happen. It's gone beyond preventing pneumonia and has grown into being more about the care and safety of intensive care unit (ICU) patients, also. That overlaps into CAUTI, so it's spread across HACs."*

Thus, a number of factors shaped HENs' strategies, and over time these strategies were adjusted to meet the needs of their hospitals and contextual factors.

Varying their strategy to fit characteristics/needs of the focus area. The characteristics of the specific focus areas also helped shape HEN strategies. For example:

- Several HENs expressed that the intervention needed to address OB-EEDs was more straightforward than what was required to address HAIs (SSI, CAUTI, central line-associated blood stream infection [CLABSI], and VAP). Many HENs implored adoption of "hard stop policies" network-wide, whereby hospitals would set scheduling policy such that early elective deliveries would not be scheduled (unless medically indicated). Such relatively simple fixes were not available for other focus areas. Also, because of widespread national momentum for OB-EED reduction, many HENs readily formed partnerships with the American Congress of Obstetricians and Gynecologists (ACOG) and March of Dimes, along with other influential organizations.
- HENs appeared to use patient and family engagement strategies most often for OB-EED, falls, pressure ulcers, and readmissions. For example, in readmissions, many interventions focused on teach-back during discharge, addressing patient needs, and working with community services. In OB-EED, about half of the HENs partnered with March of Dimes to co-brand and distribute patient educational materials to increase patient knowledge about the risks of early delivery.

[E-10] For example, the most current version of the AHA/HRET HEN change packages are found by clicking on "resources" within each topic at this website: http://www.hret-hen.org/.

- Standardization of processes was a more common focus for strategies aimed at reducing health care-acquired infections (especially CLABSI), while adaptation was a nearly universal feature of strategies for reducing readmissions, due to local population differences. Tools such as root cause analysis and patient risk assessments were key to most readmission reduction strategies to aid in identification of issues and adaptation of interventions on an as-needed basis. Even HENs that standardized interventions network-wide in other areas allowed for or aided in adaptation of interventions for readmission reduction. As one HEN that is also a health delivery system said:

  "My job was to create the global system strategy and then help them deploy that strategy. Initially, we wanted people to just use the evidence and stick with Better Outcomes for Older Adults through Safe Transitions (BOOST) or RED, but then I realized it didn't suit all of our facilities, and it made sense to create hybrids."

- Partnerships were relevant to all AEAs, but particularly ADE, OB-EED, OB-Other, and readmissions. In the area of readmission reduction, community partnerships and engagement of providers across the care continuum was another major strategy that HENs either directly engaged in or encouraged their hospitals to do so. For example, a few HENs invited community-based providers to their events to address readmissions.

Role of Partnerships in HEN Implementation Strategies

Partnerships at the HEN level with a variety of organizations playing a varied set of roles were common and frequently important to the HENs' work. HENs varied in the extent to which they partnered as a core part of their strategy.

Frequency of partnerships. Establishment or strengthening of partnerships was a highly prevalent strategy among HENs. All HENs cited some form of partnership; most HENs (19) noted newly formed partnerships, while half (13) indicated they strengthened existing relationships during the HEN work period. Almost all (24) described a two-way partnership, and almost half (12) described collaboratives or multi-organizational partnerships—for example, statewide. Consistent with the literature, partnership is another critical aspect of effective dissemination and implementation because partners can reach new audiences, lend credibility as trusted sources of information, and provide insight into target audiences such as clinicians and patients and families (Napoles et al. 2013; Kreuter et al. 2014; Greenhalgh et al. 2004). As is described above in this appendix about partnership at the campaign level, many national organizations were involved in PfP through HEN-level commitments.

Types of organizations serving as partners. Table E-27 presents the types of organizations HENs partnered with and the nature of the partnerships, as reported by HENs (Appendix C provides more detail). More HENs indicated high persistence or value for the partnerships with county or state health departments and QIOs than for other types of partners. Partnerships were particularly valuable for the areas of ADE, CAUTI, OB-EED, SSI, and readmissions (Table E-28). Some partners were paid by HENs, while others were not.

Table E-27—Types of Partner Organizations and Role of Partnerships in Harm Reduction Across HENs											
Type of Partner Organization (Examples)	Number (%) of HENs Partnering with Organization	Most Common PfP Focus Areas Addressed by Partnerships (Examples)	Degree of Integration between HEN and Partner[a] (Percent of HENs Citing)			Persistence of Partner Contribution[b] (Percent of HENs Citing)			Value of Partnership[c] (Percent of HENs Citing)		
			Loose Integration	Moderate Integration	Tight Integration	Low Persistence	Medium Persistence	High Persistence	Minimal Value	Moderate Value	Critical Value
QIOs	18 (69.2%)	ADE, CAUTI, Readm	33.3%	55.6%	44.4%	44.4%	55.6%	50.0%	27.8%	66.7%	50.0%
County/State Health Departments	11 (42.3%)	CAUTI, CLABSI, OB-Other	45.5%	81.8%	63.6%	27.3%	54.5%	63.6%	0.0%	63.6%	63.6%
Other HENs	10 (38.5%)	CAUTI, CLABSI	40.0%	70.0%	40.0%	30.0%	60.0%	40.0%	20.0%	70.0%	30.0%
March of Dimes	9 (34.6%)	OB-EED, OB-Other	44.4%	44.4%	22.2%	11.1%	55.6%	22.2%	22.2%	44.4%	44.4%
Association for Professionals in Infection Control and Epidemiology (APIC)	8 (30.8%)	CAUTI, CLABSI	12.5%	75.0%	25.0%	12.5%	50.0%	37.5%	12.5%	75.0%	25.0%
ACOG	6 (23.1%)	OB-EED, OB-Other	50.0%	33.3%	16.7%	40.0%	20.0%	20.0%	20.0%	60.0%	20.0%
State Hospital Associations (SHAs) (for the 13 HENs that were not an SHA)	5 (19.2%)	ADE	20.0%	40.0%	80.0%	20.0%	20.0%	60.0%	20.0%	60.0%	40.0%
Other	20 (76.9%)	CAUTI, OB-EED, Readm	45.0%	75.0%	70.0%	50.0%	75.0%	65.0%	25.0%	80.0%	60.0%

Source: Spreadsheets submitted by 26 HENs describing initiatives and partnerships and rating partnerships in terms of degree of integration, persistence of partner contribution, and value of partnership.

[a]Loosely integrated: little coordination across the organizations of messaging and effort to disseminate.

Moderately integrated: some coordination cross multiple organizations in messaging and an average level of outreach effort to disseminate information.

Tightly integrated: strong coordination with major contributions by multiple organization partners and intense outreach efforts.

[b]Low: Partner participated in less than 30 percent of recurring events, such as webinars or monthly meetings.

Medium: Partner participated in 30-70 percent of recurring events, such as webinars or monthly meetings.

High: Partner participated in more than 70 percent of recurring events, such as webinars or monthly meetings.

[c]Minimal: Partner in name only, and/or providing a lack of consistent contribution to the effort.

Valuable: Partner added value but was less than critical.

Critical: Partner contribution was either essential to the effort or harm reduction would likely have been much less without this partner.

Note: Percentages in columns "Degree of Integration between HEN and Partner," "Persistence of Partner Contribution," and "Value of Partnership" are percentages of HENs reporting at least one partnership meeting the column criteria; therefore, a single HEN with 10 partnerships might be counted in all columns if at least one of its partnerships was characterized as described. Therefore, columns do not add up to 100 percent within categories.

Table E-28—Percentage of HENs Indicating Partnerships Were Valuable or Critical to Harm Reduction, Overall and by PfP Focus Area												
	Overall[a]	ADE[b]	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAE	VTE	Readm
Percent of HENs Citing Partnerships as Valuable or Critical to Harm Reduction	100.0%	61.5%	61.5%	50.0%	38.5%	57.7%	50.0%	38.5%	57.7%	53.8%	34.6%	65.4%

Source: All 26 HEN completed spreadsheets describing initiatives and partnerships and rating partnerships in terms of degree of integration, persistence of partner contribution, and value of partnership. "Critical" partnerships were defined as either essential to the effort or harm reduction would likely have been much less without partner. "Valuable" partnerships were defined as partner added value but were less than critical.
[a]Six HENs completed spreadsheets describing partnerships that were relevant across several or all PfP focus areas. Six is the denominator for the "Overall" percentage column.
[b]All 26 HENs completed focus area-specific spreadsheets describing initiatives and partnerships. Twenty-six is the denominator for each PfP focus area column.

Roles played by partners. Partners played a variety of roles, including participating in educational sessions and conferences; providing on-site consultation to hospitals; helping HENs carry out dissemination campaigns; helping to reach key stakeholder groups (for example, through their constituent members); collaborating with HENs on implementation strategies; engaging with HENs in information-sharing and strategic planning; providing local expertise; and bringing increased credibility to HEN work. One HEN with many partnerships said:

"Having bigger organizations and large stakeholders endorse our work helped with credibility."

Variation in extent of HEN partnerships. The ability to partner locally varied across HENs, depending on HEN characteristics. For example, HENs that spanned geographic regions and states may not have had formal partnerships at the local level but instead encouraged hospitals to engage local partners, local chapters of large organizations, QIOs, and the Community-Based Care Transition Programs (CCTPs). HENs engaged in regional collaboratives among non-hospital providers and encouraged hospitals to develop partnerships across the care continuum and with community-based organizations to address patient harm and readmissions in particular. In a few cases, HENs engaged community organizations alongside hospitals (for example, at regional conferences).

Benefits and lessons learned. HENs noted a number of benefits due to their partnerships. Partnerships helped HENs maximize efficiency and generate momentum across the AEAs. One HEN described the mutually beneficial relationship:

"The Department of Health has long-term care, hospital physicians, and the statutory stuff in the state. But they have difficulty engaging the provider community and that's where we come in. We have developed this symbiotic relationship with the Department of Public Health. They own the strategy, and we work with them to develop a statewide task force and help them run the strategy."

Partnerships also opened up opportunities. One HEN described the result of working with partners closely on OB-EED:

"Later as PfP expanded, we worked on preeclampsia. Because of the work done with EED and those partners, it gave us the opportunity to delve into other topics we would not have had the opportunity to work on…."

HENs reported learning that mutual willingness to share data, a commitment to transparency, open communication, and shared goals were keys to strong partnerships. As one HEN described,

"We learned that partnerships can drive change more effectively and rapidly. Having a common aim helped focus everyone. That common aim was crucial."

Strategies HENs Found Most Effective

HENs shared a variety of lessons learned on their implementation strategies. HENs noted the following strategies as being important for hospital engagement and achievement results:

- Hospital-specific, individualized consultation and technical assistance—whether through virtual or on-site consultation (13 HENs)[E-11]
- Partnership with other organizations—whether newly formed or strengthened (12 HENs)
- Transparency of data reporting and sharing across the HEN's network to promote movement toward open sharing among hospitals (9 HENs)
- Stakeholder engagement, specifically leadership and patient and family engagement (9 HENs)
- Presentation of evidence to encourage adoption (8 HENs)
- Peer-to-peer learning and networking facilitated by the HEN, centered on implementing best practices and addressing barriers (7 HENs)

SHAs in AHA/HRET HEN

As the largest HEN composed of 31 SHA, AHA/HRET played a large role in the HEN component of PfP. Due to its large role, the Evaluation Contractor interviewed and collected implementation strategy information from 31 SHAs participating through AHA/HRET in fall 2014, consistent with the process for interviewing the HENs.

The AHA/HRET SHAs used many of the implementation strategies observed among the 26 HENs, with emphasis on several key strategies. Like the 26 HENs, AHA/HRET SHAs described providing consultation and coaching, skills training, making networking opportunities available, aligning and partnering with other organizations such as March of Dimes, state perinatal collaboratives, or state Medicaid agencies, and data monitoring and feedback.

The majority of SHAs in AHA/HRET HEN used implementation strategies that aligned with the national HEN's programming and strategies to reduce patient harm. AHA/HRET's approach to reducing harm consisted of improvement drivers (resources and tools, coaching and sharing of best practices, and building improvement capacity) and a combination of national and state strategies (collaboratives and improvement leader fellowships). AHA/HRET HEN also outlined crosscutting foundational topics: (1) shared commitments, transparency, and executive and physician engagement (2) small ball strategy (targeted improvement coaching); (3) boot camps and SHA CEO engagement; (4) site visits and state-level meetings; (4) measurement; (5) safety culture, teamwork, and communication; and (6) patient, family, and leadership engagement (The AHA/HRET HEN 2013).

Based on the interview data, 27 SHAs indicated that they used AHA/HRET materials, including change packages, top 10 strategy lists, and driver diagrams. Skills training was emphasized in the AHA/HRET

[E-11] "At least" as many HENs as indicated in this series of bullet points raised these points, because other HENs may have agreed this was important but not specifically mentioned it in the interviews.

network.[E-12] For example, 23 SHAs described CUSP for CAUTI or CLABSI. Additionally, at least 12 SHAs noted participation of member hospitals in the Improvement Leadership Fellowship training program for hospital leadership, and 15 SHAs described use of AHA/HRET's boot camps – a type of skills training – in certain AEAs. Ten SHAs described use of improvement advisors, dedicated to individual hospital support, and 28 described site visits as a strategy. Finally, partnership and alignment with local and state initiatives was also a predominant strategy among AHA/HRET's SHAs; most (26) described relying on partnerships and many describe concerted efforts among partners to align incentives for change, for example, through partnership with state Medicaid agencies to address OB-EED.

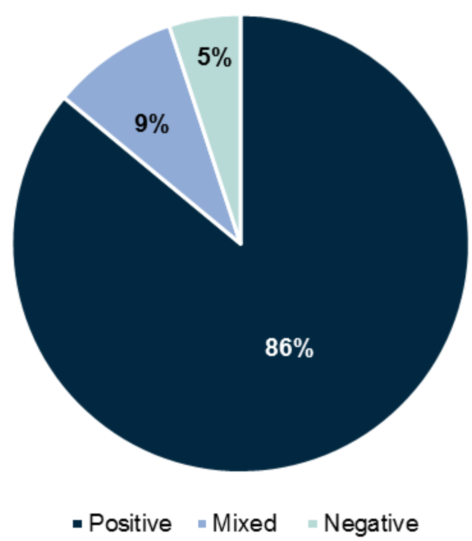
Overall, AHA/HRET SHAs leveraged the HEN-wide activities undertaken by the AHA/HRET HEN; however, nine SHAs also emphasized the importance of local expertise and adaptation. For example, one state indicated far more reliance on local programming and expertise across PfP focus areas than on the AHA/HRET HEN infrastructure, while others described a mix of use of HEN-level and local resources.

Hospitals' Engagement and Perceptions of PfP (Chapter 3)

Hospitals' Comments on PfP, in Optional Comment Space on Survey of Participation in Patient Safety Activities

Survey respondents had the opportunity to write open-ended comments regarding PfP at the end of the questionnaire. Approximately 40 percent of the 2,432 respondents took the time to write comments about the campaign, with positive remarks far outnumbering criticisms (Figure E-1).

Figure E-1—Percentage of the 971 Open-Ended Comments that Were Positive, Negative, or Mixed



Source: Survey on Hospital Participation in Safety Activities, winter 2014.

E-12 Of 31 total; however, this information could not be determined for four SHAs that did not participate in the interviews and provided supplemental documentation in lieu of participating in the interview that did not contain this information.

Positive: Across all respondents, 34 percent took the time to write positive comments about PfP. These comments typically fell into one or more of the following categories:

- *Resources/information*: Forty-six percent of survey respondents offering positive comments commended PfP's dissemination of resources and information, including toolkits, webinars, comparative data, dashboards, coaching sessions, websites/repositories, and funding. Examples include:
  - *All the input from the webinars, in-person seminars, and hospital visits from [our HEN] played an integral part in the improvement measures that were identified and implemented at our facility.*
  - *Being a small CAH, it would not have been possible to have access to all the evidence-based information we received. We were given resources and education that really did make a difference in our patients' safety.*
  - *[Our HEN] was immensely helpful and provided significant value-added resources. The website was exceptional and was very user friendly in the methods used to provide feedback reports. It made it remarkably easy to access performance data we could use in house. The "Harm Across the Board" tool was excellent. It allowed those doing the ground work to report to the C-suite and other leaders the progress and importance of what was being done. It made it easy for resources to be devoted to patient safety activities because it so clearly identified value and return on investment.*
- *HEN or staff helpfulness/support*: Forty-five percent of those offering positive comments commended their HEN's or PfP's staff helpfulness or supportiveness, many calling out specific individuals by name. Examples include:
  - *[Our HEN] has given small rural hospitals a voice.*
  - *I love working with [our HEN] on projects; they are very helpful and always available when needed.*
  - *[Our HEN] is a wonderful organization to work with. They are very proactive in ensuring that all of their member hospitals are successful in keeping patients safe.*
- *Collaboration/networking opportunities*: Thirty percent of those offering positive comments recognized the collaboration and networking opportunities afforded by PfP. Examples include:
  - *The networking with the other hospitals is extremely helpful since it provides an opportunity to share ideas and processes implemented by others to improve patient outcomes and safety.*
  - *I cannot express how valuable this program has been to me and my facility. I have never had an opportunity to sit with so many other facilities to discuss processes and practices without fear of competition type issues. Being able to share and learn from others without that fear was priceless.*
  - *It was so helpful to have not only the coaching and networking, but such a plethora of educational resources available, [especially] knowing that they aligned with Joint Commission standards.*
- *General praise*: Twenty-two percent of those offering positive comments praised the campaign generally. Examples include:
  - *I applaud CMS for this initiative. Remarkable work hard-wiring processes that are age old but were not part of a culture of safety. This has truly been a remarkable experience. We actually did something that made a real difference in healthcare. Thank you.*
  - *Participation in [our HEN] was extremely beneficial [for] our facility to make change and improve outcomes.*

A small subset of survey respondents with positive comments mentioned the skills-based training they were able to take advantage of through the campaign. Specifically, they mentioned Lean Six Sigma education, TeamSTEPPS and leadership training, and Certified Professional in Healthcare Quality (CPHQ)/Certified Professional in Patient Safety (CPPS) certifications.

Negative: The much smaller portion of survey participants who wrote negative comments about the campaign (2 percent of all respondents) primarily commented that the campaign either provided nothing new relative to resources or perspectives they already had, was burdensome or time-consuming to participate in, or was not applicable to their hospitals. Of those providing negative comments:

- *Redundant*: Twenty-nine percent of those respondents making negative comments felt the campaign was redundant or did not provide anything new. Their hospitals were already involved in improvement activities and/or data collection efforts, so they felt that their HENs were simply documenting ongoing work and/or detracting from time that could have been spent engaged in pre-existing initiatives.
- *Not applicable or confusing to understand requirements*: Thirty-one percent of those submitting negative comments complained that the campaign was irrelevant to their hospitals, or had requirements that were difficult to understand. In particular, they cited the fact that data- reporting mandates and measure definitions changed over time, creating confusion and necessitating extra work.
- *Burdensome*: Thirty-nine percent of those making negative comments felt PfP was burdensome or "time-consuming to participate in." Thirty-two percent of those citing "burden" as an issue also cited the redundancies described above.

A much smaller subset of negative commenters (8 percent) indicated other pitfalls: disorganized communication and dissemination of information, too few meetings with HEN representatives, and lack of metric standardization.

Mixed: Only 3.5 percent of survey respondents wrote "mixed" comments, in which they both complimented the program and disapproved of some aspect of it.

Perceptions of Usefulness of HEN Activities by Hospitals Receiving Site Visits

Table E-29 summarizes comments made about PfP activities, by type, by the staff interviewed by the evaluation contractor at 12 hospitals that received site visits, while Table E-30 summarizes for each visited hospital how PfP and other factors contributed to influencing or supporting their operational changes.

Table E-29–Hospital-Reported Value of PfP Campaign

PfP Campaign Features	Number of Hospitals Reporting This was Valuable to Their Work	Summary of Comments
HEN educational sessions (webinars, group meetings, conferences, etc.)	8 (of 11)	• Sharing of best practices allowed hospitals to come away with new ideas and strategies to implement in their facilities. Examples of strategies/processes implemented included multidisciplinary rounding, safety chaperones, bedside reporting, and Project RED. • Sharing of successful strategies from other hospitals was helpful. • High-quality speakers. • Content addressed issues that some of the hospitals were already working on, but helped to support and reinforce the work they were already doing.
Networking opportunities with other HEN hospitals	8 (of 11)	• Helpful to hear about challenges that other hospitals have encountered in their work to improve patient safety. • Hospitals have been able to implement successful strategies used by other hospitals in their own harm reduction work.
Training and boot-camps (including skills training)	4 (of 11)	• Hospital staff participated in skills training through the HEN - training programs included CUSP, TeamSTEPPS, Lean, and Six Sigma. • Funding for training was particularly helpful for small, rural hospitals who otherwise would not have had the resources to attend.
Data monitoring and benchmarking	8 (of 11)	• Allowed hospitals to gauge their progress towards improving patient safety and reducing readmissions. • Benchmarking across other HEN hospitals or hospitals in the state helped identify opportunities for improvement and new areas of focus. • Benchmarking allowed hospitals to identify high performers with whom they could network about successful strategies. • Some hospitals wished for greater standardization in measurement, allowing for easier comparisons to other hospitals.
Sharing of resources and tools	8 (of 11)	• Checklists, toolkits, and learning modules have helped hospitals to identify best practices. • Tools were modified to meet the needs of individual hospitals.
Increased focus and awareness around patient safety	4 (of 11)	• Motivated hospitals to continue to make positive changes to improve patient safety and reduce readmissions.

Source: Evaluation Contractor summary of site visit interviews with 12 hospitals, conducted spring 2015

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals

Visited Hospital (these hospitals participated with 7 different HENs)	**PfP Role in Influencing Operational Changes**: *Major:* • Based on the interviews, without PfP this hospital's changes would have been much different and/or occurred to a much lesser extent. *Contributing:* • Based on the interviews, PfP contributed to operational changes by the hospital made to improve patient safety, to a lesser extent than "major." *Possibly Contributing:* • Some interviews suggested likelihood that PfP contributed to the hospital's changes, but there were critical comments as well, and/or a lack of examples of the influence. *No Identified Role:* • The site visitors were unable to identify any role by PfP in the hospital's changes.	**Other Factors Influencing Change**: • *Distinguishing internal and external factors is consistent with the research framework used for qualitative analysis and were part of the interview protocol (see Appendix C).* *Internal Factors:* • Sub-headings describe the nature of the internal factor. The most common internal factors concerned strategy, leadership, and structure. A few related to relationship with another hospital, the hospital's system, and the hospital's operations. *External Factors:* • These were more numerous and varied then internal factors so are simply listed, sometimes with an explanatory note as available and needed for clarity.
A (Rural critical access hospital [CAH])	*Major:* • Major level of improvement activity; most tools used for change came from the HEN or the Rural Healthcare Association, and those two organizations work together. • Funding by HEN of training for LEAN six sigma and TeamSTEPPS was particularly helpful.	**Internal Factors**: *Strategy:* • As a CAH, want to do everything the larger hospitals do, to be able to easily change back to an acute care hospital should the opportunity make sense. *Relationships with Other Hospitals:* • Referral hospital for OB reviews all OB charts and provides specific feedback on their quality **External Factors/Sources**: • Meaningful use, Joint Commission, QIO's website, state Rural Health Association
B (medium-sized children's hospital)	*Major:* • HEN subcontract with Patient Safety Organization has allowed new, legally protected sharing among hospitals around specific adverse events, which allowed the hospital to prevent harms before they were experienced within its walls. • HEN caused hospital to shift its goal from being satisfied when it achieved benchmark levels, to aim toward zero harm. • HEN-facilitated sharing among like hospitals (children's hospitals) enabled the children's hospital to refine its initiatives more effectively than with information available for general hospitals.	**Internal Factors**: *Strategy:* • Commitment to sustaining Magnet status for excellence in nursing **External Factors/Sources**: • Medicaid policy with penalties for high readmissions rate • National Patient Safety Foundation (materials and conference), American College of Graduate Medical Education requirements, Children's Hospital Association, Patient Safety Organization

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals		
C (large urban hospital)	*Contributing:* • HEN programming and resources were relevant and high quality, and reinforced/supported their ongoing work • Hospital learned about the Licensure, Accreditation, Certification, and Education (LACE) tool (the hospital's "greatest success story") from the HEN • Hospital found the PfP benchmarking helpful; it had already established measurement and data collection but didn't have specific goals, PfP gave them that.	**Internal Factors**: *Leadership:* • New chief marketing officer (CMO) established overall strategy focused on six domains *Strategy:* • Commitment to Magnet status for excellence in nursing **External Factors/Sources**: • Readmission penalties, value-based purchasing, Delivery System Reform Incentive payments, public reporting, QIO
D (small rural hospital)	*Contributing:* • HEN consultation helped them establish a Patient and Family Advisory Committee • HEN-provided checklists helped them identify gaps in processes • Learning from a webinar enabled them to dramatically reduce catheter use • Online modules on patient safety and readmissions were found helpful • "The HEN makes you think about certain things, but you're pulling from multiple sources to make it all work."	**Internal Factors**: *Leadership:* • New CMO and Quality Director changed the culture and got safety and quality organized. Commitment to extensive training on LEAN Six Sigma (8 green belts to date). A hospital nurse is president of the local Association of Operating Room Nurses, which brings lots of networking to improve OR care *Structure:* • Integrated physician group allows for aligned implementation *Relationship with other hospital:* • Tight relationship with a large, "cutting-edge" hospital whereby that hospital's clinical leaders teach safety practices **External Factors/Sources**: *Market structure:* • *Market structure*: No significant hospital competitors, one nursing home and one home health organization; allows them to address issues in a coordinated way for prevention of readmissions *Other:* • *Other*: Insurer incentive for using teach-back technique with patients, member of National Surgical Quality Improvement Program (NSQIP)

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals		
E (CAH)	*Contributing:* • A majority of information and interventions used by the hospital to improve patient safety came from meetings with the HEN or QIO or a state-based coalition of CAHs. • The HEN was reported to have increased the hospital's focus on certain areas of harm. • The hospital learned about a modified PACE tool through the HEN, that it is about to begin using to help monitor those at risk for readmissions.	**Internal Factors**: *Structure:* • With an attached nursing home, the hospital's doctors can see their residents to help avoid readmissions, and there is a local organization that helps with ensuring home environment meets needs **External Factors/Sources**: • QIO, CAH quality network, financial incentives, meaningful use "*Google is my best friend*." • Interventions by another hospital system in the area: "*They have what we call 'cans…' they come up with the stuff at the corporate level, they 'can it out,' and they spoon feed it to you in your small facility and you do it. So it's kind of good sometimes because they're always on that bleeding edge. I can see kind of what they're doing and do it.*"
F (small rural hospital)	*Contributing:* • "*[HEN] resources and webinars are important for our quality and safety*." • Especially valuable are educational sessions, lending library, and ability to benchmark to track progress and compare to other similar facilities • Staff are receiving CUSP and TeamSTEPPS training from the HEN	**Internal Factors**: *System:* • Their system provides a lot of support and influence, including bringing on patient safety consultants; most interventions and improvements appear to come from the system **External Factors/Sources**: • Statewide perinatal collaborative, statewide health exchange network for benchmarking, clinical risk management incentive program with incentive for falls reduction, QIO

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals

G (large urban hospital)	**Possibly Contributing** : *Positive comments:* • The most compelling thing about participation was the approach the HEN taught: how to take your data, understand the contributing causes, follow up, and then sustain the improvement • Industrial engineer (IE) from the HEN along with their own IEs performed observations of care that helped pinpoint process issues for improvement • Participation "keeps your attention," the meetings and on-site visits were reported to make them more accountable • HEN benchmarking often showed them "at the wrong end." Through the HEN they had the opportunity to find out what others were doing that had better outcomes. (For example, heard about safety chaperones on a HEN webinar [related to falls prevention] and are getting ready to use them now.) *Critical comments (CMO):* • *"I was disappointed that that energy [that was there in the beginning of the HEN], the voice of the bed-side nurses somewhere along the way tapered off."* • *"It's good to have people come in to hold you accountable but if you're doing the best you can and you're still floundering, it would be good to have a little more guidance."*	**Internal Factors**: *Leadership:* • Hospital's board has high expectations and good understanding of quality and safety – they attend the Governance Institute conference which has a heavy quality and safety focus. • Safety is one of four "pillars" of the organization and has significant incentives for executives associated with outcomes. • *Strategy*: Commitment to sustaining Magnet status for excellence in nursing. **External Factors/Sources**: *Public reporting:* • State-level public reporting which showed they had worst heart failure readmissions rate in their state • Meaningful use, value-based purchasing and readmission penalties from CMS, Joint Commission Disease-Specific Accreditations, Patient Safety Organization, state hospital association (which was not their HEN)

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals		
H (medium-sized urban hospital)	**Possibly Contributing** : *Positive comments:* • **“**If you needed any help… the help was there, the information was there, and the support was there.**”** • “*Once we see an issue brewing, usually we jump on it…and we augment it with the data from Partnership for Patients, whether it was webinars about infection control, or we’ve had on-site visits where [HEN] discussed specifically some of the trends and practices going on. So we can take pieces and parts of that, take pieces and parts from other [hospitals in their system] best practices, and the regionalization of our hospital system, and then put our specific plan together.”* *Critical comments:* • HEN provided many resources, but some indicated they needed more hand-on support as well as leadership commitment to make and sustain change • Although goals were aligned at the high level, targets and benchmarks were not aligned by the system with the HEN at the detail level, creating some confusion: “[Hospital’s system] itself had targets for all these different areas, the CAUTIs, the SSIs, but then you had a different benchmark with a different number with the [HEN] group, so you might have a green on one scorecard and a red on a different scorecard.”	**Internal Factors**: *Operations:* • Running at very high capacity; decreasing overall census by reducing readmissions would create better throughput for the team. *Structure:* • Strong system-level support, priorities, culture. Patient safety goals set at corporate level, leadership performance is evaluated based on these. *Strategy:* • Commitment to sustaining Magnet status for excellence in nursing. **External Factors/Sources**: *Public reporting:* • “It seems like every insurance company has a report card now. Everybody wants to build a better mousetrap.” • Financial penalties, Medicare Shared Savings Program, state nursing association, Joint Commission alerts, QIO, Anthem, IHI safety training, March of Dimes
I (medium-sized urban)	**Possibly Contributing** *Positive comments:* • Alignment of goals between PfP, QIO, Blue Cross Blue Shield (BCBS), Joint Commission, heightened efforts to track and address low-performing areas. • HEN site visits, hospital networking opportunities, and reporting and benchmarking system supported their readmissions work. • One staff completed the leadership fellowship training with the HEN and considered it valuable, and others are now being sent for the training. Data benchmarking, site visits, and networking were described as helpful. *Critical comments:* • In general, this hospital preferred to research best practices on its own, particularly for falls and readmissions, it considered the HEN resources less useful than its own research.	**Internal Factors**: *Leadership:* • Strong executive leadership commitment; “permission to fail” promoted innovation and teamwork to try new strategies; commitment to “customer service” to establish strong, patient-centered culture. *Strategy:* • Nursing adopted a shared governance model with a focus on transparency and shared learning from successes and failures **External Factors/Sources**: • State-wide quality forum sponsored by BCBS and the hospital association, including QIO, which has met in person semi-annually and virtually semi-annually for about 10 years. Goal alignment heightened efforts to track and reduce harm. • Readmission penalties, value-based purchasing, Joint Commission policies

Table E-30—Role of PfP and Other Factors Influencing Operational Changes to Improve Patient Safety at Site-Visited Hospitals

J (medium-sized rural hospital)	**Possibly Contributing, Readmissions Only**: *Positive comments:* • Participating for readmissions reduction "*kept us moving*," and the regular sharing that occurred with other hospitals around challenges and attempted interventions was helpful to their work. *Critical comments:* • However, "*we didn't really learn anything through participation with the HEN, except with regard to readmissions.*" • The hospital had started working with the HEN on PFE, however, "*The person who was the champion for that left the HEN. They didn't replace her. That was going strong for a year, and then it all fell apart*."	**External Factors/Sources**: • CMS complaint investigation was a key motivator for change • Multiple consultants regarding patient safety, including one for leadership, and the Diligent program for falls and pressure ulcers • Participates in grant-funded LEAN program for rural hospitals (Duke Endowment). LEAN projects have involved improving patient safety-related processes.
K (CAH, aligned with their HEN in 2014)	**No Identified Role (Joined in 2014)**: • Complicated organizational relationships between QIO, HEN, and another organization makes it impossible to distinguish HEN role, although this hospital's participation to date has been low. Regarding HEN participation: "*I think it was presented as one big entity. We participated in one and it dominoes into others*."	**External Factors/Sources**: • QIO • Participates in a study on falls with an Academic Medical Center, using TeamSTEPPS • Participates in a network of 41 hospitals, that provides education, shared services, best practices ("that network influences us the most") • Receives benchmarking reports that "*spur us on.*"
L (small urban hospital, never aligned with a HEN)	**No Identified Role**: • Although not aligned with a HEN for PfP, this hospital describes their longstanding working relationship with the state hospital association, which is an SHA with the AHA/HRET HEN: "*They have the most incredible people there. They have been so helpful. There's a program coming up, a safety symposium. They come up with very targeted programs that are very relevant to our issues. They offer webinars. They're an incredible source for experts. They give you things to take home and use to make changes to policy or education*."	**Internal Factors**: *Strategy:* • Physician financial incentives for performance on safety metrics; nursing shared governance model **External Factors/Sources**: • Perinatal trust organization (state level) helped establish EED policies, along with ACOG • Hospital worked with a regional committee on antibiotic resistance regarding *C. difficile* and methicillin-resistant staphylococcus aureus (MRSA). • Joint Commission patient safety goals and sentinel alerts, public reporting, value-based purchasing, benchmarking reports

Source: Evaluation Contractor's analysis of site visit interviews to 12 hospitals, conducted spring 2015 (see Appendix C).

Hospitals' Implementation of Operational Changes (Chapter 3)

Changes in Specific Patient Safety-Related Care Processes

A majority of specific patient safety processes queried showed more extensive implementation nationally by 2014 relative to 2012. Survey data show significant improvement in hospitals' implementation of specific patient safety processes for 26 of 44 processes queried of all hospitals in 2012 and 2014 (see Appendix C, for the relevant survey items). At least half the queried processes significantly improved for CAUTI, OB-EED, OB-Other, readmissions, SSI) and hand hygiene, pressure ulcer, and falls (Table E-31).[E-13] None of the queried processes were less prevalent in 2014 than in 2012. The queried processes were a subset of processes that comprised the Organizational Assessment Tool (OAT), a survey instrument that was implemented by HENs with their hospitals during 2012, and the hospital's score on the survey was often used as a way for HENs to discuss with the hospitals what patient safety improvements the hospitals may want to consider. Therefore, improvements on these processes are not surprising.

Table E-31—Portion of Queried Patient Safety Processes Asked of All Hospitals Improved Between 2012 and 2014

Adverse Event Area	Number with Significant Improvement ($p < 0.05$)/Number Queried
OB-Other	1/1
CAUTI	7/8
OB-EED	5/7
SSI/Hand Hygiene	3/5
Falls	2/4
Pressure Ulcers	2/4
Readmissions	2/3
VAE	2/5
ADE	1/5
VTE	1/2
Total	**26/44 (59%)**

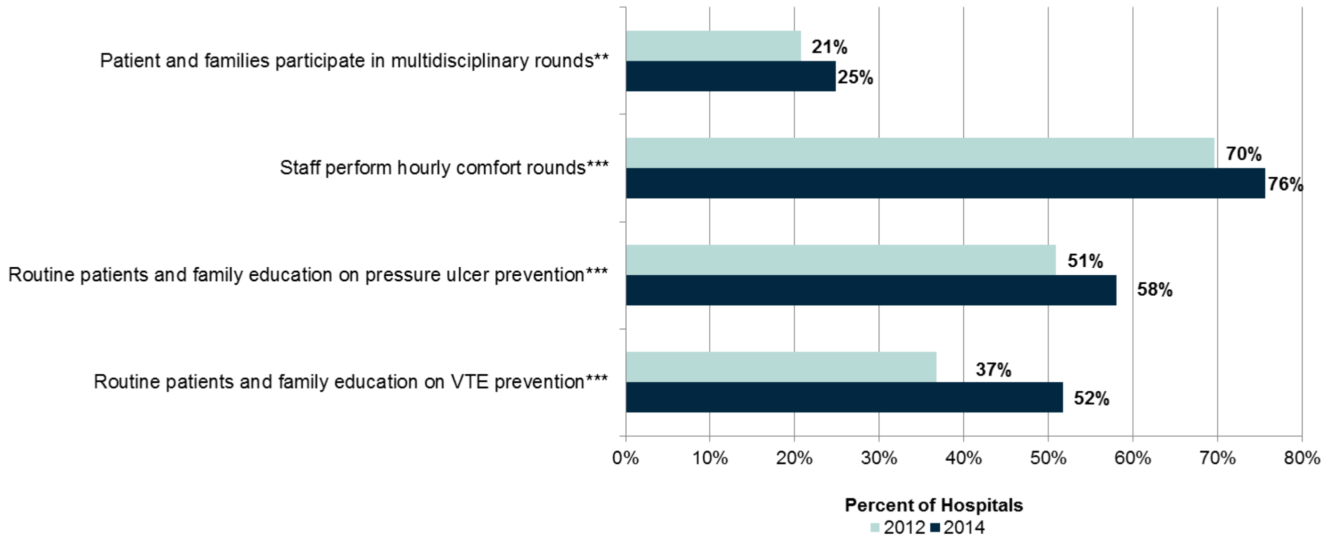
Source: Survey on Prevention of Adverse Events and Reduction of Readmissions, spring 2012 and 2014.

E-13 Consistent with this, a composite score, where hospitals were scored on a 0-10 scale regarding the portion of queried patient safety processes they implemented by focus area, showed significant improvement across all areas except hand hygiene and VAE. The score was calculated by awarding one point per "yes" divided by the number of queried practices for that area and multiplied by 10.

Changes to Patient and Family Engagement

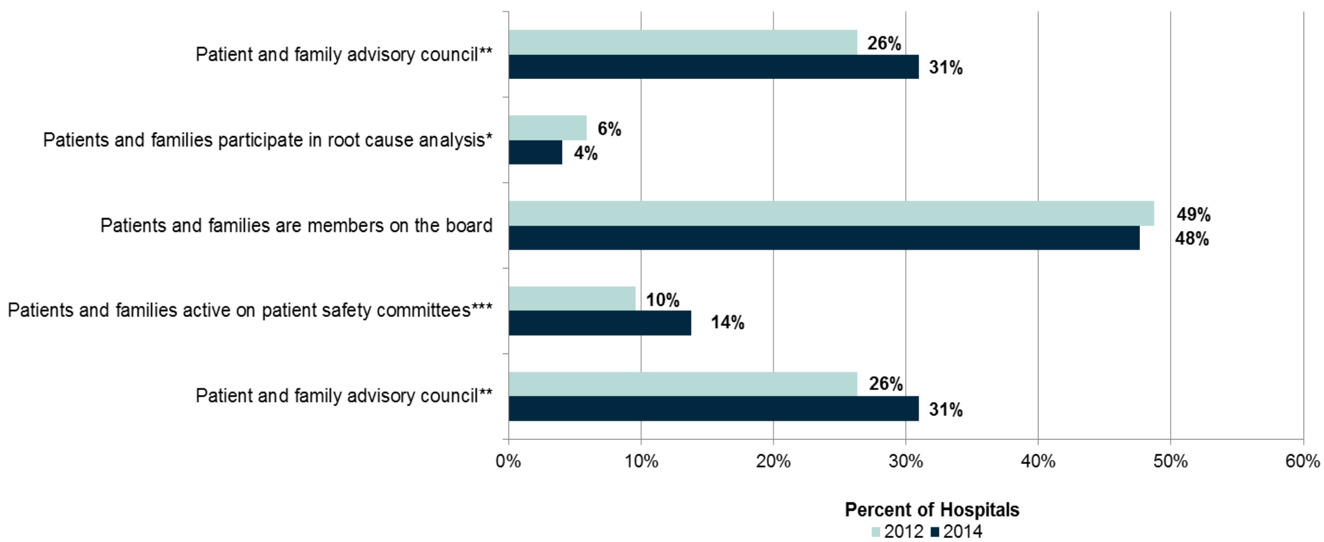
The figures below provide additional details on survey results that are summarized in Chapter 3 (Figure E-2 and Figure E-3).

Figure E-2—Percentage of All Hospitals Including Patients and Families for Greater Safety at the Point of Care, 2012-2014



Source: Survey on Prevention of Adverse Events and Reduction of Readmissions, spring 2012 and 2014.
** $p < 0.05$, *** $p < 0.01$

Figure E-3—Percentage of All Hospitals Including Patients and Families in Hospital Structures for Safety Improvement, 2012-2014



Source: Survey on Prevention of Adverse Events and Reduction of Readmissions, spring 2012 and 2014.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Association Between Participation in HEN Activity Types and Having Made Operational Changes due to PfP

Table E-32 shows among hospitals receiving a given HEN activity in a given applicable focus area, the percentage of hospitals that made operational changes to reduce harm in that area. On average, a higher percentage of hospitals that received skills training, value-added networking with other hospitals, and virtual consultation or coaching also made changes due to PfP than hospitals receiving other types of HEN activities.

Table E-32—Percentage of Hospitals Participating in a HEN Activity that Made Changes Due to PfP in the Focus Area

HEN Activity Type	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAE	VTE	Readm	Average Percent
Skills Training	69.40%	89.18%	81.50%	85.87%	87.74%	75.74%	73.31%	71.13%	73.30%	75.00%	81.64%	78.53%
Value-Added Networking with Other Hospitals	68.37%	86.20%	80.62%	83.58%	89.37%	70.32%	73.68%	68.92%	73.24%	72.88%	79.46%	76.97%
Virtual Consultation or Coaching	64.61%	87.08%	80.96%	83.17%	87.47%	69.86%	71.11%	69.47%	74.63%	73.85%	81.68%	76.72%
Other Education and Resources	61.27%	83.74%	75.40%	77.42%	86.07%	63.11%	65.34%	63.87%	62.81%	66.66%	77.37%	71.19%
On-Site Visits	60.80%	80.84%	75.89%	77.18%	83.37%	65.69%	64.95%	62.33%	61.99%	66.01%	78.37%	70.67%
Feedback on Patient Safety Performance Data	57.92%	80.18%	69.19%	73.64%	74.64%	59.45%	59.47%	55.53%	55.44%	58.22%	71.93%	65.06%

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January–March 2015.

Note: Denominator for each cell is the number of hospitals for which the focus area is applicable and they received the activity for that PfP focus area; the numerator is the number of hospitals in the denominator who made changes due to PfP in the same area.

Color Legend:

Yellow: Up to 70 percent of hospitals receiving HEN activity type also made changes due to participation in HEN activities in applicable areas.

Blue: Between 70 and 85 percent of hospitals receiving HEN activity type also made changes due to participation in HEN activities in applicable areas.

Green: More than 85 percent of hospitals receiving HEN activity type also made changes due to participation in HEN activities in applicable areas.

Table E-33 presents summary results from logistic regressions examining participation in a given HEN activity in a PfP focus area and having made changes due to participation in HEN activities in that area; the odds ratios presented show the odds of making changes due to participation in HEN activities among hospitals receiving the HEN activity compared to hospitals not receiving the HEN activity. In nine focus areas, hospitals receiving value-added networking had the highest odds of making changes due to participation in HEN activities, compared to hospitals not receiving the HEN activity type, among the other HEN activity types, and skills training had the highest odds ratios among activity types in the other two areas (CAUTI and OB-EED).

