Evaluation of the Medicare Care Choices Model

Annual Report 4

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Executive Summary

In 2016, the Centers for Medicare & Medicaid Services (CMS) launched the Medicare Care Choices Model (MCCM). The model tested whether offering eligible beneficiaries the option to receive supportive services without forgoing payment for treatment of their terminal conditions improved their quality of life and care, increased beneficiaries' satisfaction, and reduced Medicare expenditures. CMS was also interested in whether MCCM led to earlier election of the Medicare hospice benefit. This independent evaluation annual report focuses on the effects of MCCM on beneficiaries' outcomes through March 2021. Our final report, scheduled for next year, will use mixed methods to broadly evaluate model implementation, estimate impacts over the full model period, and synthesize factors associated with successful model performance and outcomes.

MCCM participants. Medicare-certified hospices played a prominent role in implementing the model, employing their staff to market, manage, and provide supportive services for MCCM enrollees. These services included care coordination and case management, round-the-clock access to health care professionals, person- and family-centered care planning, shared decision making, symptom management, and counseling. CMS accepted 141 hospices to participate in the model, of which 89 hospices (63 percent) enrolled at least one beneficiary in MCCM through September 2020 and 49 hospices (35 percent) chose to participate in a one-year model extension (through December 2021). Hospices that participated in the model and the one-year extension tended to be larger than other hospices nationwide, and more often were part of a nonprofit organization.

MCCM enrollees. Model enrollees were Medicare fee-for-service beneficiaries at the end of life (expected to live less than six months) with a diagnosis of cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS who (1) were referred to a participating hospice, (2) found to meet model eligibility criteria, and (3) chose to enroll into MCCM. When enrolled, beneficiaries received supportive services through MCCM and coverage under the Medicare fee-for-service benefit for both their terminal illness and other health care needs. Through September 2020, the model enrolled 6,427 beneficiaries. This represents a small percentage of beneficiaries who lived in participating hospices' market areas and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. Enrollees tended to be relatively sicker (for example, they used more health care services and had higher hierarchical condition category scores before enrolling) and a disproportionately higher percentage had cancer than non-enrollees. Just five hospices enrolled 45 percent of all MCCM enrollees. The average beneficiary enrolled in MCCM 185 days (about six months) before their death, but post-enrollment survival varied widely from a single day to more than two years.

To have complete data, our impact analyses focused on 4,574 beneficiaries who enrolled in MCCM from January 2016, when the model began, through September 2020, and who died by March 2021, the time of data collection. Our main impact analysis yielded several notable findings:

- **Reduced Medicare expenditures.** Medicare Part A and B expenditures per beneficiary for MCCM enrollees were $9,080 (17 percent) lower than expenditures for comparison group beneficiaries during the period between their MCCM enrollment date and death (Table ES.1). Payments to participating hospices for providing MCCM services to enrollees were $1,827 on average per enrollee, so total Medicare expenditures decreased by $7,254 (14 percent) on net. These impacts varied by the length of time beneficiaries lived after enrolling in MCCM: the largest reductions in net Medicare expenditures (in dollar terms) occurred among enrollees who lived 31 to 365 days after enrolling in

MCCM while the largest *percentage* impacts were concentrated among enrollees who lived fewer than six months after enrolling in MCCM.

- **Reduced use of resource-intensive services.** Model enrollees were less likely to use hospital services. For example, they had 26 percent fewer inpatient hospital admissions and 14 percent fewer outpatient emergency department visits and observation stays than beneficiaries in the comparison group. Enrollees spent 38 percent fewer days in an inpatient intensive care unit and 30 percent fewer days admitted to other inpatient hospital units. Decreased inpatient spending drove overall reductions in Medicare expenditures.
- **Increased use of the Medicare hospice benefit.** A large majority (83 percent) of enrollees in our analytic sample transitioned out of MCCM and subsequently enrolled in the Medicare hospice benefit. MCCM enrollees were 29 percent more likely to elect the Medicare hospice benefit before death than matched comparison beneficiaries (83 versus 64 percent). About 70 percent of the Medicare savings, mentioned earlier, were due to MCCM enrollees enrolling in hospice earlier and more often.
- **Improved quality of end-of-life care.** Finally, MCCM enrollees were more likely to receive better-quality of end-of-life care in the period between enrollment and death. For example, they were less likely to receive an aggressive life-prolonging treatment in the last 30 days of life (46 versus 62 percent) and spent about six more days at home than beneficiaries in the comparison group (a 4 percent increase).

Table ES.1. Estimated effects of MCCM on the evaluation's primary quantitative beneficiary outcome measures

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact
Average Medicare Part A and B expenditures ($ per beneficiary)	44,149	53,229	-9,080	-17%
Average Medicare Part A and B expenditures plus MCCM payments ($ per beneficiary)	45,976	53,229	-7,254	-14%
Average number of inpatient admissions (number per 1,000 beneficiaries)	1,187	1,608	-421	-26%
Number of outpatient emergency department visits and observation stays (number per 1,000 beneficiaries)	839	970	-131	-14%
Percentage who elected the Medicare hospice benefit	83	64	19	+29%
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	46	62	-16	-26%
Average number of days at home[a]	167	161	6	+4%

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. All seven impact estimates in this table were statistically significant at the $p < 0.001$ level. The rest of this report and its technical appendices discuss methods and results in more detail.

[a] Days at home counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long term care hospital, or skilled nursing facility.

MCCM = Medicare Care Choices Model.

Additional analyses revealed some **variation in outcomes across subgroups of MCCM enrollees**, including the following:

- **Qualifying condition.** Effects of the model were remarkably similar for the subgroups of beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease (although impacts across subgroups for particular outcomes varied modestly). The large, favorable estimated impacts across all target illnesses suggests improvements depend less on model features specific to a particular illness. That is, persons with a wide range of terminal conditions might benefit from similar services.
- **COVID-19.** Model effects were largely sustained among beneficiaries enrolled late enough to be potentially affected by the COVID-19 pandemic. This early evidence suggests model implementation and fidelity were not adversely affected during the pandemic among participants. In fact, reductions in Medicare expenditures were larger among beneficiaries who enrolled in MCCM during the COVID-19 pandemic than among enrollees who enrolled earlier.
- **Health equity.** Racial minority and dually eligible MCCM enrollees had less favorable outcomes than non-Hispanic White MCCM enrollees and Medicare-only MCCM enrollees, respectively, on several quality-of-care outcome measures. (Our next report will use a comparison group to determine whether MCCM reduced disparities in outcomes.)

Altogether, our impact estimates largely align with the expectations of the model—that is, they match the pattern of outcomes MCCM intended to produce. Although their paths varied, MCCM beneficiaries ultimately appeared to have received better-quality end-of-life care according to established quality measures, such as spending more days at home at the end of life. They also had lower average Medicare expenditures and acute care service use than beneficiaries in the comparison group, due in large part to increases in hospice use among model enrollees. Thus, the model provides important lessons for policymakers. However, these results might not generalize from the relatively small number of MCCM hospices and enrollees to other hospice providers or beneficiaries. And, although the evaluation has many strengths, some of the estimated differences in outcomes between MCCM enrollees and matched comparison beneficiaries could be due to unobserved differences between the two groups, such as having clinicians more likely to recommend hospice to their patients. Sensitivity analyses suggest these unobserved differences would have to be very large to *fully* negate the findings, but perhaps true impacts were not quite as large as we estimated. Thus, careful consideration is merited for those extrapolating these findings to other settings.

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I. Introduction

Services available through the Medicare hospice benefit can greatly improve the quality of life for people with life-limiting illnesses. Previous research has shown use of hospice services at the end of life can meaningfully improve the quality of life and health care outcomes by providing symptom management, pain control, and supportive services to caregivers (Connor et al. 2007; Temel et al. 2010; Aldridge et al. 2016). However, Medicare beneficiaries have traditionally underused hospice services because of a requirement that beneficiaries forgo payment for treatment of their terminal conditions to receive hospice services. Only about half of Medicare beneficiaries who died in 2019 received any hospice care before their death, with a median length of enrollment in hospice of 18 days among those who used the benefit (National Hospice and Palliative Care Organization 2021). In fact, many of those who selected hospice enrolled in the last week of their life.

The Centers for Medicare & Medicaid Services (CMS) designed the Medicare Care Choices Model (MCCM) to test whether offering eligible beneficiaries the option to receive supportive services without forgoing payment for treatment of their terminal conditions would improve their quality of life and care, increase beneficiaries' satisfaction, and reduce Medicare expenditures. CMS was also interested in whether MCCM led to earlier election of the Medicare hospice benefit.

CMS originally planned to implement the model from January 1, 2016, through December 31, 2020, but in June 2020, the agency extended the model until December 31, 2021. Under the one-year extension, participating MCCM hospices enrolled eligible beneficiaries through June 30, 2021, and provided supportive services to enrollees through December 31, 2021. CMS also extended the evaluation to include this additional experience.

A. Overview of the model

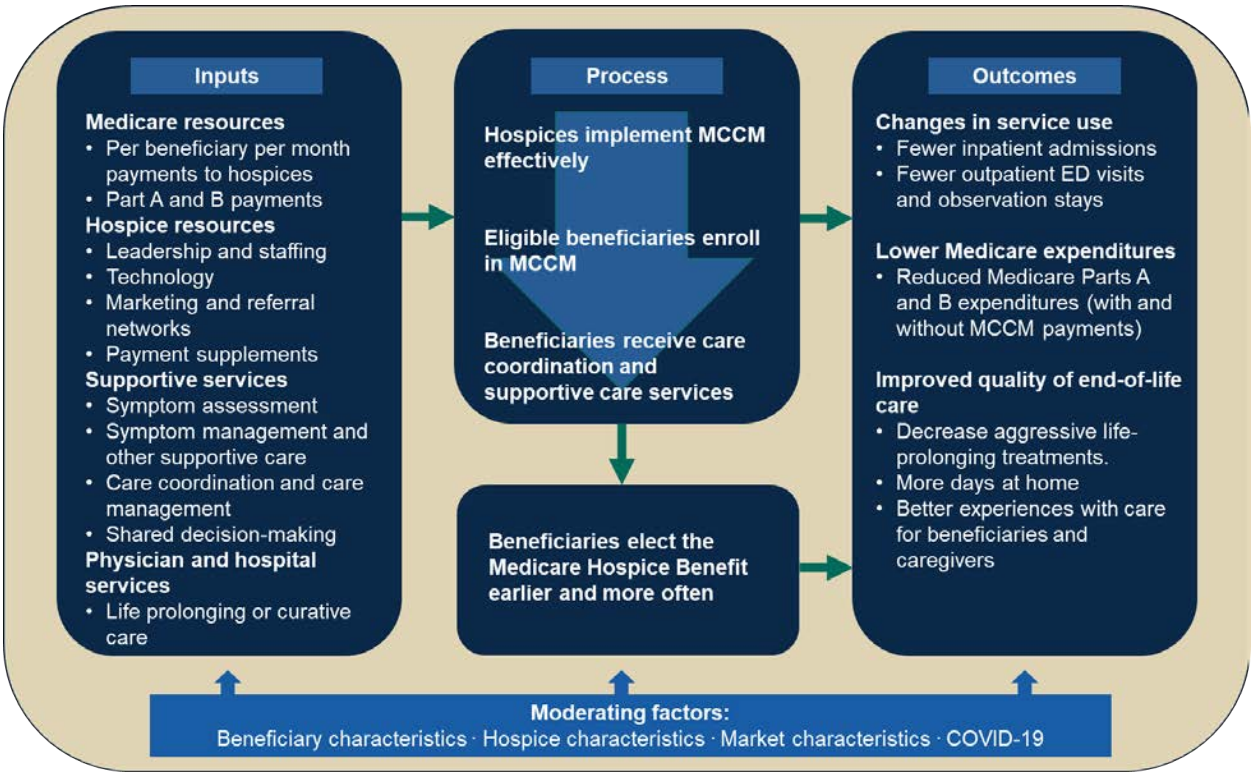
CMS intended for Medicare-certified hospices to play a prominent role in implementing MCCM (Figure I.1). The participating hospices employed their staff to market, manage, and provide services for MCCM enrollees. Simultaneously, beneficiaries received health care services under the regular Medicare fee-for-service (FFS) benefit for both their terminal illness and other health care needs.

CMS expected participating hospices to recruit MCCM beneficiaries, either through their current or new referral sources. Hospices had to educate referral sources about the MCCM option, including the beneficiary eligibility criteria and the services that would be offered. After the hospice identified a potentially eligible MCCM enrollee, it offered the beneficiary a choice to enroll in either (1) the model, (2) the traditional Medicare hospice benefit, (3) other palliative care programs offered by the hospice (or other providers) or (4) remain unenrolled from these programs.

For each beneficiary confirmed eligible and enrolled in the model, the hospice received for the first month, if the beneficiary was enrolled more than 15 days, a fixed payment amount of $400 per month for each month the beneficiary remained enrolled in the model, or $200 for the first month if the beneficiary enrolled for fewer than 15 days, and then $400 per month thereafter. Beneficiaries who enrolled in MCCM received care coordination and supportive services similar to those provided under the Medicare hospice benefit, but they did not receive all services provided under the hospice benefit, including

intensive services such as inpatient respite care or continuous care in the home, and durable medical equipment (Abt Associates 2020a, Exhibit I.3).[1]

Figure I.1. How MCCM was expected to improve care



MCCM = Medicare Care Choices Model.

The hospices were expected to provide the following types of supportive services:

1. **Care coordination and case management.** Organize the health care services provided for the care of the beneficiaries' qualifying illnesses and share information among the participants' interdisciplinary team to achieve safe, effective, and coordinated care.
2. **24/7 access to hospice team.** Provide access to health care professionals on a round-the-clock basis.
3. **Person- and family-centered care planning**. Empower the enrollee to be involved in care planning and ensure health care goals and preferences are designed for the enrollee.
4. **Shared decision making.** Share treatment options with the beneficiaries and elicit information from them to ensure their care plans support their values and preferences.
5. **Symptom management.** Manage the beneficiaries' pain and symptoms by making periodic comprehensive assessments and create individual care plans to alleviate those symptoms.
6. **Counseling.** Offer appropriate counseling to beneficiaries and their families based on assessments and the individual's plan of care.

[1] Beneficiaries in MCCM received durable medical equipment under their usual Part B benefit.

Hospices that implemented the model effectively provided these services to MCCM beneficiaries, and CMS expected to achieve several outcomes from the services provided:

- Symptom assessment and management, along with 24/7 access to health care professionals, would support families and keep enrollees comfortable in the home, avoiding unnecessary use of hospital services.
- Care coordination, care planning, and counseling would enable the beneficiaries and families to learn how supportive services work and eased the transition into the Medicare hospice benefit. These beneficiaries were expected to enroll in the Medicare hospice benefit more often (or earlier), reducing Medicare inpatient services and aggressive treatment for their terminal conditions at the end of life.
- Care coordination and supportive services would improve enrollee and caregivers' experiences at the end of life, improving both the quality of and satisfaction with health care.

The model sought to enroll beneficiaries who were eligible for the traditional hospice benefit but had not selected it. Specifically, beneficiaries must:

- Have been enrolled in Medicare FFS Part A and B for the past 12 months;[2]
- Have a diagnosis of cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS;
- Be expected to live six months or less if the beneficiary's terminal illness runs its normal course (as attested to by a physician);
- Have had at least one hospital encounter and three office visits in the past 12 months;
- Have not elected to enroll in either the Medicare or Medicaid hospice benefit in the past 30 days; and
- Reside within the service area of the participating hospice and in a traditional home (not including assisted living facilities).

B. Model implementation

In 2015, CMS accepted 141 hospices to participate in the model. It randomly assigned 71 hospices to Cohort 1, which started enrolling beneficiaries in January 2016, and 70 to Cohort 2, which started enrolling beneficiaries in January 2018. Since then, 62 hospices have formally withdrawn from MCCM for various reasons, including administrative costs associated with implementing the model, overlap with other programs, and stringent eligibility requirements (Abt Associates 2020b). In June 2020, CMS extended the model for one more year, and 49 hospices (62 percent of the 79 hospices participating at the end of 2020) chose to continue in the model during calendar year 2021. In all, 89 of the original 141 MCCM hospices (63 percent) enrolled at least one beneficiary in the model from January 1, 2016, to September 30, 2020.

C. Previous findings

A previous CMS contractor provided three evaluation reports that covered nearly four years of MCCM. The first two reports covered the implementation of the model, and the third included both implementation findings and early impact results (Abt Associates 2018, 2020a, b). Hospices had difficulty marketing the model among referring sources and recruiting eligible beneficiaries, and overall

[2] Medicare must be the primary payor at the time of entry into MCCM.

enrollment in the model remained low. Despite the enrollment challenges, the initial evaluation found several promising results. First, MCCM improved the quality of care of enrolled beneficiaries by regularly assessing enrollees' symptoms and providing relief when required. Caregivers also reported the model encouraged shared decision making and advance care planning. Second, MCCM enrollees were more likely to enroll in the Medicare hospice benefit than beneficiaries in a comparison group of similarly ill Medicare decedents. Third, MCCM enrollees who died incurred fewer Medicare costs, after accounting for model payments, relative to a matched comparison group of decedents. According to the previous evaluation, the model resulted in a net savings to Medicare of $5,962 per decedent, or a 25 percent reduction in expenditures. The reduction in expenditures stemmed from decreased use of inpatient services during the last month of life among those who transitioned to the Medicare hospice benefit. The prior evaluation used different impact analysis methods than those used in this report, which could lead to some differences in results.[3]

D. Overview of the evaluation approach

Research questions. This annual report focuses on the effects of MCCM on Medicare expenditures, service use, and quality outcomes. In particular, we address four key research questions:

1. Does MCCM result in decreased Medicare service use and expenditures, better quality of care, or better experiences of care at the end of life?
2. What are the impacts on beneficiaries based on their demographic characteristics, terminal disease type, comorbidities, functional status, service use patterns, length of time in the model, and other important factors?
3. Do beneficiaries in the model elect the Medicare hospice benefit at a higher rate and earlier in their disease trajectory compared to those not in the model?
4. Do beneficiaries in the model receive different patterns of supportive services and life-prolonging or curative care compared to those not in the model?

We plan to answer several additional evaluation research questions, including the effects of MCCM on health equity, in our final report scheduled for next year.

Data source and methods. To assess the effects of MCCM using Medicare claims data, we calculated the regression-adjusted differences in outcome measures between beneficiaries enrolled in MCCM and a matched comparison group of eligible beneficiaries who were not referred to or enrolled in MCCM but resemble MCCM enrollees in terms of prognosis (that is, died within our analysis period in the same length of time), health conditions, prior experience of care, and other observed characteristics. We drew the comparison beneficiaries from the regions served by MCCM hospices to mitigate the risk that regional differences unrelated to true model impacts might drive the impact estimates. This is especially important for enrollees who participated in 2020 and 2021, when COVID-19 might have had different effects in different parts of the country. This report focuses on impacts during the period from January 1, 2016, when the model began, through March 31, 2021.

[3] Most notably, the methods used for this report sought to achieve better balance between MCCM enrollees and comparison beneficiaries, especially on (actual or expected) survival times and patterns of service use in the period before enrollment. In addition, we (1) did not exclude MCCM enrollees who survived more than 365 days; (2) produced a single estimate of the average impact of MCCM on each outcome, following all beneficiaries in the analysis sample from enrollment to death (instead of multiple estimates over different time periods); and (3) abandoned the previous difference-in-differences approach, which we had judged to be unviable.

The following chapters in this report describe the model participants and present the results of our impact analyses—overall and for subgroups of MCCM enrollees. We also provide estimates of the potential importance of outside factors that are unobservable and might affect our estimates of the model impacts, as well as explorations of the data to address concerns of vulnerable populations and the effects of COVID-19. Details on our data sources, how we identified the intervention and comparison groups, and analysis methods, and results from robustness analyses are in the appendices.

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II. Model Participants and Enrollees

Key Findings

- Large hospices and nonprofit hospices disproportionately participated in the model and the model extension.
- Just five hospices enrolled 45 percent of all MCCM enrollees.
- The number of days from MCCM enrollment to death varied widely across enrollees, with the average MCCM enrollee living slightly more than six months after enrollment.
- A large majority of enrollees transitioned from MCCM to hospice.
- Beneficiaries who enrolled in MCCM used more health care services and had higher hierarchical condition category scores before enrolling than beneficiaries who did not enroll (but who satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data), indicating relatively sicker beneficiaries tended to be referred to the model and enrolled. A disproportionately high percentage had cancer.

This chapter provides an overview of the hospices that participated in the model, the number of referrals to MCCM, how long beneficiaries remained in the model, and the characteristics of the beneficiaries enrolled.

A. Which hospices participated in and remained in the model?

To understand whether effects of MCCM presented in this report might generalize to hospices nationwide, we have to understand whether the model hospices have the same characteristics as those nationwide. At the beginning of the model there were 141 participating hospices from 41 states and at the end of the model there were 49 hospices from 25 states. Hospice organizational characteristics such as mission and size can serve as a proxy for a hospice's approach to providing care and underlying cost structures, and thus affect how the hospices implemented the model and, in turn, the outcomes they achieved. To understand this issue, we compared the characteristics of MCCM hospices with hospices nationwide, as well as those that participated in the extension of MCCM.[4]

MCCM hospices participating at the beginning of the model differed from hospices nationwide on characteristics that could relate to model impacts. Of note, nonprofit, facility-based hospices were overrepresented in the model (Table II.1). Only about 17 percent of all MCCM hospices were for-profit compared with more than half of nationwide hospices. Nearly 70 percent of MCCM hospices were nonprofits, compared with almost one-quarter of all hospices nationwide. Slightly fewer MCCM hospices were freestanding facilities than nationwide hospices, which might have different referral sources than facility-based hospices.

[4] The inputs for this analysis include the hospice roster file, historic MCCM roster file, and a file created by the previous evaluation contractor (Abt Associates) with baseline hospice characteristics for all hospices nationwide. See Appendix A for details.

Furthermore, MCCM hospices were more likely to be larger, older, and more geographically consolidated than hospices nationwide. Large-sized hospices accounted for almost 80 percent of all MCCM hospices, whereas about one-third of all hospices nationwide are large. MCCM hospices were more likely to have been founded during the 1980s, and very few (4 percent) were established after 2010. In contrast, about one-third of the hospices nationwide were established after 2010. Geographically, proportionately more of the MCCM hospices were in the Northeast and Midwest, whereas the hospices nationwide are more likely to be in the South and West. However, MCCM hospices were similar to hospices nationwide in some other characteristics. They were just as likely to be affiliated with a chain, have a religious affiliation, and be located in an urban area.

The MCCM hospices that remained through the model extension in 2021 had similar characteristics to those that started the model. The only notable difference between these two groups is that 68 percent of all initially participating hospices in MCCM were freestanding facilities, whereas 78 percent of MCCM hospices that stayed in the model were freestanding facilities.

Table II.1. Hospice characteristics for all MCCM hospices, hospices participating in the model extension, and all hospices nationwide: Large nonprofit, facility-based hospices are overrepresented in MCCM

Hospice characteristic	Percentage of all MCCM hospices (N = 141)	Percentage hospices participating in the 2021 MCCM extension (N = 49)	Percentage of all hospices nationwide (N = 4,361)
Ownership			
Nonprofit	69	69	24
For-profit	17	20	63
Government	1	0	3
Other	13	10	10
Size			
Small	3	2	20
Medium	20	16	48
Large	77	82	32
Age			
Founded in 1980s	52	55	13
Founded in 1990s	34	29	24
Founded in 2000s	10	12	30
Founded in 2010s	4	4	33
Census region			
Northeast	20	18	10
Midwest	34	29	22
South	32	37	39
West	14	16	28
Location			
Urban	84	90	79
Rural	16	10	21

Hospice characteristic	Percentage of all MCCM hospices (N = 141)	Percentage hospices participating in the 2021 MCCM extension (N = 49)	Percentage of all hospices nationwide (N = 4,361)
Facility type			
Freestanding	68	78	81
Facility-based	32	22	19
Religious affiliation			
No	97	96	98
Yes	3	4	2
Chain affiliation			
No	54	51	57
Yes	46	49	43

Source: MCCM program data, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, b).

Note: We imputed missing data for a small number of non-MCCM hospices; see Appendix A for more details about these methods.

MCCM = Medicare Care Choices Model.

B. Who are the enrolled beneficiaries?

Understanding who enrolled in the model, how much time they spent in it, and how they compared to those who satisfied the model eligibility criteria, provides insights as to how the model might have achieved its results and the extent to which results might generalize.[5]

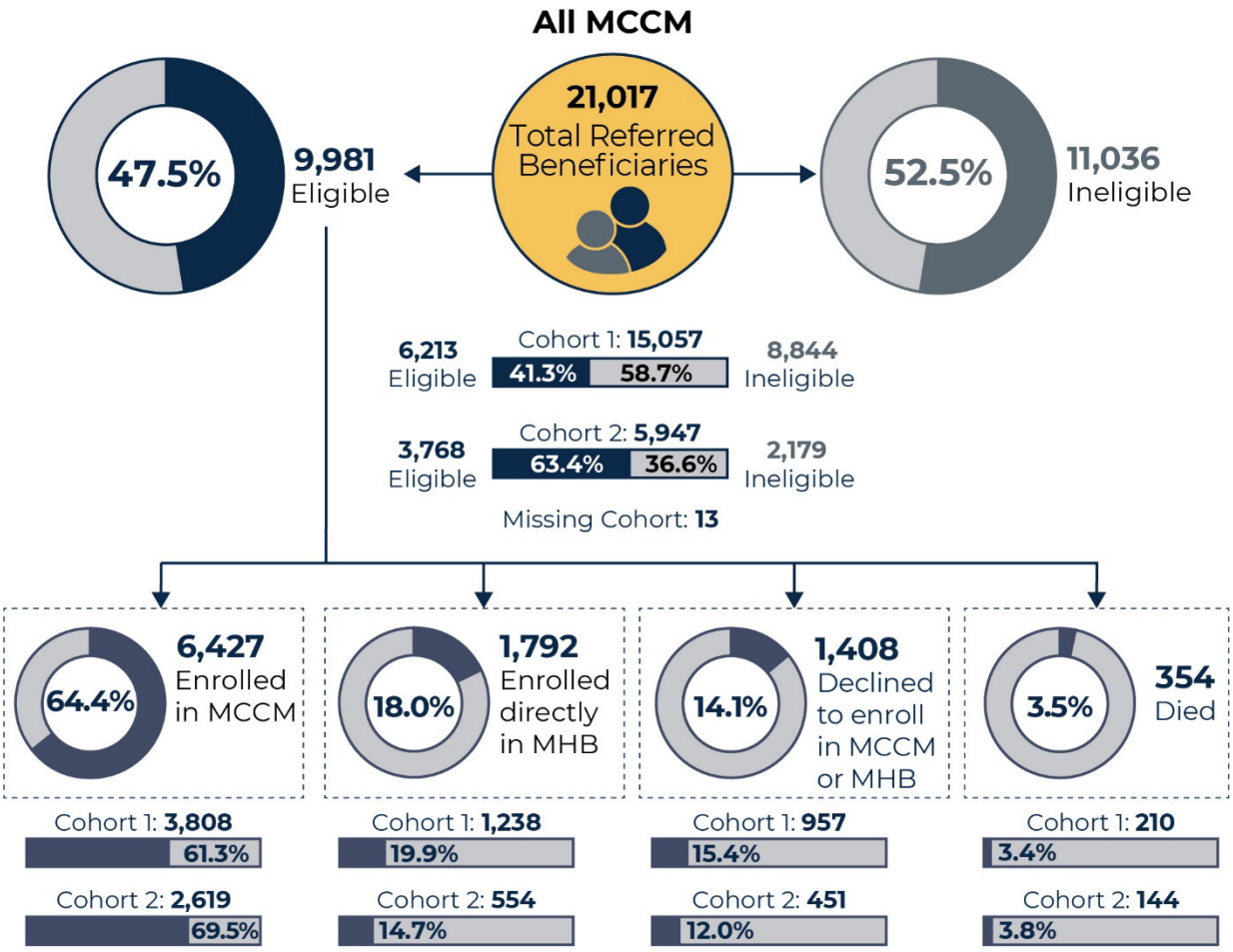
Providers referred 21,017 Medicare beneficiaries to MCCM hospices through September 30, 2020 (Figure II.1). Among all referred beneficiaries, 47 percent were eligible for MCCM. Eligibility was more likely among beneficiaries referred to Cohort 2 hospices than Cohort 1 hospices (63 versus 41 percent), which could reflect the loosened eligibility requirements before Cohort 2 started enrolling beneficiaries, that hospices made improvements in identifying eligible beneficiaries over time, or both. Of the 9,981 eligible referrals, 6,427 (64 percent) enrolled in MCCM through September 30, 2020, 1,792 (18 percent) enrolled directly in the Medicare hospice benefit; 1,408 (14 percent) declined to enroll in either, and 354 (4 percent) died before making a choice.[6] Among beneficiaries eligible for the model, those referred to Cohort 2 hospices were more likely to enroll in MCCM (70 percent for Cohort 2 versus 61 percent for Cohort 1).

The five hospices with the most enrollees together account for 45 percent of all 6,427 MCCM enrollees (see Appendix A, Table A.9 for details). This concentration of beneficiaries in just a few hospices implies the findings from this evaluation cannot be confidently generalized, as they are mostly based on the experiences of a few participating hospices.

[5] The Chronic Condition Warehouse Medicare enrollment database, the master beneficiary summary file, and MCCM program data are the primary sources of the beneficiaries' characteristics.

[6] Beneficiaries who enrolled according to MCCM program data did not always have claims for Medicare services, which is the basis of the analysis sample for our impact analyses in later chapters (see Appendix A).

Figure II.1. MCCM referrals, eligibility, and enrollment through September 30, 2020: About one-third of referred beneficiaries were enrolled in the model



Source: MCCM program data, January 1, 2013, to September 30, 2020.

Note: Updated graphic previously reported in Abt Associates 2020. This figure is based on MCCM program data alone. We used additional data sources and inclusion criteria to determine which beneficiaries to include in the impact analyses in other chapters in this report (see Appendix A).

MCCM = Medicare Care Choices Model; MHB = Medicare hospice benefit.

Among all MCCM enrollees, there were 4,574 beneficiaries for whom CMS made payments to participating hospices for providing MCCM services from January 2016 to September 2020, who died before April 2021, and who met other inclusion criteria for the impact analyses for the subsequent chapters in this report (see Appendix A for details). Among these beneficiaries in our analytic sample, the number of days they spent in MCCM varied substantially. These beneficiaries lived, on average, 185 days after enrollment, with a median of 104 days (Table II.2). Their survival times were also highly variable (standard deviation of 217 days) and skewed. Two-thirds lived less than six months and 15 percent lived longer than one year (Figure II.2). Of these MCCM enrollees, 83 percent transitioned from the model and subsequently enrolled in the Medicare hospice benefit. Those who enrolled in hospice spent, on average, about two-thirds of their time before death in the model (132 days, with a median of 59) and the rest of the time in hospice (52 days, with a median of 15). However, these averages mask substantial variety in

individual experiences; some beneficiaries spent their entire enrollment time in MCCM, whereas others moved into the Medicare hospice benefit very soon after MCCM enrollment.

Table II.2. Unadjusted time-to-event analyses for deceased MCCM enrollees: MCCM beneficiaries live slightly more than 6 months on average, with the vast majority enrolling in hospice at the end of life

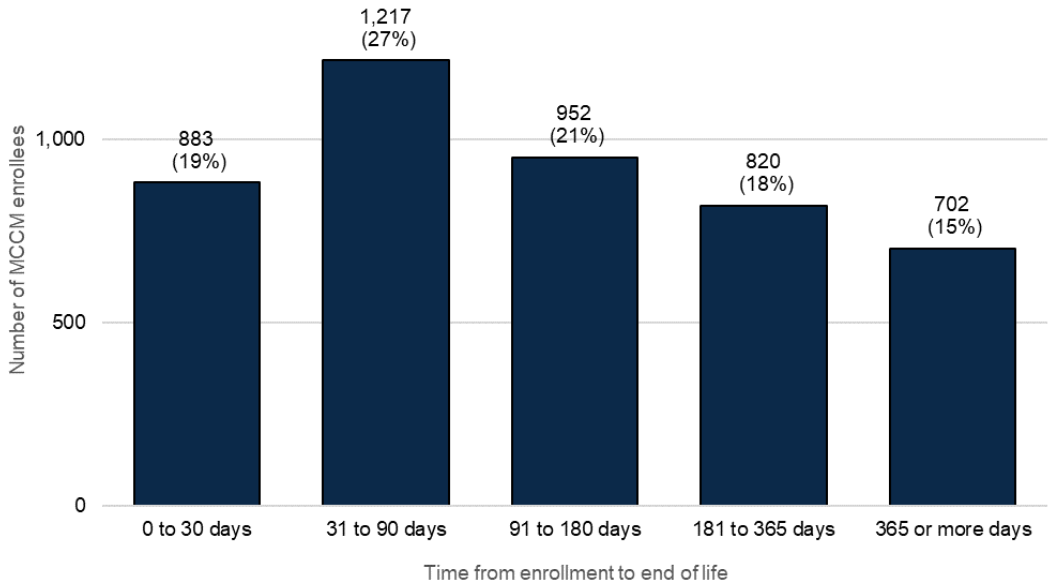
Measure	Mean number of days	Median number of days	Sample size (percentage of MCCM enrollees)
Time from enrollment to end of life	185	104	4,574 (100%)
Time from enrollment to Medicare hospice benefit enrollment[a]	132	59	3,801 (83%)
Time from Medicare hospice benefit enrollment to death[a]	52	15	3,801 (83%)

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to September 30, 2020.

[a] This measure was calculated among beneficiaries who elected the Medicare hospice benefit before death.

MCCM = Medicare Care Choices Model.

Figure II.2. Distribution of time from enrollment to end of life for deceased MCCM enrollees: Two-thirds of enrollees lived less than six months and 15 percent lived longer than one year



Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to September 30, 2020.

MCCM = Medicare Care Choices Model.

MCCM hospices enrolled only a small fraction of Medicare fee-for-service beneficiaries who lived in the market areas of the hospices that participated in the model and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. Further, beneficiaries who enrolled in MCCM were

a select group with different characteristics. This can be seen in Table II.3, which compares MCCM enrollees to other beneficiaries who met model eligibility criteria (according to Medicare claims and enrollment data) but were not referred to or enrolled in the model:

- Medicare–Medicaid dually eligible beneficiaries, older beneficiaries (ages 80 or older), racial minorities, and rural beneficiaries were underrepresented among the sample of MCCM enrollees. Specifically, 12 percent of MCCM enrollees were dually eligible (compared to 20 percent), 42 percent were ages 80 or older (compared to 51 percent), 8 percent were Black or African American (compared to 11 percent), and 14 percent lived in rural areas (compared to 22 percent).
- About 72 percent of MCCM enrollees had cancer, compared to the full group of eligible beneficiaries whereas 44 percent of eligible beneficiaries had cancer. Conversely, MCCM beneficiaries less often had congestive heart failure and chronic obstructive pulmonary disease.
- MCCM enrollees used more health care services and had higher Medicare expenditures before enrollment than eligible beneficiaries who did not enroll, suggesting they had more health care needs (that is, they were more ill).[7] Further, the average MCCM enrollees' hierarchical condition category scores were nearly 20 percent higher (5.6 versus 4.7). In the 90 days before enrollment, MCCM enrollees had higher Medicare expenditures ($31,064 versus $24,246), Part B drug expenditures ($4,704 versus $1,367), inpatient admissions (1.1 versus 0.8), outpatient emergency department visits (0.7 versus 0.5), and ambulatory visits with primary care clinicians and specialist physicians (nine versus six).[8] MCCM enrollees were more likely to have had an advance care planning visit in the previous two years, which might have made them more aware of their stage of illness and therefore potentially more willing to enter MCCM.

Overall, the evidence presented in this chapter suggests the model attracted a select group of hospice participants and, even among that select group, only a few hospices enrolled a substantial number of beneficiaries. Furthermore, enrolled beneficiaries did not have the same characteristics as the group of potential enrollees, as MCCM enrollees were more likely to have advanced cancer, had higher prior health care expenditures, and were less likely to be dually eligible or reside in rural areas. Although the following evaluation results can be interpreted only in the context of this model, it does reflect the outcomes for these beneficiaries and offers important lessons as to how Medicare can improve care at the end of life.

[7] For potential model enrollees, we measured baseline Medicare expenditures and other characteristics at one or more dates when they met eligibility criteria in extant data. Each beneficiary received equal weight in these calculations. See Appendix A for details.

[8] The higher Part B drug expenditures might relate to the higher prevalence of advanced cancer at enrollment, as cancer treatment uses many Part B drugs.

Table II.3. Characteristics of deceased MCCM enrollees and beneficiaries who satisfied MCCM eligibility criteria but did not enroll: MCCM enrollees were more likely to have cancer, had higher prior health care expenditures, and were less likely to be dually eligible or reside in rural areas

Beneficiaries' characteristics	MCCM enrollees (N = 4,574)	Eligible beneficiaries who did not enroll[a] (N = 1,776,459)
Demographics		
Average age (years)	77	79
Age 80 or older	42%	51%
Female	51%	50%
Race and ethnicity		
Non-Hispanic white	86%	81%
Black or African American	8%	11%
Other or unknown	6%	8%
Whether dually eligible	12%	20%
Resides in rural area	14%	22%
MCCM-qualifying diagnosis		
Cancer	72%	44%
Congestive heart failure	38%	50%
Chronic obstructive pulmonary disease	34%	37%
HIV/AIDS	0.4%	0.6%
Health status		
Average hierarchical condition category score	5.6	4.7
Average Medicare service use in the 90 days before enrollment		
Total Medicare expenditures	$31,064	$24,246
Part B drug expenditures	$4,704	$1,367
Number of inpatient admissions	1.1	0.8
Days from most recent inpatient discharge and enrollment	70	89
Number of outpatient emergency department visits	0.7	0.5
Number of ambulatory visits with primary care clinicians	4.1	3.3
Number of ambulatory visits with specialist physicians	4.9	2.8
Drugs for advanced stage cancer	35%	12%
Advanced care planning visit in previous 2 years	21%	11%

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to September 30, 2020.

[a] *Eligible beneficiaries who did not enroll* include 1,776,459 unique beneficiaries from our potential comparison group (22,367,931 copies) weighted equally. These beneficiaries satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. The following eligibility criteria were not directly observable in CMS administrative data: (1) 6-month prognosis, which requires clinical judgement, and (2) residing in a traditional home and not a long-term care or assisted living facility. Additional information about the MCCM enrollees and potential comparison group beneficiaries is in Appendix A, Section C.2.

MCCM = Medicare Care Choices Model.

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III. The Medicare Care Choices Model's Effect on Medicare Expenditures and Service Use

Key Findings

Overall, we found Medicare expenditures and service use were lower among beneficiaries enrolled in MCCM than among matched comparison beneficiaries. Specifically, we estimated MCCM:

- Lowered Medicare Part A and B expenditures by 17 percent between enrollment and death compared to matched comparison beneficiaries ($44,149 versus $53,229).
  - After accounting for $1,827 in average MCCM payments, net Medicare expenditures decreased by $7,254 (14 percent).
  - Decreases in inpatient expenditures (–39 percent) primarily drove the difference, although there were also notable decreases in skilled nursing facility expenditures (–22 percent) and other categories of expenditures.
  - Hospice expenditures increased by $4,199 (106 percent).
- The estimated impacts differed by enrollees' survival: the largest reductions in net Medicare expenditures (in dollar terms) occurred among enrollees who lived 31 to 365 days after enrolling in MCCM while the largest *percentage* impacts were concentrated among enrollees who lived fewer than six months after enrolling in MCCM.
- Reduced the number of inpatient admissions by 26 percent, the number of hospital readmissions by 28 percent, the number of emergency department visits and observation stays by 14 percent, and the number of ambulatory visits by 14 percent.

MCCM tested whether offering eligible beneficiaries the option to receive supportive services without forgoing payment for treatment of their terminal conditions would improve their quality of life and care, lead to earlier election of the Medicare hospice benefit, increase beneficiaries' satisfaction, or reduce Medicare expenditures. This chapter evaluates impacts of the model on Medicare expenditures and service use outcomes.

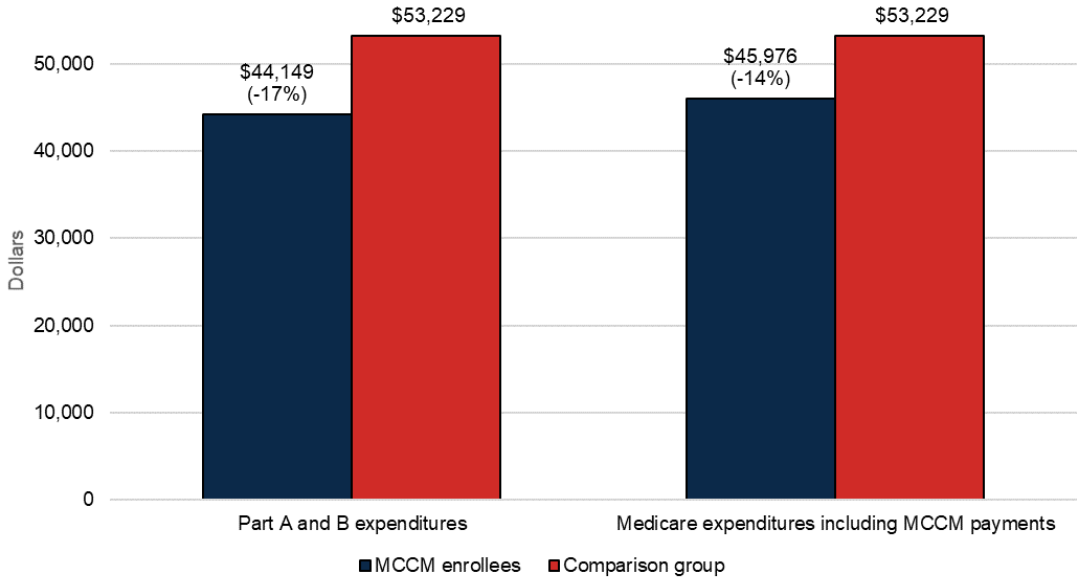
In this report, we estimate impacts for 4,574 Medicare beneficiaries who enrolled in the model before October 1, 2020; died before April 1, 2021; and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. We measured outcomes using claims through March 31, 2021, and estimated impacts of the model by comparing outcomes for enrolled MCCM beneficiaries with regression-adjusted outcomes for a matched comparison group of Medicare fee-for-service beneficiaries who (1) lived in the market area of a hospice participating in MCCM; (2) were not referred to or enrolled in MCCM; (3) satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data; and (4) resembled MCCM enrollees in terms of prognosis (expected length of life), health conditions, prior experience of care, and other observed characteristics. We assigned pseudo-enrollment dates to the comparison beneficiaries so the distribution of survival times and other characteristics were similar for MCCM and matched comparison beneficiaries. We designed this comparison group to show what would have happened to beneficiaries' outcomes for the period from enrollment to death had they

not enrolled in MCCM and, thus, received usual care (possibly receiving the Medicare hospice benefit). Our technical appendix (Appendix A) provides an overview of our analytic approach and describes how we constructed the analytic file for the analyses, identified the matched comparison group, and estimated impacts using regression modeling.

A. Effects on Medicare expenditures

MCCM enrollees had lower Medicare expenditures than the comparison group (Figure III.1). Medicare Part A and B expenditures were $44,149 for MCCM enrollees and $53,229 in the comparison group: that is, they were lower by $9,080 or 17 percent for enrollees. After accounting for the payments made to the hospices for MCCM services ($1,827 on average), we found MCCM enrollees' expenditures were $7,254 or 14 percent lower on net per enrollees. Total expenditures including model payments were $45,978, on average, for MCCM enrollees. Adding these impact estimates across all 4,574 MCCM enrollees suggests that MCCM reduced Medicare Part A and B expenditures by about $41.5 million and introduced bout $33.2 million in net Medicare savings.

Figure III.1. Average Medicare expenditures for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees had lower Medicare expenditures, even when accounting for model payments



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

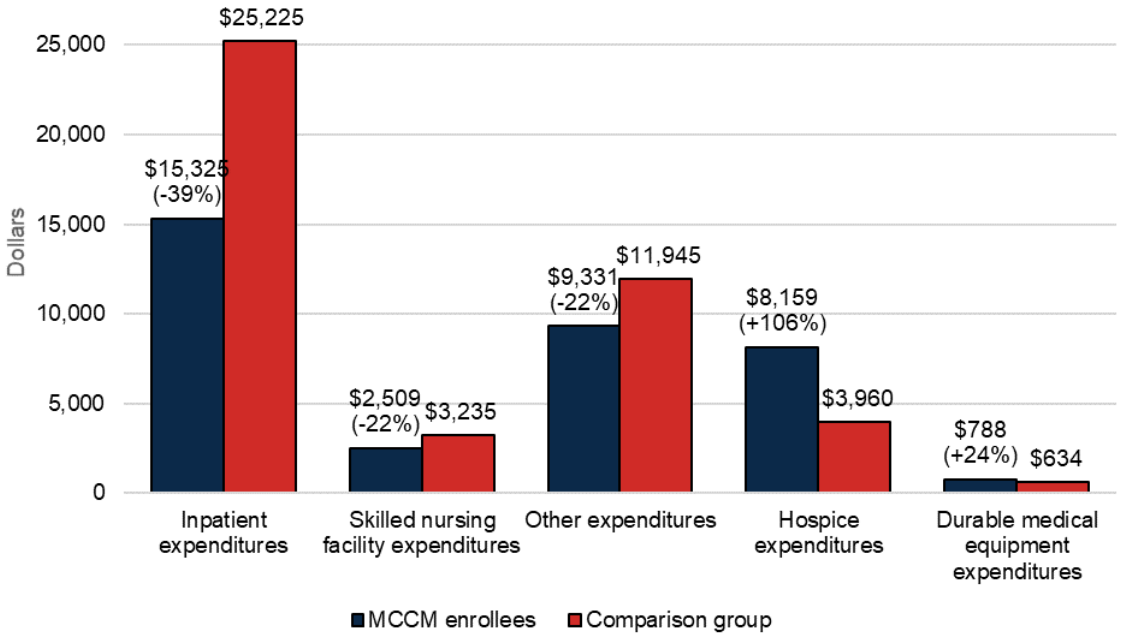
Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for Medicare expenditures were statistically significant at the $p < 0.01$ level. See Appendix D, Table D.1 for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

Reductions in inpatient expenditures drove the overall decrease in Medicare expenditures despite higher hospice expenditures among MCCM enrollees. Inpatient expenditures among MCCM enrollees were

$9,900 or 39 percent lower than in the comparison group (Figure III.2). MCCM enrollees' average inpatient expenditures were $15,325 compared to $25,225 in the comparison group. Skilled nursing facility expenditures were lower among beneficiaries enrolled in MCCM by $726 or 22 percent. We also estimated that the model reduced the category of "other expenditures" by $2,615 or 22 percent. Other expenditures include outpatient emergency department visits, ambulatory care visits, and other medically necessary services, which totaled $9,331, on average, among MCCM enrollees and $11,945 for the comparison group. In contrast, Medicare expenditures for hospice and durable medical equipment were higher among MCCM enrollees by $4,199 or 106 percent and $153 or 24 percent, respectively. Average hospice expenditures were $8,159 and average durable medical equipment expenditures were $788 among MCCM enrollees. We discuss the estimated impact on hospice use in more detail in Chapter IV.