Relative risk ratios were also calculated for two reasons. First, the outcome of interest (making changes due to participation in HEN activities) was prevalent, making relative risk ratios more appropriate than odds ratios. Second, relative risk ratios ease interpretation of results, since relative risk conveys the probability of the outcome happening given participation in a given HEN activity type. The relative risk ratios for the relationship between participation in HEN activity types and the outcome of making changes due to participation in HEN activities can be found in Chapter 3.

Table E-33—Odds Ratios for Making Changes Due to Participation in HEN Activities, by Type and PfP Focus Area

PfP Focus Area	Odds Ratios (OR), Confidence Intervals (CI), and *p*-values	HEN Activity Type					
		Skills Training	Value-Added Networking with Other Hospitals	Virtual Coaching and Consultation	Other Education and Resources	Onsite Visits	Feedback on Patient Safety Data Performance
ADE	OR	7.27	8.15	5.78	5.71	3.39	6.82
	CI	5.90	6.62	4.73	4.68	2.77	5.48
		8.95	10.03	7.07	6.98	4.16	8.49
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CAUTI	OR	8.53	7.92	6.71	4.46	2.41	5.50
	CI	6.68	6.30	5.32	3.59	1.93	4.35
		10.89	9.96	8.46	5.55	3.00	6.94
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CLABSI	OR	8.43	10.63	7.44	4.89	3.58	8.04
	CI	6.46	8.14	5.64	3.82	2.75	5.94
		11.00	13.89	9.58	6.25	4.67	10.90
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Falls	OR	7.76	7.96	6.22	3.85	2.71	5.14
	CI	6.23	6.46	5.06	3.17	2.22	4.13
		9.67	9.81	7.66	4.67	3.31	6.39
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
OB-EED	OR	9.72	15.65	9.31	10.21	4.61	5.96
	CI	7.04	11.31	6.78	7.58	3.37	4.49
		13.42	21.68	12.79	13.75	6.30	7.90
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
OB-Other	OR	13.85	12.34	10.31	9.66	6.68	9.84
	CI	9.98	9.16	7.63	7.28	4.90	7.38
		19.23	16.62	13.92	12.81	9.10	13.10
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table E-33—Odds Ratios for Making Changes Due to Participation in HEN Activities, by Type and PfP Focus Area							
PfP Focus Area	Odds Ratios (OR), Confidence Intervals (CI), and *p*-values	HEN Activity Type					
		Skills Training	Value-Added Networking with Other Hospitals	Virtual Coaching and Consultation	Other Education and Resources	Onsite Visits	Feedback on Patient Safety Data Performance
Pressure Ulcers	OR	6.96	9.40	5.83	4.70	3.10	5.84
	CI	5.55	7.48	4.66	3.81	2.47	4.60
		8.73	11.82	7.28	5.81	3.89	7.42
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
SSI	OR	7.18	7.60	6.49	5.17	3.19	5.18
	CI	5.64	5.98	5.11	4.11	2.52	3.98
		9.14	9.66	8.23	6.51	4.02	6.74
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
VAE	OR	10.49	12.532	12.278	7.19	4.227	8.405
	CI	7.53	9.02	8.78	5.32	3.07	5.99
		14.62	17.42	17.17	9.73	5.81	11.79
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
VTE	OR	7.36	8.11	7.83	6.04	3.84	5.74
	CI	5.87	6.55	6.30	4.94	3.10	4.64
		9.28	10.04	9.73	7.39	4.76	7.11
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Readmissions	OR	6.92	9.00	7.58	5.80	4.08	6.39
	CI	5.65	7.32	6.19	4.76	3.34	5.12
		8.49	11.06	9.29	7.05	4.97	7.98
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Source: Survey on Participation in Patient Safety Activities, January to March 2015.

Yellow: Hospitals receiving HEN activity type have up to five higher odds of making changes due to participation in HEN activities than hospitals who did not receive HEN activity type.

Blue: hospitals receiving HEN activity type have between 5 and 10 higher odds of making changes due to participation in HEN activities than hospitals who did not receive HEN activity type.

Green: Hospitals receiving HEN activity type have more than 10 higher odds of making changes due to participation in HEN activities than hospitals who did not receive HEN activity type.

Note: The number of included hospitals ranges from 907 (VAE) to 2,023 (Readmissions).

Factors Affecting HENs' Ability to Spread Best Practices (Chapter 3)

HENs encountered both facilitators and barriers in their work to spread best practices and reduce patient harm in their aligned hospitals. A variety of factors have been shown to be important determinants of program implementation effectiveness and scale up and spread of best practices in healthcare.[E-14] The Evaluation Contractor applied common domains from these research-based frameworks to guide analysis of facilitators and barriers impacting HEN harm reduction efforts during PfP as shown in Table E-34 (Appendix C provides more detail about the frameworks used).

Table E-34—Domains and Factors for Analysis of HEN Implementation Facilitators and Barriers

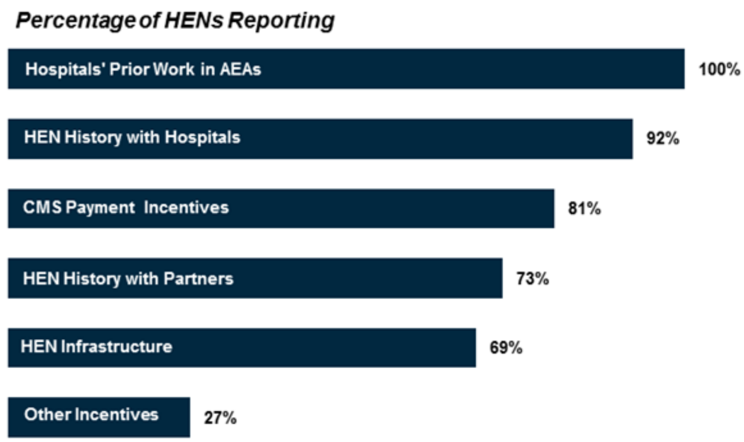
Domain	PfP Factors
External Factors (external pressures, regulations, incentives)	Payment incentives and policies
	Mandatory reporting programs
	Patient needs and expectations
Internal Factors (HEN) (organization, infrastructure, resources)	HEN infrastructure
	HEN history working with hospitals
	HEN history working with partners
Target Adopter Factors (Hospitals) (resources and capacity for change)	Hospital resources
	Hospital organizational factors
	Hospital electronic health records (EHR) implementation
	Hospital patient safety work prior to PfP
Intervention Factors (benefits, feasibility, adoptability)	AEA factors

Source: Evaluation Contractor's application of multiple frameworks to PfP (see Appendix C for details).

[E-14] Damschroder, L.J., D.C. Aron, R.E. Keith, S.R. Kirsh, J.A. Alexander, and J.C. Lowery. "Fostering Implementation of Health Services Research Findings into Practice: a Consolidated Framework for Advancing Implementation Science." *Implementation Science*, 4:50, August 2009; Yuan, C.T., I.M. Nembhard, M.F. Stern, J.E. Brush, H.M. Krumholz, and E.H. Bradley. "Blueprint for the Dissemination of Evidence-Based Practices in Health Care." Commonwealth Fund, Pub. 1399, Vol. 86, May 2010; Mittman, B. "Factors that Influence the Scale Up and Spread of Innovations." Available at: https://innovations.ahrq.gov/perspectives/factors-influence-scale-and-spread-innovations. Accessed April 6, 2015.

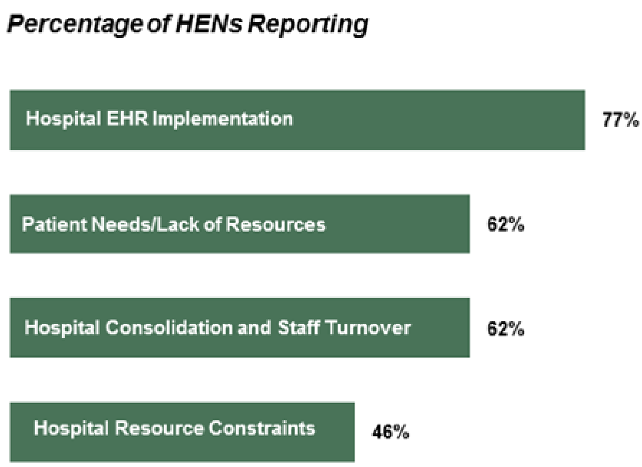
HEN-reported facilitators and barriers impacting their harm reduction progress during PfP are shown in Figure E-4 and Figure E-5 and further explained below.

Figure E-4—Facilitators of HEN Spread of Best Practices



Source: Evaluation Contractor interviews with HENs, fall 2014.

Figure E-5—Barriers to HEN Spread of Best Practices



Source: Evaluation Contractor interviews with HENs, fall 2014

External Factors

Payment Incentive Programs and Policies

HENs and hospitals participating in PfP conducted their patient safety work within an environment of payment policy changes aimed at encouraging hospitals to reduce readmissions and harm events. HENs leveraged both federal and state payment policies to motivate their aligned hospitals and focus their patient safety improvement efforts.

CMS Medicare incentive payment programs. Many HENs (21) reported that CMS payment incentives had a positive impact on driving change in their hospitals, generating a sense of urgency and accelerating hospitals' adoption of safety improvements. Under the 2010 Patient Protection and Affordable Care Act (ACA), CMS established three incentive payment programs: (1) the Hospital Readmissions Reduction Program, which reduces payment to Inpatient Prospective Payment System (IPPS) hospitals with excess readmissions effective October 2012; (2) the HAC Reduction Program, which reduces payment to hospitals in the bottom quartile of performance in preventable conditions effective October 2014; and (3) the Hospital VBP Program, which adjusts payments to hospitals based on performance using a set of quality of care measures effective October 2012.

Notably, eight HENs felt the overall impact of CMS payment penalties was limited in some ways. First, non-IPPS hospitals and non-Medicare patients are not eligible for penalties, so HENs needed to focus on other strategies to motivate many rural hospitals and CAHs to participate in improvement activities. Alternative strategies included developing the business case for change and highlighting the need to adapt to a value-based health care delivery environment. Second, hospitals' responses to payment incentives varied. For example, two HENs shared that some hospitals calculated a greater risk to their reimbursement from preventing readmissions than their penalty risk under the Hospital Readmissions Reduction Program. Consequently, while hospital leaders believe it's the right thing to do, allocating resources to reduce preventable readmissions proves challenging to justify financially. Third, several HENs emphasized that improving care and reducing readmissions is part of an overarching goal to build a better care model for the future, and while alignment with the federal agenda is helpful, penalties are secondary in driving change.

> *"Let's not underestimate the impact that payment policy reforms made on reductions and really put the spotlight on harm and strategies to reduce harm as well as reduce readmissions. It helped accelerate the improvement activities around harm events as well as reduction in readmissions and pace of change." (HEN)*
>
> *"What we've tried to do strategically is help organizations understand that regardless of the finances, from a business model perspective, it makes sense to begin thinking about caring for patients outside the walls of the hospital. Regardless of what's happening with readmission penalties and revenue from readmissions, you have to start thinking that way to manage your healthcare system in this new world or you will get left behind." (HEN)*

State Medicaid policies. Several HENs (4) reported that alignment with state Medicaid policies helped drive improvement in one area targeted by PfP: OB-EED. Medicaid non-payment for OB-EED helped engage hospitals and encourage implementation of hard stop policies, which disallow scheduling of deliveries prior to 39 weeks unless medically justified. One HEN, concerned about the effect of a Medicaid non-reimbursement policy on access to care, worked with a statewide group to compel hospitals to participate in the HEN's work and put hard stop policies in place as an alternative approach to reduce OB-EED.

Commercial payer incentive programs. Some HENs (6) reported that commercial payers and pay-for-performance programs have quality goals that are well aligned with the aims of PfP. These payer incentives have provided levers for HENs to engage hospitals and increase commitment to focus on reducing harm and readmissions. Further, these programs provide incentives to improve care in hospitals and patient populations that are not eligible for CMS payment incentive programs. For example, one HEN described a commercial payer program designed to incentivize rural hospitals and CAHs to focus improvement activities on conditions relevant for their patient populations (e.g., ADE, falls, and readmissions).

State Mandatory Reporting

Six HENs reported state mandatory reporting programs initiated prior to PfP had increased awareness and interest in harm reduction in their aligned hospitals on topics that were the focus of the mandate. Topic areas impacted by mandatory reporting requirements included HAIs (CAUTI, CLABSI, and SSI) as well as pressure ulcers, falls, and VAP. One HEN described mandatory reporting as supporting harm reduction efforts by helping to engage key leaders, increase commitment to achieve goals, and obtain resources.

Patient Needs and Expectations

Characteristics of patient populations have presented challenges in spreading best practices and reducing harm in HEN-aligned hospitals (18 HENs). Racial and ethnic diversity and varying levels of health literacy require organizations to tailor interventions to accommodate different languages and cultural preferences (6 HENs). Aging patients and patients with chronic conditions and mental health issues are at a higher risk for events such as falls, medication issues, and readmissions and often have needs that demand attention beyond hospital boundaries (5 HENs). Many (11) HENs reported that patient socioeconomic factors present a significant barrier for hospitals, particularly related to reducing readmissions. High poverty, homelessness, and food deserts contribute to poor health among patient populations. Further, uninsured, Medicaid, and dual-eligible patients often lack access to care after discharge and have higher rates of readmission. One HEN highlighted the complexity of these issues for hospitals aiming to reduce readmissions:

> *"Some of the key challenges include mental health [without] good support systems in place in the community and dental health need, [and] there is a real lack of access to care after discharge, especially for the Medicaid population. In order to address these challenges, some hospitals developed clinics to target the at-risk population. This costs money. Plus, it reduces their revenue that would be generated from repeat admissions."*

Two HENs shared a different perspective on the impact of patient population characteristics on harm reduction and readmission prevention work in their aligned hospitals. One HEN reported some pressure directly from patients has facilitated efforts to reduce readmissions. Another HEN described a positive impact of strong connections between hospitals and communities in non-urban areas. Hospital sponsorship and participation in community events to promote health, wellness, and safety have helped raise community expectations for delivery of high quality outcomes.

> *"[We] had to get intimate with facilities to understand their patients, challenges, and language issues to configure types of programs that would be helpful to them and would garner the most success. When you start people on the road and they started owning it, it made a big difference." (HEN)*

> *"There's clear and convincing evidence with regard to readmissions that social determinants have a significant impact on readmissions. So it's not one of those harm events that's easily ameliorated with protocols." (HEN)*

"Five years ago, a hospital said that we treat the patient only within the four walls of our hospital. Now hospitals think more broadly and think about what happens beyond those four walls. Readmissions is a key example. Patients go back to different socio-economic environments." (HEN)

HEN Factors

HEN Infrastructure. Many (18) HENs capitalized on existing infrastructure to support their harm reduction work during the PfP campaign. Key HEN resources included strong clinical leaders, topic area experts, and advisory councils already in place and experienced with working with aligned hospitals (6 HENs), as well as infrastructure to facilitate data sharing and progress toward standardizing metrics (2 HENs). One HEN highlighted this advantage, "We already had that structure in place. It was clear how to roll out these initiatives and make it standard across the system."

Various organizational structures also provided advantages as reported by some HENs (5 HENs). A system HEN pointed out the benefits of its organization's relationships with hospitals in promoting networking and implementation of best practices, including having the ability to enforce hospital compliance with adopting interventions. Two state hospital association HENs reported advantages in working with their aligned hospitals, citing their role as a trusted entity to support improvement efforts as well as helping hospitals in a broader way through advocacy policy work. One HEN reported that its structure as a freestanding 501(c)3 organization helped support its work with hospitals through a provider-led statewide collaborative with common goals. Finally, one HEN attributed its harm reduction progress in part to its structure as a publicly traded operating organization with a high degree of transparency and results-oriented focus. The focus on achievement includes progress toward meeting patient safety goals as evident in the organization's incentive compensation program that ties leadership compensation to performance on both safety and financial metrics.

HEN History Working with Aligned Hospitals. Nearly all HENs (24) had a history of working with their aligned hospitals on patient safety improvement projects prior to PfP, and this experience has facilitated their work in reducing harm during the campaign. Trust and relationships with hospitals developed through prior work allowed these HENs to achieve strong buy-in and commitment from hospitals at the start of PfP. HENs had also built a foundation through earlier projects, including established processes, committed resources, and data reporting systems. In addition, they gained knowledge and experience from implementing interventions to reduce harm. This existing foundation allowed HENs to expand the scale of their work and accelerate harm reduction progress during PfP. While earlier work often involved a subset of aligned hospitals and focused on a few areas of harm, HENs had already gained familiarity with best practices and achieved some success in reducing harm in areas targeted by PfP. One HEN pointed out the value of prior collaboratives in developing collegial relationships between hospitals that worked to achieve common goals and emerged from projects wanting to continue to work together. In addition, several HENs (3) reported that they had already identified both areas of excellence and opportunities for continued improvement in their networks through their previous experience working with hospitals.

HEN History Working with Partners. The majority of HENs (19) had a history of working with organization partners on patient safety improvement projects prior to participating in PfP. HENs reported a variety of ways in which relationships and prior work with partners facilitated their progress in reducing harm during the campaign. Examples included increased access to data, enhanced harm reduction progress through coordination of multiple stakeholders to achieve new common goals, and leveraging knowledge gained from prior work to develop successful strategies to tackle new topic areas.

Hospital Factors

Hospital Resources. Nearly half of HENs (12) reported hospital financial and resource constraints impacted their work. HENs encountered lack of hospital resources to support all areas of harm targeted by PfP and competing priorities, especially in many CAHs. Specifically, allocating staff to reduce readmissions through changes aimed at improving processes that occur beyond the walls of the hospital presented challenges to hospitals already struggling internally to deliver care with limited resources (3 HENs). Other challenges included hospitals pulling resources from other performance improvement efforts to meet readmission targets (1 HEN), availability of equipment to support interventions (1 HEN), and variation in hospital staff training and preparation required to implement improvement changes (1 HEN).

> *"Some of the best practices that we shared we did not provide the resources for. It was a challenge for small hospitals to implement things like home health visits. They knew it was the right thing to do, but it also reduced readmissions. It went all the way to their board to decide if it was good business and good patient care." (HEN)*

Hospital Organizational Factors. Hospital consolidation and staff turnover presented barriers to harm reduction progress in many HENs (16). Hospital mergers and reorganization of health systems resulted in changes in hospital leadership and staff. Consequently, HENs had to engage new leaders, train new quality improvement staff, and build new working relationships to restart interventions in hospitals impacted by these transitions. Organizational changes also disrupted data collection (3 HENs) and resulted in adjustments in priorities and availability of resources to support patient safety improvement work (3 HENs). One HEN described the turnover of quality staff as especially challenging in small hospitals given strong staff dependencies.

EHR Implementation. A majority of HENs (20) encountered barriers in spreading best practices in their aligned hospitals related to EHR implementation. While aligned hospitals implemented a new EHR, data reporting was often disrupted and staff attention was temporarily diverted from harm reduction work. HENs reported specific challenges related to EHRs in their aligned hospitals, including difficulty adding new measures and reports to existing EHRs in light of competing hospital information technology (IT) priorities (7 HENs) (particularly affecting ADE measures); lack of data sharing across multiple platforms (5 HENs); difficulty extracting data to track performance (2 HENs); and difficulty implementing standard alerts and standing orders (2 HEN). One HEN mentioned the challenge of implementing a transition of care component in hospital EHRs because other providers (e.g., skilled nursing facilities, home health agencies) do not always have EHRs, which limits the ability to communicate with their system.

Importantly, some HENs (4) also highlighted how EHRs facilitated their harm reduction work. Their experience reflected the usefulness of EHRs in supporting measurement and implementation of patient safety interventions when common barriers are overcome. Developing the capacity to extract data across different systems and platforms increased data access (1 HEN), and correcting electronic documentation issues resulted in documentation that is now more meaningful to patients (1 HEN). Other HENs (2) reported success in standardizing interventions when hospitals incorporated features in their EHRs to assist frontline staff in implementing best practices consistently.

> *"[EHR] technology has had a significant impact on our hospitals. So much of the work we do and the best practices we use are being implemented into the EHRs we use. If we could get the vendors to implement this, it would be great." (HEN)*

"[EHR implementation] was good and bad. A negative consequence was the disruption in workflow as new initiatives were launched. Some of the paper models they were used to did not carry over in electronic records. Some systems you thought would help them in their reporting capabilities and identifying risk factors were not always helpful….EHRs did create more potential for information communication. Some EHR systems did have good ways of identifying risk factors and stratifying patients. Some had drill down capabilities to enable a higher level root cause analysis. Another thing that has been really helpful is the ability to put in prompts for front line staff. Nurses could be prompted to provide certain types of education." (HEN)

Hospitals' Patient Safety Work Prior to PfP. HENs' and hospitals' prior work to improve patient safety in the targeted areas allowed HENs to build on hospitals' improvement efforts during the PfP campaign. Some HENs had greater depth of experience on which to build: 13 HENs had been working with their aligned hospitals to reduce harm in five or more of the PfP target areas. Similarly, some PfP focus areas were better positioned than others to build on experience: 10 or more HENs reported prior work in their hospitals included CLABSI, SSI, readmissions, and CAUTI. In contrast, ADE, OB-Other, and VTE received less focus with 4 or fewer HENs reporting prior work in these areas.

HENs identified opportunities to leverage this experience, including working to address variation in intervention implementation across hospitals and streamline processes (2 HENs), spreading lessons learned in small groups of hospitals participating in early improvement projects to all hospitals in their network (1 HEN), doing a deeper dive to refine harm reduction strategies (1 HEN), and refocusing attention on areas where hospitals had achieved success previously and discontinued improvement work (1 HEN).

Factors Specific to Each Area of Harm

HEN needs and strategies for improvement varied within each area of harm targeted by PfP, and, not surprisingly, HENs reported different challenges in spreading best practices and reducing rates of harm within each area. Yet, HENs faced some common challenges related to specific issues within some areas of harm:

- *Readmissions*: Reducing readmissions presented a complex challenge for many HENs (16). HEN-reported barriers to progress included a wide range of evidence-based best practice prevention strategies in the research literature (with no accepted standard), no standard protocols to ameliorate the impact of patient socio-economic factors on readmissions, a need for multidisciplinary solutions that go beyond the hospital setting, and cost implications of allocating resources to reduce readmissions and experiencing decreased revenue from readmissions.
- *VAE*: Many HENs (16) reported being affected by the change in measuring VAP to using the CDC's VAE measures in the final year of the campaign. Interestingly, however, while this change required HENs to help their hospitals learn the new measure definitions and revise data collection processes, some HENs (3) reported that they saw increased participation in improvement work in VAE after the definition change and increased attention to objective criteria for measuring harm in this area.
- *ADE*: Lack of standard measures for ADE created measurement and data collection difficulties for HENs (5) and hospitals and delayed harm reduction progress in this area.
- *OB-EED*: Most HENs (21) reported strong facilitation of their work by national efforts in OB-EED with guidance and support from the March of Dimes and ACOG as well as consensus around hard stop policies helping to focus their efforts in this area and encourage implementation of OB-EED interventions in their aligned hospitals.

Bayesian Difference-in-Differences Estimation of the Effect of the Hospital Engagement Network (HEN) Component of the Partnership for Patients (PfP) on Adverse Event Outcomes (Chapter 4)

This appendix presents the results of HEN alignment on Medicare beneficiaries' adverse event outcomes for subgroups of hospitals and HENs. To identify types of hospitals for which HEN alignment may have been more or less successful, the Evaluation Contractor applied a Bayesian model that increases the precision of impact estimates for each subgroup by drawing on information from other subgroups. Hospital types are defined based on three characteristics: critical access hospital (CAH) status, ownership (private for-profit, private non-profit, and government), and number of beds (less than 100, 100 to 199, 200 to 399, 400 and over). Considering these three characteristics simultaneously creates 13 subgroups as shown in Chapter 4 of the main text of this report. Despite the considerable range of characteristics these subgroups represent in patient mix, staffing, and operations, the results suggest few significant differences in the effect of the HEN component of PfP by hospital or HEN type.

For each outcome, even-numbered tables ranging from Table E-35 through Table E-80 present the point estimates, standard errors, and uncertainty intervals for HEN alignment's impact on each subgroup and HEN group in the post-intervention period (2012-2013). A Bayesian uncertainty interval defines the range within which the true parameter lies with 95 percent probability. The bounds of the uncertainty interval are estimated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Odd-numbered tables ranging from Table E-36 through Table E-81 present probabilities of observing impacts of several magnitudes in each subgroup or HEN group in the post-intervention period (2012-2013). Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions, intended to draw attention to likely improvements in outcomes. Conversely, highlighted orange are 75 percent or larger probabilities of an increase in adverse events or readmissions.

Table E-35—Estimated Impacts of HEN Alignment on Venous Thromboembolism (VTE) Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership

	CAH (N=691)	Govt, <100 (N=191)	Govt, 100-199 (N=114)	Govt, 200-399 (N=100)	Govt, ≥400 (N=72)	Non-profit, <100 (N=461)	Non-profit, 100-199 (N=549)	Non-profit, 200-399 (N=628)	Non-profit, ≥400 (N=335)	Private, <100 (N=321)	Private, 100-199 (N =233)	Private, 200-399 (N=140)	Private, ≥400 (N=32)
Point Estimates and Standard Errors for Each Subgroup													
Estimate	-0.232	-0.090	-0.271	-0.121	-0.117	-0.082	-0.219	-0.231	-0.150	-0.278	-0.155	-0.109	-0.197
Standard Error	0.342	0.348	0.337	0.337	0.338	0.336	0.338	0.283	0.329	0.354	0.323	0.329	0.332
Uncertainty Intervals for Each Subgroup													
Uncertainty Interval	(-0.907, 0.436)	(-0.730, 0.633)	(-0.952, 0.386)	(-0.757, 0.549)	(-0.751, 0.583)	(-0.728, 0.585)	(-0.879, 0.451)	(-0.785, 0.319)	(-0.788, 0.539)	(-0.984, 0.426)	(-0.789, 0.508)	(-0.740, 0.554)	(-0.829, 0.480)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, American Hospital Association (AHA) Survey (FY 2010), and Medicare claims data.
Notes: Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-36—Probabilities of HEN Alignment's Impact on VTE Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership													
Change in VTE Rate	CAH (N=691)	Govt, <100 (N=191)	Govt, 100-199 (N=114)	Govt, 200-399 (N=100)	Govt, ≥400 (N=72)	Non-profit, <100 (N=461)	Non-profit, 00-199 (N=549)	Non-profit, 200-399 (N=628)	Non-profit, ≥400 (N=335)	Private, <100 (N=321)	Private, 100-199 (N =233)	Private, 200-399 (N=140)	Private, ≥400 (N=32)
<0	0.758	0.618	0.792	0.642	0.646	0.596	0.754	0.792	0.693	0.792	0.687	0.634	0.737
≤-2%	0.672	0.524	0.715	0.553	0.556	0.506	0.663	0.704	0.593	0.713	0.596	0.540	0.644
≤-5%	0.526	0.380	0.580	0.410	0.407	0.363	0.523	0.536	0.437	0.582	0.440	0.390	0.495
≤-10%	0.302	0.176	0.334	0.206	0.190	0.162	0.282	0.262	0.207	0.352	0.217	0.175	0.253
≤-25%	0.012	0.002	0.017	0.002	0.005	0.003	0.010	0.003	0.004	0.021	0.004	0.002	0.007
>0	0.242	0.382	0.208	0.358	0.354	0.403	0.246	0.208	0.307	0.208	0.313	0.366	0.263
≥2%	0.176	0.289	0.146	0.276	0.265	0.315	0.177	0.132	0.226	0.144	0.225	0.276	0.190
≥5%	0.098	0.185	0.075	0.174	0.165	0.196	0.101	0.059	0.130	0.086	0.126	0.165	0.108
≥10%	0.029	0.078	0.022	0.063	0.061	0.072	0.035	0.012	0.047	0.028	0.045	0.056	0.037
≥25%	0.000	0.004	0.000	0.000	0.002	0.001	0.000	0.000	0.002	0.001	0.000	0.002	0.000

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.
Notes: Change in the VTE rate is relative to the baseline (2011) value of the comparison group of 4.08 per 1,000 discharges. Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-37—Estimated Impacts of HEN Alignment on VTE Rate in 2012-2013 by HEN Group									
Point Estimates and Standard Errors for Each HEN Group									
	Hosp Assn-High (N=1,081)	**Hosp Assn-High-Collab (N=91)**	**Hosp Assn-Low (N=669)**	**Hosp Assn-Low-Collab (N=229)**	**Other-High-Collab (N=25)**	**Other-Low (N=720)**	**Other-Low-Collab (N=71)**	**Other (N=4)**	**System HEN (N=169)**
Estimate	-0.147	-0.144	-0.250	-0.153	-0.155	-0.173	-0.270	-0.352	-0.169
Standard Error	0.278	0.362	0.290	0.313	0.388	0.311	0.380	0.432	0.318
Uncertainty Intervals for Each HEN Group									
Uncertainty Interval	(-0.693, 0.404)	(-0.853, 0.602)	(-0.816, 0.315)	(-0.763, 0.468)	(-0.905, 0.609)	(-0.773, 0.449)	(-1.014, 0.476)	(-1.207, 0.503)	(-0.798, 0.475)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-38—Probabilities of HEN Alignment's Impact on VTE Rate in 2012-2013 by HEN Group									
Change in VTE Rate	**Hosp Assn-High (N=1,081)**	**Hosp Assn-High-Collab (N=91)**	**Hosp Assn-Low (N=669)**	**Hosp Assn-Low Collab (N=229)**	**Other-High-Collab (N=25)**	**Other-Low (N=720)**	**Other-Low-Collab (N=71)**	**Other (N=4)**	**System HEN (N=169)**
<0	0.705	0.662	0.807	0.692	0.665	0.720	0.765	0.797	0.705
≤-2%	0.598	0.581	0.719	0.587	0.584	0.628	0.692	0.743	0.612
≤-5%	0.417	0.434	0.563	0.436	0.454	0.474	0.580	0.640	0.461
≤-10%	0.180	0.224	0.289	0.204	0.257	0.219	0.360	0.448	0.225
≤-25%	0.000	0.009	0.005	0.002	0.014	0.004	0.024	0.059	0.004
>0	0.295	0.338	0.193	0.308	0.335	0.280	0.235	0.203	0.295
≥2%	0.203	0.255	0.121	0.223	0.264	0.203	0.175	0.150	0.206
≥5%	0.102	0.160	0.055	0.123	0.176	0.116	0.102	0.095	0.118
≥10%	0.024	0.067	0.012	0.036	0.073	0.034	0.038	0.039	0.036
≥25%	0.000	0.002	0.000	0.000	0.002	0.000	0.001	0.002	0.000

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.
Notes: Change in the VTE rate is relative to the baseline (2011) value of the comparison group of 4.08 per 1,000 discharges. HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-39—Estimated Impacts of HEN Alignment on Pressure Ulcer Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership													
Point Estimates and Standard Errors for Each Subgroup													
	CAH (N=959)	Govt, <100 (N=212)	Govt, 100-199 (N=120)	Govt, 200-399 (N=101)	Govt, ≥400 (N=75)	Non-profit, <100 (N=477)	Non-profit, 100-199 (N=554)	Non-profit, 200-399 (N=631)	Non-profit, ≥400 (N=336)	Private, <100 (N=322)	Private, 100-199 (N =235)	Private, 200-399 (N=140)	Private, ≥400 (N=32)
Estimate	-0.019	-0.052	-0.039	-0.050	-0.051	-0.062	-0.035	-0.053	-0.045	-0.034	-0.042	-0.036	-0.035
Standard Error	0.044	0.042	0.043	0.044	0.043	0.041	0.043	0.040	0.043	0.047	0.036	0.044	0.043
Uncertainty Intervals for Each Subgroup													
Uncertainty Interval	(-0.107, 0.068)	(-0.135, 0.029)	(-0.124, 0.047)	(-0.137, 0.036)	(-0.135, 0.033)	(-0.142, 0.018)	(-0.120, 0.049)	(-0.132, 0.022)	(-0.129, 0.039)	(-0.124, 0.060)	(-0.111, 0.027)	(-0.120, 0.049)	(-0.118, 0.049)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-40—Probabilities of HEN Alignment's Impact on Pressure Ulcer Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership

Change in Pressure Ulcer Rate	CAH (N=959)	Govt, <100 (N=212)	Govt, 100-199 (N=120)	Govt, 200-399 (N=101)	Govt, ≥400 (N=75)	Non-profit, <100 (N=477)	Non-profit, 100-199 (N=554)	Non-profit, 200-399 (N=631)	Non-profit, ≥400 (N=336)	Private, <100 (N=322)	Private, 100-199 (N =235)	Private, 200-399 (N=140)	Private, ≥400 (N=32)
<0	0.668	0.892	0.822	0.872	0.882	0.936	0.792	0.909	0.862	0.767	0.873	0.788	0.798
≤-2%	0.652	0.882	0.810	0.862	0.872	0.930	0.776	0.902	0.847	0.754	0.858	0.772	0.786
≤-5%	0.625	0.866	0.788	0.847	0.859	0.919	0.756	0.887	0.826	0.730	0.840	0.750	0.762
≤-10%	0.580	0.838	0.756	0.813	0.829	0.896	0.716	0.861	0.787	0.693	0.803	0.710	0.720
≤-25%	0.419	0.718	0.603	0.696	0.709	0.800	0.564	0.748	0.665	0.554	0.645	0.579	0.577
>0	0.332	0.108	0.178	0.128	0.118	0.064	0.208	0.091	0.138	0.233	0.127	0.212	0.202
≥2%	0.314	0.100	0.165	0.117	0.108	0.056	0.194	0.083	0.128	0.220	0.114	0.199	0.185
≥5%	0.288	0.086	0.145	0.103	0.094	0.048	0.173	0.071	0.112	0.199	0.093	0.180	0.168
≥10%	0.247	0.064	0.121	0.086	0.074	0.039	0.142	0.056	0.090	0.170	0.067	0.150	0.141
≥25%	0.143	0.027	0.069	0.042	0.031	0.016	0.070	0.018	0.042	0.094	0.024	0.076	0.071

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Change in the pressure ulcer rate is relative to the baseline (2011) value of the comparison group of 0.11 per 1,000 discharges. Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-41—Estimated Impacts of HEN Alignment on Pressure Ulcer Rate in 2012-2013 by HEN Group										
Point Estimates and Standard Errors for Each HEN Group										
	Hosp Assn-High (N=1,077)	**Hosp Assn-High-Collab (N=254)**	**Hosp Assn-Low (N=575)**	**Hosp Assn-Low-Collab (N=328)**	**Other-High (N=361)**	**Other-High-Collab (N=25)**	**Other-Low (N=380)**	**Other-Low-Collab (N=69)**	**Other (N=6)**	**System HEN (N=171)**
Estimate	-0.034	-0.049	-0.057	-0.049	-0.045	-0.044	-0.047	-0.077	-0.043	-0.036
Standard Error	0.038	0.048	0.042	0.045	0.050	0.056	0.045	0.055	0.060	0.045
Uncertainty Intervals for Each HEN Group										
Uncertainty Interval	(-0.112, 0.039)	(-0.140, 0.048)	(-0.140, 0.026)	(-0.138, 0.039)	(-0.142, 0.055)	(-0.152, 0.065)	(-0.135, 0.040)	(-0.188, 0.033)	(-0.161, 0.077)	(-0.124, 0.052)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.
Notes: HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-42—Probabilities of HEN Alignment's Impact on Pressure Ulcers in 2012-2013 by HEN Group										
Change in Pressure Ulcer Rate	Hosp Assn-High (N=1,077)	Hosp Assn-High-Collab (N=254)	Hosp Assn-Low (N=575)	Hosp Assn-Low-Collab (N=328)	Other-High (N=361)	Other-High-Collab (N=25)	Other-Low (N=380)	Other-Low-Collab (N=69)	Other (N=6)	System HEN (N=171)
<0	0.814	0.846	0.920	0.866	0.810	0.791	0.852	0.926	0.764	0.792
≤-2%	0.800	0.835	0.911	0.856	0.798	0.779	0.843	0.920	0.754	0.778
≤-5%	0.773	0.822	0.896	0.835	0.781	0.762	0.826	0.909	0.738	0.752
≤-10%	0.731	0.792	0.867	0.804	0.748	0.730	0.790	0.892	0.706	0.709
≤-25%	0.570	0.685	0.768	0.685	0.634	0.614	0.672	0.821	0.598	0.576
>0	0.186	0.154	0.080	0.134	0.190	0.209	0.147	0.074	0.237	0.209
≥2%	0.169	0.142	0.074	0.124	0.176	0.199	0.141	0.071	0.224	0.193
≥5%	0.147	0.131	0.067	0.108	0.164	0.184	0.122	0.063	0.208	0.171
≥10%	0.119	0.101	0.052	0.083	0.136	0.158	0.098	0.051	0.184	0.144
≥25%	0.053	0.059	0.023	0.042	0.078	0.098	0.048	0.030	0.117	0.080

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Change in the pressure ulcer rate is relative to the baseline (2011) value of the comparison group of 0.11 per 1,000 discharges. HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-43—Estimated Impacts of HEN Alignment on Central Venous Catheter-Related Blood Stream Infection (CRBSI) Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership													
Point Estimates and Standard Errors for Each Subgroup													
	CAH (N=975)	Govt, <100 (N=215)	Govt, 100-199 (N=122)	Govt, 200-399 (N=103)	Govt, ≥400 (N=76)	Non-profit, <100 (N=482)	Non-profit, 100-199 (N=555)	Non-profit, 200-399 (N=631)	Non-profit, ≥400 (N=336)	Private, <100 (N=343)	Private, 100-199 (N =325)	Private, 200-399 (N=141)	Private, ≥400 (N=32)
Estimate	-0.050	-0.005	-0.023	-0.028	-0.044	-0.016	-0.053	-0.006	-0.097	-0.018	0.010	-0.033	-0.023
Standard Error	0.055	0.056	0.056	0.058	0.057	0.055	0.059	0.050	0.060	0.061	0.051	0.059	0.054
Uncertainty Intervals for Each Subgroup													
Uncertainty Interval	(-0.162, 0.055)	(-0.116, 0.102)	(-0.130, 0.085)	(-0.141, 0.084)	(-0.154, 0.069)	(-0.126, 0.089)	(-0.172, 0.063)	(-0.103, 0.093)	(-0.218, 0.018)	(-0.141, 0.102)	(-0.091, 0.109)	(-0.150, 0.084)	(-0.130, 0.081)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-44—Probabilities of HEN Alignment's Impact on CRBSI Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership												
Change in CRBSI Rate	CAH (N=975)	Govt, <100 (N=215)	Govt, 100-199 (N=122)	Govt, 200-399 (N=103)	Govt, ≥400 (N=76)	Non-profit, <100 (N=482)	Non-profit, 100-199 (N=555)	Non-profit, 200-399 (N=631)	Non-profit, ≥400 (N=336)	Private, <100 (N=343)	Private, 100-199 (N =325)	Private, 200-399 (N=141)	Private, ≥400 (N=32)
<0	0.830	0.539	0.666	0.690	0.788	0.612	0.818	0.544	0.951	0.622	0.423	0.711	0.660
≤-2%	0.798	0.502	0.634	0.651	0.754	0.576	0.796	0.504	0.941	0.587	0.385	0.681	0.627
≤-5%	0.751	0.442	0.575	0.600	0.705	0.521	0.753	0.439	0.926	0.537	0.328	0.630	0.574
≤-10%	0.674	0.348	0.478	0.513	0.624	0.424	0.675	0.344	0.882	0.451	0.240	0.543	0.475
≤-25%	0.386	0.140	0.220	0.258	0.352	0.182	0.408	0.118	0.698	0.219	0.069	0.286	0.218
>0	0.170	0.461	0.334	0.310	0.212	0.388	0.182	0.456	0.049	0.377	0.577	0.289	0.340
≥2%	0.150	0.426	0.304	0.280	0.188	0.352	0.153	0.410	0.041	0.342	0.542	0.258	0.306
≥5%	0.119	0.376	0.253	0.239	0.152	0.301	0.125	0.351	0.029	0.298	0.481	0.216	0.254
≥10%	0.078	0.294	0.186	0.175	0.102	0.225	0.087	0.259	0.017	0.234	0.378	0.158	0.178
≥25%	0.015	0.104	0.057	0.050	0.027	0.062	0.023	0.076	0.003	0.086	0.139	0.051	0.047

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Change in the CRBSI rate is relative to the baseline (2011) value of the comparison group of 0.26 per 1,000 discharges. Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-45—Estimated Impacts of HEN Alignment on CRBSI Rate in 2012-2013 by HEN Group										
Point Estimates and Standard Errors for Each HEN Group										
	Hosp Assn-High (N=1,376)	**Hosp Assn-High-Collab (N=333)**	**Hosp Assn-Low (N=183)**	**Hosp Assn-Low-Collab (N=356)**	**Other-High (N=459)**	**Other-High-Collab (N=25)**	**Other-Low (N=291)**	**Other-Low-Collab (N=69)**	**Other (N=6)**	**System HEN (N=171)**
Estimate	-0.021	-0.085	-0.038	-0.032	-0.051	-0.035	-0.058	-0.102	-0.029	-0.038
Standard Error	0.047	0.054	0.061	0.058	0.063	0.078	0.062	0.077	0.082	0.059
Uncertainty Intervals for Each HEN Group										
Uncertainty Interval	(-0.115, 0.069)	(-0.191, 0.021)	(-0.162, 0.080)	(-0.144, 0.081)	(-0.177, 0.070)	(-0.186, 0.117)	(-0.177, 0.064)	(-0.252, 0.043)	(-0.192, 0.133)	(-0.152, 0.078)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.
Notes: HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-46—Probabilities of HEN Alignment's Impact on CRBSI Rate in 2012-2013 by HEN Group										
Change in CRBSI Rate	Hosp Assn-High (N=1,376)	Hosp Assn-High-Collab (N=333)	Hosp Assn-Low (N=183)	Hosp Assn-Low-Collab (N=356)	Other-High (N=459)	Other-High-Collab (N=25)	Other-Low (N=291)	Other-Low-Collab (N=69)	Other (N=6)	System HEN (N=171)
<0	0.672	0.946	0.743	0.712	0.785	0.671	0.824	0.909	0.638	0.736
≤-2%	0.630	0.933	0.711	0.679	0.760	0.650	0.802	0.895	0.612	0.709
≤-5%	0.568	0.911	0.666	0.630	0.720	0.612	0.768	0.876	0.574	0.657
≤-10%	0.451	0.867	0.578	0.548	0.652	0.550	0.702	0.837	0.511	0.584
≤-25%	0.172	0.632	0.320	0.274	0.408	0.351	0.450	0.686	0.331	0.326
>0	0.328	0.054	0.257	0.288	0.215	0.329	0.176	0.091	0.362	0.264
≥2%	0.289	0.045	0.229	0.257	0.189	0.310	0.154	0.080	0.339	0.235
≥5%	0.229	0.034	0.194	0.213	0.156	0.271	0.125	0.067	0.302	0.196
≥10%	0.152	0.017	0.140	0.154	0.112	0.219	0.088	0.043	0.250	0.138
≥25%	0.029	0.002	0.047	0.046	0.031	0.102	0.024	0.015	0.123	0.041

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Change in the CRBSI rate is relative to the baseline (2011) value of the comparison group of 0.26 per 1,000 discharges. HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-47—Estimated Impacts of HEN Alignment on Readmission Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership													
Point Estimates and Standard Errors for Each Subgroup													
	CAH (N=1,246)	Govt, <100 (N=341)	Govt, 100-199 (N=141)	Govt, 200-399 (N=32)	Govt, ≥400 (N=235)	Non-profit, <100 (N=215)	Non-profit, 100-199 (N=102)	Non-profit, 200-399 (N=76)	Non-profit, ≥400 (N=122)	Private, <100 (N=482)	Private, 100-199 (N =632)	Private, 200-399 (N=336)	Private, ≥400 (N=554)
Estimate	1.101	1.695	2.405	1.168	0.432	1.425	2.215	2.007	0.765	1.676	2.575	1.993	2.178
Standard Error	1.409	1.502	1.357	1.492	1.379	1.396	1.357	1.402	1.465	1.301	1.132	1.126	1.174
Uncertainty Intervals for Each Subgroup													
Uncertainty Interval	(-1.790, 3.788)	(-1.435, 4.543)	(-0.183, 5.055)	(-1.818, 4.051)	(-2.453, 2.984)	(-1.339, 4.109)	(-0.414, 4.967)	(-0.649, 4.802)	(-2.228, 3.591)	(-0.944, 4.160)	(0.380, 4.814)	(-0.232, 4.239)	(-0.089, 4.452)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-48—Probabilities of HEN Alignment's Impact on Readmission Rate in 2012-2013 by Subgroup of Hospitals Based on CAH Status, Bed Size, and Ownership													
	CAH (N=1,246)	Govt, <100 (N=341)	Govt, 100-199 (N=141)	Govt, 200-399 (N=32)	Govt, ≥400 (N=235)	Non-profit, <100 (N=215)	Non-profit, 100-199 (N=102)	Non-profit, 200-399 (N=76)	Non-profit, ≥400 (N=122)	Private, <100 (N=482)	Private, 100-199 (N =632)	Private, 200-399 (N=336)	Private, ≥400 (N=554)
<0	0.206	0.122	0.036	0.214	0.362	0.148	0.050	0.072	0.294	0.101	0.009	0.040	0.028
≤-2%	0.001	0.001	0.000	0.001	0.003	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
≤-5%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≤-10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≤-25%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
>0	0.794	0.878	0.964	0.786	0.638	0.852	0.950	0.928	0.706	0.899	0.991	0.960	0.972
≥2%	0.026	0.077	0.164	0.038	0.003	0.043	0.125	0.110	0.016	0.050	0.148	0.055	0.083
≥5%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≥25%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.
Notes: Change in the readmission rate is relative to the baseline (2011) value of the comparison group of 188.9 per 1,000 discharges. Subgroup labels refer to a combination of ownership type (private for-profit, government, or non-profit) and bed size. Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Table E-49—Estimated Impacts of HEN Alignment on Readmission Rate in 2012-2013 by HEN Group										
Point Estimates and Standard Errors for Each HEN Group										
	Hosp Assn-High (N=1,588)	**Hosp Assn-High-Collab (N=401)**	**Hosp Assn-Low (N=95)**	**Hosp Assn-Low-Collab (N=164)**	**Other-High (N=35)**	**Other-High-Collab (N=391)**	**Other-Low (N=346)**	**Other-Low-Collab (N=71)**	**Other (N=201)**	**System HEN (N=171)**
Estimate	1.794	2.203	2.181	2.289	3.185	1.619	2.548	1.750	2.271	2.091
Standard Error	1.086	1.423	1.795	1.533	1.809	1.824	1.454	1.913	1.817	1.383
Uncertainty Intervals for Each HEN Group										
Uncertainty Interval	(-0.304, 3.894)	(-0.621, 4.983)	(-1.343, 5.700)	(-0.710, 5.381)	(-0.352, 6.702)	(-1.903, 5.353)	(-0.325, 5.456)	(-2.037, 5.569)	(-1.260, 5.802)	(-0.644, 4.739)

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). The Bayesian uncertainty interval is roughly analogous to the frequentist confidence interval. The endpoints of the uncertainty interval are calculated as the 2.5 and 97.5 percentiles of the posterior probability distribution.

Table E-50—Probabilities of HEN Alignment's Impact on Readmission Rate in 2012-2013 by HEN Group										
Change in Readmission Rate	Hosp Assn-High (N=1,588)	Hosp Assn-High-Collab (N=401)	Hosp Assn-Low (N=95)	Hosp Assn-Low-Collab (N=164)	Other-High (N = 35)	Other-High-Collab (N=391)	Other-Low (N=346)	Other-Low-Collab (N=71)	Other (N=201)	System HEN (N=171)
<0	0.049	0.062	0.110	0.068	0.038	0.188	0.041	0.180	0.106	0.070
≤-2%	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.002	0.000
≤-5%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≤-10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≤-25%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
>0	0.951	0.938	0.890	0.932	0.962	0.812	0.959	0.820	0.894	0.930
≥2%	0.034	0.129	0.179	0.154	0.372	0.113	0.193	0.144	0.197	0.114
≥5%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
≥25%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Analysis of 2014 Survey on Prevention of Adverse Events and Readmissions, AHA Survey (FY 2010), and Medicare claims data.

Notes: Change in the readmission rate is relative to the baseline (2011) value of the comparison group of 188.9 per 1,000 discharges. HEN-group labels refer to a combination of organization (for example, hospital association), intensity (high/low), and collaboration (no/yes). Highlighted green are 75 percent or larger probabilities of a decrease in adverse events or readmissions. Conversely, highlighted red are 75 percent or larger probabilities of an increase in adverse events.

Difference-In-Differences Analysis of Composite Measure of Harms from Medicare Patient Safety Monitoring System (MPSMS) (Chapter 4)

Table E-51 presents regression-adjusted difference-in-differences results for the six composite measures and all 21 individual measures. (The main report presented the results for the 6 composite measures in Chapter 4, Table 4-9.) Table E-52 below provides support of the finding of no impacts for the composite outcome variables. This table shows regression-adjusted trends for HEN-aligned hospitals and non-aligned hospitals for each outcome. It can be seen that the occurrence of any of the 21 adverse events was trending downwards essentially equally for both non-HEN– and HEN– aligned hospitals alike. Table E-53 shows the unadjusted trends for both groups. Table E-54 tests the robustness of the main difference-in-differences results for the five binary composite outcomes using four alternative models: (1) unadjusted difference-in-differences, (2) linear regression models that controlled for hospital fixed effects (the data was limited to the subset of hospitals with data before and after January 1, 2012), (3) logit models that controlled for hospital random effects, and (4) models that excluded 2012 discharges. As reported in Chapter 5, results for all of these robustness checks turned out to be roughly similar to the main findings. Table E-54 presents the subgroup impact estimates for hospital adverse events for hospitals in different subgroups of patients and subgroups of hospitals. In addition, the bottom panel of the table presents impact estimates separately for selected categories of HENs.

Table E-51–Difference-in-Differences Impact Analyses for Composite Adverse Event Outcomes and the 21 Individual MPSMS Adverse Event Measures										
Measure	Unadjusted							Regression-Adjusted Difference-in-Differences	Number of Observations	Power to Detect a 5 Percent Effect[a]
	Non-Aligned Hospitals			HEN-Aligned Hospitals			Difference-in-Differences			
	Pre 2009-2011	Post 2012-2013	Difference	Pre 2009-2011	Post 2012-2013	Difference				
Any adverse event[b]	13.74	11.92	-1.81 (0.58)**	14.79	13.47	-1.33 (0.27)**	0.49 (0.63)	**0.44 (0.53)**	125,004	25.1
Number of adverse events[c] (per 1,000 discharges)	183.41	157.15	-26.26 (9.29)**	199.57	177.71	-21.87 (4.14)**	4.39 (10.17)	**-4.02 (8.92)**	125,004	17.5
Adverse Drug Events (ADE) Measures										
Hospital-Acquired Antibiotic-Associated *Clostridium difficile (C. difficile)*	0.33	0.37	0.04 (0.11)	0.49	0.58	0.09 (0.06)	0.05 (0.12)	**0.00 (0.16)**	94,901	3.2
ADE associated with Hypoglycemic Agent	10.82	9.27	-1.54 (0.81)	10.41	8.41	-2.00 (0.34)**	-0.45 (0.88)	**-0.80 (0.83)**	43,911	9.5
ADE Associated with IV Heparin	11.72	10.52	-1.20 (1.73)	11.96	10.67	-1.29 (0.73)	-0.08 (1.88)	**-0.43 (1.87)**	10,950	5.0
ADE Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	4.86	4.29	-0.57 (0.50)	4.93	4.00	-0.93 (0.22)**	-0.36 (0.54)	**-0.57 (0.54)**	49,460	6.6
ADEs Associated with Warfarin	5.57	4.86	-0.71 (0.84)	5.50	5.27	-0.23 (0.39)	0.48 (0.93)	**0.47 (0.93)**	18,655	4.8
Any ADE event[b]	6.85	6.09	-0.75 (0.41)	7.45	6.50	-0.95 (0.19)**	-0.20 (0.45)	**-0.20 (0.42)**	117,234	12.5
General Adverse Event Measures										
Hospital Acquired Pressure Ulcers (HAPU)	4.48	4.09	-0.38 (0.32)	5.00	4.55	-0.45 (0.16)**	-0.07 (0.36)	**-0.36 (0.41)**	125,004	7.9
In-Hospital Patient Falls	1.04	0.61	-0.44 (0.12)**	1.04	0.90	-0.14 (0.06)*	0.29 (0.14)*	**0.32 (0.16)**	125,004	5.1
Any General Adverse Event[b]	5.44	4.63	-0.80 (0.34)*	5.89	5.36	-0.53 (0.17)**	0.27 (0.38)	**0.04 (0.43)**	125,004	9.3

Table E-51–Difference-in-Differences Impact Analyses for Composite Adverse Event Outcomes and the 21 Individual MPSMS Adverse Event Measures										
Measure	Unadjusted							Regression-Adjusted Difference-in-Differences	Number of Observations	Power to Detect a 5 Percent Effect[a]
	Non-Aligned Hospitals			HEN-Aligned Hospitals			Difference-in-Differences			
	Pre 2009-2011	Post 2012-2013	Difference	Pre 2009-2011	Post 2012-2013	Difference				
Post-Procedural Adverse Event Measures										
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic	1.69	1.69	0.00 (0.58)	2.27	2.24	-0.03 (0.30)	-0.03 (0.65)	**0.07 (0.73)**	14,011	3.3
Adverse Events Associated with Hip Joint Replacements	7.51	3.96	-3.54 (1.30)**	7.55	6.44	-1.10 (0.79)	2.44 (1.52)	**3.09 (1.67)**	5,960	4.1
Adverse Events Associated with Knee Joint Replacements	3.50	2.88	-0.62 (0.79)	4.81	3.30	-1.50 (0.51)**	-0.88 (0.94)	**-0.22 (1.11)**	9,025	3.6
Contrast Nephropathy Associated with Catheter Angiography	13.44	11.33	-2.11 (1.54)	11.81	11.52	-0.29 (0.61)	1.82 (1.66)	**1.44 (1.60)**	14,628	6.2
Mechanical Complications Associated with Central Venous Catheters	3.76	2.11	-1.65 (0.65)*	3.60	3.65	0.05 (0.33)	1.70 (0.73)*	**1.80 (0.89)***	16,817	4.0
Postoperative Cardiac/Non-cardiac Arrest Events	0.67	0.66	-0.01 (0.19)	1.05	1.09	0.04 (0.13)	0.05 (0.22)	**-0.11 (0.32)**	38,177	3.2
Postoperative Venous Thromboembolic (VTE) Event	0.39	0.51	0.12 (0.16)	0.63	0.68	0.05 (0.10)	-0.07 (0.19)	**-0.12 (0.27)**	38,179	2.9
Any Post Procedural Adverse Event[b]	5.76	4.59	-1.17 (0.50)*	6.79	6.35	-0.44 (0.25)	0.73 (0.56)	**0.99 (0.56)**	58,663	7.5
Hospital-Acquired Infection (HAI) Measures										
Blood Stream Infection Associated with Central Venous Catheter	1.73	1.53	-0.20 (0.76)	1.16	0.84	-0.33 (0.23)	-0.13 (0.79)	**-0.17 (0.92)**	8,674	3.1
Catheter-Associated Urinary Tract Infections (CAUTI)	3.27	2.98	-0.29 (0.38)	3.32	2.94	-0.38 (0.18)*	-0.09 (0.42)	**-0.15 (0.46)**	56,568	5.5
Hospital-Acquired Vancomycin Resistant Enterococcus	0.07	0.03	-0.05 (0.03)	0.03	0.03	0.00 (0.01)	0.05 (0.03)	**0.02 (0.03)**	124,462	3.2

Table E-51–Difference-in-Differences Impact Analyses for Composite Adverse Event Outcomes and the 21 Individual MPSMS Adverse Event Measures

Measure	Unadjusted							Regression-Adjusted Difference-in-Differences	Number of Observations	Power to Detect a 5 Percent Effect[a]
	Non-Aligned Hospitals			HEN-Aligned Hospitals			Difference-in-Differences			
	Pre 2009-2011	Post 2012-2013	Difference	Pre 2009-2011	Post 2012-2013	Difference				
Postoperative Pneumonia	1.81	1.38	-0.42 (0.30)	2.21	2.06	-0.15 (0.18)	0.28 (0.35)	**0.47 (0.42)**	37,323	4.1
Ventilator-Associated Pneumonia (VAP)	11.45	10.07	-1.38 (3.04)	10.98	10.56	-0.42 (1.41)	0.96 (3.35)	**0.73 (2.99)**	2,498	3.9
Any HAI[b]	2.39	2.08	-0.30 (0.22)	2.31	2.09	-0.22 (0.10)*	0.08 (0.24)	**0.02 (0.25)**	124,933	7.0

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Note: *Unadjusted* rates were not regression-adjusted. *Regression-adjusted* difference-in-differences analyses were adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.

*$p < 0.05$, **$p < 0.01$

Each model included all at-risk patients in MPSMS sample.

[a] "Power to detect a difference," or the statistical power, is the probability of concluding that the program had a statistically significant effect when the true effect was of the specified size. The power calculation is based on actual standard errors from analysis. For example, in the first row, a 5 percent effect on the "any adverse event" rate would be a change of 0.7 percentage points. Given the standard error of 0.53 from the regression model, the Evaluation Contractor would only be able to detect a statistically significant result 25.1 percent of the time if the impact was truly 0.7 percentage points, assuming a two-sided statistical test at the $p < 0.05$ significance level.

[b] Binary composite measure for having one or more adverse events. Composite measures include cases at risk for one or more of the contributing measures.

[c] Continuous composite measure with number of adverse events per 1,000 discharges.

Table E-52–Trends in the Regression-Adjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Any Adverse Event[a]	16.04	14.70	14.86	13.94	12.75	16.86	14.53	15.26	13.53	12.96	-0.82 (0.70)	0.17 (0.51)	-0.40 (0.57)	0.41 (0.54)	-0.21 (0.79)
Number of Adverse Events[b] (per 1,000 cases)	227.91	206.99	206.40	188.87	160.69	226.05	209.19	208.25	187.01	176.61	1.86 (10.21)	-2.20 (8.16)	-1.84 (8.50)	1.87 (9.29)	-15.92 (12.56)
ADE Measures															
Hospital-Acquired Antibiotic-Associated *C. difficile*	0.53	0.50	0.54	0.58	0.59	0.48	0.35	0.56	0.53	0.51	0.05 (0.18)	0.15 (0.11)	-0.02 (0.14)	0.05 (0.16)	0.08 (0.23)
ADE Associated with Hypoglycemic Agent	12.05	10.25	10.33	8.55	8.20	12.14	10.11	11.20	9.31	9.69	-0.09 (1.13)	0.13 (0.78)	-0.86 (0.87)	-0.76 (0.95)	-1.49 (1.10)
ADE Associated with IV Heparin	13.20	12.29	11.75	10.81	10.49	14.76	11.02	10.45	10.51	9.60	-1.55 (2.91)	1.26 (1.74)	1.30 (1.83)	0.29 (1.83)	0.89 (2.44)
ADE Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	5.77	4.99	4.92	4.49	3.27	5.22	4.81	4.81	4.79	3.64	0.54 (0.70)	0.18 (0.47)	0.11 (0.52)	-0.30 (0.56)	-0.37 (0.56)
ADE Associated with Warfarin	4.56	6.02	6.48	5.42	5.04	5.66	5.56	6.53	4.58	5.53	-1.10 (1.17)	0.46 (0.88)	-0.06 (1.06)	0.85 (0.96)	-0.49 (1.29)
Any ADE[a]	8.21	7.47	7.64	6.72	6.18	8.44	7.18	8.00	6.87	6.65	-0.23 (0.57)	0.29 (0.38)	-0.36 (0.43)	-0.15 (0.44)	-0.46 (0.57)
General Adverse Event Measures															
HAPU	6.21	5.08	5.20	4.96	3.92	6.03	5.01	5.01	5.08	4.21	0.19 (0.49)	0.07 (0.35)	0.19 (0.36)	-0.12 (0.39)	-0.29 (0.51)
In-Hospital Patient Falls	1.46	0.96	0.96	0.90	0.89	1.42	1.10	0.96	0.60	0.70	0.03 (0.24)	-0.14 (0.16)	-0.00 (0.15)	0.31 (0.14)*	0.19 (0.18)
Any General Adverse Event[a]	7.43	5.90	6.02	5.76	4.74	7.42	5.97	5.83	5.51	4.88	0.01 (0.54)	-0.08 (0.37)	0.20 (0.39)	0.25 (0.40)	-0.13 (0.52)
Post Procedural Adverse Event Measures															
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic	2.86	2.17	2.08	2.61	1.75	2.82	2.07	1.23	1.45	2.46	0.04 (1.13)	0.09 (0.70)	0.85 (0.56)	1.17 (0.72)	-0.71 (1.08)

Table E-52–Trends in the Regression-Adjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Adverse Events Associated with Hip Joint Replacements	6.99	7.58	8.43	6.84	5.78	7.68	10.31	7.97	4.82	3.41	-0.69 (2.16)	-2.73 (1.99)	0.46 (2.01)	2.02 (1.46)	2.36 (1.64)
Adverse Events Associated with Knee Joint Replacements	2.89	5.61	5.20	3.68	2.62	4.60	4.82	4.36	3.89	2.29	-1.72 (1.31)	0.79 (1.30)	0.85 (1.12)	-0.22 (1.13)	0.33 (1.20)
Contrast Nephropathy Associated with Catheter Angiography	12.01	11.31	11.93	11.67	11.35	9.25	13.45	13.59	10.63	12.19	2.76 (1.85)	-2.14 (1.42)	-1.67 (1.65)	1.05 (1.73)	-0.84 (1.92)
Mechanical Complications Associated with Central Venous Catheters	4.42	3.18	3.85	3.85	3.33	3.61	3.71	4.47	2.22	2.26	0.81 (1.18)	-0.53 (0.76)	-0.62 (0.86)	1.63 (0.74)*	1.07 (0.87)
Postoperative Cardiac/Non-cardiac Arrest Events	1.05	1.09	1.25	1.25	0.83	1.13	0.73	0.86	0.85	0.95	-0.08 (0.40)	0.36 (0.24)	0.39 (0.29)	0.41 (0.29)	-0.12 (0.41)
Postoperative VTE Event	0.56	0.79	0.56	0.67	0.69	0.81	0.73	0.57	1.05	0.39	-0.25 (0.35)	0.05 (0.28)	-0.01 (0.23)	-0.38 (0.35)	0.31 (0.31)
Any Post Procedural Adverse Event [a]	6.40	6.60	7.03	6.61	5.98	5.96	6.97	7.07	5.62	5.20	0.45 (0.65)	-0.37 (0.56)	-0.04 (0.56)	0.99 (0.57)	0.78 (0.70)
HAI Measures															
Blood Stream Infection Associated with Central Venous Catheter	1.30	1.16	1.36	1.08	0.42	1.62	0.99	2.03	1.74	0.56	-0.32 (0.90)	0.17 (0.57)	-0.67 (0.79)	-0.66 (0.80)	-0.14 (0.60)
CAUTI	3.44	3.55	3.14	2.99	2.87	3.89	3.40	3.94	3.43	3.49	-0.45 (0.60)	0.15 (0.43)	-0.80 (0.44)	-0.44 (0.44)	-0.62 (0.68)
Hospital Acquired Vancomycin Resistant Enterococcus	0.04	0.05	0.02	0.02	0.05	0.04	0.10	0.09	0.03	0.05	0.00 (0.05)	-0.05 (0.05)	-0.07 (0.05)	-0.01 (0.03)	0.00 (0.05)
Postoperative Pneumonia	2.06	2.31	2.43	2.28	1.70	1.95	2.93	2.12	1.65	1.81	0.11 (0.52)	-0.62 (0.44)	0.32 (0.40)	0.63 (0.40)	-0.12 (0.52)
VAP	6.57	11.74	11.86	10.48	10.68	6.68	10.53	12.96	8.58	12.65	-0.11 (4.18)	1.22 (3.09)	-1.10 (3.85)	1.90 (3.38)	-1.97 (5.25)
Any HAI[a]	2.31	2.50	2.28	2.17	1.95	2.37	2.60	2.68	2.28	2.32	-0.06 (0.30)	-0.10 (0.23)	-0.39 (0.24)	-0.11 (0.23)	-0.37 (0.36)

Table E-52–Trends in the Regression-Adjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Notes: Adverse event rates were regression-adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.

[a] Binary composite measure for having one or more adverse events. Composite measures include cases at risk for one or more of the contributing measures.

[b] Continuous composite measure with number of adverse events per 1,000 patients.

Table E-53–Trends in the Unadjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Any Adverse Event[a]	14.96	14.83	14.67	13.99	12.67	14.14	14.02	13.26	12.11	11.62	0.82 (0.71)	0.81 (0.64)	1.42 (0.68)*	1.88 (0.70)**	1.06 (0.93)
Number of Adverse Events[b] (per 1,000 cases)	205.69	198.88	197.13	186.16	164.82	182.56	191.60	176.43	161.39	150.10	23.13 (10.76)*	7.28 (9.96)	20.70 (10.37)*	24.77 (10.95)*	14.72 (14.49)
ADE Measures															
Hospital-Acquired Antibiotic-Associated *C. difficile*	0.44	0.50	0.52	0.57	0.60	0.31	0.28	0.39	0.37	0.37	0.13 (0.12)	0.22 (0.09)*	0.13 (0.10)	0.20 (0.12)	0.23 (0.17)
ADE Associated with Hypoglycemic Agent	11.55	10.17	10.11	8.51	8.26	11.60	10.33	10.85	9.12	9.51	-0.05 (1.08)	-0.16 (0.79)	-0.74 (0.81)	-0.61 (0.94)	-1.26 (1.10)
ADE Associated with IV Heparin	13.59	11.77	11.49	11.31	9.86	15.59	11.65	9.95	11.44	9.22	-2.00 (3.01)	0.12 (1.82)	1.54 (1.85)	-0.13 (1.99)	0.64 (2.45)
ADE Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	5.79	4.76	4.71	4.47	3.29	5.11	4.99	4.61	4.79	3.39	0.68 (0.70)	-0.23 (0.52)	0.10 (0.52)	-0.32 (0.60)	-0.10 (0.59)
ADE Associated with Warfarin	4.16	5.55	6.16	5.51	4.91	5.43	5.48	5.75	4.58	5.32	-1.27 (1.10)	0.07 (0.91)	0.41 (1.05)	0.93 (0.97)	-0.41 (1.34)
Any ADE[a]	7.39	7.43	7.49	6.63	6.31	6.87	6.95	6.74	6.14	6.02	0.53 (0.51)	0.49 (0.43)	0.75 (0.45)	0.49 (0.48)	0.29 (0.63)

Table E-53–Trends in the Unadjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
General Adverse Event Measures															
HAPU	5.32	4.86	4.98	4.95	3.94	4.80	4.61	4.18	4.41	3.57	0.52 (0.41)	0.25 (0.33)	0.81 (0.34)*	0.54 (0.39)	0.37 (0.48)
In-Hospital Patient Falls	1.46	0.94	0.93	0.90	0.89	1.35	1.03	0.87	0.57	0.66	0.10 (0.22)	-0.09 (0.15)	0.06 (0.14)	0.33 (0.13)*	0.23 (0.17)
Any General Adverse Event[a]	6.54	5.67	5.79	5.75	4.76	6.12	5.53	4.95	4.87	4.23	0.42 (0.47)	0.13 (0.36)	0.83 (0.36)*	0.88 (0.41)*	0.52 (0.50)
Post Procedural Adverse Event Measures															
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic	2.89	2.19	2.06	2.65	1.72	2.50	1.85	1.09	1.32	2.19	0.39 (1.01)	0.34 (0.62)	0.97 (0.49)*	1.32 (0.66)*	-0.47 (0.98)
Adverse Events Associated with Hip Joint Replacements	6.77	7.35	8.18	6.97	5.59	7.58	9.00	6.25	4.41	3.30	-0.81 (2.11)	-1.65 (1.83)	1.93 (1.64)	2.56 (1.41)	2.29 (1.61)
Adverse Events Associated with Knee Joint Replacements	3.09	5.49	5.24	3.77	2.51	3.92	3.66	3.20	3.47	1.78	-0.84 (1.13)	1.83 (1.03)	2.05 (0.87)*	0.29 (0.99)	0.73 (0.99)
Contrast Nephropathy Associated with Catheter Angiography	12.22	11.54	11.92	11.59	11.44	9.63	14.56	14.13	11.06	11.71	2.59 (1.95)	-3.02 (1.48)*	-2.21 (1.75)	0.54 (1.82)	-0.26 (1.99)
Mechanical Complications Associated with Central Venous Catheters	4.10	3.17	3.82	3.78	3.44	3.28	3.42	4.34	2.04	2.20	0.82 (1.07)	-0.26 (0.69)	-0.52 (0.81)	1.74 (0.69)*	1.23 (0.85)
Postoperative Cardiac/Non-cardiac Arrest Events	0.92	1.08	1.10	1.22	0.87	0.80	0.66	0.60	0.66	0.67	0.12 (0.29)	0.41 (0.22)	0.51 (0.23)*	0.56 (0.25)*	0.20 (0.31)
Postoperative VTE Event	0.52	0.79	0.53	0.66	0.71	0.48	0.44	0.30	0.66	0.22	0.03 (0.22)	0.35 (0.18)	0.23 (0.14)	0.00 (0.22)	0.49 (0.22)*
Any Post Procedural Adverse Event [a]	6.35	6.92	6.90	6.38	6.31	5.13	6.58	5.39	4.54	4.67	1.22 (0.64)	0.34 (0.60)	1.51 (0.55)**	1.84 (0.57)**	1.64 (0.76)*

Table E-53–Trends in the Unadjusted Adverse Event Rates, by HEN-Alignment															
Measure	HEN-Aligned Hospitals					Non-Aligned Hospitals					Difference				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
HAI Measures															
Blood Stream Infection Associated with Central Venous Catheter	1.30	1.09	1.17	1.11	0.40	1.93	1.29	2.13	2.21	0.54	-0.63 (1.01)	-0.20 (0.70)	-0.96 (0.92)	-1.11 (0.90)	-0.14 (0.58)
CAUTI	3.08	3.65	3.13	2.91	3.00	3.20	3.36	3.22	2.88	3.15	-0.13 (0.50)	0.29 (0.43)	-0.09 (0.40)	0.03 (0.40)	-0.15 (0.64)
Hospital Acquired Vancomycin Resistant Enterococcus	0.03	0.04	0.02	0.02	0.05	0.03	0.11	0.06	0.02	0.04	0.00 (0.03)	-0.06 (0.05)	-0.05 (0.04)	-0.00 (0.02)	0.02 (0.04)
Postoperative Pneumonia	1.93	2.32	2.28	2.24	1.75	1.39	2.60	1.43	1.34	1.46	0.54 (0.39)	-0.28 (0.40)	0.85 (0.32)**	0.89 (0.35)*	0.30 (0.48)
VAP	7.14	11.85	11.94	10.36	10.88	7.14	11.02	13.73	9.09	12.00	-0.00 (4.30)	0.83 (3.04)	-1.79 (3.93)	1.27 (3.54)	-1.12 (4.79)
Any HAI[a]	2.27	2.45	2.19	2.23	1.86	2.03	2.63	2.36	2.09	2.07	0.24 (0.28)	-0.18 (0.24)	-0.18 (0.24)	0.14 (0.24)	-0.21 (0.35)

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.

Notes: Adverse event rates were regression-adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.

[a] Binary composite measure for having one or more adverse events. Composite measures include cases at risk for one or more of the contributing measures.

[b] Continuous composite measure with number of adverse events per 1,000 patients.

Table E-54—Difference-in-Differences Robustness Checks						
Measure	Controlling for Hospital Fixed Effects		Controlling for Hospital Random Effects		Model Excluded 2012 Discharges[a]	
	Adjusted Difference-in-Differences	N[b]	Adjusted Difference-in-Differences	N	Adjusted Difference-in-Differences	N[b]
Any Adverse Event[c]	0.22 (0.60)	80,332	6.70 (5.35)	125,004	0.07 (0.81)	98,895
Number of Adverse Events[d] (per 1,000 discharges)	-1.45 (9.97)	80,332	4.75 (10.21)	125,004	-15.56 (13.18)	98,895
Any ADE[c]	-0.24 (0.47)	75,291	-0.85 (7.36)	117,234	-0.39 (0.61)	92,635
Any General Adverse Event[c]	0.12 (0.45)	80,332	7.99 (7.88)	125,004	-0.18 (0.57)	98,895
Any Post-Procedural Adverse Event[c]	0.71 (0.62)	38,348	19.55 (11.11)	58,663	0.93 (0.81)	46,072
Any HAI[c]	-0.08 (0.28)	80,290	3.82 (11.12)	124,933	-0.16 (0.38)	98,838

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.
Notes: "Adjusted" difference-in-differences analyses were regression-adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.
$^{*}p < 0.05$, $^{**}p < 0.01$
[a] To address the concern that the PfP campaign had barely started in 2012, and that including 2012 in the post-period would "dilute" impacts, the evaluation contractor performed an additional check in which hospital discharges occurring in 2012 were dropped from the sample. The main model from Table E-51 was then re-run with discharges in 2009 through 2011 (the pre-PfP period) and 2013 alone (the post-PfP period).
[b] The models with hospital-fixed effects were limited to hospitals that were included in the MPSMS data in both the baseline and intervention periods.
[c] Binary composite measure for having one or more adverse events. Composite measures include cases at risk for one or more of the contributing measures.
[d] Continuous composite measure with number of adverse events per 1,000 patients.

Table E-55—Difference-in-Differences Impact Analyses, by Subgroup					
Subgroup	Any Adverse Event	Any Adverse Drug Event	Any General Adverse Event	Any Post-Procedural Adverse Event	Any HAI
All Patients/Subgroups					
All Patients/Subgroups	0.44 (0.53)	-0.20 (0.42)	0.04 (0.43)	0.99 (0.56)	0.02 (0.25)
Subgroups of Patients					
Patient's Payer					
Non-Medicare	-1.11 (0.88)	-1.65 (0.74)*	-0.91 (0.80)	0.40 (0.79)	0.09 (0.38)
Medicare	1.14 (0.65)	0.49 (0.50)	0.36 (0.48)	1.43 (0.77)	-0.04 (0.31)
Patient's Condition					
Acute myocardial infarction (AMI)	0.14 (1.35)	-1.18 (0.96)	0.98 (0.89)	0.71 (1.13)	-1.07 (0.87)

Table E-55—Difference-in-Differences Impact Analyses, by Subgroup					
Subgroup	**Any Adverse Event**	**Any Adverse Drug Event**	**Any General Adverse Event**	**Any Post-Procedural Adverse Event**	**Any HAI**
Heart Failure (HF)	1.26 (1.44)	0.02 (0.98)	0.02 (0.91)	1.28 (3.00)	0.48 (1.06)
Pneumonia (PN)	0.09 (0.88)	-0.14 (0.75)	-0.38 (0.66)	0.63 (1.69)	-0.19 (0.53)
Surgical Care Improvement Project (SCIP)	0.61 (0.80)	0.21 (0.72)	0.35 (0.84)	1.00 (0.73)	0.19 (0.26)
Subgroups of Hospitals					
Hospital Ownership Type					
Private	-0.47 (0.88)	-1.34 (0.71)	0.67 (0.69)	0.87 (0.88)	-0.09 (0.41)
Non-profit	0.63 (0.91)	0.30 (0.66)	-0.07 (0.73)	0.61 (0.97)	-0.09 (0.37)
Government	2.22 (1.36)	0.94 (1.13)	0.09 (1.14)	-0.21 (1.66)	1.18 (0.63)
Hospital Size					
>400 beds (non-critical access hospital [CAH])	-2.01 (1.42)	0.57 (1.22)	-2.20 (1.62)	-2.19 (1.85)	-0.94 (0.89)
200-399 beds (non-CAH)	-0.11 (1.13)	-1.67 (0.85)	-0.85 (0.95)	1.50 (1.15)	-0.11 (0.57)
100-199 beds (non-CAH)	0.35 (0.99)	0.66 (0.77)	-0.32 (0.87)	1.70 (0.97)	0.28 (0.49)
<100 beds (non-CAH) or CAH	1.34 (0.84)	-0.03 (0.66)	0.99 (0.54)	-0.10 (1.14)	0.26 (0.39)
Teaching Hospital					
Non-teaching hospital	0.40 (0.62)	-0.27 (0.48)	0.17 (0.48)	1.42 (0.67)*	-0.02 (0.29)
Teaching Hospital	0.41 (0.99)	0.07 (0.86)	-0.28 (0.86)	-0.02 (1.14)	0.23 (0.54)
Region					
Northeast	2.75 (1.58)	2.26 (1.29)	0.62 (1.33)	3.21 (1.51)*	0.57 (0.93)
Midwest	-0.34 (1.25)	-0.46 (0.96)	0.00 (0.90)	-1.60 (1.36)	0.38 (0.52)
South	-0.17 (0.71)	-1.06 (0.58)	-0.11 (0.58)	1.60 (0.67)*	-0.42 (0.33)
West	0.19 (1.39)	0.99 (0.99)	-1.16 (1.18)	-0.54 (1.64)	0.73 (0.58)
Rural or Urban					
Urban	0.30 (0.63)	-0.21 (0.48)	-0.44 (0.53)	0.87 (0.60)	0.10 (0.29)

Table E-55—Difference-in-Differences Impact Analyses, by Subgroup					
Subgroup	**Any Adverse Event**	**Any Adverse Drug Event**	**Any General Adverse Event**	**Any Post-Procedural Adverse Event**	**Any HAI**
Rural	0.85 (1.01)	-0.18 (0.85)	1.17 (0.68)	1.55 (1.40)	-0.43 (0.53)
Medicaid Patients (as a percentage of all patients at baseline)					
Over 25%	1.49 (1.21)	-0.24 (1.06)	0.70 (0.99)	2.12 (1.28)	0.19 (0.43)
Below 25%	0.20 (0.59)	-0.22 (0.46)	-0.05 (0.47)	0.73 (0.62)	0.00 (0.29)
HEN Categories					
HEN Type					
Complex HEN	0.71 (0.63)	-0.47 (0.49)	0.29 (0.50)	1.12 (0.66)	0.09 (0.30)
Hospital Association HEN	0.68 (0.63)	0.31 (0.51)	0.05 (0.49)	1.13 (0.65)	-0.17 (0.29)
System HEN	-1.09 (1.00)	-1.09 (0.63)	0.44 (0.79)	-1.02 (1.03)	-0.02 (0.41)
Other HEN	0.48 (0.67)	-0.15 (0.51)	-0.08 (0.53)	1.13 (0.67)	0.18 (0.30)
HEN size					
<50 hospitals	0.75 (1.14)	-0.07 (0.72)	1.85 (0.90)*	1.31 (1.13)	-0.25 (0.43)
50-99 hospitals	0.40 (0.71)	-0.29 (0.55)	0.05 (0.53)	0.96 (0.68)	-0.16 (0.30)
100-400 hospitals	0.43 (0.61)	0.16 (0.48)	-0.21 (0.49)	0.92 (0.64)	0.13 (0.29)
>1,000 hospitals	0.72 (0.63)	-0.46 (0.49)	0.29 (0.50)	1.14 (0.66)	0.10 (0.30)

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data.
Notes: Difference-in-differences analyses were regression-adjusted adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.
$^{*}p < 0.05$, $^{**}p < 0.01$
These analyses included all at-risk patients in MPSMS sample.
The five outcome variables are all binary composite measures for having one or more adverse events. Composite measures include cases at-risk for one or more of the contributing measures.

Table E-56—Details on Subgroup Impact Estimates in Table E-55 that are Statistically Significant at the 5 Percent Level								
Measure	**Subgroup**	**Non-Aligned Hospitals**			**HEN-Aligned Hospitals**			**Difference-in-Differences**
		Pre 2009-2012	**Post 2012-2013**	**Difference**	**Pre 2009-2012**	**Post 2012-2013**	**Difference**	
Any Adverse Drug Event	Patients not covered by Medicare	5.68	6.98	1.30	6.52	6.18	-0.34	-1.65 (0.74)*
Any Post-Procedure Event	Non-teaching hospitals	7.50	5.44	-2.06	7.15	6.50	-0.65	1.42 (0.67)*
	Hospitals in the northeast region	7.66	3.52	-4.14	8.07	7.14	-0.93	3.21 (1.51)*
	Hospitals in the south region	5.30	4.92	-0.38	4.66	5.89	1.22	1.60 (0.67)*
Any General Adverse Event	HENs with <50 hospitals	7.78	5.27	-2.51	7.19	6.53	-0.66	1.85 (0.90)*

Source: The Evaluation Contractor's analysis of MPSMS 2009-2013 data and Table E-55 above.

Notes: The five statistically significant results from Table E-55were selected for inclusion in Table E-56. For those results, this table presents additional information—means and first differences for the Non-aligned hospitals and HEN-aligned hospitals—to provide context for the magnitude of the impact estimates within each subgroup.

Difference-in-differences analyses were regression-adjusted adjusted using the characteristics as described in Appendix D. Robust standard errors, clustered at the hospital level, are in parenthesis.

$^{*}p < 0.05$, $^{**}p < 0.01$

These analyses included all at-risk patients in MPSMS sample.

The outcome variables are all binary composite measures for having one or more adverse events. Composite measures include cases at risk for one or more of the contributing measures.

Vital Records (Chapter 4)

This section presents results for additional analyses of the six key birth outcomes. Table E-57 presents subgroup regression analyses for rural and urban counties. It is followed by supplemental graphical presentations of the difference-in-differences estimates of Hospital Engagement Network (HEN) alignment on the six key outcomes presented in Chapter 4. Also presented are results of a correlation analysis of vital records data for obstetrical early-elective delivery (OB-EED) and other obstetrical adverse event (OB-Other) outcomes.

Table E-57—Subgroup Analyses: Regression-Adjusted (with County Fixed Effects) Estimated Impacts of HEN-Alignment on Six Key Outcomes for Rural and Urban Counties, 2009-2013

Subgroup	Difference-in-Differences Estimate (SE)					
	Early Induction or Cesarean Section (C-Section)	Non-Medically Indicated Early Term Singleton Birth (OB-EED)	APGAR Score 0-6	Assisted Ventilation Required Immediately Following Delivery	Admission to Neonatal Intensive Care Unit (NICU)	Low Birth Weight at 37+ Weeks (<2.500g)
Urban Counties	0.64 (0.40)	1.12 (0.40)**	- 0.05 (0.11)	- 0.03 (0.57)	0.16 (0.24)	0.03 (0.06)
Mixed: Urban/Rural Counties	- 0.49 (0.76)	0.69 (1.43)	- 0.36 (0.15)**	- 0.15 (0.16)	- 0.07 (0.33)	- 0.08 (0.14)
Rural Counties	- 0.28 (0.37)	- 0.28 (0.38)	- 0.06 (0.09)	- 0.13 (0.45)	0.20 (0.16)	- 0.00 (0.07)

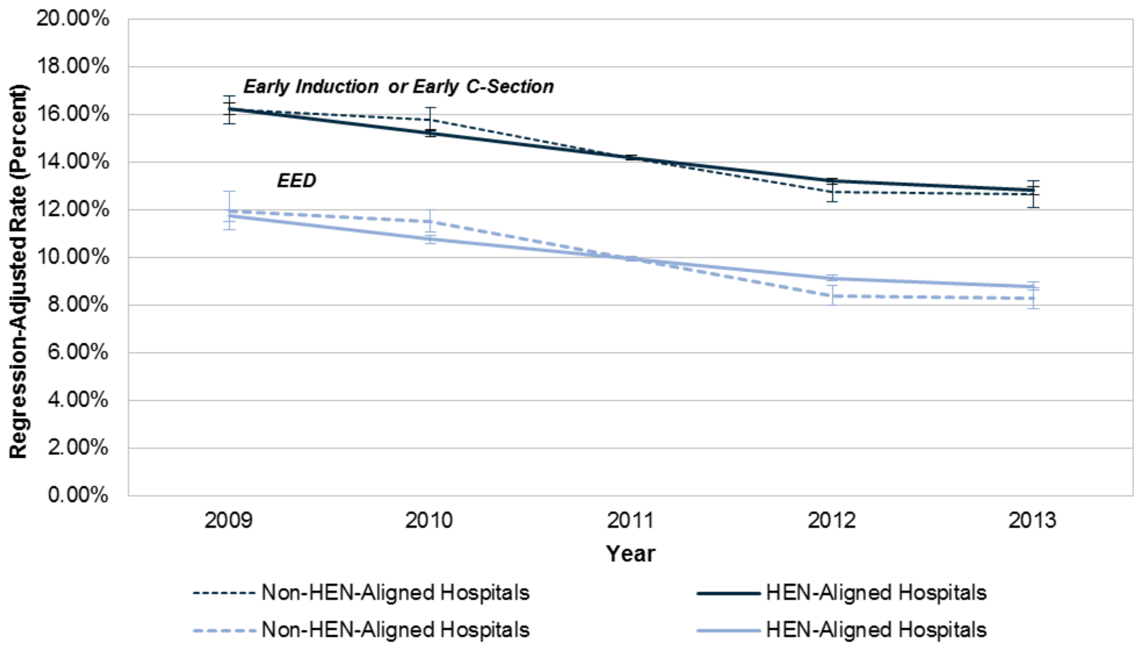
Source: Evaluation Contractor's analysis of 2010 AHA survey and 2009–2013 NVSS Vital Records.
Note: Robust standard errors, clustered by county, are in parentheses.
** $p < 0.01$.

Supplemental Graphical Representations of Results

This section displays a selected set of visual representations of the results either listed in the tables or related to them, as presented in Chapter 4. Figure E-6 through Figure E-8 show the regression-adjusted (using county fixed effects) rate trends for the six key outcomes by HEN alignment, 2009–2013.