Figure III.2. Average Medicare expenditures, by type of health care service, for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees had lower inpatient, skilled nursing facility, and other expenditures and higher hospice and durable medical equipment expenditures



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

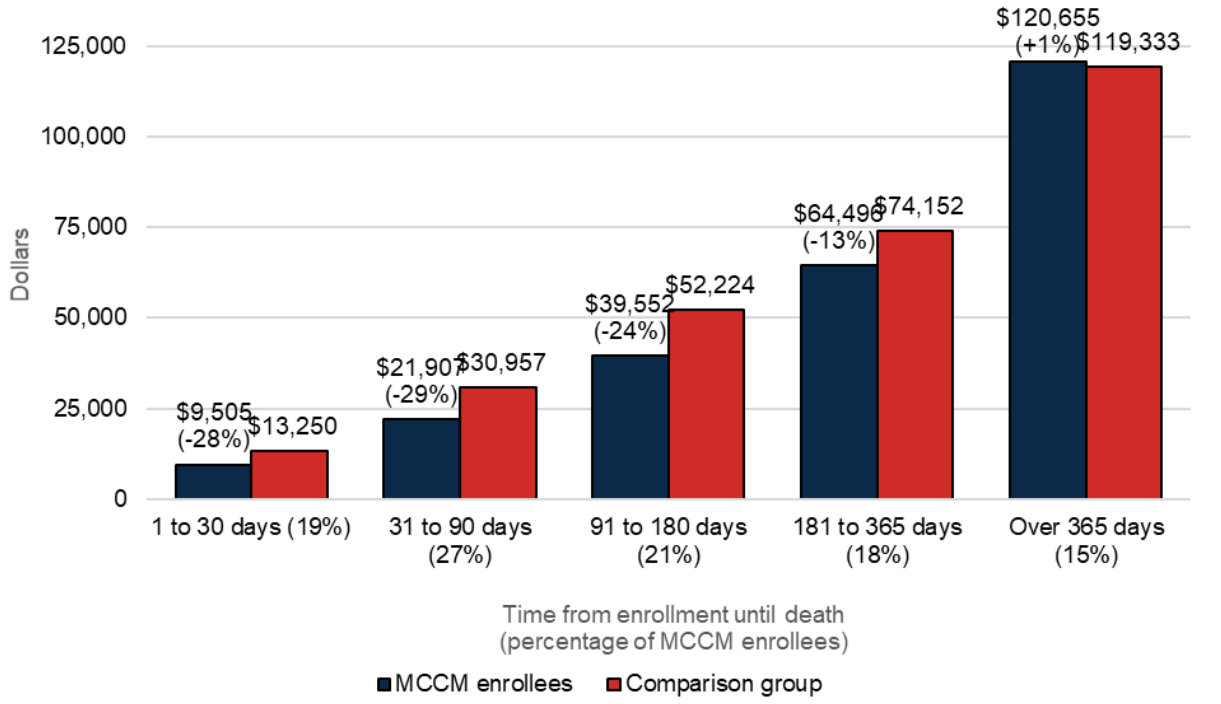
Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. "Other expenditures" include expenditures for outpatient emergency department visits, ambulatory care visits, and other medically necessary services. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates were statistically significant at the $p < 0.05$ level. See Appendix D, Table D.1 for full impact analysis results for these outcome measures and other categories of Medicare expenditures.

MCCM = Medicare Care Choices Model.

Enrollment in MCCM is intended for Medicare beneficiaries with a prognosis of six months or less but, as noted in Chapter II, survival times differed substantially across enrollees. To understand and account for potential variation in the model's effects on Medicare expenditures by survival time, we conducted two analyses:

1. We estimated impacts on Medicare expenditures (including MCCM payments) for subgroups of model enrollees with longer versus shorter survival times. We found the estimated reduction in total Medicare expenditures was larger in absolute (dollar) terms for enrollees with *longer* survival times, but larger in percentage terms for enrollees with the *shorter* survival times (Figure III.3). Specifically, total expenditures including model payments were $3,745 (28 percent) lower among MCCM enrollees who survived at most 30 days after their enrollment date than among matched comparison beneficiaries. Total Medicare expenditures among MCCM enrollees were reduced by $9,050 (29 percent) for those with survival times from 31 to 90 days, $12,672 (24 percent) from 91 to 180 days, and $9,657 (13 percent) from 181 to 365 days, relative to the comparison group. Meanwhile, we estimated Medicare expenditures for the 15 percent of MCCM enrollees who lived longer than one year after enrollment were similar to the expenditures of their matched comparison beneficiaries on average. To summarize, we found the largest *percentage* impacts on the enrollees the model sought to engage—those who lived less than six months—but found larger *absolute* impacts, in dollar terms, for beneficiaries who survived longer than six months but less than one year and thus had more time for the model to accrue impacts.
2. We estimated impacts on Medicare expenditures *per day* by dividing total expenditures by the number of days that elapsed between enrollment and death. We estimated daily Medicare Part A and B expenditures (excluding model payments) were $155 lower among model enrollees, which corresponds to 30 percent of the comparison group mean. When including model payments, we estimated MCCM reduced daily total expenditures by $138 (27 percent) on net (Appendix D, Table D.1).

Figure III.3. Average Medicare expenditures including model payments, by survival time, for deceased MCCM enrollees and matched comparison beneficiaries: The difference in expenditures between MCCM enrollees and comparison beneficiaries increased in dollar terms, but decreased in percentage terms, with survival time



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

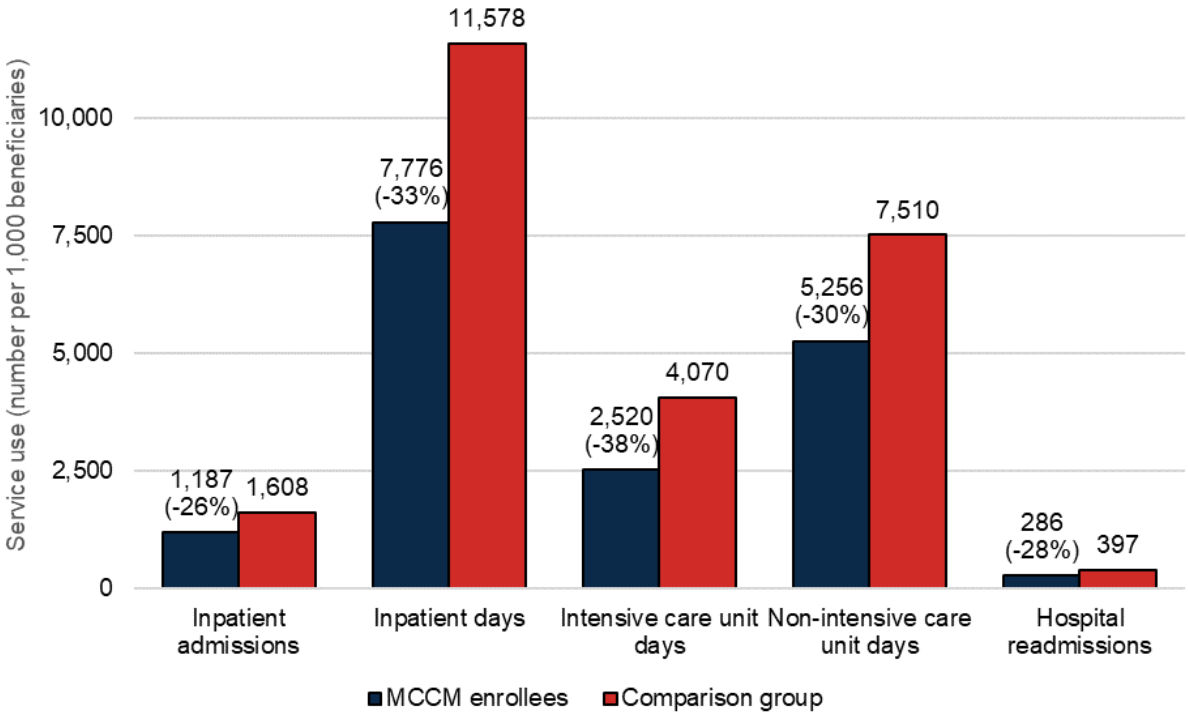
Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. The regression-adjusted means differed statistically from one another at the $p < 0.01$ level except for the "over 365 days" category ($p = 0.85$). See Appendix D, Table D.6 for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

B. Effects on health care service use

We estimated MCCM enrollees had fewer inpatient admissions and readmissions and spent less time in hospitals between enrollment and death than matched comparison beneficiaries (Figure III.4). Specifically, we estimated a reduction in the average number of inpatient admissions per 1,000 beneficiaries between enrollment and death from 1,608 to 1,187, a reduction of 421 admissions per 1,000 beneficiaries. This represents a 26 percent decrease in the admission rate relative to the comparison group mean. We also found beneficiaries enrolled in MCCM had 3,802 or 33 percent fewer inpatient days per 1,000 beneficiaries, on average, than matched comparison beneficiaries (7,776 versus 11,578). We can attribute this estimated reduction in inpatient stay length to 1,055 (38 percent) fewer days in intensive care units and 2,255 (30 percent) fewer non-intensive care hospital unit days per 1,000 beneficiaries. In addition, we estimated MCCM enrollees had, on average, 112 or 28 percent fewer hospital readmissions per 1,000 beneficiaries after they enrolled in the model.

Figure III.4. Average inpatient care service use for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees had fewer inpatient admissions and readmissions and spent less time in hospitals than comparison beneficiaries



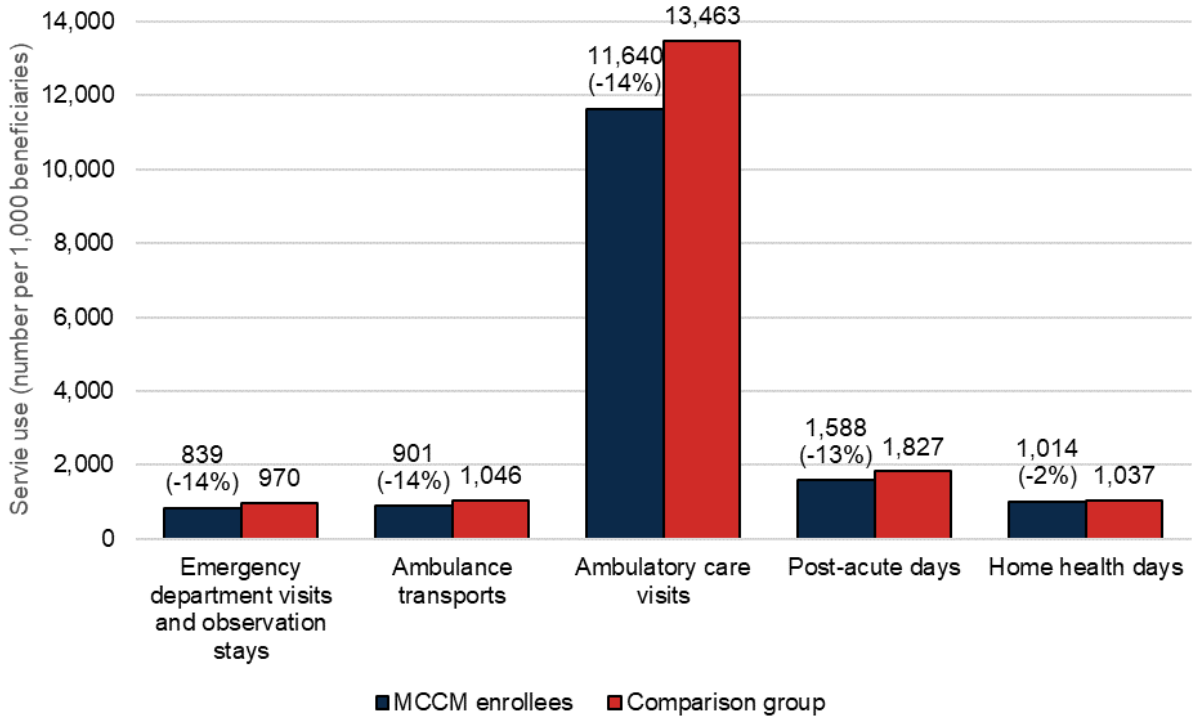
Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for these service use measures were statistically significant at the $p < 0.01$ level. See Appendix D, Table D.2 for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

We also estimated impacts on several other types of health care use (Figure III.5). Beneficiaries enrolled in MCCM did not have many emergency department visits and observation stays or ambulance transports: 839 and 901 events per 1,000 beneficiaries, respectively. We estimated beneficiaries enrolled in the model had 131 or 14 percent fewer emergency department visits and observation stays per 1,000 beneficiaries than comparison beneficiaries. Model enrollees also had an estimated 145 or 14 percent fewer ambulance uses for emergent conditions per 1,000 beneficiaries than matched comparison beneficiaries. We further estimated model enrollees had 1,823 (14 percent) fewer ambulatory care visits with primary care physicians and specialist physicians per 1,000 beneficiaries, on average, than beneficiaries in the comparison group. Finally, we estimated an impact of 2 or 13 percent fewer post-acute days per beneficiary for MCCM enrollees. The average number of home health days were similar for model enrollees and comparison group beneficiaries.

Figure III.5. Average outpatient care service use for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees had fewer emergency department stays and observation visits, ambulance transports, ambulatory care visits, and post-acute days than comparison beneficiaries



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for these service use measures were statistically significant at the $p < 0.01$ level, except for home health days ($p = 0.50$). See Appendix D, Table D.2 for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

In summary, we found enrollment in MCCM was associated with lower health care use for almost all categories of health care use we measured. We observed the largest estimated reductions for inpatient care, but also estimated sizable reductions in outpatient services and other types of care. These reductions in health care service use among MCCM enrollees (relative to comparison beneficiaries) are consistent with and largely explain the reductions in Medicare expenditures discussed earlier in this chapter.

C. Sensitivity analyses

To assess the robustness of the estimated differences in Medicare expenditures and health care use between beneficiaries enrolled in MCCM and the comparison group to alternative specifications, we conducted several sensitivity checks, such as trimming outcomes for outliers or using alternative functional forms. As discussed in Appendix D, we obtained qualitatively similar impact estimates with

these alternative modeling approaches as the main approach (presented earlier), which increases our confidence in the main findings.

One remaining concern about our impact estimates is there could be factors we cannot measure that influence the outcomes and are more prevalent among MCCM enrollees or beneficiaries in the comparison group. For example, we might estimate reductions in Medicare expenditures and inpatient service use among MCCM enrollees if beneficiaries in the comparison group had doctors who practiced a style of medicine with relatively less hospice care and more hospital care. In other words, we are concerned we might be overstating (or understating) our impact results but cannot directly assess the influence of unobserved differences in beneficiaries' characteristics between MCCM enrollees and comparison group beneficiaries. To better understand this, we used the *E*-value method developed by Ding and VanderWeele (2016) and VanderWeele and Ding (2017) to estimate how large and important differences in unmeasured factors would have to be to negate our estimated impacts. (See Appendix D for more details.) *E*-values are measured on a risk ratio scale. Larger *E*-values indicate larger unobserved differences between the intervention and comparison groups, on variables strongly related to outcomes, would be needed to produce the observed impact estimate if the true impact of the model is 0; meanwhile, while *E*-values close to 1 (the minimum) indicate very small (or negligible) unobserved differences between the intervention and comparison groups could explain the observed differences in outcomes.

We found that for our estimated impact of MCCM on total Medicare expenditures (including MCCM payments) to be fully negated (*E*-value = 1.48), the unmeasured factors would have to account for a difference in expenditures equivalent to increasing an average enrollee's hierarchical condition category score from 5.2 (the median value) to 10.8 (the 98th percentile) and be imbalanced (between MCCM and comparison groups) to the same degree.[9,10] To fully negate the estimated impact on inpatient admissions (*E*-value = 1.75), unmeasured factors would have to account for a difference in inpatient admissions in the follow-up period equivalent to increasing the number of inpatient stays in the last quarter of the baseline period from 1.0 (the median) to 3.8 (the 98th percentile). **Although MCCM's true impact could be larger or smaller than what we estimated due to unmeasured factors, we believe these unmeasured factors are unlikely to fully explain the estimated impacts of MCCM on Medicare expenditures and inpatient admissions.**

For emergency department visits and observation stays (*E*-value = 1.33), more modest confounding could fully explain the estimated impact of the model. For example, an unmeasured factor on par with an increase from 0 to just 1 emergency department visit or observation stay in the last quarter of the baseline period could fully negate MCCM's estimated impact on the outcome. Unlike the estimated impacts for Medicare expenditures and inpatient stays, only a small degree of confounding could negate the estimated impact of MCCM on emergency department visits. We therefore have less confidence that MCCM affected emergency department visits and observation stays, even though the estimated impacts are qualitatively large, precisely estimated, and highly statistically significant.

[9] A similarly sized unmeasured factor would be needed to negate the estimated impact of MCCM on Medicare Part A and B expenditures excluding MCCM payments (*E*-value = 1.56).

[10] We chose variables with strong and intuitive relationships with the outcomes as benchmarks for whether unobserved factors could plausibly relate more strongly to spending and inpatient admissions than MCCM enrollment. We chose the hierarchical condition category score as a benchmark for expenditures because it is a robust predictor for Medicare expenditures after enrollment, and it is commonly used in risk adjustment (a higher score predicts higher expenditures). Likewise, we used baseline inpatient admissions as a benchmark for inpatient admissions in the follow-up period because it is one of the strongest predictors of that outcome in our data.

IV. The Medicare Care Choices Model's Effect on Hospice Use and Its Contribution to Expenditure Reductions

Key Findings

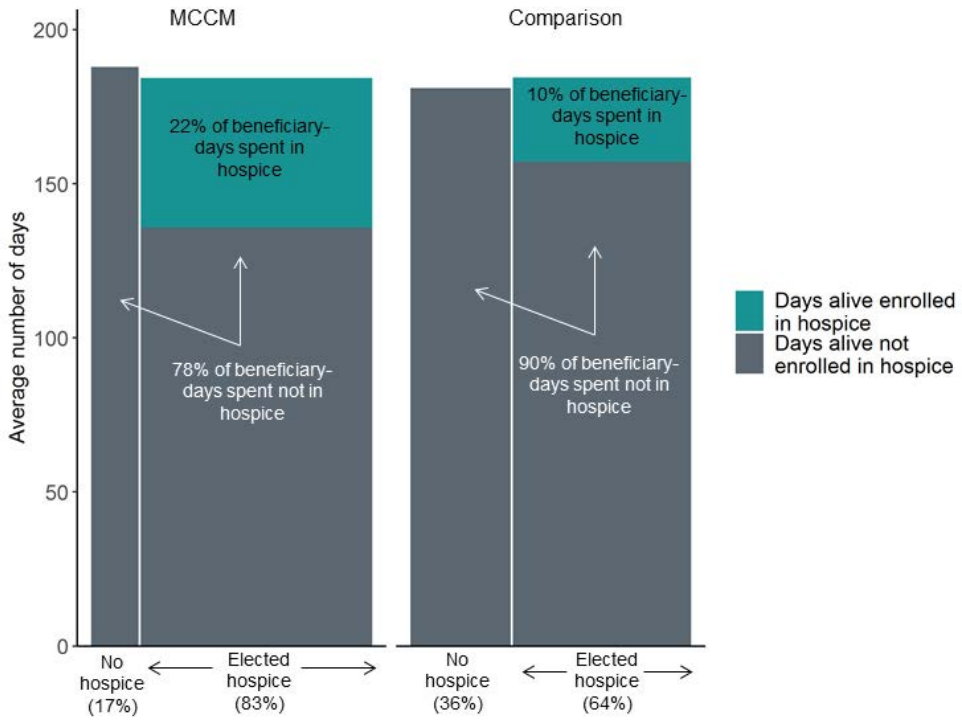
- Beneficiaries enrolled in MCCM were more likely to elect the Medicare hospice benefit than matched comparison beneficiaries, and they did so earlier.
- Increased use of hospice accounted for about 70 percent of overall reductions in Medicare expenditures.

One of the primary mechanisms by which MCCM can improve enrollees' outcomes and lower Medicare expenditures is by familiarizing terminally ill beneficiaries with hospice and providing a range of palliative care treatments while still allowing enrollees to receive payment for treatment of their terminal conditions. By introducing enrollees to hospice providers earlier in their disease trajectory, MCCM could help ease the often-difficult transition to hospice if and when beneficiaries choose to do so. By increasing the use of the Medicare hospice benefit, MCCM could potentially reduce Medicare expenditures and improve quality of life for enrollees. This chapter evaluates impacts of the model on hospice use.

A. Effects on hospice use

Descriptive analyses indicate MCCM enrollees were more likely to enroll in hospice in the period between their MCCM enrollment date and death than beneficiaries in the comparison group, and when they did choose hospice, they did so earlier in their disease trajectories. Before showing the results of our impact analyses, we first used unadjusted analyses to compare MCCM enrollees and matched comparison beneficiaries on (1) the rate of enrollment in hospice, (2) the average number of days from enrollment to death, and (3) the average number of days enrolled in hospice among those who chose to switch from MCCM to hospice. The horizontal axis in Figure IV.1 shows a larger percentage of MCCM enrollees (83 percent) elected hospice than the comparison group (64 percent). The vertical axis shows MCCM enrollees who transitioned to hospice spent more days enrolled in hospice, on average, than comparison beneficiaries who enrolled in hospice. The green area in this figure shows that, altogether, MCCM enrollees spent more than twice as much time in hospice, on average, as those in the comparison group (22 versus 10 percent of all beneficiary-days).

Figure IV.1. Unadjusted average number of days spent in hospice by deceased MCCM enrollees and matched comparison beneficiaries: In unadjusted analysis, MCCM enrollees elected hospice at higher rates and spent more days in hospice than comparison beneficiaries



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to March 31, 2021.

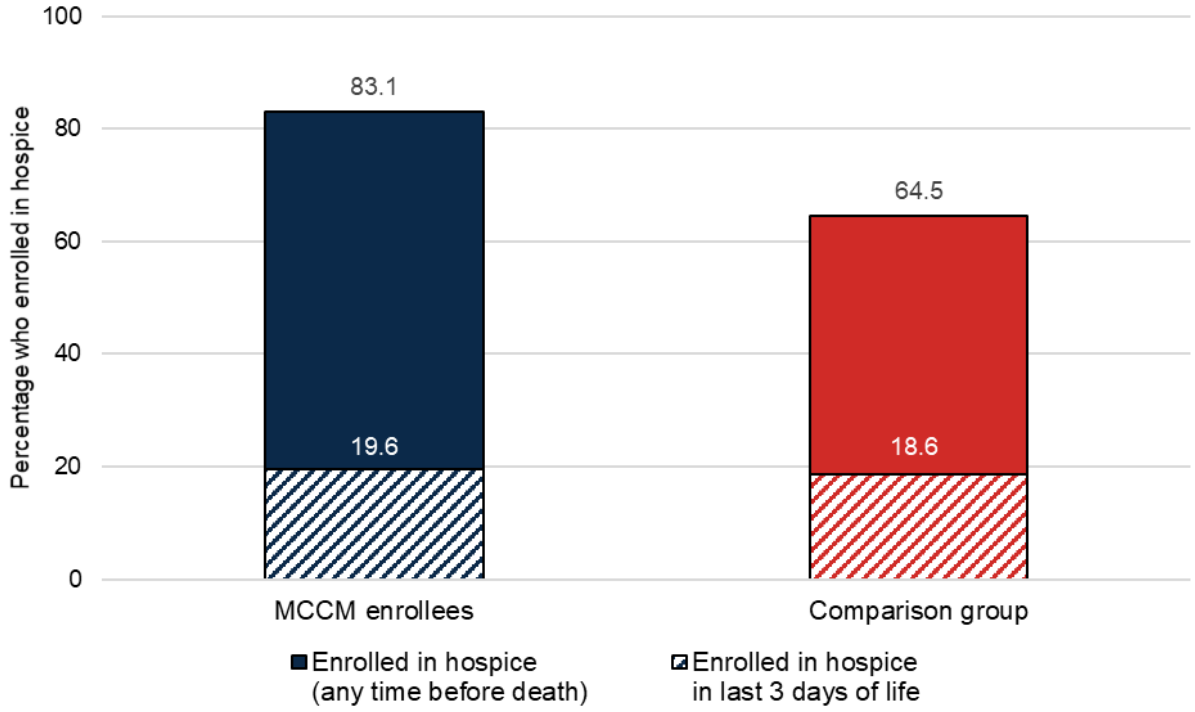
Note: This figure is based on unadjusted averages, not impact estimates, for MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Refer to the remainder of this chapter for regression-adjusted impact estimates.

MCCM = Medicare Care Choices Model.

In regression-adjusted impact analyses, MCCM enrollees were more likely to enter hospice than matched comparison beneficiaries. We estimated hospice use was 19 percentage points higher in the enrolled beneficiary group (83.1 versus 64.5 percent, Figure IV.2). Despite an increase in hospice enrollment, there was not a significant increase in the rate of beneficiaries electing hospice in the last three days of life. This suggests the additional beneficiaries enrolling in hospice chose to enroll early enough to benefit from doing so.[11]

[11] Beneficiaries admitted to hospice less than three days before death will not receive the full array of benefits hospice care can provide (National Quality Forum measure 0216).

Figure IV.2. Hospice enrollment for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees elected hospice at higher rates than comparison beneficiaries, but the difference was not driven by those who elected hospice in the last three days of life



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Impact estimates for electing hospice (solid shading) were statistically significant at the $p < 0.01$ level. However, estimates for MCCM's impact on electing hospice in the last three days of life (dotted shading) were not statistically significant. See Appendix D, Table D.3 for full impact analysis results for these outcome measures.

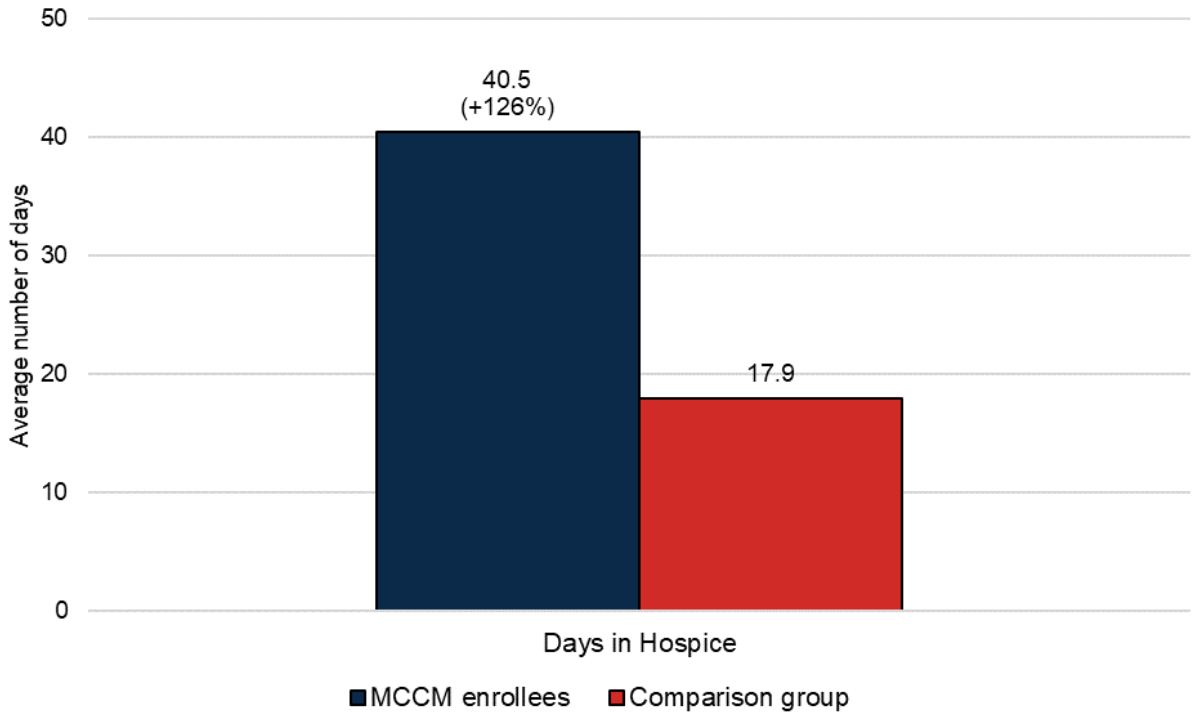
MCCM = Medicare Care Choices Model.

Further, the time from enrollment (or pseudo enrollment) to electing hospice was faster among MCCM enrollees than those in the comparison group, and hence enrollees also spent more time in hospice (because enrollees and the comparison group are closely matched on survival time). We found MCCM enrollees spent an additional 23 days in hospice—more than double (126 percent more) the average number of days in hospice among the comparison group (Figure IV.3). Framed differently, MCCM enrollees spent 28 percent of the days from MCCM enrollment to death enrolled in hospice (and not enrolled in MCCM) compared to the 15 percent of days comparison beneficiaries spent enrolled in hospice (Appendix D, Table D.3). We used survival analysis methods (Cox proportional hazards regression models) to study how quickly MCCM enrollees switched to hospice compared to matched

comparison beneficiaries, and we found enrollees were 43 percent more likely than comparison beneficiaries to enroll in hospice on any given day following their MCCM enrollment date.[12]

Overall, we found consistent evidence that MCCM enrollees were more likely to enroll in hospice and more likely to enroll earlier than those in the matched comparison group.

Figure IV.3. Average number of days in hospice for deceased MCCM enrollees and matched comparison beneficiaries: MCCM enrollees spent more time in hospice between enrollment and death than comparison beneficiaries



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impact estimates for days in hospice were statistically significant at the $p < 0.01$ level. See Appendix D, Table D.3 for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

[12] The estimated hazard ratio was 1.43 with 90 percent confidence interval [1.38, 1.49] and $p < .001$. A hazard ratio of 1 would indicate no model effect on this outcome, while ratios over 1 indicate the propensity to enter hospice was higher for MCCM beneficiaries than matched comparison beneficiaries.

B. Sensitivity analyses

We explored alternative regression specifications to check the robustness of our regression estimates and found very similar results (see Appendix D, Section B). These checks increase our confidence that MCCM enrollees used the Medicare hospice benefit more than matched comparison beneficiaries.

We used the *E*-values method to estimate how large unmeasured factors would have to be to negate our estimated impacts (described in Section III.C and Appendix D.4). We found *E*-values of 2.85 and 1.89 for our estimated impacts on the proportion of beneficiaries enrolling in hospice and time to enrollment, respectively. When we compare these *E*-values to other established benchmarks in the literature, such as doctors' likelihood of referring beneficiaries to hospice, we concluded that unobserved factors are unlikely to fully explain the estimated impacts, even if we cannot rule out that these factors might have partly affected our estimates. Obermeyer and coauthors (2015) found a physician's practice style was the strongest predictor (among all covariates observed in their data) for whether a terminally ill beneficiary with cancer would elect hospice. Our *E*-values suggests that, to fully negate MCCM's estimated impact on electing hospice, unmeasured factors would have to account for a difference in the rate of hospice enrollment larger than switching from a doctor in the bottom decile for referring terminally ill beneficiaries to hospice to one in the top decile. Therefore, unobserved factors in our evaluation, such as having a physician who is likely to encourage hospice to beneficiaries, would have to be much more likely among MCCM-enrolled beneficiaries than the comparison groups and be strongly related to the outcome variables to fully explain away the estimated impacts of MCCM.

As another point of comparison, to fully negate the estimated impact of MCCM on the time until electing hospice, the unmeasured factors would need to have a stronger relationship with both the outcome variable and with enrollment than we observed for all of the *E*-values calculated for any of the expenditures and service use outcomes in Chapter III. **Based on this, we believe it is unlikely unmeasured factors that cannot be controlled for in the regression analysis could fully explain the estimated impacts of MCCM on expenditures and service use, and our sensitivity tests suggest it is even less likely unmeasured factors could explain our findings for hospice related outcomes.**

C. Understanding how increased use of hospice drove changes in Medicare expenditures and hospital service use

The first section of this chapter shows MCCM beneficiaries enrolled in hospice more often and spent more time enrolled in hospice than beneficiaries in the comparison group. Meanwhile, in Chapter III we found MCCM enrollees had lower Medicare expenditures and used fewer hospital and other health care services on average. Because beneficiaries receiving hospice benefits must forgo payment for treatment of their terminal conditions, Medicare expenditures (per day) and rates of service use might be lower after a beneficiary enrolls in hospice.[13] By extension, MCCM's impacts on hospice use could have driven at least some of MCCM's overall impacts on Medicare expenditures and service use for beneficiaries in MCCM. To understand this pathway better, we used a system of regression models that quantified how much of the overall decrease in Medicare expenditures and service use was explained by the increased time that MCCM beneficiaries spent enrolled in hospice. That is, our analysis disaggregated the total effect on Medicare expenditures into two components: (1) the reduction in Medicare expenditures due to increased

[13] The literature on the effect of hospice and palliative care on Medicare expenditures and service use has provided mixed evidence, partially due to methodological difficulties; see, for example, Gomes et al. (2013), Smith et al. (2014), Hogan (2015), Kaufman et al. (2021). Among MCCM enrollees, average daily Medicare expenditures (including model payments) were $543 before hospice enrollment and $166 while enrolled in hospice.

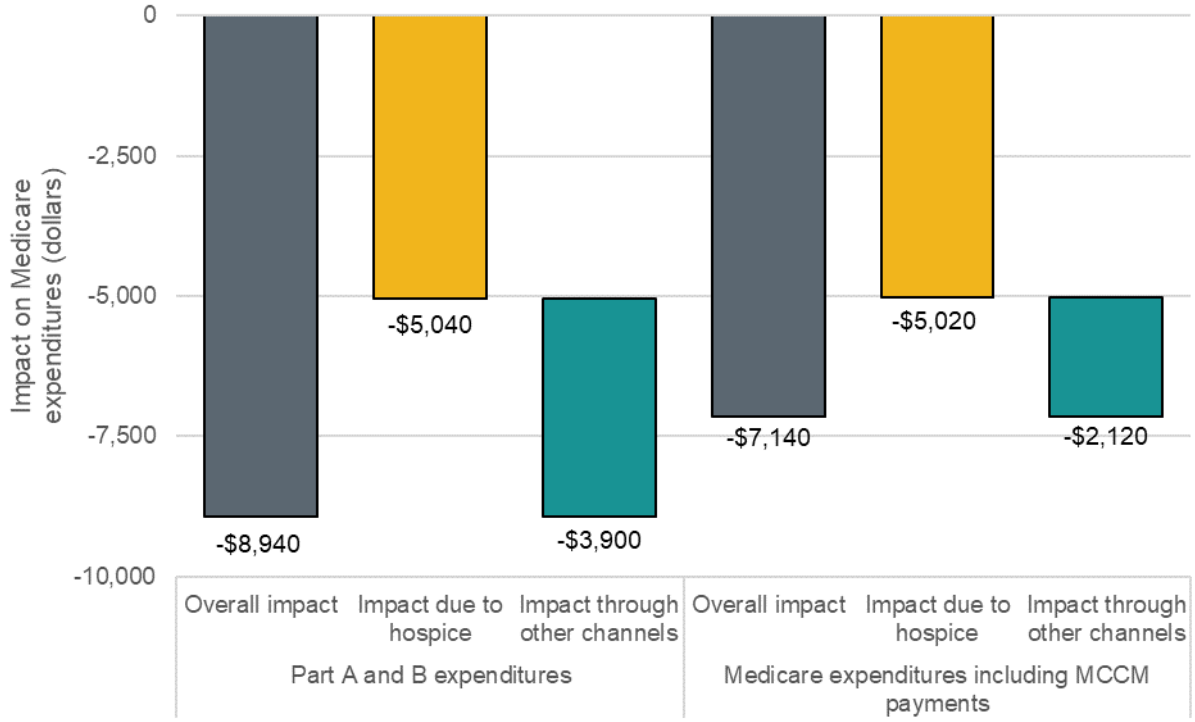
hospice use and (2) a residual impact capturing all the other ways MCCM affected Medicare expenditures. As an example of the residual impact, MCCM may have reduced Medicare expenditure before enrollees entered hospice by preventing some emergency department visits and inpatient stays through symptom management and care coordination.

Using the approach described in Appendix A, Section D.3, we estimated the following:

- The overall $8,940 reduction in Medicare Part A and B expenditures can be decomposed into (1) a $5,040 decrease in expenditures due to increased hospice use and (2) another $3,900 decrease due to effects of MCCM on Medicare Part A and B expenditures (Figure IV.4). This means MCCM enrollees' more frequent and earlier hospice enrollment accounted for 56 percent of the overall impact on Medicare Part A and B expenditures. The $5,040 decrease in expenditures due to increased hospice use captures the combination of two factors. First, MCCM beneficiaries spent about 29 percent of their time between enrollment and death in hospice, which is 13 percentage points higher than matched comparison beneficiaries (16 percent). Second, Medicare expenditures are lower after MCCM beneficiaries enrolled in hospice compared to before they enrolled, on average.
- After accounting for MCCM payments, the story is similar: the overall estimated effect of MCCM on total Medicare expenditures ($7,140) can be decomposed into (1) a $5,020 reduction due to increased hospice use and (2) a residual impact of $2,120 after netting out direct model payments. That is, hospice enrollment accounted for 70 percent of the estimated impact on total Medicare expenditures.
- For inpatient admissions, we estimated an overall reduction due to MCCM of 414 admissions per 1,000 beneficiaries, which we decomposed into a reduction of 170 admissions associated with hospice enrollment and a residual decrease of 245 admissions (Figure IV.5). That is, hospice enrollment accounted for 41 percent of the estimated impact inpatient admissions.
- We estimated an overall decrease of 130 in emergency department visits and observations stays per 1,000 beneficiaries. This reduction is mostly due to hospice enrollment (decrease of 95 per 1,000 beneficiaries) with the remainder due to other factors.

In summary, we found 70 percent of MCCM's estimated impacts on net Medicare expenditures and 59 percent of its estimated impacts on emergency department visits and observation stays operate through MCCM enrollees choosing the Medicare hospice benefit earlier and more often. However, only 41 percent of the model's estimated impact on inpatient admissions operates through hospice enrollment.

Figure IV.4. Impacts of MCCM on Medicare expenditures operating through increased hospice use versus other factors: Most of MCCM's impact on expenditures operated through MCCM enrollees' higher hospice use relative to the comparison group

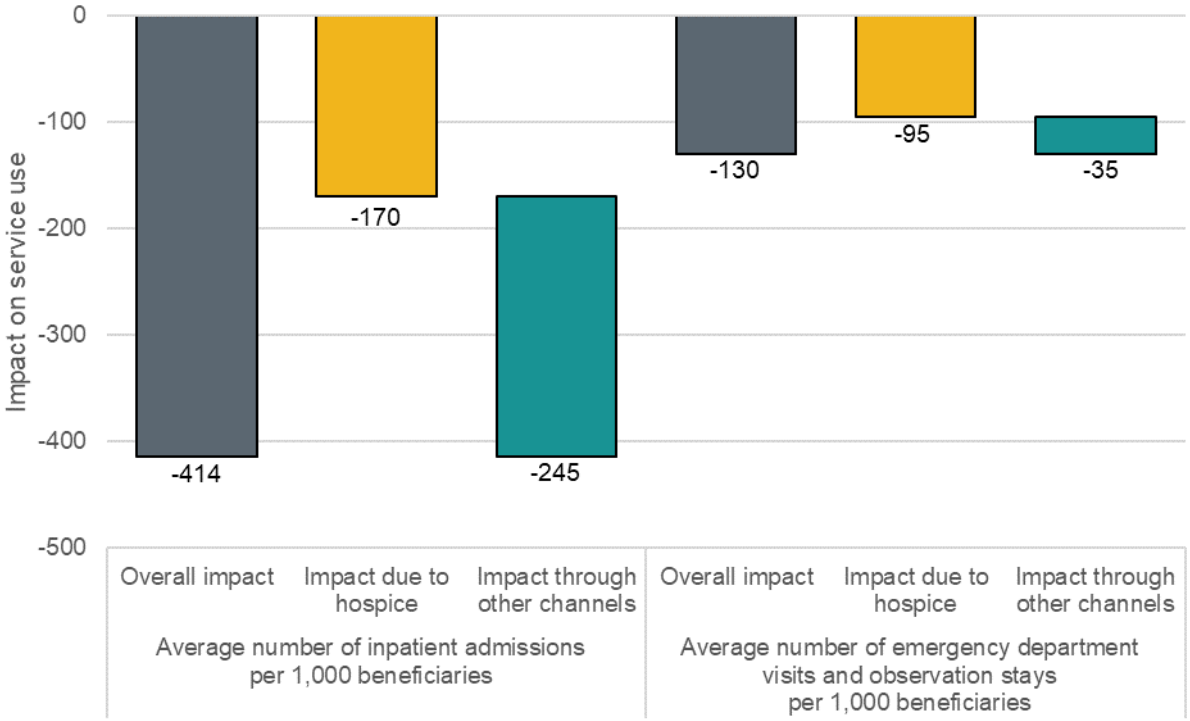


Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,555) and matched comparison beneficiaries (N = 13,484 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. We used a system of regressions to estimate overall impacts, and impacts operating through hospice enrollment and other factors; see Appendix A, Section D.3 for details. All estimated impacts are statistically significant at the $p < 0.01$ level. See Appendix D, Table D.4 for full results. The estimated overall impacts differ slightly from those reported in Chapter III because of different sample restrictions (this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit) and we use net expenditures (including MCCM payments) as the dependent variable (in the panel on the right).

MCCM = Medicare Care Choices Model.

Figure IV.5. Impacts of MCCM on hospital and emergency department use operating through hospice enrollment versus other factors: MCCM enrollees' hospice use explains most of the estimated reduction in their emergency department visits and observations stays (but less than half the reduction in inpatient admissions)



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,555) and matched comparison beneficiaries (N = 13,484 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. We used a system of regressions to estimate overall impacts, and impacts operating through hospice enrollment and other factors; see Appendix A, Section D.3 for details. All estimated impacts are statistically significant at the $p < 0.01$ level except for the remaining impact on emergency department visits and observation stays ($p = 0.17$). See Appendix D, Table D.4 for full results. The estimated overall impacts differ slightly from those reported in Chapter III because of different sample restrictions: this analysis excludes a small number of beneficiaries who did more than 30 days after disenrolling from the hospice benefit.

MCCM = Medicare Care Choices Model.

V. The Medicare Care Choices Model's Effect on the Quality of End-of-Life Care

Key Findings

- MCCM beneficiaries more often had outcomes consistent with higher quality end-of-life care by having fewer treatments before death likely to cause distress, discomfort, and pain, and time away from home.
- At the end of life, we found MCCM enrollees were less likely to receive an aggressive life-prolonging treatment in the last 30 days of life and spent more days at home than beneficiaries in the comparison group.

CMS designed MCCM to maintain or improve the quality of end-of-life care for Medicare beneficiaries. We analyzed Medicare claims data for MCCM and comparison beneficiaries to see whether MCCM improved various measures of end-of-life care, such as decreasing the percentage of beneficiaries receiving an aggressive life-prolonging treatment in the last 30 days of life, increasing beneficiaries' days at home, and decreasing the percentage of beneficiaries dying in an acute care hospital (Breslow 2015; Grunfeld et al. 2008; Earle et al. 2004, 2005; Emanuel and Emanuel 1998). We also investigated impacts on the percentage of beneficiaries who received, in the last 30 days of life, care likely to cause distress, discomfort, pain, and time away from home—more than one outpatient emergency department visit, more than one hospitalization, or an intensive care unit admission (adapted from National Quality Forum measures 0211, 0212, and 0213).

A. Impacts on quality outcomes

Overall, MCCM beneficiaries were more likely to receive better-quality end-of-life care. Relative to the comparison group, the model enrollees were 26 percent less likely to receive an inappropriately aggressive life-prolonging treatment in the last 30 days of life (Table V.1). The peer-reviewed studies that have analyzed potentially inappropriate aggressive life-prolonging treatments as measures of the quality of end of life, and the related National Quality Forum-endorsed measures, have focused on cancer and chronic obstructive pulmonary disease; there are relatively fewer studies and measures focusing on individuals with congestive heart failure.[14] Rather than separately analyzing the validated aggressive life-prolonging treatments specific for beneficiaries with each of the conditions, we used a measure applicable to all model enrollees in their last 30 days of life.[15] Therefore, we created a composite outcome of aggressive life-prolonging treatments, using a combined list of these treatments specific to the three conditions, plus a number of treatments that are *not* specific to a disease or condition (for example,

[14] Appendix B describes in detail the different validated aggressive life-prolonging treatments specific to each condition (for example, lung volume reduction surgery for chronic obstructive pulmonary disease), as well as a number *not* specific to a disease or condition.

[15] As shown in Chapter II, model enrollees were distributed across the three major qualifying conditions of cancer, congestive heart failure, and chronic obstructive pulmonary disease. In addition, a small number (N = 20) were diagnosed with HIV/AIDS. Enrollees often had more than one of the three conditions.

insertion of a feeding tube, cardiopulmonary resuscitation, or mechanical ventilation) all within the last 30 days of life.[16]

We also found MCCM enrollees spent 4 percent more days at home (167 versus 161 days). Spending more days at home at the end of life has been identified as a quality metric that is intuitively easy to understand and meaningful for beneficiaries (for example, Lee et al. 2019; Medicare Payment Advisory Commission 2015). Days at home are days during which a beneficiary is not in a medical care facility observable in Medicare claims, that is, a hospital, an inpatient rehabilitation hospital, a long-term care hospital, or a skilled nursing facility. In the last 30 days of life, MCCM enrollees were also 21 percent less likely to have multiple emergency department visits, 45 percent less likely to have multiple hospital admissions, and 46 percent less likely to have an intensive care unit admission. They were 54 percent less likely to die in an acute care hospital. These estimates align with the goals of MCCM of improving the quality of end-of-life care.

Table V.1. Regression-adjusted differences in quality of care and beneficiaries' experiences between deceased MCCM enrollees and matched comparison beneficiaries: MCCM beneficiaries more often had outcomes consistent with higher quality end-of-life care

Outcomes	MCCM enrollees' mean	Percentage impact[a]
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life[b]	46.1	26% decrease
Number of days at home[c]	167.5	4% increase
Percentage with more than one outpatient emergency department visit in last 30 days of life	2.6	21% decrease
Percentage with more than one hospitalization in last 30 days of life	5.2	45% decrease
Percentage with an intensive care unit admission in last 30 days of life	17.4	46% decrease
Percentage with death in an acute care hospital	10.1	54% decrease

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,038) and matched comparison beneficiaries (N = 11,935). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. See Appendix D, Table D.5 for full impact analysis results for these outcome measures.

[a] MCCM mean minus the comparison mean divided by the comparison mean (regression adjusted). All impact estimates in this table were statistically significant at the $p < 0.05$ level. As described in Appendix A, even after matching, the regression models controlled for residual differences in beneficiaries' characteristics, differences in baseline outcomes, and hospice market area fixed effects.

[b] As discussed in the text, nearly all of the validated aggressive life-prolonging treatments are disease-specific, so we created a composite outcome of *any* of the validated aggressive life-prolonging treatment specific to a beneficiary's condition in the last 30 days of life. See Appendix B, Exhibit B.3 for details.

[c] Days at home counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long term care hospital, or skilled nursing facility. The number of days at home is calculated only for those

[16] Since beneficiaries frequently had multiple diagnoses, our composite measure did not restrict potentially inappropriate aggressive life-prolonging treatments measure to a condition in which they were classified. For example, our composite measure captures a beneficiary categorized as having congestive heart failure who received chemotherapy in the last month of life as having received a potentially inappropriate aggressive life-prolonging treatment, even though chemotherapy is cancer-specific treatment.

beneficiaries who are fully observable in Medicare FFS enrollment and claims data from their enrollment date until death (about 97 percent of beneficiaries).