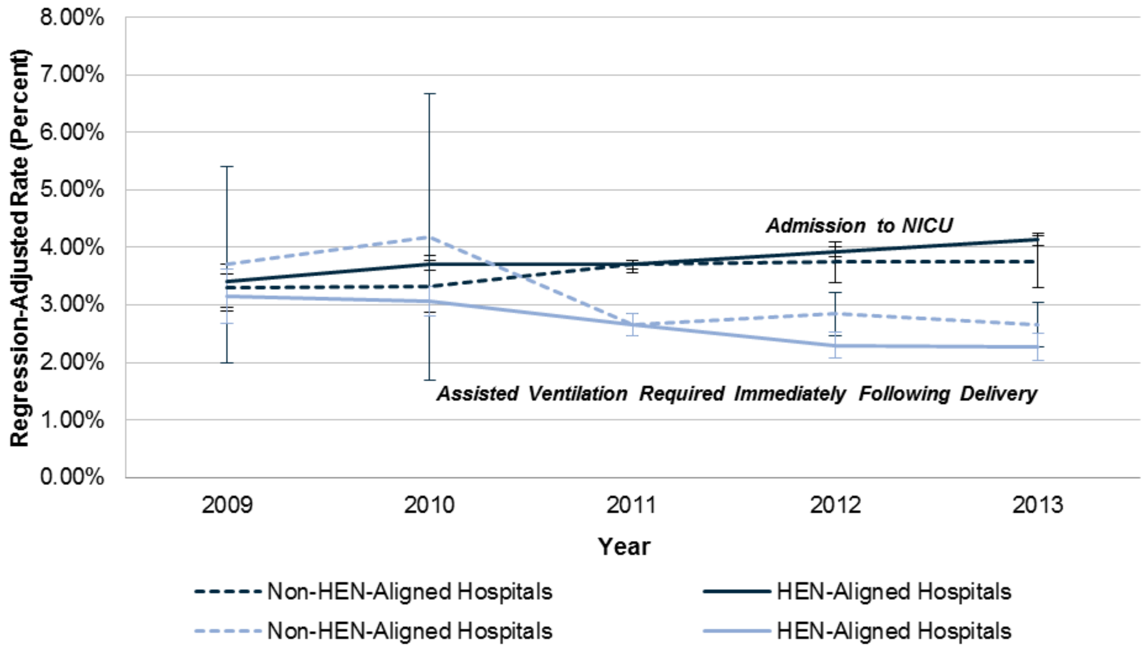
Regression-Adjusted Trends for HEN-Aligned and Non-HEN-Aligned Counties, 2009–2013

Figure E-6—Regression-Adjusted Rate Trends for Early Induction or C-Section and OB-EEDs by Treatment Group, 2009-2013



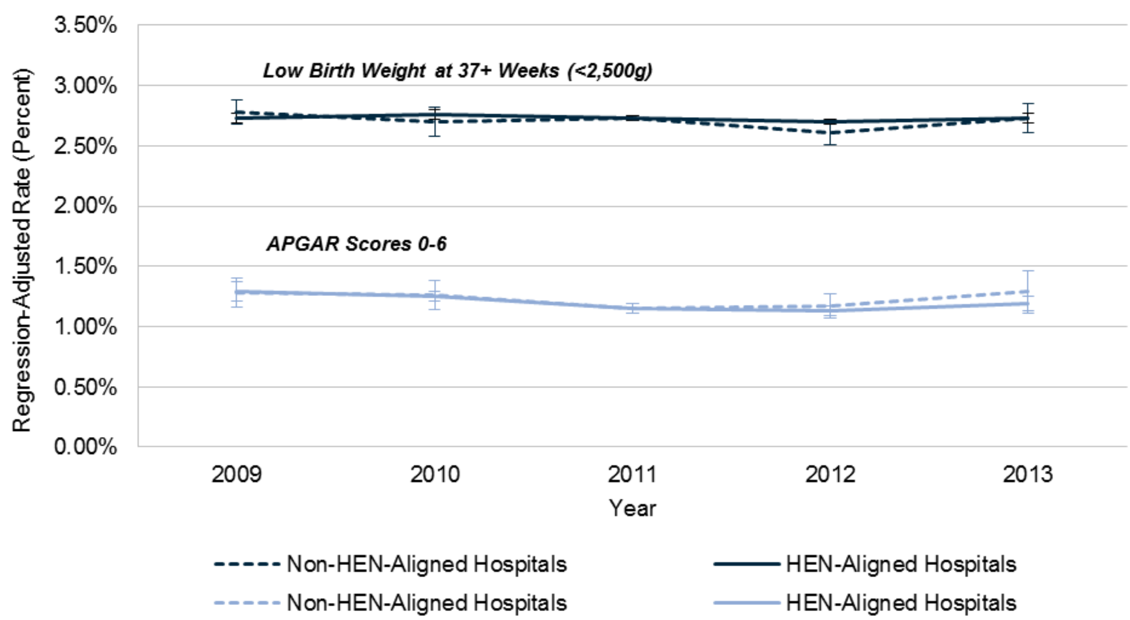
Source: Evaluation Contractor's calculations from Vital Records data.

Figure E-7—Regression-Adjusted Rate Trends for Assisted Ventilation Required Immediately Following Delivery and Admission to NICU, 2009-2013



Source: Evaluation Contractor's calculations from Vital Records data.

Figure E-8—Regression-Adjusted Rate Trends for APGAR Scores 0-6 and Low Birth Weight at 37+ Weeks (<2,500g)



Source: Evaluation Contractor's calculations from Vital Records data.

Correlation Analysis of Key Birth Outcomes

The underlying assumption behind the "hard stop" policy implementation is that adverse birth outcomes such as poor APGAR scores, NICU admissions, assisted ventilation, and low birth weight would improve if there is a decrease in the OB-EED (and early induction or C-section) rates. Accordingly, the Evaluation Contractor investigated this assumption. Table E-58 shows the county-level correlation matrix for the six key birth outcomes in year 2013. Results from this exercise show a very low level of association between the variables.

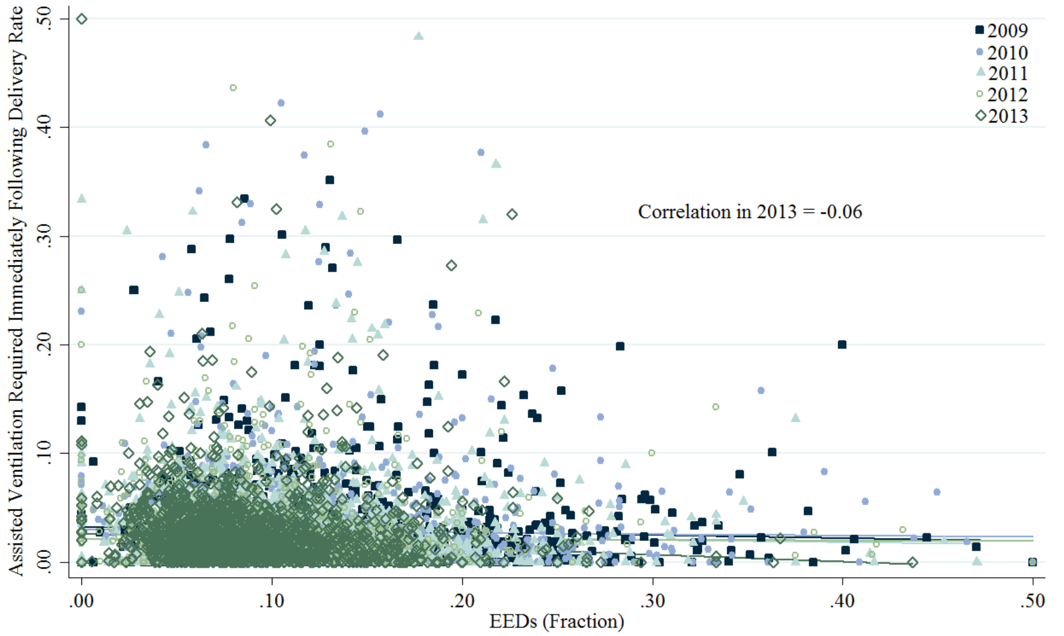
Table E-58—Six Key Birth Outcomes County-Level Correlation Matrix, 2013

	Early Induction or Early C-Section	OB-EED	APGAR Scores 0-6	Assisted Ventilation	Admission to NICU	Low Birth Weight
Early Induction or Early C-Section	1.00					
OB-EED	0.90*	1.00				
APGAR Scores 0-6	0.04*	0.02*	1.00			
Assisted Ventilation	0.01*	- 0.06*	0.13*	1.00		
Admission to NICU	- 0.06*	- 0.13*	0.01*	0.14*	1.00	
Low Birth Weight	0.36*a	0.29*	0.15*	0.00*	0.05*	1.00

Source: Evaluation Contractor's calculations of Vital Records data.
Note: Weighted 2013 correlations.
* $p < 0.05$
[a] Given that the hard stop policy directly intervenes on the time of gestation, there is an expected, moderate correlation between OB-EEDs and low birth weight (which is known to be moderately correlated with gestational age).
The shaded cells are for better readability of the table. If completed, the cells would duplicate other populated cells. For example, the correlation between APGAR score 0–6 and OB-EED is shown in the cell with the row "APGAR score 0–6" and the column "OB-EED" and would be duplicative if also shown in the cell with the row "OB-EED" and the column "APGAR score 0–6."

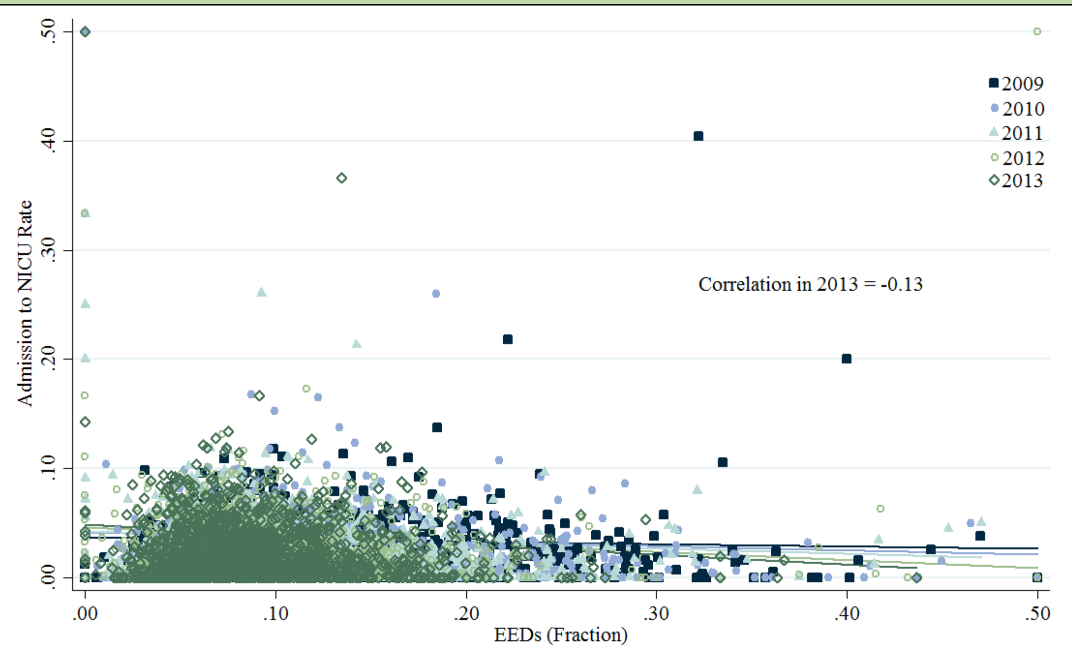
Figure E-9 and Figure E-10 present annual county-level scatterplots (with annual linear fits) of early ventilation and NICU admissions with OB-EEDs, respectively. The figures show there is a very low level of association between the variables (Table E-58). The annual county-level rates show high dispersion in the data frame and the slopes of the annual associations is close to zero in all instances. Table E-58 shows the correlations for year 2013, and Figure E-9 and Figure E-10 show that the low level of association is not unique to 2013.

Figure E-9—Annual County-Level Correlations and Linear Fit For Assisted Ventilation Required Immediately Following Delivery Rate and OB-EEDs, 2009-2013



Source: Evaluation Contractor's calculations from Vital Records data.
Note: Each dot is a county-year observation. When calculating annual correlation and linear regression line, counties were weighted by the total number of births in the county.

Figure E-10—Annual County-Level Correlations and Linear Fit For Admissions to NICU Rates and OB-EEDs, 2009-2013



Source: Evaluation Contractor's calculations from Vital Records data.
Note: Each dot is a county-year observation. When calculating annual correlation and linear regression line, counties were weighted by thee-51
total number of births in the county.

Repeated Measures Analysis of the Association between HEN Activities and Partnerships and Common Measure Outcomes (Chapter 4)

The mixed model analysis of common measures presented in Chapter 4 was developed to assess the extent to which Hospital Engagement Network (HEN) activities and partnerships are associated with rates of patient harms over time. Specifically, the analysis sought to determine if there was a campaign-level association, for which the models estimated an average association between a 1 unit increase in the number of activities or partnerships of each type and the subsequent change in the outcome. The models were estimated for each of the 50 combinations of common measures and data sources available.

Common measures are defined as outcome measures of patient harms that were reported by multiple HENs with the same or highly consistent specifications, such that the resulting rates may be considered comparable. Common measures were available for all 11 adverse event areas, ranging from 1 common measure reported for ventilator-associated pneumonia (VAP) to 7 common measures reported for adverse drug events (ADE) and catheter-associated urinary tract infections (CAUTI) each. The number of HEN-cohorts for which data was available also varied across common measures, from 1 HEN for ADE: Number of Patients with Blood Glucose (BG) Levels < 40 mg/dl, to 26 HENs for the National Healthcare Safety Network (NHSN) CAUTI device utilization ratio, NHSN central line-associated blood stream infections (CLABSI) standardized infection ratio (SIR), obstetrical early elective deliveries (OB-EED) perinatal care (PC)-01, and NHSN surgical site infections (SSI)-colon surgery SIR.[E-15,E-16]

Table E-59 provides the results for each of the 50 models estimated across the common measures and different data sources. To ease interpretation, only the statistically significant coefficients ($p < 0.05$) were included in the table. Additionally, some coefficients could not be estimated due to a lack of unique variation among the covariates. When this occurred, the corresponding cell in the table has been shaded grey.

E-15 The data for the one HEN ADE: Number of Patients with Blood Glucose (BG) Levels < 40 mg/dl was not sufficient to estimate the model due to a lack of variation in the outcome.

E-16 Five HENs reported data for multiple cohorts AHA/HRET, Ascension, JCR, Michigan, and Ohio Children's. Therefore the number of common measures included in the analysis may be greater than 30. The number of HEN-cohort measures included in each model is provided in the HEN-Cohorts Included in Model column of Table E-59.

Table E-59—Detailed Results from Repeated Measure Mixed Model Analysis of HEN-Level Common Measures

Common Name	Data Source	HEN Cohorts Submitting Data	HEN Cohorts Included in This Model	Intercept	Quarterly Change	Hospitals Submitting Data	Initiatives				Partners							
							Tools	Education	Coaching	Leadership	Federal	National Private	State and Local Health Org	State and Local Private Org	SHA	Subject Matter Experts	Other HEN	Other
ADE																		
C. difficile per 10,000 patient days	HEN	9	9	6.993														
Number of Patients with BG Levels <40mg/dL	HEN	1	0															
Number of Patients with BG Levels <50mg/dL	HEN	5	5	6.278														
Number of Readings with BG Levels <40mg/dL	HEN	5	5	0.125			0.055	0.014					0.205	0.236		1.051	-0.909	
Number of Readings with BG Levels <50mg/dL	HEN	5	5	0.677					0.246		-1.056							
Patients with international normalized ratio (INR) > 5 among patients on warfarin	HEN	6	6	3.129										4.580				
Readings with INR > 5 among patients on warfarin	HEN	7	7	1.287							-1.317					-0.753		

Table E-59—Detailed Results from Repeated Measure Mixed Model Analysis of HEN-Level Common Measures																		
							Initiatives				Partners							
Common Name	Data Source	HEN Cohorts Submitting Data	HEN Cohorts Included in This Model	Intercept	Quarterly Change	Hospitals Submitting Data	Tools	Education	Coaching	Leadership	Federal	National Private	State and Local Health Org	State and Local Private Org	SHA	Subject Matter Experts	Other HEN	Other
CAUTI																		
CAUTI device utilization ratio	HEN	27	24	0.358														
	NHSN	26	26	0.617														
CAUTI per 1,000 catheter days: Hospital-Wide	HEN	4	4	1.171														
CAUTI per 1,000 catheter days: intensive care unit (ICU)	HEN	21	21	2.357		-0.002							0.407	-0.293				
CAUTI per 1,000 catheter days: ICU-plus	HEN	18	16	1.544			0.211											
	NDNQI	16	16	1.679				0.059					0.339					
CAUTI per 1,000 catheter days: Non-ICU	HEN	5	5	2.338														
CAUTI per 1,000 patient days	HEN	7	4															
CAUTI SIR	HEN	10	8	1.399		0.002									-0.685	-0.336		
CLABSI																		
CLABSI device utilization ratio	HEN	20	18	0.334			-0.026											0.162
	NHSN	26	26	0.439			-0.006											
CLABSI per 1,000 central line days: Hospital-Wide	HEN	4	4	1.125		-0.008												

Table E-59—Detailed Results from Repeated Measure Mixed Model Analysis of HEN-Level Common Measures

Common Name	Data Source	HEN Cohorts Submitting Data	HEN Cohorts Included in This Model	Intercept	Quarterly Change	Hospitals Submitting Data	Initiatives				Partners							
							Tools	Education	Coaching	Leadership	Federal	National Private	State and Local Health Org	State and Local Private Org	SHA	Subject Matter Experts	Other HEN	Other
CLABSI per 1,000 central line days: ICU	HEN	22	20	1.025														
CLABSI per 1,000 central line days: ICU-plus	HEN	16	14	0.903				0.110	-0.281	-0.130								
	NDNQI	16	16	0.860			0.082		-0.106	-0.074								
CLABSI per 1,000 central line days: Non-ICU	HEN	4	4	1.581		0.022							1.209	-0.873			1.647	
CLABSI SIR	HEN	9	7	0.472		-0.004												
	NHSN	26	26	0.519	-0.010													
Falls																		
Falls per 1,000 patient days (National Database of Nursing Quality Indicators® [NDNQI®] defn)[E-17]	HEN	21	18	2.938														
	NDNQI	19	19	3.393	-0.032		0.046											0.079
Falls with injury per 1,000 patient days (NDNQI defn)	HEN	22	20	0.651				-0.051	0.144		-0.780							
	NDNQI	19	19	0.805														0.042
OB-EED																		
PC-01	HEN	26	26	4.881					0.763		-6.856							

[E-17] NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

Table E-59—Detailed Results from Repeated Measure Mixed Model Analysis of HEN-Level Common Measures

Common Name	Data Source	HEN Cohorts Submitting Data	HEN Cohorts Included in This Model	Intercept	Quarterly Change	Hospitals Submitting Data	Initiatives				Partners							
							Tools	Education	Coaching	Leadership	Federal	National Private	State and Local Health Org	State and Local Private Org	SHA	Subject Matter Experts	Other HEN	Other
Other Obstetrical Adverse Events (OB-Other)																		
PSI-17	HEN	23	23	1.803												-0.814		
PSI-18	HEN	22	22	154.559		-0.089												
PSI-19	HEN	21	21	22.990														
Pressure Ulcers																		
All-Stage hospital-acquired pressure ulcers (HAPU) per 100 assessed patients (NDNQI)	HEN	2	2															
	NDNQI	18	18	2.823	-0.074		-0.108		-0.117					0.153	-0.767			0.188
PSI-03 (all-payer)	HEN	19	17	0.757			-0.105	0.061			0.761				-0.461	0.247		
PSI-03 (Medicare)	Medicare	25	25	0.519					0.071		0.322							
Stage 2+ HAPU per 100 assessed patients (NDNQI)	HEN	7	7	0.668														
	NDNQI	18	18	2.116	-0.053				-0.092		0.478			0.099	-0.567			0.115
Readmissions																		
30-day all-cause all-payer readm	HEN	26	24	10.417								1.321	-1.385					
30-day all-cause Medicare readm	CMS	25	25	0.185														
	HEN	3	3	0.162														-0.009
SSI																		
SSI-abdominal hysterectomy SIR	HEN	6	6	0.989														
	NHSN	25	25	0.904			0.067					0.158						

Table E-59—Detailed Results from Repeated Measure Mixed Model Analysis of HEN-Level Common Measures

Common Name	Data Source	HEN Cohorts Submitting Data	HEN Cohorts Included in This Model	Intercept	Quarterly Change	Hospitals Submitting Data	Initiatives				Partners							
							Tools	Education	Coaching	Leadership	Federal	National Private	State and Local Health Org	State and Local Private Org	SHA	Subject Matter Experts	Other HEN	Other
SSI-colon surgery SIR	HEN	7	7	0.860					-0.229									
	NHSN	26	26	0.817	0.035							-0.095	-0.099					
VAP																		
VAP per 1,000 ventilator days	HEN	17	14	1.691														
	NDNQI	11	11	1.103			0.134											0.653
Venous Thromboembolism (VTE)																		
PSI-12 (all-payer)	HEN	25	25	5.385														
PSI-12 (Medicare)	Medicare	25	25	5.713							2.105						0.533	

Source: Evaluation Contractor analysis of HEN-level data.

Note: Only statistically significant coefficients (*p* < 0.05) are shown in the table. Grey cells represent coefficients that could not be estimated due to a lack of variation in the measure, or collinerity with other measures.

Hospital Engagement Network (HEN)-Level Statistical Process Control (SPC) Chart (Chapter 5)

Table E-60 presents the 37 common measures used in the development of SPC charts using HEN-submitted data. The table identifies the HENs that reported in each common measure category, as well as if the measure improved, worsened, or showed no change.

Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
Adverse Drug Events (ADE)		
***Clostridium difficile* (*C. difficile*) per 10,000 Patient Days**		
• Minnesota • Ohio	• AHA/HRET • Georgia • Iowa • LifePoint • Premier • VHA	• UHC
Number of Readings with Blood Glucose (BG) Levels < 40 milligrams per deciliter (mg/dL)		
• Dignity • Michigan (Cohort 1)	• Ascension (Cohort 1) • Ascension (Cohort 2) • Georgia (Cohort 2) • JCR (Cohort 1) • LifePoint	
Number of Patients with BG Levels < 50 mg/dL		
	• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • New York • NoCVA	• AHA/HRET (Cohort 4)
Number of Readings with BG Levels < 50 mg/dL		
• Georgia (Cohort 1) • VHA	• Ascension (Cohort 1) • Ascension (Cohort 2) • EHEN • Iowa • Ohio	
Patients with International Normalized Ratio (INR) > 5 Among Patients on Warfarin		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3)	• AHA/HRET (Cohort 4) • Dignity • New York • NoCVA	
Readings with INR > 5 Among Patients on Warfarin		
• Georgia (Cohort 1) • LifePoint • Michigan (Cohort 1)	• Ascension (Cohort 1) • EHEN • Iowa • VHA	

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Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
Catheter-Associated Urinary Tract Infections (CAUTI)		
CAUTI Device Utilization Ratio		
• AHA/HRET • Ascension (Cohort 1) • Ascension (Cohort 2) • Carolinas • Dignity • EHEN • Georgia • Iowa • JCR (Cohort 1) • Michigan (Cohort 1) • Michigan (Cohort 2) • Minnesota • Nevada • Nevada (Cohort 1) • New York • Pennsylvania • Tennessee • VHA	• NoCVA • Ohio • Ohio Children's (Cohort 2) • Washington	• Nevada (Cohort 2) • Ohio Children's (Cohort 1)
CAUTI Rate per 1,000 Catheter Days (Intensive Care Unit [ICU])		
	• AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Ascension (Cohort 2) • Intermountain • JCR (Cohort 1) • Michigan (Cohort 1) • Minnesota • New Jersey • Ohio • Tennessee • Washington	• AHA/HRET (Cohort 1) • Ascension (Cohort 1) • Georgia • Michigan (Cohort 2) • Nevada (Cohort 2) • New York • Pennsylvania • Premier • UHC
CAUTI Rate per 1,000 Catheter Days (ICU-Plus)		
• AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Ohio Children's (Cohort 1)	• AHA/HRET (Cohort 1) • Ascension (Cohort 1) • Carolinas • EHEN • Iowa • JCR (Cohort 1) • LifePoint • Ohio Children's (Cohort 2) • VHA	• Intermountain • Nevada • New York • NoCVA
CAUTI Rate per 1,000 Catheter Days (Non-ICU)		
	• Ascension (Cohort 1) • Ascension (Cohort 2) • Georgia • Michigan (Cohort 1) • Pennsylvania • Tennessee	• New York

Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
CAUTI Rate per 1,000 Catheter Days Hospital-Wide		
• Dignity	• Michigan (Cohort 1) • Michigan (Cohort 2) • Pennsylvania	
CAUTI Standardized Infection Ratio (SIR)		
	• Ascension (Cohort 1) • Ascension (Cohort 2) • Minnesota • Ohio	• EHEN • Georgia • New York • NoCVA
Central Line-Associated Blood Stream Infection (CLABSI)		
CLABSI Device Utilization Ratio		
• AHA/HRET • Ascension (Cohort 1) • Ascension (Cohort 2) • Carolinas • Georgia • Minnesota • New York • Pennsylvania • Tennessee	• EHEN • Georgia • LifePoint • New Jersey • NoCVA • Premier • Washington	• Dignity • Ohio Children's (Cohort 1) • Ohio Children's (Cohort 2)
CLABSI Rate per 1,000 Central Line Days (ICU)		
• AHA/HRET (Cohort 1) • New York • UHC	• AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Ascension (Cohort 1) • Ascension (Cohort 2) • Georgia • Intermountain • JCR (Cohort 1) • Minnesota • Nevada • New Jersey • Ohio • Pennsylvania • Premier • Tennessee • VHA • Washington	
CLABSI Rate per 1,000 Central Line Days (ICU-Plus)		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • Dignity • JCR (Cohort 1) • New York	• AHA/HRET (Cohort 3) • Carolinas • EHEN • LifePoint • Michigan (Cohort 1) • Michigan (Cohort 2) • Nevada • NoCVA	
CLABSI Rate per 1,000 Central Line Days (Non-ICU)		
• New York	• Ascension (Cohort 1) • Ascension (Cohort 2) • Georgia • Pennsylvania • Tennessee	

Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
CLABSI Rate per 1,000 Central Line Days (Hospital-Wide)		
• Iowa • Ohio Children's (Cohort 2)	• Ohio Children's (Cohort 1) • Pennsylvania	
CLABSI SIR		
• EHEN • New York	• Georgia • NoCVA • Ohio	
CLABSI SIR (ICU)		
• New York	• Ascension (Cohort 1) • Ascension (Cohort 2)	
CLABSI SIR (Non-ICU)		
• New York		
Falls		
Falls per 1,000 Patient Days (National Database of Nursing Quality Indicators® [NDNQI®] Definition)[E-18]		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 3) • Carolinas • JCR (Cohort 1) • Michigan (Cohort 1) • New York	• AHA/HRET (Cohort 2) • Ascension (Cohort 1) • Ascension (Cohort 2) • Iowa • JCR (Cohort 1) • JCR (Cohort 2) • Michigan (Cohort 2) • Minnesota • New Jersey • Ohio Children's (Cohort 1) • Ohio Children's (Cohort 2) • VHA	• EHEN • Intermountain
Falls with Injury per 1,000 Patient Days (NDNQI Definition)		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • Dignity • Intermountain • Michigan (Cohort 1) • Minnesota • UHC • VHA • Washington	• AHA/HRET (Cohort 3) • Carolinas • EHEN • Georgia • Iowa • JCR (Cohort 1) • JCR (Cohort 2) • Michigan (Cohort 2) • New Jersey • NoCVA • Tennessee • VHA	• JCR (Cohort 1)

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Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
Obstetrical Early Elective Deliveries (OB-EED)		
Elective Delivery (The Joint Commission Perinatal Care [PC]-01)		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Ascension (Cohort 1) • Ascension (Cohort 2) • Carolinas • Dignity • Georgia • Intermountain • Iowa • JCR (Cohort 1) • Nevada • New York • NoCVA • Ohio • Tennessee • UHC • VHA • Washington	• Michigan (Cohort 2) • New Jersey • Premier	• AHA/HRET (Cohort 4) • EHEN • Michigan (Cohort 1)
Other Obstetrical Adverse Events (OB-Other)		
Birth Trauma Rate–Injury to Neonate (Patient Safety Indicator [PSI]-17)		
	• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Ascension (Cohort 1) • Carolinas • DFW • EHEN • Georgia • Intermountain • Iowa • JCR • LifePoint • Minnesota • New Jersey • New York • Ohio • Pennsylvania • Tennessee • UHC • Washington	• VHA
OB Trauma Rate–Vaginal Delivery with Instrument (PSI-18)		
• Carolinas • JCR (Cohort 1) • New York • NoCVA • Ohio	• AHA/HRET • Ascension (Cohort 1) • Ascension (Cohort 2) • DFW • EHEN • Georgia • Intermountain • Iowa • LifePoint • Minnesota • Nevada • New Jersey • Pennsylvania • Premier • Tennessee • UHC • VHA • Washington	

Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
OB Trauma Rate–Vaginal Delivery without Instrument (PSI-19)		
• AHA/HRET • Carolinas • Iowa • Nevada • Ohio • Premier • UHC • Washington	• Ascension (Cohort 1) • Ascension (Cohort 2) • DFW • EHEN • Georgia • Intermountain • LifePoint • Minnesota • New Jersey • New York • NoCVA • Pennsylvania • Tennessee • VHA	
Pressure Ulcers		
Pressure Ulcer Rate (PSI-03)		
• Carolinas • NoCVA (Cohort 2) • Ohio • Premier	• Ascension (Cohort 1) • EHEN • Georgia • Intermountain • JCR (Cohort 1) • LifePoint • Minnesota • Nevada • New Jersey • NoCVA (Cohort 1) • NoCVA (Cohort 2) • Pennsylvania • UHC	
Stage 2+ Hospital-Acquired Pressure Ulcers (HAPU) per 100 Assessed Patients		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • JCR (Cohort 1) • New York • UHC	• AHA/HRET (Cohort 3) • AHA/HRET (Cohort 4) • Intermountain	
All Stages HAPU per 100 Assessed Patients		
• New Jersey	• Michigan (Cohort 2)	
Surgical Site Infections (SSI)		
SSI–Colon Surgery SIR		
	• Ascension (Cohort 1) • Ascension (Cohort 2) • EHEN • Minnesota (Cohort 3) • Nevada • NoCVA	• New York
SSI–Abdominal Hysterectomy Surgery SIR		
	• Ascension (Cohort 1) • Ascension (Cohort 2) • EHEN • Minnesota (Cohort 3) • New York • NoCVA	

Table E-60—Improving, No Change, and Worsening HEN-Submitted SPC Charts, by Common Measure		
Improving	**No Change**	**Worsening**
Ventilator-Associated Pneumonia (VAP)		
VAP per 1,000 Ventilator Days		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • Dignity • Michigan (Cohort 1) • Ohio Children's (Cohort 1) • Ohio Children's (Cohort 2) • VHA • Washington	• AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • Minnesota • New Jersey • New York • NoCVA • Pennsylvania • Premier • Tennessee	
Venous Thromboembolism (VTE)		
Perioperative Pulmonary Embolism (PE) or Deep Vein Thrombosis (DVT) Rate (PSI-12)		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 3) • JCR (Cohort 1) • VHA • Washington	• AHA/HRET (Cohort 4) • Ascension (Cohort1) • Ascension (Cohort 2) • Carolinas • DFW • Georgia • Intermountain • Iowa • LifePoint • Minnesota • Nevada • New Jersey • New York • NoCVA • Ohio • Pennsylvania • Premier • Tennessee • UHC	
Readmissions		
30-Day All-Cause Readmissions, All-Payer		
• AHA/HRET (Cohort 1) • AHA/HRET (Cohort 2) • AHA/HRET (Cohort 4) • Ascension (Cohort 1) • Ascension (Cohort 2) • DFW • EHEN • Intermountain • Iowa • LifePoint • Michigan (Cohort 1) • New York • NoCVA • Premier • UHC	• AHA/HRET (Cohort 3) • Carolinas • Dignity • JCR (Cohort 1) • Michigan (Cohort 2) • Nevada • Ohio • Pennsylvania • Tennessee	• JCR (Cohort 1)
30-Day All-Cause Readmissions, Medicare		
• Georgia • Intermountain • Nevada		

Relationship Between Level of Hospital Engagement with Hospital Engagement Network (HEN) and Outcome Trends (Dose-Response) (Chapter 5)

This section presents supplementary tables supporting the Dose-Response analyses presented in Chapter 5.

This section is divided into three parts: The first part presents descriptive statistics for the Dose-Response metrics of improvement by reporting status and adverse event area (AEA). The tables in this section complement Chapter 5 by breaking out the considerable AEA-by-AEA variation. In this part and throughout this supplementary section, analyses of less-widely-reported measures are presented as a check on the robustness of the results presented for widely-reported measures. The less-widely-reported results should be considered less reliable and representative than results for widely-reported measures because the measure data were drawn from smaller numbers of hospitals, from groups of hospitals that varied widely from month to month, or both.

The second part includes tables for analyses regarding the proportion of hospitals taking action or making changes in policy to improve patient safety. These actions and changes represent a different kind of "dose" than participation in HEN-sponsored patient safety activities, and were only incidentally reported in Chapter 5. In this part of the Appendix, tables are presented for widely-reported measures only. The actions and changes are of interest because these behaviors are logically more directly connected to outcomes than, for example, participating in value-added networking with other hospitals.

The third part of this section replicates the complete set of tables included in Chapter 5 for less-widely-reported measures. Added on to the tables from Chapter 5 are results from analyses of the proportion of hospitals taking action or making changes in policy to improve patient safety. Those results for less-widely-reported measures can be compared to results presented for widely-reported measures in the second part of this Appendix. It is expected that the results for the less-widely-reported measures will broadly resemble those for the widely-reported measures, but the less-widely-reported measures, because they are presumed to be less reliable, are expected to exhibit more variability.

Metrics of Improvements in Patient Safety

See Table E-61 through Table E-65 for evidence of wide AEA-by-AEA variations in the Dose-Response metrics of improvements in patient safety. The obstetrical early elective deliveries (OB-EED) AEA performed best on every metric of improvement, often exceeding the performance of the next best-performing AEA by a considerable margin. An extreme example of this is the percentage of measures meeting 40 percent/20 percent goals as shown in Table E-62; 80.00 percent of widely-reported OB-EED measures met these goals, while just 37.50 of the measures in the next-best-performing AEA, pressure ulcers, met goals.

Among widely-reported measures, the second-best-performing AEA was the pressure ulcers AEA for four of five improvement metrics, with a 30.16 average percentage improvement in measures, for example (see Table E-63), that does not fall far short of the 34.14 percent improvement for OB-EED. The Other obstetrical adverse events (OB-Other) AEA performed second-best in months to 40 percent/20 percent goals, with 10.50 months to goal versus 4.67 months for OB-EED and 15.21 for the pressure ulcers AEA (Table E-65). Conversely, the readmissions AEA performed least well for three of five improvement metrics, with, for example, only 18.18 percent of readmissions measures meeting 17.6 percent/10 percent goals (Table E-61). The falls AEA performed worse in percent meeting 40 percent/20 percent goals, with 0.00 percent

(Table E-62), and ventilator-associated pneumonia (VAP)/ventilator-associated event (VAE) performed worse in average percentage change in measures, with a 29.27 percent worsening (Table E-63).

Aside from the high performance of the OB-EED AEA, the story for less-widely-reported measures shows much less consistency. Four different AEAs performed second-best across the five improvement metrics: OB-Other, pressure ulcers, readmissions, surgical site infections (SSI), and VAP/VAE. Four different AEAs performed worst: catheter-associated urinary tract infection (CAUTI), central line-associated blood stream infection (CLABSI), falls, and SSI. This level of variability is consistent with concerns about the reliability of the less-widely-reported measures.

The large observed variations in performance across AEAs are unlikely to be due entirely to factors internal to the Partnership for Patients (PfP) campaign. For example, actions by government agencies and private insurers have undoubtedly had an impact; nowhere as dramatically as in the widespread implementation of Hard Stop policies in OB. Furthermore, while it has been determined that much of the harms in each of the AEAs is preventable, the fraction of harms that are preventable varies across AEAs. These factors that are external to PfP or intrinsic in the AEAs are not directly captured in the models presented in Chapter 5 or in subsequent portions of this Appendix, and it should be kept in mind that those factors are likely to weaken the observed relationship between hospital participation in patient safety activities ("dose") and metrics of improvement in patient safety ("response").

Table E-61—Descriptive Statistics by AEA and Reporting Status, Metric of Improvement = Percent Meeting 17.6 Percent/10 Percent Goals

	Well-Reported Measures					Less-Well-Reported Measures				
AEA	Average	Standard Deviation	Minimum	Maximum	N	Average	Standard Deviation	Minimum	Maximum	N
ADE	45.45	65.75	0.00	100.00	15	37.50	52.75	0.00	100.00	17
CAUTI	22.67	38.88	0.00	50.00	17	26.56	49.64	0.00	100.00	17
CLABSI	47.54	49.38	0.00	100.00	15	48.39	49.93	0.00	100.00	12
Falls	27.78	60.48	0.00	100.00	14	41.67	52.62	0.00	100.00	14
OB-EED	86.67	38.01	0.00	100.00	13	85.71	22.27	66.67	100.00	7
OB-Other	30.67	57.21	0.00	100.00	15	35.48	63.96	0.00	100.00	8
Pressure Ulcers	76.79	59.40	0.00	100.00	19	72.13	54.01	0.00	100.00	16
Readmissions	18.18	36.35	0.00	66.67	19	73.68	42.84	0.00	100.00	6
SSI	30.14	36.68	0.00	66.67	17	35.71	57.04	0.00	100.00	10
VAP/VAE	26.32	50.77	0.00	100.00	12	46.30	50.28	0.00	100.00	15
Venous Thromboembolism (VTE)	51.06	58.51	0.00	100.00	19	56.00	56.86	0.00	100.00	10

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN; observations were weighted by the number of measures in the HEN/AEA.

Table E-62—Descriptive Statistics by AEA and Reporting Status, Metric of Improvement = Percent Meeting 40 Percent/20 Percent Goals										
	Well-Reported Measures					Less-Well-Reported Measures				
AEA	Average	Standard Deviation	Minimum	Maximum	N	Average	Standard Deviation	Minimum	Maximum	N
ADE	20.45	48.56	0.00	100.00	15	27.27	48.73	0.00	100.00	17
CAUTI	5.33	17.74	0.00	25.00	17	4.69	20.81	0.00	33.33	17
CLABSI	13.11	41.70	0.00	100.00	15	16.13	30.55	0.00	50.00	12
Falls	0.00	0.00	0.00	0.00	14	16.67	46.23	0.00	100.00	14
OB-EED	80.00	39.79	0.00	100.00	13	85.71	22.27	66.67	100.00	7
OB-Other	16.00	39.48	0.00	42.86	15	25.81	50.03	0.00	75.00	8
Pressure Ulcers	37.50	64.51	0.00	100.00	19	42.62	73.14	0.00	100.00	16
Readmissions	6.82	23.12	0.00	50.00	19	52.63	36.61	0.00	100.00	6
SSI	10.96	30.34	0.00	50.00	17	17.86	48.39	0.00	100.00	10
VAP/VAE	13.16	29.52	0.00	50.00	12	25.93	38.77	0.00	100.00	15
VTE	8.51	20.77	0.00	33.33	19	32.00	52.07	0.00	100.00	10

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN; observations were weighted by the number of measures in the HEN/AEA.

Table E-63—Descriptive Statistics by AEA and Reporting Status, Metric of Improvement=Avgerage Percent Change in Measures										
	Well-Reported Measures					Less-Well-Reported Measures				
AEA	Avg.	Std. Dev.	Min.	Max.	N	Avg.	Std. Dev.	Min.	Max.	N
ADE	-17.91	39.84	-70.78	23.42	15	2.54	72.11	-100.00	73.27	17
CAUTI	-6.67	20.37	-17.94	12.85	17	5.94	54.57	-42.57	74.64	17
CLABSI	-15.89	24.52	-53.64	0.51	15	-10.64	33.52	-40.86	13.57	12
Falls	-13.15	21.72	-33.40	19.93	14	-14.57	37.12	-48.69	22.76	14
OB-EED	-34.14	139.11	-98.47	383.26	13	-54.54	45.06	-93.54	-20.08	7
OB-Other	-12.58	31.91	-46.64	5.76	15	-14.13	61.50	-74.86	41.97	8
Pressure Ulcers	-30.16	59.23	-85.64	69.16	19	-27.35	72.64	-96.68	83.44	16
Readmissions	-7.02	6.67	-14.27	5.17	19	-20.84	30.49	-85.94	-9.16	6
SSI	6.83	37.98	-28.01	54.46	17	24.88	136.39	-72.80	300.97	10
VAP/VAE	29.27	60.68	-24.20	99.34	12	0.53	142.93	-100.00	459.88	15
VTE	-15.40	17.48	-29.76	7.83	19	3.95	85.87	-95.57	69.50	10

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN; observations were weighted by the number of measures in the HEN/AEA.

Table E-64—Descriptive Statistics by AEA and Reporting Status, Metric of Improvement = Months to 17.6 Percent/10 Percent Goal										
	Well-Reported Measures					Less-Well-Reported Measures				
AEA	Average	Standard Deviation	Minimum	Maximum	N	Average	Standard Deviation	Minimum	Maximum	N
ADE	14.31	10.08	1.00	31.00	16	8.50	8.58	1.00	29.00	26
CAUTI	14.29	8.33	1.00	30.00	14	11.92	8.92	1.00	31.00	13
CLABSI	15.62	9.19	1.00	33.00	21	12.19	10.13	1.00	30.00	16
Falls	13.55	10.95	1.00	30.00	11	1 4.38	9.05	1.00	30.00	21
OB-EED	1.67	2.31	1.00	9.00	12	3.30	5.66	1.00	19.00	10
OB-Other	10.81	9.10	1.00	31.00	26	7.30	8.71	1.00	29.00	10
Pressure Ulcers	9.09	8.81	1.00	30.00	33	9.00	8.23	1.00	25.00	40
Readmissions	17.88	6.98	11.00	29.00	8	5.69	5.42	1.00	19.00	13
SSI	11.95	8.61	1.00	25.00	20	11.33	9.73	1.00	30.00	12
VAP/VAE	12.13	6.98	1.00	24.00	8	5.33	5.24	1.00	16.00	27
VTE	16.55	9.25	1.00	28.00	11	6.58	8.80	1.00	28.00	12

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Only measures meeting goal during the current period were included in these statistics. Each observation was a single measure.

Table E-65—Descriptive Statistics by AEA and Reporting Status, Metric of Improvement = Months to 40 Percent/20 Percent Goal										
	Well-Reported Measures					Less-Well-Reported Measures				
AEA	Average	Standard Deviation	Minimum	Maximum	N	Average	Standard Deviation	Minimum	Maximum	N
ADE	10.83	8.40	1.00	23.00	6	11.00	10.47	1.00	28.00	18
CAUTI	17.50	10.28	5.00	30.00	4	9.33	12.74	1.00	24.00	3
CLABSI	20.57	9.20	1.00	28.00	7	18.25	7.14	12.00	28.00	4
Falls	18.50	13.44	9.00	28.00	2	17.25	12.95	1.00	31.00	8
OB-EED	4.67	6.65	1.00	19.00	12	5.60	6.62	1.00	22.00	10
OB-Oth	10.50	9.44	1.00	27.00	8	12.00	5.14	5.00	19.00	6
Pressure Ulcers	15.21	9.73	1.00	29.00	14	11.70	10.57	1.00	30.00	20
Readmissions	28.00	.	28.00	28.00	1	12.44	8.90	1.00	30.00	9
SSI	15.14	11.68	1.00	32.00	7	7.40	10.06	1.00	24.00	5
VAP/VAE	15.80	6.87	9.00	27.00	5	11.00	7.18	1.00	25.00	19
VTE	20.00	12.73	1.00	28.00	4	7.67	8.44	1.00	28.00	9

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Only measures meeting goal during the current period were included in these statistics. Each observation was a single measure.

Supplementary Tables for Widely-Reported Measures

Actions or Changes in Policies to Improve Patient Safety

In addition to being asked about hospital participation in six types of patient safety activities, hospitals were also asked if they had taken actions or changed policies to improve patient safety in each AEA as a result of participating in these activities. As shown in Table E-66, on average, fewer than half of hospitals made changes due to PfP, either hospital-wide or at the unit level. On average, nearly one-quarter of hospitals made changes that were unrelated to their PfP participation.