FFS = fee-for-service; MCCM = Medicare Care Choices Model.

B. Sensitivity analyses

We used the *E*-values method—described in Section III.C and Appendix D, section B—to estimate how large unmeasured factors would have to be to negate our estimated impacts. To fully negate MCCM's estimated impact on days at home (*E*-value = 1.20), unmeasured factors would have to have a stronger effect on outcomes than increasing the number of inpatient stays in the last quarter of the baseline period from 1.0 (the median) to 11.7 (greater than the 99th percentile).[17] The *E*-value for receiving aggressive life-prolonging treatments was 2.20, which is a larger *E*-value than we calculated for all the expenditures and service use outcomes in Chapter III. Thus, among the results, this is the least sensitive to selection bias: unmeasured factors would need to have even stronger relationships with both the outcome variable and with enrollment to explain the estimated impact on an aggressive life-prolonging treatment. **Therefore, we believe it is unlikely that unobserved factors exist that are highly imbalanced between the enrolled and comparison groups and strongly enough related to the outcomes to fully explain the estimated impacts of MCCM on either the number of days at home or the receipt of an aggressive life-prolonging treatment in the last 30 days of life.**

[17] We chose inpatient admissions in the baseline period as the benchmark because it was strongly associated with inpatient and post-acute care days in the follow-up period, which represent a large proportion of the days not spent at home. For receiving aggressive life-prolonging treatment, we could not find an appropriate benchmark because there are no obvious predictors for this outcome. As an alternative, we compare the *E*-value for aggressive life-prolonging treatments to *E*-values for other measures.

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VI. Variation in the Medicare Care Choices Model's Effects Across Qualifying Conditions

Key Findings

Impacts of MCCM were remarkably similar for the subgroups of beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease, although there was some modest variation in impacts across subgroups for particular outcomes:

- The model increased hospice enrollment and number of days at home the most for beneficiaries with congestive heart failure and chronic obstructive pulmonary disease.
- The model decreased the likelihood of receiving an aggressive life-prolonging treatment in the last 30 days of life the most for beneficiaries with cancer and chronic obstructive pulmonary disease.

As noted in Chapter I, beneficiaries had to have one of four qualifying conditions—cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS—to qualify for enrollment in MCCM. We investigated whether MCCM had similar impacts for beneficiaries with these different qualifying conditions. The results help us understand whether the model benefited all enrollees, with implications about how well the model might work if extended to include beneficiaries with other conditions. If the model works only for certain target conditions, it suggests features of the specific illnesses and how they progress, the clinicians who provide care, or other model- and condition-specific factors help to make the model more effective and might limit expansion of the model to beneficiaries with other clinical conditions. Alternatively, favorable impacts across all target illnesses suggest improvements depend less on the features specific to a particular illness, and that future models might wish to include additional conditions (that is, that extrapolating to other clinical conditions would be more reasonable).

Altogether we found MCCM had remarkably similar impacts on the subgroups of beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease at enrollment.[18] Regardless of which qualifying medical condition (or conditions) they had, model enrollees were more likely than matched comparison beneficiaries to enroll in hospice, less likely to use resource-intensive hospital services (having inpatient admissions and outpatient emergency department visits and observation visits), and more likely to receive better-quality end-of-life care (Table VI.1). These differences in health care services result in lower Medicare expenditures for model enrollees than comparison group beneficiaries, before and after accounting for model payments. These estimated effects of the model on quality of end-of-life care and Medicare expenditures are in line with the goals of the model.

[18] We did not estimate impacts for the 20 MCCM enrollees (less than 1 percent) with HIV/AIDS because the sample size was too small. Most of the enrolled beneficiaries had a diagnosis of cancer (72 percent). Fewer had a diagnosis of congestive heart failure (38 percent) or chronic obstructive pulmonary disease (34 percent). Some beneficiaries had two or more qualifying conditions at enrollment and were counted in multiple categories.

Table VI.1. Estimated effects of MCCM for deceased beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease: Impacts of MCCM did not vary substantially across beneficiaries with different qualifying conditions

Outcome measure	MCCM enrollees with cancer (N = 3,289)			MCCM enrollees with congestive heart failure (N = 1,732)			MCCM enrollees with chronic obstructive pulmonary disease (N= 1,539)		
	Mean	Impact estimate [90% CI]	Percentage impact	Mean	Impact estimate [90% CI]	Percentage impact	Mean	Impact estimate [90% CI]	Percentage impact
Average Medicare Part A and B expenditures plus MCCM payments ($ per beneficiary)	42,961	-7,976 [-9,353, -6,599]	-16%	51,323	-7,121 [-9,395, -4,848]	-12%	50,866	-6,016 [-8,283, -3,748]	-11%
Average Medicare Part A and B expenditures ($ per beneficiary)	41,337	-9,600 [-10,980, -8,221]	-19%	49,219	-9,225 [-11,513, -6,937]	-16%	48,824	-8,057 [-10,342, -5,772]	-14%
Average number of inpatient admissions (number per 1,000 beneficiaries)	979	-431 [-478, -384]	-31%	1,591	-403 [-487, -318]	-20%	1,464	-475 [-567, -382]	-24%
Number of outpatient emergency department visits and observation stays (number per 1,000 beneficiaries)	712	-86* [-133, -40]	-11%	1,079	-125 [-211, -40]	-10%	1,010	-213 [-307, -119]	-17%
Percentage who elected the Medicare hospice benefit	86	16.7* [15.1, 18.0]	24%	76	21.2* [18.7, 23.1]	38%	80	22.1* [19.8, 24.2]	38%
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	45	-16.4 [-18.1, -14.6]	-27%	52	-14.5* [-16.9, -12.2]	-22%	47	-17.4 [-19.9, -14.9]	-27%
Average number of days at home	146	5.5* [4.7, 6.3]	4%	186	7.4* [5.9, 8.8]	4%	193	7.1* [5.5, 8.6]	4%

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to September 30, 2020.

Notes: We based impact estimates on regression-adjusted differences between MCCM enrollees and comparison beneficiaries. The impact estimates in each row come from three separate regression models—one model for beneficiaries with cancer, one model for beneficiaries with congestive heart failure, and one model for beneficiaries with chronic obstructive pulmonary disease. It covers beneficiaries who enrolled through March 31, 2020, and their experiences in the model. All of the impact estimates in this table were statistically significant at the $p < 0.01$ level, except for the impact on number of outpatient emergency department visits and observation stays for beneficiaries with congestive heart failure ($p = 0.02$).

The yellow shading with an asterisk identifies cases in which the estimated impact for beneficiaries with the qualifying condition were statistically different (at $p < 0.10$) than the estimated impact for beneficiaries without the condition. For example, shading in the third column indicates outcomes in which the estimated impact for enrollees with cancer differed from the estimated impact for enrollees without cancer. We tested for differences in impacts between the three conditions using pooled regression models that included interaction terms between intervention group and qualifying condition. We did not adjust *p*-values for multiple comparisons.

CI = confidence interval; MCCM = Medicare Care Choices Model

That said, there was some minor, but notable, variation in impacts across beneficiaries with the different qualifying conditions, most notably for enrolling in the Medicare hospice benefit and days spent at home.[19] We discuss each of the three subgroups in turn:

- **Cancer.** MCCM enrollees diagnosed with cancer had 11 percent fewer outpatient emergency department visits and observation stays, were 24 percent more likely to elect the Medicare hospice benefit, and spent six additional days at home, relative to their matched comparison beneficiaries (left panel in Table VI.1). Impacts on these three outcomes were smaller than impacts of the model on the same outcomes for other beneficiaries. MCCM beneficiaries diagnosed with cancer also had lower Medicare expenditures (with and without model payments) than matched comparison beneficiaries diagnosed with cancer, fewer inpatient admissions, and were less likely to receive an aggressive life-prolonging treatment in the last 30 days of life, but we estimate the model's effects on those outcomes were similar for enrollees with and without cancer.
- **Congestive heart failure.** MCCM enrollees diagnosed with congestive heart failure were 38 percent more likely to elect the Medicare hospice benefit, were 22 percent less likely to receive an aggressive life-prolonging treatment in the last 30 days of life, and spent seven additional days at home, compared with comparison beneficiaries with congestive heart failure (middle panel in Table VI.1). Model beneficiaries diagnosed with congestive heart failure compared to matched comparison beneficiaries diagnosed with congestive heart failure also had lower Medicare expenditures (with and without model payments), fewer inpatient admissions, and fewer outpatient emergency department visits and observation stays, but we estimate the model's effects on those outcomes were similar for enrollees with and without congestive heart failure.
- **Chronic obstructive pulmonary disease.** Model enrollees diagnosed with chronic obstructive pulmonary disease were 38 percent more likely to elect the Medicare hospice benefit and spent seven more days at home than matched comparison group beneficiaries with chronic obstructive pulmonary disease (right panel in Table VI.1). These are larger impacts than we estimated for enrollees with cancer but similar to the estimated impact on enrollees with congestive heart failure. Among beneficiaries with chronic obstructive pulmonary disease, model beneficiaries also had lower Medicare expenditures (with and without model payments) than matched comparison beneficiaries, had fewer inpatient admissions and outpatient emergency department visits and observation stays, and were less likely to receive an aggressive life-prolonging treatment in the last 30 days of life, but we estimate the model's effects on those outcomes were similar for enrollees with and without chronic obstructive pulmonary disease.

[19] The yellow shading in Table VI.1 highlights the most notable differences in impacts across subgroups of beneficiaries with different qualifying conditions. That is, we highlight areas in which impacts on an outcome are larger or smaller for MCCM beneficiaries with a particularly qualifying condition relative to estimated impacts for model beneficiaries without the condition.

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VII. Did Outcomes Differ for Medicare Care Choices Model Enrollees from Underserved Communities?

Key Findings

- Racial minority and dually eligible MCCM beneficiaries had less favorable outcomes than the reference group—of non-Hispanic White model beneficiaries and Medicare-only model beneficiaries, respectively—on five of six quality-of-care outcomes.
- More analyses will be needed to determine whether MCCM affected disparities in outcomes.

The Innovation Center's 2021 Strategy Refresh underscores the Center's commitment to advancing health equity. As part of that strategy, it is important to better understand the impact of Innovation Center models across all beneficiaries, including those from underserved communities. For this reason, we investigated the beneficiary outcomes for MCCM enrollees from traditionally underserved communities.

MCCM provides additional choices to beneficiaries—offering them services that are not normally paid for by Medicare. For this reason, we would not expect this model to have negative consequences for beneficiaries who choose to enroll in the model. However, the model does pay for services on a fixed-price basis, which suggests that, if it is more expensive to provide services to a particular subgroup, they might receive a lower level of services and not benefit equally from the model. For MCCM, there are concerns that:

- **Beneficiaries living in rural areas**, due to the higher travel costs, might not receive the same set of services.
- **Racial and ethnic minorities**, due to cultural differences or failures in the health care system, might not receive the services that best meet their needs.
- **Dually eligible beneficiaries** might have challenges coordinating care across multiple payment sources and in-home service providers.

In keeping with the Innovation Center's strategy, we wished to determine whether outcomes differed between beneficiaries enrolled in MCCM from these underserved communities and other MCCM enrollees. This analysis also aligns with a broader desire to understand whether impacts differ by subgroup; even if impacts are comparable or more favorable for subgroups, variation in impacts is of interest in its own right and can inform the design of other CMS models.

For MCCM, low levels of participation in the model make it unlikely to detect either impacts for the subgroups themselves or differences in impacts between a subgroup and other enrollees. Rural, minority, and dually eligible beneficiaries represent 12 to 14 percent of model enrollees in our impact analysis, respectively, with correspondingly large minimal detectable effects for the primary outcomes of interest in this evaluation. To mitigate this concern, we adopted a two-phase strategy: in the first phase, we conducted descriptive analyses to gauge whether disparities exist; in the second phase, we will examine the identified areas more closely in impact analyses. This chapter presents results of the first, descriptive phase of analysis.

Approach. The goal of the first phase was to identify disparities. We compared the average outcomes for each of the three subgroups to the average outcomes for a reference group on six quality-of-care measures, comparing rural to nonrural beneficiaries, racial minority to non-Hispanic White beneficiaries, and dually eligible to Medicare-only beneficiaries. Analyses focused on MCCM enrollees only. We then identified subgroups experiencing disparities using the following criteria: (1) for four or more outcomes, the average outcomes for beneficiaries from an underserved community was at least 10 percent worse than the reference group's average outcome; and (2) the differences between the two groups across all six outcomes was statistically significant.

Results. The results of the analysis, shown in Table VII.1, indicate that rural and nonrural MCCM enrollees have similar outcomes. However, racial minorities and dually eligible beneficiaries fare worse than the reference groups, on average, across most of the quality-of-care measures examined. Beneficiaries living in rural areas had an emergency department visit in the last 30 days of life more often than other beneficiaries, but otherwise had comparable or better outcomes. By contrast, racial minority and dually eligible model beneficiaries were substantially more likely than the reference groups to have an aggressive life-prolonging treatment, emergency department visits, hospital admissions, and intensive care unit admissions in the last 30 days of life or to die in an acute care facility.[20] Statistical tests largely confirm this finding, indicating the differences between each subgroup (underserved community) and its reference group are larger than we would expect by chance for these six outcomes. Taken together with the descriptive statistics, for racial minority and dually eligible beneficiaries the statistical test reflects a consistent pattern of disparities, which requires further investigation. The outcomes for rural beneficiaries are relatively less concerning; rural beneficiaries more often have outpatient emergency department visits in the last 30 days of life, but they have similar or even better outcomes than the reference group on all other measures.

Next steps (phase two). These findings signal that among MCCM enrollees, there are disparities in outcomes for beneficiaries from underserved communities. We must therefore investigate the experience of these subgroups in our final report to determine more precisely how the model affects them. Importantly, the current evidence does not suggest the model differentially affected these groups—MCCM enrollees from these underserved communities might have had worse (or better) outcomes without the model. We will need further analysis to determine how the model contributes to the observed differences in outcomes. To determine the model's effects, we will conduct subgroup impact analyses comparing outcomes between MCCM enrollees and comparison beneficiaries within each subgroup. However, we defer this analysis until our final report next year to provide time to develop a modeling approach that appropriately handles the small sample sizes.

[20] These findings held even after adjusting for differences between the vulnerable and reference groups on key background characteristics such as age, gender, hierarchical condition category risk score, primary diagnosis, and survival time (results not shown).

Table VII.1. Identifying subgroups of concern

Outcomes	All MCCM beneficiaries (N = 4,574)	Rural MCCM beneficiaries (N = 618, 13.5%)	Nonrural MCCM beneficiaries (N = 3,956, 86.5%)	Difference (%)	Racial minority MCCM beneficiaries (N = 627, 13.7%)	Non-Hispanic White MCCM beneficiaries (N = 3,947, 86.3%)	Difference (%)	Dually eligible MCCM beneficiaries (N = 541, 11.8%)	Medicare-only MCCM beneficiaries (N = 4,033, 88.2%)	Difference (%)
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	46.1	48.1	45.8	2.3 (5%)	53.0	45.0	7.9* (18%)	50.1	45.6	4.5* (10%)
Average number of days at home	167	186	165	21 (13%)	160	169	-9 (-5%)	200	163	36 (22%)
Percentage with more than one outpatient emergency department visit in last 30 days of life	2.6	6.1	2.0	4.2* (208%)	3.7	2.4	1.3* (54%)	4.4	2.3	2.1* (92%)
Percentage with more than one hospitalization in last 30 days of life	5.2	4.9	5.3	-0.4 (-8%)	8.5	4.7	3.7* (79%)	9.2	4.7	4.6* (97%)
Percentage with an intensive care unit admission in last 30 days of life	17.4	16.2	17.6	-1.4 (-8%)	21.4	16.7	4.6* (28%)	20.1	17.0	3.1* (18%)
Percentage with death in an acute care hospital	10.1	10.7	10.1	0.6 (6%)	14.7	9.4	5.2* (56%)	13.5	9.7	3.8* (39%)
Yes or no: Does the subgroup have four outcomes that are worse than the reference population group?	-		No			Yes			Yes	
p-value[a]	-		< 0.001			< 0.001			0.001	
Yes or no: Is there a signal that more effort is needed to ensure this subgroup's experiences are understood?	-		No			Yes			Yes	

Note: Cells highlighted in yellow with an asterisk mark unfavorable differences in outcomes of 10 percent or more between the beneficiaries from the underserved community and the reference group.

[a] *p*-values are from a test of the null hypothesis that the difference in means between the beneficiaries from the underserved community and the reference group, after adjusting for key background characteristics (age, gender, Census region, hierarchical condition category risk score, primary diagnosis, and survival time), is equal to zero across all six outcomes.

MCCM = Medicare Care Choices Model.

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VIII. Did COVID-19 Change Medicare Care Choice Model's Effectiveness?

Key Findings

The COVID-19 pandemic overlaps with MCCM implementation period and had the potential to change the model's implementation and impacts on beneficiary outcomes.

- We found MCCM reduced Medicare expenditures, acute care use, and the likelihood of receiving an aggressive life-prolonging treatment in the last 30 days of life for beneficiaries enrolled in MCCM both during the pre-COVID-19 period and during the COVID-19 period. In addition, MCCM increased the likelihood of enrolling in hospice and the average number of days spent at home for both subgroups.
- MCCM reduced expenditures more for beneficiaries who enrolled during the COVID-19 pandemic than it did for beneficiaries who enrolled earlier.

The last two years of MCCM (2020 and 2021) coincided with the worldwide COVID-19 pandemic. Ultimately, 500,000 to 700,000 additional Americans died in the first 13 months of the pandemic than would have typically died in the same period (Rossen et al. 2021). For vulnerable individuals with weakened immune systems who contracted the virus, COVID-19 often caused severe disease resulting in long hospitalizations or death. Even for beneficiaries who did not contract the virus, the pandemic at times severely disrupted their ability to access medical care due to fears of infection or limited capacity at health care facilities that were overwhelmed and unable to treat beneficiaries without COVID-19. During this period, nationwide Medicare fee-for-service expenditures and rates of service use decreased (Shah et al. 2021; Tarazi et al. 2021). In addition, implementation of the model could have changed, and different types of beneficiaries might have chosen to enroll in the model during COVID-19.[21] As a result of these disruptions, the effects of MCCM on beneficiaries' outcomes might have changed during the COVID-19 pandemic. The previous chapters present average impacts for a pooled sample of beneficiaries enrolled both before and during the pandemic, but some stakeholders might want to focus on the model's impacts during relatively normal times (that is, without an ongoing pandemic) by estimating the model's effects among the cohort of beneficiaries enrolled before the COVID-19 pandemic began. Others might be more interested in learning whether the model's effectiveness did, in fact, change for beneficiaries who enrolled in MCCM during the COVID-19 pandemic versus those who enrolled earlier. We provide both of these estimates in this chapter.

A. Model effects for beneficiaries enrolled before and during the COVID-19 period

We examined impacts of MCCM separately for (1) beneficiaries enrolled through August 31, 2019 (pre-COVID-19 period) and (2) beneficiaries enrolled September 1, 2019 through September 30, 2020

[21] In our final report, scheduled for next year, we plan to present qualitative data on model implementation during the pandemic.

(COVID-19 period) and also examined whether the model effects were the same for the two groups.[22] Among beneficiaries who met the inclusion criteria for the analysis, 3,605 enrolled during the pre-COVID-19 period at 79 participating hospices and 969 enrolled during the COVID-19 at 51 participating hospices.

We designed our evaluation of MCCM to mitigate the potential biases the COVID-19 pandemic might have introduced. For example, we chose comparison group beneficiaries from the same regions as MCCM enrollees and matched closely on calendar time during the COVID-19 period so enrollees and matched comparison beneficiaries would be similarly influenced by local rates of COVID-19 transmission and any local restrictions, such as shelter-in-place orders. This should mitigate concerns that estimated differences in outcomes between MCCM enrollees and comparison beneficiaries were due to differences in local conditions, on average, between the two groups. We used regression models to ensure any observed differences in model effects between the pre-COVID-19 and COVID-19 cohorts were not due to changes in beneficiary or hospice characteristics.[23,24]

Among MCCM enrollees in the pre-COVID-19 cohort, we estimated the model reduced Medicare expenditures, reduced hospital service use, and improved measures of quality-of-life measures (Figure VIII.1). Specifically, we estimated that, for the pre-COVID-19 cohort, the model reduced Medicare expenditures plus MCCM payments by 12 percent, decreased the average number of inpatient admissions by 26 percent, and decreased the average number of outpatient emergency department visits and observation stays by 14 percent. Further, beneficiaries in this cohort were 18 percentage points more likely to enroll in the Medicare hospice benefit before death than matched comparison beneficiaries, were 16 percentage points less likely to receive an aggressive life-prolonging treatment in the last 30 days of life, and spent 4 percent more days at home. These estimates are broadly similar to the effects of the model we estimated among all MCCM enrollees, which is unsurprising because the majority of MCCM enrollees had enrolled and died before the COVID-19 pandemic began.

The effects of MCCM differed somewhat for enrollees in the COVID-19 cohort. Most notably, we found the estimated reduction in total Medicare expenditures (including MCCM payments) from MCCM was larger for those in the COVID-19 cohort than for those in the pre-COVID-19 cohort. As summarized in Figure VIII.1, enrollees in the COVID-19 cohort had expenditures that were 23 percent lower than those in the comparison group, while we had estimated expenditures for the pre-COVID-19 cohort were 12

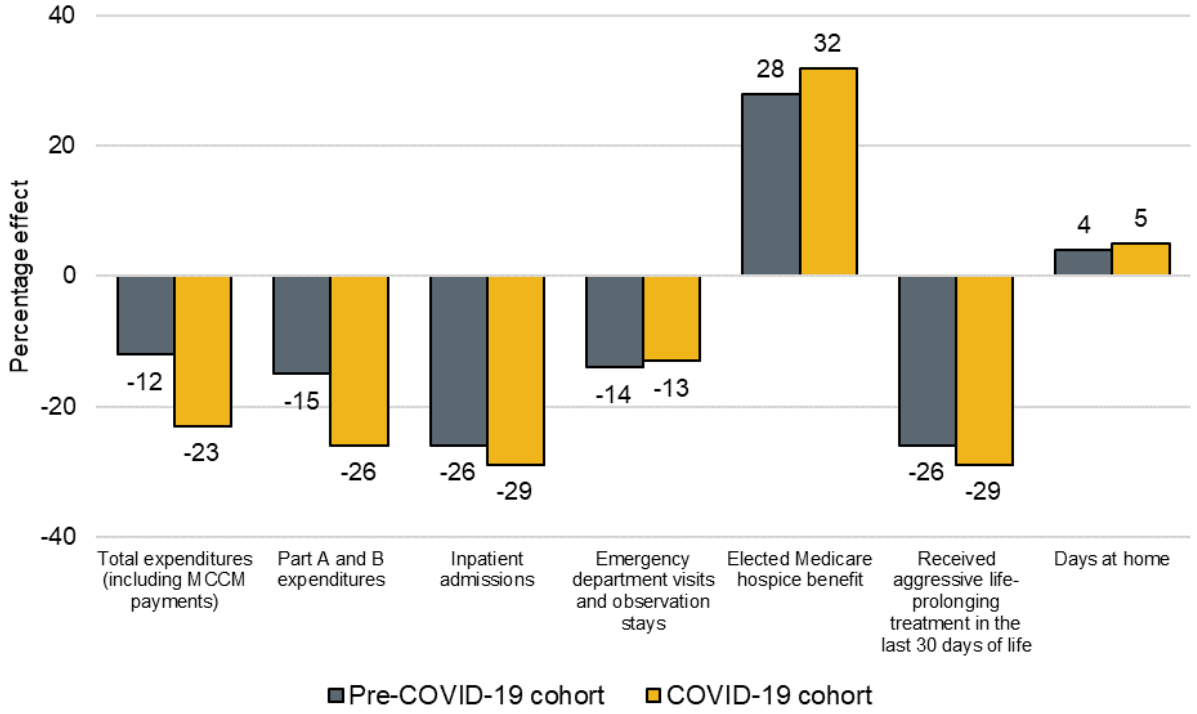
[22] Beneficiaries enrolled through August 31, 2019, should provide an estimate of the models' effect without significant interference from the COVID-19 pandemic. We chose this cutoff based on the distribution of survival times for MCCM beneficiaries and in consultation with CMS. At the time the decision was made, we expected that the vast majority of beneficiaries enrolled through August 31, 2019, would have died before the pandemic began around March 1, 2020. All beneficiaries enrolled later than this cutoff were more likely affected by the pandemic and therefore included in the COVID-19 cohort.

[23] Beneficiaries enrolled during the COVID-19 period were more likely to reside in the American West and have cancer or congestive heart failure, but less likely to have chronic obstructive pulmonary disease or be dually eligible for Medicaid and Medicare than beneficiaries who enrolled in MCCM before the pandemic. They also had higher Medicare expenditures before their MCCM enrollment date. Finally, there were more enrollees in the pre-COVID-19 cohort than COVID-19 cohort with long (more than six month) survival times, given that the earlier cohort had more follow-up data available at the time of these analysis.

[24] We cannot disentangle the COVID-19 pandemic's influence on the model's effectiveness from other factors that could have led to changes in effectiveness during the same period. As we note later, model effectiveness might have changed in 2020 and 2021 as hospices continued to gain experience participating in the model, even if COVID-19 had not happened.

percent lower than comparison beneficiaries.[25] The estimated impacts of MCCM on Medicare Part A and B expenditures *without MCCM payments* had the same pattern: MCCM enrollees had even lower expenditures relative to the comparison group when they enrolled during the COVID-19 period than when they enrolled in the pre-COVID-19 period.

Figure VIII.1. MCCM impacts by COVID-19 cohort: MCCM continued to have favorable effects in the COVID-19 period, and was associated with a more pronounced decrease in Medicare expenditures in the COVID-19 period than in the pre-COVID-19 period



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N=4,574) and matched comparison beneficiaries (N=13,575 before weighting). It covers beneficiaries who enrolled through September 30, 2020, and their experiences in the model. The percentage impact is the regression-adjusted impact estimate divided by the regression-adjusted comparison group mean. Impacts estimates were statistically significant ($p < 0.10$) for all outcomes for both subgroups. Differences in impact estimates between enrollees in the pre-COVID-19 versus COVID-19 cohorts were statistically significantly different ($p < 0.10$) for Medicare expenditures (with and without MCCM payments). For other outcomes, the model had similar impacts for the two cohorts (differences in impacts had $p \geq 0.10$). See Appendix D, Table D.7. for full impact analysis results for these outcome measures.

[25] The estimated effect of MCCM is less precisely estimated during the post-COVID-19 period, when we have smaller sample sizes. Nonetheless, the difference in impacts on Medicare spending between the pre- and post-COVID-19 periods was statistically significant at the $p < .01$ level

MCCM's estimated impacts on the average number of inpatient admissions, emergency department visits and observation stays, rates of electing hospice, rates of receiving an aggressive life-prolonging treatment in the last 30 days of life, and days at home were not statistically significantly different between enrollees in the pre-COVID-19 and COVID-19 cohorts. However, this null finding for impacts on the *levels* of these outcome measures masks an interesting pattern that *percentage* impacts were estimated to be higher for those who enrolled during the post-COVID-19 period for some outcomes. For example, the estimated impact on inpatient admissions was similar for those who enrolled in the pre- and post-COVID-19 periods. (We estimate MCCM decreased admissions by 375 and 433 admissions per 1,000 beneficiaries enrolled in the pre- and post-COVID-19 periods, respectively). However, the average number of admissions in the comparison group was much lower for those who enrolled during COVID-19 (1,279 versus 1,696 in the comparison group), so impact estimates suggest the model reduced inpatient admissions by 29 percent for those who enrolled during the COVID-19 period, compared to a 26 percent reduction before COVID-19.

Although we estimated more pronounced impacts of MCCM on expenditures for those who enrolled in the COVID-19 period than before, we recognize these differences in impacts might be due to factors other than COVID-19 that evolved during the study period. For example, the subset of hospices that continued participating in the model in 2021 might have gained experience over time and have improved processes and services for enrollees in later years. It is also possible MCCM had larger impacts relative to the status quo during the COVID-19 pandemic, when home-based care might have been particularly important for improving beneficiaries' access to care.

B. Rates of COVID-19 among model enrollees

We also explored whether enrolled beneficiaries were more or less likely to have a COVID-19 diagnosis than matched comparisons after their enrollment date (or pseudo enrollment date). Even after matching and controlling for a number of observable differences between the two groups at baseline, we found that beneficiaries alive during the COVID-19 period had somewhat lower rates of COVID-19 than those in the comparison group: 61 enrollees who were alive during the pandemic (5 percent) were diagnosed with COVID-19 versus 121 comparison beneficiaries who were alive during the pandemic (9 percent). This difference could possibly be a protective effect of MCCM, due to unobserved differences in COVID-19 risk factors, or random chance.

If the difference in COVID-19 incidence between enrollees and the comparison groups are effects of the model it would not bias results in our main analysis approach. But, if this difference in COVID-19 incidence is due to unobserved differences in risk factors or random chance, it could make expenditures even higher in the comparison group and, by extension, make the estimated reduction in expenditures due to MCCM enrollment look bigger than it truly is. However, we would expect such biases to be small because very few beneficiaries in our overall analysis sample (less than 2 percent) were diagnosed with COVID-19. To better understand this, we conducted additional regression analyses that controlled for whether beneficiaries received a COVID-19 diagnosis in the follow-up period, which assumes the model had no effect on COVID-19 incidence.[26] MCCM enrollees had slightly lower rates of COVID-19

[26] We do not typically regression-control for factors measured in the follow-up period because model enrollment could influence them. In the case of COVID-19 diagnosis, it is possible that MCCM enrollment did not affect the risk of COVID-19 exposure. In that case, it would be appropriate to control for COVID-19 diagnosis in the follow-up period in this sensitivity analysis. The truth might lie somewhere in between: MCCM might explain part but not all of the difference in COVID-19 incidence between the intervention and comparison groups. By running the

diagnoses, and such diagnoses were associated with higher expenditures and utilization of acute care services in the follow-up period. We found that MCCM's estimated impact on each of our main outcomes was in the same direction but was slightly smaller than the main regression models' estimates that did not control for COVID-19 (see Section C in Appendix D).

analyses both ways—with and without COVID-19 as a control variable—we bound the potential effects of the model.

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IX. Discussion

Key Findings

Altogether, our impact estimates largely align with the expectations of the model.

- We see patterns of outcomes that MCCM intended to produce between enrollment and death. MCCM enrollees were:
  - More likely to enroll in the Medicare hospice benefit than matched comparison beneficiaries
  - Less likely to use resource-intensive services (such as being admitted to an inpatient hospital)
  - More likely to receive better-quality end-of-life care
- This reduced net Medicare expenditures (including MCCM payments) by $7,254 per beneficiary, or 14 percent.
- Estimated effects of the model were remarkably similar effects by qualifying condition, and we see early evidence that effects were sustained during the COVID-19 pandemic.

The model provides important lessons for policymakers. Using these findings merits careful consideration, however, because they might not generalize to other settings given the small number of hospices that participated in MCCM and the small percentage of eligible beneficiaries that enrolled in the model.

This year's independent evaluation of MCCM explored whether offering eligible beneficiaries the option to receive supportive services at the end of life without forgoing payment for treatment of their terminal conditions, which is required to enroll in the Medicare hospice benefit, resulted in better-quality end-of-life care, changed patterns of service use, and decreased Medicare expenditures. We also explored the role of changes in hospice use in explaining these effects and variation in impacts across subgroups.

A. Key findings

Altogether, our impact estimates largely align with the expectations of the model—that is, they match the pattern of outcomes MCCM intended to produce. Specifically, our results tell a consistent story that model enrollees were more likely to enroll in hospice than matched comparison beneficiaries, less likely to use resource-intensive services (such as being admitted to an inpatient hospital), and more likely to receive better-quality end-of-life care in the period between enrollment and death (see box). For example, we estimated model beneficiaries were 18.6 percentage points more likely to elect the Medicare hospice benefit (83.1 versus 64.5 percent), had 26 percent fewer inpatient hospital admissions and 14 percent fewer outpatient emergency department visits and observation stays, were 16 percentage points less likely to receive an aggressive life-prolonging treatment in the last 30 days of life (46 versus 62 percent), and spent about 4 percent more days at home compared to beneficiaries in the comparison group.

The differences in health care service use resulted in $9,080 (17 percent) lower Medicare Part A and B expenditures per beneficiary for MCCM enrollees than comparison group beneficiaries during the period between their MCCM enrollment date and death. Payments to participating hospices for providing MCCM services to enrollees were $1,827 on average per enrollee, so total (net) Medicare expenditures decreased by $7,254 (14 percent). In other words, Medicare expenditures at the end of beneficiaries' lives

declined, and these savings were substantial. More than half (70 percent) of the Medicare savings was associated with increased hospice use among model enrollees: they enrolled in hospice earlier and more often, leading to cost savings as daily Medicare expenditures (and rates of service use) were lower after beneficiaries enrolled in hospice. The remaining Medicare savings in the period resulted from when beneficiaries were not yet enrolled in hospice. Likewise, part of the overall decreased hospital service use from the model was due to increased and earlier hospice enrollment, but part of the decrease in hospital service use came through other channels, including care received under MCCM. We also found that effects of the model on Medicare expenditures varied by the length of time beneficiaries lived after enrolling in MCCM: the largest reductions in net Medicare expenditures (in dollar terms) occurred among enrollees who lived 31 to 365 days after enrolling in MCCM while the largest percentage impacts were concentrated among enrollees who lived fewer than six months after enrolling in MCCM.

Our subgroup analyses also suggest several policy implications and areas for future work.

- Beneficiaries with cancer were relatively more likely to enroll in MCCM, but the model also achieved savings and improved care across beneficiaries diagnosed with congestive heart failure and chronic obstructive pulmonary disease. The remarkable lack of variation in impacts across these three qualifying conditions suggests that improvements depend less on model features specific to a particular illness. That is, persons with a wide range of terminal conditions might benefit from similar services.[27]
- Eligible beneficiaries from underserved communities—racial minorities, dually eligible beneficiaries, and beneficiaries living in rural areas—were relatively less likely to enroll in MCCM and we identified disparities in quality-of-care outcomes between the racial minorities and dually eligible beneficiaries who enrolled in the model and other model enrollees. It is not a new finding to document disparities in outcomes for these groups (for example, Ornstein et al. 2020), but it does suggest the model did not fully overcome embedded disparities. More work is needed to (1) examine whether the model helped reduce disparities from what they might have otherwise been among underserved communities (we plan such analyses for our next report) and (2) better understand how supply and demand factors affect enrollment in MCCM (and hospice) among beneficiaries from underserved communities.
- The model continued to have substantial effects during the COVID-19 pandemic, even though this was a period of substantial disruption with lower rates of service use and Medicare expenditures nationwide (Shaw et al. 2021; Tarazi et al. 2021). Large effects during the COVID-19 pandemic suggest model implementation and fidelity did not suffer greatly during the pandemic among participants, although planned primary data collection and analysis will address this question more fully.

B. Strengths and limitations

Our evaluation has many strengths. A diverse set of hospice agencies, from many regions in the United States, volunteered to implement the model. Using Medicare claims data for this evaluation means we can observe outcomes of all enrolled beneficiaries, even after their discharge from the model. We also used claims to develop many baseline characteristics (including measures of health status and health trends to account as much as possible for beneficiaries' disease trajectories) for millions of potential comparison

[27] We could not separately evaluate impacts for the 20 model enrollees with HIV/AIDS.

beneficiaries and used matching to select a comparison group of beneficiaries who resembled the enrollees on these numerous characteristics.

Nevertheless, our evaluation does have limitations. We used observational causal inference methods to estimate the effects of MCCM and, absent a randomized controlled trial, it remains possible that unobserved differences between the model beneficiaries and the comparison group could have led to differences in outcomes, even if the model had no effect.[28] However, we matched on a wide array of observed characteristics to mitigate this risk. Further, our sensitivity analyses suggest such differences in beneficiaries' characteristics would have to be substantial to *fully* explain differences in their outcomes. Selection bias might have affected our estimates to some degree, but substantial differences between the intervention and comparison groups, on variables strongly related to outcomes, would have to remain after matching for us to estimate such large differences in outcomes if the model truly had no effect. To us, this seems unlikely. (In almost all cases, these hypothetical unobserved characteristics would have to relate more strongly to outcomes than any of the baseline characteristics included in our regression models. In addition, for these unobserved characteristics to account for the differences in the outcomes, they must have comprised different proportions of the intervention and comparison groups, which suggests they were not correlated with observed characteristics used in matching.) Nonetheless, we plan to continue exploring ways to better understand whether unobserved differences between the two groups could bias the impact estimates.

A challenge to constructing the comparison group was to narrow the pool of potential comparison beneficiaries to those who met MCCM's beneficiary eligibility criterion of having a certifiable prognosis of six months or less to live. There was no certification of six-month prognoses for comparison beneficiaries, so we used a decedents approach, which limited the pool of comparison beneficiaries to those who died. Intuitively, we used actual dates of death to determine the period when each comparison beneficiary would have been certified as having a prognosis of less than six months to live (implicitly assuming health care providers can accurately judge such prognoses). A unique advantage of the decedents approach is that we can ensure the distribution of the length of follow-up—the time from enrollment to death, or survival time—was similar between the model and comparison groups.[29] If the length of follow-up were to have different distributions between the intervention and comparison groups, we would expect average outcomes to differ between the two groups as well, biasing impact estimates. An important downside of the decedents approach is we did not measure impacts among all enrollees; in this approach, we restricted the analysis sample to model enrollees who had died at the time of data collection (1,035 enrollees were excluded for this reason). The timing of our next report will allow for a longer follow-up period, letting us include more enrollees and making this a less important limitation.

[28] Hospices were randomized into two cohorts at the start of the model. Participating hospices in Cohort 1 and Cohort 2 implemented the model in January 2016 and January 2018, respectively. However, we could not make use of this design in the evaluation because (1) enrollment in MCCM was low and (2) Cohort 2 hospices did not collect data during the first years of the model.

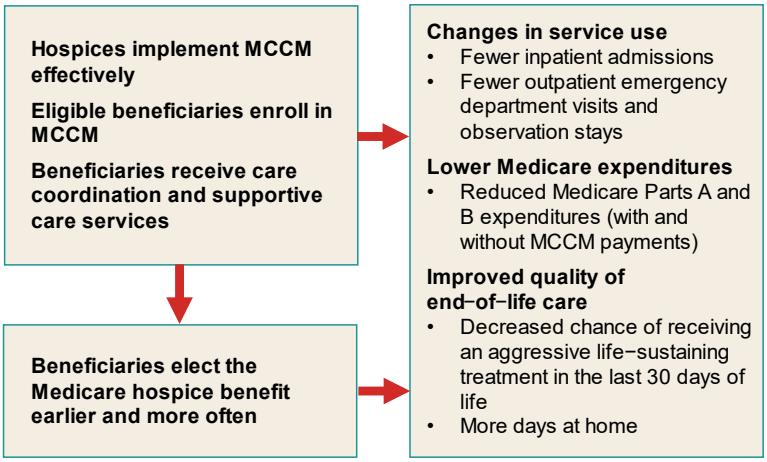
[29] Because we know when each comparison beneficiary died, we could count backward to establish pseudo-enrollment dates for each comparison beneficiary and match in a way that ensured balance on survival times between model enrollees and comparison beneficiaries. After using sophisticated matching techniques to achieve tight balance on survival times, we could measure beneficiaries' outcomes from their enrollment dates (or pseudo-enrollment dates) until death for all beneficiaries and conduct impact analyses. In this way, we would measure outcomes over (virtually) the same length of time for model enrollees and their matched comparisons. Because of this, the decedents approach cannot estimate potential effects of the model on time until death or any indirect effects on other outcomes that operate through changes in survival.

Our results agree, in part, with the previous MCCM evaluation contractor's assessment that the model increased hospice care use and achieved Medicare savings (Abt Associates 2020b). Although both analyses indicate the model produced large, statistically significant, and policy-relevant effects, we found smaller Medicare savings and reductions in hospital service use than were previously reported.[30] Our methods differed from the prior evaluation in several ways, and any of these methodological differences could have led to different results. Notably, we explicitly aimed to select a comparison group that better resembled MCCM enrollees according to many baseline characteristics, including patterns of service use in the period before enrollment and survival times. In doing so, we potentially mitigated selection bias to a greater degree, resulting in smaller (though still substantial) estimates of the model's effects on Medicare expenditures and service use. In addition, our sensitivity analysis helps increase our confidence the model had *some* impact on these outcomes in the expected direction even if, perhaps, true impacts were not quite as large as we estimated.

Although our results are promising, they might not generalize from MCCM to other hospice providers or beneficiaries. A limited number of hospices volunteered to participate in MCCM, with only five hospices enrolling about half the beneficiaries. Further, the 4,574 beneficiaries included in our analyses represent a small percentage of the 1.8 million or more beneficiaries who, according to Medicare claims and enrollment data, lived near a participating hospice during model implementation and satisfied the model eligibility criteria but were neither referred to the model nor enrolled. The enrollees were also notably different from nonparticipating beneficiaries before matching, more often having cancer and high rates of Medicare expenditures and service use before enrollment. Voluntary selection into the model by hospices and beneficiaries limits the generalizability of the evaluation findings to a broader population of Medicare beneficiaries with less than six months to live (in addition to raising concerns about selection bias noted before).

C. Relevance beyond the Medicare Care Choices Model

Despite limited participation, MCCM offers several important lessons for Medicare policymaking. Some very ill Medicare beneficiaries at the end of life will accept palliative care services if they do not have to forgo payment for treatment of their terminal conditions. Among the eligible beneficiaries referred to the model, about two-thirds (64 percent) chose to enroll in the model over other available options. Most model enrollees (83 percent) subsequently made the decision to switch from the model into hospice before the end of life, which involved forgoing payment for treatment of their terminal conditions. Enrollees also tended to make this decision to enroll in hospice earlier than those in the comparison group, thus potentially benefiting from more days in hospice.



[30] The previous evaluation did not report impacts on claims-based quality measures. Both approaches found similar, 18 to 20 percent effects of MCCM on the percentage of beneficiaries who elected the Medicare hospice benefit.

Gaining experience with palliative care through MCCM possibly helped with beneficiaries' decision process.

Although their paths varied, MCCM beneficiaries and their caregivers ultimately appeared to have received better-quality end-of-life care according to established quality measures, such as spending more days at home at the end of life. Moreover, because we found increased hospice use accounted for substantial savings, this evaluation suggests efforts to increase exposure to palliative care options and reduce barriers to hospice enrollment could be a promising approach for achieving Medicare savings. But some of MCCM's impact on Medicare expenditures and rates of service use came through channels other than increased hospice use; the model also reduced expenditures and rates of service use while beneficiaries were enrolled in the model. That is, MCCM had more substantial effects than solely acting as a gateway into hospice. Given the extent to which effects of the model were driven by increases in hospice use among model enrollees, this analysis might have broader implications about the association between Medicare hospice benefit and the quality of life, Medicare expenditures, and service use for terminally ill Medicare beneficiaries.

D. Next steps

We plan to conduct and report several additional analyses in the upcoming year. Given the timing of this report, we have thus far focused on beneficiaries enrolled in the model through September 30, 2020, and we measured outcomes through March 31, 2021 (for beneficiaries who died before April 1, 2021). In our next report, we plan to include the entire enrolled period through June 30, 2021, and measure outcomes for the entire scheduled duration of the model (from January 1, 2016, to December 31, 2021) and more fully explore potential heterogeneity of impacts across subgroups of enrollees. The final report will include a qualitative analysis of exemplar hospice interviews and hospice exit interviews and quantitative analysis of MCCM program data to obtain additional insights and verify details necessary for interpreting impact estimates, and synthesize qualitative and quantitative findings to identify model, hospice, and market characteristics associated with successful model performance and outcomes.

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Appendix A:

Technical Appendix

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This appendix provides an overview of the evaluation approach, a detailed description of how we constructed the analytic files and measures used in the analysis, and a description of the statistical methods we used.

A. Overview of the impact evaluation approach

The goal of our impact analyses was to determine whether the Medicare Care Choices Model (MCCM) decreased service use and Medicare fee-for-service expenditures, increased frequency or earlier timing of electing the Medicare hospice benefit, or improved quality of care and experiences of care at the end of life among enrolled beneficiaries. We used claims data to measure a range of claims-based outcomes from date of MCCM enrollment until death, and then we estimate impacts of the model—overall and for key subgroups. The impact evaluation used a matched comparison group evaluation design. Specifically, we measured differences in outcomes between beneficiaries enrolled in MCCM and a matched comparison group of beneficiaries who (1) lived in the market area of a hospice participating in MCCM; (2) were not referred to or enrolled in MCCM; (3) satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data, and (4) resembled MCCM enrollees in terms of prognosis (expected length of life), prior experience of care, and other observed characteristics.[31] We designed this comparison group to provide a counterfactual of beneficiaries' outcomes had they not enrolled in MCCM and, thus, received usual care or received the Medicare hospice benefit. Regression models, described later in this appendix, improve the precision of the estimates, and adjust for observed differences between MCCM beneficiaries and the matched comparison group (that is, they control for residual differences that remain after matching). In future reports, robustness analyses will test the sensitivity of the impact estimates to core evaluation design decisions.

We drew comparison beneficiaries from the regions served by MCCM hospices. A careful comparison group selection approach provides both the rigor to estimate impacts of MCCM and, as we describe later, the flexibility to examine impacts under alternative definitions of the beneficiary study population. The benefit of the internal comparison areas is that it limits the risk that regional differences unrelated to true model impacts might drive the impact estimates. This was especially important in 2020 and 2021, when the COVID-19 pandemic might have had different effects in different parts of the country. Drawing comparison regions from the same areas as MCCM beneficiaries introduces the potential for either beneficiary selection or spillover to affect the impact estimates, but we think these concerns are minimal considering the enrollment rates.[32] Low MCCM enrollment rates among eligible beneficiaries suggest (1) that selection bias would be similar regardless of whether we matched to non-enrolled beneficiaries from within or outside of areas served by MCCM hospices and (2) that spillover will be negligible.

A primary challenge to constructing the comparison group was to narrow the pool of potential comparison beneficiaries to those who met all MCCM eligibility criteria—mainly to limit the sample to those with a certifiable prognosis of six months or less to live. Beneficiaries' prognoses were not

[31] The following eligibility criteria were not directly observable in CMS administrative data: (1) 6-month prognosis, which requires clinical judgement, and (2) residing in a traditional home and not a long-term care or assisted living facility.

[32] For the period covered by this report, we observed referrals to MCCM for 9,981 eligible beneficiaries, of whom 6,427 (64 percent) enrolled in MCCM. (See Chapter II, Figure II.1 in this report.) As a point of comparison, our potential comparison group (described below in Section B.4) included 1,776,459 unique beneficiaries who lived in the market areas of MCCM hospices and met MCCM eligibility criteria we can observe in Medicare claims and enrollment data. This latter figure suggests that less than 0.5 percent of eligible beneficiaries in these markets were referred to MCCM and less than 0.3 percent were enrolled.

universally assessed and reported in extant data sources. The prior evaluation contractor, Abt Associates, limited the pool of comparison beneficiaries to those who died (Abt Associates 2020a, 2020b), an approach that implicitly assumes health care providers accurately judge a beneficiary's prognosis. That is, the approach used actual dates of death to determine the period in which each beneficiary would have been certified as having a prognosis of less than six months to live. To align with the previous evaluation design, we also used this decedent analysis approach in this report, with some important methodological changes. In the decedent approach, we measured regression-adjusted differences in outcomes between (1) beneficiaries who died and were enrolled in MCCM and (2) a matched comparison group of beneficiaries who died; were not enrolled in or referred to MCCM; lived in the market area of a hospice participating in MCCM; satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data (see footnote 31); and otherwise appeared similar to MCCM enrollees on health status, prior experience of care, and other observed baseline characteristics. A unique advantage of the decedents approach is that we can ensure the distribution of the length of follow-up—the time from enrollment to death, or survival time—was similar between MCCM and comparison groups. Because we know when each comparison beneficiary died, we can count backward to establish pseudo-enrollment dates for each comparison beneficiary and match in a way that ensured balance on survival times between intervention and comparison beneficiaries. If the length of follow-up were to have different distributions between the intervention and comparison groups, we would expect mean outcomes to differ between the two groups as well, biasing impact estimates.

Because comparison beneficiaries did not enroll in the model or the evaluation, we had to determine, for each matched comparison beneficiary, when to begin measuring outcomes—a *pseudo-enrollment* date. We considered multiple potential pseudo-enrollment dates for each beneficiary, and then we picked the best available pseudo-enrollment date using a novel matching technique named `GroupMatch` that originated at Mathematica (Pimentel et al. 2019). `GroupMatch` allowed us to use variable-ratio optimal matching and select just one observation—the best pseudo-enrollment date—per comparison beneficiary. We used various matching techniques (discussed more in Section C of this appendix) to ensure intervention beneficiaries and their matched comparison beneficiaries had the same qualifying conditions, lived in the same areas, and (as mentioned above) had the same length of time between enrollment (or pseudo-enrollment) and death.

B. Analytic file construction

In this section, we describe how we constructed the analytic files for the decedents' analysis. We start with a short overview of the sources of data used and then describe the approaches to identifying the beneficiaries we included in the intervention and potential comparison groups. We also provide detailed descriptions of the variables we constructed and included in the analytic files.

1. Data sources

The data sources used in the file construction include MCCM program data; Medicare fee-for-service claims and enrollment data; other Medicare data sets; and publicly available data.

a. MCCM program data

MCCM program data (also known as portal data) included information about participating hospices, their beneficiaries, and model services. We obtained these data monthly from The Lewin Group, the implementation contractor. These data are based on four forms:

1. *The Hospice Information Form,* which includes contact information, identification numbers, and MCCM personnel information for participating hospices.
2. *The Patient Baseline Information Form,* which includes information about all beneficiaries referred to MCCM, such as beneficiary demographics and characteristics, information about the referring provider, and information about baseline beneficiary assessments.[33] The Patient Baseline Information form is submitted after the beneficiary has been referred and deemed eligible, and generally is done at an intake visit.
3. *The Service and Activity Log,* which tracks services provided to MCCM beneficiaries and changes to beneficiaries' living situations, changes in health status, and metrics associated with quality of care.
4. *The Patient Discharge Form,* which collects information about why an MCCM beneficiary might be transferred, discharged, or disenrolled from the model.

We list the types of information available from these files in Appendix Table A.1. Except where noted, Lewin collects these data from the hospices participating in MCCM. We used these data to report the number of referrals and enrollments as well as to help identify hospice market areas and to identify beneficiaries who were referred but not enrolled in order to exclude them from the comparison groups for the evaluation (as we describe later in this appendix). We expect to use more of this data in future reports (for example, for implementation analyses).

Table A.1. Type of information reported in the MCCM program data

Data domain	Type of information reported
Model participation and demographics	Referral outcomes Enrollment outcomes Disposition at discharge Age, gender, and race and ethnicity Qualifying diagnosis at enrollment
Model operations and service delivery	Recipient of service Type of encounter Communications barrier during encounter Mode of encounter Location of encounter Level of care Team member providing service Number of encounters by staff discipline and type of service
Status at most recent assessment	Presence of active caregiver Functional status Terminal status

[33] In the impact analyses, we relied on Medicare claims and enrollment data for information about beneficiaries' demographics and other characteristics so we could use the same data source for the intervention and comparison groups' beneficiaries. The information in Medicare and MCCM program data did not always align.

Data domain	Type of information reported
Quality	Pain screening and management Bowel regimen for opioid use Shortness of breath screening and treatment Psychological and emotional well-being screening and treatment Advance care planning discussions Spiritual and religious discussions
Other health care service use[a]	Emergency department visits Hospital admissions Concurrent home health use Concurrent inpatient rehabilitation use Concurrent skilled nursing facility use
Model fidelity	Completion of subsequent comprehensive assessments Completion of interdisciplinary group meetings

[a] Lewin adds the claims-based outcomes after hospices submit their data.

MCCM = Medicare Care Choices Model.

b. Medicare claims and enrollment data

We used Medicare Part A, B, and D claims and Medicare enrollment data as key inputs to our analytic files for the impact evaluation. These files enabled us to generate outcomes measures to estimate the impacts of the model (including measures of quality of care, service use, and Medicare fee-for-service expenditures) and to construct beneficiary-level covariates for matching, balance tests, and regression models. These files for the interim report span from 2014 (to accommodate constructing quality measures with two-year look-back periods for beneficiaries enrolled as early as January 1, 2016) to March 31, 2021, allowing for 90 days of run-out (in accordance with standard research practices).[34] We processed Medicare enrollment data from the Medicare Enrollment Database and Master Beneficiary Summary Files, and we processed Medicare Part A and B claims data from the Medicare fee-for-service Research Identifiable Files within the Chronic Conditions Warehouse Virtual Research Data Center and incorporated monthly updates into our analytic file. We also used Part D Characteristics, Denominator, and Event files as key inputs to our analytic files.[35] The Part D Event files are as current as Part A and B data files with 99 percent of pharmacy events available within three months of the service month. These data covered most, but not all, Medicare beneficiaries enrolled in a stand-alone prescription drug plan.

We also used software developed by the Centers for Medicare & Medicaid Services (CMS), coupled with International Classification of Diseases 9 and 10 diagnosis codes found in claims data, to assign hierarchical condition category flags and calculate hierarchical condition category scores. We used the Medicare Enrollment Database and the Master Beneficiary Summary File (by year) to extract information on beneficiaries, including (1) Medicare Part A, B, C, and D enrollment and termination dates, (2) residence state and zip code, (3) whether Medicare was the primary payer for a beneficiary's medical expenses, (4) reasons for entitlement, (5) Medicare–Medicaid dual eligibility, and (6) basic demographic information.

[34] We extracted in early July 2021, so we chose March 31, 2021, as a cutoff date to allow for at least 90 days of claims runout.

[35] In all, 77 percent of MCCM beneficiaries were enrolled in Medicare Part D the month they enrolled in MCCM.

MCCM hospices submitted claims to receive payment for model services. We used these data to identify the list of beneficiaries enrolled in MCCM when we constructed our beneficiary finder file (see details below). In addition, we used these data to measure Medicare payments for MCCM services and to construct measures of MCCM service receipt.

c. Other Medicare data sources

We supplemented claims and enrollment data with additional CMS data sets to obtain details on beneficiaries' participation in other Center for Medicare & Medicaid Innovation (CMMI) models, receipt of long-term care services, and difficulties with activities of daily living. We also used the Chronic Conditions Warehouse beneficiary crosswalk to link across different files.

- *Master Data Management.* This data set provides information on the enrollment of Medicare beneficiaries in CMMI models. Specifically, we used the Master Data Management to identify beneficiaries who were participating in certain CMMI models (see details in Appendix B, Exhibit B.2).
- *Minimum Data Set and Outcome and Assessment Information Set.* The Minimum Data Set collects information on all users of nursing facilities for quality purposes, and Outcome and Assessment Information Set does the same for all recipients of home health care. We used the 2015 to 2020 Minimum Data Set and Outcome and Assessment Information Set data to determine whether beneficiaries were likely living in a long-term care nursing setting or in an assisted living facility, respectively, at the time of enrollment (or pseudo-enrollment). We also used the Outcome and Assessment Information Set data to identify any recorded activities of daily living for beneficiaries within 30 days of their [pseudo-] enrollment date.
- *Chronic Conditions Warehouse Beneficiary Crosswalk Files.* We used the Chronic Conditions Warehouse beneficiary crosswalk files to link Medicare claims and enrollment data to other data sources. These crosswalk files link beneficiaries' Chronic Conditions Warehouse identification numbers to their Health Insurance Claim number, Social Security number, or Medicare Beneficiary Identifier. We used these identifiers to link various data on the Virtual Research Data Center and to link Medicare claims and enrollment data with MCCM program data.[36]

d. Publicly available data

The final data sets used were the American Community Survey, the Federal Office of Rural Health Policy, and the Dartmouth Atlas.

- *American Community Survey.* This ongoing survey is used to measure topics such as education and employment. We used the five-year American Community Survey files to identify characteristics of the zip codes where each beneficiary lived. We used the 2015 data (2011–2015) for Cohort 1 hospices, which started enrolling MCCM beneficiaries in 2016, and we used the 2017 data (2013–2017) for Cohort 2 hospices, which started enrolling MCCM beneficiaries in 2018. We accessed the data through the Agency for Healthcare Research and Quality's Social Determinants of Health data files.[37]

[36] MCCM program data did not always include Medicare identification numbers, so we used a "fuzzy matching" process that used Medicare beneficiary identification numbers when identifiers were available and valid; we used names, dates of birth, genders, and zip codes where identifiers were not available or not valid.
[37] https://www.ahrq.gov/sdoh/data-analytics/sdoh-data.html.

- *Federal Office of Rural Health Policy. The Federal Office of Rural Health Policy* data identify which areas of the country are defined as rural. We downloaded the rural zip code-level definitions of "rural" from the office's website.[38]
- *The Dartmouth Atlas. This* project aggregates Medicare and Medicaid data at the geographic level to provide information on national and regional health care markets. We downloaded data from the Dartmouth Atlas to identify the zip codes in each hospital referral region.[39] As we describe later, MCCM hospice market areas were defined as one or more hospital referral region where a hospice's enrollees commonly lived.

e. Evaluation data

The prior evaluation contractor, Abt Associates, constructed a data set that described all hospice agencies participating in the Medicare program. It used this file to construct a matched comparison group of hospices that resembled the hospices participating in MCCM. Abt Associates (2020a, 2020b) previously described the process for creating this data set and its contents. We merged this data set from Abt Associates with MCCM program data and then used the merged files to describe MCCM participants and compare them with non-participating hospices (see section G in this appendix).

2. Identifying MCCM enrollees

The study population for the decedents analysis in the interim report was first limited to 5,048 beneficiaries who enrolled in MCCM between January 1, 2016, and September 30, 2020, and who had a verified death date on or before March 31, 2021.[40] To be included in the intervention group, the beneficiary had to have at least one paid Medicare hospice claim with the associated MCCM demonstration identification number (73).[41] We assigned an MCCM enrollment date based on the earliest MCCM paid claim date.

Next, we restricted the intervention group to 4,574 beneficiaries who met the model eligibility criteria that we could assess using Medicare claims and enrollment data. We did this so that the same criteria would apply to both MCCM enrollees and the comparison group. Specifically, beneficiaries had to meet the following six criteria:

1. Have been enrolled in fee-for-service Medicare Part A and B as the primary payer for at least 12 consecutive months before MCCM enrollment

[38] https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html.
[39] https://data.dartmouthatlas.org/supplemental/.
[40] The March 2021 cutoff allows for up to six months of observability before death, and adequate claims runout per the requirements outlined in Section B.1.b above.
[41] Enrollees were screened for eligibility at the time of MCCM enrollment, and MCCM claims were later validated by the Medicare Administrative Contractor based on program eligibility standards. We initially considered using MCCM program data as a data source to identify MCCM enrollees, but ultimately decided on limiting the intervention group to those beneficiaries with positive paid MCCM claims to ensure that these beneficiaries were eligible and would continue receiving services. That is, we did not include beneficiaries who were enrolled in the model but did not receive any services according to MCCM claims data. Our understanding is that because the sites did not have the ability to verify all the information needed for enrollment, beneficiaries could be enrolled in the model but not have claims paid because the Medicare Administrative Contractor deemed the beneficiary was ineligible. Among 5,742 beneficiaries who were enrolled in the model (in MCCM program data) or had MCCM claims before October 1, 2020 (and died before April 1, 2021), there were 5,048 beneficiaries (88 percent) who had a MCCM claim with a positive payment amount.

2. Have had at least one claim with a primary diagnosis for one of the four MCCM-qualifying terminal conditions (cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS, using the definition from the MCCM Resource Manual) in claims for 12 months before enrollment[42]
3. Did not reside in an institutional setting for 30 days before enrollment [43]
4. Did not elect the Medicare hospice benefit (receive hospice benefits) within 30 days before enrollment
5. Had at least one hospital encounter (inpatient stay, observation stay, or emergency department visit) within 12 months before enrollment
6. Had at least 3 office visits within 12 months before enrollment.
7. Met more strict inclusion criteria applicable at time of enrollment (if applicable). During the first year, CMS also required enrollment in Medicare Part D and at least two hospital encounters (January 1, 2016, to March 31, 2016) and at least three office visits with the same provider for the MCCM-qualifying terminal condition (January 1, 2016, to December 31, 2016), but these stricter eligibility requirements were discontinued. We applied these criteria only in the periods where they were applicable.[44]

We could not verify life expectancy of six months or fewer. In Appendix B, Exhibit B.1, we provide details on how we defined each of these eligibility criteria; in Appendix Table A.2, we report the number of observations that we originally identified, the number excluded with each additional criterion, and the dollar value of the claims paid for MCCM services for each of these excluded groups.

3. Identifying MCCM hospices' market areas

Our process for identifying potential comparison beneficiaries required identifying a *geographic market area* for each MCCM hospice.[45] For each hospice, we identified a market area that consists of one or more hospital referral regions. These regions were defined in 1996 to represent regional health care markets for tertiary medical care (Dartmouth Atlas Project 2020a). We chose to define hospice market areas by hospital referral regions because they are small enough to capture local variation in patterns of end-of-life care (Dartmouth Atlas Project 2020b) but are still large enough to provide an adequate number of comparison beneficiaries to support our design.

[42] Appendix C, Table C.1 provides all the International Classification of Diseases 9 and 10 codes used to identify these conditions.
[43] The actual eligibility rule is that an individual must live in a regular home, with an exception for short skilled nursing facility stays. However, living in a regular home cannot be identified with available data. Instead, we excluded beneficiaries that resided in an institutional setting. See Appendix B, Exhibit B.1 for additional details.
[44] During the COVID-19 pandemic, CMS broadened access to telehealth services, and telehealth encounters were counted in determining MCCM eligibility. We included telehealth visit procedure codes in our measure of total office visits after March 6, 2020 (when the change in the eligibility criterion occurred).
[45] Our impact analyses focused on beneficiaries enrolled in MCCM, so hospices needed to enroll at least one beneficiary in MCCM to be included in the impact analyses. We were not able to, but did not need to, identify market areas for the participating hospices that enrolled zero beneficiaries.

Table A.2. Sample sizes for report after sequentially applying model inclusion criteria using claims

#	Criteria	Number of beneficiaries		CMS payments for MCCM claims ($)	
		Excluded	Remaining	Excluded	Remaining
—	Beneficiaries who had MCCM services before October 1, 2020, and died before April 1, 2021	—	5,048	—	$9,553,360
1	Exclude beneficiaries who were not fully observable during the baseline period	50	4,998	$70,408	$9,482,952
2	Exclude beneficiaries without one of the four MCCM qualifying conditions	136	4,862	$304,048	$9,178,904
3	Exclude beneficiaries residing in an institutional setting	117	4,745	$287,924	$8,890,980
4	Exclude beneficiaries receiving hospice benefits	1	4,744	$588	$8,890,392
5	Exclude beneficiaries without a hospital encounter	37	4,707	$68,364	$8,822,028
6	Exclude beneficiaries without three office visits	15	4,692	$31,780	$8,790,248
7	Exclude beneficiaries who did not meet more strict inclusion criteria applicable at time of enrollment	118	**4,574**	$435,444	**$8,354,804**

Note: Bolded green text indicates the final sample and final payments included.

MCCM = Medicare Care Choices Model

Three factors influence whether any particular hospital referral region is included in the market area for a given hospice: (1) the geographic location of the hospital referral region relative to the hospital referral region of the hospice, (2) the zip code of residence of all beneficiaries who filed claims at the hospice, and (3) the zip code of residence for beneficiaries enrolled in MCCM by the hospice. More specifically, we defined the market area for any hospice to include all hospital referral regions that meet **any** of the following criteria:

1. The hospice was physically located in the hospital referral region
2. Among beneficiaries who received hospice services from the hospice (regardless of participation in MCCM), at least 25 percent had a zip code of residence in the hospital referral region and the region was adjacent to the hospital referral region where the hospice was physically located
3. At least 25 percent of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence in the hospital referral region
4. At least 10 percent of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence if the 10 percent number constitutes at least 5 beneficiaries
5. At least 10 of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence in the hospital referral region

To implement the first two criteria, we reviewed all Medicare fee-for-service hospice claims submitted by the hospice during the year before model implementation (2015 for Cohort 1 hospices and 2017 for Cohort 2 hospices) and assigned the hospice to an hospital referral region based on the facility zip code

recorded on their claims.[46] Next, we assigned each Medicare fee-for-service beneficiary in the hospice's claims to a single hospital referral region based on the beneficiary's zip code of residence recorded on the hospice claims, then counted the number of beneficiaries served by the hospice who were from each hospital referral region.[47] We used files provided by the Dartmouth Atlas (Dartmouth Atlas Project 2020a) to map all zip codes to hospital referral regions and to identify neighboring (adjacent) hospital referral regions. Finally, for each hospice, we determined the proportion of beneficiaries who live in each hospital referral region and selected all hospital referral regions that meet the 25 percent threshold.

The last three criteria were based on enrolled MCCM beneficiaries. We identified all enrolled beneficiaries (through September 2020) and their zip codes from the MCCM program data and mapped the beneficiaries' zip codes to a hospital referral region using the Dartmouth Atlas. For each hospice, we then determined the total number of beneficiaries that live in each hospital referral region and identified the regions that met any of the three criteria.

In the end, we were able to identify a market area for each MCCM hospice: we identified a total of 101 unique hospital referral regions as the market areas for the 89 hospices that enrolled at least one beneficiary in MCCM. Sixty-two hospices (70 percent) had a market area comprising a single hospital referral region—the region where the hospice was physically located—and the remaining 27 hospices (30 percent) had a market area that included two or more hospital referral regions (Appendix Table A.3).

Table A.3. Hospice market area sizes

Number of hospital referral regions in the hospice's market area	Number of hospices (hospice market areas)	Percentage of hospices
1	62	70
2	20	22
3	5	6
4	1	1
9	1[a]	1

Note: This analysis reports the number of hospital referral regions that constitute a hospice market area. It includes the 89 hospices that enrolled one or more beneficiaries in MCCM.

[a] This market area corresponds to the hospice JourneyCare in Barrington, Illinois, a town which is close to a relatively large number of small hospital referral regions. The hospice eventually withdrew from MCCM.

MCCM = Medicare Care Choices Model.

[46] After the hospice's facility zip code on each claim was mapped to a hospital referral region using the Dartmouth Atlas, we selected the hospital referral region that was recoded most often among the hospice's claims. If two hospital referral regions were recorded the same number of times, we chose the one recorded most recently.

[47] For cases where the beneficiary had multiple hospice claims and the zip codes of residence on these claims indicated the beneficiary lived in more than one hospital referral region, we assigned the beneficiary to a single region, selecting the hospital referral region corresponding to the most days of service.

There was some overlap in the market areas of the MCCM hospices. Specifically, among all hospital referral regions that were selected as belonging to a hospice's market area, 24 percent of the time the hospital referral region was in the market area of two or three different hospices (Appendix Table A.4). There were a few beneficiaries enrolled in MCCM who lived outside the hospital referral regions that we selected as the market areas of the MCCM hospices, but this was rare.[48]

Table A.4. Overlap of hospice market areas

Number of hospices whose market area includes the hospital referral region	Number of hospital referral regions	Percentage of hospital referral regions
1	77	76
2	19	19
3	5	5

Note: This analysis includes the 101 hospital referral regions that were selected as belonging to the market area of one or more hospices.

4. Identifying potential comparison beneficiaries (decedent analyses)

We identified potential comparison beneficiaries from among fee-for-service Medicare beneficiaries who lived in the MCCM hospices' market area, met the MCCM eligibility criteria observable in Medicare claims and enrollment data, and subsequently died between January 1, 2016, and March 31, 2021 (the end of the analysis period). From the potential comparison pool, we removed any beneficiaries who were (1) ever enrolled in MCCM or (2) ever referred to MCCM (according to MCCM program data) but did not enroll.

To identify the potential comparison beneficiary pool, we took the following steps. First, we identified the set of potential comparison beneficiaries who died between January 1, 2016, and March 31, 2021. We then excluded those beneficiaries who never lived in any of the MCCM hospice market areas during the potential pseudo-enrollment period (January 1, 2016, to September 30, 2020) or who did not have a claim with an MCCM qualifying diagnoses during the potential baseline period (January 1, 2015, to September 30, 2020) or were referred or enrolled in MCCM (according to MCCM program data and Medicare claims).

For each remaining potential comparison beneficiary, we created 29 potential pseudo-enrollment dates which were then used to construct time-varying eligibility measures, such as the number of office visits in the 12 months before the pseudo-enrollment date. To assign pseudo-enrollment dates, we calculated the empirical distribution of survival times (in days) for the intervention group and then used this distribution to assign 29 different possible survival times for each potential comparison beneficiary.[49] To ensure that

[48] The market areas we selected included the hospital referral region of 6,407 of the 6,531 MCCM beneficiaries, or 98 percent. Here, 6,531 is total number of beneficiary-hospice records in MCCM as of November 2020. The final impact analysis, which excludes beneficiaries for various reasons (see Appendix Table A.2), is based on 4,038 MCCM enrollees.

[49] Specifically, we observed the survival times for MCCM enrollees in our analysis sample (see the previous section) and measured the distribution in the following increments: minimum, 1st percentile, 2nd percentile, 3rd percentile, 4th percentile, 5th percentile, 7.5th percentile, 10th percentile, 12.5th percentile, 15th percentile, 17.5th percentile, 20th percentile, 22.5th percentile, 25th percentile, 27.5th percentile, 30th percentile, 35th percentile, 40th percentile, 45th percentile, …, 90th percentile, 95th percentile, and maximum. Next, we created 29 copies of each potential comparison beneficiary. Each copy was assigned a survival time: for the first copy, we randomly drew a

we had copies of each comparison beneficiary with short and long survival times, we used stratified random draws so that one observation falls in each stratum. Thus, we created 29 "copies" for each eligible beneficiary (that is, 29 observations of the same individual, same date of death, and a unique pseudo-enrollment date).

Finally, we assessed whether the beneficiary met our inclusion criteria on their pseudo-enrollment date, keeping only the copies where the pseudo-enrollment date fell between January 1, 2016, and September 30, 2020, and where the beneficiary met the inclusion criteria on the pseudo-enrollment date. Inclusion criteria included requiring the beneficiary to have died before April 1, 2021; lived in one of the hospice market areas on their pseudo-enrollment date; and met MCCM eligibility criteria on their pseudo-enrollment date (as best we can determine using claims and enrollment data, per the criteria described in Section B.2 of this appendix.) That is, we applied the time-varying eligibility criteria to each person/enrollment date combination and excluded any copy that did not meet the criteria.

The potential comparison group comprised 1,782,555 unique beneficiaries, with 1 to 29 potential pseudo-enrollment dates available for each beneficiary. In total, there were 22,677,915 potential comparison observations that met our inclusion criteria. We then removed a relatively small number of potential comparison observations (about 1 percent) that had outlier values for one or more matching variables and could not possibly be good matches for any intervention beneficiary. This left a final sample of 22,367,931 potential comparison observations for 1,776,459 unique beneficiaries (12.6 observations per unique beneficiary on average) to use in matching.

5. Constructing baseline measures to use in matching and as control variables

To conduct propensity score matching, we constructed the following kinds of variables:

- Demographic and insurance characteristics, which include beneficiaries' age, sex, race, Medicaid status, and characteristics of their local area (such as average income)
- Prior health care use, which includes beneficiaries' use of health care services such as hospitalizations, emergency department, and Part B drug use over the prior year
- Health at enrollment, which includes beneficiaries' qualifying MCCM diagnosis, hierarchical condition category score at enrollment, and hierarchical condition category score in the year prior to enrollment
- Disease-specific measures, which include measures specific to the MCCM qualifying diagnosis

The details of these variables are available in Appendix B, Exhibit B.2, including each variable's data source. (We always used the same data source for both intervention and potential comparison beneficiaries when constructing variables.)

Two categories of matching variables consisted of many potentially correlated predictors: binary hierarchical condition category flags (61 variables) and county-level demographic variables (11 variables). Including all 72 of these variables in the propensity score model could have negatively impacted the balance on other matching variables. To reduce this likelihood while still achieving adequate

survival time between the minimum and 1st percentile; for the second copy, we randomly drew a survival time between the 1st and 2nd percentile; for the third copy, we randomly drew a survival time between the 2nd and 3rd percentile; and so on. Finally, for each potential comparison copy, we set the pseudo-enrollment date equal to their date of death minus the survival time. Using this procedure, MCCM enrollees' and the potential comparison group beneficiaries' distributions of survival times were reasonably balanced before matching.

balance on each variable, we conducted a principal component analysis for the two sets of variables. Then we included the principal component scores in the propensity score model instead of using all 72 indicator variables in matching. Principal component analysis is a common dimension-reduction technique that can be used to represent the most important patterns in a set of covariates, using as few variables as possible. By matching on the principal component scores, we aimed to achieve balance on the underlying variables, without having to include dozens of additional covariates in the propensity score model.

We fit each model using only the intervention beneficiaries because our goal was to match the patterns in the intervention group. We selected the number of principal component scores to include in the final models based on the percentage of the total variance explained for each additional principal component. Our propensity score models included six principal components corresponding to hierarchical condition category flags and two corresponding to county-level demographics. Because hierarchical condition category flags are all binary, we used a specialized version of principal components analysis designed for binary data (Landgraf and Lee, 2015); for county-level demographics, we used standard principal components analysis designed for continuous measures.

6. Constructing outcome measures

Once we identified the comparison group, we constructed the following outcomes measures. These measures fall into four groups:

1. *Expenditures*. We measured total Medicare fee-for-service Part A and B expenditures, with and without MCCM payments, as well as expenditures stratified by type of service (including inpatient, hospice, skilled nursing facility, home health, Part B drugs, and others).
2. *Service use*. We measured the number of inpatient admissions and length of stay (both within and outside of the intensive care unit), 30-day readmissions, number of ambulance transports, and number of emergency department visits.
3. *Hospice-related measures.* We measured admission to hospice, the length of time until beneficiaries elect the Medicare hospice benefit, the number of days in hospice care, and admission to hospice less than three days before death.
4. *Quality measures of end-of-life care*. We measured receipt of an aggressive life-prolonging treatment in the last 30 days of life; days at home; emergency department visits, hospitalizations, and intensive care unit admissions in the last 30 days of life; receipt of advance care planning; and rate of death in the hospital.

Appendix B, Exhibit B.3 provides the details on how we constructed these variables.

C. Identifying the matched comparison beneficiaries

1. Matching process

To select matched comparison beneficiaries and their associated pseudo-enrollment dates, we used a matching technique called `GroupMatch` (Pimentel et al. 2019). `GroupMatch` is a propensity score matching procedure designed for situations in which the intervention group is enrolled into a model on a rolling basis, and there is no corresponding enrollment date for members of the comparison group. The key innovation of `GroupMatch` is that the model considers many potential pseudo-enrollment dates for each potential comparison beneficiary, while simultaneously imposing restrictions such that at most one version of each potential comparison is selected for the final match. We implemented this algorithm in

such a way that each potential comparison beneficiary is selected as a comparison beneficiary (exactly) once or not at all. An optimal matching algorithm determines the resulting matched comparison group, including the choice of pseudo-enrollment date for each member. We used exact matching and calipers to make sure intervention and comparison beneficiaries matched closely on key matching variables, as described in more detail below.

We favored `GroupMatch`, and more generally the optimal matching algorithm that it extends (Hansen 2006), based on its advantageous theoretical properties and Mathematica's track record using optimal matching to produce well-matched comparison groups for previous evaluations. By considering many potential pseudo-enrollment dates for each potential comparison beneficiary, `GroupMatch` can identify a comparison group that more closely resembles the intervention group than alternative approaches that choose a fixed pseudo-enrollment date per beneficiary. Each potential comparison beneficiary is used exactly once (with their corresponding optimized pseudo-enrollment date) or not at all.[50] At the same time, by using variable-ratio matching (where the number of comparisons assigned to each intervention beneficiary can vary), we make the best possible use of our comparison pool: we select more comparisons for intervention beneficiaries with many high-quality matches and fewer comparisons for intervention beneficiaries with few high-quality matches. We allowed one to three comparison beneficiaries to match to each intervention beneficiary.

Propensity scores. As in optimal matching (Hansen 2006), `GroupMatch` assigns matches that minimize the difference in propensity scores between the MCCM and comparison groups.[51] The propensity score summarizes the beneficiary's characteristics in a single value; by matching the MCCM and comparison groups' propensity score distributions, we can theoretically expect the two groups to have similar covariate distributions (Rosenbaum and Rubin 1983; Rosenbaum 1989; Stuart 2020). After an initial round of matching, we manually added a few select interaction terms into the model to improve balance on particular matching variables that were not initially well-balanced within subgroups.

For this evaluation, we estimated propensity scores separately for each of the six qualifying condition groups listed in Appendix Table A.5. Estimating propensity score models for the six groups had two advantages. First, it allowed the relationship between the matching variables and MCCM participation to vary across groups. For example, it allowed any particular variable to be more or less strongly associated with MCCM participation among beneficiaries with cancer compared to the association among beneficiaries with congestive heart failure. Second, separating the propensity score models let us tailor the

[50] This is the key innovation in the `GroupMatch` algorithm, which grew out of the need to apply this restriction on other evaluations with rolling enrollment. Allowing each potential comparison to take on different pseudo-enrollment dates avoids the arbitrariness of selecting a single date at random but introduces the challenge of accounting correctly for correlation between two pseudo-enrollment dates for the same comparison if both are selected. To solve this problem, `GroupMatch` takes as input the beneficiary ID number, which it uses to ensure that at most one version of a beneficiary is matched.

[51] The `GroupMatch` algorithm extends the optimal matching approach in the `optmatch` package in R as implemented by Ben Hansen and coauthors. The main difference between `GroupMatch` and `optmatch` is precisely the feature mentioned in the previous footnote 50: `GroupMatch` allows us to give the algorithm more than one copy of each potential comparison beneficiary and subsequently constrains the algorithm to pick only one copy in the matched comparison group. Otherwise `GroupMatch` solves the same optimization problem as `optmatch` and requires that the solution meets the same constrains (for example, for this analysis, we required that the solution include no more than three comparison beneficiaries for each intervention beneficiary). The main input to the `optmatch` package is a large matrix containing the distances between each intervention and potential comparison beneficiary (of the difference in propensity scores between two beneficiaries). This distance matrix can be manipulated before matching using all our usual matching tricks (including exact matching, calipers, and penalties).

variables included to those that are most salient for each set of diagnoses. Specifically, the propensity score models contained a set of core matching variables common to each diagnosis group, plus additional variables specific to the diagnosis group. For example, in the cancer-only diagnosis group, we included indicators for cancer type (such as breast, colorectal, and lung) in addition to the core matching variables. Appendix Table A.6 categorizes the variables, identifying those used in matching across diagnosis groupings and those specific to one or more diagnoses. Because only 20 intervention beneficiaries were in Group 6, we were able to use only the most important matching variables for that group.

Table A.5. Qualifying condition groupings used to estimate propensity scores

Group	Qualifying condition combinations included	Number of MCCM enrollees in the group
1	Cancer	2,003
2	Cancer and COPD	1,272
	Cancer and CHF	
	Cancer and COPD and CHF	
3	CHF	562
4	COPD	266
5	COPD and CHF	451
6	HIV/AIDS	20
	HIV/AIDS and cancer	
	HIV/AIDS and cancer and COPD	
	HIV/AIDS and cancer and CHF	
	HIV/AIDS and COPD	
	HIV/AIDS and COPD and CHF	

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; MCCM = Medicare Care Choices Model.

Matching constraints. We placed several constraints on the matching algorithm to ensure that certain key covariates are well-balanced between the intervention and comparison groups. These constraints fall into three categories:

1. *Exact matching*. Exact matching is the strictest constraint applied to the matching algorithm and is appropriate for binary or categorical variables. For variables with exact matching constraints, we required matched comparison beneficiaries to have the same value as that of the intervention beneficiary. We matched exactly on the beneficiary's qualifying condition group (from Appendix Table A.5), as well as hospice market area; whether the beneficiary's (pseudo-) enrollment date occurred before September 1, 2019 (about six months before the COVID-19 pandemic began); and the beneficiary's dual eligibility status.[52]
2. *Strict calipers*. A caliper is a constraint that is appropriate for continuous variables. Whereas exact matching requires matched comparisons to have the same value of a variable as the intervention beneficiary, a caliper restricts the matched comparisons to have a value of the variable within a small window around the value of the intervention beneficiary. For example, we placed calipers on both the

[52] An added benefit of exact matching was that we could run the optimal matching algorithm separately for subgroups of beneficiaries, decreasing computation time.

survival time and (pseudo-) enrollment date variables to ensure that intervention and matched comparison beneficiaries have similar survival times and were enrolled around the same date.[53]

3. *Penalized calipers*. Like the strict calipers described above, a penalized caliper defines a small window around the intervention beneficiary's value of a certain variable. However, instead of not allowing potential comparisons to match to the intervention beneficiary if their value of the variable falls outside the window, a penalized caliper imposes a penalty on these potential comparisons—making them less likely to match. A penalized caliper can also serve as an alternative to exact matching on a binary or categorical variable; in this case, rather than removing potential comparisons from consideration if they do not have the same value of the variable as the intervention beneficiary, we penalize the match. This type of constraint is appropriate for cases when a strict caliper may be overly restrictive, leaving some intervention beneficiaries without any potential comparisons that meet all the matching criteria. We applied penalized calipers to both categorical variables (such as hospital referral region) and continuous variables (such as the number of days between hospital admission and enrollment).[54]

In some cases, we applied more than one of these constraints on the same variable. For example, for any given matched set, we placed the following restrictions on enrollment date: (1) we did not allow any matches with enrollment dates more than one year apart, (2) we penalized any potential matches that are more than six months apart (so matches more than six months apart are very rare), and (3) we had even tighter restrictions on beneficiaries enrolled during COVID.

2. Results of propensity score matching and final analysis number of observations

Our matching approach proved feasible, and we successfully identified matched comparison beneficiaries for each of the 4,574 MCCM enrollees. Specifically, 4,480 MCCM enrollees (97.9 percent) were matched to 3 comparison beneficiaries, 41 (0.9 percent) were matched to 2 comparison beneficiaries, and 53 (1.2 percent) were matched to 1 comparison beneficiary.[55] Across the matched sets, there are 13,575 unique matched comparison beneficiaries in total, or an average ratio of 2.97 comparison beneficiaries per intervention beneficiary.

Each matched comparison beneficiary was given a single pseudo-enrollment date through the methods described earlier. Pseudo-enrollment dates for matched comparison beneficiaries were broadly the same as the enrollment dates for MCCM enrollees, with similar percentages of beneficiaries in each group enrolling per year. At their pseudo-enrollment date, the matched comparison beneficiaries always resided in the market area of the hospice that enrolled the intervention beneficiary in MCCM. Because some MCCM hospices had market areas with more than one hospital referral region, 82 percent of the comparison beneficiaries lived in the same hospital referral region.

[53] For beneficiaries with shorter survival times, we matched closely on survival time. For beneficiaries in the right tail of the distribution (longer time between MCCM enrollment and death) where survival times are more dispersed, we allowed for wider calipers.

[54] As discussed earlier, beneficiaries included in our analysis were eligible for the model at their enrollment or pseudo-enrollment, as best we can determine from claims. Model eligibility requirements changed over time, and we accounted for this in matching using calipers that required matched comparison beneficiaries to meet, at a minimum, all the same eligibility criteria that MCCM participant met.

[55] MCCM participants were slightly less likely to be matched to three comparison beneficiaries if they (1) had HIV/AIDS or (2) had cancer only (that is, cancer without congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS).

In Appendix Table A.6, we present descriptive statistics for each of the baseline characteristics (matching variables) for MCCM enrollees, the potential comparison group before matching, and the matched comparison group. The standardized difference column in the table presents the difference between MCCM enrollees and matched comparison beneficiaries after matching, expressed in standard deviation units. (In a private memo to CMS, we also showed that we achieved balance on a number of other baseline characteristics that we had not included in matching. Those covariates are omitted from Table A.6 for the sake of brevity.)

Table A.6. Matching variables and characteristics of deceased MCCM enrollees and comparison beneficiaries, before and after matching

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 1,776,459 unique beneficiaries)	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)	Standardized difference
COVID-19 cohort	Yes*	Exact matching	20.0	21.2	21.2	0.000
Dual eligibility	Yes*	Exact matching	20.4	11.8	11.8	0.000
Primary diagnosis cancer	Yes*	Penalized caliper c	43.7	71.9	71.8	0.002
Primary diagnosis CHF	Yes*	Penalized caliper c	49.8	37.9	37.9	0.000
Primary diagnosis COPD	Yes*	Penalized caliper c	37.0	33.6	33.7	-0.001
Primary diagnosis HIV/AIDS	Yes*	Penalized caliper c	0.6	0.4	0.4	0.000
Indicator for rural zip code	Yes*	Penalized caliper	21.8	13.5	13.9	-0.010
Medicare A/B as primary payer in previous 2 years	Yes*	Penalized caliper	96.3	95.6	99.2	-0.179
Age	Yes*	Penalized caliper	78.8	77.2	77.0	0.026
Age less than 65	Yes*		8.6	7.1	5.3	0.069
Age 65-80	Yes*		40.6	51.4	57.0	-0.111
Age 80 or over	Yes*		50.8	41.5	37.7	0.076
Medicare entitlement: OASIS	Yes		78.2	81.3	81.9	-0.014
Medicare entitlement: disability	Yes		19.9	17.9	17.5	0.012
Medicare entitlement: ESRD	Yes		1.0	0.5	0.4	0.018
Medicare entitlement: disability/ESRD	Yes		0.9	0.3	0.3	-0.007
Male	Yes*	Exact matching*	50.4	49.4	50.5	-0.022
Female	Yes*	Exact matching*	49.6	50.6	49.5	0.022
Northeast region	Yes		20.6	19.6	19.9	-0.007
Midwest region	Yes		28.5	21.0	20.6	0.009
South region	Yes		38.9	39.8	39.3	0.010
West region	Yes		12.0	19.6	20.2	-0.014
Days in COVID-19 period	Yes*	Strict caliper	39.7	33.8	33.9	0.000
Encounters for cancer Q2-4	Condition		4.6	12.6	13.7	-0.065
Encounters for cancer Q1	Condition		2.4	7.1	7.1	0.006
Encounters for CHF Q2-4	Condition		2.7	3.3	3.4	-0.009
Encounters for CHF Q1	Condition		1.5	2.1	2.0	0.030

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 1,776,459 unique beneficiaries)	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)	Standardized difference
Encounters for COPD Q2-4	Condition		2.6	3.5	3.7	-0.038
Encounters for COPD Q1	Condition		1.3	2.0	1.9	0.029
Encounters for HIV/AIDS Q2-4	Condition		0.0	0.1	0.0	0.011
Encounters for HIV/AIDS Q1	Condition		0.0	0.0	0.0	0.014
HCC score at enrollment	Yes*		4.7	5.6	5.4	0.054
HCC score one year before enrollment	Yes		2.6	3.1	3.2	-0.062
HCC: Ischemic or unspecified stroke	Yes		10.7	9.1	9.1	-0.002
HCC: Dialysis status	Yes		7.0	5.3	5.1	0.009
HCC: Kidney disease	Yes		50.5	48.9	50.8	-0.039
HCC: Diabetes with acute/chronic complications	Yes		36.0	33.7	35.1	-0.029
HCC: Coma	Yes		3.8	6.7	4.6	0.084
HCC: Cardio-respiratory failure	Yes		34.0	36.1	35.6	0.008
HCC: Acute myocardial infarction	Yes		13.2	11.3	11.0	0.011
Days from most recent IP discharge and enrollment	Yes	Penalized caliper	89.3	69.8	69.7	0.001
Inpatient stay on enrollment date	Yes		16.9	0.4	0.7	-0.057
Medicare expenditures Q1	Yes		24,246	31,064	29,942	0.044
Medicare expenditures Q2	Yes		13,386	20,157	20,307	-0.006
Medicare expenditures Q3	Yes		10,502	15,347	15,840	-0.022
Medicare expenditures Q4	Yes		9,459	12,976	13,345	-0.019
Primary diagnosis breast cancer	Condition		4.9	8.8	8.7	0.006
Primary diagnosis colorectal cancer	Condition		4.5	8.2	7.9	0.008
Primary diagnosis lung cancer	Condition		10.4	24.9	22.3	0.060
Primary diagnosis other cancer	Condition		31.6	62.8	61.1	0.034
Primary diagnosis prostate cancer	Condition		6.8	9.3	10.2	-0.031
Logit of propensity score	Yes*		-9.2	-4.8	-5.1	0.218
Non-Hispanic white	Yes	Penalized caliper	81.2	86.3	87.7	-0.041
Black or African-American	Yes		10.9	8.2	8.0	0.009
Other, unknown, missing race/ethnicity	Yes		7.9	5.5	4.3	0.051
SNF stay on enrollment date	Yes		8.5	0.1	0.1	-0.002
Days between enrollment and death	Yes*	Strict caliper	181.7	185.0	183.3	0.008
Outpatient ED visits/observation stays Q1	Yes		0.5	0.7	0.7	-0.012
Outpatient ED visits/observation stays Q2-4	Yes		0.9	1.0	1.1	-0.108
Inpatient admissions Q1	Yes		0.8	1.1	1.0	0.083
Inpatient admissions Q2	Yes		0.4	0.5	0.5	-0.006

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 1,776,459 unique beneficiaries)	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)	Standardized difference
Inpatient admissions Q3	Yes		0.3	0.4	0.4	-0.015
Inpatient admissions Q4	Yes		0.3	0.3	0.3	-0.021
Advanced care planning visit in previous 2 years	Yes		10.5	20.7	16.3	0.109
Drugs for advanced stage cancer Q2-4	Condition		13.6	32.6	36.3	-0.078
Drugs for advanced stage cancer Q1	Condition		12.0	34.7	34.4	0.006
Diagnoses of advanced stage cancer Q2-4	Condition		39.1	51.5	55.2	-0.074
Diagnoses of advanced stage cancer Q1	Condition		32.9	52.9	53.3	-0.009
Diagnostic tests/procedures for advanced stage cancer Q2-4	Condition		12.0	33.8	36.8	-0.063
Diagnostic tests/procedures for advanced stage cancer Q1	Condition		10.6	33.2	31.9	0.026
Hormonal therapies Q2-4	Condition		1.6	3.4	3.9	-0.029
Hormonal therapies Q1	Condition		2.2	4.9	5.8	-0.044
Hospitalization with cardiac procedure Q2-4	Condition		0.1	0.2	0.1	0.009
Hospitalization with cardiac procedure Q1	Condition		0.2	0.0	0.0	-Inf
Participation in OCM at enrollment	Condition		2.2	10.1	10.7	-0.020
Hospitalization with lung-related procedure Q2-4	Condition		4.2	6.4	6.3	0.004
Hospitalization with lung-related procedure Q1	Condition		4.5	5.5	4.1	0.060
Automatic implantable cardioverter defibrillator Q1-4	Condition		0.5	0.4	0.4	0.002
Coronary artery bypass surgery Q1-4	Condition		0.4	0.1	0.2	-0.016
Percutaneous intervention Q1-4	Condition		1.6	1.0	1.2	-0.018
Admitted to hospital on enrollment date	Yes		2.2	0.3	0.4	-0.011
Discharged from hospital on enrollment date	Yes		1.3	1.7	1.4	0.022
Length of most recent inpatient stay	Yes		6.8	6.6	6.2	0.090
Inpatient days Q1	Yes		6.7	7.0	6.1	0.115
Inpatient days Q2-4	Yes		6.8	8.2	8.0	0.010
Inpatient expenditures Q1	Yes		13,706	14,010	13,336	0.037
Inpatient expenditures Q2-4	Yes		14,495	17,877	17,748	0.004
Admitted to SNF on enrollment date	Yes		0.8	0.0	0.0	-0.015
Discharged from SNF on enrollment date	Yes		0.8	0.5	0.8	-0.040

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 1,776,459 unique beneficiaries)	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)	Standardized difference
Any DME claims Q1-4	Yes		59.6	72.9	71.8	0.024
DME hospital bed claims Q1-4	Yes		0.2	0.3	0.2	0.071
DME oxygen claims Q1-4	Yes		1.6	2.1	2.0	0.005
DME walker/cane claims Q1-4	Yes		0.1	0.1	0.1	0.026
DME wheelchair claims Q1-4	Yes		0.4	0.4	0.3	0.047
SNF days Q1	Yes		5.7	4.0	3.8	0.018
SNF days Q2-4	Yes		6.7	5.2	5.1	0.002
Post-acute care Q1	Yes		11.1	11.9	10.2	0.103
Post-acute care Q2-4	Yes		17.8	15.4	14.3	0.040
Number of ADLs at most recent assessment	Yes		4.5	4.7	4.5	0.131
OASIS care assessment D30	Yes		14.4	37.5	27.9	0.198
OASIS discharge assessment D30	Yes		27.0	26.7	24.8	0.043
Inpatient ICU days Q1	Yes		2.5	2.1	1.8	0.071
Inpatient ICU days Q2-4	Yes		2.2	2.5	2.4	0.012
Outpatient expenditures Q1	Yes		1,987	3,763	3,882	-0.021
Outpatient expenditures Q2-4	Yes		4,526	7,657	8,169	-0.042
Part B drug expenditures Q1	Yes		1,367	4,704	5,086	-0.038
Part B drug expenditures Q2-4	Yes		3,152	10,118	10,739	-0.028
Unique inpatient procedures Q1	Yes		1.7	1.4	1.3	0.027
Unique inpatient procedures Q2-4	Yes		1.7	2.0	2.0	-0.023
Home health days Q1	Yes		4.5	7.3	5.8	0.149
Home health days Q2-4	Yes		10.1	9.4	8.5	0.055
ED visits resulting in inpatient admission Q1	Yes		0.7	0.9	0.8	0.108
ED visits resulting in inpatient admission Q2-4	Yes		0.8	1.0	1.0	-0.010
PCP visits Q1	Yes		3.3	4.1	3.9	0.038
PCP visits Q2-4	Yes		6.8	7.6	8.0	-0.051
Specialist visits Q1	Yes		2.8	4.9	4.8	0.021
Specialist visits Q2-4	Yes		7.0	10.7	11.2	-0.064
Number of EMS ambulance transports in quarter 4 before (pseudo) enrollment	Yes		0.2	0.2	0.2	-0.017
Number of EMS ambulance transports in quarter 3 before (pseudo) enrollment	Yes		0.2	0.2	0.2	-0.006
Number of EMS ambulance transports in quarter 2 before (pseudo) enrollment	Yes		0.3	0.3	0.3	0.014

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 1,776,459 unique beneficiaries)	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)	Standardized difference
Number of EMS ambulance transports in quarter 1 before (pseudo) enrollment	Yes		0.5	0.5	0.5	0.067
Number of EMS ambulance transports in quarters 2 to 4 before (pseudo) enrollment	Yes		0.6	0.6	0.6	-0.003
Medicare expenditures Q1-4	Condition		57,592	79,543	79,433	0.002
Outpatient ED visits/observation stays Q1-4	Condition		1.4	1.6	1.8	-0.086
Inpatient admissions Q1-4	Condition		1.8	2.3	2.3	0.028

Note: The fourth, fifth, and sixth columns present the intervention or comparison group mean for continuous variables or the percentage of beneficiaries for binary and categorical variables. The fourth column is based on 22,367,931 observations (copies) for 1,776,459 unique beneficiaries, with beneficiaries weighted equally.