Table E-66—Descriptive Statistics: Percent of Hospitals Making Changes to Improve Patient Safety, Widely-Reported PfP Outcome Measures

Percent of Hospitals Making Changes to Improve Patient Safety	Average	Standard Deviation	Minimum	Maximum
Hospital-wide changes due to PfP	48.49	39.52	7.14	96.00
Unit-specific changes due to PfP	40.09	36.40	0.00	100.00
Patient safety improvements not due to PfP	23.35	23.23	2.27	61.54

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN (N = 175). Averages were weighted by the number of widely reported measures in the HEN-AEA.

Table E-67 shows regression results regarding the association between the percentage of hospitals making changes to improve patient safety and the percent of measures meeting 17.6 percent/10 percent goals and 40 percent/20 percent goals, for widely reported measures. There is no evidence of an association between the percentage of hospitals making any type of change and the improvement metrics after controlling for HEN and AEA.

Table E-67—Regression Results: Association Between Percent of Hospitals Making Changes to Improve Patient Safety and Percent of Measures Meeting 17.6 Percent/10 Percent Goals and 40 Percent/20 Percent Goals, Widely-Reported Measures

	Percent of Measures in HEN-AEA Meeting 17.6 Percent/10 Percent Goals		Percent of Measures in HEN-AEA Meeting 40 Percent/20 Percent Goals	
Percent of Hospitals Making Changes to Improve Patient Safety	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Hospital-wide changes due to PfP	0.47	0.27	0.10	0.13
Unit-specific changes due to PfP	0.26	0.18	0.08	0.07
Patient safety improvements not due to PfP	0.11	0.23	0.14	0.15

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN. N varied with the number of highly influential observations omitted from the analysis, ranging from 165 to 172 of 175 total observations. Each row represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table E-68 shows results for regressions regarding the association between the percentage of hospitals making changes and the average percentage change in measures. As in preceding table, none of the results for these improvement metrics was statistically significant.

Table E-68—Association Between Percent of Hospitals Making Changes to Improve Patient Safety and Average Percentage Improvement in Measure Rates by HEN and AEA, Widely-Reported Measures

	Average Percentage Improvement in HEN-AEA	
Percent of Hospitals Making Changes to Improve Patient Safety	**Coefficient**	**Standard Error**
Hospital-wide changes due to PfP	-0.23	0.20
Unit-specific changes due to PfP	-0.17	0.16
Patient safety improvements not due to PfP	-0.37	0.21

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN. N varied with the number of highly influential observations omitted from the analysis, ranging from 167 to 173 of 175 total observations. Each row represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table E-69 shows the results of Cox proportional hazards regression analyses examining the association between the percentage of hospitals making changes to improve patient safety and the number of months to reach PfP goals, for widely reported measures. There were no statistically significant results for 17.6 percent/10 percent goals, but there were two for 40 percent/20 percent goals.

First, an association was detected between the percentage of hospitals taking hospital-wide action to improve patient safety and time to goal. Higher proportions of hospitals making hospital-wide changes are associated with lower hazards of meeting 40 percent/20 percent goals/longer times to goal (hazard ratio = 0.98). This unexpected relationship was not constant over time, however; it slowly changed so that by the end of the campaign, having a proportion of hospitals making hospital-wide changes was associated with shorter times to goal (interaction = 0.00002, $p < 0.05$). To illustrate, a 10 percent increase in the percentage of hospitals making patient safety improvements would be associated with a 21.85 percent *lower* hazard of meeting goal in the first month of the post-baseline period.[E-19] By the twentieth month of the post-baseline period, the hazard of meeting goal would only be 3.79 lower and by the thirtieth month, the hazard would be 24.84 percent *higher*.[E-20] One interpretation of these results is that hospitals reporting making hospital-wide changes may not have been able to devote as much focused attention as would be found when making unit-specific changes to patient safety. If there was a dilution-of-effort effect, this might result in longer times for measures to reach goal.

Second, there was an association between the proportion of hospitals taking action to improve patient safety not due to participation in PfP activities and the time required to meet the 40 percent/20 percent goals. A 10 percent increase in the percentage of hospitals making such changes was associated with a 50 percent

E-19 The estimated change in the hazard of reaching the 40 percent/20 percent goals associated with a 10 percentage point increase in the proportion of hospitals making patient safety improvements is $100 \times (\exp((\ln(0.97559792) \times 10) + (\ln(1.00005211) \times 10 \times 1)) - 1) = -21.85$.

E-20 These results should not be extrapolated beyond the period for which data were available, which is no more than 32 months for any measure.

decrease in the hazard of reaching goal in a given month.[E-21] This is another unexpected result, but it is consistent with a number of possible interpretations, including that changes made without PfP prompting or support were less likely to be compatible with the deep reductions in harms required to meet 40 percent/20 percent goals.

Table E-69—Cox Proportional Hazards Regression Analyses: Association Between Percent of Hospitals Making Changes to Improve Patient Safety and Number of Months to Reach PfP Goals, Widely Reported Measures

	Months to 17.6 Percent/10 Percent Goal		Months to 40 Percent/20 Percent Goal	
Percent of Hospitals Making Changes to Improve Patient Safety	**Hazard Ratio**	**Standard Error**	**Hazard Ratio**	**Standard Error**
Hospital-wide changes due to PfP	1.01	0.01	0.98	0.02
Interaction: Hospital-wide changes due to PfP with month squared			1.00005	0.00002*
Unit-specific changes due to PfP	1.01	0.01	1.00	0.01
Patient safety improvements not due to PfP	1.00	0.01	0.95	0.03*

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each row except "Interaction: Hospital-wide changes due to PfP with month squared" represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity. Observations were individual measures (N = 519).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In sum, the evidence of relationships between the proportion of hospitals that make changes to improve patient safety and statistically significant changes in metrics of improvement was limited to the time required to reach 40 percent/20 percent goals. Moreover, the detected relationships defied expectations. Overall, these results are not a robust indication that hospital-level changes to improve patient safety were associated with reductions in patient harms.

Supplementary Tables for Less-Widely-Reported Measures

Table E-70 presents descriptive statistics on hospital participation in patient safety activities and PfP outcome measures for less-widely-reported measures. The percentages of hospitals participating in each of the six types of patient safety activities were uniformly lower than those reported for widely-reported measures presented in Chapter 5.[E-22] The proportions of hospitals making changes to improve patient safety due to PfP were also lower than those shown in Table E-66.

On the other hand, all of the metrics of improvement were more favorable for the less-widely-reported measures than for the widely-reported measures, aside from the average percentage improvement in

E-21 For a continuous covariate like the proportion of hospitals taking action to improve patient safety not due to participation in PfP activities, the estimated percentage change in the hazard of meeting goal associated with a 1 percentage point change in hospitals taking action is $100 \times (hazard\ ratio - 1) = 100 \times (.95 - 1) = -5$ percent. For a 10 percentage point change in hospitals taking action, the estimated percentage change in the hazard is 10 × (-5) = -50 percent.

E-22 Note that activities were not measured separately for widely-reported and less-widely reported measures; the reported averages were weighted by the number of measures in each HEN/AEA, and differences in how the two types of measures were distributed across HENs and AEAs resulted in the discrepancies.

measures. Only there did the widely-reported measures appeared to perform better, with a 9.39 average percentage improvement, versus a 6.19 average percentage improvement for the less-widely-reported measures. That the less-widely-reported measures generally showed greater improvements than the widely-reported measures does not make the less-widely-reported measures "better" however; they are simply different.

Table E-70—Descriptive Statistics: Hospital Participation in Patient Safety Activities/Changes to Improve Patient Safety and Less-Widely-Reported PfP Outcome Measures

Outcome/Activity	Average[a]	Standard Deviation	Minimum	Maximum
Activities (Percent of Hospitals Participating in HEN/AEA)				
Skills training	38.29	34.60	0.00	87.18
Value-added Networking with Other Hospitals	47.81	37.60	8.33	95.65
Virtual Consultation or Coaching	42.58	35.68	0.00	90.00
On-Site Visits	29.69	45.68	0.00	95.65
Feedback on Patient Safety Performance Data	63.13	34.49	0.00	100.00
Other Education and Resources	47.75	26.97	11.11	87.50
Percent of Hospitals Making Changes to Improve Patient Safety				
Hospital-wide changes due to PfP	38.57	37.56	0.00	92.00
Unit-specific changes due to PfP	30.24	30.50	0.00	74.07
Patient safety improvements not due to PfP	24.25	19.76	0.00	66.67
Outcomes				
Percent meeting 17.6/10 goals	46.44	58.24	0.00	100.00
Percent meeting 40/20 goals	26.57	53.59	0.00	100.00
Average percent change in measures	-6.19	83.87	-100.00	459.88
Average months to 17.6/10 goal (n = 200)[b]	8.86	8.51	1.00	31.00
Average months to 40/20 goal (n = 111)[b]	11.05	9.40	1.00	31.00

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
[a]There were 132 HEN/AEA combinations representing 463 less-widely-reported measures.
[b]There were 200 measures meeting 17.6/10 goals and 11 measures meeting 40/20 goals, each with at least 8 post-baseline monthly or quarterly observations.

Table E-71 shows results for regressions relating hospital participation in patient safety activities and changes to improve patient safety with the percentage of measures meeting 17.6 percent/10 percent goals and 40 percent/20 percent goals. The only statistically significant result in the table indicates that a 10 percent increase in hospital participation in on-site visits was associated with a 4.8 percent decrease in the average percentage of measures meeting 40 percent/20 percent goals. This is consistent with the result in Table 5-2, where a 10 percentage point increase in the percent of measures in HEN-AEA meeting 17.6 percent/10 percent goals was associated with a 6.7 percent decrease in measures meeting goals. As noted in that section, this association may be spurious because a hospital may be more likely to request on-site visits when it is having difficulties reducing harms in an AEA. This would mean that the use of on-site visits and the lower proportion of measures meeting goal were both results of difficulties in reducing harms encountered by hospitals and were not causally related.

Table E-71—Regression Results: Association Between Hospital Participation in Patient Safety Activities/Changes to Improve Patient Safety and Percent of Measures Meeting 17.6 Percent/10Percent Goals and 40 Percent/20 Percent Goals, Less-Widely-Reported Measures				
	Percent of Measures in HEN-AEA Meeting 17.6 Percent/10 Percent Goals		Percent of Measures in HEN-AEA Meeting 40 Percent/20 Percent Goals	
Percent of Hospitals Participating in HEN Activities	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Skills Training	0.36	0.27	-0.15	0.22
Value-added Networking with Other Hospitals	0.08	0.20	-0.20	0.20
Virtual Consultation or Coaching	0.18	0.33	-0.42	0.22
On-Site Visits	-0.45	0.30	-0.48	0.22*
Feedback on Patient Safety Performance Data	0.36	0.27	-0.37	0.22
Other Education and Resources	-0.67	0.36	-0.41	0.38
Percent of Hospitals Making Changes to Improve Patient Safety	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Hospital-wide changes due to PfP	-0.06	0.23	-0.32	0.20
Unit-specific changes due to PfP	-0.26	0.18	-0.34	0.19
Patient safety improvements not due to PfP	0.51	0.32	0.36	0.22

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each observation was an AEA within a HEN. N varied with the number of highly influential observations omitted from the analysis, ranging from 118 to 127 of 132 total observations. Each row represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table E-72 also presents regression results, but the metric of improvement in these analyses is average percentage improvement in measures. The only statistically significant result is that a 10 percent increase in hospital participation in on-site visits was associated with a 5.3 percent worsening in average percentage change. This is consistent with the results shown in Table E-71 for the average percentage of measures meeting 40 percent/20 percent goals.

There other notable result in Table E-72 regards the relationship between the percentage of hospitals making changes to improve patient safety not due to PfP and the average percentage change in measures; a 10 percent increase in hospitals making these types of changes was associated with a 13 percentage point greater average decline in measure rate.[E-23]

[E-23] The average decline is calculated as (-1.31 * 10) = -13.1.

Table E-72—Association Between Hospital Participation in Patient Safety Activities/Changes to Improve Patient Safety and Average Percentage Improvement in Measure Rates by HEN and AEA		
	Average Percentage Improvement in HEN andAEA	
Percent of Hospitals Participating in HEN Activities	**Coefficient**	**Standard Error**
Skills Training	-0.12	0.33
Value-added Networking with Other Hospitals	0.40	0.24
Virtual Consultation or Coaching	-0.03	0.37
On-Site Visits	0.53	0.22*
Feedback on Patient Safety Performance Data	-0.38	0.25
Other Education and Resources	0.69	0.66
Percent of Hospitals Making Changes to Improve Patient Safety	**Coefficient**	**Standard Error**
Hospital-wide changes due to PfP	-0.09	0.34
Unit-specific changes due to PfP	0.41	0.33
Patient safety improvements not due to PfP	-1.31	0.41**

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each row represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity. Analyses include only non-widely and inconsistently reported measures. GLS regressions were computed with standard errors adjusted to compensate for clustering of observations within HENs and were weighted by the number of non-widely and inconsistently reported PfP outcome measures in each HEN/AEA. Influential observations were deleted based on regression diagnostics; N varies from 122 to 128 of 132.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table E-73 presents the results of regressions analyzing the relationship between hospital participation in patient safety activities/changes to improve patient safety and time to goal. Consistent with other analyses presented in this part of the Appendix, there are no significant results for 17.6 percent/10 percent goals, but there are significant results respecting 40 percent/20 percent goals. The first statistically significant result is that a 1 percentage point increase in hospital participation in on-site visits was associated with a 5 percent decrease in the hazard of reaching 40 percent/20 percent goals, all else being equal. The negative association between on-site visits and desired results seen here is consistent with the results shown in Table E-71 and Table E-72.

Table E-73—Cox Proportional Hazards Regression Analyses: Association Between Hospital Participation in Patient Safety Activities/Changes to Improve Patient Safety and Number of Months to Reach PfP Goals, Less-Widely-Reported Measures				
	Months to 17.6 Percent/10 Percent Goals		Months to 40 Percent/20 Percent Goals	
Percent of Hospitals Participating in HEN Activities	**Hazard Ratio**	**Standard Error**	**Hazard Ratio**	**Standard Error**
Skills Training	1.00	0.01	0.99	0.01
Value-added Networking with Other Hospitals	1.00	0.01	0.99	0.01
Virtual Consultation or Coaching	1.00	0.01	0.99	0.01
On-Site Visits	0.98	0.01	0.95	0.02**
Feedback on Patient Safety Performance Data	1.00	0.01	0.98	0.02

Table E-73—Cox Proportional Hazards Regression Analyses: Association Between Hospital Participation in Patient Safety Activities/Changes to Improve Patient Safety and Number of Months to Reach PfP Goals, Less-Widely-Reported Measures				
	Months to 17.6 Percent/10 Percent Goals		Months to 40 Percent/20 Percent Goals	
Other Education and Resources	1.01	0.01	1.01	0.02
Percent of Hospitals Making Changes to Improve Patient Safety	**Hazard Ratio**	**Standard Error**	**Hazard Ratio**	**Standard Error**
Hospital-wide changes due to PfP	0.99	0.01	0.97	0.01*
Unit-specific changes due to PfP	0.99	0.01	0.98	0.01
Patient safety improvements not due to PfP[1]	1.02	0.01	1.04	0.02*
Interaction: Patient safety improvements not due to PfP with month squared			0.997	0.001*

Source: Evaluation Contractor's Survey of Hospital Participation in Patient Safety Activities, January-March 2015; HSAG's analysis of HEN monthly reports, November 2014.
Notes: Each row except "Interaction: Patient safety improvements not due to PfP with month squared" represents the results of a separate regression analysis with vectors of HEN and AEA variables to control for unmeasured heterogeneity. Analyses include only measures with at least 8 post-baseline monthly or quarterly observations (N = 417).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There were also two notable results regarding the association between changes made to improve patient safety and time to 40 percent/20 percent goals. First, the higher the proportion of hospitals making hospital-wide changes, the longer the time to goal for 40/20 measures. For example, a 10 percent increase in hospitals making hospital-wide changes was associated with a 30 percent decrease in the hazard of meeting goal.

Second, there was an association between the proportion of hospitals making changes not due to PfP and time to 40 percent/20 percent goals. Higher proportions of hospitals making improvements initially resulted in larger hazards/shorter times to goal, but as the campaign progressed the hazards gradually become lower/times to goal longer. For example, a 10 percentage point increase in hospitals making patient safety improvements not due to PfP would be associated with a 47.23 percent *greater* hazard of reaching goal in the first post-baseline month. By the tenth month, however, the 10 percentage point increase would be associated with a 90.52 percent *decrease* in the hazard of meeting goal.

These two results should be interpreted in the context of the results shown in Table E-69. In that analysis of widely-reported measures, increases in the proportion of hospitals making hospital-wide changes due to PfP were initially associated with longer times to goal, but over the course of the campaign times to goal became shorter. Here, such increases were associated with longer times to goal for the whole length of the campaign. In the earlier analysis, increases in the proportion of hospitals making changes not due to PfP participation were associated with longer times to goal. Here, such increases were associated with shorter times to goal initially, but increasingly long times to goal towards the end of the campaign.

Each set of results defies easy interpretation. Applications of effort should logically be associated with better outcomes, assuming that the efforts are appropriate and well-executed. It cannot be ignored, however, that both sets of analyses produced similar results using different sets of measures. At the same time, it cannot be determined which set of results most accurately characterizes the relationships between changes to improve patient safety and time to goal. The best that can be said at this point is that this bears further investigation with higher-quality data.

Interrupted Time Series (ITS) Cluster Analysis (Chapter 5)

Chapter 5 presents the results of a hierarchical cluster analysis that attempts to identify measures exposed to similar patterns of Hospital Engagement Network (HEN) interventions and group them into clusters. For each cluster, the analysis then calculated the average number of structural breaks identified in ITS analysis, and the average percentage change across the measures included in each group. The results presented in Chapter 5 were for the catheter-associated urinary tract infection (CAUTI) device utilization ratio, using data from 37 measures submitted for 24 HENs. The results did not reveal any clear patterns to indicate that the exposure to specific HEN activities or for specific periods of time were associated with greater average reductions in patient harms or larger numbers of structural breaks identified. The results for the remaining 22 common measures for which there were at least 5 HEN cohorts of data reported are presented in the following supplemental tables. The results are consistent with those observed for the CAUTI device utilization ratio. No clear patterns emerge to suggest that exposure to specific types of HEN activities are associated with greater numbers of structural breaks or larger average reductions in patient harms.

Table E-74—*Clostridium difficile* (*C. difficile*) per 10,000 Patient Days, Adverse Drug Events (ADE)

			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	2	163.50	0.00	4.50	0.00	14.50	0.00%	11.76%	0.00%	52.94%	0.00	(0.19%)
2	2	63.00	11.00	21.50	8.00	4.00	56.14%	82.95%	42.50%	21.14%	0.00	9.03%
3	1	54.00	32.00	32.00	25.00	29.00	71.74%	71.74%	47.83%	56.52%	2.00	23.76%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-75—CAUTI per 1,000 Catheter Days (Intensive Care Unit [ICU]), CAUTI

Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	4	59.50	15.25	25.00	2.50	24.25	42.66%	66.18%	0.78%	68.19%	0.75	(5.07%)
2	2	34.00	0.00	13.50	0.00	0.00	0.00%	45.16%	0.00%	0.00%	0.50	11.85%
3	1	51.00	27.00	28.00	28.00	14.00	87.50%	28.13%	68.75%	46.88%	1.00	(62.71%)

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-76—CAUTI per 1,000 Catheter Days (ICU-Plus), CAUTI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	3	74.67	25.67	24.67	21.67	24.00	80.82%	78.97%	55.37%	75.12%	0.67	6.38%
2	3	45.00	25.00	24.33	1.67	20.67	79.02%	70.94%	6.67%	73.97%	0.67	(5.38%)
3	3	49.00	1.33	20.00	14.33	0.00	7.79%	40.78%	3.61%	0.00%	0.67	6.26%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-77—Central Line-Associated Blood Stream Infection (CLABSI) Standard Infection Ration (SIR), CLABSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	8	43.13	25.00	24.50	24.50	17.75	86.24%	62.33%	70.62%	49.50%	0.375	23.31%
2	11	66.46	24.00	25.37	0.00	22.00	64.22%	78.70%	0.91%	71.91%	0.36	21.85%
3	11	133.91	2.46	16.37	6.82	4.10	10.00%	42.73%	16.36%	12.73%	0.00	9.01%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-78—CLABSI Device Utilization Ratio, CLABSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	6	65.50	11.67	3.00	1.33	6.50	51.50%	12.65%	15.00%	26.83%	0.50	3.59%
2	12	68.50	23.08	25.33	0.00	21.08	59.90%	68.04%	1.20%	59.26%	0.67	1.87%
3	10	112.40	1.30	18.90	9.70	1.50	5.41%	40.10%	11.85%	3.85%	0.40	(1.26%)
4	9	102.67	19.22	23.78	24.00	19.89	58.40%	51.70%	54.69%	45.31%	0.67	4.25%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-79—CLABSI per 1,000 Central Line Days (ICU), CLABSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	7	68.14	26.29	28.00	0.00	24.14	60.88%	75.64%	0.95%	64.88%	0.29	19.31%
2	3	44.33	27.00	27.67	28.00	17.33	77.16%	34.07%	69.96%	35.54%	0.00	40.68%
3	3	132.50	0.67	24.00	15.67	17.00	2.38%	28.21%	27.08%	30.92%	1.33	18.16%
4	1	46.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00	38.25%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-80—CLABSI per 1,000 Central Line Days (ICU-Plus), CLABSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	4	84.75	4.25	28.25	10.50	1.25	13.55%	49.44%	29.41%	3.57%	1.25	29.50%
2	3	39.00	26.67	22.00	0.00	22.33	67.83%	35.86%	0.00%	57.57%	1.67	30.88%
3	2	37.50	25.00	25.00	25.00	22.50	93.45%	93.45%	73.45%	84.91%	0.00	22.31%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-81—Falls per 1,000 Patient Days (National Database of Nursing Quality Indicators® [NDNQI®] Definition), Falls[E-24]												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	4	37.25	0.00	24.25	0.00	4.50	0.00%	69.82%	0.00%	9.09%	0.00	13.33%
2	4	84.50	24.50	25.50	9.75	24.25	78.06%	88.67%	13.64%	65.94%	0.00	11.66%

[E-24] NDNQI® is a registered trademark of the American Nurses Association (ANA). NDNQI® data were supplied by ANA. The ANA disclaims responsibility for any analyses, interpretations, or conclusions.

Table E-81—Falls per 1,000 Patient Days (National Database of Nursing Quality Indicators® [NDNQI®] Definition), Falls[E-24]												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
3	4	27.00	11.75	16.75	3.25	2.25	50.54%	58.85%	1.19%	9.09%	0.75	14.72%
4	1	28.00	2.00	15.00	30.00	0.00	9.09%	12.12%	6.06%	0.00%	1.00	2.57%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-82—Falls with Injury per 1,000 Patient Days (NDNQI Definition), Falls												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	3	24.67	0.00	26.33	0.00	0.00	0.00%	84.00%	0.00%	0.00%	0.00	17.21%
2	5	48.60	14.00	20.60	3.20	8.40	52.42%	64.79%	17.00%	23.43%	1.00	26.63%
3	5	70.80	22.60	24.40	4.60	23.20	82.23%	86.85%	19.09%	83.49%	0.60	3.28%
4	1	64.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00	5.37%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-83—Obstetrical Early-Elective Delivery (PC-01), OB-EED												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	3	60.33	25.67	25.67	20.33	24.00	88.55%	90.57%	70.82%	63.30%	2.33	90.55%
2	4	13.25	0.00	5.75	0.00	0.00	0.00%	25.58%	0.00%	0.00%	0.75	6.99%
3	6	26.67	20.83	20.67	0.83	21.83	71.99%	76.40%	0.69%	70.98%	1.00	3.69%
4	3	42.67	27.00	7.00	8.33	0.00	82.67%	19.05%	28.89%	0.00%	0.67	88.13%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-84—Rate of Birth Trauma–Injury to Neonate (PSI-17), Other Obstetrical Adverse Events (OB-Other)												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	10	45.90	2.50	13.60	2.50	1.70	8.74%	35.09%	7.88%	3.26%	0.50	3.99%
2	3	74.33	26.67	24.33	0.00	25.67	78.82%	71.04%	0.00%	76.97%	1.00	23.09%
3	3	38.67	28.00	26.67	26.67	24.00	66.84%	63.74%	55.99%	42.33%	0.00	(20.26%)

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-85—Rate of Obstetric Trauma–Vaginal Delivery with Instrument (PSI-18), OB-Other												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	10	47.70	1.80	12.10	0.00	2.70	5.71%	29.03%	0.00%	7.35%	0.50	11.89%
2	3	35.67	28.00	26.67	26.67	24.00	67.36%	64.19%	56.25%	42.74%	0.00	24.63%
3	2	74.50	26.50	23.00	0.00	25.00	72.78%	61.11%	0.00%	70.00%	0.00	3.50%
4	2	106.50	3.50	14.50	26.00	15.00	12.12%	15.29%	55.02%	38.92%	1.00	15.04%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-86— Rate of Obstetric Trauma–Vaginal Delivery without Instrument (PSI-19), OB-Other												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	10	49.20	1.80	12.10	0.00	2.70	5.71%	29.03%	0.00%	7.35%	0.20	21.18%
2	3	75.33	25.67	23.33	0.00	24.67	78.52%	70.74%	0.00%	76.67%	0.00	0.87%
3	3	38.67	28.00	26.67	26.67	24.00	67.36%	64.19%	56.25%	42.74%	0.00	15.17%
4	3	75.00	7.33	17.00	24.67	14.67	23.77%	20.00%	59.23%	26.93%	0.67	20.70%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-87—Pressure Ulcers (PSI-03) (Medicare), Pressure Ulcers											
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	6	71.83	25.00	25.00	2.5	24.5	84.85%	84.85%	10.61%	83.33%	0.00	40.76%
2	9	212.78	5.00	15.33	2.00	0.00	15.15%	46.46%	7.07%	1.01%	0.22	35.35%
3	7	95.57	26.14	20.57	25.29	16.71	88.31%	63.64%	62.34%	49.35%	0.00	51.43%
4	3	184.67	0.00	23.00	8.00	23.00	0.00%	48.48%	12.12%	60.61%	0.00	0.09%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-88—Pressure Ulcers (PSI-03) (All-Payer), Pressure Ulcers												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	4	69.75	0.00	14.25	0.00	0.00	1.39%	33.61%	0.00%	0.00%	0.00	36.05%
2	5	70.20	26.00	22.80	25.40	18.40	72.98%	56.87%	66.47%	40.02%	0.20	29.45%
3	4	61.75	11.50	22.00	0.00	22.00	46.54%	73.20%	0.00%	74.59%	0.25	23.73%
4	1	249.00	0.00	27.00	27.00	28.00	0.00%	18.75%	31.25%	56.25%	1.00	59.81%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-89—Surgical Site Infection (SSI)–Abdominal Hysterectomy SIR, SSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	7	105.43	0.00	12.86	3.00	8.14	0.00%	38.10%	6.35%	26.98%	0.00	19.21%
2	6	92.50	19.50	21.00	1.50	20.50	83.33%	88.89%	9.26%	87.04%	0.00	5.87%
3	5	35.80	23.20	22.60	19.80	21.80	83.41%	81.19%	61.61%	63.33%	0.40	28.88%
4	4	40.50	20.25	12.00	0.00	3.00	86.11%	52.78%	0.00%	13.89%	0.00	(40.69%)
5	4	220.00	10.50	18.75	18.75	0.00	45.28%	57.22%	65.00%	2.50%	0.25	(16.29%)

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

Table E-90—SSI–Colon Surgery SIR, SSI												
Characteristics			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	8	142.25	2.25	14.75	5.875	0.00	6.94%	48.15%	25.00%	0.00%	0.00	(8.26%)
2	5	92.60	19.80	21.00	1.80	21.00	84.44%	88.89%	11.11%	88.89%	0.00	(33.84%)
3	5	36.00	23.20	22.60	19.80	21.80	83.41%	81.19%	61.61%	63.33%	1.00	(70.09%)
4	4	40.75	20.25	12.00	0.00	3.00	86.11%	52.78%	0.00%	13.89%	0.00	(48.96%)
5	3	38.33	20.00	20.00	24.00	0.00	69.80%	39.60%	63.43%	6.36%	0.00	(7.79%)
6	3	152.33	0.00	18.00	7.00	19.00	0.00%	44.44%	14.81%	62.96%	0.00	(7.77%)

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

Table E-91—Ventilator-Associated Pneumonia (VAP) per 1,000 Ventilator Days, VAP												
			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	2	56.00	7.50	20.50	0.00	19.00	23.08%	55.77%	0.00%	74.65%	1.00	95.03%
2	2	28.00	0.00	15.00	21.50	0.00	0.00%	15.58%	5.41%	0.00%	0.00	47.61%
3	2	35.00	18.50	0.00	0.00	0.00	65.20%	0.00%	0.00%	0.00%	0.50	63.37%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-92—Post-Operative Pulmonary Embolism (PE) or Deep Vein Thrombosis (DVT) (PSI-12) (Medicare), Venous Thromboembolism (VTE)												
			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	5	74.80	0.00	18.60	0.00	0.00	0.00%	41.82%	0.00%	0.00%	0.20	20.08%
2	7	101.00	25.29	25.71	0.86	26.14	85.71%	81.82%	5.19%	88.31%	0.14	12.07%
3	5	59.40	22.20	17.40	0.00	1.80	69.09%	56.36%	0.00%	7.27%	0.20	12.58%
4	5	327.40	22.20	22.80	23.40	16.20	76.36%	69.09%	67.27%	36.36%	0.40	27.90%
5	3	184.67	0.00	23.00	8.00	23.00	0.00%	45.45%	12.12%	60.61%	0.33	15.89%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-93—Post-Operative PE or DVT (PSI-12) (All-Payer), VTE												
			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	5	69.40	25.00	25.60	0.00	21.80	75.25%	76.57%	1.54%	65.76%	0.00	(3.39%)
2	4	78.25	0.00	23.25	0.00	10.25	0.00%	37.27%	0.00%	25.17%	0.25	17.95%
3	3	74.33	25.33	24.67	27.33	17.00	63.49%	58.04%	52.67%	25.28%	0.33	21.38%
4	4	64.50	9.00	8.25	0.00	0.00	20.96%	13.99%	0.00%	0.00%	0.25	14.49%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-94—30-Day All-Cause Medicare Readmissions, Readmissions												
			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	9	61.00	6.22	14.33	0.00	0.89	15.87%	33.83%	0.00%	0.92%	0.78	5.85%
2	5	402.00	2.20	23.60	8.60	23.60	5.71%	42.86%	13.81%	43.81%	1.00	5.60%
3	5	91.40	26.00	26.00	0.40	25.20	68.66%	69.13%	1.43%	67.23%	1.40	5.84%
4	9	84.33	25.11	24.11	25.22	21.44	61.38%	56.08%	47.88%	41.96%	1.67	5.67%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-95—30-Day All-Cause All-Payer Readmissions, Readmissions												
			Average Activity Experience (in Months)				Average Percentage of Data Points with Activity				Outcomes	
Cluster	Number HENs	Average Number of Hospitals	Tools	Education	Leadership	Coaching	Tools (%)	Education (%)	Leadership (%)	Coaching (%)	Average Number of ITS Breakpoints	Average Percentage Improvement
1	5	48.20	1.20	7.60	0.00	0.60	4.62%	21.53%	0.00%	1.18%	0.40	4.87%
2	8	76.50	17.88	23.88	0.625	19.50	58.39%	71.03%	2.50%	60.76%	0.63	6.76%
3	4	41.50	24.75	24.25	25.25	18.50	68.33%	59.08%	64.20%	49.44%	0.50	6.97%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Interrupted Time Series (ITS) Stratified by Hospital Engagement Network (HEN) Activity Dosage (Chapter 5)

Chapter 5 presents the results of interrupted time series analysis stratified by the amount of activities the HENs reported providing to their participating hospitals. For each HEN, the number of activities reported within each adverse event area (AEA) was summed, and the distribution of AEA activities across HENs was divided into three groups using the 25th percentile and the median (50th percentile) as thresholds. Once the low, medium, and high activity groups were defined for an AEA, the ITS results for measures within each AEA were stratified by the HEN activity dosage, and summarized. The results in Chapter 5 present the results aggregated across all 11 AEAs. That presentation does not provide a clear understanding of how the results differed across AEAs. Table E-96 through Table E-107 present the results for each AEA individually, and allow the reader to observe the differences in performance for high, medium, and low activity HENs. The results contained in these tables do not provide any clear evidence that HENs engaged in more activities were able to generate greater results among larger proportions of measures, or that they were able to induce structural breaks toward more improvement among the Partnership for Patients (PfP) campaign outcomes. While each of these individual results occurs in one AEA or another, the patterns do not coalesce in a single AEA to provide evidence of a clear dose-response relationship between HEN activities and reductions in patient harms.

Table E-96—Stratification of Outcome Metrics by Activity Level

Results	Level of Activity							
	Low		Medium		High		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	21.98%	153	20.00%	69	21.27%	94	21.31%	316
Percent of Measures that Met 40%/20% Goal	19.68%	137	21.45%	74	25.57%	113	21.85%	324
Percent of Measures that Did Not Meet Goal	54.13%	406	57.71%	202	52.11%	235	54.35%	843
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-34.03%	270	-34.76%	159	-40.32%	187	-36.13%	616
Average Change in Rate (No Sig Change)	-5.78%	334	-6.44%	144	-2.05%	196	-4.84%	674
Average Change in Rate (Worsening)	62.47%	73	84.40%	35	97.10%	52	78.52%	160
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	17.92%	98	26.21%	81	25.43%	104	22.37%	283
Percent of Measures with No Significant Break	67.64%	370	58.58%	181	55.99%	229	61.66%	780
Percent of Measures with Break Toward Less Improvement	14.44%	79	15.21%	47	18.58%	76	15.97%	202
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	10.60%	58	14.24%	44	11.49%	47	11.78%	149
Overall Rate Reduction and no Break or Break Toward Less Improvement	34.00%	186	33.66%	104	31.05%	127	32.96%	417
No Rate Change	46.44%	254	41.42%	128	45.23%	185	44.82%	567
Overall Rate Increase	8.96%	49	10.68%	33	12.22%	50	10.43%	132

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-97—Stratification of Outcome Measures, Adverse Drug Events (ADEs)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	13.25%	11	14.29%	8	23.53%	8	15.61%	27
Percent of Measures that Met 40%/20% Goal	22.89%	19	33.93%	19	20.59%	7	26.01%	45
Percent of Measures that Did Not Meet Goal	60.92%	53	50.00%	29	54.29%	19	56.11%	101
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-37.89%	31	-43.32%	29	-41.75%	16	-40.77%	76
Average Change in Rate (No Sig Change)	9.02%	32	-2.46%	19	0.43%	9	4.10%	60
Average Change in Rate (Worsening)	35.74%	17	84.20%	8	102.20%	9	64.74%	34
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	16.67%	7	39.22%	20	29.63%	8	29.17%	35
Percent of Measures with No Significant Break	54.76%	23	50.98%	26	44.44%	12	50.83%	61
Percent of Measures with Break Toward Less Improvement	28.57%	12	9.80%	5	25.93%	7	20.00%	24
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	9.52%	4	25.49%	13	11.11%	3	16.67%	20
Overall Rate Reduction and no Break or Break Toward Less Improvement	42.86%	18	29.41%	15	37.04%	10	35.83%	43
No Rate Change	33.33%	14	29.41%	15	22.22%	6	29.17%	35
Overall Rate Increase	14.29%	6	15.69%	8	29.63%	8	18.33%	22

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
[1]Low activity HENs engaged in 10 or fewer activities.
[2]Medium activity HENs engaged in between 11 and 21 activities.
[3]High activity HENs engaged in 22 activities or more.

Table E-98—Stratification of Outcome Measures, Catheter-Associated Urinary Tract Infection (CAUTI)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	19.54%	17	9.30%	4	18.03%	11	16.75%	32
Percent of Measures that Met 40%/20% Goal	12.64%	11	0	0	6.56%	4	7.85%	15
Percent of Measures that Did Not Meet Goal	67.05%	59	90.70%	39	73.02%	46	74.23%	144
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-26.90%	32	-16.45%	12	-23.38%	21	-23.83%	65
Average Change in Rate (No Sig Change)	-16.88%	34	1.54%	15	-2.59%	20	-8.73%	69
Average Change in Rate (Worsening)	24.33%	9	36.60%	9	60.51%	13	43.06%	31
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	24.62%	16	33.33%	11	38.46%	20	31.33%	47
Percent of Measures with No Significant Break	64.62%	42	48.48%	16	42.31%	22	53.33%	80
Percent of Measures with Break Toward Less Improvement	10.77%	7	18.18%	6	19.23%	10	15.33%	23
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	9.23%	6	9.09%	3	9.62%	5	9.33%	14
Overall Rate Reduction and no Break or Break Toward Less Improvement	33.85%	22	27.27%	9	28.85%	15	30.67%	46
No Rate Change	44.62%	29	39.39%	13	36.54%	19	40.67%	61
Overall Rate Increase	12.31%	8	24.24%	8	25.00%	13	19.33%	29

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
[1]Low activity HENs engaged in 10 or fewer activities.
[2]Medium activity HENs engaged in between 11 and 21 activities.
[3]High activity HENs engaged in 22 activities or more.

Table E-99—Stratification of Outcome Measures, Central Line-Associated Blood Stream Infection (CLABSI)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	32.61%	30	26.92%	7	30.36%	17	31.03%	54
Percent of Measures that Met 40%/20% Goal	11.96%	11	11.54%	3	30.36%	17	17.82%	31
Percent of Measures that Did Not Meet Goal	54.26%	51	55.17%	16	37.29%	22	48.90%	89
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-31.13%	41	-22.00%	6	-32.58%	34	-31.06%	81
Average Change in Rate (No Sig Change)	-3.87%	45	-4.14%	19	-7.00%	21	-4.70%	85
Average Change in Rate (Worsening)	5.43%	6	23.91%	1	149.24%	1	25.72%	8
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	21.43%	18	19.23%	5	15.38%	8	19.14%	31
Percent of Measures with No Significant Break	65.48%	55	65.38%	17	65.38%	34	65.43%	106
Percent of Measures with Break Toward Less Improvement	13.10%	11	15.38%	4	19.23%	10	15.43%	25
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	14.29%	12	3.85%	1	13.46%	7	12.35%	20
Overall Rate Reduction and no Break or Break Toward Less Improvement	34.52%	29	19.23%	5	48.08%	25	36.42%	59
No Rate Change	45.24%	38	73.08%	19	38.46%	20	47.53%	77
Overall Rate Increase	5.95%	5	3.85%	1	0	0	3.70%	6

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 10 or fewer activities.

[2]Medium activity HENs engaged in between 11 and 17 activities.

[3]High activity HENs engaged in 18 activities or more.

Table E-100—Stratification of Outcome Measures, Falls

Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	25.00%	14	21.95%	9	21.43%	6	23.20%	29
Percent of Measures that Met 40%/20% Goal	16.07%	9	12.20%	5	10.71%	3	13.60%	17
Percent of Measures that Did Not Meet Goal	58.93%	33	65.85%	27	67.86%	19	63.20%	79
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-32.36%	30	-24.85%	29	-23.13%	8	-28.01%	67
Average Change in Rate (No Sig Change)	-4.78%	23	-5.30%	11	-3.02%	17	-4.31%	51
Average Change in Rate (Worsening)	216.02%	1	13.74%	1	33.92%	3	66.31%	5
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	18.18%	8	16.22%	6	28.57%	8	20.18%	22
Percent of Measures with No Significant Break	61.36%	27	62.16%	23	53.57%	15	59.63%	65
Percent of Measures with Break Toward Less Improvement	20.45%	9	21.62%	8	17.86%	5	20.18%	22
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	11.36%	5	13.51%	5	7.14%	2	11.01%	12
Overall Rate Reduction and no Break or Break Toward Less Improvement	50.00%	22	59.46%	22	21.43%	6	45.87%	50
No Rate Change	36.36%	16	24.32%	9	60.71%	17	38.53%	42
Overall Rate Increase	2.27%	1	2.70%	1	10.71%	3	4.59%	5

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 9 or fewer activities.

[2]Medium activity HENs engaged in between 10 and 20 activities.

[3]High activity HENs engaged in 21 activities or more.

Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	7.14%	1	0	0	12.50%	2	7.32%	3
Percent of Measures that Met 40%/20% Goal	78.57%	11	90.91%	10	75.00%	12	80.49%	33
Percent of Measures that Did Not Meet Goal	13.33%	2	9.09%	1	12.50%	2	11.90%	5
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-77.19%	10	-67.32%	9	-82.60%	11	-76.22%	30
Average Change in Rate (No Sig Change)	-47.73%	2	-72.73%	1	-22.71%	4	-37.01%	7
Average Change in Rate (Worsening)	117.63%	2	77.06%	1	383.26%	1	173.90%	4
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	33.33%	3	9.09%	1	50.00%	5	30.00%	9
Percent of Measures with No Significant Break	44.44%	4	36.36%	4	10.00%	1	30.00%	9
Percent of Measures with Break Toward Less Improvement	22.22%	2	54.55%	6	40.00%	4	40.00%	12
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	22.22%	2	9.09%	1	50.00%	5	26.67%	8
Overall Rate Reduction and no Break or Break Toward Less Improvement	44.44%	4	72.73%	8	40.00%	4	53.33%	16
No Rate Change	11.11%	1	9.09%	1	0	0	6.67%	2
Overall Rate Increase	22.22%	2	9.09%	1	10.00%	1	13.33%	4

Table E-101—Stratification of Outcome Measures, Obstetrical Early Elective Deliveries (OB-EEDs)

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 6 or fewer activities.

[2]Medium activity HENs engaged in between 7 and 12 activities.

[3]High activity HENs engaged in 13 activities or more.

Table E-102—Stratification of Outcome Measures, Other Obstetrical Adverse Events (OB-Other)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	13.70%	10	11.54%	3	17.65%	9	14.67%	22
Percent of Measures that Met 40%/20% Goal	13.70%	10	15.38%	4	21.57%	11	16.67%	25
Percent of Measures that Did Not Meet Goal	68.83%	53	73.08%	19	60.78%	31	66.88%	103
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-31.12%	18	-31.04%	8	-42.88%	16	-35.59%	42
Average Change in Rate (No Sig Change)	-2.63%	45	-6.45%	15	-12.58%	29	-6.52%	89
Average Change in Rate (Worsening)	57.73%	10	21.33%	3	42.24%	6	47.09%	19
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	10.20%	5	20.83%	5	30.00%	15	20.33%	25
Percent of Measures with No Significant Break	83.67%	41	75.00%	18	52.00%	26	69.11%	85
Percent of Measures with Break Toward Less Improvement	6.12%	3	4.17%	1	18.00%	9	10.57%	13
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	6.12%	3	12.50%	3	8.00%	4	8.13%	10
Overall Rate Reduction and no Break or Break Toward Less Improvement	30.61%	15	12.50%	3	22.00%	11	23.58%	29
No Rate Change	55.10%	27	62.50%	15	58.00%	29	57.72%	71
Overall Rate Increase	8.16%	4	12.50%	3	12.00%	6	10.57%	13

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 4 or fewer activities.

[2]Medium activity HENs engaged in between 5 and 18 activities.

[3]High activity HENs engaged in 19 activities or more.