[a] "Yes*" identifies variables used for matching all 6 qualifying condition groups. "Yes" identifies variables used for matching for 5 out of 6 qualifying condition groups (all except the HIV/AIDS group). "Condition" identifies variables used for matching at more than 1 but less than 5 qualifying condition groups.

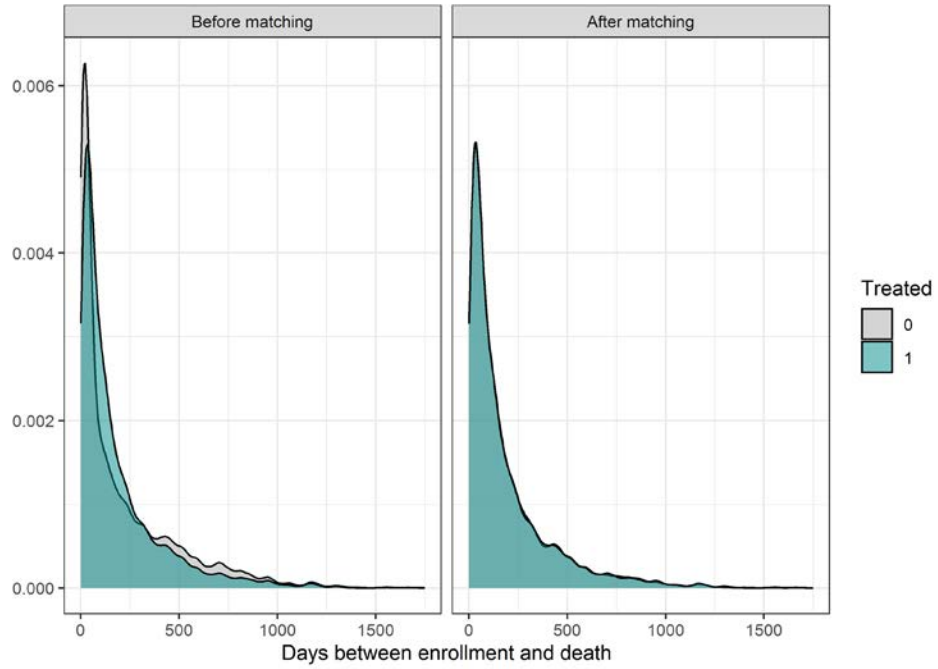
[b] Exact matching" identifies variables used as exact matching variables for all diagnosis groups, while "Exact matching*" identifies variables used as exact-matching variables in the HIV/AIDS qualifying condition group only. "Strict caliper" and "Penalized caliper" identify variables with strict and penalized calipers, respectively.

[c] In addition, we exactly matched on the qualifying condition groups described in Appendix Table A.5.

ADL = activities of daily living; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DME = durable medical equipment; ED = emergency department; ESRD = end-stage renal disease; HCC = hierarchical condition category; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; ICU = intensive care unit; IP = inpatient; MCCM = Medicare Care Choices Model; n.a. = not applicable; OASI = Old-Age and Survivors Insurance; OASIS = Outcome and Assessment Information Set.; OCM = Oncology Care Model; PCP = primary care provider; Q1 = 1st quarter before enrollment or pseudo enrollment; Q2 = 2nd quarter before enrollment or pseudo enrollment; Q3 = 3rd quarter before enrollment or pseudo enrollment; Q4 = 4th quarter before enrollment or pseudo enrollment; SNF = skilled nursing facility.

The table, and other diagnostic analyses not presented here, show that the intervention and comparison groups are closely balanced for many of the matching variables and we generally met or exceeded our goal that differences for high-priority measures would be no larger than 0.10 standard deviations while differences for lower priority measures would be no larger than 0.25 standard deviations. It was especially important that the distribution of survival times—time between enrollment and death—for MCCM and comparison beneficiaries align closely. As Appendix Figure A.1 and Table A.7 show, we achieved that goal.

Figure A.1 Survival time kernel densities for deceased MCCM and matched comparison beneficiaries, before and after matching



Note: In the right panel (after matching), the kernel densities for MCCM enrollees (1, in green) and comparison beneficiaries (0, in gray) are almost identical.

MCCM = Medicare Care Choices Model.

Table A.7. The distribution of survival times for deceased MCCM and matched comparison beneficiaries, before and after matching

Variable	MCCM enrollees (N = 4,574)	Matched comparison group (N = 13,575)
Percentage of beneficiaries with survival times		
Between 1 and 7 days	3.3	3.1
Between 8 and 30 days	16.0	16.0
Between 31 and 90 days	26.6	27.1
Between 91 and 180 days	20.8	20.7
Between 181 and 365 days	17.9	18.0
More than 365 days	15.3	15.1
Distribution of survival times		
Minimum	1 day	1 day
10th percentile	17 days	17 days
25th percentile	40 days	41 days
50th percentile	104 days	105 days
75th percentile	243 days	242 days
90th percentile	469 days	465 days
Maximum	1,663 days	1,663 days

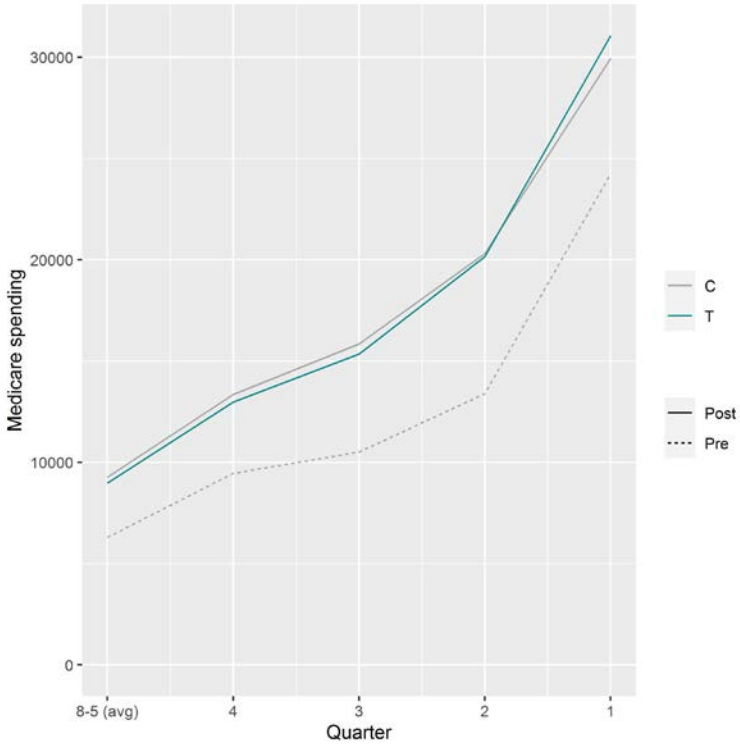
MCCM = Medicare Care Choices Model.

Notable findings include the following:

1. Because of the exact-matching constraints discussed earlier, the intervention and matched comparison groups had virtually the same percentage of beneficiaries with each of the four qualifying conditions (cancer, congestive heart failure, chronic obstructive pulmonary disease, and HIV/AIDS), the same percentage who are dually eligible for Medicare and Medicaid, and the same percentage enrolled on or after September 1, 2019 (those most likely affected by the COVID-19 pandemic).
2. Pseudo-enrollment dates for matched comparison beneficiaries were broadly the same as the enrollment dates for MCCM enrollees, with similar percentages of beneficiaries in each group enrolling per year.
3. At their pseudo-enrollment date, the matched comparison beneficiaries always resided in the market area of the hospice that enrolled the intervention beneficiary in MCCM. Because some MCCM hospices had market areas with more than one hospital referral region, 82 percent of the comparison beneficiaries lived in the same hospital referral region as MCCM enrollee to whom they were matched.
4. The decedents approach was explicitly designed to produce a matched comparison group that closely resembled the intervention group in terms of the distribution of time from enrollment (or pseudo-enrollment) until death—that is, survival time. After matching beneficiaries on survival time (and other variables), MCCM enrollees and matched comparison beneficiaries had highly similar survival time distributions (Appendix Figure A.1 and Table A.7). On average, MCCM enrollees lived 185.0 days, compared to 183.3 days in the matched comparison group—a difference of only 0.01 standard deviations (Appendix Table A.6). In addition, there was little difference in the survival times *within each matched set*—that is, each MCCM enrollee and their matched comparison beneficiaries had similar survival times.
5. MCCM enrollees and matched comparison beneficiaries were similar in terms of demographics, with good balance on sex (50.6 versus 49.5 percent female), age (both groups age 77 on average), and race/ethnicity (86.3 versus 87.7 percent non-Hispanic White and 8.2 versus 8.0 percent Black).[56]
6. The two groups had similar numbers and distributions of chronic conditions. The average hierarchical condition category score at enrollment for MCCM beneficiaries was 5.55, compared to 5.44 for matched comparison beneficiaries—a difference of 0.05 standard deviations. The two groups also were well matched in the prevalence of many of the specific chronic conditions we examined, such as history of diabetes (33.7 versus 35.1 percent), stroke (9.1 percent in both groups), and acute myocardial infarction (11.3 versus 11.0 percent).
7. Compared with the pool of potential comparison beneficiaries, MCCM enrollees had notably high Medicare fee-for-service expenditures and service use in the year before enrollment, and they had very high expenditures and service use in the quarter before enrollment. Through matching, we were able to identify comparison beneficiaries that also fit this pattern (Appendix Figure A.2). For instance, in the quarter immediately before the pseudo-enrollment date, matched comparison beneficiaries had $29,942 in Medicare expenditures and 0.99 inpatient admissions on average, similar to MCCM enrollees, who had $31,064 in Medicare expenditures and 1.08 inpatient admissions on average. The two groups also appeared similar on other expenditures and utilization measures and had similar rates of condition-specific medical encounters and procedures.

[56] Although the average age of beneficiaries in the intervention and comparison groups is similar, the comparison group has fewer very old and very young beneficiaries and more beneficiaries in their late 70s and early 80s.

Figure A.2 Baseline trends in Medicare spending, 1 to 8 quarters before enrollment, for MCCM and matched comparison beneficiaries, before and after matching



C = comparison beneficiaries; MCCM = Medicare Care Choices Model; T = MCCM beneficiaries; Pre = before matching; Post = after matching

D. Regression models for estimating impacts

In this section, we describe the regression models we used to estimate impacts. The regression models used a data set that combines data for the beneficiaries who enrolled in MCCM during the model period with data for the matched comparison beneficiaries. We included one observation per beneficiary because most beneficiaries remained alive a relatively short time before their deaths (MCCM enrollees lived 167.6 days, on average) and many outcomes are defined only on the beneficiary level (for example, whether a beneficiary died with more than one emergency department visit in the last 30 days of life). Therefore, it would not be very informative to estimate a longitudinal model that can distinguish between impacts in the first and second year of enrollment, and so on.

1. Primary impact analyses

Our main impact estimation regression model included observations from model years 2016 to 2020 (including beneficiaries enrolled by March 31, 2020), pooling data from the two MCCM cohorts (that started in 2016 and 2018) and their matched comparison beneficiaries. The unit of observation was a beneficiary. Specifically, we compared outcomes of beneficiaries enrolled in MCCM to those of matched comparison beneficiaries by estimating the following regression:

(1) $$y_i^1 = \alpha + MCCM_i\,\delta + Y_i^{0'}\gamma + X_{ir}^{'}\beta + \mu_r + \varepsilon_i$$

In this model, y_i^1 represents the outcome for beneficiary i in the intervention period—that is, measured after enrollment in MCCM for intervention group beneficiaries and after the pseudo-enrollment date for matched comparison group beneficiaries. $MCCM_i$ is an indicator variable that equals 1 for the beneficiaries enrolled in MCCM and 0 for beneficiaries in the matched comparison group. Y_i^0 is a vector of pre-intervention outcomes measured at baseline—that is, before the intervention. We cannot include all considered outcome variables in Y_i^0 because some outcomes are not defined at baseline (for example, outcomes related to health care use in the last 30 days of life), but we can include a vector of variables that capture pre-intervention Medicare expenditures and health care service use. X_{ir} is a set of independent beneficiary- or region-level covariates, which is a subset of the variables used to obtain the matched comparison group (Appendix Table A.8 shows the variables included in Y_i^0 and X_{ir}); μ_r is a hospice market area fixed effect; and ε_i is an error term that is independent of the included regressors and has the same distribution for all beneficiaries.[57]

Table A.8. Variables used for regression adjustment

Variables included as covariates in regression models
Demographics and eligibility
Age at (pseudo) enrollment
Age category (younger than 65, 65 to 74, 75 to 84, and 85 or older)
Sex
Dually eligible
Non-Hispanic White
Black
Other race
Old-Age and Survivors Insurance
Disability insurance benefits
End-stage renal disease
Both disability insurance benefits and end-stage renal disease
Rural zip code
Northeast
Midwest
South
West
Zip code demographics 1st principal component
Zip code demographics 2nd principal component
Had two hospital encounters (inpatient stay, ED visit, or observation stay) in the 12 months before enrollment
Part D drug plan requirement
Had three office visits for with the same provider for the MCCM-qualifying terminal condition in the 12 months before enrollment

[57] We combined hospice market areas for hospices that enrolled fewer than 25 beneficiaries into one residual market area category. This affected 44 hospices and about 10 percent of beneficiaries.

Variables included as covariates in regression models
Participated in an ACO at the time of enrollment
Year of (pseudo) enrollment
Quarter of (pseudo) enrollment
Date of (pseudo) enrollment occurred more than 6 months before the start of the COVID-19 public health emergency (on or before August 31, 2019)
Time from (pseudo) enrollment to death[a]
Time from (pseudo) enrollment to death squared[a]
Time from (pseudo) enrollment to death cubed[a]
Indicator for which MCCM hospice enrolled the beneficiary
Health at (pseudo) enrollment
HCC: 1st principal component
HCC: 2nd principal component
HCC: 3rd principal component
HCC: 4th principal component
HCC: 5th principal component
HCC: 6th principal component
HCC Score at (pseudo) enrollment
HCC Score one year before (pseudo) enrollment
HCC: Ischemic or Unspecified Stroke
HCC: Kidney Disease
HCC: Diabetes with Acute or Chronic Complications
HCC: Hip Fracture/Dislocation
HCC: Artificial Openings for Feeding or Elimination
HCC: Dementia with or Without Complication
HCC: Multiple Sclerosis
HCC: Parkinson's and Huntington's Diseases
HCC: Coma, Brain Compression/Anoxic Damage
HCC: Respirator Dependence/Tracheostomy Status
HCC: Cardio-Respiratory Failure and Shock
HCC: Acute Myocardial Infarction
Had primary diagnosis of cancer
Had primary diagnosis of CHF
Had primary diagnosis of COPD
Had primary diagnosis of HIV/AIDS
Breast cancer
Colorectal cancer
Lung cancer
Prostate cancer
Other cancer
Health care use at baseline
Advance care planning visit in the two years before enrollment
Admitted to hospital on (pseudo-) enrollment date

Variables included as covariates in regression models
Discharged from hospital on (pseudo-) enrollment date
Inpatient stay on (pseudo-) enrollment date
Number of days between enrollment or pseudo-enrollment date and most recent inpatient discharge (using admission date)
Length of stay for most recent baseline inpatient stay
Flag for no inpatient stays in baseline year
Discharged from SNF on (pseudo-) enrollment date
Total Medicare Part A and B expenditures in quarter 1 before (pseudo) enrollment
Total Medicare Part A and B expenditures in quarters 2 to 4 before (pseudo) enrollment
Number of inpatient admissions in quarter 1 before (pseudo) enrollment
Number of inpatient admissions in quarters 2 to 4 before (pseudo) enrollment
Number of outpatient ED visits and observation stays in quarter 1 before (pseudo) enrollment
Number of outpatient ED visits and observation stays in quarters 2 to 4 before (pseudo) enrollment
Diagnostic tests and procedures indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Diagnostic tests and procedures indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Diagnoses indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Diagnoses indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Drugs indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Drugs indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Flag for receipt of hormonal therapies in quarter 1 before (pseudo) enrollment
Flag for receipt of hormonal therapies in quarters 2 to 4 before (pseudo) enrollment
Hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation in quarter 1 before (pseudo) enrollment
Hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation in quarters 2 to 4 before (pseudo) enrollment
History of an automatic implantable cardioverter defibrillator in the 12 months before enrollment
History of artery bypass surgery in the 12 months before enrollment
History of percutaneous coronary intervention in the 12 months before enrollment
Lagged outcomes[b]
Inpatient expenditures in quarter 1 before (pseudo) enrollment
Inpatient expenditures in quarters 2 to 4 before (pseudo) enrollment
Drug expenditures in quarter 1 before (pseudo) enrollment
Drug expenditures in quarters 2 to 4 before (pseudo) enrollment
SNF expenditures in quarter 1 before (pseudo) enrollment
SNF expenditures in quarters 2 to 4 before (pseudo) enrollment
Home health expenditures in quarter 1 before (pseudo) enrollment
Home health expenditures in quarters 2 to 4 before (pseudo) enrollment
DME expenditures in quarter 1 before (pseudo) enrollment
DME expenditures in quarters 2 to 4 before (pseudo) enrollment
Hospice expenditures in quarter 1 before (pseudo) enrollment
Hospice expenditures in quarters 2 to 4 before (pseudo) enrollment

Variables included as covariates in regression models
Other expenditures in quarter 1 before (pseudo) enrollment
Other expenditures in quarters 2 to 4 before (pseudo) enrollment
Outpatient ED visits in quarter 1 before (pseudo) enrollment
Outpatient ED visits in quarters 2 to 4 before (pseudo) enrollment
Outpatient observation stays in quarter 1 before (pseudo) enrollment
Outpatient observation stays in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with primary care providers in quarter 1 before (pseudo) enrollment
Ambulatory visits with primary care providers in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with specialist physicians in quarter 1 before (pseudo) enrollment
Ambulatory visits with specialist physicians in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with primary care providers and specialist physicians in quarter 1 before (pseudo) enrollment
Ambulatory visits with primary care providers and specialist physicians in quarters 2 to 4 before (pseudo) enrollment
Number of days in hospice in quarter 1 before (pseudo) enrollment
Number of days in hospice in quarters 2 to 4 before (pseudo) enrollment
Number of post-acute care days in quarter 1 before (pseudo) enrollment
Number of post-acute care days in quarters 2 to 4 before (pseudo) enrollment
Number of home health visits in quarter 1 before (pseudo) enrollment
Number of home health visits in quarters 2 to 4 before (pseudo) enrollment
Inpatient days in quarter 1 before (pseudo) enrollment
Inpatient days in quarters 2 to 4 before (pseudo) enrollment
Inpatient ICU days in quarter 1 before (pseudo) enrollment
Inpatient ICU days in quarters 2 to 4 before (pseudo) enrollment
Days in hospital without ICU in quarter 1 before (pseudo) enrollment
Days in hospital without ICU in quarters 2 to 4 before (pseudo) enrollment
EMS ambulance transports in quarter 1 before (pseudo) enrollment
EMS ambulance transports in quarters 2 to 4 before (pseudo) enrollment

[a] This is not used in hazard models.

[b] This is only included in regressions with the corresponding outcome.

ACO = accountable care organization; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DME = durable medical equipment; ED = emergency department; EMS = emergency medical services; HCC = hierarchical condition category; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; ICU = intensive care unit; SNF = skilled nursing facility.

The Greek letters (α, δ, γ, β, and μ_r) are the parameters we estimated. The key parameter of interest is δ, which represents the impact of the model. In a linear model, δ equals the difference in regression-adjusted mean outcomes between the intervention and comparison groups. The parameters γ and β represent the effects of baseline outcomes and covariates, respectively. These terms improve the precision of the impact estimates and net out effects of any observed residual differences in characteristics between the intervention and comparison groups that remain after matching. We note in particular that including baseline outcomes (Y_i^0) is important because any pre-intervention differences in health care use could be associated with health care use in the follow-up period and thereby affect impact estimates if not

accounted for. [58,59] Finally, we included a fixed effect for each hospice market area, which we defined to include a single hospice and all matched comparison beneficiaries. These fixed effects net out the effects of any characteristics shared within a hospice's market area, including characteristics of the health care system, care delivery patterns, local policies, and other factors.[60] Collectively, these terms improve the precision of the impact estimates by reducing the amount of unexplained variation in the outcome (ε_i).

We estimated the regression shown in Equation (1) using a model that corresponds to the distribution of the outcome variable. We used ordinary least squares to estimate the models described by Equation (1) for most outcomes, including Medicare Part A and B expenditures, service use, and other continuous outcomes.[61] We used similar regression models for binary outcomes (such as enrollment in the hospice benefit). For binary outcomes, we used a logistic regression model that is analogous to Equation (1). Then, we expressed impacts from these models as average marginal effects, so they are on the same scale as the outcome (that is, in percentage point impacts). For time-to-event outcomes, we used survival analysis techniques (details provided later in this section).

Appropriate standard errors and weighting. We assigned beneficiaries to the intervention or comparison group based on their enrollment on an individual level. That is, we did not assign entire hospice market areas to the intervention or comparison group. Therefore, it was not appropriate to calculate standard errors that account for clustering on hospice market areas or any other geographic-level regions (Abadie et al. 2017). Because we include only one observation per beneficiary, it was also not necessary to cluster standard errors on the beneficiary level. Instead, we calculated robust standard errors.

We followed beneficiaries after their enrollment (or pseudo enrollment) until they died. That is, we reported a single impact estimate rather than different impact estimates for different follow-up lengths ("in last X days of life"). Thus, the regression models produced the average impact *per beneficiary*, averaging across beneficiaries that have shorter and longer survival times. For example, impacts on Medicare expenditures can be interpreted as the average change in Medicare expenditures that result from enrolling one more beneficiary in MCCM. For the comparison group, we also employed matching weights to balance the intervention and comparison groups, to account for our matched comparison group design. (Weights equal 1 for intervention beneficiaries and equal $1/n$ for the comparison beneficiaries, where n equals the number of matched comparison beneficiaries matched to the beneficiary enrolled in

[58] By including baseline outcomes on the right-hand side of the regression in Equation (1), we implicitly assume unconfoundedness of MCCM enrollment conditional on the baseline outcomes. That is, when comparing intervention and matched comparison beneficiaries with the same pre-(pseudo-) enrollment outcomes, there are no unobserved beneficiary characteristics that correlate with MCCM enrollment: that is, there is no selection on unobserved variables conditional on baseline outcomes (Imbens and Wooldridge 2009).

[59] Note that in this model, the parameter γ governs regression to the mean whenever the vector of pre-intervention outcomes, Y_i^0, includes the pre-intervention outcome model corresponding to the outcome measure, y_i^1. We do not restrict the parameter γ to equal 1 and this is a not a difference-in-differences model; thus, we avoid some recently raised concerns about difference-in-differences models combined with beneficiary-level matching if there is regression to the mean (Daw and Hatfield 2018).

[60] Our model with hospice market area fixed effects is analogous to what we would do if instead this were a randomized controlled trial, stratified by hospice market area, with random assignment of beneficiaries within each market area to the intervention or comparison group.

[61] To obtain impacts on Medicare Part A and B expenditures plus MCCM payments per enrollee, we (1) estimated regression-adjusted impacts on Medicare Part A and B expenditures (without MCCM payments) and (2) added average (unadjusted) MCCM payments. We used seemingly unrelated estimation to combine the two estimates and obtain standard errors.

MCCM. The sum of the weights across comparison group beneficiaries equaled the number of MCCM enrollees.)

2. Time-to-event analyses

We used survival analysis techniques to estimate impacts of MCCM on the length of time from enrollment to electing hospice benefit. For this outcome, our analyses used data at the beneficiary level. We used two variables to describe each outcome: (1) a variable with the length of time (number of days) a beneficiary was in the sample and observed after the (pseudo-) enrollment date and (2) an indicator variable that equals 1 if the outcome occurred and 0 if the beneficiary's data were censored before the event occurred. Censoring occurs (1) for the hospice benefit when beneficiaries do not elect the hospice benefit before their death or (2) for death when beneficiaries are alive at the end of the study period (when applicable, depending on the study population).

We used hazard modeling to estimate impacts of enrollment in MCCM on the risk of having these events throughout the study period. Specifically, we used a Cox proportional hazard model. A hazard is the estimated probability of the event occurring at a certain time. Biostatistics and clinical trials frequently use Cox proportional hazard models to model impacts on event data. A major advantage of this model is that it uses data for all beneficiaries, including beneficiaries who enrolled in MCCM late during the study period (and their matched comparisons). For the hospice benefit outcome, this included beneficiaries who died before they could enroll in the hospice benefit. The Cox proportional hazards model is expressed as:

$$(2) \qquad h_i(t) = h_0(t) e^{\left(\alpha + m_r\delta + Y_i^{0'}\gamma + X_{ir}'\beta + \mu_r\right)},$$

where $h_i(t)$ is the hazard (that is, the estimated probability the event occurs at time t) for beneficiary i; $h_0(t)$ is a baseline hazard (which does not need to be known for us to estimate the other model parameters); and the other variables are defined as in Equation (1). The Greek letters ($\delta, \gamma, \beta, \mu$) are parameters to be estimated. As in Equation (1), we included covariates (X_{ir}), baseline outcomes (Y_i^0), and hospice market area fixed effects (μ_r) to account for observed differences between the intervention and comparison groups at baseline and differences across hospice market areas.[62]

The coefficient δ captures the effect of MCCM on the outcome $\left(h_i(t)\right)$, adjusted for the remaining covariates in the model. We expressed δ as a hazard ratio for intervention versus comparison beneficiaries, along with its *p*-value and confidence interval. The hazard ratio is the ratio between the intervention and comparison groups in the risk of enrolling in the hospice benefit or dying at each time point throughout the study period, with values less than 1 indicating that risk is lower in the intervention group than the comparison group.

[62] We also estimated logistic regression models for the outcomes that equaled 1 if a beneficiary died within 30, 90, 180, and 365 days, respectively, after (pseudo) enrollment. These models yielded qualitatively similar results to the proportional hazard model.

3. Accounting for differences due to impacts on hospice enrollment

One possible effect of the model is that it increases enrollment in the Medicare hospice benefit. Because beneficiaries receiving hospice benefits must forgo payment for treatments of their terminal conditions, Medicare expenditures (per day) and rates of service use might be lower after a beneficiary enrolls in hospice. By extension, MCCM's impacts on hospice use could have driven at least some of the model's overall impacts on Medicare expenditures and service use for beneficiaries in MCCM.[63]

To disentangle the impact of MCCM on expenditures and hospice use, we used a simple model in which beneficiaries can either be in hospice (h) or the community (c). Total expenditures from enrollment to death, y, are the weighted sum of expenditures for beneficiaries in hospice (y_h) and expenditures for beneficiaries in the community (y_c), where weights are the fractions of time from enrollment to death spent in hospice (f_h) and the community (f_c), respectively:

$$(3) \quad y = y_h f_h + y_c f_c$$

In this model, the difference in expenditures between MCCM enrollees (indicated by 1) and comparison group beneficiaries (indicated by 0) is the difference:

$$(4) \quad \Delta y = y_1 - y_0 = \left(y_{h1} f_{h1} + y_{c1} f_{c1}\right) - \left(y_{h0} f_{h0} + y_{c0} f_{c0}\right)$$

After some algebra to rearrange terms, we can write the difference in expenditures as:

$$(5) \quad \Delta y = \underbrace{(y_{h0} - y_{c0})(f_{h1} - f_{h0})}_{A} + \underbrace{(y_{h1} - y_{h0}) f_{h0}}_{B} + \underbrace{(y_{c1} - y_{c0}) f_{c1}}_{C} + \underbrace{(y_{h1} - y_{h0})(f_{h1} - f_{h0})}_{D}$$

The four terms in equation (5) show that the effect of MCCM on Medicare expenditures can be decomposed into the following:

A. The effect on expenditures that is the result of MCCM moving some beneficiaries from the community to hospice or prolonging the time that beneficiaries spend enrolled in the Medicare hospice benefit. The term $y_{h0} - y_{c0}$ is the difference in expenditures between hospice and the community that we see in the comparison group, and the term $f_{h1} - f_{h0}$ is the difference in the fraction of time enrolled in hospice between MCCM enrollees and beneficiaries in the comparison group.

B. The effect of MCCM on expenditures for beneficiaries enrolled in hospice.

C. The effect of MCCM on expenditures for beneficiaries in the community.

D. The interaction of effects (A) and (B). This term captures the effect of MCCM on expenditures for beneficiaries enrolled in hospice among the beneficiaries who moved from the community to hospice.

Equation (5) shows that the total impact of MCCM on expenditures (or other outcomes) operates through the expenditure difference between being enrolled in hospice and being in the community multiplied by

[63] For simplicity, this section focuses on Medicare expenditures as the outcome of interest. We repeated the same analysis for other outcomes, including inpatient admissions and emergency department visits and observation stays.

the impact of MCCM on time spent in hospice $\left(\left(y_{h0}-y_{c0}\right)\left(f_{h1}-f_{h0}\right)\right)$ and the remainder $\left(\Delta y-\left(y_{h0}-y_{c0}\right)\left(f_{h1}-f_{h0}\right)\right)$.

To disentangle the total impact of MCCM on the key outcomes total Medicare expenditures, we separately measured expenditures (1) for the time from MCCM enrollment until enrollment in the Medicare hospice benefit and (2) for the time from hospice enrollment to death.[64] For beneficiaries who did not enroll in the Medicare hospice benefit, we set outcomes corresponding to the time from hospice enrollment until death to zero dollars. We also created a variable for the fraction of time after Medicare hospice enrollment relative to the total follow-up period.[65]

We jointly estimated regressions for the following four outcomes: (1) the fraction of the follow-up period spent in hospice, (2) the total outcome during the follow-up period, (3) the outcome before enrollment in the Medicare hospice benefit, and (4) the outcome after hospice enrollment. Each regression was specified the same as in equation (1) and included Y_i^0, X_{ir}, and μ_r as covariates. We specified a general linear model with a log link function and a negative binomial distribution for outcome (1) and standard linear models for outcomes (2) to (4). By estimating these regressions jointly, we were able to obtain robust standard errors that account for dependencies between these outcomes.

We then obtained predicted outcomes corresponding to the terms in equation (5) that allowed us to construct the impact of MCCM that operated though hospice enrollment and the impact that was attributable to other factors. Specifically, we obtained the term $y_{h0}-y_{c0}$ by calculating the difference in predicted outcomes for the periods after and before hospice enrollment, respectively, for each beneficiary in the comparison group. We calculated $f_{h1}-f_{h0}$ as the impact of MCCM on the fraction of the follow-up period after enrollment in the hospice benefit. Finally, we obtained the impact of MCCM that did not operate through hospice (for each beneficiary) as the difference between the overall impact of MCCM on Medicare expenditures during the follow-up period and $\left(y_{h0}-y_{c0}\right)\left(f_{h1}-f_{h0}\right)$. Finally, we took averages for each of these parameters, averaging across MCCM enrollees.

E. Subgroup analyses

We conducted several subgroup analyses to provide insight into where, when, for whom, and in what context MCCM is most effective. Subgroup analyses focused on impacts on our primary outcome measures for the following groups:[66]

1. Beneficiaries with different survival times: 1 to 30, 31 to 90, 91 to 180, 181 to 365, and more than 365 days (Chapter III and Appendix D)

[64] A few beneficiaries in our sample enrolled and then disenrolled from the Medicare Hospice Benefit before their death. We excluded the 0.5 percent of beneficiaries from this analysis for whom more than 30 days passed between hospice disenrollment and death.

[65] For most beneficiaries, this variable equals the fraction of the follow-up period spent in hospice. For some beneficiaries who disenrolled from the hospice benefit before their death, this variable can (slightly) overstate the fraction of the follow-up period spent in hospice.

[66] We plan to conduct subgroup analyses for beneficiaries with dual eligibility status (enrolled in both Medicare and Medicaid) versus those who are not dually eligible, for beneficiaries from racial or ethnic minority groups versus those who are white and non-Hispanic, and (possibly) for beneficiaries living in rural versus non-rural areas in the final report. Chapter VII discusses these plans.

2. Beneficiaries with each of the three most common qualifying conditions: cancer, congestive heart failure, and chronic obstructive pulmonary disease (Chapter VI)
3. Beneficiaries enrolled January 1, 2016, to August 31, 2019 (the pre-COVID-19 cohort), and those enrolled September 1, 2019, to September 30, 2021 (the COVID-19 cohort), to provide an estimate of the models' effect before and during the COVID19 pandemic (Chapter VIII)
4. Beneficiaries enrolled by MCCM hospices that started participating in the model in 2016 (Cohort 1) versus 2018 (Cohort 2) because there were some differences in model implementation between the two cohorts (Appendix D)
5. Beneficiaries enrolled by the top five enrolling hospices, which account for 45 percent of enrollees through September 2020 (Appendix D)
6. Beneficiaries enrolled through March 31, 2020, to align with the evaluation period of the previous evaluation contractor, Abt Associates, to better facilitate comparisons between the different methodologies (Appendix D)

The way we conducted matching (described earlier in this appendix) has important implications for how we conducted subgroup analyses. We exact-matched on primary MCCM diagnosis, dual eligibility status, and COVID-19 cohort, so all matched sets have the same values for these covariates. We assigned comparison beneficiaries to the same survival time category as their matched MCCM enrollee. Because comparison beneficiaries never enrolled in the model, we assigned them to the same hospice as their matched MCCM enrollee, and therefore all matched sets have the same values for (1) hospice cohort and (2) top five enrolling hospices flag. For other subgroup identifiers, there were sometimes differences between the subgroup of MCCM enrollee and one or more matched comparison beneficiaries. For rural status, we dropped comparison beneficiaries who belonged to a different subgroup than their matched MCCM enrollee. For example, if an MCCM enrollee lived in a rural area and was matched to two comparison beneficiaries in a rural area and one MCCM enrolled beneficiary in a non-rural area, we dropped the matched comparison beneficiary from the non-rural area and changed the weights for the two remaining matched comparisons from 1/3 to 1/2. There were still many matched comparison beneficiaries, and we retained good balance even in these subgroups. For race and ethnicity subgroups, we did not drop comparison beneficiaries who were in a different race or ethnicity subgroup than their matched MCCM enrollee because there were more discordant matched pairs (than for rural area and pre-COVID-19 subgroup analyses).

We used regression models to (1) estimate impacts for each subgroup of MCCM enrollees and (2) implement statistical tests for different estimated impacts between subgroups. The exact method varied across subgroup analyses:

- For subgroup analyses 1 and 3 (survival time categories and beneficiaries enrolled before versus during the COVID-19 pandemic), we included an interaction term in the regression for the subgroup and intervention group indicator variables. For survival time categories, we chose to only interact the intervention group indicator with the subgroup indicator because each of the five subgroups was small relative to the overall sample, and we did not have sufficient degrees of freedom to estimate a fully interacted model. We believe that the COVID-19 period changed many of the associations between health care outcomes and beneficiary covariates, and we would have preferred to estimate a fully interacted model (that is, interact the COVID-19 period indicator with all covariates, not just the intervention indicator). However, we did not have sufficient degrees of freedom to do this, because

the subgroup that enrolled during the COVID-19 period was relatively small. Therefore, we only interacted the subgroup indicator with the intervention group indicator.

- For subgroup analyses 4 and 5 (beneficiaries enrolled with the 2016 and 2018 hospice cohorts and beneficiaries enrolled with one of the top five enrolling hospices versus those in other MCCM hospices), we fully interacted all variables in the model (see equation 1) with the subgroup identifier. This was possible because the subgroups were relatively evenly split (closer to 50 percent in each category).
- For subgroup analysis 2 (beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease), we used a hybrid approach because the subgroups were not mutually exclusive categories: some of the beneficiaries were assigned to two or even three of the subgroups. First, we obtained impact estimates by estimating separate regression models for the three qualifying condition groups (analogous to a fully interacted model). Second, we tested for differences in impacts between subgroups using a pooled regression model with interactions between qualifying condition indicators variables and the intervention group indicator variable.
- Subgroup analysis 6 did not involve a contrast, so we simply limited the sample to beneficiaries in the subgroup and re-ran the main regression models.

F. Beneficiary-level descriptive information

To report on the number of beneficiaries referred to or enrolled in MCCM (in Chapter II), we counted all referrals from MCCM program data from the Patient Baseline Information Form with enrollment dates on or before September 30, 2020, or signature dates (time stamp for data entry) before September 30, 2020, if the beneficiary was not enrolled. We excluded all inactivated records (`record_type` = 2) and kept only one record (the most recent) per beneficiary. We then classified beneficiaries into one of four categories: (1) enrolled in MCCM, (2) enrolled directly into hospice, (3) declined to enroll in MCCM, or (4) died before enrollment. We then performed tabulations with this data set to conduct descriptive analyses in this report. As reported in Chapter II, MCCM program data indicate participating hospices enrolled 6,427 beneficiaries in MCCM. As shown in Table A.9, some participating hospices enrolled considerably more beneficiaries in the model than other participating hospices.

Table A.9. Distribution of MCCM enrollees across participating hospices

Hospice group characteristic	Hospices with low MCCM enrollment	Hospices with medium MCCM enrollment	Top 5 hospices with the highest MCCM enrollment	All MCCM hospices
Number of hospices	39	45	5	89[a]
Minimum count of MCCM enrollees	1	25	361	1
Maximum count of MCCM enrollees	23	209	875	875
Total number of MCCM enrollees	303	3,207	2,917	6,427

Hospice group characteristic	Hospices with low MCCM enrollment	Hospices with medium MCCM enrollment	Top 5 hospices with the highest MCCM enrollment	All MCCM hospices
Percentage of the total number of MCCM enrollees	5	50	45	100

Source: MCCM program data, January 1, 2013, to September 30, 2020.

[a] There were 141 hospices who were selected to participate in the model, but only 89 of them enrolled one or more beneficiaries in the model.

G. Hospice-level descriptive information

To analyze the hospice-level descriptive information reported in Chapter II, we started with MCCM hospice roster file from June 1, 2021. This file included all 141 hospices selected by CMS to participate in MCCM. and identified the subset of hospices participating the 2020 extension. We then merged this data set with a file created by Abt Associates that contained one record for all hospices in the nation, with baseline hospice characteristics for each hospice (see Section B.1.e in this appendix). The merged data set had 4,361 observations and contained characteristics of all hospices in Abt Associates' file regardless of whether they participated in MCCM. A few non-MCCM hospices were missing data on census region, chain affiliation, or hospice size. To analyze all hospices, we conducted multiple imputation of missing values by chained equations. Then, averaging across the imputed data sets to obtain a final estimate, we calculated the proportion of hospices with each characteristic for all MCCM participants, the hospices participating in MCCM 2021 extension, and all hospices in the file.

Appendix B:

File Construction and Description of Variables Used in the Analysis

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Exhibit B.1. Description of variables used to identify MCCM enrollees and the comparison beneficiaries

Has been enrolled in Medicare Part A and B for the past 12 months
Beneficiary was continuously enrolled in Medicare fee for service Part A and B with Medicare as their primary payer for the 12 months prior to their enrollment (or pseudo-enrollment) date. Data came from the Medicare Enrollment Database.

Had a Medicare Care Choices Model- (MCCM-) qualifying diagnosis
Beneficiary had at least one inpatient, outpatient, or carrier claim in the 12 months before their enrollment (or pseudo-enrollment) date with an International Classification of Diseases 10 Clinical Modification or International Classification of Diseases 9 Clinical Modification primary diagnosis for an MCCM-qualifying condition: cancer, chronic obstructive pulmonary disease, congestive heart failure, or human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). We used the definition from MCCM Resource Manual; the full list of diagnosis codes can be found in Appendix C, Table C.1.

Had at least one hospital encounter in past 12 months
Beneficiary had one hospital encounter (inpatient stay, emergency department visit, or observation stay) in the 12 months before their enrollment (or pseudo-enrollment) date. To identify hospital encounters, we used the approach described in Appendix Exhibit B.2 to count the number inpatient admissions, emergency department visits, or observation stays in the 12 months before their enrollment (or pseudo-enrollment) date, and then included those beneficiaries had at least one encounter.

Have had at least three office visits with any Medicare clinician in past 12 months
Beneficiary had at least three office visits with any Medicare eligible providers with the provider types listed in Appendix C, Table C.2 within the last 12 months before their enrollment (or pseudo-enrollment) date, including visits in a Federally Qualified Health Center, rural health clinic, and critical access hospital setting. Beneficiaries enrolled between January 1, 2016, and December 31, 2016 (as well as their matched comparisons) must also have met the requirement that all three office visits were with the same provider and for the beneficiary's terminal medical condition (cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS). During the COVID-19 pandemic, the CMS model team changed this model inclusion criterion to allow telehealth encounter to count as a visit. We accommodated this change in eligibility by including telehealth visit procedure codes in our measure of total office visits between March 6, 2020, and December 31, 2021. See the approach for defining office visits described in Appendix Exhibit B.2.

Have not elected Medicare hospice benefit in past 30 days[67]
Beneficiary did not elect the Medicare hospice benefit at enrollment (or pseudo-enrollment) and were not enrolled in the Medicare hospice benefit in the 30 days prior to enrollment date. Data comes from the Medicare Enrollment Database.

Did not reside in an institutional setting in the past 30 days
The actual eligibility rule is that an individual must live in a regular home, but this cannot be identified with available data. Instead, we excluded beneficiaries that resided in an institutional setting. Note that we could not reliably observe *all* instances of beneficiaries living outside of a traditional home setting

[67] We were unable to screen for enrollment in the Medicaid hospice benefit.

because not beneficiaries receive the care or assessments needed to identify them. However, since this rule was enforced for all enrollees, we thought it was important to remove them from the comparison group. We do this as follows:

To identify those that live in a nursing home, we used the Minimum Data Set assessments and identified those that had assessments indicating that they were living in a long-term care setting within four months before their enrollment date.[68] If yes, the individual was deemed ineligible.

To identify those in assisted living facilities and other congregate facilities, we identified those that had had a Part B medical claim with a place of service code indicating assisted living (13), group home (14), custodial care facility (33), or residential substance abuse treatment facility (55), or had a specific procedure codes (99324–99328 or 99334–99337) indicating care received in a domiciliary or rest home within 64 days before enrollment.[69] We used 64 days to allow for the gap between part B home visits (which allow us to identify their residence.) (Kimmey et al. forthcoming.) [70] because the two service types are often collocated.

We also identified those residing in assisted living facilities using Outcome and Assessment Information Set assessments. If the individual had an Outcome and Assessment Information Set assessment within 4 months (123 days) before their enrollment (or pseudo-enrollment) date that indicated the individual lived in an assisted living facility, we excluded that individual.

[68] The four-month requirement excludes beneficiaries who may be in the facility for short-term skilled nursing facility services for 100 days or less.
[69] We allowed for 64 days because current research suggests that is a typical gap between home care visits (Kimmey et al, forthcoming.)
[70] We did not include place of service codes for nursing facility (32) because this resulted in a large number of otherwise eligible MCCM enrollees being labeled ineligible. It is likely that place of service code 32 is picking up skilled nursing facility stays in addition to longer term nursing facility stays,

Exhibit B.2. Description of beneficiary baseline (pre-enrollment) covariates used for matching, balance checking, predictive risk modeling, and regression adjustment

a. Demographic and insurance characteristics at enrollment or pseudo enrollment

Age
Age in years, as of the beneficiary's enrollment (or pseudo-enrollment) date. We calculated age as the beneficiary's enrollment (or pseudo-enrollment) date minus their date of birth (as reported in the Medicare Enrollment Database), converted to whole years.

Sex
Beneficiary sex as reported in the Medicare Enrollment Database, equaled 0 if the beneficiary's sex is unknown, 1 if the beneficiary was male, or 2 if the beneficiary was female.[71]

Race and ethnicity
Beneficiary race/ethnicity as reported in the Research Triangle Institute race code (`RTI_RACE_CD`) variable in the Medicare Enrollment Database. The value was set equal to 1 if the beneficiary is non-Hispanic white, 2 if the beneficiary is Black. We modified the variable by combining "missing," "other," and "unknown" as a single category with the value of 3. We also included Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native in category 3.

Dual eligibility
Indicator for beneficiaries who receive full Medicaid benefits and/or assistance with Medicare premiums or cost sharing as of the beneficiary's enrollment (or pseudo-enrollment) date according to the Medicare Enrollment Database. A beneficiary was determined to be dually eligible for Medicare and Medicaid if values of 0, 1, 2, 3, 4, 5, 6 are the first digit in the Third Party Part B Premium Payer Code (`BENE_TP_PTB_PRM_PYR_CD`) which indicates the state was paying the part B premium during the calendar month.

Original reason for Medicare entitlement
Original reason for beneficiary Medicare entitlement from the Medicare Enrollment Database, equal to 0 if the beneficiary received old age and survivor's insurance, 1 if the beneficiary received disability insurance benefits, 2 if the beneficiary had end-stage renal disease, or 3 if the beneficiary received disability insurance benefits and has end-stage renal disease.

Region
Census region based on beneficiary's address in the Medicare Enrollment Database. This variable takes on one of four values: Northeast, South, Midwest, or West.

Rural
Indicator for rural status of the beneficiary's ZIP code of residence at their enrollment (or pseudo-enrollment) date, as measured by the Medicare Enrollment Database. We used data from the Federal Office of Rural Health Policy to identify rural ZIP codes. The Federal Office of Rural Health Policy counts as rural: (1) all non-Metro counties, (2) all areas with Rural-Urban Commuting Area codes 4-10, and (3) 132 large area census tracts with Rural-Urban Commuting Area codes 2 or 3 that are at least 400

[71] In many of the analytic steps, including matching and regression models, we changed categorical variables into an array of binary (indicator) measures indicating whether the beneficiary belonged to each category.

square miles in area with a population density of no more than 35 people per square mile. Following the 2010 Census the Federal Office of Rural Health Policy definition included approximately 57 million people, about 18% of the U.S. population and 84% of U.S. land area.

ZIP code characteristics
We included the following characteristics for the ZIP code of residence at the beneficiary's enrollment (or pseudo-enrollment) date, as measured by the Medicare Enrollment Database. We used data from the American Community Survey 5-year files for 2011-2015 for Cohort 1 hospices and 2013-2017 for Cohort 2 hospices. We combined all measures in a principal components analysis and used the resulting principal components in matching and as control variables in regression analysis. (For details, see Appendix A.)

1. *Median income*: Median household income (in dollars, inflation-adjusted to file data year)
2. *Poverty rate:* Percentage of families with income below the Federal Poverty level
3. *English proficiency:* Percentage of population ages 5 and over that speaks English well
4. *Percentage of population that was unemployed*: Percentage of population (ages 16 years and over) that was unemployed
5. *Percentage of population with less than high school education:* Percentage of population (ages 25 and over) with no schooling completed to 12th grade and no diploma (inclusive)
6. *Percentage of population with any postsecondary education:* Percentage of population (ages 25 and over) with some college to doctorate degree (inclusive)
7. *Percentage of population living in housing in structures with 10 or more units*: Percentage of population living in housing in structures with 10 or more units
8. *Percentage of population living in institutionalized group quarters*: Percentage of population living in institutionalized group quarters
9. *Percentage of population living in mobile homes*: Percentage of population living in mobile homes
10. *Population density:* Population density (based on 2010 Census)

Month/quarter during year when enrollment (or pseudo-enrollment) date falls
Indicator variable for quarter during the year when the beneficiary's enrollment (or pseudo-enrollment) date occurs. This takes the value of 1 for January, February, and March; 2 for April, May, and June; 3 for July, August, and September; and 4 for October, November, and December. (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix A, Sections B.2 and B.4.)

Participation in Accountable Care Organization Model
This variable indicates whether a beneficiary was participating in the Accountable Care Organization Model at the beneficiary's date of enrollment (or pseudo-enrollment). Accountable Care Organization enrollment was indicated by program ID code of 07 (Pioneer), 08 (Shared Savings Program), 21 (Next Generation Accountable Care Organization), or 18 (Comprehensive end-stage renal disease Care) in the Master Data Management data set.

Participation in Oncology Care Model
This variable indicates whether a beneficiary was participating in the Oncology Care Model at the beneficiary's date of enrollment (or pseudo-enrollment). We identified a beneficiary as participating in the Oncology Care Model if they had any Carrier claims with a G code of G9678 ("Monthly Enhanced Oncology Services") within 31 days prior to the beneficiary's date of enrollment (or pseudo-enrollment).

COVID-19 cohort
We defined the COVID-19 cohort as those who enrolled on or after September 1, 2019, which was six months before the start of the COVID-19 period on March 1, 2020. All those with enrollment (or pseudo-enrollment) dates on or before August 31, 2019, are assigned to the pre-COVID-19 cohort. (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix A, Sections B.2 and B.4.)

Days in the COVID-19 period
We defined days in the COVID-19 period as days in the follow-up period that occurred on or after March 1, 2020. The variable is set to zero, regardless of survival time, for those whose enrollment (or pseudo-enrollment) date was on or before August 31, 2019 (6 months before the start of the COVID-19 period). (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix A, Sections B.2 and B.4.)

COVID-19 diagnosis
We defined a diagnosis of COVID-19 as a primary diagnosis of B9729 in claims from January 1, 2020, through March 31, 2020, or a primary diagnosis of U071 in claims from April 1, 2020, to the end of the analysis period. We used inpatient, outpatient and carrier Part A and B claims to identify the diagnosis in each beneficiary's follow up period (that is, between a beneficiary's enrollment or pseudo-enrollment date and death).

b. Prior Medicare expenditures

Total Medicare (Part A plus Part B) expenditures in prior year
These measures are the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims with from-dates during a baseline period (each of four quarters before the [pseudo] enrollment date). These payments include any payments that the Centers for Medicare & Medicaid Services (CMS) made to providers for (1) participating in advanced alternative payment models (participating providers receive a 5 percent increase in their professional claims), or (2) for their performance under the Merit-Based Incentive Payment System. Medicare adjusts payments to providers through the amounts they pay on Part B claims, and these adjustments are already factored into the Part B claims in the Research Identifiable File. These measures exclude non-claims payments—that is, payments from CMS to providers that were made separately from claims.

Total Medicare (Part A plus Part B) expenditures two years prior
This measure is the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims with from-dates during the 12-month period starting 24 months and ending 12 months before the enrollment (or pseudo-enrollment) date.

Inpatient expenditures
These measures are the sum of Medicare Part A payments for inpatient claims with admission dates during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date).

Outpatient expenditures
These measures are the sum of Medicare Part B payments for outpatient claims and carrier claims not categorized as Part B drugs. This includes facility and professional fees for emergency department visits, observation stays that did not lead to an inpatient admission, and ambulatory care visits during a baseline period (each of four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date).

Part B drug expenditures
These measures are the sum of Medicare Part B payments for drugs covered by during a baseline period (each of four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). Specifically, we identified Medicare payments for claims lines in outpatient claims, carrier claims, and durable medical equipment claims files where the procedure code (Healthcare Common Procedure Coding System) was for a drug paid for under the Average Sales Price payment and that had a positive payment amount. We compiled a list of the unique Healthcare Common Procedure Coding System codes included in the Average Sales Price payment system, which CMS published quarterly, then identified outpatient, carrier, and durable medical equipment claims (or claim lines) where the Healthcare Common Procedure Coding System code was covered by Average Sales Price in the year in which the claim occurred or in the previous or following year.[72]

c. Prior health care use

Number of inpatient admissions
These measures are the number of Medicare-paid hospitalizations in acute, critical access, and children's hospitals in the Research Identifiable File inpatient claims file for the beneficiary with an admission date during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). Multiple claims for admissions that involved transfers between hospitals were combined into a single record, as were multiple claims for the same beneficiary at the same facility with overlapping dates, so that these count as one admission.

Days admitted to hospital
These measures are the number of days in acute, critical access, and children's hospitals reported in the Research Identifiable File inpatient claims file for the beneficiary during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). As was the case for the hospital admission measures described above, we combined multi-claim stays and transfers between hospitals into a single record. For a given hospital stay, the number of days was the discharge date minus the admission date plus one. Then we summed the number of days each beneficiary was admitted to the hospital across all hospital stays with an admission date during the respective baseline period.[73]

[72] The Medicare Part B drug ASP files are available at https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Part-B-Drugs/McrPartBDrugAvgSalesPrice (accessed December 4, 2020). The list of ASP drugs includes, in some years, temporary ("Q") codes that were only used for ASP drugs in certain years (and used for other purposes in other years). For this reason, we used a list of ASP HCPCS codes that varied by year.
[73] If a beneficiary was in the hospital on their [pseudo] enrollment date (this occurred main in the potential comparison group, when pseudo enrollment dates were chosen through an algorithm), we did not count the days after the [pseudo] enrollment as baseline inpatient days. Similar rules were used for related measures discussed below.

Number of inpatient intensive care unit days
These measures are the number of Medicare-paid days during which the beneficiary was in the intensive care unit during inpatient stays with an admission date during a baseline period (each of the four quarters before the [pseudo] enrollment date). For each hospitalization, the number of days in the intensive care unit equals the number of revenue units for claim line revenue center codes that equaled 020X or 021X. Then we summed the number of days each beneficiary was in the intensive care unit across all hospital admissions in the respective baseline period.

Number of days between enrollment (or pseudo-enrollment) date and most recent inpatient discharge
This measure is the number of days between the discharge from the Medicare-paid hospital stay with a discharge date closest to and before the enrollment (or pseudo-enrollment) date. The measure equals the enrollment (or pseudo-enrollment) date minus the discharge date. The measure was set to missing in the rare case that there was no discharge during this period.

Length of most recent hospital stay
This measure is the number of days admitted to a hospital for the Medicare-paid hospital admission with an admission date closest to and before the enrollment (or pseudo-enrollment) date. The number of days was the discharge date minus the admission date plus one.

Number of unique inpatient procedures
These measures are the number of Medicare-paid procedures that were performed during hospital stays with an admission date during a baseline period (each of the four quarters before the enrollment (or pseudo-enrollment) date). The measures equal the total number of *unique,* non-missing procedure code variables associated with the beneficiary's hospital stays during the respective baseline period.

Number of emergency department visits resulting in a hospital admission
These measures are the number of Medicare-paid hospitalizations with an admission date during a baseline period (each of the four quarters before the [pseudo] enrollment date) that included an emergency department visit or observation stay for the beneficiary. These measures include all-cause hospital admissions (see definition above) where at least one claim line revenue center code equaled 045X or 0981 (emergency room care) or 0762 (treatment or observation room).

Number of outpatient emergency department visits and observation stays
These measures are the sum of the number of outpatient emergency department visits and outpatient observation stays (see below) for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date).

Number of outpatient emergency department visits
These measures are the number of Medicare-paid outpatient emergency department visits for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date) that did not lead to a hospitalization. Visits that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 045X or 0981. We then capped the number of visits to one per day.

Number of outpatient observation stays
These measures are the number of Medicare-paid outpatient observation stays for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date) that did not lead to a

hospitalization. Stays that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 0760 or 0762, a corresponding Healthcare Common Procedure Coding System code of G0378, and a length of stay of at least eight hours. We then capped the number of visits to one per day.

Number of ambulatory visits with primary care providers and specialist physicians
These measures are the sum of the number of ambulatory visits with primary care providers and the number of ambulatory visits with specialist physicians (see below) for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date).

Number of ambulatory visits with primary care providers
These measures are the number of Medicare-paid visits with primary care practitioners (regardless of place of service), at clinics (Federally Qualified Health Centers and rural health clinics), and with nurse practitioners, physician assistants, and other advanced practice nurses during a baseline period (each of the four quarters before the [pseudo] enrollment date). This measure includes (1) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was a primary care;[74] (2) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was a nurse practitioner, physician assistant, or other advanced practice nurse; and (3) outpatient claims with an ambulatory evaluation and management procedure code provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital.[75] Provider types are defined in Appendix C, Table C.2. Most of the visits in the latter two categories are expected to be for primary care, although the measure might capture some visits for other services, including visits with specialist or behavioral health providers. The main reason these visits are grouped together is that the Medicare specialty field on the claims data does not include more detailed specialty data for nurse practitioner, physician assistant, and other advanced practice nurses. Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulatory visits with specialist physicians
These measures are the number of Medicare-paid visits with specialist during a baseline period (each of the four quarters before the [pseudo] enrollment date). Specifically, they include carrier claim lines with an ambulatory evaluation and management procedure code (see previous definition) and the provider's Medicare provider specialty category indicated the provider was a specialist physician (as defined in Appendix C, Table C.2). Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulance transports
These measures are the number of emergency medical services ambulance transports for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date). The number of ambulance transports was identified from Medicare carrier and outpatient claims with a procedure code of

[74] See list of relevant codes in Appendix C, Table C.3.
[75] Outpatient Claims with an Ambulatory Evaluation and Management Procedure Code (from Appendix C, Table C.3) provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital. Revenue center code equal to 0510, 0513, 0514, 0515, 0517, 0519, 0520, 0521, 0522, 0523, 0527, 0528, or 0529 plus one of the following: (1) Federally Qualified Health Center claim; (2) rural health clinic claim; (3) critical access hospital claim (see Appendix C, Table C.4).

A0425-A0436 and associated procedure modifier code of "EH," "RH," or "SH" to indicate transport from home, residential facility, or scene of an accident to the hospital and to rule out transports between hospitals or to/from dialysis clinics. We then capped the number of transports to one per day.

Number of skilled nursing facility days
These measures are the number of Medicare-paid days in a skilled nursing facility during the baseline period (each of the four quarters before the [pseudo] enrollment date). For skilled nursing facility claims with overlapping time periods, we only counted each day once. These measures included service use recorded in the Research Identifiable File skilled nursing facility claims file for which Medicare made a positive payment. It included skilled nursing services provided in swing beds in short term acute care hospitals or critical access hospitals.

Number of home health visit days
This measure is the number of Medicare-paid home health visit days in the baseline period (each of the four quarters before the [pseudo] enrollment date). Specifically, we included home health visits covered by Medicare Part A recorded in the Research Identifiable File home health claims file with positive payment amounts, except for interim "request for anticipated payment" claims. We included home health visits covered by Part A alone, covered by Part B alone, or covered by both Part A and B. We identified each day a visit occurred and summed the number of days. If multiple visits occurred on the same day, it was only counted once.

Number of durable medical equipment claims for any equipment and for specific subcategories
These measures are the number of unique Medicare-paid claims for any durable medical equipment during the baseline period (each of the four quarters before the [pseudo] enrollment date) in the durable medical equipment Research Identifiable File. In addition, we measured the number of durable medical equipment claims for oxygen equipment, home hospital beds, walkers or canes, and wheelchairs.[76]

Had an advance care planning visit in the previous two years
This measure is an indicator of whether a beneficiary had advance care planning visit, including the explanation and discussion of standard forms, with a physician or other qualified health care professional within 24 months of their enrollment (or pseudo-enrollment). We set the measure equal to 1 if the beneficiary received a service in carrier claims with billing code 99497 and 0 otherwise.

d. Health at enrollment

Indicator for each of four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, and HIV/AIDS
These measures are indicators of which MCCM-qualifying diagnosis a beneficiary had. Beneficiaries whose primary diagnosis on inpatient, outpatient, or carrier claims submitted within a year of enrollment (or pseudo-enrollment) falls within a list of MCCM-eligible International Classification of Diseases 10 Clinical Modification diagnosis codes and corresponding International Classification of Diseases 9 Clinical Modification diagnosis codes are considered to have cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS. Among those with an MCCM-qualifying cancer diagnosis, we further stratified beneficiaries by the type of cancer they had: breast, lung, colorectal, prostate, or other. The full list of diagnosis codes can be found in Appendix C, Table C.1.

[76] See list of relevant codes in Appendix C, Table C.5.

CMS hierarchical condition category score
This measure represents the prospective (expected) medical cost of a beneficiary in the coming year and is based on community scores calculated using CMS's 2020 risk-adjustment model. There were 77 hierarchical condition categories each month for each enrolled beneficiary in MCCM impact evaluation at the time of their enrollment (or pseudo-enrollment) date. We used Medicare claims and Version 21 of the hierarchical condition category software. We used the community score for those with at least 10 months of observability in the 13 to 24 months before enrollment (or pseudo-enrollment) and we used the new enrollee score for beneficiaries who were enrolled for less than 10 months during that time period.

CMS hierarchical condition category score prior year
This measure represents the prospective (expected) medical cost one year before a beneficiary's enrollment (or pseudo-enrollment) date. We calculated this measure the same as above, except that we calculated the beneficiary's hierarchical condition category scores as of their enrollment (or pseudo-enrollment) date minus 365 days. We used Version 21 of the hierarchical condition category software. We used the community score for those with at least 10 months of observability in the 13 to 24 months before enrollment (or pseudo-enrollment) and we used the new enrollee score for beneficiaries who were enrolled for less than 10 months during that time period.

Individual hierarchical condition category condition variables
These are a group of 83 indicators used to consolidate beneficiaries into hierarchical condition categories based on their International Classification of Diseases 9 Clinical Modification and International Classification of Diseases 10 Clinical Modification diagnosis codes in a beneficiary's baseline year (one year before enrollment or pseudo-enrollment date).[78,79] These indicators are assigned using Medicare claims and a master format library that includes International Classification of Diseases 9 and International Classification of Diseases 10 codes and are equal to 1 when CMS's 2020 risk-adjustment model software identifies the condition as present and 0 otherwise.

Number of medical encounters (in carrier, inpatient, and outpatient claims) for each of 20 conditions from the Gagne comorbidity index
These measures are the number of physician encounters, inpatient stays, and outpatient visits for the beneficiary for each of 20 conditions identified by Gagne et al. (2011) to be significant predictors of mortality among the elderly.[80] We calculated these measures for the baseline period (quarter 1 and quarters 2 to 4 before the [pseudo] enrollment date). The full list of conditions and their definitions are described in Appendix C, Table C.7.

[77] CMS's 2020 risk adjustment software and ICD-10 mappings are available at the following link: https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors-Items/Risk2020.
[78] See list of relevant codes in Appendix C, Table C.6.
[79] CMS's 2020 risk adjustment software and ICD-10 mappings are available at the following link: https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors-Items/Risk2020.
[80] For ICD-9 mappings to condition categories, see Gagne et al.'s SAS program, which is available at the following link: https://scholar.harvard.edu/files/gagne/files/jjg-comorbidity-sas-program.txt. Condition categories include the following: alcohol or other drug abuse or dependence (ICD-9-CM 291x, 3039x, 3050x; ICD-10-CM V113, F101x, F102x, F109x), any tumor (includes leukemia and lymphoma), cardiac arrhythmias, CHF, coagulopathy, complicated diabetes, chronic obstructive pulmonary disease, deficiency anemias, dementia, fluid and electrolyte disorders), hemiplegia (ICD-9-CM 342x, 344x; ICD-10-CM G81x, G82x, G83x), HIV/AIDS, hypertension (both complicated/uncomplicated), liver disease, metastatic cancer, peripheral vascular disorder, psychosis, pulmonary circulation disorders, renal failure, and weight loss. We identify these types of services using the diagnosis and procedure codes listed in Appendix C, Table C.7.

Up to 530 clinical categories based on the Agency for Healthcare Research and Quality Clinical Classification Software
These measures are a series of clinical classification flags created using the Agency for Healthcare Research and Quality's Clinical Classification Software for claims submitted prior to September 30, 2015, and Clinical Classifications Software Refined for claims submitted after October 1, 2015. Flags were created using primary diagnosis codes appearing inpatient, outpatient, and carrier claims in the previous 12 months. We set each flag equal to 1 if the condition is met for at least one of the beneficiary's claims, and 0 otherwise. Variables are measured based on the presence of International Classification of Diseases 9 Clinical Modification and International Classification of Diseases 10 Clinical Modification diagnosis codes found in inpatient and outpatient facility claims and carrier claims submitted before the beneficiary's enrollment (or pseudo-enrollment) date.

Activities of daily living
This measure is a count of the number (up to 6) of activities of daily living from functional status assessments measured in any Outcome and Assessment Information Set data within 30 days prior to a beneficiary's enrollment (or pseudo-enrollment) date. We restricted this measurement to those measured in the 30 days before enrollment (or pseudo-enrollment)—about one-third of MCCM enrollees—to ensure that the measure was reflective of the beneficiary's health status at the start of the follow-up period, because activities of daily living can change over the course of several home health visits, especially if the beneficiary was released from an acute or another post-acute care setting just before the beginning of home health services. We also included an indicator and interaction term for whether the assessment was conducted at discharge from home health services, because activities of daily living measured at discharge are likely to reflect the beneficiary's highest level of functioning, while assessments at entry are expected to improve. Finally, we accounted for missing values through a variable that indicated whether a beneficiary was assessed as a part of receiving home health services in the 30 days before enrollment (or pseudo-enrollment).

Measures of acute care hospitalization at enrollment (or pseudo-enrollment)
In order to capture the trajectory of beneficiary health care utilization at the start of the follow up period, we included indicators for the following events on a beneficiary's enrollment (or pseudo-enrollment) date (1) they were admitted to an acute care hospital, (2) they were in the middle of an acute care hospitalization (admitted before and discharged after [pseudo] enrollment date), or (3) they were discharged from an acute care hospital in the inpatient claims data.

Measures of skilled nursing facility services at enrollment (or pseudo-enrollment)
We also included indicators for the following events on a beneficiary's enrollment (or pseudo-enrollment) date: (1) they were admitted to a skilled nursing facility, (2) they were in the middle of skilled nursing facility stay (admitted before and discharged after [pseudo] enrollment date), or (3) they were discharged from a skilled nursing facility in the skilled nursing facility claims data.

e. Disease-specific measures

Number of medical encounters (in carrier, inpatient, outpatient claims) for each of four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, and HIV/AIDS
These four measures capture the number of physician encounters, inpatient stays, and outpatient visits that the beneficiary had for each of the four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS during the baseline period (each of the four quarters before the [pseudo] enrollment date). We restricted this count to only include up to one encounter per day to avoid

double-counting in cases where multiple claims were submitted for the same medical encounter (for example, separate claims for an office visit and laboratory test on the same day).

Congestive heart failure

Any coronary artery bypass surgery in the 2 years before enrollment
This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving a coronary artery bypass surgery. We identify these surgeries using the codes listed in Appendix C, Table C.8 among paid inpatient claims with admission dates in the year prior to enrollment (or pseudo-enrollment).

Any percutaneous intervention in the 2 years before enrollment
This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving a percutaneous intervention. We identify percutaneous interventions using the codes listed in Appendix C, Table C.8 among paid inpatient claims with admissions dates in the year prior to enrollment (or pseudo-enrollment).

Prior insertion of an automatic implantable cardioverter defibrillator in the 2 years before enrollment
This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving the insertion of an automatic implantable cardioverter defibrillator. We identify automatic implantable cardioverter defibrillator insertions using the codes listed in Appendix C, Table C.8 in paid inpatient claims admission dates in the year prior to enrollment (or pseudo-enrollment).

Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)
This measure is an indicator of whether the beneficiary was hospitalized with inotropes or a cardiac procedure at any point within days 1-90 or days 91-365 prior to enrollment or pseudo-enrollment. We identify these hospitalizations using the codes listed in Appendix C, Table C.8 in paid inpatient claims with admission dates in the year prior to enrollment (or pseudo-enrollment). These definitions are from Parikh et al. (2019).

Participated in outpatient cardiac rehabilitation program
This measure is an indicator of whether the beneficiary received physician services for outpatient cardiac rehabilitation during the baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date) or in the follow-up period. We identify these services in paid carrier and outpatient claims using the codes listed in Appendix C, Table C.8.

Number of congestive heart failure related events
We defined congestive heart failure related versions of several measures by adding the additional condition that the event also had a primary diagnosis of congestive heart failure (See Appendix C, Table C.1 for a list of diagnosis codes). All measures were defined using claims data for the same time periods as the main measures above. We included the following congestive heart failure related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days

4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

Chronic obstructive pulmonary disease[81]

Lung cancer or thoracic malignancies
These measures are indicators of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with lung cancer or a thoracic malignancy. We identified lung cancer or thoracic malignancies in outpatient claims using the codes listed in Appendix C, Table C.9.

Nutritional abnormalities
The measures are indicators of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with nutritional abnormalities. We identified nutritional abnormalities in outpatient claims using the codes listed in Appendix C, Table C.9.

Skeletal muscle dysfunction
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with skeletal muscle dysfunction. We identified skeletal muscle dysfunction in outpatient claims using the codes listed in Appendix C, Table C.9.

Osteoporosis
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with osteoporosis. We identified osteoporosis in outpatient claims using the codes listed in Appendix C, Table C.9.

Bone fracture
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with a bone fracture. We identified bone fractures in outpatient claims using the codes listed in Appendix C, Table C.9.

Glaucoma
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with glaucoma. We identified glaucoma in outpatient claims using the codes listed in Appendix C, Table C.9.

[81] Several of these variables are indicators of chronic obstructive pulmonary disease severity and were described in Macaulay et al. (2013). It should be noted, however, that Macaulay et al. used managed care administrative data, and used older ICD-9 codes which we converted to ICD-10 codes.

Obesity-related condition
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with an obesity-related condition. We identified obesity and overweight in outpatient claims using the codes listed in Appendix C, Table C.9.

Chronic obstructive pulmonary disease exacerbation
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with exacerbation. We identified chronic obstructive pulmonary disease exacerbation in inpatient claims using International Classification of Diseases 9 Clinical Modification codes 49x and in outpatient claims using the codes listed in Appendix C, Table C.9.

Number of respiratory therapist visits
These measures are the number of respiratory therapy specialist visits during the baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date) and in the follow-up period that were related to chronic obstructive pulmonary disease. We constructed these measures the same way as the number of chronic obstructive pulmonary disease related specialty care visits but restricted to carrier and outpatient claims with the codes listed in Appendix C, Table C.11.

Any hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation
This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease was hospitalized in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) and received lung volume reduction surgery, oxygen therapy, or ventilation, according to inpatient claims data. See Appendix C, Table C.11.

Number of chronic obstructive pulmonary disease related events
We defined chronic obstructive pulmonary disease related versions of several measures by adding the additional condition that the event also had a primary diagnosis of chronic obstructive pulmonary disease (See Appendix C, Tables C.1 for a list of diagnosis codes). All measures were defined using claims data for the same time periods as the main measures above. We included the following chronic obstructive pulmonary disease related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days
4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

Cancer

Type/location of cancer
These are indicators of the specific type or location of cancer diagnoses that beneficiaries had in the year before (pseudo) enrollment. We construct indicator flags for the four most common lethal cancers

affecting Medicare beneficiaries—breast, colorectal/anorectal, lung, and prostate—as well as an indicator for other types of cancers (See Appendix C, Table C.1 for a list of diagnosis codes). Our process for flagging cancer location/type is based on our process for determining whether the beneficiary qualified for MCCM based on having cancer, described in Section II.B.2.b). To ensure that a beneficiary's specific cancer type is correctly identified, we assign a beneficiary a breast cancer, colorectal cancer, lung cancer, or prostate cancer flag if they have at least one paid inpatient or skilled nursing facility claim or at least two outpatient or provider claims prior to enrollment (or pseudo-enrollment) with International Classification of Diseases 9 Clinical Modification or International Classification of Diseases 10 Clinical Modification codes indicating the condition. We identified beneficiaries as having other cancers if they had at least one paid claim with a diagnosis code falling in the other cancers' category prior to enrollment (or pseudo-enrollment).

Poor prognosis solid and hematological malignancies
This measure is an indicator of poor prognosis cancers *other* than the four main cancers of lung, colon, prostate, or breast (Obermeyer et al. 2014). We identify these cancers in inpatient, outpatient, and carrier claims using the codes listed in Appendix C, Table C.12. The measure is equal to 1 if one or more of these diagnosis codes is present on inpatient, outpatient, or carrier claims, and 0 otherwise.

Diagnosis, drug, and procedure codes indicating advanced stage or poor prognosis lung, colon, breast, and prostate cancers
These measures indicate whether the beneficiary had diagnosis codes,[82] received drugs,[83] or had procedures[84] indicating advanced-stage or poor-prognosis cancer. There is one indicator for each of the four most common cancer types (based on the beneficiary's primary cancer diagnosis, as defined above), which equals 1 if the beneficiary has an inpatient, outpatient, or carrier claim containing any of these diagnosis, drug, or procedure codes.

Hormonal therapy, alone or with surgery for excision, within one year of enrollment
This measure indicates that a beneficiary with breast cancer may have early-stage disease. We used claims data to identify beneficiaries who received hormonal therapies commonly given to beneficiaries diagnosed with early-stage breast cancer, alone or with a lumpectomy: tamoxifen, anastrozole, letrozole, and exemestane.[85]

Number of cancer related events
We defined cancer related versions of several measures by adding the additional condition that the event also had a primary diagnosis of cancer (See Appendix C for a list of diagnosis codes). All measures were defined for the same time periods as the main measures above. We included the following cancer related measures: Inpatient admissions, inpatient days, intensive care unit days, outpatient emergency department visits and observation stays, primary care visits, specialty care visits, and skilled nursing facility days.

Number of cancer-related events
We defined cancer-related versions of several measures by adding the additional condition that the event also had a primary diagnosis of cancer (See Appendix C, Tables C.1 for a list of diagnosis codes). All

[82] Diagnosis codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix C, Table C.12.
[83] Drug codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix C, Table C.13.
[84] Procedure codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix C, Table C.14.
[85] See list of relevant codes in Appendix C Table 15.

measures were defined using claims data for the same time periods as the main measures above. We included the following cancer related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days
4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

Exhibit B.3. Description of outcome variables

The following financial outcome measures are measured from the day after enrollment (or pseudo-enrollment) to the end of the study period (March 31, 2021). We used this period since it captures all the expenditures that Medicare has paid. The following utilization measures are measured from the day after the enrollment (or pseudo-enrollment) date to the beneficiary's death or the end of the study period, whichever comes first.

a. Expenditure measures

Medicare Part A and B expenditures plus MCCM payments
This measure is the sum of Medicare payments for Part A and B services and expenditures for services provided through MCCM. The two components of this measure, payments for Medicare Part A and B services and MCCM payments, are described in more detail below.

Medicare Part A and B expenditures
This measure is the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims. These payments will include any payments that CMS made to providers for (1) participating in advanced alternative payment models (participating providers receive a 5 percent increase in their professional claims), or (2) for their performance under the Merit-Based Incentive Payment System. Medicare adjusts payments to providers through the amounts they pay on Part B claims, and these adjustments are already factored into the Part B claims in the Research Identifiable File. This measure excludes MCCM payments and non-claims payments—that is, payments from CMS to providers that were made separately from claims.

Inpatient expenditures
This measure is the sum of Medicare Part A payments for inpatient claims with admission dates during the study period.

Hospice expenditures
This measure is the sum of Medicare payments for hospice services that started during the study period excluding MCCM payments.

Skilled nursing facility expenditures
This measure is the sum of Medicare payments for stays at skilled nursing facilities that started during the study period. We identified skilled nursing facility payments from Medicare skilled nursing facility claims.

Home health expenditures
This measure is the sum of Medicare payments for home health services during the study period. We identified home health payments from Medicare home health claims.

Part B drug expenditures
This measure is the sum of Medicare Part B payments for drugs during the study period. Specifically, we identified Medicare payments for claims lines in outpatient claims, carrier claims, and durable medical equipment claims files where the Healthcare Common Procedure Coding System procedure code was for a drug paid for under the Average Sales Price payment and that had a positive payment amount. We

compiled a list of the unique Healthcare Common Procedure Coding System codes included in the Average Sales Price payment system, which CMS published quarterly, then identified outpatient, carrier, and durable medical equipment claims (or claim lines) where the Healthcare Common Procedure Coding System code was covered by Average Sales Price in the year in which the claim occurred or in the previous or following year (see footnote 72).

Durable medical equipment expenditures
This measure is the sum of Medicare payments for durable medical equipment. We identified durable medical equipment payments from Medicare durable medical equipment claims.

Other expenditures
This measure is the sum of Medicare Part A and B payments that do not fall into the categories of inpatient, hospice, skilled nursing facility, home health, Part B drugs, or durable medical equipment payments. Other expenditures include payments for outpatient, primary care, and specialist visits and were identified from Medicare outpatient and carrier claims.

MCCM payments
This measure is the sum of Medicare payments to participating hospices for MCCM services, identified by code 73.

b. Service Use

Number of inpatient admissions
This measure is the number of Medicare-paid hospital admissions reported in the Research Identifiable File inpatient claims file for the beneficiary in the study period. Multiple claims for admissions that involved transfers between hospitals were combined into a single record, as were multiple claims for the same beneficiary at the same facility with overlapping dates, so that these count as one admission.

Days admitted to hospital
This measure is the number of days in the hospital reported in the Research Identifiable File inpatient claims file for the beneficiary in the study period. As was the case for the hospital admission measure described above, we combined multi-claim stays and transfers between hospitals into a single record. For a given hospital stay, the number of days was the discharge date minus the admission date plus one. Then we summed the number of days each beneficiary was admitted to the hospital across all hospital admissions in the period.

Days in hospital intensive care unit
This measure is the number of Medicare-paid days during which the beneficiary was in the intensive care unit during inpatient stays with an admission date during the study period. For each hospitalization, the number of days in the intensive care unit equals the number of revenue units for claim line revenue center codes that equaled 020X or 021X. Then we summed the number of days each beneficiary was in the intensive care unit across all hospital admissions in the period.

Days in hospital without intensive care unit
This measure is the number of Medicare-paid days during which the beneficiary was not in the (intensive care unit during inpatient stays with an admission date during the study period. It was calculated as the

difference between the number of days admitted to a hospital and the number of days in hospital intensive care unit.

Number of 30-day all-cause readmissions
This measure is the number of discharges (the "index" admissions) that were followed by a Medicare-paid hospital admission within 30 days, regardless of whether the readmission was planned or unplanned and regardless of whether the readmission occurred at the same hospital or a different hospital. For an inpatient discharge to qualify as an index admission, the beneficiary must have (1) been alive at discharge and (2) not been discharged against medical advice. In addition, certain admissions were excluded from the universe of index admissions, including discharges with lengths of stay longer than one year; stays at cancer hospitals exempt from the Prospective Payment System; and stays for psychiatric conditions, rehabilitation, or cancer. Our definition of this measure is based on the Yale readmission measure developed by the Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE 2018) that is used in the Hospital Readmission Reduction Program under Section 3025 of the Affordable Care Act (CMS QualityNet 2020). An admission that counts as a readmission because it fell within 30 days of an earlier index stay also can count as an index stay for a potential subsequent readmission if it meets the index admission inclusion criteria.

Number of ambulance transports
This measure is the number of Medicare-paid land, air, and water ambulance transports for the beneficiary. The number of ambulance transports was identified from Medicare carrier claims with a place of service code indicating either land ambulance (41) or air or water ambulance (42).

Number of outpatient emergency department visits and observation stays
This measure is the sum of the number of Medicare-paid outpatient emergency department visits and the number of observation stays that did not lead to a hospitalization. See below for details on emergency department visits and observation stays.

Number of outpatient emergency department visits
This measure is the number of Medicare-paid outpatient emergency department visits for the beneficiary that did not lead to a hospitalization. Visits that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 045X or 0981.

Number of outpatient observation stays
This measure is the number of Medicare-paid outpatient observation stays for the beneficiary that did not lead to a hospitalization. Stays that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 0760 or 0762, a corresponding Healthcare Common Procedure Coding System code of G0378, and a length of stay of at least eight hours.

Number of ambulatory visits with primary care providers and specialist physicians
This measure is the sum of number of Medicare-paid ambulatory visits with primary care providers and number of Medicare-paid specialist physicians.

Number of ambulatory visits with primary care providers
This measure is the number of Medicare-paid visits with primary care practitioners, at clinics (Federally Qualified Health Centers and rural health clinics), critical access hospitals, and with nurse practitioners, physician assistants, and other advanced practice nurses. This measure includes (1) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was a primary care; (2) Carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was an nurse practitioner, a physician assistant, or other advanced practice nurse; and (3) outpatient claims with an ambulatory evaluation and management procedure code provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital. Provider types are defined in Appendix C, Table C.2 and additional details can be found in footnotes 74 and 75. Most of the visits in the latter three categories are expected to be for primary care, although the measure might capture some visits for other services, including visits with specialist or behavioral health providers. The main reason these visits are grouped together is that the Medicare specialty field on the claims data does not include more detailed specialty data for nurse practitioners, physician assistants, and other advanced practice nurses. Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulatory visits with specialist physicians
This measure is the number of Medicare-paid visits with specialist during the study period. Specifically, it includes carrier claim lines (see previous definition) with the provider's Medicare provider specialty category indicating the provider was a specialist physician (as defined in Appendix C, Table C.2). Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of post-acute care days
This measure is the number of Medicare-paid days of post-acute care services; it is the sum of four components: (1) skilled nursing facility days, (2) number of home health visit days, (3) inpatient rehabilitation facility days, and (4) long-term care hospital days. The number of days in skilled nursing facilities is the sum of unique days covered by claims in the skilled nursing facility claims file for which Medicare made a positive payment and includes services provided in swing beds in short-term acute care hospitals or critical access hospitals. The number of home health visit days is defined as the number of days during which a home health visit took place. The visits had to be had to be covered by Part A alone or covered by both Part A and B.[86] (If multiple home health visits occurred on the same day, it was counted only as one day. The number of days in inpatient rehabilitation facilities is defined as the sum of unique days covered by claims in the inpatient claims file for which Medicare made a positive payment and (1) the provider was an inpatient rehabilitation hospital or unit; (2) revenue center code or 0024, 0118, 0128, 0138, 0148, or 0158; or (3) an inpatient primary diagnosis that is grouped by the Agency for Healthcare Research and Quality Clinical Classification Software into category 254 (rehabilitation care; fitting of prostheses; and adjustment of devices). The number of days in long-term care hospitals is defined as the sum of unique days covered by claims in the inpatient claims file for which Medicare made a positive payment and the provider was a long-term care hospital.

[86] This limits to home health visits most likely provided after qualifying inpatient stays; many home health visits covered by Part B are not post-acute).

c. Hospice-related measures

Elected the Medicare hospice benefit
This measure is an indicator of whether the beneficiary elected the Medicare hospice benefit at any point during the study period. We consider a beneficiary to have elected the Medicare hospice benefit if they have one or more hospice claims where the demonstration identification number was not equal to 73, which would indicate participation in MCCM. This definition was adapted from National Quality Forum measure 0215.

Length of time from enrollment (or pseudo-enrollment) to electing hospice benefit
This measure is the number of days between a beneficiary's enrollment (or pseudo-enrollment) and the from date the next following hospice claim for hospice services.[87])

Number of days in hospice
This measure is the total number of Medicare-paid days for hospice care received by the beneficiary. The number of days in hospice is defined as the sum of days across all of a beneficiary's hospice claims whose admission date was in the period. The measure is set to zero if a beneficiary did not elect the hospice benefit during the follow up period.

Admitted to hospice less than three days before death
This measure is an indicator of whether the beneficiary enrolled in the Medicare hospice benefit and was admitted to hospice fewer than three days prior to their death. (The measure was set to missing for beneficiaries who did not die in the follow up period.)

d. Quality Measures

Received an aggressive life-prolonging treatment in the last 30 days of life
This measure indicates whether a beneficiary received treatments (after enrollment or pseudo-enrollment) that are generally believed to be inappropriate at the end of life and are therefore indicative of low-quality care in the last 30 days of life. Such treatments may include mechanical ventilation (CPT 94003), hemodialysis (CPT 90935-90940), enteral or parenteral nutrition (CPT 43761; HCPCS B40-B42, B50-B52, B90, B99), and cardiopulmonary resuscitation (CPT 92950)(Wasp et al. 2020; DeSchreye et al. 2018; DeSchreye et al. 2017) . In addition, at the end of their lives, beneficiaries with cancer might receive infusion or oral chemotherapy (RC 0331-0335; ICD-9-CM 9925; CPT 96401-96450, 96521-96542; HCPCS J85-J99, Q0083-Q0085) (Wasp et al. 2020; DeSchreye et al. 2017; Earle et al. 2005). Beneficiaries with chronic obstructive pulmonary disease might receive endotracheal intubation or tracheotomy (CPT 31500, 31605), lung volume reduction surgery (CPT 32491), coronary or abdominal surgery (CPT 229x, 441x-442x, 451x, 492x-493x, 929x-935x; HCPCS G0269), spirometry (CPT 940x, 94150, 94200, 94375, 94727), phlebotomy for diagnostic testing (CPT 99195), or electrocardiography (CPT 930x) (DeSchreye et al. 2018; DeSchreye et al. 2017). The measure is an indicator of whether the beneficiary received one or more of the above-mentioned treatments from after enrollment (or pseudo-enrollment) in the last 30 days of life.

[87] For certain planned time-to-event analyses, such as Cox proportional hazard regression models, we recoded missing data to the length of observed follow-up, using it in conjunction with the previous measure (whether, yes or no, the beneficiary elected the hospice benefit).

Days at home
This is a measure of the number of days the beneficiary spent at home from the time of enrollment (or pseudo-enrollment) to the time of death or the study period end. We define this measure as the number of days between enrollment and death for a beneficiary, less days spent in hospitals, inpatient rehabilitation facilities, long term care hospitals, and skilled nursing facilities. The measure was adapted from Lee et al. (2019) and Medicare Payment Advisory Commission (2015).

More than one emergency department visit in last 30 days of life
This measure indicates whether a decedent had more than one emergency department visits in the last 30 days of life. Emergency department visits were identified the same way as we described above. This measure is based on National Quality Forum measure 0211. (The measure was set to missing for beneficiaries who did not die in the follow up period.)

More than one hospitalization in last 30 days of life
This measure indicates whether a decedent had more than one inpatient admission in the last 30 days of life. Inpatient admissions were identified the same way as we described above. This measure is based on National Quality Forum measure 0212. (The measure was set to missing for beneficiaries who did not die in the follow up period.)

Any intensive care unit admission in last 30 days of life
This measure indicates whether a decedent had any intensive care unit admissions in the last 30 days of life. Intensive care unit admissions were identified the same way as we described above. This measure is based on National Quality Forum measure 0213. (The measure was set to missing for beneficiaries who did not die in the follow up period.)

Rate of death in the hospital
This is a measure of the proportion of beneficiaries who died in hospital. It is defined as the proportion of decedents, with one or more inpatient facility claims (hospital, skilled nursing facility, rehabilitation hospital, or long-term acute care hospital) claims in which discharge status is "expired" (discharge status code 20). (The measure was set to missing for beneficiaries who did not die in the follow-up period.)

Survival time: length of time from enrollment (or pseudo-enrollment) until death
This is a measure of how long beneficiaries lived were alive after enrollment (or pseudo-enrollment). It is defined as the number of days between a beneficiary's enrollment (or pseudo-enrollment) date and the death date. It is set to missing for beneficiaries who did not die during the study period.

Appendix C:

Detailed Information on Health Care Measures

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A. Eligibility measures

Table C.1. Diagnosis codes indicating each of the four MCCM-eligible conditions

Disease		Code system	Codes
Congestive heart failure		ICD-9-CM	4280, 4281, 4289, 40201, 40211, 40291, 40401, 40411, 40491, 42820, 42821, 42822, 42823, 42830, 42831, 42832, 42833, 42840, 42841, 42842, 42843
		ICD-10-CM	I110, I130, I501, I502, I5020, I5021, I5022, I5023, I503, I5030, I5031, I5032, I5033, I504, I5040, I5041, I5042, I5043, I509
Chronic obstructive pulmonary disease		ICD-9-CM	4920, 4928, 4940, 4941, 49120, 49121, 49122, 49320, 49321
		ICD-10-CM	J430, J431, J432, J438, J439, J440, J441, J449, J470, J471, J479
HIV/AIDS		ICD-9-CM	042
		ICD-10-CM	B20
Cancer	Breast	ICD-9-CM	1740, 1741, 1742, 1743, 1744, 1745, 1746, 1748, 1749, 1750, 1759
		ICD-10-CM	C50011, C50012, C50019, C50021, C50022, C50029, C50111, C50112, C50119, C50121, C50122, C50129, C50211, C50212, C50219, C50221, C50222, C50229, C50311, C50312, C50319, C50321, C50322, C50329, C50411, C50412, C50419, C50421, C50422, C50429, C50511, C50512, C50519, C50522, C50529, C50611, C50612, C50619, C50621, C50622, C50629, C50811, C50812, C50819, C50821, C50822, C50829, C50911, C50912, C50919, C50921, C50922, C50929, C7981, C946
Cancer	Colorectal	ICD-9-CM	1520, 1521, 1522, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1548, 20901, 20902, 20903, 20910, 20911, 20912, 20913, 20914, 20915, 20916, 20917
		ICD-10-CM	C170, C171, C172, C180, C181, C182, C183, C184, C185, C186, C187, C188, C189, C19, C20, C218, C785, C7A010, C7A011, C7A012, C7A020, C7A021, C7A022, C7A023, C7A024, C7A025, C7A026, C7A029, C7A094, C7A095, C7A096, C883
Cancer	Lung	ICD-9-CM	1622, 1622, 1623, 1623, 1624, 1624, 1625, 1628, 1629, 1764
		ICD-10-CM	C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C4650, C4651, C4652, C7800, C7801, C7802, C7A090

Disease		Code system	Codes
Cancer	Other	ICD-9-CM	1400, 1401, 1403, 1404, 1405, 1406, 1408, 1409, 179, 181, 193, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1418, 1419, 1420, 1421, 1422, 1428, 1429, 1430, 1431, 1438, 1439, 1440, 1441, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1478, 1479, 1480, 1481, 1482, 1483, 1488, 1489, 1490, 1491, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1523, 1528, 1529, 1542, 1543, 1550, 1551, 1552, 1560, 1561, 1562, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1591, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1608, 1609, 1610, 1611, 1612, 1613, 1618, 1619, 1620, 1630, 1631, 1638, 1639, 1639, 1640, 1640, 1641, 1641, 1642, 1642, 1643, 1643, 1648, 1648, 1649, 1649, 1650, 1650, 1658, 1658, 1659, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 17301, 17302, 17309, 1760, 1761, 1762, 1763, 1765, 1768, 1769, 1800, 1801, 1808, 1809, 1820, 1821, 1828, 1830, 1832, 1833, 1834, 1835, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1848, 1849, 1860, 1869, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906,1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1929, 1930, 1940, 1941, 1943, 1944, 1945, 1946, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 1982, 2733, 20000, 20001, 20002, 20003, 20004, 20005, 20006, 20007, 20008, 20010, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20020, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20030, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20040, 20041, 20042, 20043, 20044, 20045, 20046, 20047, 20048, 20050, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20060, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20070, 20071, 20072, 20073, 20074, 20075, 20076, 20077, 20078, 20080, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20100, 20101, 20102, 20103, 20104, 20105, 20106, 20107, 20108, 20110, 20111, 20112, 20113, 20114, 20115, 20116, 20117, 20118, 20120, 20121, 20122, 20123, 20124, 20125, 20126, 20127, 20128, 20140, 20141, 20142, 20143, 20144, 20145, 20146, 20147, 20148, 20150, 20151, 20152, 20153, 20154, 20155, 20156, 20157, 20158, 20160, 20161, 20162, 20163, 20164, 20165, 20166, 20167, 20168, 20170, 20171, 20172, 20173, 20174, 20175, 20176, 20177, 20178, 20190, 20191, 20192, 20193, 20194, 20195, 20196, 20197, 20198, 20200, 20201, 20202, 20203, 20204, 20205, 20206, 20207, 20208, 20210, 20211, 20212, 20213, 20214, 20215, 20216, 20217, 20218, 20220, 20221, 20222, 20223, 20224, 20225, 20226, 20227, 20228, 20230, 20231, 20232, 20233, 20234, 20235, 20236, 20237, 20238, 20240, 20241, 20242, 20243, 20244, 20245, 20246, 20247, 20248, 20250, 20251, 20252, 20253, 20254, 20255, 20256, 20257, 20258, 20260, 20261, 20262, 20263, 20264, 20265, 20266, 20267, 20268, 20270, 20271, 20272, 20273, 20274, 20275, 20276, 20277, 20278, 20280, 20281, 20282, 20283, 20284, 20285, 20286, 20287, 20288, 20290, 20291, 20292, 20293, 20294, 20295, 20296, 20297, 20298, 20300, 20301, 20302, 20310, 20311, 20312, 20380, 20381, 20382, 20400, 20401, 20402, 20410, 20411, 20412, 20420, 20421, 20422, 20480, 20481, 20482, 20490, 20491,