Table E-103—Stratification of Outcome Measures, Pressure Ulcers								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	31.94%	23	40.00%	18	25.00%	11	32.30%	52
Percent of Measures that Met 40%/20% Goal	27.78%	20	33.33%	15	63.64%	28	39.13%	63
Percent of Measures that Did Not Meet Goal	40.28%	29	26.67%	12	11.36%	5	28.57%	46
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-45.98%	27	-43.50%	26	-57.56%	31	-49.48%	84
Average Change in Rate (No Sig Change)	-14.34%	36	-20.22%	14	-39.15%	13	-20.77%	63
Average Change in Rate (Worsening)	108.73%	8	195.12%	5	0	0	141.96%	13
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	12.31%	8	24.44%	11	10.00%	4	15.33%	23
Percent of Measures with No Significant Break	83.08%	54	57.78%	26	77.50%	31	74.00%	111
Percent of Measures with Break Toward Less Improvement	4.62%	3	17.78%	8	12.50%	5	10.67%	16
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	6.15%	4	15.56%	7	7.50%	3	9.33%	14
Overall Rate Reduction and no Break or Break Toward Less Improvement	33.85%	22	42.22%	19	62.50%	25	44.00%	66
No Rate Change	50.77%	33	31.11%	14	30.00%	12	39.33%	59
Overall Rate Increase	9.23%	6	11.11%	5	0	0	7.33%	11

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
[1]Low activity HENs engaged in 8 or fewer activities.
[2]Medium activity HENs engaged in between 9 and 15 activities.
[3]High activity HENs engaged in 16 activities or more.

Table E-104—Stratification of Outcome Measures, Readmissions								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	20.00%	8	22.22%	4	10.34%	3	17.24%	15
Percent of Measures that Met 40%/20% Goal	5.00%	2	11.11%	2	34.48%	10	16.09%	14
Percent of Measures that Did Not Meet Goal	73.17%	30	66.67%	12	55.17%	16	65.91%	58
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-8.76%	32	-10.56%	17	-16.68%	21	-11.57%	70
Average Change in Rate (No Sig Change)	1.62%	8	-2.88%	1	-14.14%	6	-4.99%	15
Average Change in Rate (Worsening)	0	0	0	0	12.76%	2	12.76%	2
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	25.64%	10	28.57%	4	34.48%	10	29.27%	24
Percent of Measures with No Significant Break	41.03%	16	42.86%	6	37.93%	11	40.24%	33
Percent of Measures with Break Toward Less Improvement	33.33%	13	28.57%	4	27.59%	8	30.49%	25
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	20.51%	8	28.57%	4	17.24%	5	20.73%	17
Overall Rate Reduction and no Break or Break Toward Less Improvement	58.97%	23	71.43%	10	55.17%	16	59.76%	49
No Rate Change	20.51%	8	0	0	20.69%	6	17.07%	14
Overall Rate Increase	0	0	0	0	6.90%	2	2.44%	2

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 13 or fewer activities.

[2]Medium activity HENs engaged in between 14 and 23 activities.

[3]High activity HENs engaged in 24 activities or more.

Table E-105—Stratification of Outcome Measures, Surgical Site Infections (SSI)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	18.52%	15	26.32%	5	17.65%	9	19.21%	29
Percent of Measures that Met 40%/20% Goal	24.69%	20	10.53%	2	11.76%	6	18.54%	28
Percent of Measures that Did Not Meet Goal	56.10%	46	63.16%	12	69.23%	36	61.44%	94
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-48.25%	14	-42.52%	5	-32.99%	6	-43.44%	25
Average Change in Rate (No Sig Change)	-1.73%	59	1.57%	12	13.01%	36	3.60%	107
Average Change in Rate (Worsening)	61.75%	7	95.84%	2	111.56%	9	90.45%	18
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	11.84%	9	36.84%	7	15.69%	8	16.44%	24
Percent of Measures with No Significant Break	78.95%	60	57.89%	11	74.51%	38	74.66%	109
Percent of Measures with Break Toward Less Improvement	9.21%	7	5.26%	1	9.80%	5	8.90%	13
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	6.58%	5	15.79%	3	1.96%	1	6.16%	9
Overall Rate Reduction and no Break or Break Toward Less Improvement	11.84%	9	10.53%	2	9.80%	5	10.96%	16
No Rate Change	72.37%	55	63.16%	12	70.59%	36	70.55%	103
Overall Rate Increase	9.21%	7	10.53%	2	17.65%	9	12.33%	18

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.
[1]Low activity HENs engaged in 10 or fewer activities.
[2]Medium activity HENs engaged in between 11 and 13 activities.
[3]High activity HENs engaged in 14 activities or more.

Table E-106—Stratification of Outcome Measures, Ventilator-Associated Pneumonia (VAP)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	22.41%	13	17.95%	7	7.69%	3	16.91%	23
Percent of Measures that Met 40%/20% Goal	31.03%	18	30.77%	12	17.95%	7	27.21%	37
Percent of Measures that Did Not Meet Goal	45.76%	27	51.28%	20	70.73%	29	54.68%	76
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-46.43%	18	-53.40%	14	-69.33%	7	-53.04%	39
Average Change in Rate (No Sig Change)	-16.79%	28	-12.40%	22	31.50%	26	1.00%	76
Average Change in Rate (Worsening)	107.68%	12	130.79%	3	79.66%	6	102.98%	21
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	28.57%	12	25.00%	7	20.51%	8	24.77%	27
Percent of Measures with No Significant Break	64.29%	27	64.29%	18	61.54%	24	63.30%	69
Percent of Measures with Break Toward Less Improvement	7.14%	3	10.71%	3	17.95%	7	11.93%	13
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	21.43%	9	14.29%	4	12.82%	5	16.51%	18
Overall Rate Reduction and no Break or Break Toward Less Improvement	19.05%	8	25.00%	7	5.13%	2	15.60%	17
No Rate Change	38.10%	16	53.57%	15	66.67%	26	52.29%	57
Overall Rate Increase	21.43%	9	7.14%	2	15.38%	6	15.60%	17

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
[1]Low activity HENs engaged in 8 or fewer activities.
[2]Medium activity HENs engaged in between 9 and 12 activities.
[3]High activity HENs engaged in 13 activities or more.

Table E-107—Stratification of Outcome Measures, Venous Thromboembolism (VTE)								
Results	Level of Activity							
	Low[1]		Medium[2]		High[3]		Total	
	Percent	N	Percent	N	Percent	N	Percent	N
Goal Performance								
Percent of Measures that Met 17.6%/10% Goal	27.50%	11	19.05%	4	45.45%	15	31.91%	30
Percent of Measures that Met 40%/20% Goal	15.00%	6	9.52%	2	24.24%	8	17.02%	16
Percent of Measures that Did Not Meet Goal	57.50%	23	71.43%	15	30.30%	10	51.06%	48
Measures Tested for Overall Change								
Average Change in Rate (Improving)	-31.77%	17	-23.86%	4	-42.19%	16	-35.42%	37
Average Change in Rate (No Sig Change)	-3.32%	22	-3.83%	15	-26.17%	15	-10.06%	52
Average Change in Rate (Worsening)	77.91%	1	106.37%	2	473.68%	2	247.60%	5
Changes in Measure Trends (ITS)								
Percent of Measures with Break Toward Greater Improvement	6.25%	2	19.05%	4	32.26%	10	19.05%	16
Percent of Measures with No Significant Break	65.63%	21	76.19%	16	48.39%	15	61.90%	52
Percent of Measures with Break Toward Less Improvement	28.13%	9	4.76%	1	19.35%	6	19.05%	16
Key Trend Profiles								
Overall Rate Reduction and Break Toward Greater Improvement	0	0	0	0	22.58%	7	8.33%	7
Overall Rate Reduction and no Break or Break Toward Less Improvement	43.75%	14	19.05%	4	25.81%	8	30.95%	26
No Rate Change	53.13%	17	71.43%	15	45.16%	14	54.76%	46
Overall Rate Increase	3.13%	1	9.52%	2	6.45%	2	5.95%	5

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

[1]Low activity HENs engaged in 8 or fewer activities.

[2]Medium activity HENs engaged in between 9 and 15 activities.

[3]High activity HENs engaged in 16 activities or more.

Interrupted Time Series (ITS) By Hospital Engagement Network (HEN) (Chapter 5)

Chapter 5 presents results based on ITS analyses by HEN. To facilitate the comparison of performance across HENs, the results are presented in a summary format that assesses overall performance. In contrast to the summary discussion presented in Chapter 5, Table E-108 through Table E-136 provides detailed results for each HEN, and each adverse event area (AEA) within HENs.[E-25] The tables include results for several key dimensions of the data. First, each table presents the percentage of measures that are widely-reported and consistently reported, and the percentage that are not widely-reported or consistently reported. Second, the tables prove the percentage of measures that met the 17.6 percent/10 percent goals and the 40 percent/20 percent goals of the campaign. Third, the table presents the number of measures that improved significantly, worsened significantly, or exhibited no significant change over time between the baseline rates and most recent 90 days of data; and also presents the average percentage change across measures within the AEA. Fourth, from the ITS analysis, the percentage of measures exhibiting structural breaks toward more improvement over time, or toward less improvement over time is presented. Finally, the table presents the percentage of measures falling into key trend profiles including, measures that improved overall and exhibited structural breaks toward more improvement. The results presented in the following tables are broken out by HEN-cohorts for the four HENs that reported identifiable hospital lists for multiple cohorts (i.e., Ascension, JCR, Michigan, and Ohio Children's HENs).

Table E-108—Summary of Outcome Measures, AHA/HRET

Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	109	11	10	10	9	4	11	12	8	14	9	11
Widely Consistent	11.01%	0.00%	20.00%	40.00%	0.00%	0.00%	9.09%	8.33%	25.00%	0.00%	11.11%	9.09%
Not Widely Consistent	88.99%	100.00%	80.00%	60.00%	100.00%	100.00%	90.91%	91.67%	75.00%	100.00%	88.89%	90.91%
Goal Performance												
Number of Outcomes	109	11	10	10	9	4	11	12	8	14	9	11
Meeting 17.6%/10% Goal	57.80%	45.45%	40.00%	70.00%	44.44%	75.00%	45.45%	83.33%	62.50%	42.86%	66.67%	72.73%
Meeting 40%/20% Goal	30.28%	45.45%	0.00%	20.00%	11.11%	75.00%	27.27%	41.67%	0.00%	28.57%	44.44%	54.55%
Measure Tested for Overall Change												
Measure with Change Tested	108	11	9	10	9	4	11	12	8	14	9	11
Improving Measures												
Improving Measures	61	6	3	8	7	3	5	9	3	5	5	7
Average Change Improving	39.24%	-43.08%	-24.48%	-32.69%	-27.57%	-66.87%	-36.29%	-46.46%	-31.77%	-55.86%	-57.17%	-20.94%
Measures without Significant Change												
Not Significant Measures	37	2	5	2	2	0	5	2	5	8	3	3

[E-25] AEAs: adverse drug events (ADE), catheter-associated urinary tract infection (CAUTI), central line-associated blood stream infection (CLABSI), obstetrical early elective deliveries (OB-EED), other obstetrical adverse events (OB-Other), pressure ulcers, surgical site infections (SSI), ventilator-associated pneumonia (VAP), venous thromboembolism (VTE), and readmissions (Readm)

Table E-108—Summary of Outcome Measures, AHA/HRET												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Average Change Not Significant	-8.48%	-6.74%	-8.92%	1.59%	-3.28%	.	-15.57%	-15.48%	0.53%	2.99%	-38.99%	-17.67%
Worsening Measures												
Worsened Measures	10	3	1	0	0	1	1	1	0	1	1	1
Average Change Worsened	169.88%	139.52%	20.64%	.	.	77.06%	4.99%	194.92%	.	23.09%	946.48%	13.07%
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	105	11	9	10	9	4	10	12	8	12	9	11
Trend Showing Improvement	30.48%	45.45%	0.00%	30.00%	11.11%	0.00%	30.00%	25.00%	62.50%	41.67%	22.22%	45.45%
Trend Showing No Change	45.71%	45.45%	77.78%	60.00%	55.56%	25.00%	30.00%	50.00%	37.50%	33.33%	55.56%	27.27%
Trend Showing Worsening	23.81%	9.09%	22.22%	10.00%	33.33%	75.00%	40.00%	25.00%	0.00%	25.00%	22.22%	27.27%
Key Trend Profiles												
Total Trend Profile Measures	105	11	9	10	9	4	10	12	8	12	9	11
Trend Improvement Level	8.10%	27.27%	0.00%	30.00%	11.11%	0.00%	10.00%	25.00%	37.50%	16.67%	11.11%	18.18%
Level Improvement	38.10%	27.27%	33.33%	50.00%	66.67%	75.00%	30.00%	50.00%	0.00%	16.67%	44.44%	45.45%
No Change	34.29%	18.18%	55.56%	20.00%	22.22%	0.00%	50.00%	16.67%	62.50%	58.33%	33.33%	27.27%
Worsened	9.52%	27.27%	11.11%	0.00%	0.00%	25.00%	10.00%	8.33%	0.00%	8.33%	11.11%	9.09%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-109—Summary of Outcome Measures, Ascension Cohort 1

TYPE	All AEA	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	51	11	6	6	2	1	5	4	4	6	3	3
Widely Consistent	84.31%	54.55%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	75.00%	100.00%	100.00%	100.00%
Not Widely Consistent	15.69%	45.45%	33.33%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	51	11	6	6	2	1	5	4	4	6	3	3
Meeting 17.6%/10% Goal	35.29%	54.55%	0.00%	83.33%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	66.67%	0.00%
Meeting 40%/20% Goal	7.84%	9.09%	0.00%	33.33%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	50	11	5	6	2	1	5	4	4	6	3	3
Improving Measures												
Improving Measures	19	6	1	4	1	1	0	2	0	0	2	2
Average Change Improving	-25.56%	-24.89%	-3.41%	-35.42%	-8.19%	-77.31%	.	-26.88%	.	.	-18.82%	-7.19%
Measures without Significant Change												
Not Significant Measures	24	4	1	2	1	0	5	2	2	5	1	1
Average Change Not Significant	6.80%	4.30%	2.05%	-13.73%	-16.90%	.	5.76%	-23.03%	27.38%	33.96%	-18.55%	-0.54%
Worsening Measures												
Worsened Measures	7	1	3	0	0	0	0	0	2	1	0	0
Average Change Worsened	92.16%	71.20%	70.67%	.	.	.	.	.	168.23%	25.45%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	50	11	5	6	2	1	5	4	4	6	3	3
Trend Showing Improvement	36.00%	63.64%	20.00%	16.67%	50.00%	100.00%	20.00%	75.00%	25.00%	0.00%	33.33%	33.33%
Trend Showing No Change	48.00%	27.27%	20.00%	83.33%	50.00%	0.00%	80.00%	25.00%	75.00%	66.67%	66.67%	0.00%
Trend Showing Worsening	16.00%	9.09%	60.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	0.00%	66.67%
Key Trend Profiles												
Total Trend Profile Measures	50	11	5	6	2	1	5	4	4	6	3	3
Trend Improvement Level	20.00%	45.45%	20.00%	16.67%	0.00%	100.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%
Level Improvement	18.00%	9.09%	0.00%	50.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.67%	66.67%
No Change	48.00%	36.36%	20.00%	33.33%	50.00%	0.00%	100.00%	50.00%	50.00%	83.33%	33.33%	33.33%
Worsened	14.00%	9.09%	60.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	16.67%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-110—Summary of Outcome Measures, Ascension Cohort 2												
TYPE	All AEA	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	41	10	4	4	2	1	5	3	2	6	2	2
Widely Consistent	34.15%	20.00%	0.00%	50.00%	100.00%	0.00%	0.00%	0.00%	100.00%	100.00%	0.00%	0.00%
Not Widely Consistent	65.85%	80.00%	100.00%	50.00%	0.00%	100.00%	100.00%	100.00%	0.00%	0.00%	100.00%	100.00%
Goal Performance												
Number of Outcomes	41	10	4	4	2	1	5	3	2	6	2	2
Meeting 17.6%/10% Goal	26.83%	20.00%	0.00%	75.00%	50.00%	100.00%	0.00%	33.33%	50.00%	0.00%	50.00%	50.00%
Meeting 40%/20% Goal	17.07%	20.00%	0.00%	50.00%	0.00%	100.00%	0.00%	33.33%	0.00%	0.00%	0.00%	50.00%
Measure Tested for Overall Change												
Measure with Change Tested	41	10	4	4	2	1	5	3	2	6	2	2
Improving Measures												
Improving Measures	6	3	0	2	0	0	0	0	0	0	0	1
Average Change Improving	-39.24%	-42.20%	.	-44.20%	.	.	.	.	.	.	.	-20.47%
Measures without Significant Change												
Not Significant Measures	29	6	2	2	2	1	5	1	2	5	2	1
Average Change Not Significant	7.52%	15.14%	16.55%	-20.74%	-20.97%	-72.73%	8.21%	-100.00%	7.34%	63.24%	-8.36%	-4.86%
Worsening Measures												
Worsened Measures	6	1	2	0	0	0	0	2	0	1	0	0
Average Change Worsened	95.44%	145.05%	15.29%	.	.	.	.	175.16%	.	46.68%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	38	7	4	4	2	1	5	3	2	6	2	2
Trend Showing Improvement	31.58%	0.00%	50.00%	25.00%	0.00%	0.00%	60.00%	100.00%	0.00%	16.67%	50.00%	50.00%
Trend Showing No Change	60.53%	100.00%	50.00%	75.00%	100.00%	100.00%	20.00%	0.00%	100.00%	66.67%	50.00%	0.00%
Trend Showing Worsening	7.89%	0.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.00%	0.00%	16.67%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	38	7	4	4	2	1	5	3	2	6	2	2
Trend Improvement Level	5.26%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%
Level Improvement	10.53%	42.86%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
No Change	68.42%	42.86%	50.00%	50.00%	100.00%	100.00%	100.00%	33.33%	100.00%	83.33%	100.00%	50.00%
Worsened	15.79%	14.29%	50.00%	0.00%	0.00%	0.00%	0.00%	66.67%	0.00%	16.67%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-111—Summary of Outcome Measures, Carolinas												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	48	3	6	6	5	1	5	6	6	4	3	3
Widely Consistent	83.33%	100.00%	83.33%	83.33%	60.00%	100.00%	100.00%	50.00%	100.00%	75.00%	100.00%	100.00%
Not Widely Consistent	16.67%	0.00%	16.67%	16.67%	40.00%	0.00%	0.00%	50.00%	0.00%	25.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	48	3	6	6	5	1	5	6	6	4	3	3
Meeting 17.6%/10% Goal	45.83%	100.00%	33.33%	33.33%	80.00%	100.00%	80.00%	16.67%	33.33%	25.00%	33.33%	33.33%
Meeting 40%/20% Goal	20.83%	66.67%	16.67%	16.67%	0.00%	100.00%	40.00%	0.00%	33.33%	25.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	47	3	5	6	5	1	5	6	6	4	3	3
Improving Measures												
Improving Measures	20	3	2	2	4	1	3	0	1	1	0	3
Average Change Improving	-40.69%	-38.07%	-46.99%	-42.73%	-27.85%	-72.28%	-66.08%	.	-100.00%	-8.00%	.	-10.08%
Measures without Significant Change												
Not Significant Measures	25	0	3	4	1	0	2	6	4	2	3	0
Average Change Not Significant	-1.30%	.	-2.68%	15.26%	-32.71%	.	-17.49%	7.59%	0.03%	-16.38%	-10.29%	.
Worsening Measures												
Worsened Measures	2	0	0	0	0	0	0	0	1	1	0	0
Average Change Worsened	154.22%	.	.	.	.	.	.	.	114.68%	193.76%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	47	3	5	6	5	1	5	6	6	4	3	3
Trend Showing Improvement	21.28%	33.33%	60.00%	33.33%	20.00%	0.00%	0.00%	0.00%	33.33%	25.00%	0.00%	0.00%
Trend Showing No Change	61.70%	33.33%	40.00%	66.67%	20.00%	0.00%	60.00%	100.00%	66.67%	75.00%	100.00%	66.67%
Trend Showing Worsening	17.02%	33.33%	0.00%	0.00%	60.00%	100.00%	40.00%	0.00%	0.00%	0.00%	0.00%	33.33%
Key Trend Profiles												
Total Trend Profile Measures	47	3	5	6	5	1	5	6	6	4	3	3
Trend Improvement Level	12.77%	33.33%	40.00%	16.67%	20.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%
Level Improvement	29.79%	66.67%	0.00%	16.67%	60.00%	100.00%	60.00%	0.00%	16.67%	0.00%	0.00%	100.00%
No Change	53.19%	0.00%	60.00%	66.67%	20.00%	0.00%	40.00%	100.00%	66.67%	50.00%	100.00%	0.00%
Worsened	4.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.67%	25.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-112—Summary of Outcome Measures, DFW												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	47	6	5	4	3	1	5	7	3	4	3	6
Widely Consistent	74.47%	50.00%	80.00%	75.00%	33.33%	0.00%	100.00%	57.14%	100.00%	75.00%	100.00%	100.00%
Not Widely Consistent	25.53%	50.00%	20.00%	25.00%	66.67%	100.00%	0.00%	42.86%	0.00%	25.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	47	6	5	4	3	1	5	7	3	4	3	6
Meeting 17.6%/10% Goal	55.32%	33.33%	40.00%	25.00%	66.67%	0.00%	60.00%	85.71%	33.33%	75.00%	66.67%	66.67%
Meeting 40%/20% Goal	34.04%	33.33%	40.00%	25.00%	33.33%	0.00%	20.00%	57.14%	0.00%	75.00%	66.67%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	44	5	4	4	3	1	5	7	2	4	3	6
Improving Measures												
Improving Measures	25	2	3	1	3	0	3	3	0	3	2	5
Average Change Improving	-45.04%	-71.08%	-60.03%	-90.09%	-41.54%	.	-34.79%	-65.27%	.	-34.71%	-59.13%	-13.28%
Measures without Significant Change												
Not Significant Measures	15	0	1	3	0	0	2	4	2	1	1	1
Average Change Not Significant	-9.08%	.	-3.90%	-1.10%	.	.	4.83%	-26.02%	20.17%	-75.93%	-0.62%	1.57%
Worsening Measures												
Worsened Measures	4	3	0	0	0	1	0	0	0	0	0	0
Average Change Worsened	44.30%	25.50%	.	.	.	100.69%	.	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	41	3	4	4	3	1	5	7	2	3	3	6
Trend Showing Improvement	12.20%	33.33%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.67%	0.00%	16.67%
Trend Showing No Change	70.73%	33.33%	75.00%	75.00%	66.67%	100.00%	100.00%	100.00%	100.00%	0.00%	33.33%	66.67%
Trend Showing Worsening	17.07%	33.33%	0.00%	25.00%	33.33%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	16.67%
Key Trend Profiles												
Total Trend Profile Measures	41	3	4	4	3	1	5	7	2	3	3	6
Trend Improvement Level	9.76%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.67%	0.00%	16.67%
Level Improvement	51.22%	66.67%	50.00%	25.00%	100.00%	0.00%	60.00%	42.86%	0.00%	33.33%	66.67%	66.67%
No Change	34.15%	0.00%	25.00%	75.00%	0.00%	0.00%	40.00%	57.14%	100.00%	0.00%	33.33%	16.67%
Worsened	4.88%	33.33%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-113—Summary of Outcome Measures, Dignity												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	39	4	4	4	3	1	4	5	4	5	3	2
Widely Consistent	92.31%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	40.00%	100.00%	100.00%	100.00%	100.00%
Not Widely Consistent	7.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	60.00%	0.00%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	39	4	4	4	3	1	4	5	4	5	3	2
Meeting 17.6%/10% Goal	41.03%	50.00%	25.00%	50.00%	66.67%	100.00%	25.00%	60.00%	25.00%	40.00%	33.33%	0.00%
Meeting 40%/20% Goal	20.51%	50.00%	0.00%	25.00%	0.00%	100.00%	0.00%	20.00%	25.00%	20.00%	33.33%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	37	3	3	4	3	1	4	5	4	5	3	2
Improving Measures												
Improving Measures	16	1	3	2	3	1	1	1	0	1	1	2
Average Change Improving	-34.18%	-74.20%	-17.26%	-47.65%	-26.16%	-98.47%	-24.37%	-42.66%	.	-53.53%	-17.09%	-5.51%
Measures without Significant Change												
Not Significant Measures	20	2	0	1	0	0	3	4	4	4	2	0
Average Change Not Significant	-5.20%	-56.19%	.	-0.71%	.	.	-1.71%	-21.28%	9.00%	27.71%	-23.70%	.
Worsening Measures												
Worsened Measures	1	0	0	1	0	0	0	0	0	0	0	0
Average Change Worsened	4.88%	.	.	4.88%	.	.	.	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	36	2	3	4	3	1	4	5	4	5	3	2
Trend Showing Improvement	8.33%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.00%	50.00%
Trend Showing No Change	63.89%	0.00%	66.67%	25.00%	66.67%	0.00%	100.00%	60.00%	100.00%	80.00%	100.00%	0.00%
Trend Showing Worsening	27.78%	100.00%	33.33%	50.00%	33.33%	100.00%	0.00%	40.00%	0.00%	0.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	36	2	3	4	3	1	4	5	4	5	3	2
Trend Improvement Level	5.56%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.00%	50.00%
Level Improvement	38.89%	50.00%	100.00%	50.00%	100.00%	100.00%	25.00%	20.00%	0.00%	0.00%	33.33%	50.00%
No Change	52.78%	50.00%	0.00%	25.00%	0.00%	0.00%	75.00%	80.00%	100.00%	80.00%	66.67%	0.00%
Worsened	2.78%	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-114—Summary of Outcome Measures, EHEN												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	55	5	8	7	5	1	7	6	9	3	2	2
Widely Consistent	72.73%	20.00%	87.50%	85.71%	40.00%	100.00%	85.71%	50.00%	100.00%	33.33%	100.00%	100.00%
Not Widely Consistent	27.27%	80.00%	12.50%	14.29%	60.00%	0.00%	14.29%	50.00%	0.00%	66.67%	0.00%	0.00%
Goal Performance												
Number of Outcomes	55	5	8	7	5	1	7	6	9	3	2	2
Meeting 17.6%/10% Goal	40.00%	60.00%	37.50%	71.43%	0.00%	0.00%	14.29%	83.33%	33.33%	0.00%	100.00%	0.00%
Meeting 40%/20% Goal	10.91%	20.00%	0.00%	42.86%	0.00%	0.00%	0.00%	33.33%	0.00%	0.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	54	5	7	7	5	1	7	6	9	3	2	2
Improving Measures												
Improving Measures	25	3	5	7	0	0	1	5	1	0	1	2
Average Change Improving	-31.40%	-31.95%	-24.73%	-30.91%	.	.	-27.96%	-52.96%	-26.29%	.	-20.83%	-4.64%
Measures without Significant Change												
Not Significant Measures	20	1	2	0	3	0	3	1	7	2	1	0
Average Change Not Significant	-2.49%	-16.76%	-8.15%	.	-1.92%	.	-5.38%	-12.08%	-5.10%	44.08%	-35.24%	.
Worsening Measures												
Worsened Measures	9	1	0	0	2	1	3	0	1	1	0	0
Average Change Worsened	87.58%	119.48%	.	.	31.51%	383.26%	28.33%	.	43.05%	94.42%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	54	5	7	7	5	1	7	6	9	3	2	2
Trend Showing Improvement	16.67%	20.00%	14.29%	14.29%	20.00%	0.00%	14.29%	0.00%	22.22%	0.00%	50.00%	50.00%
Trend Showing No Change	66.67%	60.00%	57.14%	57.14%	60.00%	0.00%	71.43%	100.00%	77.78%	100.00%	50.00%	0.00%
Trend Showing Worsening	16.67%	20.00%	28.57%	28.57%	20.00%	100.00%	14.29%	0.00%	0.00%	0.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	54	5	7	7	5	1	7	6	9	3	2	2
Trend Improvement Level	7.41%	0.00%	14.29%	14.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	50.00%
Level Improvement	38.89%	60.00%	57.14%	85.71%	0.00%	0.00%	14.29%	83.33%	11.11%	0.00%	0.00%	50.00%
No Change	37.04%	20.00%	28.57%	0.00%	60.00%	0.00%	42.86%	16.67%	77.78%	66.67%	50.00%	0.00%
Worsened	16.67%	20.00%	0.00%	0.00%	40.00%	100.00%	42.86%	0.00%	11.11%	33.33%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-115—Summary of Outcome Measures, Georgia												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	57	9	10	9	4	1	3	6	7	3	2	3
Widely Consistent	52.63%	11.11%	40.00%	66.67%	50.00%	100.00%	100.00%	50.00%	42.86%	66.67%	100.00%	100.00%
Not Widely Consistent	47.37%	88.89%	60.00%	33.33%	50.00%	0.00%	0.00%	50.00%	57.14%	33.33%	0.00%	0.00%
Goal Performance												
Number of Outcomes	57	9	10	9	4	1	3	6	7	3	2	3
Meeting 17.6%/10% Goal	40.35%	55.56%	30.00%	55.56%	25.00%	100.00%	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%
Meeting 40%/20% Goal	17.54%	22.22%	10.00%	11.11%	0.00%	100.00%	0.00%	83.33%	0.00%	0.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	56	9	9	9	4	1	3	6	7	3	2	3
Improving Measures												
Improving Measures	27	5	4	5	2	1	1	4	0	0	2	3
Average Change Improving	-34.06%	-38.72%	-24.93%	-32.77%	-23.06%	-97.56%	-13.58%	-59.14%	.	.	-26.89%	-4.97%
Measures without Significant Change												
Not Significant Measures	20	2	2	4	1	0	2	2	6	1	0	0
Average Change Not Significant	10.64%	11.82%	7.78%	6.64%	-12.28%	.	-10.14%	-46.74%	24.98%	123.26%	.	.
Worsening Measures												
Worsened Measures	9	2	3	0	1	0	0	0	1	2	0	0
Average Change Worsened	116.40%	167.07%	107.39%	.	38.74%	.	.	.	135.30%	108.64%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	51	6	8	9	4	1	3	5	7	3	2	3
Trend Showing Improvement	19.61%	16.67%	37.50%	22.22%	0.00%	0.00%	0.00%	40.00%	0.00%	0.00%	100.00%	0.00%
Trend Showing No Change	62.75%	33.33%	50.00%	66.67%	75.00%	0.00%	100.00%	60.00%	85.71%	100.00%	0.00%	66.67%
Trend Showing Worsening	17.65%	50.00%	12.50%	11.11%	25.00%	100.00%	0.00%	0.00%	14.29%	0.00%	0.00%	33.33%
Key Trend Profiles												
Total Trend Profile Measures	51	6	8	9	4	1	3	5	7	3	2	3
Trend Improvement Level	11.76%	0.00%	0.00%	22.22%	0.00%	0.00%	0.00%	40.00%	0.00%	0.00%	100.00%	0.00%
Level Improvement	31.37%	33.33%	37.50%	33.33%	50.00%	100.00%	33.33%	20.00%	0.00%	0.00%	0.00%	100.00%
No Change	39.22%	33.33%	25.00%	44.44%	25.00%	0.00%	66.67%	40.00%	85.71%	33.33%	0.00%	0.00%
Worsened	17.65%	33.33%	37.50%	0.00%	25.00%	0.00%	0.00%	0.00%	14.29%	66.67%	0.00%	0.00%

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

Table E-116—Summary of Outcome Measures, Iowa												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	50	6	5	5	5	1	7	6	6	4	3	2
Widely Consistent	46.00%	33.33%	20.00%	20.00%	60.00%	100.00%	100.00%	50.00%	0.00%	0.00%	100.00%	100.00%
Not Widely Consistent	54.00%	66.67%	80.00%	80.00%	40.00%	0.00%	0.00%	50.00%	100.00%	100.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	50	6	5	5	5	1	7	6	6	4	3	2
Meeting 17.6%/10% Goal	30.00%	33.33%	0.00%	20.00%	0.00%	100.00%	42.86%	50.00%	50.00%	25.00%	33.33%	0.00%
Meeting 40%/20% Goal	26.00%	33.33%	0.00%	0.00%	0.00%	100.00%	42.86%	50.00%	33.33%	25.00%	33.33%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	49	6	4	5	5	1	7	6	6	4	3	2
Improving Measures												
Improving Measures	16	2	1	0	2	1	2	3	1	1	1	2
Average Change Improving	-53.25%	-70.78%	-15.96%	.	-11.99%	-95.31%	-35.74%	-85.64%	-89.16%	-100.00%	-40.69%	-8.47%
Measures without Significant Change												
Not Significant Measures	30	2	3	5	3	0	5	3	5	2	2	0
Average Change Not Significant	2.19%	-0.66%	-0.39%	0.62%	-4.19%	.	-19.46%	7.79%	2.20%	38.15%	32.09%	.
Worsening Measures												
Worsened Measures	3	2	0	0	0	0	0	0	0	1	0	0
Average Change Worsened	98.34%	147.19%	.	.	.	.	.	.	.	0.65%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	48	5	4	5	5	1	7	6	6	4	3	2
Trend Showing Improvement	27.08%	40.00%	25.00%	20.00%	20.00%	0.00%	28.57%	33.33%	0.00%	75.00%	0.00%	50.00%
Trend Showing No Change	56.25%	20.00%	75.00%	60.00%	60.00%	0.00%	71.43%	66.67%	83.33%	0.00%	100.00%	0.00%
Trend Showing Worsening	16.67%	40.00%	0.00%	20.00%	20.00%	100.00%	0.00%	0.00%	16.67%	25.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	48	5	4	5	5	1	7	6	6	4	3	2
Trend Improvement Level	14.58%	0.00%	25.00%	0.00%	0.00%	0.00%	28.57%	33.33%	0.00%	25.00%	0.00%	50.00%
Level Improvement	18.75%	40.00%	0.00%	0.00%	40.00%	100.00%	0.00%	16.67%	16.67%	0.00%	33.33%	50.00%
No Change	60.42%	20.00%	75.00%	100.00%	60.00%	0.00%	71.43%	50.00%	83.33%	50.00%	66.67%	0.00%
Worsened	6.25%	40.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-117—Summary of Outcome Measures, JCR Cohort 1												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	56	8	6	5	7	3	4	7	4	4	5	3
Widely Consistent	19.64%	0.00%	50.00%	40.00%	0.00%	0.00%	0.00%	14.29%	50.00%	0.00%	20.00%	66.67%
Not Widely Consistent	80.36%	100.00%	50.00%	60.00%	100.00%	100.00%	100.00%	85.71%	50.00%	100.00%	80.00%	33.33%
Goal Performance												
Number of Outcomes	56	8	6	5	7	3	4	7	4	4	5	3
Meeting 17.6%/10% Goal	60.71%	75.00%	33.33%	40.00%	28.57%	100.00%	100.00%	100.00%	25.00%	50.00%	80.00%	33.33%
Meeting 40%/20% Goal	42.86%	62.50%	16.67%	0.00%	0.00%	100.00%	75.00%	100.00%	25.00%	25.00%	40.00%	33.33%
Measure Tested for Overall Change												
Measure with Change Tested	55	8	5	5	7	3	4	7	4	4	5	3
Improving Measures												
Improving Measures	21	4	2	2	1	2	1	3	1	1	2	2
Average Change Improving	-60.02%	-68.05%	-19.21%	-17.56%	-30.63%	-90.32%	-76.39%	-88.15%	-73.07%	-100.00%	-50.66%	-44.03%
Measures without Significant Change												
Not Significant Measures	31	4	3	3	6	1	3	4	2	3	2	0
Average Change Not Significant	-23.89%	-26.16%	-25.86%	13.57%	31.66%	-100.00%	-74.36%	-100.00%	16.06%	9.00%	-62.48%	.
Worsening Measures												
Worsened Measures	3	0	0	0	0	0	0	0	1	0	1	1
Average Change Worsened	129.91%	.	.	.	.	.	.	.	376.39%	.	0.89%	12.45%
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	52	7	5	5	7	2	4	6	4	4	5	3
Trend Showing Improvement	32.69%	42.86%	40.00%	20.00%	28.57%	100.00%	75.00%	16.67%	25.00%	25.00%	0.00%	33.33%
Trend Showing No Change	51.92%	57.14%	60.00%	80.00%	42.86%	0.00%	25.00%	50.00%	75.00%	50.00%	60.00%	33.33%
Trend Showing Worsening	15.38%	0.00%	0.00%	0.00%	28.57%	0.00%	0.00%	33.33%	0.00%	25.00%	40.00%	33.33%
Key Trend Profiles												
Total Trend Profile Measures	52	7	5	5	7	2	4	6	4	4	5	3
Trend Improvement Level	17.31%	28.57%	20.00%	20.00%	0.00%	100.00%	25.00%	0.00%	0.00%	25.00%	0.00%	33.33%
Level Improvement	21.15%	14.29%	20.00%	20.00%	14.29%	0.00%	0.00%	50.00%	25.00%	0.00%	40.00%	33.33%
No Change	55.77%	57.14%	60.00%	60.00%	85.71%	0.00%	75.00%	50.00%	50.00%	75.00%	40.00%	0.00%
Worsened	5.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	20.00%	33.33%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-118—Summary of Outcome Measures, JCR Cohort 2												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	30	4	3	3	4	3	1	3	3	2	2	2
Widely Consistent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Not Widely Consistent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Goal Performance												
Number of Outcomes	30	4	3	3	4	3	1	3	3	2	2	2
Meeting 17.6%/10% Goal	60.00%	50.00%	66.67%	66.67%	75.00%	66.67%	0.00%	66.67%	66.67%	50.00%	0.00%	100.00%
Meeting 40%/20% Goal	46.67%	50.00%	33.33%	33.33%	50.00%	66.67%	0.00%	66.67%	66.67%	50.00%	0.00%	50.00%
Measure Tested for Overall Change												
Measure of Change Tested	30	4	3	3	4	3	1	3	3	2	2	2
Improving Measures												
Improving Measures	9	2	2	0	0	1	0	2	0	0	0	2
Average Change Improving	-59.38%	-71.70%	-37.86%	.	.	-100.00%	.	-84.97%	.	.	.	-22.68%
Measures without Significant Change												
Not Significant Measures	21	2	1	3	4	2	1	1	3	2	2	0
Average Change Not Significant	-12.51%	-16.01%	0.88%	-40.86%	-41.12%	19.89%	0.92%	83.64%	2.61%	-43.26%	4.94%	.
Worsening Measures												
Worsened Measures	0	0	0	0	0	0	0	0	0	0	0	0
Average Change Worsened	.	.	.	.	.	.	.	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	26	3	3	3	4	1	1	2	3	2	2	2
Trend Showing Improvement	11.54%	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	0.00%
Trend Showing No Change	73.08%	100.00%	66.67%	66.67%	25.00%	100.00%	100.00%	50.00%	100.00%	100.00%	50.00%	100.00%
Trend Showing Worsening	15.38%	0.00%	33.33%	33.33%	25.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	26	3	3	3	4	1	1	2	3	2	2	2
Trend Improvement Level	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Level Improvement	30.77%	66.67%	66.67%	0.00%	0.00%	100.00%	0.00%	50.00%	0.00%	0.00%	0.00%	100.00%
No Change	69.23%	33.33%	33.33%	100.00%	100.00%	0.00%	100.00%	50.00%	100.00%	100.00%	100.00%	0.00%
Worsened	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-119—Summary of Outcome Measures, LifePoint												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	53	4	6	6	1	2	10	5	5	2	6	6
Widely Consistent	94.34%	75.00%	100.00%	83.33%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	83.33%	100.00%
Not Widely Consistent	5.66%	25.00%	0.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%
Goal Performance												
Number of Outcomes	53	4	6	6	1	2	10	5	5	2	6	6
Meeting 17.6%/10% Goal	58.49%	75.00%	16.67%	50.00%	100.00%	100.00%	60.00%	100.00%	40.00%	50.00%	83.33%	33.33%
Meeting 40%/20% Goal	28.30%	25.00%	16.67%	0.00%	0.00%	50.00%	30.00%	80.00%	20.00%	50.00%	16.67%	33.33%
Measure Tested for Overall Change												
Measure of Change Tested	52	4	5	6	1	2	10	5	5	2	6	6
Improving Measures												
Improving Measures	23	3	2	0	1	1	5	4	0	1	3	3
Average Change Improving	-43.06%	-52.50%	-34.95%	.	-30.69%	-94.62%	-37.70%	-70.68%	.	-44.42%	-28.08%	-12.57%
Measures without Significant Change												
Not Significant Measures	26	0	3	6	0	1	3	1	5	1	3	3
Average Change Not Significant	3.50%	.	13.08%	-2.76%	.	-30.62%	-21.07%	-32.35%	54.46%	25.61%	-23.83%	-10.62%
Worsening Measures												
Worsened Measures	3	1	0	0	0	0	2	0	0	0	0	0
Average Change Worsened	81.92%	82.32%	.	.	.	.	81.72%	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	50	4	5	6	1	1	10	5	5	2	5	6
Trend Showing Improvement	38.00%	50.00%	40.00%	0.00%	100.00%	100.00%	40.00%	20.00%	20.00%	100.00%	60.00%	33.33%
Trend Showing No Change	48.00%	25.00%	40.00%	83.33%	0.00%	0.00%	50.00%	40.00%	80.00%	0.00%	40.00%	50.00%
Trend Showing Worsening	14.00%	25.00%	20.00%	16.67%	0.00%	0.00%	10.00%	40.00%	0.00%	0.00%	0.00%	16.67%
Key Trend Profiles												
Total Trend Profile Measures	50	4	5	6	1	1	10	5	5	2	5	6
Trend Improvement Level	22.00%	50.00%	0.00%	0.00%	100.00%	100.00%	20.00%	20.00%	0.00%	50.00%	60.00%	0.00%
Level Improvement	24.00%	25.00%	40.00%	0.00%	0.00%	0.00%	30.00%	60.00%	0.00%	0.00%	0.00%	50.00%
No Change	48.00%	0.00%	60.00%	100.00%	0.00%	0.00%	30.00%	20.00%	100.00%	50.00%	40.00%	50.00%
Worsened	6.00%	25.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-120—Summary of Outcome Measures, Michigan Cohort 1												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	45	7	10	4	2	1	6	4	3	3	3	2
Widely Consistent	71.11%	28.57%	100.00%	100.00%	100.00%	100.00%	66.67%	50.00%	100.00%	0.00%	66.67%	100.00%
Not Widely Consistent	28.89%	71.43%	0.00%	0.00%	0.00%	0.00%	33.33%	50.00%	0.00%	100.00%	33.33%	0.00%
Goal Performance												
Number of Outcomes	45	7	10	4	2	1	6	4	3	3	3	2
Meeting 17.6%/10% Goal	42.22%	14.29%	50.00%	50.00%	50.00%	0.00%	33.33%	50.00%	66.67%	66.67%	66.67%	0.00%
Meeting 40%/20% Goal	15.56%	0.00%	10.00%	0.00%	0.00%	0.00%	33.33%	25.00%	33.33%	33.33%	33.33%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	44	7	9	4	2	1	6	4	3	3	3	2
Improving Measures												
Improving Measures	15	2	4	2	1	0	0	2	0	2	1	1
Average Change Improving	-28.62%	-15.94%	-31.86%	-24.18%	-28.25%	.	.	-32.87%	.	-46.69%	-30.68%	-3.51%
Measures without Significant Changes												
Not Significant Measures	22	2	5	2	1	0	4	1	3	1	2	1
Average Change Not Significant	-11.24%	30.07%	-9.45%	-4.82%	-11.65%	.	-28.51%	42.91%	-28.01%	-7.15%	-37.94%	-0.64%
Worsening Measures												
Worsened Measures	7	3	0	0	0	1	2	1	0	0	0	0
Average Change Worsened	66.87%	15.38%	.	.	.	134.56%	95.99%	95.42%	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	31	2	9	3	2	1	1	3	3	3	2	2
Trend Showing Improvement	41.94%	0.00%	55.56%	66.67%	0.00%	100.00%	100.00%	33.33%	33.33%	66.67%	0.00%	0.00%
Trend Showing No Change	45.16%	0.00%	33.33%	33.33%	100.00%	0.00%	0.00%	66.67%	66.67%	33.33%	100.00%	50.00%
Trend Showing Worsening	12.90%	100.00%	11.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	31	2	9	3	2	1	1	3	3	3	2	2
Trend Improvement Level	22.58%	0.00%	22.22%	66.67%	0.00%	0.00%	0.00%	33.33%	0.00%	66.67%	0.00%	0.00%
Level Improvement	25.81%	100.00%	22.22%	0.00%	50.00%	0.00%	0.00%	33.33%	0.00%	0.00%	50.00%	50.00%
No Change	48.39%	0.00%	55.56%	33.33%	50.00%	0.00%	100.00%	33.33%	100.00%	33.33%	50.00%	50.00%
Worsened	3.23%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-121—Summary of Outcome Measures, Michigan Cohort 2												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	29	5	8	2	2	1	3	3	1	2	1	1
Widely Consistent	27.59%	20.00%	0.00%	50.00%	0.00%	100.00%	0.00%	33.33%	0.00%	100.00%	100.00%	100.00%
Not Widely Consistent	72.41%	80.00%	100.00%	50.00%	100.00%	0.00%	100.00%	66.67%	100.00%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	29	5	8	2	2	1	3	3	1	2	1	1
Meeting 17.6%/10% Goal	48.28%	60.00%	62.50%	0.00%	50.00%	100.00%	33.33%	33.33%	0.00%	100.00%	0.00%	0.00%
Meeting 40%/20% Goal	34.48%	40.00%	50.00%	0.00%	50.00%	0.00%	0.00%	33.33%	0.00%	100.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	29	5	8	2	2	1	3	3	1	2	1	1
Improving Measures												
Improving Measures	3	1	1	0	1	0	0	0	0	0	0	0
Average Change Improving	-33.81%	-49.84%	-8.00%	.	-43.60%	.	.	.	.	.	.	.
Measures without Significant Change												
Not Significant Measures	23	3	7	2	1	1	2	3	0	2	1	1
Average Change Not Significant	-8.01%	49.52%	-49.23%	17.03%	11.51%	-33.65%	107.99%	-21.84%	.	-100.00%	47.78%	1.69%
Worsening Measures												
Worsened Measures	3	1	0	0	0	0	1	0	1	0	0	0
Average Change Worsened	159.74%	34.23%	.	.	.	.	247.32%	.	197.68%	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	9	0	5	0	0	1	0	1	1	0	0	1
Trend Showing Improvement	55.56%	.	80.00%	.	.	0.00%	.	100.00%	0.00%	.	.	0.00%
Trend Showing No Change	33.33%	.	20.00%	.	.	100.00%	.	0.00%	100.00%	.	.	0.00%
Trend Showing Worsening	11.11%	.	0.00%	.	.	0.00%	.	0.00%	0.00%	.	.	100.00%
Key Trend Profiles												
Total Trend Profile Measures	9	0	5	0	0	1	0	1	1	0	0	1
Trend Improvement Level	0.00%	.	0.00%	.	.	0.00%	.	0.00%	0.00%	.	.	0.00%
Level Improvement	11.11%	.	20.00%	.	.	0.00%	.	0.00%	0.00%	.	.	0.00%
No Change	77.78%	.	80.00%	.	.	100.00%	.	100.00%	0.00%	.	.	100.00%
Worsened	11.11%	.	0.00%	.	.	0.00%	.	0.00%	100.00%	.	.	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-122—Summary of Outcome Measures, Minnesota												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	44	4	6	6	2	1	6	4	7	3	3	2
Widely Consistent	40.91%	25.00%	0.00%	33.33%	0.00%	0.00%	100.00%	75.00%	0.00%	33.33%	100.00%	100.00%
Not Widely Consistent	59.09%	75.00%	100.00%	66.67%	100.00%	100.00%	0.00%	25.00%	100.00%	66.67%	0.00%	0.00%
Goal Performance												
Number of Outcomes	44	4	6	6	2	1	6	4	7	3	3	2
Meeting 17.6%/10% Goal	45.45%	25.00%	33.33%	66.67%	100.00%	100.00%	0.00%	75.00%	42.86%	66.67%	33.33%	50.00%
Meeting 40%/20% Goal	27.27%	25.00%	16.67%	33.33%	50.00%	100.00%	0.00%	50.00%	42.86%	33.33%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	43	4	5	6	2	1	6	4	7	3	3	2
Improving Measures												
Improving Measures	15	2	2	3	2	1	1	1	0	0	1	2
Average Change Improving	-35.65%	-34.43%	-25.40%	-51.93%	-30.31%	-92.22%	-16.54%	-34.34%	.	.	-35.34%	-10.09%
Measures without Significant Change												
Not Significant Measures	24	1	3	3	0	0	4	2	6	3	2	0
Average Change Not Significant	-19.02%	-4.87%	-19.75%	-14.09%	.	.	10.73%	-84.73%	-22.62%	-25.96%	-5.01%	.
Worsening Measures												
Worsened Measures	4	1	0	0	0	0	1	1	1	0	0	0
Average Change Worsened	77.87%	23.42%	.	.	.	.	10.74%	226.05%	51.25%	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	34	1	4	6	2	0	4	4	7	1	3	2
Trend Showing Improvement	14.71%	100.00%	0.00%	0.00%	0.00%	.	25.00%	0.00%	28.57%	0.00%	0.00%	50.00%
Trend Showing No Change	85.29%	0.00%	100.00%	100.00%	100.00%	.	75.00%	100.00%	71.43%	100.00%	100.00%	50.00%
Trend Showing Worsening	0.00%	0.00%	0.00%	0.00%	0.00%	.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	34	1	4	6	2	0	4	4	7	1	3	2
Trend Improvement Level	8.82%	100.00%	0.00%	0.00%	0.00%	.	25.00%	0.00%	0.00%	0.00%	0.00%	50.00%
Level Improvement	26.47%	0.00%	25.00%	50.00%	100.00%	.	0.00%	25.00%	0.00%	0.00%	33.33%	50.00%
No Change	58.82%	0.00%	75.00%	50.00%	0.00%	.	75.00%	50.00%	85.71%	100.00%	66.67%	0.00%
Worsened	5.88%	0.00%	0.00%	0.00%	0.00%	.	0.00%	25.00%	14.29%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-123—Summary of Outcome Measures, Nevada												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	46	3	8	8	2	1	5	3	6	4	3	3
Widely Consistent	63.04%	0.00%	0.00%	75.00%	0.00%	100.00%	100.00%	100.00%	83.33%	75.00%	100.00%	100.00%
Not Widely Consistent	36.96%	100.00%	100.00%	25.00%	100.00%	0.00%	0.00%	0.00%	16.67%	25.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	46	3	8	8	2	1	5	3	6	4	3	3
Meeting 17.6%/10% Goal	41.30%	33.33%	12.50%	37.50%	100.00%	100.00%	40.00%	100.00%	50.00%	75.00%	0.00%	0.00%
Meeting 40%/20% Goal	21.74%	33.33%	0.00%	12.50%	100.00%	100.00%	20.00%	0.00%	33.33%	50.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	45	3	7	8	2	1	5	3	6	4	3	3
Improving Measures												
Improving Measures	15	2	3	2	2	1	1	1	0	0	0	3
Average Change Improving	-28.52%	-42.36%	-18.03%	-7.98%	-48.69%	-91.10%	-34.86%	-34.72%	.	.	.	-5.01%
Measures without Significant Change												
Not Significant Measures	24	0	1	5	0	0	4	2	6	3	3	0
Average Change Not Significant	-20.42%	.	22.31%	-9.33%	.	.	-30.96%	-22.93%	-21.02%	-60.83%	4.18%	.
Worsening Measures												
Worsened Measures	6	1	3	1	0	0	0	0	0	1	0	0
Average Change Worsened	59.05%	85.91%	54.64%	23.91%	.	.	.	.	.	80.54%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	44	3	7	8	2	1	4	3	6	4	3	3
Trend Showing Improvement	20.45%	33.33%	42.86%	25.00%	100.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Trend Showing No Change	54.55%	0.00%	14.29%	37.50%	0.00%	0.00%	100.00%	100.00%	100.00%	100.00%	33.33%	66.67%
Trend Showing Worsening	25.00%	66.67%	42.86%	37.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.67%	33.33%
Key Trend Profiles												
Total Trend Profile Measures	44	3	7	8	2	1	4	3	6	4	3	3
Trend Improvement Level	6.82%	0.00%	0.00%	0.00%	100.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Level Improvement	27.27%	66.67%	42.86%	25.00%	0.00%	0.00%	25.00%	33.33%	0.00%	0.00%	0.00%	100.00%
No Change	52.27%	0.00%	14.29%	62.50%	0.00%	0.00%	75.00%	66.67%	100.00%	75.00%	100.00%	0.00%
Worsened	13.64%	33.33%	42.86%	12.50%	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-124—Summary of Outcome Measures, New Jersey												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	50	9	5	5	4	1	6	6	5	5	2	2
Widely Consistent	84.00%	77.78%	80.00%	80.00%	100.00%	100.00%	100.00%	100.00%	100.00%	20.00%	100.00%	100.00%
Not Widely Consistent	16.00%	22.22%	20.00%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	80.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	50	9	5	5	4	1	6	6	5	5	2	2
Meeting 17.6%/10% Goal	38.00%	22.22%	40.00%	40.00%	0.00%	100.00%	0.00%	100.00%	20.00%	60.00%	50.00%	50.00%
Meeting 40%/20% Goal	10.00%	22.22%	0.00%	0.00%	0.00%	100.00%	0.00%	16.67%	20.00%	0.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	49	9	4	5	4	1	6	6	5	5	2	2
Improving Measures												
Improving Measures	22	4	3	2	3	1	1	5	0	0	1	2
Average Change Improving	-27.34%	-35.65%	-25.64%	-22.30%	-15.35%	-55.28%	-17.24%	-35.13%	.	.	-22.37%	-10.40%
Measures without Significant Change												
Not Significant Measures	22	5	1	3	1	0	3	1	3	4	1	0
Average Change Not Significant	-9.36%	0.88%	-0.97%	-3.61%	-6.37%	.	-9.08%	-22.18%	-10.60%	-24.26%	-13.88%	.
Worsening Measures												
Worsened Measures	5	0	0	0	0	0	2	0	2	1	0	0
Average Change Worsened	26.60%	.	.	.	.	.	11.05%	.	54.60%	1.71%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	46	9	3	5	4	1	6	6	5	4	2	1
Trend Showing Improvement	2.17%	0.00%	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%
Trend Showing No Change	84.78%	66.67%	100.00%	80.00%	100.00%	100.00%	83.33%	100.00%	80.00%	100.00%	100.00%	0.00%
Trend Showing Worsening	13.04%	33.33%	0.00%	20.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.00%	0.00%	100.00%
Key Trend Profiles												
Total Trend Profile Measures	46	9	3	5	4	1	6	6	5	4	2	1
Trend Improvement Level	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Level Improvement	43.48%	44.44%	66.67%	40.00%	75.00%	100.00%	16.67%	83.33%	0.00%	0.00%	50.00%	100.00%
No Change	45.65%	55.56%	33.33%	60.00%	25.00%	0.00%	50.00%	16.67%	60.00%	75.00%	50.00%	0.00%
Worsened	10.87%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	0.00%	40.00%	25.00%	0.00%	0.00%

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	72	6	11	10	6	3	5	5	12	7	4	3
Widely Consistent	55.56%	0.00%	27.27%	70.00%	66.67%	66.67%	60.00%	20.00%	83.33%	57.14%	75.00%	100.00%
Not Widely Consistent	44.44%	100.00%	72.73%	30.00%	33.33%	33.33%	40.00%	80.00%	16.67%	42.86%	25.00%	0.00%
Goal Performance												
Number of Outcomes	72	6	11	10	6	3	5	5	12	7	4	3
Meeting 17.6%/10% Goal	41.67%	16.67%	27.27%	90.00%	0.00%	100.00%	20.00%	80.00%	25.00%	42.86%	25.00%	66.67%
Meeting 40%/20% Goal	19.44%	16.67%	0.00%	70.00%	0.00%	100.00%	0.00%	40.00%	0.00%	14.29%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	71	6	10	10	6	3	5	5	12	7	4	3
Improving Measures												
Improving Measures	36	2	4	9	4	3	2	4	2	2	1	3
Average Change Improving	-33.58%	-25.12%	-19.29%	-42.38%	-12.09%	-86.74%	-15.78%	-42.06%	-7.27%	-64.95%	-14.91%	-10.85%
Measures without Significant Change												
Not Significant Measures	24	2	1	1	2	0	3	1	6	5	3	0
Average Change Not Significant	0.90%	-0.14%	2.49%	1.53%	-4.19%	.	-2.21%	-13.16%	-9.11%	26.96%	-11.35%	.
Worsening Measures												
Worsened Measures	11	2	5	0	0	0	0	0	4	0	0	0
Average Change Worsened	31.88%	8.00%	44.37%	.	.	.	.	.	28.21%	.	.	.
Cahnges in Measure Trends (ITS)												
Total ITS Tested Measures	68	6	10	10	6	3	3	5	12	7	4	2
Trend Showing Improvement	29.41%	33.33%	80.00%	10.00%	16.67%	66.67%	0.00%	0.00%	16.67%	14.29%	25.00%	100.00%
Trend Showing No Change	51.47%	66.67%	10.00%	60.00%	83.33%	0.00%	100.00%	100.00%	50.00%	42.86%	50.00%	0.00%
Trend Showing Worsening	19.12%	0.00%	10.00%	30.00%	0.00%	33.33%	0.00%	0.00%	33.33%	42.86%	25.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	68	6	10	10	6	3	3	5	12	7	4	2
Trend Improvement Level	14.71%	16.67%	20.00%	10.00%	16.67%	66.67%	0.00%	0.00%	0.00%	14.29%	0.00%	100.00%
Level Improvement	33.82%	16.67%	20.00%	80.00%	50.00%	33.33%	0.00%	80.00%	16.67%	14.29%	25.00%	0.00%
No Change	35.29%	33.33%	10.00%	10.00%	33.33%	0.00%	100.00%	20.00%	50.00%	71.43%	75.00%	0.00%
Worsened	16.18%	33.33%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	0.00%	0.00%	0.00%

Table E-125—Summary of Outcome Measures, New York

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-126—Summary of Outcome Measures, NoCVA												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	51	5	6	6	5	1	3	8	6	6	3	2
Widely Consistent	47.06%	0.00%	83.33%	50.00%	40.00%	100.00%	66.67%	25.00%	66.67%	16.67%	66.67%	100.00%
Not Widely Consistent	52.94%	100.00%	16.67%	50.00%	60.00%	0.00%	33.33%	75.00%	33.33%	83.33%	33.33%	0.00%
Goal Performance												
Number of Outcomes	51	5	6	6	5	1	3	8	6	6	3	2
Meeting 17.6%/10% Goal	45.10%	20.00%	16.67%	66.67%	40.00%	100.00%	0.00%	75.00%	33.33%	50.00%	100.00%	0.00%
Meeting 40%/20% Goal	25.49%	20.00%	16.67%	33.33%	20.00%	100.00%	0.00%	50.00%	33.33%	16.67%	0.00%	0.00%
Measure Tested for Overall Changes												
Measure with Change Tested	50	5	5	6	5	1	3	8	6	6	3	2
Improving Measures												
Improving Measures	25	2	3	3	3	1	2	5	0	2	2	2
Average Change Improving	-33.68%	-35.41%	-18.95%	-40.28%	-33.86%	-73.58%	-12.75%	-45.67%	.	-53.99%	-22.48%	-5.72%
Measures without Significant Change												
Not Significant Measures	20	2	0	2	2	0	1	3	6	3	1	0
Average Change Not Significant	0.22%	4.96%	.	-11.03%	-5.39%	.	29.63%	-15.30%	2.51%	15.66%	-18.36%	.
Worsening Measures												
Worsened Measures	5	1	2	1	0	0	0	0	0	1	0	0
Average Change Worsened	54.02%	154.27%	49.81%	1.47%	.	.	.	.	.	14.74%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	38	1	5	6	3	1	2	7	6	3	2	2
Trend Showing Improvement	7.89%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	14.29%	0.00%	33.33%	0.00%	0.00%
Trend Showing No Change	84.21%	100.00%	100.00%	100.00%	66.67%	0.00%	100.00%	71.43%	100.00%	66.67%	100.00%	50.00%
Trend Showing Worsening	7.89%	0.00%	0.00%	0.00%	33.33%	0.00%	0.00%	14.29%	0.00%	0.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	38	1	5	6	3	1	2	7	6	3	2	2
Trend Improvement Level	5.26%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	14.29%	0.00%	0.00%	0.00%	0.00%
Level Improvement	50.00%	0.00%	60.00%	50.00%	66.67%	0.00%	100.00%	57.14%	0.00%	33.33%	100.00%	100.00%
No Change	31.58%	0.00%	0.00%	33.33%	33.33%	0.00%	0.00%	28.57%	100.00%	33.33%	0.00%	0.00%
Worsened	13.16%	100.00%	40.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-127—Summary of Outcome Measures, Ohio Children's Cohort 1												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	34	2	5	5	4		2	3	7	2	2	2
Widely Consistent	82.35%	100.00%	60.00%	100.00%	75.00%		100.00%	100.00%	57.14%	100.00%	100.00%	100.00%
Not Widely Consistent	17.65%	0.00%	40.00%	0.00%	25.00%		0.00%	0.00%	42.86%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	34	2	5	5	4		2	3	7	2	2	2
Meeting 17.6%/10% Goal	44.12%	100.00%	20.00%	20.00%	50.00%		100.00%	0.00%	71.43%	100.00%	0.00%	0.00%
Meeting 40%/20% Goal	29.41%	100.00%	20.00%	0.00%	50.00%		100.00%	0.00%	14.29%	100.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	33	2	4	5	4		2	3	7	2	2	2
Improving Measures												
Improving Measures	15	2	2	1	2		2	0	4	2	0	0
Average Change Improving	-45.15%	-44.50%	-27.11%	-6.30%	-75.78%		-57.29%	.	-42.12%	-46.55%	.	.
Measures without Significant Change												
Not Significant Measures	13	0	1	3	1		0	1	3	0	2	2
Average Change Not Significant	6.43%	.	-7.56%	-11.63%	-2.57%		.	11.71%	34.10%	.	2.27%	5.03%
Worsening Measures												
Worsened Measures	5	0	1	1	1		0	2	0	0	0	0
Average Change Worsened	63.54%	.	16.77%	5.98%	216.02%		.	39.45%	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	33	2	4	5	4		2	3	7	2	2	2
Trend Showing Improvement	18.18%	0.00%	0.00%	20.00%	50.00%		50.00%	0.00%	0.00%	50.00%	0.00%	50.00%
Trend Showing No Change	60.61%	100.00%	25.00%	80.00%	0.00%		50.00%	66.67%	100.00%	50.00%	50.00%	50.00%
Trend Showing Worsening	21.21%	0.00%	75.00%	0.00%	50.00%		0.00%	33.33%	0.00%	0.00%	50.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	33	2	4	5	4		2	3	7	2	2	2
Trend Improvement Level	6.06%	0.00%	0.00%	0.00%	0.00%		50.00%	0.00%	0.00%	50.00%	0.00%	0.00%
Level Improvement	39.39%	100.00%	50.00%	20.00%	50.00%		50.00%	0.00%	57.14%	50.00%	0.00%	0.00%
No Change	39.39%	0.00%	25.00%	60.00%	25.00%		0.00%	33.33%	42.86%	0.00%	100.00%	100.00%
Worsened	15.15%	0.00%	25.00%	20.00%	25.00%		0.00%	66.67%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
Note: OB-EED does not apply to the Ohio Children's HEN.

Table E-128—Summary of Outcome Measures, Ohio Children's Cohort 2												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	28	2	3	3	4		2	3	5	2	2	2
Widely Consistent	89.29%	100.00%	100.00%	100.00%	100.00%		50.00%	66.67%	80.00%	100.00%	100.00%	100.00%
Not Widely Consistent	10.71%	0.00%	0.00%	0.00%	0.00%		50.00%	33.33%	20.00%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	28	2	3	3	4		2	3	5	2	2	2
Meeting 17.6%/10% Goal	42.86%	100.00%	33.33%	33.33%	0.00%		50.00%	0.00%	100.00%	100.00%	0.00%	0.00%
Meeting 40%/20% Goal	14.29%	0.00%	0.00%	0.00%	0.00%		0.00%	0.00%	60.00%	50.00%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	28	2	3	3	4		2	3	5	2	2	2
Improving Measures												
Improving Measures	13	1	1	2	0		1	0	4	2	0	2
Average Change Improving	-29.88%	-20.00%	-26.76%	-19.85%	.		-19.16%	.	-48.15%	-38.89%	.	-6.24%
Measures without Significant Change												
Not Significant Measures	9	1	1	0	4		1	0	1	0	1	0
Average Change Not Significant	-5.19%	-17.99%	-7.14%	.	-4.26%		-13.68%	.	-34.46%	.	43.59%	.
Worsening Measures												
Worsened Measures	6	0	1	1	0		0	3	0	0	1	0
Average Change Worsened	51.08%	.	22.89%	3.94%	.		.	67.24%	.	.	77.91%	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	28	2	3	3	4		2	3	5	2	2	2
Trend Showing Improvement	50.00%	100.00%	33.33%	33.33%	25.00%		0.00%	100.00%	80.00%	0.00%	50.00%	50.00%
Trend Showing No Change	42.86%	0.00%	66.67%	66.67%	25.00%		100.00%	0.00%	20.00%	100.00%	50.00%	50.00%
Trend Showing Worsening	7.14%	0.00%	0.00%	0.00%	50.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	28	2	3	3	4		2	3	5	2	2	2
Trend Improvement Level	17.86%	50.00%	0.00%	0.00%	0.00%		0.00%	0.00%	60.00%	0.00%	0.00%	50.00%
Level Improvement	28.57%	0.00%	33.33%	66.67%	0.00%		50.00%	0.00%	20.00%	100.00%	0.00%	50.00%
No Change	32.14%	50.00%	33.33%	0.00%	100.00%		50.00%	0.00%	20.00%	0.00%	50.00%	0.00%
Worsened	21.43%	0.00%	33.33%	33.33%	0.00%		0.00%	100.00%	0.00%	0.00%	50.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
Note: OB-EED does not apply to the Ohio Children's HEN.

Table E-129—Summary of Outcome Measures, Ohio												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	50	4	7	7	3	2	5	6	5	6	3	2
Widely Consistent	56.00%	25.00%	71.43%	71.43%	0.00%	100.00%	60.00%	33.33%	80.00%	33.33%	66.67%	100.00%
Not Widely Consistent	44.00%	75.00%	28.57%	28.57%	100.00%	0.00%	40.00%	66.67%	20.00%	66.67%	33.33%	0.00%
Goal Performance												
Number of Outcomes	50	4	7	7	3	2	5	6	5	6	3	2
Meeting 17.6%/10% Goal	48.00%	25.00%	14.29%	42.86%	33.33%	100.00%	40.00%	83.33%	60.00%	50.00%	100.00%	0.00%
Meeting 40%/20% Goal	28.00%	0.00%	0.00%	14.29%	33.33%	50.00%	0.00%	83.33%	40.00%	50.00%	33.33%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	49	4	6	7	3	2	5	6	5	6	3	2
Improving Measures												
Improving Measures	25	1	1	3	3	2	1	5	2	3	2	2
Average Change Improving	-37.33%	-29.30%	-3.04%	-19.81%	-23.14%	-40.14%	-18.41%	-51.18%	-42.02%	-70.32%	-57.04%	-4.16%
Measures without Significant Change												
Not Significant Measures	22	2	5	4	0	0	4	1	3	2	1	0
Average Change Not Significant	-5.81%	-0.71%	-10.24%	-16.95%	.	.	-5.11%	-15.14%	9.09%	10.35%	-19.72%	.
Worsening Measures												
Worsened Measures	2	1	0	0	0	0	0	0	0	1	0	0
Average Change Worsened	83.81%	73.46%	.	.	.	.	.	.	.	94.16%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	38	1	5	6	3	0	3	5	5	6	2	2
Trend Showing Improvement	23.68%	0.00%	20.00%	33.33%	33.33%	.	0.00%	0.00%	20.00%	50.00%	0.00%	50.00%
Trend Showing No Change	60.53%	100.00%	60.00%	50.00%	66.67%	.	33.33%	100.00%	80.00%	50.00%	50.00%	0.00%
Trend Showing Worsening	15.79%	0.00%	20.00%	16.67%	0.00%	.	66.67%	0.00%	0.00%	0.00%	50.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	38	1	5	6	3	0	3	5	5	6	2	2
Trend Improvement Level	15.79%	0.00%	0.00%	16.67%	33.33%	.	0.00%	0.00%	20.00%	33.33%	0.00%	50.00%
Level Improvement	39.47%	100.00%	20.00%	33.33%	66.67%	.	33.33%	80.00%	20.00%	16.67%	50.00%	50.00%
No Change	42.11%	0.00%	80.00%	50.00%	0.00%	.	66.67%	20.00%	60.00%	33.33%	50.00%	0.00%
Worsened	2.63%	0.00%	0.00%	0.00%	0.00%	.	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-130—Summary of Outcome Measures, Pennsylvania												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	63	9	8	8	7	1	6	6	4	7	3	4
Widely Consistent	63.49%	55.56%	75.00%	50.00%	42.86%	100.00%	50.00%	33.33%	75.00%	85.71%	100.00%	100.00%
Not Widely Consistent	36.51%	44.44%	25.00%	50.00%	57.14%	0.00%	50.00%	66.67%	25.00%	14.29%	0.00%	0.00%
Goal Performance												
Number of Outcomes	63	9	8	8	7	1	6	6	4	7	3	4
Meeting 17.6%/10% Goal	42.86%	55.56%	25.00%	37.50%	42.86%	100.00%	33.33%	83.33%	75.00%	14.29%	33.33%	25.00%
Meeting 40%/20% Goal	19.05%	22.22%	0.00%	0.00%	28.57%	100.00%	16.67%	16.67%	50.00%	14.29%	33.33%	25.00%
Measure Tested for Overall Change												
Measure with Change Tested	61	8	7	8	7	1	6	6	4	7	3	4
Improving Measures												
Improving Measures	29	3	2	5	5	1	1	4	2	1	2	3
Average Change Improving	-33.54%	-43.05%	-22.38%	-20.82%	-28.00%	-58.50%	-43.28%	-35.43%	-51.07%	-100.00%	-36.74%	-11.88%
Measures without Significant Change												
Not Significant Measures	28	4	2	3	2	0	5	2	2	6	1	1
Average Change Not Significant	-5.77%	-13.46%	-4.44%	-12.66%	-14.30%	.	14.07%	-13.21%	-15.31%	-6.37%	-4.57%	-2.88%
Worsening Measures												
Worsened Measures	4	1	3	0	0	0	0	0	0	0	0	0
Average Change Worsened	25.99%	19.93%	28.01%	.	.	.	.	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	41	5	6	7	3	0	5	6	4	1	2	2
Trend Showing Improvement	19.51%	0.00%	50.00%	57.14%	0.00%	.	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%
Trend Showing No Change	73.17%	100.00%	50.00%	42.86%	66.67%	.	100.00%	100.00%	75.00%	100.00%	50.00%	50.00%
Trend Showing Worsening	7.32%	0.00%	0.00%	0.00%	33.33%	.	0.00%	0.00%	0.00%	0.00%	50.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	41	5	6	7	3	0	5	6	4	1	2	2
Trend Improvement Level	14.63%	0.00%	33.33%	42.86%	0.00%	.	0.00%	0.00%	25.00%	0.00%	0.00%	0.00%
Level Improvement	41.46%	40.00%	0.00%	28.57%	100.00%	.	20.00%	66.67%	25.00%	100.00%	50.00%	100.00%
No Change	36.59%	60.00%	16.67%	28.57%	0.00%	.	80.00%	33.33%	50.00%	0.00%	50.00%	0.00%
Worsened	7.32%	0.00%	50.00%	0.00%	0.00%	.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-131—Summary of Outcome Measures, Premier												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	54	4	6	7	4	1	4	7	7	8	4	2
Widely Consistent	53.70%	100.00%	50.00%	57.14%	50.00%	0.00%	100.00%	57.14%	71.43%	0.00%	50.00%	50.00%
Not Widely Consistent	46.30%	0.00%	50.00%	42.86%	50.00%	100.00%	0.00%	42.86%	28.57%	100.00%	50.00%	50.00%
Goal Performance												
Number of Outcomes	54	4	6	7	4	1	4	7	7	8	4	2
Meeting 17.6%/10% Goal	33.33%	50.00%	16.67%	57.14%	0.00%	100.00%	25.00%	71.43%	0.00%	37.50%	25.00%	0.00%
Meeting 40%/20% Goal	9.26%	0.00%	0.00%	14.29%	0.00%	100.00%	0.00%	28.57%	0.00%	12.50%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	53	4	5	7	4	1	4	7	7	8	4	2
Improving Measures												
Improving Measures	24	1	2	5	3	1	2	5	0	2	1	2
Average Change Improving	-28.19%	-27.09%	-16.83%	-24.68%	-12.38%	-69.70%	-26.69%	-39.64%	.	-41.82%	-35.57%	-7.43%
Measures without Significant Change												
Not Significant Measures	20	3	3	2	1	0	0	2	5	1	3	0
Average Change Not Significant	-6.76%	-14.64%	-2.16%	2.36%	-9.52%	.	.	-7.57%	0.85%	-38.71%	-10.14%	.
Worsening Measures												
Worsened Measures	9	0	0	0	0	0	2	0	2	5	0	0
Average Change Worsened	37.57%	.	.	.	.	.	12.93%	.	27.30%	51.53%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	53	4	5	7	4	1	4	7	7	8	4	2
Trend Showing Improvement	20.75%	25.00%	40.00%	14.29%	25.00%	0.00%	50.00%	14.29%	0.00%	0.00%	25.00%	100.00%
Trend Showing No Change	56.60%	50.00%	40.00%	71.43%	75.00%	0.00%	50.00%	85.71%	42.86%	87.50%	0.00%	0.00%
Trend Showing Worsening	22.64%	25.00%	20.00%	14.29%	0.00%	100.00%	0.00%	0.00%	57.14%	12.50%	75.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	53	4	5	7	4	1	4	7	7	8	4	2
Trend Improvement Level	13.21%	25.00%	0.00%	14.29%	25.00%	0.00%	25.00%	14.29%	0.00%	0.00%	0.00%	100.00%
Level Improvement	32.08%	0.00%	40.00%	57.14%	50.00%	100.00%	25.00%	57.14%	0.00%	25.00%	25.00%	0.00%
No Change	37.74%	75.00%	60.00%	28.57%	25.00%	0.00%	0.00%	28.57%	71.43%	12.50%	75.00%	0.00%
Worsened	16.98%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%	0.00%	28.57%	62.50%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-132—Summary of Outcome Measures, Tennessee												
Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	49	4	6	7	4	1	5	3	8	7	2	2
Widely Consistent	75.51%	0.00%	100.00%	85.71%	25.00%	100.00%	100.00%	66.67%	62.50%	100.00%	100.00%	100.00%
Not Widely Consistent	24.49%	100.00%	0.00%	14.29%	75.00%	0.00%	0.00%	33.33%	37.50%	0.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	49	4	6	7	4	1	5	3	8	7	2	2
Meeting 17.6%/10% Goal	30.61%	25.00%	0.00%	14.29%	75.00%	100.00%	0.00%	66.67%	37.50%	42.86%	50.00%	0.00%
Meeting 40%/20% Goal	18.37%	25.00%	0.00%	14.29%	25.00%	100.00%	0.00%	66.67%	25.00%	14.29%	0.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	48	4	5	7	4	1	5	3	8	7	2	2
Improving Measures												
Improving Measures	17	1	1	4	2	1	0	1	1	3	1	2
Average Change Improving	-32.39%	-61.66%	-4.75%	-14.12%	-39.34%	-85.98%	.	-66.73%	-66.61%	-31.33%	-25.97%	-4.91%
Measures without Significant Change												
Not Significant Measures	24	1	3	2	2	0	3	1	7	4	1	0
Average Change Not Significant	-9.99%	-4.27%	6.14%	-10.92%	-14.85%	.	0.42%	-64.69%	-14.19%	-7.83%	-8.13%	.
Worsening Measures												
Worsened Measures	7	2	1	1	0	0	2	1	0	0	0	0
Average Change Worsened	84.14%	57.03%	5.72%	149.24%	.	.	26.11%	267.76%	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	27	2	3	4	3	1	0	1	4	7	1	1
Trend Showing Improvement	18.52%	50.00%	66.67%	0.00%	0.00%	0.00%	.	0.00%	25.00%	14.29%	0.00%	0.00%
Trend Showing No Change	62.96%	50.00%	0.00%	50.00%	100.00%	0.00%	.	100.00%	75.00%	85.71%	100.00%	0.00%
Trend Showing Worsening	18.52%	0.00%	33.33%	50.00%	0.00%	100.00%	.	0.00%	0.00%	0.00%	0.00%	100.00%
Key Trend Profiles												
Total Trend Profile Measures	27	2	3	4	3	1	0	1	4	7	1	1
Trend Improvement Level	11.11%	50.00%	0.00%	0.00%	0.00%	0.00%	.	0.00%	25.00%	14.29%	0.00%	0.00%
Level Improvement	29.63%	0.00%	33.33%	50.00%	33.33%	100.00%	.	0.00%	0.00%	28.57%	0.00%	100.00%
No Change	59.26%	50.00%	66.67%	50.00%	66.67%	0.00%	.	100.00%	75.00%	57.14%	100.00%	0.00%
Worsened	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	.	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-133—Summary of Outcome Measures, TCQPS												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	45	6	6	6	7	3	4	4	2	3	3	1
Widely Consistent	40.00%	16.67%	50.00%	50.00%	14.29%	0.00%	75.00%	25.00%	100.00%	33.33%	66.67%	100.00%
Not Widely Consistent	60.00%	83.33%	50.00%	50.00%	85.71%	100.00%	25.00%	75.00%	0.00%	66.67%	33.33%	0.00%
Goal Performance												
Number of Outcomes	45	6	6	6	7	3	4	4	2	3	3	1
Meeting 17.6%/10% Goal	44.44%	33.33%	16.67%	66.67%	14.29%	100.00%	50.00%	75.00%	0.00%	100.00%	33.33%	0.00%
Meeting 40%/20% Goal	20.00%	33.33%	0.00%	0.00%	0.00%	100.00%	25.00%	0.00%	0.00%	66.67%	33.33%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	44	6	5	6	7	3	4	4	2	3	3	1
Improving Measures												
Improving Measures	7	1	1	0	0	2	0	1	0	0	1	1
Average Change Improving	-40.49%	-56.50%	-17.07%	.	.	-64.10%	.	-35.95%	.	.	-40.43%	-5.24%
Measures without Significant Change												
Not Significant Measures	35	5	3	5	7	1	4	3	2	3	2	0
Average Change Not Significant	-9.92%	12.82%	-11.10%	-24.32%	0.76%	-61.81%	-30.73%	-20.55%	71.92%	-50.35%	-4.15%	.
Worsening Measures												
Worsened Measures	2	0	1	1	0	0	0	0	0	0	0	0
Average Change Worsened	6.25%	.	7.98%	4.53%	.	.	.	.	.	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	15	0	2	3	2	0	0	4	2	0	1	1
Trend Showing Improvement	0.00%	.	0.00%	0.00%	0.00%	.	.	0.00%	0.00%	.	0.00%	0.00%
Trend Showing No Change	93.33%	.	100.00%	100.00%	100.00%	.	.	100.00%	100.00%	.	100.00%	0.00%
Trend Showing Worsening	6.67%	.	0.00%	0.00%	0.00%	.	.	0.00%	0.00%	.	0.00%	100.00%
Key Trend Profiles												
Total Trend Profile Measures	15	0	2	3	2	0	0	4	2	0	1	1
Trend Improvement Level	0.00%	.	0.00%	0.00%	0.00%	.	.	0.00%	0.00%	.	0.00%	0.00%
Level Improvement	20.00%	.	0.00%	0.00%	0.00%	.	.	25.00%	0.00%	.	100.00%	100.00%
No Change	80.00%	.	100.00%	100.00%	100.00%	.	.	75.00%	100.00%	.	0.00%	0.00%
Worsened	0.00%	.	0.00%	0.00%	0.00%	.	.	0.00%	0.00%	.	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Table E-134—Summary of Outcome Measures, UHC

Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	49	6	7	6	5		6	7	4	2	4	2
Widely Consistent	91.84%	100.00%	71.43%	83.33%	100.00%		100.00%	100.00%	100.00%	50.00%	100.00%	100.00%
Not Widely Consistent	8.16%	0.00%	28.57%	16.67%	0.00%		0.00%	0.00%	0.00%	50.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	49	6	7	6	5		6	7	4	2	4	2
Meeting 17.6%/10% Goal	28.57%	0.00%	14.29%	33.33%	20.00%		16.67%	42.86%	50.00%	50.00%	75.00%	0.00%
Meeting 40%/20% Goal	4.08%	0.00%	0.00%	16.67%	0.00%		0.00%	0.00%	0.00%	0.00%	25.00%	0.00%
Measure Tested for Overall Change												
Measure with Change Tested	45	6	6	6	3		6	6	4	2	4	2
Improving Measures												
Improving Measures	26	3	3	4	2		3	3	1	1	4	2
Average Change Improving	-17.69%	-9.64%	-12.32%	-20.09%	-19.78%		-16.98%	-20.58%	-36.89%	-24.20%	-23.44%	-3.27%
Measures without Significant Change												
Not Significant Measures	12	0	1	2	1		2	3	2	1	0	0
Average Change Not Significant	-4.20%	.	0.53%	-4.16%	-2.06%		-11.81%	1.03%	-5.04%	-9.92%	.	.
Worsening Measures												
Worsened Measures	7	3	2	0	0		1	0	1	0	0	0
Average Change Worsened	16.48%	11.91%	23.61%	.	.		12.84%	.	19.54%	.	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	44	6	6	6	3		6	6	4	2	3	2
Trend Showing Improvement	13.64%	0.00%	33.33%	33.33%	33.33%		0.00%	0.00%	0.00%	50.00%	0.00%	0.00%
Trend Showing No Change	77.27%	83.33%	66.67%	66.67%	66.67%		83.33%	83.33%	75.00%	50.00%	100.00%	100.00%
Trend Showing Worsening	9.09%	16.67%	0.00%	0.00%	0.00%		16.67%	16.67%	25.00%	0.00%	0.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	44	6	6	6	3		6	6	4	2	3	2
Trend Improvement Level	11.36%	0.00%	16.67%	33.33%	33.33%		0.00%	0.00%	0.00%	50.00%	0.00%	0.00%
Level Improvement	45.45%	50.00%	33.33%	33.33%	33.33%		50.00%	50.00%	25.00%	0.00%	100.00%	100.00%
No Change	27.27%	0.00%	16.67%	33.33%	33.33%		33.33%	50.00%	50.00%	50.00%	0.00%	0.00%
Worsened	15.91%	50.00%	33.33%	0.00%	0.00%		16.67%	0.00%	25.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.
Note: OB-EED was excluded from this analysis due to mathematical inconsistencies in UHC's reported data.

Table E-135—Summary of Outcome Measures, VHA												
Type	**All AEAs**	**ADE**	**CAUTI**	**CLABSI**	**Falls**	**OB-EED**	**OB-Other**	**Pressure Ulcers**	**SSI**	**VAP**	**VTE**	**Readm**
Measure Counts												
Total Measures	54	7	5	5	6	2	6	7	3	5	4	4
Widely Consistent	22.22%	0.00%	60.00%	60.00%	0.00%	50.00%	0.00%	14.29%	66.67%	0.00%	25.00%	25.00%
Not Widely Consistent	77.78%	100.00%	40.00%	40.00%	100.00%	50.00%	100.00%	85.71%	33.33%	100.00%	75.00%	75.00%
Goal Performance												
Number of Outcomes	54	7	5	5	6	2	6	7	3	5	4	4
Meeting 17.6%/10% Goal	38.89%	28.57%	0.00%	20.00%	50.00%	100.00%	16.67%	71.43%	0.00%	100.00%	0.00%	50.00%
Meeting 40%/20% Goal	22.22%	28.57%	0.00%	0.00%	16.67%	100.00%	16.67%	28.57%	0.00%	60.00%	0.00%	25.00%
Measure Tested for Overall Change												
Measure with Change Tested	53	7	4	5	6	2	6	7	3	5	4	4
Improving Measures												
Improving Measures	29	4	3	1	4	2	1	5	1	4	0	4
Average Change Improving	-35.45%	-39.94%	-14.71%	-25.31%	-32.74%	-62.64%	-67.49%	-40.67%	-17.28%	-50.00%	.	-13.59%
Measures without Significant Change												
Not Significant Measures	19	1	1	4	1	0	4	2	2	1	3	0
Average Change Not Significant	0.64%	-4.57%	3.38%	1.82%	8.64%	.	3.08%	7.30%	12.37%	-44.65%	-3.22%	.
Worsening Measures												
Worsened Measures	5	2	0	0	1	0	1	0	0	0	1	0
Average Change Worsened	19.31%	14.44%	.	.	13.74%	.	38.11%	.	.	.	15.82%	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	52	7	4	5	6	2	6	7	3	4	4	4
Trend Showing Improvement	23.08%	42.86%	0.00%	20.00%	50.00%	0.00%	16.67%	14.29%	0.00%	25.00%	25.00%	25.00%
Trend Showing No Change	61.54%	42.86%	100.00%	80.00%	33.33%	50.00%	66.67%	57.14%	66.67%	75.00%	50.00%	75.00%
Trend Showing Worsening	15.38%	14.29%	0.00%	0.00%	16.67%	50.00%	16.67%	28.57%	33.33%	0.00%	25.00%	0.00%
Key Trend Profiles												
Total Trend Profile Measures	52	7	4	5	6	2	6	7	3	4	4	4
Trend Improvement Level	15.38%	28.57%	0.00%	0.00%	50.00%	0.00%	0.00%	14.29%	0.00%	25.00%	0.00%	25.00%
Level Improvement	38.46%	28.57%	75.00%	20.00%	16.67%	100.00%	16.67%	57.14%	33.33%	50.00%	0.00%	75.00%
No Change	36.54%	14.29%	25.00%	80.00%	16.67%	0.00%	66.67%	28.57%	66.67%	25.00%	75.00%	0.00%
Worsened	9.62%	28.57%	0.00%	0.00%	16.67%	0.00%	16.67%	0.00%	0.00%	0.00%	25.00%	0.00%

Source: Evaluation Contractor’s analysis of HEN-submitted data, November 2014.