Disease		Code system	Codes
Cancer	Other	ICD-9-CM	20492, 20500, 20501, 20502, 20510, 20511, 20512, 20520, 20521, 20522, 20530, 20531, 20532, 20580, 20581, 20582, 20590, 20591, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20682, 20690, 20691, 20692, 20700, 20701, 20702, 20720, 20721, 20722, 20780, 20781, 20782, 20800, 20801, 20802, 20810, 20811, 20812, 20820, 20821, 20822, 20880, 20881, 20882, 20890, 20891, 20892, 20900, 20920, 20921, 20922, 20923, 20924, 20925, 20926, 20927, 20929, 20930, 20931, 20932, 20933, 20934, 20935, 20936, 20970, 20971, 20972, 20973, 20974, 20979, 23879, 27789
		ICD-10-CM	C4400, C4401, C4402, C4409, C01, C020, C021, C022, C023, C024, C028, C029, C030, C031, C039, C040, C041, C048, C049, C050, C051, C052, C058, C059, C060, C061, C062, C0680, C0689, C069, C07, C080, C081, C089, C090, C091, C098, C099, C100, C101, C102, C103, C104, C108, C109, C110, C111, C112, C113, C118, C119, C12, C130, C131, C132, C138, C139, C140, C142, C148, C153, C154, C155, C158, C159, C160, C161, C162, C163, C164, C165, C166, C168, C169, C173, C178, C179, C210, C211, C212, C220, C221, C222, C223, C224, C227, C228, C229, C23, C240, C241, C248, C249, C250, C251, C252, C253, C254, C257, C258, C259, C260, C261, C269, C300, C301, C310, C311, C312, C313, C318, C319, C320, C321, C322, C323, C328, C329, C33, C37, C380, C381, C382, C383, C384, C388, C390, C399, C4000, C4001, C4002, C4010, C4011, C4012, C4020, C4021, C4022, C4030, C4031, C4032, C4080, C4081, C4082, C4090, C4091, C4092, C410, C411, C412, C413, C414, C419, C430, C4310, C4311, C4312, C4320, C4321, C4322, C4330, C4331, C4339, C434, C4351, C4352, C4359, C4360, C4361, C4362, C4370, C4371, C4372, C438, C439, C450, C451, C452, C457, C459, C460, C461, C462, C463, C464, C467, C469, C470, C4710, C4711, C4712, C4720, C4721, C4722, C473, C474, C475, C476, C478, C480, C481, C482, C488, C490, C4910, C4911, C4912, C4920, C4921, C4922, C493, C494, C495, C496, C498, C499, C510, C511, C512, C518, C519, C530, C531, C538, C539, C540, C541, C542, C543, C548, C549, C55, C561, C562, C569, C5700, C5701, C5702, C5710, C5711, C5712, C5720, C5721, C5722, C573, C574, C577, C578, C579, C58, C600, C601, C602, C608, C609, C6200, C6201, C6202, C6210, C6211, C6212, C6290, C6291, C6292, C6300, C6301, C6302, C6310, C6311, C6312, C632, C637, C638, C639, C641, C642, C649, C651, C659, C661, C669, C670, C671, C672, C673, C674, C675, C676, C677, C678, C679, C680, C681, C688, C689, C6900, C6901, C6902, C6910, C6911, C6912, C6920, C6921, C6922, C6930, C6931, C6932, C6940, C6941, C6942, C6950, C6951, C6952, C6960, C6961, C6962, C6980, C6981, C6982, C6990, C6991, C6992, C700, C701, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C7220, C7221, C7222, C7230, C7231, C7232, C7240, C7241, C7242, C7250, C7259, C729, C73, C7400, C7401, C7402, C7410, C7411, C7412, C7490, C7491, C7492, C750, C751, C752, C753, C754, C755, C758, C759, C760, C761, C762, C763, C7640, C7641, C7642, C7650, C7651, C7652, C768, C770, C771, C772, C773, C774, C775, C778, C779, C781, C782, C7830, C7839, C784, C786, C787, C7880, C7889, C7900, C7901, C7902, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7982, C7989, C799, C7A00, C7A019, C7A091, C7A092, C7A093, C7A098, C7A1, C7A8, C7B00, C7B01, C7B02, C7B03, C7B04, C7B09, C7B1, C7B8, C800,

Disease		Code system	Codes
Cancer	Other	ICD-10-CM	C801, C802, C8100, C8101, C8102, C8103, C8104, C8105, C8106, C8107, C8108, C8109, C8110, C8111, C8112, C8113, C8114, C8115, C8116, C8117, C8118, C8119, C8120, C8121, C8122, C8123, C8124, C8125, C8126, C8127, C8128, C8129, C8130, C8131, C8132, C8133, C8134, C8135, C8136, C8137, C8138, C8139, C8140, C8141, C8142, C8143, C8144, C8145, C8146, C8147, C8148, C8149, C8170, C8171, C8172, C8173, C8174, C8175, C8176, C8177, C8178, C8179, C8190, C8191, C8192, C8193, C8194, C8195, C8196, C8197, C8198, C8199, C8200, C8201, C8202, C8203, C8204, C8205, C8206, C8207, C8208, C8209, C8210, C8211, C8212, C8213, C8214, C8215, C8216, C8217, C8218, C8219, C8220, C8221, C8222, C8223, C8224, C8225, C8226, C8227, C8228, C8229, C8230, C8231, C8232, C8233, C8234, C8235, C8236, C8237, C8238, C8239, C8240, C8241, C8242, C8243, C8244, C8245, C8246, C8247, C8248, C8249, C8250, C8251, C8252, C8253, C8254, C8255, C8256, C8257, C8258, C8259, C8260, C8261, C8262, C8264, C8265, C8266, C8267, C8268, C8269, C8280, C8281, C8282, C8283, C8284, C8285, C8286, C8287, C8288, C8289, C8290, C8291, C8292, C8293, C8294, C8295, C8296, C8297, C8298, C8299, C8300, C8301, C8302, C8303, C8304, C8305, C8306, C8307, C8308, C8309, C8310, C8311, C8312, C8313, C8314, C8315, C8316, C8317, C8318, C8319, C8330, C8331, C8332, C8333, C8334, C8335, C8336, C8337, C8338, C8339, C8350, C8351, C8352, C8353, C8354, C8355, C8356,C8357, C8358, C8359, C8370, C8371, C8372, C8373, C8374, C8375, C8376, C8377, C8378, C8380, C8381, C8382, C8383, C8384, C8385, C8386, C8387, C8388, C8389, C8390, C8391, C8392, C8393, C8394, C8395, C8396, C8397, C8398, C8399, C8400, C8401, C8402, C8403, C8405, C8406, C8407, C8408, C8409, C8410, C8411, C8412, C8413, C8414, C8415, C8416, C8417, C8418, C8419, C8440, C8441, C8442, C8443, C8444, C8445, C8446, C8447, C8448, C8449, C8460, C8461, C8462, C8463, C8464, C8465, C8466, C8467, C8468, C8469, C8470, C8471, C8472, C8473, C8474, C8475, C8476, C8477, C8478, C8479, C8490, C8491, C8492, C8493, C8494, C8495, C8496, C8497, C8498, C8499, C84A0, C84A1, C84A2, C84A3, C84A4, C84A5, C84A6, C84A7, C84A8, C84A9, C84Z0, C84Z1, C84Z2, C84Z3, C84Z4, C84Z5, C84Z6, C84Z7, C84Z8, C84Z9, C8510, C8511, C8512, C8513, C8514, C8515, C8516, C8517, C8518, C8519, C8520, C8521, C8522, C8523, C8524, C8525, C8526, C8527, C8528, C8529, C8580, C8581, C8582, C8583, C8584, C8585, C8586, C8587, C8588, C8589, C8590, C8591, C8592, C8593, C8594, C8595, C8596, C8597, C8598, C8599, C860, C861, C862, C863, C864, C865, C866, C880, C882, C884, C888, C889, C9000, C9001, C9002, C9010, C9011, C9012, C9021, C9022, C9030, C9031, C9032, C9100, C9101, C9102, C9110, C9110 , C9111, C9112, C9130, C9131, C9132, C9140, C9141, C9142, C9150, C9151, C9152, C9160, C9161, C9162, C9190, C9191, C9192, C91A0, C91A1, C91A2, C91Z0, C91Z1, C91Z2, C9200, C9201, C9202, C9210, C9211, C9212, C9220, C9221, C9222, C9230, C9231, C9232, C9240, C9241, C9242, C9250, C9251, C9252, C9260, C9261, C9262, C9290, C9291, C9292, C92A0, C92A1, C92A2, C92Z0, C92Z1, C92Z2, C9300, C9301, C9302, C9310, C9311, C9312, C9331, C9332, C9390, C9391, C9392, C93Z0, C93Z1, C93Z2, C9400, C9401, C9402, C9420, C9421, C9422, C9430, C9431, C9432, C9440, C9441, C9442, C9480, C9481, C9482, C9500, C9501, C9502, C9510, C9511, C9512, C9590, C9591, C9592, C960, C962, C9620, C9621, C9622, C9629, C964, C965, C966, C96A, C96Z

Disease		Code system	Codes
Cancer	Prostate	ICD-9-CM	185
		ICD-10-CM	C61

B. Provider types

Table C.2. Provider type definitions based on Medicare specialty code

Provider type	Medicare specialty codes
Primary care providers	01 (General practice), 08 (Family practice), 11 (Internal medicine), 16 (Obstetrics/gynecology), 37 (Pediatric medicine), and 38 (Geriatric medicine).
Nurse practitioners, physician assistants, and clinical nurse specialists	42 (Certified nurse midwife), 43 (Certified registered nurse anesthetists (eff. 1/87) (Anesthesiologist assistants were removed from this specialty 4/1/03)), 50 (Nurse practitioner), 89 (Certified clinical nurse specialist), and 97 (Physician assistant).
Specialists	02 (General surgery), 03 (Allergy/immunology), 04 (Otolaryngology), 05 (Anesthesiology), 06 (Cardiology), 07 (Dermatology), 09 (Interventional Pain Management (eff. 4/1/03)), 10 (Gastroenterology),12 (Osteopathic manipulative therapy), 13 (Neurology), 14 (Neurosurgery), 17 (Hospice and palliative care), 18 (Ophthalmology), 19 (Oral surgery (dentists only)), 20 (Orthopedic surgery), 21 (Cardiac electrophysiology), 22 (Pathology), 23 (Sports medicine), 24 (Plastic and reconstructive surgery), 25 (Physical medicine and rehabilitation), 26 (Psychiatry), 27 (Geriatric psychiatry colorectal surgery), 28 (Colorectal surgery (formerly proctology)), 29 (Pulmonary disease), 30 (Diagnostic radiology), 33 (Thoracic surgery), 34 (Urology), 35 (Chiropractic), 36 (Nuclear medicine), 39 (Nephrology), 40 (Hand surgery), 44 (Infectious disease), 46 (Endocrinology), 48 (Podiatry), 66 (Rheumatology (eff 5/92)), 70 (Multispecialty clinic or group practice), 72 (Pain management (eff. 1/1/02)), 76 (Peripheral vascular disease), 77 (Vascular surgery), 78 (Cardiac surgery), 79 (Addiction medicine), 81 (Critical care (intensivists)), 82 (Hematology), 83 (Hematology/oncology), 84 (Preventive medicine), 85 (Maxillofacial surgery), 86 (Neuropsychiatry), 90 (Medical oncology), 91 (Surgical oncology), 92 (Radiation oncology), 93 (Emergency medicine), 94 (Interventional radiology), 98 (Gynecologist/oncologist), 99 (Unknown physician specialty), C0 (Sleep medicine), C3 (Interventional cardiology), C5 (Dentist (eff. 7/2016)), C6 (hospitalist), C7 (advanced heart failure and transplant cardiology), C8 (medical toxicology), C9 (hematopoietic cell transplantation and cellular therapy), D3 (Medical genetics and genomics), D4 (Undersea and hyperbaric medicine), D5 (Opioid treatment program), D7 (Micrographic dermatologic surgery (effective October 1, 2020)) and D8 (Adult congenital heart disease (effective October 1, 2020)).

C. Prior health care use

Table C.3. Codes used for identifying ambulatory visits

Type	Code system	Codes
Excluded Place of Service Codes for ambulatory visit claims	Place of service	20 (Urgent care), 21 (Inpatient Hospital), 23 (Emergency room), 51 (Inpatient Psychiatric Facility), 55 (Residential Substance Abuse Treatment Facility), 56 (Psychiatric Residential Treatment Center), or 61 (Comprehensive Inpatient Rehabilitation Facility)
Evaluation and management procedure codes	CPT code	99201-99205, 99211-99215, 99324-99328, 99334-99337, 99339-99340, 99341-99345, 99347-99350, 99354-99355, 99358-99359, 99415-99416, 99421-99423, 99381-99387, 99391-99397, 98966-98968, 99441-99443, 98969, 99444, 99453-99454, 99457, 99458, 99461, 99473-99474, 99483, 99487, 99489, 99490, 99491, 99492-99493, 99494, 99495-99496, 99484, 99497, 99498, 99091, 90785, 90791-90792, 90832, 90834, 90837, 90833, 90836, 90838, 90839, 90840, 90845-90847, 90849, 90853, 96150-96151, 96152-96155, 96156, 96158-96159, 96160-96161, 96164-96165, 96167-96168, 97151-97158, G0076-G0087, G2010, G2011, G2012, G2061, G2062, G2063, G0402, G0438-G0439, G0502-G0503, G0504, G0505, G0506, G0507, G0513-G0514, G9978-G9986, G9987, G0463, G0466-G0467, G0468, G0469-G0470, G0071, G0511, and G0512.

Table C.4. Identifying Federally Qualified Health Center, rural health clinic, or critical access hospital claims

Place of service	Definition
Federally Qualified Health Center claim	Claim type code is 7 (clinic or hospital-based renal dialysis facility) and claim service classification type code is 3 (free-standing provider based Federally Qualified Health Center) or 7 (Federally Qualified Health Center)
Rural health clinic claim	Claim type code is 7 (clinic or hospital-based renal dialysis facility) and claim service classification type code is 1 (rural health clinic)
Critical access hospital claim	3rd and 4th digit of CCN = “13” and one of the following: claim type code 1 and claim service classification, claim type code 1 and claim service classification 4, or claim type code 8 and claim service classification 5. For critical access hospital claims, we also included revenue center codes 0960, 0969, 0982, 0983, 0988, 0989, 0210, 0219, 0280, 0289, 0410, 0419, 0460, 0470, 0471, 0479, 0480, 0489, 0530, 0750, 0759, 0770, 0779, 0780, 0789, 0961, and 0962.

Table C.5. Durable medical equipment codes, by type

Type	Code system	Codes
Oxygen equipment	HCPCS	E0424 to E0455, E0467, E0550, E0560, E1352 to E1358, E1390 to E1392, or E1405 to E1406
Home hospital beds	HCPCS	E0250 to E0373
Walkers or canes	HCPCS	E0100 to E0105 or E0130 to E0159
Wheelchairs	HCPCS	E1130 to E1161 or K0001 to K0195

D. Health care at enrollment and individual hierarchical condition category condition variables

Table C.6. List of the hierarchical condition category indicators

Indicator	Indicator (continued)
1. HIV/AIDS	42. Respiratory arrest
2. Septicemia, sepsis, systemic inflammatory response syndrome/shock	43. Cardio-respiratory failure and shock
3. Opportunistic infections	44. Congestive heart failure
4. Metastatic cancer and acute leukemia	45. Acute myocardial infarction
5. Lung and other severe cancers	46. Unstable angina and other acute ischemic heart disease
6. Lymphoma and other cancers	47. Angina pectoris
7. Colorectal, bladder, and other cancers	48. Specified heart arrhythmias
8. Breast, prostate, and other cancers and tumors	49. Intracranial hemorrhage
9. Diabetes with acute complications	50. Ischemic or unspecified stroke
10. Diabetes with chronic complications	51. Hemiplegia/hemiparesis
11. Diabetes without complication	52. Monoplegia, other paralytic syndromes
12. Protein-calorie malnutrition	53. Atherosclerosis of the extremities with ulceration or gangrene
13. Morbid obesity	54. Vascular disease with complications
14. Other significant endocrine and metabolic disorders	55. Vascular disease
15. End-stage liver disease	56. Cystic fibrosis
16. Cirrhosis of liver	57. Chronic obstructive pulmonary disease
17. Chronic hepatitis	58. Fibrosis of lung and other chronic lung disorders
18. Intestinal obstruction/perforation	59. Aspiration and specified bacterial pneumonias
19. Chronic pancreatitis	60. Pneumococcal pneumonia, empyema, lung abscess
20. Inflammatory bowel disease	61. Proliferative diabetic retinopathy and vitreous hemorrhage
21. Bone/joint/muscle infections/necrosis	62. Exudative macular degeneration
22. Rheumatoid arthritis and inflammatory connective tissue disease	63. Dialysis status
23. Severe hematological disorders	64. Acute renal failure
24. Disorders of immunity	65. Chronic kidney disease, stage 5
25. Coagulation defects and other specified hematological disorders	66. Chronic kidney disease, severe (stage 4)
26. Drug/alcohol psychosis	67. Chronic kidney disease, moderate (stage 3)
27. Drug/alcohol dependence	68. Chronic kidney disease, mild or unspecified (stages 1-2 or unspecified)
28. Schizophrenia	69. Unspecified renal failure
29. Reactive and unspecified psychosis	70. Pressure ulcer of skin with necrosis through to muscle, tendon, or bone
30. Quadriplegia	71. Pressure ulcer of skin with full thickness skin loss
31. Paraplegia	72. Chronic ulcer of skin, except pressure
32. Spinal cord disorders/injuries	73. Severe skin burn or condition
33. Amyotrophic lateral sclerosis and other motor neuron disease	74. Severe head injury
34. Cerebral palsy	75. Major head injury
35. Myasthenia gravis/myoneural disorders and Guillain-Barre syndrome/inflammatory and toxic neuropathy	76. Vertebral fractures without spinal cord injury
36. Muscular dystrophy	77. Hip fracture/dislocation
37. Multiple sclerosis	78. Traumatic amputations and complications
38. Parkinson's and Huntington's diseases	79. Complications of specified implanted device or graft
39. Seizure disorders and convulsions	80. Major organ transplant or replacement status
40. Coma, brain compression/anoxic damage	81. Artificial openings for feeding or elimination
41. Respirator dependence/tracheostomy status	82. Amputation status, lower limb/amputation complications.

Note: These hierarchical condition category indicators serve to consolidate beneficiaries into hierarchical condition categories based on their ICD-9-CM and ICD-10-CM diagnosis codes at the beneficiaries' enrollment (or pseudo-enrollment) date.

E. Gagne comorbidity index

Table C.7. Diagnosis codes for each condition from the Gagne comorbidity index

Gagne condition	Code system	Code
Alcohol	ICD-9-CM	2911, 2912, 2915, 2919, 29181, 29182, 29189, 30390, 30391, 30392, 30393, 30500, 30501, 30502, 30503, V113
	ICD-10-CM	F1010, F1011, F10120, F10129, F10150, F10159, F10180, F10181, F10182, F10188, F1019, F1020, F1021, F10239, F10250, F10259, F1026, F1027, F10280, F10281, F10282, F10288, F1029, F1094, F10950, F10959, F1096, F1097, F10980, F10982, F1099
Any tumor (includes leukemia and lymphoma)	ICD-9-CM	1400, 1401, 1403, 1404, 1405, 1406, 1408, 1409, 151, 155, 179, 181, 185, 193, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1419, 1420, 1421, 1422, 1428, 1430, 1431, 1438, 1440, 1441, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1478, 1479, 1480, 1481, 1482, 1483, 1488, 1489, 1490, 1491, 1498, 1500, 1501, 1502, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1520, 1521, 1522, 1523, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1548, 1550, 1551, 1552, 1560, 1561, 1562, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1590, 1591, 1598, 1600, 1601, 1602, 1603, 1604, 1605, 1608, 1609, 1610, 1611, 1612, 1613, 1618, 1619, 1620, 1622, 1623, 1624, 1625, 1628, 1629, 1630, 1639, 1640, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1740, 1741, 1742, 1743, 1744, 1745, 1746, 1748, 1749, 1750, 1759, 1760, 1761, 1762, 1763, 1764, 1765, 1768, 1769, 1800, 1801, 1808, 1809, 1820, 1821, 1828, 1830, 1832, 1833, 1834, 1835, 1838, 1841, 1842, 1843, 1844, 1848, 1849, 1860, 1869, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1940, 1941, 1943, 1944, 1945, 1946, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 2001, 2002, 2003, 2004, 2005, 2006, 2008, 2730, 2733, 20000, 20001, 20001, 20002, 20002, 20003, 20003, 20004, 20004, 20005, 20005, 20006, 20006, 20007, 20007, 20008, 20008, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20041, 20042, 20043, 20044, 20045, 20046, 20047, 20048, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20070, 20071, 20071, 20072, 20072, 20073,

Gagne condition	Code system	Code
Any tumor (includes leukemia and lymphoma)	ICD-9-CM	20073, 20074, 20074, 20075, 20075, 20076, 20076, 20077, 20077, 20078, 20078, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20100, 20101, 20102, 20103, 20104, 20105, 20106, 20107, 20108, 20110, 20111, 20112, 20113, 20114, 20115, 20116, 20117, 20118, 20120, 20121, 20122, 20123, 20124, 20125, 20126, 20127, 20128, 20140, 20141, 20142, 20143, 20144, 20145, 20146, 20147, 20148, 20150, 20151, 20152, 20153, 20154, 20155, 20156, 20157, 20158, 20160, 20161, 20162, 20163, 20164, 20165, 20166, 20167, 20168, 20170, 20171, 20172, 20173, 20174, 20175, 20176, 20177, 20178, 20190, 20191, 20192, 20193, 20194, 20195, 20196, 20197, 20198, 20200, 20201, 20202, 20203, 20204, 20205, 20206, 20207, 20208, 20210, 20211, 20212, 20213, 20214, 20215, 20216, 20217, 20218, 20220, 20221, 20222, 20223, 20224, 20225, 20226, 20227, 20228, 20230, 20231, 20232, 20233, 20234, 20235, 20236, 20237, 20238, 20240, 20241, 20242, 20243, 20244, 20245, 20246, 20247, 20248, 20250, 20251, 20252, 20253, 20254, 20255, 20256, 20257, 20258, 20260, 20261, 20262, 20263, 20264, 20265, 20266, 20267, 20268, 20270, 20271, 20272, 20273, 20274, 20275, 20276, 20277, 20278, 20280, 20281, 20282, 20283, 20284, 20285, 20286, 20287, 20288, 20290, 20291, 20292, 20293, 20294, 20295, 20296, 20297, 20298, 20300, 20301, 20302, 20310, 20311, 20312, 20380, 20381, 20382, 20400, 20401, 20402, 20410, 20411, 20412, 20420, 20421, 20422, 20480, 20481, 20482, 20490, 20491, 20492, 20500, 20501, 20502, 20510, 20511, 20512, 20520, 20521, 20522, 20530, 20531, 20532, 20580, 20581, 20582, 20590, 20591, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20682, 20690, 20691, 20692, 20700, 20701, 20702, 20720, 20721, 20722, 20780, 20781, 20782, 20800, 20801, 20802, 20810, 20811, 20812, 20820, 20821, 20822, 20880, 20881, 20882, 20890, 20891, 20892, V1046
	ICD-10-CM	C55, C58, C61, C6202, C73, C880, D890
Cardiac arrhythmias	ICD-9-CM	4262, 4263, 4264, 4266, 4267, 4270, 4272, 4279, 7850, 42610, 42611, 42613, 42650, 42651, 42652, 42653, 42681, 42682, 42689, 42731, 42760, V450, V533
	ICD-10-CM	I440, I441, I4430, I4439, I444, I445, I4460, I4469, I447, I450, I4510, I4519, I452, I454, I455, I456, I471, I479, I480, I481, I482, I4891, I492, I4940, I499, R000
Congestive heart failure	ICD-9-CM	4250, 4252, 4253, 4254, 4255, 4257, 4258, 4259, 4280, 4281, 4289, 4293, 40201, 40211, 40291, 42511, 42518, 42820, 42821, 42822, 42823, 42830, 42831, 42832, 42833, 42840, 42841, 42842, 42843
	ICD-10-CM	I110, I517

Gagne condition	Code system	Code
Coagulopathy	ICD-9-CM	2860, 2861, 2862, 2863, 2864, 2866, 2867, 2869, 2871, 2875, 28652, 28653, 28659, 28730, 28731, 28732, 28733, 28739, 28741, 28749
	ICD-10-CM	D65, D66, D67, D681, D6832, D684, D688, D689, D691, D696
Complicated diabetes	ICD-9-CM	25040, 25042, 25050, 25052, 25060, 25062, 25070, 25072, 25090, 25092
	ICD-10-CM	E1021, E1022, E1029, E10311, E10319, E103211, E103212, E103213, E103219, E103291, E103292, E103293, E103299, E103311, E103312, E103313, E103319, E103391, E103392, E103393, E103399, E103411, E103412, E103413, E103419, E103491, E103492, E103493, E103499, E103511, E103512, E103513, E103519, E103521, E103522, E103523, E103529, E103531, E103532, E103533, E103539, E103541, E103542, E103543, E103549, E103551, E103552, E103553, E103559, E103591, E103592, E103593, E103599, E1036, E1037X1, E1037X2, E1037X3, E1037X9, E1039, E1040, E1041, E1042, E1043, E1044, E1049, E1051, E1052, E1059, E10610, E1065, E108, E1121, E1122, E1129, E11311, E11311, E11319, E11319, E113211, E113212, E113213, E113219, E113291, E113292, E113293, E113299, E113311, E113312, E113313, E113319, E113391, E113392, E113393, E113399, E113411, E113412, E113413, E113419, E113491, E113492, E113493, E113499, E113511, E113512, E113513, E113519, E113521, E113522, E113523, E113529, E113531, E113532, E113533, E113539, E113541, E113542, E113543, E113549, E113551, E113552, E113553, E113559, E113591, E113592, E113593, E113599, E1136, E1136, E1137X1, E1137X2, E1137X3, E1137X9, E1139, E1139, E1140, E1141, E1142, E1143, E1144, E1149, E1151, E1152, E1159, E11610, E1165, E1165, E118, E1321, E1322, E1329, E13311, E13319, E133211, E133212, E133213, E133219, E133291, E133292, E133293, E133299, E133311, E133312, E133313, E133319, E133391, E133392, E133393, E133399, E133411, E133412, E133413, E133419, E133491, E133492, E133493, E133499, E133511, E133512, E133513, E133519, E133521, E133522, E133523, E133529, E133531, E133532, E133533, E133539, E133541, E133542, E133543, E133549, E133551, E133552, E133553, E133559, E133591, E133592, E133593, E133599, E1336, E1337X1, E1337X2, E1337X3, E1337X9, E1339, E1340, E1341, E1342, E1343, E1344, E1349, E1351, E1352, E1359, E13610, E138
Chronic obstructive pulmonary disease	ICD-9-CM	496, 4150, 4168, 4169, 4910, 4911, 4918, 4919, 4920, 4928, 4940, 4941, 49120, 49121, 49122, 49300, 49301, 49302, 49310, 49311, 49312, 49320, 49321, 49322, 49381, 49382, 49390, 49391, 49392
	ICD-10-CM	I2601, I2602, I2609, I2722, I2723, I2781, I2789, I279, J449

Gagne condition	Code system	Code
Deficiency anemias	ICD-9-CM	2801, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2818, 2819, 2859
	ICD-10-CM	D501, D508, D509, D510, D511, D512, D513, D518, D519, D520, D521, D528, D529, D530, D531, D532, D538, D539, D649, D680
Dementia	ICD-9-CM	2900, 2903, 2908, 2909, 3310, 3312, 29010, 29011, 29012, 29013, 29020, 29021, 29040, 29041, 29042, 29043, 33111, 33119
	ICD-10-CM	G300, G301, G308, G309, G311
Fluid and electrolyte disorders	ICD-9-CM	2760, 2761, 2762, 2763, 2764, 2767, 2768, 2769, 27650, 27651, 27652, 27659, 27661, 27669
	ICD-10-CM	E870, E871, E872, E873, E874, E875, E876, E878
Hemiplegia	ICD-9-CM	3441, 3442, 3445, 3449, 34200, 34201, 34202, 34210, 34211, 34212, 34280, 34281, 34282, 34290, 34291, 34292, 34400, 34401, 34402, 34403, 34404, 34409, 34430, 34431, 34432, 34440, 34441, 34442, 34460, 34461, 34481, 34489
	ICD-10-CM	G8100, G8101, G8102, G8103, G8104, G8110, G8111, G8112, G8113, G8114, G8190, G8191, G8192, G8193, G8194, G8220, G8221, G8222, G8250, G8251, G8252, G8253, G8254, G830, G8310, G8311, G8312, G8313, G8314, G8320, G8321, G8322, G8323, G8324, G8330, G8331, G8332, G8333, G8334, G834, G835, G8381, G8382, G8383, G8384, G8389, G839
HIV/AIDS	ICD-9-CM	042
	ICD-10-CM	B20
Hypertension (both complicated/uncomplicated)	ICD-9-CM	4011, 4019, 40210, 40290, 40410, 40490, 40511, 40519, 40591, 40599
	ICD-10-CM	I10, I119, I1310, I1311, I150, I151, I152, I158, I159, I160, I161, I169, I2720, I2721, I2724, I2729, N262
Liver disease	ICD-9-CM	4560, 4561, 5710, 5712, 5713, 5715, 5716, 5718, 5719, 5723, 5728, 7032, 7033, 45620, 45621, 57140, 57141, 57142, 57149, V427
	ICD-10-CM	B180, B181, D682, I8500, I8501, I8510, I8511, K700, K702, K7030, K7031, K7040, K7041, K709, K7210, K7211, K7290, K7291, K730, K731, K732, K738, K739, K740, K741, K742, K743, K744, K745, K7460, K7469, K754, K7581, K760, K766, K7689, K769, Z4823, Z944
Metastatic cancer	ICD-9-CM	1960, 1961, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1986, 1987, 1990, 1991, 1992, 19881, 19882, 19889
	ICD-10-CM	C770, C771, C772, C773, C774, C775, C778, C779, C7800, C7801, C7802, C781, C782, C7830, C7839, C784, C785, C786, C787, C7880, C7889, C7900, C7901, C7902, C791, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7981, C7982, C7989, C799, C800, C801, C802

Gagne condition	Code system	Code
Peripheral vascular disorder	ICD-9-CM	4400, 4401, 4404, 4408, 4409, 4412, 4414, 4417, 4419, 4431, 4439, 4471, 5571, 5579, 44020, 44021, 44022, 44023, 44024, 44029, 44030, 44031, 44032, 44321, 44322, 44323, 44324, 44329, 44381, 44382, 44389, V434
	ICD-10-CM	I700, I701, I708, I7090, I7091, I7092, I712, I714, I716, I719, I731, I739, I771, I790, K551, K558, K559, Z95820, Z95828
Psychosis	ICD-9-CM	2967, 2970, 2973, 2979, 2980, 2981, 2982, 2983, 2984, 2988, 2989, 29500, 29501, 29502, 29503, 29504, 29505, 29510, 29511, 29512, 29513, 29514, 29515, 29520, 29521, 29522, 29523, 29524, 29525, 29530, 29531, 29532, 29533, 29534, 29535, 29540, 29541, 29542, 29543, 29544, 29545, 29550, 29551, 29552, 29553, 29554, 29555, 29560, 29561, 29562, 29563, 29564, 29565, 29570, 29571, 29572, 29573, 29574, 29575, 29580, 29581, 29582, 29583, 29584, 29585, 29590, 29591, 29592, 29593, 29594, 29595, 29600, 29601, 29602, 29603, 29604, 29605, 29606, 29610, 29611, 29612, 29613, 29614, 29615, 29616, 29620, 29621, 29622, 29623, 29624, 29625, 29626, 29630, 29631, 29632, 29633, 29634, 29635, 29636, 29640, 29641, 29642, 29643, 29644, 29645, 29646, 29650, 29651, 29652, 29653, 29654, 29655, 29656, 29660, 29661, 29662, 29663, 29664, 29665, 29666, 29680, 29680, 29681, 29682, 29689, 29690, 29699
	ICD-10-CM	F200, F201, F202, F203, F205, F2081, F2089, F209, F22, F23, F24, F250, F251, F258, F259, F3010, F3011, F3012, F3013, F302, F303, F304, F308, F309, F310, F3110, F3111, F3112, F3113, F312, F3130, F3131, F3132, F314, F315, F3160, F3161, F3162, F3163, F3164, F3173, F3174, F3175, F3176, F3177, F3178, F3181, F3189, F319, F320, F321, F322, F323, F324, F325, F3289, F329, F330, F331, F332, F333, F3340, F3341, F3342, F338, F339, F3481, F3489, F349, Z658
Pulmonary circulation disorders	ICD-9-CM	4160, 4161, 4162, 4168, 4169, 4179
	ICD-10-CM	I289
Renal failure	ICD-9-CM	586, 5851, 5852, 5853, 5854, 5855, 5856, 5859, 40311, 40391, 40412, 40492, V420, V4511, V4512, V560, V568
	ICD-10-CM	F39, I120, N19, Z4822, Z4931, Z4932, Z940
Weight loss	ICD-9-CM	260, 261, 262, 2630, 2631, 2632, 2638, 2639
	ICD-10-CM	E40, E41, E42, E43

F. Disease-specific measures

1. Congestive heart failure

Table C.8. Diagnosis codes for measures specific to beneficiaries with congestive heart failure

Measure	Code system	Codes
Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)	ICD-9-CM	99683, V421
	ICD-10-CM	T8621, Z941
Prior insertion of an automatic implantable cardioverter defibrillator	ICD-9-CM	V4502
	ICD-10-CM	Z95810
Any coronary artery bypass surgery in the 2 years before enrollment	ICD-9-CM	3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619
	ICD-10-PCS	0210083, 0210088, 0210089, 0210093, 0210098, 0210099, 0210344, 0210444, 0210483, 0210488, 0210489, 0210493, 0210498, 0210499, 021008C, 021008F, 021008W, 021009C, 021009F, 021009W, 02100A3, 02100A8, 02100A9, 02100AC, 02100AF, 02100AW, 02100J3, 02100J8, 02100J9, 02100JC, 02100JF, 02100JW, 02100K3, 02100K8, 02100K9, 02100KC, 02100KF, 02100KW, 02100Z3, 02100Z8, 02100Z9, 02100ZC, 02100ZF, 02103D4, 021048C, 021048F, 021048W, 021049C, 021049F, 021049W, 02104A3, 02104A8, 02104A9, 02104AC, 02104AF, 02104AW, 02104D4, 02104J3, 02104J8, 02104J9, 02104JC, 02104JF, 02104JW, 02104K3, 02104K8, 02104K9, 02104KC, 02104KF, 02104KW, 02104Z3, 02104Z8, 02104Z9, 02104ZC, 02104ZF
	ICD-9-CM	0066, 390, 391, 3606, 3607

Measure	Code system	Codes
Any percutaneous intervention in the 2 years before enrollment	ICD-10-PCS	0270046, 0270056, 0270066, 0270076, 0270346, 0270356, 0270366, 0270376, 0270446, 0270456, 0270466, 0270476, 0610075, 0610076, 0610095, 0610096, 0610475, 0610476, 0610495, 0610496, 02700E6, 02703E6, 02704E6, 027004Z, 027005Z, 027006Z, 027007Z, 02700D6, 02700DZ, 02700EZ, 02700F6, 02700FZ, 02700G6, 02700GZ, 02700T6, 02700TZ, 02700Z6, 02700ZZ, 027034Z, 027035Z, 027036Z, 027037Z, 02703D6, 02703DZ, 02703EZ, 02703F6, 02703FZ, 02703G6, 02703GZ, 02703T6, 02703TZ, 02703Z6, 02703ZZ, 027044Z, 027045Z, 027046Z, 027047Z, 02704D6, 02704DZ, 02704EZ, 02704F6, 02704FZ, 02704G6, 02704GZ, 02704T6, 02704TZ, 02704Z6, 02704ZZ, 061007P, 061007Q, 061007R, 061007Y, 061009P, 061009Q, 061009R, 061009Y, 06100A5, 06100A6, 06100AP, 06100AQ, 06100AR, 06100AY, 06100J5, 06100J6, 06100JP, 06100JQ, 06100JR, 06100JY, 06100K5, 06100K6, 06100KP, 06100KQ, 06100KR, 06100KY, 06100Z5, 06100Z6, 06100ZP, 06100ZQ, 06100ZR, 06100ZY, 061047P, 061047Q, 061047R, 061047Y, 061049P, 061049Q, 061049R, 061049Y, 06104A5, 06104A6, 06104AP, 06104AQ, 06104AR, 06104AY, 06104J5, 06104J6, 06104JP, 06104JQ, 06104JR, 06104JY, 06104K5, 06104K6, 06104KP, 06104KQ, 06104KR, 06104KY, 06104Z5, 06104Z6, 06104ZP, 06104ZQ, 06104ZR, 06104ZY
Prior insertion of an automatic implantable cardioverter defibrillator in the 2 years before enrollment	CPT	33216, 33217, 33225, 33230, 33231, 33240
	ICD-9-CM	0051, 0052, 0054, 3794, 3795, 3796, 3797, 3798
	ICD-10-PCS	02H43KZ, 02H43MZ, 02H44KZ, 02H60KZ, 02H63KZ, 02H63KZ , 02H64KZ, 02H70KZ, 02H73KZ, 02H74KZ, 02HK0KZ, 02HK3KZ, 02HK4KZ, 02HL0KZ, 02HL3KZ, 02HL4KZ, 02HN0KZ, 02HN4KZ, 0JH608Z, 0JH609Z, 0JH639Z, 0JH809Z, 0JH839Z, OJH638Z, OJH838Z
Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)	CPT	33945, 33975, 33976, 33977, 33978, 33979, 33980, 33981, 33982, 33983, 33990, 33991, 33992
	HCPCS	J1250, J1250, J1265, J2260
	ICD-10-PCS	5A02210
	ICD-9-CM	3761
Participated in outpatient cardiac rehabilitation program	CPT	93797, 93798

2. Chronic obstructive pulmonary disease

Table C.9. Diagnosis codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	Code system	Codes
Lung cancer or thoracic malignancies	ICD-9-CM	1622, 1623, 1624, 1625, 1628, 1629, 1639, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1659
	ICD-10-CM	C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C37, C380, C381, C382, C383, C384, C388, C390, C399
Nutritional abnormalities	ICD-9-CM	260, 261, 262, 267, 2630, 2631, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2661, 2662, 2669, 2680, 2681, 2689, 2690, 2691, 2692, 2693, 2698, 2699, 2782, 2783, 2784, 2788, 7830, 7831, 7833, 7835, 7836, 7837, 7839, 78321, 78321, 78322, V121
	ICD-10-CM	E40, E41, E42, E43, E44, E440, E441, E46, E50, E500, E501, E502, E503, E504, E505, E506, E507, E508, E509, E51, E5111, E5112, E512, E518, E519, E52, E53, E530, E531, E538, E539, E54, E55, E550, E559, E56, E560, E561, E568, E569, E58, E59, E60, E61, E610, E611, E612, E613, E614, E615, E616, E617, E618, E619, E62, E630, E631, E638, E639, E640, E641, E642, E643, E648, E649, E65, R627, R630, R631, R632, R633, R634, R635, R636, R638, Z8639
Skeletal muscle dysfunction	ICD-9-CM	7282, 7283, 7289, 72883, 72884, 72885, 72887, 72888, 72889
	ICD-10-CM	M62, M6200, M62011, M62012, M62019, M62021, M62022, M62029, M62031, M62032, M62039, M62041, M62042, M62049, M62051, M62052, M62059, M62061, M62062, M62069, M62071, M62072, M62079, M6208, M6210, M62111, M62112, M62119, M62121, M62122, M62129, M62131, M62132, M62139, M62141, M62142, M62149, M62151, M62152, M62159, M62161, M62162, M62169, M62171, M62172, M62179, M6218, M6220, M62211, M62212, M62219, M62221, M62222, M62229, M62231, M62232, M62239, M62241, M62242, M62249, M62251, M62252, M62259, M62261, M62262, M62269, M62271, M62272, M62279, M6228, M623, M6240, M62411, M62412, M62419, M62421, M62422, M62429, M62431, M62432, M62439, M62441, M62442, M62449, M62451, M62452, M62459, M62461, M62462, M62469, M62471, M62472, M62479, M6248, M6249, M6250, M62511, M62512, M62519, M62521, M62522, M62529, M62531, M62532, M62539, M62541, M62542, M62549, M62551,
Skeletal muscle dysfunction	ICD-10-CM	M62552, M62559, M62561, M62562, M62569, M62571, M62572, M62579, M6258, M6259, M6281, M6282, M62830, M62831, M62838, M6284, M6289, M629, M63, M6380, M63811, M63812, M63819, M63821, M63822, M63829, M63831, M63832, M63839, M63841, M63842, M63849, M63851, M63852, M63859, M63861, M63862, M63869, M63871, M63872, M63879, M6388, M6389

Measure	Code system	Codes
Osteoporosis	ICD-9-CM	73300, 73301, 73302, 73303, 73309, V1781
	ICD-10-CM	M80, M8000XA, M8000XD, M8000XG, M8000XK, M8000XP, M8000XS, M80011A, M80011D, M80011G, M80011K, M80011P, M80011S, M80012A, M80012D, M80012G, M80012K, M80012P, M80012S, M80019A, M80019D, M80019G, M80019K, M80019P, M80019S, M80021A, M80021D, M80021G, M80021K, M80021P, M80021S, M80022A, M80022D, M80022G, M80022K, M80022P, M80022S, M80029A, M80029D, M80029G, M80029K, M80029P, M80029S, M80031A, M80031D, M80031G, M80031K, M80031P, M80031S, M80032A, M80032D, M80032G, M80032K, M80032P, M80032S, M80039A, M80039D, M80039G, M80039K, M80039P, M80039S, M80041A, M80041D, M80041G, M80041K, M80041P, M80041S, M80042A, M80042D, M80042G, M80042K, M80042P, M80042S, M80049A, M80049D, M80049G, M80049K, M80049P, M80049S, M80051A, M80051D, M80051G, M80051K, M80051P, M80051S, M80052A, M80052D, M80052G, M80052K, M80052P, M80052S, M80059A, M80059D, M80059G, M80059K, M80059P, M80059S, M80061A, M80061D, M80061G, M80061K, M80061P, M80061S, M80062A, M80062D, M80062G, M80062K, M80062P, M80062S, M80069A, M80069D, M80069G, M80069K, M80069P, M80069S, M80071A, M80071D, M80071G, M80071K, M80071P, M80071S, M80072D, M80072K, M80072P, M80072S, M80079A, M80079D, M80079G, M80079K, M80079P, M80079S, M8008XA, M8008XD, M8008XG, M8008XK, M8008XP, M8008XS, M8080XA, M8080XD, M8080XG, M8080XK, M8080XP, M8080XS, M80811A, M80811D, M80811G, M80811K, M80811P, M80811S, M80812A, M80812D, M80812G, M80812K, M80812P, M80812S, M80819A, M80819D, M80819G, M80819K, M80819P, M80819S, M80821A, M80821D, M80821G, M80821K, M80821P, M80821S, M80822A, M80822D, M80822G, M80822K, M80822P, M80822S, M80829A, M80829D, M80829G, M80829K, M80829P, M80829S, M80831A, M80831D, M80831G, M80831K, M80831P, M80831S, M80832A, M80832D, M80832G, M80832K, M80832P, M80832S, M80839A, M80839D, M80839G, M80839K, M80839P, M80839S, M80841A, M80841D, M80841G, M80841K, M80841P, M80841S, M80842A, M80842D, M80842G, M80842K, M80842P, M80842S, M80849A, M80849D, M80849G, M80849K, M80849P, M80849S, M80851A, M80851D, M80851G, M80851K, M80851P, M80851S, M80852A, M80852D, M80852G, M80852K, M80852P, M80852S, M80859A, M80859D, M80859G, M80859K, M80859P, M80859S, M80861A, M80861D, M80861G, M80861K, M80861P, M80861S, M80862A, M80862D, M80862G, M80862K, M80862P, M80862S, M80869A, M80869D, M80869G, M80869K, M80869P, M80869S, M80871A, M80871D, M80871G, M80871K, M80871P, M80871S, M80872A, M80872D, M80872G, M80872K, M80872P, M80872S, M80879A, M80879D, M80879G, M80879K, M80879P, M80879S, M8088XA, M8088XD, M8088XG, M8088XK, M8088XP, M8088XS, M81, M810, M816, M818, Z8262

Measure	Code system	Codes
Bone fracture	ICD-9-CM	8020, 8021, 8024, 8025, 8026, 8027, 8028, 8029, 8052, 8053, 8054, 8055, 8056, 8057, 8058, 8059, 8064, 8065, 8068, 8069, 8072, 8073, 8074, 8075, 8076, 8080, 8081, 8082, 8083, 8088, 8089, 8090, 8091, 8170, 8171, 8180, 8181, 8190, 8191, 8208, 8209, 8220, 8221, 8240, 8241, 8242, 8243, 8244, 8245, 8246, 8247, 8248, 8249, 8250, 8251, 8260, 8261, 8270, 8271, 8280, 8281, 9050, 9051, 9052, 9053, 9054, 9055, 73310, 73311, 73312, 73313, 73314, 73315, 73316, 73319, 73381, 73382, 80000, 80001, 80002, 80003, 80004, 80005, 80006, 80009, 80010, 80011, 80012, 80013, 80014, 80015, 80016, 80019, 80020, 80021, 80022, 80023, 80024, 80025, 80026, 80029, 80030, 80031, 80032, 80033, 80034, 80035, 80036, 80039, 80040, 80041, 80042, 80043, 80044, 80045, 80046, 80049, 80050, 80051, 80052, 80053, 80054, 80055, 80056, 80059, 80060, 80061, 80062, 80063, 80064, 80065, 80066, 80069, 80070, 80071, 80072, 80073, 80074, 80075, 80076, 80079, 80080, 80081, 80082, 80083, 80084, 80085, 80086, 80089, 80090, 80091, 80092, 80093, 80094, 80095, 80096, 80099, 80100, 80101, 80102, 80103, 80104, 80105, 80106, 80109, 80110, 80111, 80112, 80113, 80114, 80115, 80116, 80119, 80120, 80121, 80122, 80123, 80124, 80125, 80126, 80129, 80130, 80131, 80132, 80133, 80134, 80135, 80136, 80139, 80140, 80141, 80142, 80143, 80144, 80145, 80146, 80149, 80150, 80151, 80152, 80153, 80154, 80155, 80156, 80159, 80160, 80161, 80162, 80163, 80164, 80165, 80166, 80169, 80170, 80171, 80172, 80173, 80174, 80175, 80176, 80179, 80180, 80181, 80182, 80183, 80184, 80185, 80186, 80189, 80190, 80191, 80192, 80193, 80194, 80195, 80196, 80199, 80220, 80221, 80222, 80223, 80224, 80225, 80226, 80227, 80228, 80229, 80230, 80231, 80232, 80233, 80234, 80235, 80236, 80237, 80238, 80239, 80300, 80301, 80302, 80303, 80304, 80305, 80306, 80309, 80310, 80311, 80312, 80313, 80314, 80315, 80316, 80319, 80320, 80321, 80322, 80323, 80324, 80325, 80326, 80329, 80330, 80331, 80332, 80333, 80334, 80335, 80336, 80339, 80340, 80341, 80342, 80343, 80344, 80345, 80346, 80349, 80350, 80351, 80352, 80353, 80354, 80355, 80356, 80359, 80360, 80361, 80362, 80363, 80364, 80365, 80366, 80369, 80370, 80371, 80372, 80373, 80374, 80375, 80376, 80379, 80380, 80381, 80382, 80383, 80384, 80385, 80386, 80389, 80390, 80391, 80392, 80393, 80394, 80395, 80396, 80399, 80400, 80401, 80402, 80403, 80404, 80405, 80406, 80409, 80410, 80411, 80412, 80413, 80414, 80415, 80416, 80419, 80420, 80421, 80422, 80423, 80424, 80425, 80426, 80429, 80430, 80431, 80432, 80433, 80434, 80435, 80436, 80439, 80440, 80441, 80442, 80443, 80444, 80445, 80446, 80449, 80450, 80451, 80452, 80453, 80454, 80455, 80456, 80459, 80460, 80461, 80462, 80463, 80464, 80465, 80466, 80469, 80470, 80471, 80472, 80473, 80474, 80475, 80476, 80479, 80480, 80481, 80482, 80483, 80484, 80485, 80486, 80489, 80490, 80491, 80492, 80493, 80494, 80495, 80496, 80499, 80500, 80501, 80502, 80503, 80504, 80505, 80506, 80507, 80508, 80510, 80511, 80512, 80513, 80514, 80515, 80516, 80517, 80518, 80600, 80601, 80602, 80603, 80604, 80605, 80606, 80607, 80608, 80609, 80610, 80611, 80612, 80613, 80614, 80615, 80616, 80617, 80618, 80619, 80620, 80621, 80622, 80623, 80624, 80625, 80626, 80627, 80628, 80629, 80630, 80631, 80632, 80633, 80634, 80635, 80636, 80637, 80638, 80639, 80660, 80661, 80662, 80669, 80670, 80671, 80672, 80679, 80700, 80701, 80702, 80703, 80704, 80705, 80706, 80707, 80708, 80709, 80710, 80711, 80712, 80713, 80714, 80715, 80716, 80717, 80718, 80719, 80841, 80842, 80843, 80844, 80849, 80851, 80852, 80853, 80854, 80859, 81000, 81001, 81002, 81003, 81010, 81011, 81012, 81013, 81100, 81101, 81102, 81103, 81109, 81110, 81111, 81112, 81113, 81119, 81200, 81201, 81202, 81203, 81209, 81210, 81211, 81212, 81213, 81219, 81220, 81221, 81230, 81231, 81240, 81241, 81242, 81243, 81244, 81249,