Table E-136—Summary of Outcome Measures, Washington

Type	All AEAs	ADE	CAUTI	CLABSI	Falls	OB-EED	OB-Other	Pressure Ulcers	SSI	VAP	VTE	Readm
Measure Counts												
Total Measures	45	7	6	5	3	1	6	5	3	5	2	2
Widely Consistent	73.33%	14.29%	100.00%	100.00%	33.33%	100.00%	100.00%	40.00%	100.00%	80.00%	100.00%	100.00%
Not Widely Consistent	26.67%	85.71%	0.00%	0.00%	66.67%	0.00%	0.00%	60.00%	0.00%	20.00%	0.00%	0.00%
Goal Performance												
Number of Outcomes	45	7	6	5	3	1	6	5	3	5	2	2
Meeting 17.6%/10% Goal	37.78%	42.86%	0.00%	20.00%	66.67%	100.00%	33.33%	80.00%	33.33%	20.00%	50.00%	50.00%
Meeting 40%/20% Goal	17.78%	14.29%	0.00%	0.00%	0.00%	100.00%	33.33%	40.00%	0.00%	20.00%	0.00%	50.00%
Measure Tested for Overall Change												
Measure with Change Tested	44	7	5	5	3	1	6	5	3	5	2	2
Improving Measures												
Improving Measures	17	3	1	1	2	1	2	2	1	1	1	2
Average Change Improving	-36.56%	-32.35%	-6.49%	-20.62%	-25.22%	-88.61%	-57.67%	-42.77%	-19.58%	-90.06%	-19.28%	-14.27%
Measures without Significant Change												
Not Significant Measures	21	3	3	3	1	0	4	3	2	1	1	0
Average Change Not Significant	10.15%	79.58%	-5.89%	3.79%	-4.49%	.	-5.79%	-21.20%	48.63%	-13.86%	-11.40%	.
Worsening Measures												
Worsened Measures	6	1	1	1	0	0	0	0	0	3	0	0
Average Change Worsened	142.80%	17.45%	3.88%	11.79%	.	.	.	.	.	274.56%	.	.
Changes in Measure Trends (ITS)												
Total ITS Tested Measures	30	0	3	4	3	1	6	5	3	1	2	2
Trend Showing Improvement	3.33%	.	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%
Trend Showing No Change	80.00%	.	100.00%	0.00%	100.00%	100.00%	83.33%	100.00%	100.00%	100.00%	100.00%	50.00%
Trend Showing Worsening	16.67%	.	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%
Key Trend Profiles												
Total Trend Profile Measures	30	0	3	4	3	1	6	5	3	1	2	2
Trend Improvement Level	3.33%	.	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%
Level Improvement	40.00%	.	0.00%	25.00%	66.67%	100.00%	16.67%	40.00%	33.33%	100.00%	50.00%	100.00%
No Change	50.00%	.	66.67%	50.00%	33.33%	0.00%	66.67%	60.00%	66.67%	0.00%	50.00%	0.00%
Worsened	6.67%	.	33.33%	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Evaluation Contractor's analysis of HEN-submitted data, November 2014.

Descriptive Statistics of Medicare Expenditures (Chapter 6)

Subgroup Results for Cost-Adverted Due to HEN-Alignment

While Hospital Engagement Network (HEN) alignment may not have affected expenditures overall, it is possible that certain types of hospitals benefited more from the HEN programs. Small rural hospitals, for example, who have limited resources to address quality improvement, may have benefitted more by being HEN aligned and having access to up-to-date resources. The same may be true for non-teaching hospitals. The Evaluation Contractor tested if the HEN alignment component of PfP had a significant effect on expenditures among particular subgroups of hospitals.[E-26]

The findings indicate that HEN alignment did not affect Medicare expenditures across different hospital types. The results of this subgroup analysis are presented in Table E-137 and Table E-138 for the 90- and 180-day outlook periods, respectively. While there were several scattered estimated effects that are statistically significant, some are favorable and some are not favorable to PfP, and there are no consistent patterns. It is consequently unlikely that there is a plausible mechanism that would consistently generate the handful of scattered significant effects. Table E-137 and Table E-138 show there are predominately no statistically significant effects of HEN alignment on Medicare expenditures across the different subgroups of hospitals and types of expenditures.

E-26 To derive the difference-in-differences estimates, the same approach was taken as in the main analysis using all hospitals, but the estimates were allowed to differ across subgroups in a pooled analysis.

Table E-137—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (90-Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge Inpatient (IP) (SE)	Out-Patient (SE)	Durable Medical Equipment (DME) (SE)	Home Health (SE)	Skilled Nursing Facilities (SNF) (SE)	Hospice (SE)	Professionals (SE)
Hospital Type: Critical Access Hospital (CAH)										
CAH	-336.03 (294.09)	-50.87 (137.75)	-266.08 (212.07)	415.17 (305.00)	34.66 (74.46)	-4.31 (7.79)	-42.81 (54.36)	-426.81 (267.66)	5.20 (19.37)	-0.08 (3.31)
Non-CAH	73.00 (127.86)	-26.30 (80.42)	150.46 (89.45)	25.91 (51.70)	1.40 (13.31)	5.28 (3.41)	3.59 (16.33)	98.72 (53.92)	7.13 (8.44)	-1.62 (1.35)
Hospital Size										
< 100 beds	-352.29 (197.62)	-12.16 (96.18)	-319.73 (197.90)	28.05 (178.99)	1.52 (45.18)	-3.22 (6.57)	-16.06 (28.03)	-304.68 (159.99)	-1.94 (12.38)	2.64 (1.96)
100-199 Beds	291.15 (234.17)	-11.13 (160.84)	379.10** (135.49)	57.64 (89.23)	16.21 (24.12)	2.03 (7.90)	39.05 (30.95)	252.35* (115.69)	4.05 (11.46)	-0.18 (1.92)
200-399 Beds	129.67 (174.06)	-83.61 (154.83)	222.12 (116.19)	116.92 (64.97)	1.37 (25.12)	6.81 (5.84)	-10.31 (26.54)	78.33 (87.30)	7.46 (12.39)	-3.44 (1.92)
More than 400 Beds	-104.04 (291.06)	-15.10 (129.14)	25.07 (214.44)	-48.67 (120.44)	-2.31 (19.34)	7.26 (5.30)	-0.34 (29.83)	65.30 (91.57)	11.49 (16.77)	-1.20 (2.82)
Location										
Rural	-76.31 (185.28)	-36.41 (94.00)	-82.72 (141.07)	7.21 (71.01)	-13.58 (43.84)	0.82 (7.95)	-34.91 (27.11)	-136.97 (87.15)	-8.81 (20.08)	0.54 (1.73)
Urban	80.24 (144.26)	-0.14 (64.23)	190.93 (97.70)	54.15 (62.56)	6.99 (12.63)	6.01 (3.48)	10.83 (17.54)	126.97* (61.25)	10.57 (8.19)	-2.05 (1.55)
Region										
Northeast	330.34 (433.64)	-255.20 (236.74)	463.73 (267.72)	170.12 (211.87)	-19.93 (33.10)	-17.96** (6.84)	-12.27 (34.36)	458.99* (200.08)	19.19 (13.20)	0.60 (2.91)

Table E-137—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (90-Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge Inpatient (IP) (SE)	Out-Patient (SE)	Durable Medical Equipment (DME) (SE)	Home Health (SE)	Skilled Nursing Facilities (SNF) (SE)	Hospice (SE)	Professionals (SE)
Midwest	35.07 (150.82)	-76.20 (147.85)	135.92 (103.84)	73.35 (65.00)	20.14 (25.25)	4.64 (4.35)	1.46 (25.44)	-46.09 (64.06)	0.59 (12.04)	-1.69 (2.84)
South	65.00 (202.62)	32.40 (72.03)	131.83 (153.81)	52.98 (96.34)	-0.78 (15.20)	6.71 (5.52)	1.59 (33.55)	62.10 (87.37)	20.48 (13.37)	-3.49** (1.32)
West	-114.51 (310.93)	14.76 (163.83)	-81.11 (210.39)	-61.48 (101.83)	-14.10 (42.11)	-0.78 (9.47)	-8.20 (31.06)	122.86 (157.38)	-10.55 (8.34)	1.41 (2.01)
Teaching										
Teaching	-51.69 (200.59)	-88.63 (131.38)	72.66 (143.85)	17.19 (79.61)	2.20 (17.72)	7.18 (3.85)	-3.15 (23.03)	37.39 (63.45)	7.16 (12.76)	-2.07 (2.15)
Non-Teaching	162.96 (123.23)	34.93 (62.98)	197.69* (91.31)	73.41 (66.63)	5.88 (19.03)	2.33 (5.34)	6.39 (20.68)	100.61 (92.33)	6.65 (7.96)	-0.93 (1.17)
Ownership										
Private (for-profit)	309.14 (259.92)	115.65 (88.65)	154.92 (218.56)	-38.43 (129.99)	9.66 (20.63)	-8.50 (10.34)	8.68 (18.16)	115.04* (58.56)	-1.15 (8.38)	0.70 (1.31)
Non-Government (not-for-profit)	65.43 (132.74)	-51.14 (95.82)	159.71 (94.81)	87.28 (55.09)	2.61 (15.67)	7.83* (3.67)	-8.24 (15.89)	47.88 (56.84)	11.85 (9.91)	-1.29 (1.59)
Government	-250.72 (437.57)	-23.55 (191.59)	-69.11 (291.11)	-169.05 (151.12)	0.71 (30.82)	-5.84 (9.23)	36.81 (54.57)	159.09 (246.73)	-20.01* (7.96)	-4.77* (2.17)
HEN Type										
System HEN	15.84 (172.43)	-101.08 (99.43)	169.91 (116.83)	9.83 (77.36)	21.40 (16.43)	1.15 (5.45)	-7.82 (19.99)	127.16 (65.27)	14.26 (9.63)	-1.44 (1.70)
Hospital Association HEN	56.92 (129.52)	-35.90 (81.30)	145.59 (90.97)	16.39 (54.91)	-1.02 (14.23)	9.25** (3.58)	11.36 (16.33)	97.93 (56.05)	7.66 (8.36)	-1.32 (1.34)

Table E-137—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (90-Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge Inpatient (IP) (SE)	Out-Patient (SE)	Durable Medical Equipment (DME) (SE)	Home Health (SE)	Skilled Nursing Facilities (SNF) (SE)	Hospice (SE)	Professionals (SE)
Complex HEN	17.41 (132.47)	-33.80 (82.52)	103.85 (92.69)	60.57 (55.68)	-4.92 (14.33)	3.62 (3.65)	12.41 (16.58)	19.11 (58.08)	8.99 (8.38)	-1.15 (1.36)
Other HEN	66.82 (136.10)	-4.69 (87.06)	124.44 (91.45)	58.15 (56.15)	14.92 (14.83)	3.03 (3.89)	-16.22 (16.50)	57.45 (55.92)	4.13 (8.30)	-2.25 (1.34)
HEN Size										
< 50 Hospitals	121.83 (190.73)	16.25 (122.80)	158.34 (117.29)	90.77 (79.64)	-8.53 (19.82)	-3.44 (5.99)	-8.96 (21.32)	78.85 (72.02)	5.75 (10.42)	-1.26 (1.58)
50-99 Hospitals	71.80 (138.30)	28.67 (89.29)	96.06 (92.48)	29.48 (57.01)	16.32 (14.78)	2.29 (3.89)	-11.97 (16.67)	51.03 (56.36)	6.06 (8.34)	-2.49 (1.36)
100-400 Hospitals	42.59 (129.41)	-67.30 (80.87)	162.72 (90.36)	34.06 (54.60)	4.80 (14.26)	8.99* (3.61)	3.33 (16.27)	100.82 (55.62)	6.81 (8.30)	-1.36 (1.33)
> 1,000 Hospitals	17.41 (132.47)	-33.80 (82.52)	103.85 (92.69)	60.57 (55.69)	-4.92 (14.33)	3.62 (3.65)	12.41 (16.58)	19.11 (58.08)	8.99 (8.38)	-1.15 (1.36)

Source: The Evaluation Contractor's analysis of Medicare inpatient claims data.

Notes: Each cell in the table contains the impact estimate on the outcome indicated in the column heading for the subgroup indicated in the row label. For all 10 outcomes, expenditures are price-adjusted and are expressed in January 2010 dollars. Within each of the panels, each column corresponds to a separate difference-in-differences regression model using discharge-level data, with discharges weighted using propensity score–based weights. The models control for patient demographics, patient risk factors, and hospital fixed effects and were calculated by using linear regression models. Appendix D provides the full list of controls included in the regression. Robust standard errors (SEs), clustered by hospital, are in parenthesis below the impact estimate. The coefficient shows the average effect of HEN alignment in the 2013 period. Hospitals with missing subgroup information that were included in the main impact analysis are not shown in this table.

*Difference-in-differences treatment-comparison impact estimate significantly different from zero at the 0.05 level, two-tailed test.

**Difference-in-differences treatment-comparison impact estimate significantly different from zero at the 0.01 level, two-tailed test.

Table E-138—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (180 Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge IP (SE)	Out-Patient (SE)	DME (SE)	Home Health (SE)	SNF (SE)	Hospice (SE)	Professionals (SE)
Hospital Type: CAH										
CAH	-260.53 (419.35)	-146.45 (165.19)	-162.69 (336.62)	335.87 (250.58)	-21.48 (75.79)	17.92 (29.89)	-31.85 (60.08)	-429.00 (235.86)	131.74 (67.74)	0.39 (3.12)
Non-CAH	31.98 (181.73)	-37.53 (96.79)	138.32 (120.26)	-62.35 (99.46)	20.64 (21.93)	2.94 (9.66)	-4.69 (23.40)	92.72 (58.21)	13.70 (19.11)	-0.88 (1.27)
Hospital Size										
< 100 beds	-300.10 (254.44)	-78.81 (115.19)	-245.26 (261.67)	5.57 (170.85)	33.75 (62.61)	12.94 (17.59)	-25.82 (34.70)	-273.00 (153.36)	47.44 (35.55)	2.94 (2.28)
100-199 Beds	182.13 (254.99)	-82.36 (160.83)	355.15* (179.05)	59.32 (134.93)	40.97 (42.74)	2.34 (13.20)	47.15 (38.49)	219.81 (114.35)	4.69 (19.17)	-0.52 (1.52)
200-399 Beds	-103.59 (291.07)	-134.73 (184.11)	103.47 (169.09)	-140.26 (169.35)	3.32 (40.57)	-12.23 (18.83)	-31.15 (38.25)	90.84 (99.25)	3.23 (24.96)	0.02 (1.17)
More than 400 Beds	107.10 (359.15)	62.24 (140.12)	124.24 (263.52)	-12.29 (180.59)	18.42 (28.77)	21.33* (8.99)	-2.96 (43.24)	46.13 (99.26)	39.46 (39.66)	-2.75 (3.01)
Location										
Rural	-64.03 (204.39)	-16.75 (72.85)	-3.76 (188.50)	48.08 (110.04)	10.12 (47.52)	-16.88 (28.49)	-72.99 (44.98)	-132.92 (82.55)	17.23 (44.14)	0.97 (1.53)
Urban	33.39 (209.54)	-50.95 (113.76)	160.04 (136.16)	-67.21 (115.78)	21.52 (23.94)	10.89 (6.89)	10.64 (24.00)	123.84 (66.62)	19.53 (19.78)	-1.25 (1.47)
Region										
Northeast	394.46 (406.65)	-316.96 (236.81)	604.46* (289.23)	300.09 (210.97)	36.91 (56.76)	-15.99 (15.25)	-8.90 (38.57)	522.39** (194.84)	38.25 (29.29)	3.40 (1.75)
Midwest	-137.13 (284.88)	-156.67 (179.10)	133.99 (169.26)	-23.50 (165.66)	46.53 (35.36)	-3.82 (9.88)	-11.86 (36.36)	-25.68 (69.87)	-17.51 (21.27)	-2.05 (1.69)

Table E-138—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (180 Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge IP (SE)	Out-Patient (SE)	DME (SE)	Home Health (SE)	SNF (SE)	Hospice (SE)	Professionals (SE)
South	127.00 (265.44)	116.61 (64.29)	62.55 (220.24)	-107.36 (185.85)	21.74 (22.76)	-0.15 (21.85)	-9.57 (48.12)	21.62 (89.24)	67.70* (32.33)	-3.60* (1.59)
West	-132.20 (281.89)	-25.51 (164.26)	-33.65 (213.78)	-104.64 (151.69)	-54.52 (71.08)	6.24 (13.41)	-12.06 (38.31)	86.02 (171.46)	-9.13 (15.89)	4.21 (2.92)
Teaching										
Teaching	-42.99 (294.38)	-84.95 (160.58)	83.74 (196.67)	-18.62 (146.70)	21.78 (29.67)	8.97 (8.70)	-12.59 (33.69)	24.21 (69.91)	16.73 (29.92)	-2.53 (1.80)
Non-Teaching	65.13 (151.81)	-2.09 (58.48)	164.01 (123.18)	-74.92 (117.31)	18.75 (29.63)	-2.13 (16.68)	1.23 (27.06)	104.35 (91.88)	21.78 (17.40)	1.35 (1.33)
Ownership										
Private (For-Profit)	187.09 (267.18)	118.00 (91.48)	160.76 (239.47)	37.88 (196.08)	91.97 (54.61)	-18.73 (18.74)	-2.39 (27.35)	76.38 (65.81)	8.65 (17.25)	0.86 (2.06)
Non-Government (Not-for-Profit)	-5.13 (216.95)	-92.32 (114.37)	155.25 (137.99)	-5.93 (114.86)	9.14 (23.94)	3.27 (11.22)	-23.10 (21.99)	55.33 (58.52)	26.10 (22.36)	-1.06 (1.36)
Government	-79.05 (381.97)	93.58 (213.28)	-114.20 (303.23)	-362.18 (189.71)	34.23 (48.48)	16.01 (14.54)	60.57 (78.24)	95.74 (249.84)	-22.93 (24.44)	-0.26 (4.20)
HEN Type										
System HEN	37.27 (225.80)	-66.76 (117.79)	171.13 (153.09)	-98.61 (120.45)	49.72 (28.79)	3.07 (11.83)	-10.19 (28.37)	115.45 (67.47)	38.52 (20.63)	0.17 (1.65)
Hospital Association HEN	46.49 (182.01)	-52.16 (96.26)	165.43 (122.34)	-50.44 (99.26)	18.53 (22.72)	10.48 (9.64)	6.33 (23.24)	94.36 (59.16)	13.37 (18.68)	-0.03 (1.28)
Complex HEN	-22.38 (186.12)	-34.88 (98.52)	79.19 (124.76)	-33.58 (100.37)	6.71 (22.95)	1.84 (9.71)	4.11 (23.53)	1.01 (61.61)	27.09 (18.74)	-0.60 (1.29)

Table E-138—Estimated Impacts of HEN-Alignment on Expenditures within Subgroups of HENs Between 2011 and 2013 (180 Day Lookout Period)										
	Outcome									
	Total Expenditures (SE)	Index Discharge (SE)	Post-Discharge (SE)	Post-Discharge IP (SE)	Out-Patient (SE)	DME (SE)	Home Health (SE)	SNF (SE)	Hospice (SE)	Professionals (SE)
Other HEN	-2.88 (187.07)	-37.97 (101.28)	101.96 (123.18)	-46.79 (100.81)	30.66 (23.68)	-0.84 (10.04)	-28.23 (23.51)	60.68 (58.85)	15.68 (18.61)	-2.00 (1.27)
HEN size										
< 50 Hospitals	92.42 (255.78)	-32.09 (137.60)	190.57 (168.08)	11.12 (130.42)	20.34 (36.56)	-15.05 (14.23)	-16.54 (30.38)	93.51 (81.77)	25.51 (22.05)	-0.21 (1.65)
50-99 Hospitals	-4.86 (189.00)	-16.14 (102.62)	78.16 (125.39)	-48.91 (102.87)	27.94 (23.53)	1.34 (10.05)	-23.10 (23.76)	34.39 (59.31)	15.01 (18.65)	-1.26 (1.32)
100-400 Hospitals	32.57 (181.47)	-68.32 (96.35)	167.80 (120.85)	-61.68 (98.30)	26.55 (22.76)	8.85 (9.65)	-2.93 (23.14)	108.63 (58.44)	16.23 (18.62)	-0.84 (1.26)
> 1,000 Hospitals	-22.38 (186.12)	-34.88 (98.52)	79.19 (124.76)	-33.58 (100.37)	6.71 (22.95)	1.84 (9.71)	4.11 (23.53)	1.01 (61.61)	27.09 (18.74)	-0.60 (1.29)

Source: The Evaluation Contractor's analysis of Medicare inpatient claims data.

Notes: Each cell in the table contains the impact estimate on the outcome indicated in the column heading for the subgroup indicated in the row label. For all 10 outcomes, expenditures are price-adjusted and are expressed in January 2010 dollars. Within each of the panels, each column corresponds to a separate difference-in-differences regression model using discharge-level data, with discharges weighted using propensity score-based weights. The models control for patient demographics, patient risk factors, and hospital fixed effects and were calculated by using linear regression models. Appendix D provides the full list of controls included in the regression. Robust SEs, clustered by hospital, are in parenthesis below the impact estimate. The coefficient shows the average effect of HEN alignment in the 2013 period. Hospitals with missing subgroup information that were included in the main impact analysis are not shown in this table.

*Difference-in-differences treatment-comparison impact estimate significantly different from zero at the 0.05 level, two-tailed test.

**Difference-in-differences treatment-comparison impact estimate significantly different from zero at the 0.01 level, two-tailed test.

Table E-139 provides a breakdown of Medicare expenditures by year and HEN alignment status. It shows average expenditures associated with an index discharge for the 90-day lookout and the 180-day lookout.

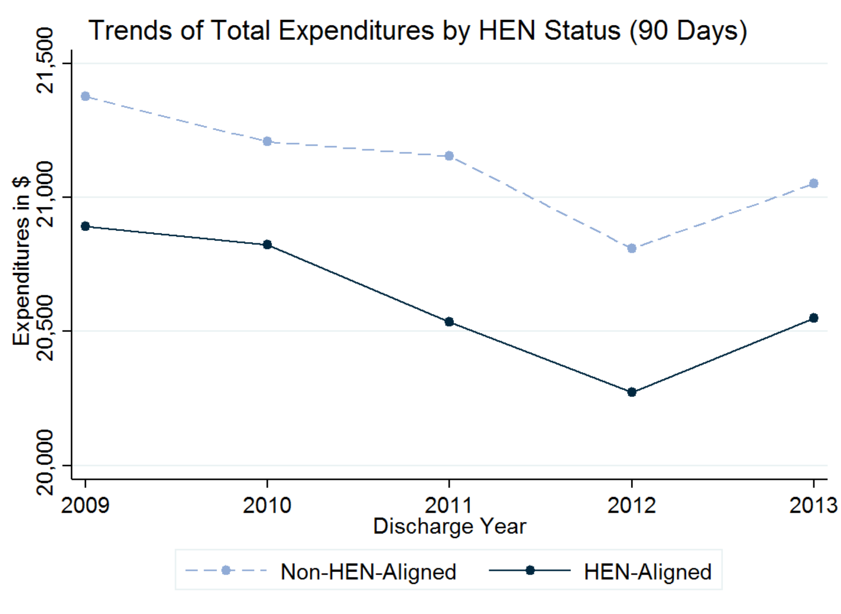
Table E-139—Mean Medicare Expenditures per Person, by Expenditure Type and Lookout Period, 2011 and 2013

Expenditure Type	HEN				Non-HEN			
	2011		2013		2011		2013	
	90-Day	180-Day	90-Day	180-Day	90-Day	180-Day	90-Day	180-Day
Total Expenditures	20,600.20	24,542.55	20,899.09	24,528.03	21,014.08	25,067.45	21,403.88	25,192.16
Index Discharges	9,141.13	9,102.89	9,544.89	9,383.65	9,316.50	9,272.17	9,860.45	9,720.60
Post-Discharge	11,459.07	15,439.67	11,354.21	15,144.38	11,735.61	15,996.74	11,522.79	15,594.91
Post-Discharge Inpatient (IP)	5,489.32	7,403.24	5,437.31	7,241.61	5,529.53	7,392.86	5,458.42	7,317.43
Outpatient	1,234.82	2,118.55	1,341.54	2,264.48	1,269.23	2,186.33	1,396.96	2,348.30
Durable Medical Equipment	234.72	406.54	204.45	350.87	238.64	413.39	206.78	358.14
Home Health	991.65	1,405.58	983.89	1,375.48	984.29	1,421.16	980.99	1,404.88
Skilled Nursing Facilities (SNF)	3,232.77	3,719.66	3,113.61	3,531.45	3,531.31	4,083.52	3,293.21	3,750.62
Hospice	175.38	283.92	175.97	281.05	186.44	304.95	182.63	288.23
Professionals (i.e., Carrier)	100.41	102.17	97.43	99.44	97.67	99.55	96.62	97.91

Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Each row corresponds to a separate outcome using index discharge-level data, with discharges weighted by propensity-score based weights. For all ten outcomes, expenditures are price-adjusted and are expressed in January 2010 dollars. Each cell shows the average per discharge expenditure for a given expenditure category.

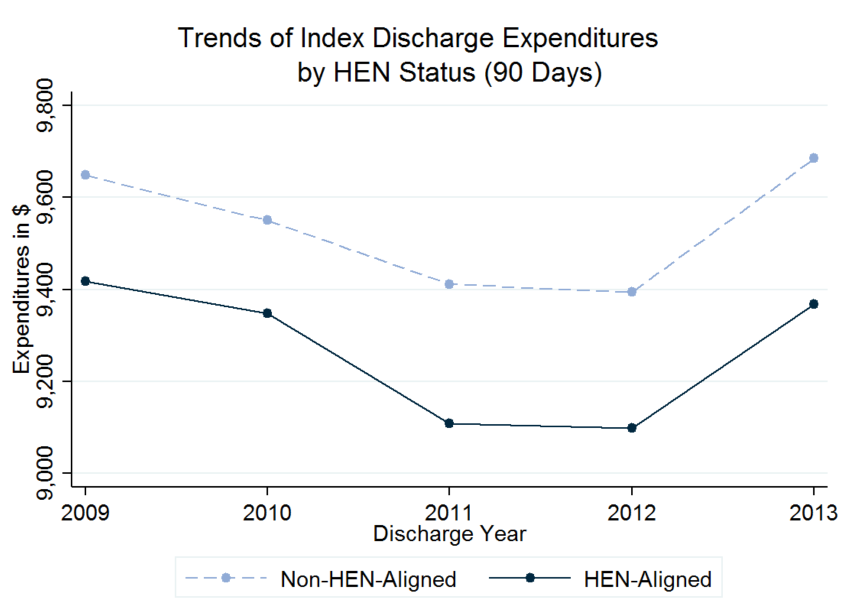
The trends from 2009 to 2013 by HEN-alignment status across expenditures, adjusting for patient and hospital characteristics are shown in Figure E-11 to Figure E-16 (see Appendix D for the full list of controls). These figures show that the changes over time for different expenditure categories are fairly similar between HEN and non-HEN aligned hospitals in the sample period.

Figure E-11—Trends of Total Expenditures by HEN Status (90 Days)



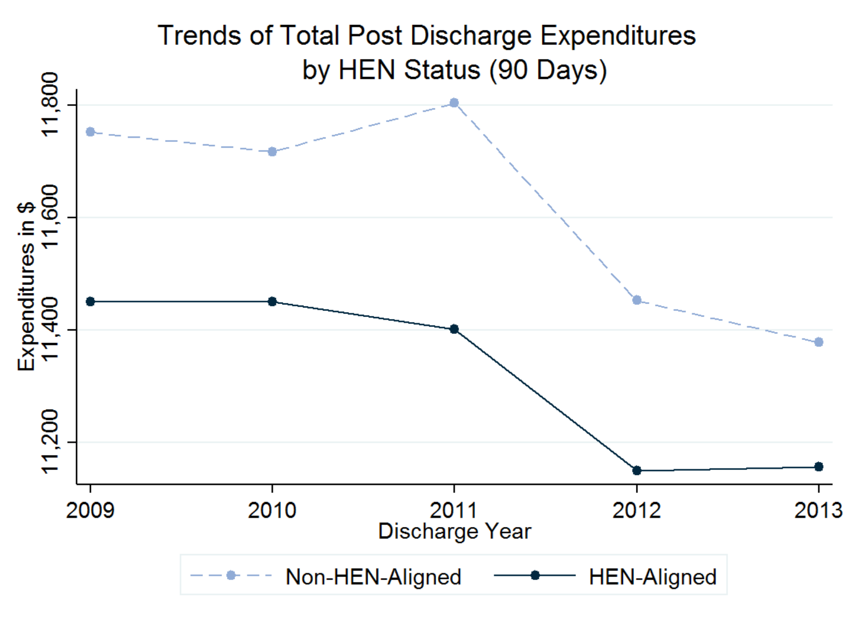
Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare fee-for-service (FFS) beneficiary demographics (age, sex, and race) over time and hospital characteristics (American Hospital Association [AHA] survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Figure E-12—Trends of Index Discharge Expenditures by HEN Status (90 Days)



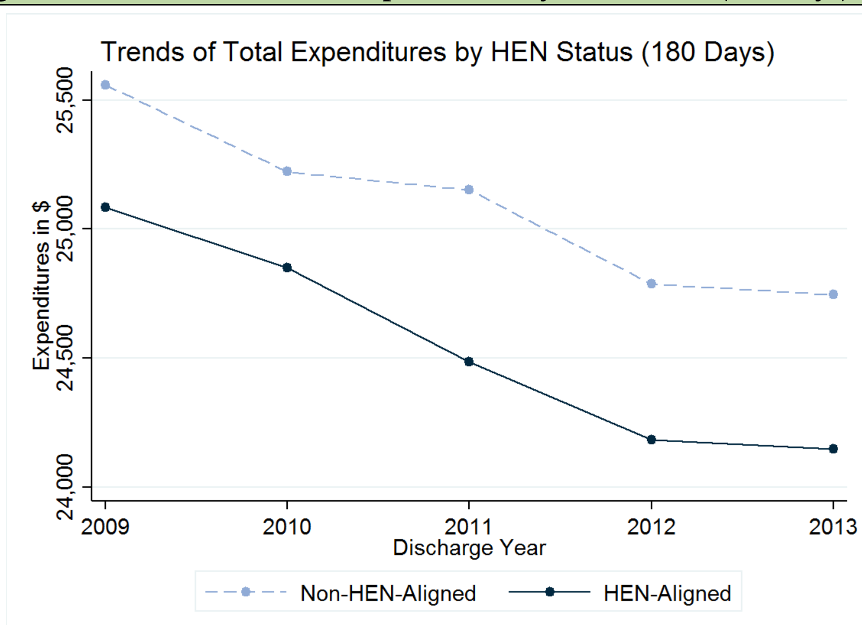
Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare FFS beneficiary demographics (age, sex, and race) over time and hospital characteristics (AHA survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Figure E-13—Trends of Total Post Discharge Expenditures by HEN Status (90 Days)



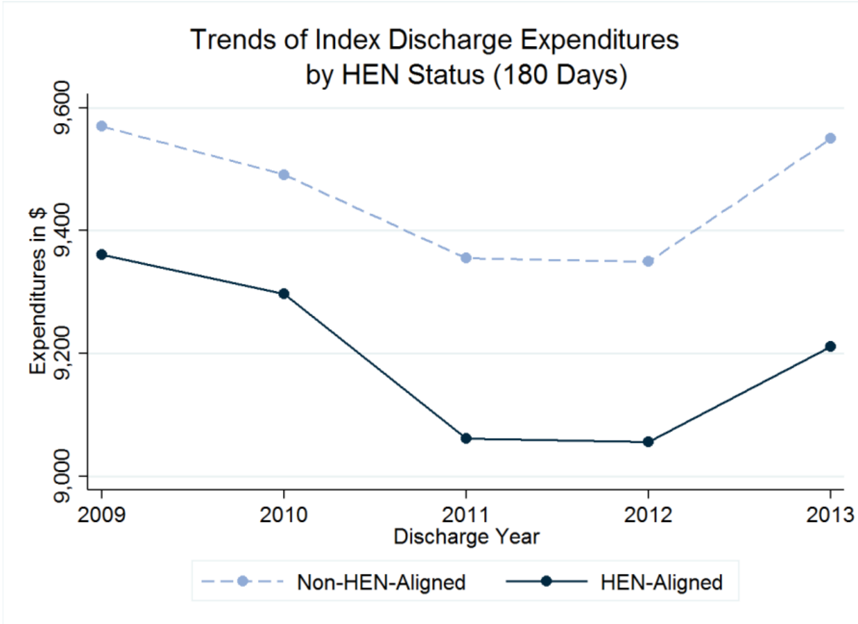
Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare FFS beneficiary demographics (age, sex, and race) over time and hospital characteristics (AHA survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Figure E-14—Trends of Total Expenditures by HEN Status (180 Days)



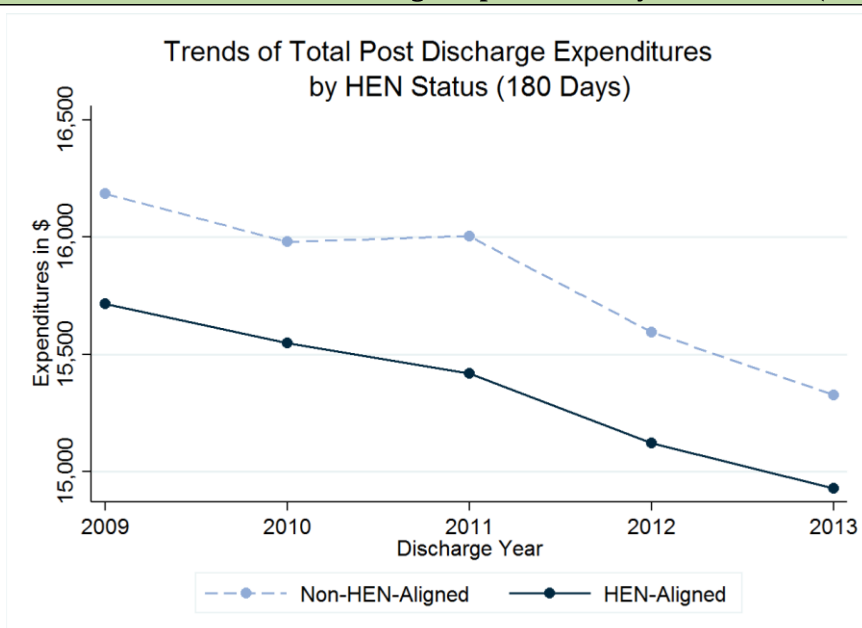
Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare FFS beneficiary demographics (age, sex, and race) over time and hospital characteristics (AHA survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Figure E-15—Trends of Index Discharge Expenditures by HEN Status (180 Days)



Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare FFS beneficiary demographics (age, sex, and race) over time and hospital characteristics (AHA survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Figure E-16—Trends of Total Post Discharge Expenditures by HEN Status (180 Days)



Source: The Evaluation Contractor's analyses of Medicare claims data.
Notes: Adjusted for changes in Medicare FFS beneficiary demographics (age, sex, and race) over time and hospital characteristics (AHA survey data). Appendix B provides the full list of controls. The solid line shows the adjusted rate for Medicare beneficiaries with index discharges at HEN-aligned facilities. The dashed line shows the Medicare beneficiaries in the propensity score reweighted comparison group of non-aligned hospitals.

Recommendation (Chapter 8)

Interventions to Reduce Readmissions

Hospital Engagement Networks (HENs) report that HEN-aligned hospitals are using a variety of interventions in their efforts to reduce readmissions, as displayed in Table E-140.

Table E-140—Readmissions Interventions HENs Reported In Place in at Least 30 Percent of Their Hospitals

Intervention	AHA/HRET	Ascension	Carolinas	DFW	Dignity	EHEN	Georgia	Intermountain	Iowa	JCR	LifePoint	Michigan	Minnesota	Nevada	New York*	New Jersey	NoCVA	Ohio	Ohio Children's	Pennsylvania	Premier	TCQPS	Tennessee	UHC	VHA	Washington	Totals
Hospital Care Processes																											
Risk Assessment*																											**18**
Risk assessment at admission—LACE	✓		✓		✓	✓					✓	✓			✓	✓		✓	✓		✓						**11**
Risk assessment at admission—CORE, Yale					✓	✓									✓				✓								**4**
Other risk assessment		✓	✓		✓		✓			✓			✓	✓			✓	✓			✓			✓			**11**
Physician assessment before discharge										✓		✓	✓	✓		✓											**5**
Use of electronic health record (EHR) to flag a patient who has been admitted to the hospital in the past 30 days, to alert the emergency department (ED) physician	✓		✓		✓	✓					✓	✓						✓			✓						**8**
Care Coordination*																											**24**
Case management (care manager, care transitions coordinator, etc.)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		✓	**22**

Table E-140—Readmissions Interventions HENs Reported In Place in at Least 30 Percent of Their Hospitals

Intervention	AHA/HRET	Ascension	Carolinas	DFW	Dignity	EHEN	Georgia	Intermountain	Iowa	JCR	LifePoint	Michigan	Minnesota	Nevada	New York*	New Jersey	NoCVA	Ohio	Ohio Children's	Pennsylvania	Premier	TCQPS	Tennessee	UHC	VHA	Washington	Totals
Identify primary care provider during stay	✓	✓	✓		✓	✓			✓	✓	✓	✓		✓	✓	✓	✓				✓	✓		✓			**16**
Provide patients' primary care providers with discharge summary		✓	✓		✓				✓	✓	✓	✓	✓		✓	✓		✓		✓	✓			✓			**14**
Hardwire communications when patients are discharged to post-acute settings		✓	✓		✓		✓			✓		✓				✓		✓			✓	✓		✓			**11**
Discharge Planning*																											**22**
Interdisciplinary discharge planning	✓	✓	✓		✓	✓				✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓			**17**
Standardized discharge bundle										✓			✓	✓		✓			✓		✓						**6**
Use of the Centers for Medicare & Medicaid Services (CMS) patient discharge checklist									✓			✓		✓		✓					✓						**5**
Use of Project RED tool	✓			✓	✓	✓	✓			✓		✓	✓			✓		✓		✓	✓	✓					**13**
Medication Reconciliation*																											**18**
Engagement of pharmacists in medication reconciliation before discharge		✓				✓		✓	✓	✓		✓	✓	✓	✓			✓[a]			✓	✓	✓				**13**
Fill prescriptions for patient before discharge	✓	✓		✓		✓	✓		✓			✓	✓	✓	✓	✓		✓[a]		✓	✓						**14**
Staff Education*																											**3**
Training nursing staff on pre-admission hand-offs										✓		✓		✓													**3**

Table E-140—Readmissions Interventions HENs Reported In Place in at Least 30 Percent of Their Hospitals																											
Intervention	**AHA/HRET**	**Ascension**	**Carolinas**	**DFW**	**Dignity**	**EHEN**	**Georgia**	**Intermountain**	**Iowa**	**JCR**	**LifePoint**	**Michigan**	**Minnesota**	**Nevada**	**New York***	**New Jersey**	**NoCVA**	**Ohio**	**Ohio Children's**	**Pennsylvania**	**Premier**	**TCQPS**	**Tennessee**	**UHC**	**VHA**	**Washington**	**Totals**
Patient and Family Engagement (PFE)																											
PFE*																											**25**
Patient education and teach-back, may be targeted to certain conditions, (e.g., congestive heart failure [CHF], etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	**24**
Provide comprehensive written discharge plan to the patient/family	✓				✓		✓			✓		✓	✓	✓	✓	✓			✓		✓	✓		✓			**13**
Patient advocate program to resolve challenges for patients before discharge		✓		✓								✓		✓		✓					✓			✓			**7**
Family engagement in discharge process	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓			**17**
Family interview to assess effective discharge communication						✓				✓		✓					✓		✓								**5**
Information sharing with caregivers when patient is transferred		✓	✓		✓					✓		✓		✓		✓					✓	✓		✓			**10**
Creating a resource room to allow for information sharing for patients, families, and members of the medical community in hospital area with high traffic					✓							✓				✓					✓						**4**
Palliative Care*																											**5**
Roll out of Practitioner Orders for Life-Sustaining Treatment (POLST) to all healthcare professionals in pre-hospital, acute care hospital and long-term care settings									✓			✓			✓	✓				✓							**5**

Table E-140—Readmissions Interventions HENs Reported In Place in at Least 30 Percent of Their Hospitals

Intervention	AHA/HRET	Ascension	Carolinas	DFW	Dignity	EHEN	Georgia	Intermountain	Iowa	JCR	LifePoint	Michigan	Minnesota	Nevada	New York*	New Jersey	NoCVA	Ohio	Ohio Children's	Pennsylvania	Premier	TCQPS	Tennessee	UHC	VHA	Washington	Totals
Post-Discharge Follow-Up																											
Post-Discharge Follow-Up*																											**22**
Call patients within 72 hours following discharge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		✓		✓	**22**
Post-discharge call center for patients			✓			✓	✓			✓		✓		✓		✓					✓						**8**
Schedule follow-up visit at discharge	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓		✓	✓			✓			**17**
Visit patient/family at home within 24–48 hours post discharge					✓	✓				✓		✓	✓								✓						**6**
Follow-up primary care visit within 72 hours of discharge					✓			✓		✓		✓	✓					✓[b]			✓						**7**
In-home remote monitoring of patients			✓									✓	✓														**3**
Other discharge planning and follow-up							✓											✓									**2**
Care Transitions																											
Care Transitions Models*																											**15**
Use of Care Transitions Intervention (CTI) ("Coleman Model")	✓											✓	✓			✓					✓						**5**
Use of Transitional Care Model ("Naylor Model")																✓											**1**
Use of Better Outcomes for Older Adults through Safe Transitions (BOOST)	✓				✓	✓		✓		✓		✓		✓		✓				✓	✓						**10**

Table E-140—Readmissions Interventions HENs Reported In Place in at Least 30 Percent of Their Hospitals																											
Intervention	**AHA/HRET**	**Ascension**	**Carolinas**	**DFW**	**Dignity**	**EHEN**	**Georgia**	**Intermountain**	**Iowa**	**JCR**	**LifePoint**	**Michigan**	**Minnesota**	**Nevada**	**New York***	**New Jersey**	**NoCVA**	**Ohio**	**Ohio Children's**	**Pennsylvania**	**Premier**	**TCQPS**	**Tennessee**	**UHC**	**VHA**	**Washington**	**Totals**
Use of State Action on Avoidable Rehospitalizations (STAAR) (IHI initiative)	✓			✓[e]				✓	✓			✓				✓	✓			✓	✓						**9**
National Transitions of Care Coalition (NTOCC) bundle													✓			✓							✓				**3**
Community Partners*																											**24**
Creation and empowerment of cross-continuum community transition teams	✓	✓	✓		✓				✓			✓	✓		✓	✓	✓	✓		✓	✓		✓			✓	**15**
Participation in Community-Based Care Transitions Program (CCTP)	✓			✓	✓		✓					✓			✓	✓	✓	✓			✓		✓				**11**
Coordination with community-based physicians, Federally Qualified Health Center (FQHC)	✓	✓	✓		✓	✓	✓	✓	✓					✓	✓	✓	✓			✓		✓	✓			✓	**16**
Coordination with home health agencies	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	**21**
Coordination with senior centers, social services	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓				**19**
Coordination with long-term care facilities, skilled nursing facilities (SNFs)		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	**21**
Other*				✓[f]			✓[d]																				**2**

Source: HEN readmissions intervention tables submitted October 2013. Three HENs (DFW, Intermountain, and VHA) did not provide updated intervention tables; their interventions included are based on narrative provided in their September and October 2013 monthly reports.

[a]Use of online outpatient pharmacy medical reconciliation for transfer to nursing home, hospital assistance with filling medications for indigent, engage community pharmacist to assist with discharge medication education, hospital peer (MD, NP) to SNF peer (MD, NP) hand offs.

[b]Pay physician if they call patient and set up appointment within 48 hours.

[c]Root cause analysis with SNFs.

[d]Timely handover communication.

[e]Aspect of the Institute for Healthcare Improvement (IHI) bundle "Improving Transitions to Reduce Readmissions: has been a focus since 2006.

[f]Revised medication lists to include non-prescription and herbal medications and educate patients on their medications.

[*]Total equals number of HENs reporting at least one intervention in the category.