Measure	Code system	Codes
Bone fracture	ICD-9-CM	81250, 81251, 81252, 81253, 81254, 81259, 81300, 81301, 81302, 81303, 81304, 81305, 81306, 81307, 81308, 81310, 81311, 81312, 81313, 81314, 81315, 81316, 81317, 81318, 81320, 81321, 81322, 81323, 81330, 81331, 81332, 81333, 81340, 81341, 81342, 81343, 81344, 81345, 81346, 81347, 81350, 81351, 81352, 81353, 81354, 81380, 81381, 81382, 81383, 81390, 81391, 81392, 81393, 81400, 81401, 81402, 81403, 81404, 81405, 81406, 81407, 81408, 81409, 81410, 81411, 81412, 81413, 81414, 81415, 81416, 81417, 81418, 81419, 81500, 81501, 81502, 81503, 81504, 81509, 81510, 81511, 81512, 81513, 81514, 81519, 81600, 81601, 81602, 81603, 81610, 81611, 81612, 81613, 82000, 82001, 82002, 82003, 82009, 82010, 82011, 82012, 82013, 82019, 82020, 82021, 82022, 82030, 82031, 82032, 82100, 82101, 82110, 82111, 82120, 82121, 82122, 82123, 82129, 82130, 82131, 82132, 82133, 82139, 82300, 82301, 82302, 82310, 82311, 82312, 82320, 82321, 82322, 82330, 82331, 82332, 82340, 82341, 82342, 82380, 82381, 82382, 82390, 82391, 82392, 82520, 82521, 82522, 82523, 82524, 82525, 82529, 82530, 82531, 82532, 82533, 82534, 82535, 82539,
	ICD-10-CM	S02, S020, S021, S022, S023, S024, S026, S028, S029, S12, S120, S121, S122, S123, S124, S125, S126, S128, S129, S22, S220, S222, S223, S224, S225, S229, S32, S320, S321, S322, S323, S324, S325, S326, S328, S329, S42, S420, S421, S422, S423, S424, S429, S52, S520, S521, S522, S523, S525, S526, S529, S62, S620, S621, S622, S623, S625, S626, S629, S72, S720, S721, S722, S723, S724, S728, S729, S82, S820, S821, S822, S823, S824, S825, S826, S828, S829, S92, S920, S921, S922, S923, S924, S925, S928, S929

Measure	Code system	Codes
Glaucoma	ICD-9-CM	3659, 36422, 36500, 36501, 36502, 36503, 36504, 36506, 36510, 36511, 36512, 36513, 36515, 36520, 36521, 36522, 36523, 36524, 36531, 36532, 36541, 36542, 36543, 36551, 36552, 36559, 36560, 36561, 36562, 36563, 36564, 36565, 36570, 36571, 36572, 36573, 36574, 36581, 36582, 36583, 36589
	ICD-10-CM	H40, H40001, H40002, H40003, H40009, H40011, H40012, H40013, H40019, H40021, H40022, H40023, H40029, H40031, H40032, H40033, H40039, H40041, H40042, H40043, H40049, H40051, H40052, H40053, H40059, H40061, H40062, H40063, H40069, H4010X0, H4010X1, H4010X2, H4010X3, H4010X4, H401110, H401111, H401112, H401113, H401114, H401120, H401121, H401122, H401123, H401124, H401130, H401131, H401132, H401133, H401134, H401190, H401191, H401192, H401193, H401194, H401210, H401211, H401212, H401213, H401214, H401220, H401221, H401222, H401223, H401224, H401230, H401231, H401232, H401233, H401234, H401290, H401291, H401292, H401293, H401294, H401310, H401311, H401312, H401313, H401314, H401320, H401321, H401322, H401323, H401324, H401330, H401331, H401332, H401333, H401334, H401390, H401391, H401392, H401393, H401394, H401410, H401411, H401412, H401413, H401414, H401420, H401421, H401422, H401423, H401424, H401430, H401431, H401432, H401433, H401434, H401490, H401491, H401492, H401493, H401494, H40151, H40152, H40153, H40159, H4020X0, H4020X1, H4020X2, H4020X3, H4020X4, H40211, H40212, H40213, H40219, H402210, H402211, H402212, H402213, H402214, H402220, H402221, H402222, H402223, H402224, H402230, H402231, H402232, H402233, H402234, H402290, H402291, H402292, H402293, H402294, H40231, H40232, H40233, H40239, H40241, H40242, H40243, H40249, H4030X0, H4030X1, H4030X2, H4030X3, H4030X4, H4031X0, H4031X1, H4031X2, H4031X3, H4031X4, H4032X0, H4032X1, H4032X2, H4032X3, H4032X4, H4033X0, H4033X1, H4033X2, H4033X3, H4033X4, H4040X0, H4040X1, H4040X2, H4040X3, H4040X4, H4041X0, H4041X1, H4041X2, H4041X3, H4041X4, H4042X0, H4042X1, H4042X2, H4042X3, H4042X4, H4043X0, H4043X1, H4043X2, H4043X3, H4043X4, H4050X0, H4050X1, H4050X2, H4050X3, H4050X4, H4051X0, H4051X1, H4051X2, H4051X3, H4051X4, H4052X0, H4052X1, H4052X2, H4052X3, H4052X4, H4053X0, H4053X1, H4053X2, H4053X3, H4053X4, H4060X0, H4060X1, H4060X2, H4060X3, H4060X4, H4061X0, H4061X1, H4061X2, H4061X3, H4061X4, H4062X0, H4062X1, H4062X2, H4062X3, H4062X4, H4063X0, H4063X1, H4063X2, H4063X3, H4063X4, H40811, H40812, H40813, H40819, H40821, H40822, H40823, H40829, H40831, H40832, H40833, H40839, H4089, H409

Measure	Code system	Codes
Obesity-related condition	ICD-9-CM	2781, 27800, 27801, 27802, 27803
	ICD-10-CM	E6601, E6609, E661, E662, E663, E668, E669
Chronic obstructive pulmonary disease exacerbation	ICD-9-CM	466, 480, 481, 482, 483, 484, 485, 486, 487, 490, 506, 507, 511, 512, 518, 1363, 4910, 4911, 4918, 4919, 4928, 4941, 5061, 5062, 5063, 5111, 5171, 5188, 46611, 46619, 49120, 49121, 49122, 51881, 51882
	ICD-10-CM	J438, J471

Table C.10. National drug codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	National drug codes (NDCs)
PDE-4 inhibitor	0310-0088, 0310-0095

Table C.11. Procedure codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	Code system	Codes
Any hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation	CPT	32124, 32141, 32440, 32442, 32445, 32480, 32482, 32484, 32486, 32488, 32491, 32500, 32501, 32503, 32504, 32540, 32655, 32657, 94002, 94003, 94004, 94005, 94656, 94657, 94660
	HCPCS	A7030, A7031, A7032, A7033, A7034, A7035, A7036, A7037, A7038, A7039, A7044, A7045, A7046, E0424, E0425, E0430, E0431, E0433, E0434, E0435, E0439, E0440, E0470, E0471, E0472, E0561, E0562, E0601, E1399, G0302, G0303, G0304, G0305, K0553, K0554, K0555
	ICD-9-CM	0091, 0092, 0093, 315, 329, 336, 3144, 3145, 3201, 3209, 3220, 3222, 3228, 3229, 3230, 3239, 3320, 3324, 3325, 3326, 3327, 3328, 3350, 3351, 3352, 3420, 3424, 3427, 3459, 3481, 9390, 9391, 9399
	ICD-10-PCS	00BB0ZX, 00BB0ZZ, 00BB3ZX, 00BB3ZZ, 00BB4ZX, 00BB4ZZ, 0BB10ZX, 0BB10ZZ, 0BB13ZX, 0BB13ZZ, 0BB14ZX, 0BB14ZZ, 0BB17ZX, 0BB17ZZ, 0BB18ZX, 0BB18ZZ, 0BB20ZX, 0BB20ZZ, 0BB23ZX, 0BB23ZZ, 0BB24ZX, 0BB24ZZ, 0BB27ZX, 0BB27ZZ, 0BB28ZX, 0BB28ZZ, 0BB30ZX, 0BB30ZZ, 0BB33ZX, 0BB33ZZ, 0BB34ZX, 0BB34ZZ, 0BB37ZX, 0BB37ZZ, 0BB38ZX, 0BB38ZZ, 0BB40ZX, 0BB40ZZ, 0BB43ZX, 0BB43ZZ, 0BB44ZX, 0BB44ZZ, 0BB47ZX, 0BB47ZZ, 0BB48ZX, 0BB48ZZ, 0BB50ZX, 0BB50ZZ, 0BB53ZX, 0BB53ZZ, 0BB54ZX, 0BB54ZZ, 0BB57ZX, 0BB57ZZ, 0BB58ZX, 0BB58ZZ, 0BB60ZX, 0BB60ZZ, 0BB63ZX, 0BB63ZZ, 0BB64ZX, 0BB64ZZ, 0BB67ZX, 0BB67ZZ, 0BB68ZX, 0BB68ZZ, 0BB70ZX, 0BB70ZZ, 0BB73ZX, 0BB73ZZ, 0BB74ZX, 0BB74ZZ, 0BB77ZX, 0BB77ZZ, 0BB78ZX, 0BB78ZZ, 0BB80ZX, 0BB80ZZ, 0BB83ZX, 0BB83ZZ, 0BB84ZX, 0BB84ZZ, 0BB87ZX, 0BB87ZZ, 0BB88ZX, 0BB88ZZ, 0BB90ZX, 0BB90ZZ, 0BB93ZX, 0BB93ZZ, 0BB94ZX, 0BB94ZZ, 0BB97ZX, 0BB97ZZ, 0BB98ZX, 0BB98ZZ, 0BBB0ZX, 0BBB0ZZ, 0BBB3ZX, 0BBB3ZZ, 0BBB4ZX, 0BBB4ZZ, 0BBB7ZX, 0BBB7ZZ, 0BBB8ZX, 0BBB8ZZ, 0BBC0ZX, 0BBC0ZZ, 0BBC3ZX, 0BBC3ZZ, 0BBC4ZX, 0BBC4ZZ, 0BBC7ZX, 0BBC7ZZ, 0BBC8ZX, 0BBC8ZZ, 0BBD0ZX, 0BBD0ZZ, 0BBD3ZX, 0BBD3ZZ, 0BBD4ZX, 0BBD4ZZ, 0BBD7ZX, 0BBD7ZZ, 0BBD8ZX, 0BBD8ZZ, 0BBF0ZX, 0BBF0ZZ, 0BBF3ZX, 0BBF3ZZ, 0BBF4ZX, 0BBF4ZZ, 0BBF7ZX, 0BBF7ZZ, 0BBF8ZX, 0BBF8ZZ, 0BBG0ZX, 0BBG0ZZ,

Measure	Code system	Codes
Any hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation	ICD-10-PCS	0BBG3ZX, 0BBG3ZZ, 0BBG4ZX, 0BBG4ZZ, 0BBG7ZX, 0BBG7ZZ, 0BBG8ZX, 0BBG8ZZ, 0BBH0ZX, 0BBH0ZZ, 0BBH3ZX, 0BBH3ZZ, 0BBH4ZX, 0BBH4ZZ, 0BBH7ZX, 0BBH7ZZ, 0BBH8ZX, 0BBH8ZZ, 0BBJ0ZX, 0BBJ0ZZ, 0BBJ3ZX, 0BBJ3ZZ, 0BBJ4ZX, 0BBJ4ZZ, 0BBJ7ZX, 0BBJ7ZZ, 0BBJ8ZX, 0BBJ8ZZ, 0BBK0ZX, 0BBK0ZZ, 0BBK3ZX, 0BBK3ZZ, 0BBK4ZX, 0BBK4ZZ, 0BBK7ZX, 0BBK7ZZ, 0BBK8ZX, 0BBK8ZZ, 0BBL0ZX, 0BBL0ZZ, 0BBL3ZX, 0BBL3ZZ, 0BBL4ZX, 0BBL4ZZ, 0BBL7ZX, 0BBL7ZZ, 0BBL8ZX, 0BBL8ZZ, 0BBM0ZX, 0BBM0ZZ, 0BBM3ZX, 0BBM3ZZ, 0BBM4ZX, 0BBM4ZZ, 0BBM7ZX, 0BBM7ZZ, 0BBM8ZX, 0BBM8ZZ, 0BBN0ZX, 0BBN0ZZ, 0BBN3ZX, 0BBN3ZZ, 0BBN4ZX, 0BBN4ZZ, 0BBN8ZX, 0BBN8ZZ, 0BBP0ZX, 0BBP0ZZ, 0BBP3ZX, 0BBP3ZZ, 0BBP4ZX, 0BBP4ZZ, 0BBP8ZX, 0BBP8ZZ, 0BBT0ZX, 0BBT0ZZ, 0BBT3ZX, 0BBT3ZZ, 0BBT4ZX, 0BBT4ZZ, 0BYC0Z0, 0BYC0Z1, 0BYD0Z0, 0BYD0Z1, 0BYF0Z0, 0BYF0Z1, 0BYG0Z0, 0BYG0Z1, 0BYH0Z0, 0BYH0Z1, 0BYJ0Z0, 0BYJ0Z1, 0BYK0Z0, 0BYK0Z0 , 0BYK0Z1, 0BYK0Z2, 0BYL0Z0, 0BYL0Z0 , 0BYL0Z1, 0BYL0Z2, 0BYM0Z0, 0BYM0Z1, 5A09357, 5A09358, 5A09359, 5A0935B, 5A0935Z
Number of respiratory therapist visits	HCPCS	G0237, G0238, G0239
	Revenue Center	0410, 0412, 0413, 0419, 0976

3. Cancer

Table C.12. Diagnosis codes for measures specific to beneficiaries with cancer

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	ICD-9-CM	151, 155, 159, 191, 200, 204, 205, 206, 208, 209, 1500, 1501, 1502, 1503, 1504, 1505, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1550, 1551, 1552, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1590, 1591, 1598, 1599, 1620, 1622, 1623, 1624, 1625, 1628, 1629, 1630, 1631, 1638, 1639, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1659, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1929, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 1960, 1961, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1990, 1991, 1992, 2001, 2002, 2003, 2004, 2005, 2006, 2008, 2031, 2038, 2041, 2048, 2049, 2051, 2052, 2053, 2058, 2059, 2061, 2062, 2068, 2069, 2078, 2081, 2088, 2089, 2091, 2092, 2093, 2097, 2375, 2391, 2396, 7331, 19881, 19882, 19889, 20000, 20001, 20002, 20003, 20004, 20005, 20006, 20007, 20008, 20010, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20020, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20030, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20040, 20041, 20042, 20043, 20044, 20045, 20045, 20046, 20047, 20048, 20050, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20060, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20068, 20070, 20071, 20072, 20073, 20074, 20075, 20076, 20077, 20078, 20080, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20155, 20300, 20302, 20380, 20400, 20410, 20412, 20480, 20490, 20500, 20502, 20510, 20512, 20520, 20522, 20530, 20532, 20580, 20582, 20590, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20690, 20691, 20692, 20780, 20800, 20810, 20880, 20890, 20892, 20900, 20901, 20902, 20903, 20910, 20911, 20912, 20913, 20914, 20915, 20916, 20917, 20920, 20921, 20922, 20923, 20924, 20925, 20926, 20927, 20929, 20930, 20931, 20932, 20933, 20934, 20935, 20936, 20970, 20971, 20972, 20973, 20974, 20975, 20979, 23873, 73310, 73311, 73312, 73313, 73314, 73315, 73316, 73319, 78951, V5420, V5421, V5422, V5423, V5424, V5425, V5426, V5427, V5429
	ICD-10-CM	C153, C154, C155, C158, C159, C160, C161, C162, C163, C164, C165, C166, C168, C169, C220, C221, C222, C223, C224, C227, C228, C229, C250, C251, C252, C253, C254, C257, C258, C259, C260, C261, C269, C33, C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C37, C380, C381, C382, C383, C384, C388, C390, C399, C450, C451, C452, C457, C459, C480, C481, C482, C488, C4A0, C4A10, C4A11, C4A12, C4A20, C4A21, C4A22, C4A30, C4A31, C4A39, C4A4, C4A51, C4A52, C4A59, C4A60, C4A61, C4A62, C4A70, C4A71, C4A72, C4A8, C4A9, C700, C701, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C7220, C7221, C7222, C7230, C7231, C7232, C7240,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	ICD-10-CM	C7241, C7242, C7250, C7259, C729, C760, C761, C762, C763, C7640, C7641, C7642, C7650, C7651, C7652, C768, C770, C771, C772, C773, C774, C775, C778, C779, C7800, C7801, C7802, C781, C782, C7830, C7839, C784, C785, C786, C787, C7880, C7889, C7900, C7901, C7902, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7981, C7982, C7989, C799, C7A00, C7A010, C7A011, C7A012, C7A019, C7A020, C7A021, C7A022, C7A023, C7A024, C7A025, C7A026, C7A029, C7A090, C7A091, C7A092, C7A093, C7A094, C7A095, C7A096, C7A098, C7A1, C7A8, C7B00, C7B01, C7B02, C7B03, C7B04, C7B09, C7B1, C7B8, C800, C801, C802, C8115, C8251, C8252, C8253, C8254, C8255, C8256, C8257, C8258, C8300, C8301, C8302, C8303, C8304, C8305, C8306, C8307, C8308, C8309, C8310, C8311, C8312, C8313, C8314, C8315, C8316, C8317, C8318, C8319, C8330, C8331, C8332, C8333, C8334, C8335, C8336, C8337, C8338, C8339, C8350, C8351, C8352, C8353, C8354, C8355, C8356, C8357, C8358, C8359, C8370, C8371, C8372, C8373, C8373, C8374, C8375, C8376, C8377, C8378, C8379, C8380, C8381, C8382, C8383, C8384, C8385, C8386, C8387, C8388, C8389, C8390, C8391, C8392, C8393, C8394, C8395, C8396, C8397, C8398, C8399, C8460, C8461, C8462, C8463, C8464, C8465, C8466, C8467, C8468, C8469, C8470, C8471, C8472, C8473, C8474, C8475, C8476, C8477, C8478, C8479, C8491, C8492, C8493, C8494, C8495, C8496, C8497, C8498, C84A1, C84A2, C84A3, C84A4, C84A5, C84A6, C84A7, C84A8, C84Z1, C84Z2, C84Z3, C84Z4, C84Z5, C84Z6, C84Z7, C84Z8, C8511, C8512, C8513, C8514, C8515, C8516, C8517, C8518, C8520, C8521, C8522, C8523, C8524, C8525, C8526, C8527, C8528, C8529, C8581, C8582, C8583, C8584, C8585, C8586, C8587, C8588, C8591, C8592, C8593, C8594, C8595, C8596, C8597, C8598, C860, C861, C862, C863, C865, C866, C882, C883, C884, C888, C889, C9000, C9002, C9020, C9030, C9100, C9110, C9112, C9130, C9150, C9160, C9190, C91A0, C91Z0, C9200, C9202, C9210, C9212, C9220, C9222, C9230, C9232, C9240, C9242, C9250, C9252, C9260, C9262, C9290, C9292, C92A0, C92A2, C92Z0, C92Z2, C9300, C9301, C9302, C9310, C9311, C9312, C9330, C9330, C9390, C9391, C9392, C93Z0, C93Z1, C9430, C9480, C9500, C9510, C9590, C9592, D430, D431, D432, D434, D4622, D491, D496, M4840XD, M4840XG, M4841XD, M4841XG, M4842XD, M4842XG, M4843XD, M4843XG, M4844XD, M4844XG, M4845XD, M4845XG, M4846XD, M4846XG, M4847XD, M4847XG, M4848XD, M4848XG, M4850XA, M4850XD, M4850XG, M4851XA, M4851XD, M4851XG, M4852XA, M4852XD, M4852XG, M4853XA, M4853XD, M4853XG, M4854XA, M4854XD, M4854XG, M4855XA, M4855XD, M4855XG, M4856XA, M4856XD, M4856XG, M4857XA, M4857XD, M4857XG, M4858XA, M4858XD, M4858XG, M8000XA, M8000XD, M8000XG, M80011A, M80011D, M80011G, M80012A, M80012D, M80012G, M80019A, M80019D, M80019G, M80021A, M80021D, M80021G, M80022A, M80022D, M80022G, M80029A, M80029D, M80029G, M80031A, M80031D, M80031G, M80032A, M80032D, M80032G,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	ICD-10-CM	M80039A, M80039D, M80039G, M80041A, M80041D, M80041G, M80042A, M80042D, M80042G, M80049A, M80049D, M80049G, M80051A, M80051D, M80051G, M80052A, M80052D, M80052G, M80059A, M80059D, M80059G, M80061A, M80061D, M80061G, M80062A, M80062D, M80062G, M80069A, M80069D, M80069G, M80071A, M80071D, M80071G, M80072A, M80072D, M80072G, M80079A, M80079D, M80079G, M8008XA, M8008XD, M8008XG, M8080XA, M8080XD, M8080XG, M80811A, M80811D, M80811G, M80812A, M80812D, M80812G, M80819A, M80819D, M80819G, M80821A, M80821D, M80821G, M80822A, M80822D, M80822G, M80829A, M80829D, M80829G, M80831A, M80831D, M80831G, M80832A, M80832D, M80832G, M80839A, M80839D, M80839G, M80841A, M80841D, M80841G, M80842A, M80842D, M80842G, M80849A, M80849D, M80849G, M80851A, M80851D, M80851G, M80852A, M80852D, M80852G, M80859A, M80859D, M80859G, M80861A, M80861D, M80861G, M80862A, M80862D, M80862G, M80869A, M80869D, M80869G, M80871A, M80871D, M80871G, M80872A, M80872D, M80872G, M80879A, M80879D, M80879G, M8088XA, M8088XD, M8088XG, M8430XD, M8430XG, M84311D, M84311G, M84312D, M84312G, M84319D, M84319G, M84321D, M84321G, M84322D, M84322G, M84329D, M84329G, M84331D, M84331G, M84332D, M84332G, M84333D, M84333G, M84334D, M84334G, M84339D, M84339G, M84341D, M84341G, M84342D, M84342G, M84343D, M84343G, M84344D, M84344G, M84345D, M84345G, M84346D, M84346G, M84350D, M84350G, M84351D, M84351G, M84352D, M84352G, M84353D, M84353G, M84359D, M84359G, M84361D, M84361G, M84362D, M84362G, M84363D, M84363G, M84364D, M84364G, M84369D, M84369G, M84371D, M84371G, M84372D, M84372G, M84373D, M84373G, M84374D, M84374G, M84375D, M84375G, M84376D, M84376G, M84377D, M84377G, M84378D, M84378G, M84379D, M84379G, M8438XD, M8438XG, M8440XA, M8440XD, M8440XG, M84411A, M84411D, M84411G, M84412A, M84412D, M84412G, M84419A, M84419D, M84419G, M84421A, M84421D, M84421G, M84422A, M84422D, M84422G, M84429A, M84429D, M84429G, M84431A, M84431D, M84431G, M84432A, M84432D, M84432G, M84433A, M84433D, M84433G, M84434A, M84434D, M84434G, M84439A, M84439D, M84439G, M84441A, M84441D, M84441G, M84442A, M84442D, M84442G, M84443A, M84443D, M84443G, M84444A, M84444D, M84444G, M84445A, M84445D, M84445G, M84446A, M84446D, M84446G, M84451A, M84451D, M84451G, M84452A, M84452D, M84452G, M84453A, M84453D, M84453G, M84454A, M84454D, M84454G, M84459A, M84459D, M84459G, M84461A, M84461D, M84461G, M84462A, M84462D, M84462G, M84463A, M84463D, M84463G, M84464A, M84464D, M84464G, M84469A, M84469D, M84469G, M84471A, M84471D, M84471G, M84472A, M84472D, M84472G, M84473A, M84473D, M84473G, M84474A, M84474D, M84474G, M84475A, M84475D, M84475G, M84476A, M84476D, M84476G, M84477A, M84477D, M84477G, M84478A, M84478D, M84478G, M84479A, M84479D, M84479G, M8448XA, M8448XD, M8448XG, M8450XA, M8450XD, M8450XG, M84511A, M84511D, M84511G, M84512A, M84512D, M84512G, M84519A, M84519D, M84519G, M84521A, M84521D, M84521G, M84522A, M84522D,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	ICD-10-CM	M84522G, M84529A, M84529D, M84529G, M84531A, M84531D, M84531G, M84532A, M84532D, M84532G, M84533A, M84533D, M84533G, M84534A, M84534D, M84534G, M84539A, M84539D, M84539G, M84541A, M84541D, M84541G, M84542A, M84542D, M84542G, M84549A, M84549D, M84549G, M84550A, M84550D, M84550G, M84551A, M84551D, M84551G, M84552A, M84552D, M84552G, M84553A, M84553D, M84553G, M84559A, M84559D, M84559G, M84561A, M84561D, M84561G, M84562A, M84562D, M84562G, M84563A, M84563D, M84563G, M84564A, M84564D, M84564G, M84569A, M84569D, M84569G, M84571A, M84571D, M84571G, M84572A, M84572D, M84572G, M84573A, M84573D, M84573G, M84574A, M84574D, M84574G, M84575A, M84575D, M84575G, M84576A, M84576D, M84576G, M8458XA, M8458XD, M8458XG, M8460XA, M8460XD, M8460XG, M84611A, M84611D, M84611G, M84612A, M84612D, M84612G, M84619A, M84619D, M84619G, M84621A, M84621D, M84621G, M84622A, M84622D, M84622G, M84629A, M84629D, M84629G, M84631A, M84631D, M84631G, M84632A, M84632D, M84632G, M84633A, M84633D, M84633G, M84634A, M84634D, M84634G, M84639A, M84639D, M84639G, M84641A, M84641D, M84641G, M84642A, M84642D, M84642G, M84649A, M84649D, M84649G, M84650A, M84650D, M84650G, M84651A, M84651D, M84651G, M84652A, M84652D, M84652G, M84653A, M84653D, M84653G, M84659A, M84659D, M84659G, M84661A, M84661D, M84661G, M84662A, M84662D, M84662G, M84663A, M84663D, M84663G, M84664A, M84664D, M84664G, M84669A, M84669D, M84669G, M84671A, M84671D, M84671G, M84672A, M84672D, M84672G, M84673A, M84673D, M84673G, M84674A, M84674D, M84674G, M84675A, M84675D, M84675G, M84676A, M84676D, M84676G, M8468XA, M8468XD, M8468XG, M84750A, M84750D, M84750G, M84751A, M84751D, M84751G, M84752A, M84752D, M84752G, M84753A, M84753D, M84753G, M84754A, M84754D, M84754G, M84755A, M84755D, M84755G, M84756A, M84756D, M84756G, M84757A, M84757D, M84757G, M84758A, M84758D, M84758G, M84759A, M84759D, M84759G, M9701XD, M9702XD, M9711XD, M9712XD, M9721XD, M9722XD, M9731XD, M9732XD, M9741XD, M9742XD, M978XXD, M979XXD, R180
Diagnosis codes indicating advanced stage or poor prognosis cancers	ICD-9-CM	214, 218, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1960, 1960, 1961, 1961, 1962, 1962, 1963, 1963, 1965, 1965, 1966, 1966, 1968, 1968, 1969, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1990, 1991, 1992, 2140, 2141, 2142, 2143, 2144, 2148, 2149, 2180, 2181, 2182, 2189, 2281, 2377, 2383, 2384, 2850, 2851, 2852, 2853, 2858, 2858, 2859, 9952, 19881, 19881, 19882, 19882, 19889, 19889, 22527, 22529, 23770, 23771, 23772, 23773, 23779, 23871, 23872, 23873, 23874, 23875, 23876, 23877, 23879, 28521, 28522, 28529, 28803, 78701, 99520, 99521, 99522, 99523, 99524, E9331, V5811, V5869
	ICD-10-CM	C792, D181, D251, D62, D630, D631, D638, D640, D6481, D701, T383X5A, T410X5A, T411X5A, T41205A, T41295A, T413X5A, T4145XA, T451X5A, T451X5S, T50905A, T7841XA, T8852XA, Z1501, Z5111, Z7984, Z79891

Table C.13. National drug codes for measures specific to beneficiaries with cancer

Measure	National Drug Codes (NDCs)
Drug codes indicating advanced stage or poor prognosis cancers	16729-276, 25021-215, 50742-423, 50742-481, 50742-482, 50742-483, 63323-117, 68001-266, 68083-269, 68083-270, 68083-292, 68083-293, 0002-4483, 0002-4815, 0002-5337, 0002-6216, 50242-087, 50242-088, 68817-134, 0078-0701, 0078-0708, 0078-0715, 0093-7536, 0904-6195, 16571-421, 16729-035, 42291-085, 43063-383, 50090-2453, 50268-075, 51991-620, 59651-236, 60429-286, 60505-2985, 60687-112, 60763-376, 62175-710, 62559-670, 63187-080, 63850-0010, 65841-743, 68001-155, 68071-1682, 68071-5203, 68382-209, 68788-6774, 69117-0003, 70518-2420, 70518-2484, 72789-008, 76420-004, 76519-1224, 50242-917, 50242-918, 0069-0315, 0069-0342, 50242-060, 50242-061, 55513-206, 55513-207, 0904-6019, 16714-816, 16729-023, 47335-485, 60429-177, 62559-680, 62559-890, 63629-8308, 65841-613, 68382-224, 00024-5824, 44567-620, 44567-621, 50090-3398, 51662-1312, 51662-1347, 52584-360, 63323-360, 0004-1100, 0004-1101, 0054-0271, 0054-0272, 0093-7473, 0093-7474, 0378-2511, 0378-2512, 16714-467, 16714-468, 16729-072, 16729-073, 50268-154, 51079-510, 51407-095, 51407-096, 59651-204, 59651-205, 59923-721, 59923-722, 60687-149, 62756-238, 62756-239, 64980-276, 64980-277, 65162-843, 65162-844, 67877-458, 67877-459, 69097-948, 69097-949, 70756-815, 70756-816, 72205-006, 72205-007, 72485-204, 72485-205, 72606-554, 72606-555, 0703-4239, 0703-4244, 0703-4246, 0703-4248, 16729-295, 50742-445, 50742-446, 50742-447, 50742-448, 55150-333, 55150-334, 55150-335, 55150-386, 61703-339, 63323-172, 68083-190, 68083-191, 68083-192, 68083-193, 69448-005, 69539-019, 71288-100, 69539-020, 66733-948, 66733-958, 0143-9504, 0143-9505, 0703-5747, 0703-5748, 16729-288, 44567-509, 44567-510, 44567-511, 44567-530, 63323-103, 68001-283, 68083-162, 68083-163, 70860-206, 0054-0382, 0054-0383, 0781-3233, 0781-3244, 0781-3255, 10019-935, 10019-936, 10019-937, 10019-938, 10019-939, 10019-942, 10019-943, 10019-944, 10019-945, 10019-955, 10019-956, 10019-957, 10019-982, 10019-984, 16714-857, 16714-858, 16714-859, 43975-307, 43975-308, 50742-519, 50742-520, 54879-021, 54879-022, 62559-930, 62559-931, 68001-370, 68001-371, 68001-372, 68001-442, 68001-443, 68001-444, 69097-516, 69097-517, 70121-1238, 70121-1239, 70121-1240, 72603-104, 72603-326, 72603-411, 55513-002, 55513-003, 55513-004, 55513-005, 55513-006, 55513-021, 55513-023, 55513-025, 55513-027, 55513-028, 55513-032, 55513-057, 55513-098, 55513-110, 55513-111, 55566-8303, 55566-8403, 55513-710, 55513-730, 0054-3177, 0054-4179, 0054-4180, 0054-4181, 0054-4182, 0054-4183, 0054-4184, 0054-4186, 0054-8174, 0054-8175, 0054-8176, 0054-8179, 0054-8180, 0054-8181, 0054-8183, 0095-0087, 0095-0088, 0095-0089, 15014-211, 42195-121, 42195-127, 42195-149, 42195-151, 42195-221, 42195-270, 42195-490, 42195-721, 43063-266, 45865-989, 48102-045, 48102-046, 48102-047, 48102-048, 49999-059, 50090-0088, 50090-0089, 50090-0090, 50090-0091, 51407-361, 54879-003, 55154-4901, 55154-4914, 55289-582, 55289-903, 55700-854, 58463-014, 58463-015, 58463-016, 58463-017, 60432-466, 61919-269, 61919-827, 63187-383, 63187-561, 63629-2696, 63629-3742, 63629-4127, 63629-4129, 63629-7806, 63629-7850, 64980-509, 67296-0326, 67296-1090, 68071-4127, 68788-7142, 68788-7267, 69306-111, 69306-112, 69306-114, 70518-1534, 70569-151, 71205-012, 71205-013, 71335-0077, 71335-0177, 71905-400, 72893-015, 79043-200, 76168-065, 00069-9144, 00075-8003, 00075-8004, 00409-0366, 00409-0367, 00409-0368, 00409-0369, 00703-5720, 00703-5730, 0075-8004, 00955-1020, 00955-1021, 00955-1022, 0409-0366, 0409-0367, 0409-0368, 0955-1020, 0955-1021, 0955-1022, 16714-0465, 16714-0500, 16729-0120, 16729-0228, 16729-0231, 43598-389, 43598-610, 43598-611, 45963-0765, 45963-0781, 45963-0790, 45963-734, 45963-765, 45963-790, 57884-3021, 57884-3041, 57884-3042, 57884-3043, 63739-0932, 63739-0971, 66758-0050, 66758-050, 66758-0950,

Measure	National Drug Codes (NDCs)
Drug codes indicating advanced stage or poor prognosis cancers	66758-950, 67457-781, 70121-1221, 70121-1222, 70121-1223, 72485-214, 72485-215, 72485-216, 25021-0245, 47335-0285, 50742-0428, 50742-0431, 50742-0463, 0069-3030, 0069-3031, 0069-3032, 0069-3033, 0069-3034, 0069-4004, 0069-4015, 0069-4026, 0069-4030, 0069-4031, 0069-4032, 0069-4033, 0069-4034, 0069-4037, 0143-9275, 0143-9277, 0143-9369, 0143-9370, 0143-9371, 0143-9372, 0143-9546, 0143-9547, 0143-9548, 0143-9549, 0338-0063, 0338-0067, 0338-0080, 0338-0086, 16714-742, 16714-856, 43598-283, 43598-541, 43598-682, 43598-683, 45963-733, 47335-049, 47335-050, 49315-008, 49315-009, 62756-826, 62756-827, 63323-101, 63323-883, 67457-436, 68001-345, 68083-248, 68083-249, 68083-250, 70121-1218, 70121-1219, 70710-1530, 70710-1531, 70860-208, 72603-103, 72603-200, 50242-091, 50242-094, 0009-5091, 0009-5093, 0143-9202, 0143-9203, 45963-608, 59923-701, 0069-1305, 0069-1306, 0069-1307, 0069-1308, 0069-1309, 55513-126, 55513-144, 55513-148, 55513-267, 55513-283, 55513-478, 59353-002, 59353-003, 59353-004, 59353-010, 43624-002, 62856-389, 0093-7663, 0093-7664, 0378-7131, 0378-7132, 0378-7133, 42292-051, 42292-052, 42292-053, 50242-062, 50242-063, 50242-064, 51991-890, 51991-891, 51991-892, 59923-725, 59923-726, 54436-025, 59137-505, 59137-510, 59137-515, 59137-520, 59137-525, 59137-530, 59137-535, 59137-540, 59137-550, 59651-182, 61703-350, 61703-408, 59923-727, 63304-095, 63304-096, 63304-135, 68382-913, 68382-914, 68382-915, 70771-1521, 70771-1522, 70771-1523, 72485-217, 72485-218, 72485-219, 0009-7663, 0054-0080, 0378-5001, 0832-0595, 44278-025, 47781-108, 50090-5193, 51991-005, 59762-2858, 65162-240, 68382-383, 69097-316, 70771-1374, 65597-406, 55513-209, 55513-530, 55513-546, 55513-924, 0832-0086, 49884-753, 60429-272, 69097-915, 0310-0720, 0310-7720, 0591-5019, 0781-3079, 0781-3492, 16714-118, 25021-462, 43598-262, 63323-715, 67457-311, 68001-424, 68462-317, 68842-301, 70121-1463, 70534-002, 70860-211, 71288-555, 71731-6121, 72603-105, 0409-0181, 0409-0182, 0409-0183, 0409-0185, 0409-0186, 0409-0187, 16729-391, 16729-419, 16729-423, 16729-426, 25021-239, 45963-624, 50742-496, 50742-497, 50742-498, 55111-686, 55111-687, 62756-008, 62756-073, 62756-102, 62756-219, 62756-321, 62756-438, 62756-533, 62756-614, 62756-746, 62756-974, 63323-102, 63323-125, 63323-126, 68001-342, 68001-348, 68001-350, 68001-359, 0002-7501, 0002-7502, 16714-909, 16714-930, 16729-092, 16729-117, 16729-118, 25021-234, 25021-235, 45963-619, 60505-6113, 60505-6114, 60505-6115, 67457-462, 67457-463, 67457-464, 67457-616, 67457-617, 67457-618, 68001-282, 68083-148, 68083-149, 69097-313, 69097-314, 70860-204, 70860-205, 71288-113, 71288-114, 72485-221, 72485-222, 72485-223, 0009-7529, 0143-9583, 0143-9701, 0143-9702, 15054-0043, 25021-230, 45963-614, 50742-401, 50742-402, 59923-702, 59923-714, 59923-715, 59923-716, 60505-6128, 61703-349, 63323-193, 67184-0511, 67184-0512, 67184-0513, 68001-284, 68001-425, 68001-426, 68083-381, 68083-382, 70700-169, 70700-170, 72485-211, 72485-212, 72485-213, 70020-1910, 0078-0671, 68180-801, 50419-390, 50419-391, 71777-390, 71777-391, 71777-392, 0078-0249, 0093-7620, 16729-034, 17856-0032, 42291-374, 50268-476, 51991-759, 55111-646, 57884-2021, 59651-180, 60505-3255, 68071-5264, 69117-0004, 70518-1869, 70518-2020, 71335-1526, 0054-4496, 0054-4497, 0054-4498, 0054-4499, 0054-8496, 0555-0484, 0555-0485, 0904-6703, 42806-358, 42806-359, 50742-181, 50742-182, 50742-183, 50742-184, 51079-581, 51079-582, 60687-227, 0074-2108, 0074-2282, 0074-2440, 0074-3346, 0074-3473, 0074-3641, 0074-3642, 0074-3663, 0074-3683, 0074-3779, 0074-9694, 0781-4003, 47335-936, 62935-153, 62935-223, 62935-303, 62935-453, 62935-753, 0054-3542, 0121-0887, 0121-4776, 0555-0606, 0555-0607, 0904-3571, 17856-0907, 24979-041, 49884-230, 49884-289, 49884-290, 49884-907, 50383-859, 51079-434, 51991-313, 55154-5776, 60429-433, 60432-126, 63629-7631, 63739-165, 63739-549, 66689-020,

Measure	National Drug Codes (NDCs)
Hormonal therapy	0093-1125, 0143-9597, 0378-6920, 0378-6924, 0904-6948, 16714-963, 42292-057, 43598-358, 47335-401, 51407-181, 57894-150, 57894-155, 57894-195, 60505-4327, 64679-021, 64980-418, 69539-049, 72205-030, 72606-566, 0093-7536, 0904-6195, 16571-421, 16729-035, 42291-085, 43063-383, 50090-2453, 50268-075, 51991-620, 59651-236, 60429-286, 60505-2985, 60687-112, 60763-376, 62175-710, 62559-670, 63187-080, 63850-0010, 65841-743, 68001-155, 68071-1682, 68071-5203, 68382-209, 68788-6774, 69117-0003, 70518-2420, 70518-2484, 72789-008, 76420-004, 76519-1224, 59676-600, 0469-0125, 0469-0625, 0469-0725, 0009-7663, 0054-0080, 0378-5001, 0832-0595, 44278-025, 47781-108, 50090-5193, 51991-005, 59762-2858, 65162-240, 68382-383, 69097-316, 70771-1374, 50090-3466, 70720-950, 70720-951, 0378-0261, 35573-433, 43063-036, 43063-882, 50090-1992, 51672-4026, 60429-020, 64380-827, 66267-400, 68788-9708, 70518-2027, 70518-2315, 70518-2831, 71335-0439, 71335-1652, 71337-035, 72789-052, 0078-0249, 0093-7620, 16729-034, 17856-0032, 42291-374, 50268-476, 51991-759, 55111-646, 57884-2021, 59651-180, 60505-3255, 68071-5264, 69117-0004, 70518-1869, 70518-2020, 71335-1526, 59212-111, 62559-173, 66993-212, 0378-0144, 0378-0274, 0591-2472, 0591-2473, 50090-0485, 50090-0942, 51862-446, 51862-447, 59651-299, 59651-300, 60429-909, 60429-910, 63187-976, 63739-269, 68071-5005, 68071-5254, 68382-826, 68382-827, 70518-1881, 70518-2721, 70771-1184, 70771-1185, 71335-0237, 71335-0893, 71335-1424, 89141-123

Table C.14. Procedure codes for measures specific to beneficiaries with cancer

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	HCPCS	G9066, G9069, G9075, G9087, G9088, G9094, G9098, G9103, G9107, G9111, G9834, G9842
Procedure codes indicating advanced stage or poor prognosis cancers	CPT	19301, 19302, 19303, 19304, 19305, 19306, 19307, 31652, 31653, 36640, 38300, 38305, 38500, 38505, 38510, 38520, 38525, 38530, 38531, 38570, 38572, 38573, 38589, 38700, 38720, 38724, 38740, 38745, 38746, 38747, 38760, 38765, 38770, 38780, 38790, 38792, 39402, 55812, 55842, 55862, 61517, 76950, 77011, 77014, 77261, 77262, 77263, 77280, 77285, 77290, 77293, 77295, 77299, 77300, 77301, 77305, 77306, 77307, 77310, 77315, 77316, 77317, 77318, 77321, 77326, 77327, 77328, 77331, 77332, 77333, 77334, 77336, 77338, 77370, 77371, 77372, 77373, 77385, 77386, 77387, 77399, 77401, 77402, 77403, 77404, 77406, 77407, 77408, 77409, 77411, 77412, 77413, 77414, 77416, 77417, 77421, 77422, 77423, 77424, 77425, 77427, 77431, 77432, 77435, 77469, 77470, 77499, 77520, 77522, 77523, 77525, 77600, 77605, 77610, 77615, 77620, 77750, 77761, 77762, 77763, 77767, 77768, 77776, 77777, 77778, 77785, 77786, 77787, 77789, 77790, 77799, 79005, 79101, 79200, 79300, 79403, 79440, 79445, 79999, 81162, 81163, 96401, 96402, 96405, 96406, 96409, 96411, 96413, 96415, 96416, 0182T, 0197T, 0394T, 0395T
	HCPCS	E0791, E0791, G0498, G3001, G6001, G6002, G6003, G6004, G6005, G6006, G6007, G6008, G6009, G6010, G6011, G6012, G6013, G6014, G6016, G6017, J0610, J0881, J0885, J0897, J1442, J1447, J1950, J2430, J2469, J2505, J3315, J3489, J8530, J8610, J9000, J9022, J9035, J9043, J9045, J9055, J9060, J9155, J9171, J9178, J9179, J9198, J9198, J9206, J9207, J9217, J9218, J9219, J9250, J9260, J9264, J9267, J9271, J9299, J9303, J9306, J9354, J9355, J9358, J9390, J9395

Table C.15. National drug codes to identify hormonal therapies commonly given to beneficiaries with early-stage breast cancer

Drug	National drug codes (NDCs)
Tamoxifen	378, 591, 50090, 51862, 59651, 60429, 63187, 63739, 68071, 68382, 70518, 70771, 71335, and 89141
Anastrazole	93, 904, 16571, 16729, 42291, 43063, 50090, 50268, 51991, 59651, 60429, 60505, 60687, 60763, 62175, 62559, 63187, 63850, 65841, 68001, 68071, 68382, 68788, 69117, 70518, 72789, 76420, and 76519
Letrozole	78, 93, 16729, 17856, 42291, 50268, 51991, 55111, 57884, 59651, 60505, 68071, 69117, 70518, and 71335
Exemestane	9, 54, 378, 832, 44278, 47781, 50090, 51991, 59762, 65162, 68382, 69097, and 70771

G. Quality measures

Table C.16. Procedure codes for quality measures

Measure	Code system	Codes
Received an aggressive life-prolonging treatment after enrollment (or pseudo-enrollment)	**CPT**	22900, 22901, 22902, 22903, 22904, 44147, 44150, 44151, 44155, 44156, 44157, 44158, 45111, 45114, 45120, 45121, 49203, 49204, 49205, 49215, 49220, 51720, 96401, 96402, 96405, 96406, 96409, 96411, 96413, 96415, 96416, 96417, 96420, 96422, 96423, 96425, 96440, 96445, 96446, 96450, 96521, 96522, 96523, 96542, 96549, 33215, 33216, 33217, 33218, 33220, 33223, 33224, 33225, 33226, 33230, 33231, 33240, 33249, 33262, 33263, 33264, 33967, 33968, 33990, 33991, 33992, 33993, 92920, 92921, 92924, 92925, 92928, 92929, 92933, 92934, 92937, 92938, 92941, 92943, 92944, 92973, 92975, 92977, 92978, 92979, 93451, 93452, 93453, 93454, 93455, 93456, 93457, 93459, 93460, 93461, 93462, 93463, 93464, 93468, 93503, 93505, 93530, 93531, 93532, 93533, 93561, 93562, 93563, 93564, 93565, 93566, 93567, 93568, 93571, 93572 31500, 31605, 31647, 31648, 31649, 31651, 32491, 32851, 32852, 32853, 32854, 36415, 44210, 44211, 44212, 49320, 49321, 49324, 49325, 49326, 93000, 93005, 93010, 94002, 94004, 94010, 94060, 94070, 94150, 94200, 94375, 94660, 94726, 94727, 99195
	DRG	410
	HCPCS	B4034, B4035, B4036, B4081, B4082, B4083, B4086, B4087, B4088, B4100, B4102, B4103, B4104, B4105, B4149, B4150, B4152, B4153, B4154, B4155, B4157, B4158, B4159, B4160, B4161, B4162, B4164, B4168, B4172, B4176, B4178, B4180, B4185, B4187, B4189, B4193, B4197, B4199, B4216, B4220, B4222, B4224, B5000, B5100, B5200, B9000, B9002, B9004, B9006, B9998, B9999, G0269, G6003, G6004, G6005, G6006, G6007, G6008, G6009, G6010, G6011, G6012, G6013, G6014, J8501, J8510, J8515, J8520, J8521, J8530, J8540, J8560, J8562, J8565, J8597, J8600, J8610, J8650, J8655, J8670, J8700, J8705, J8999, J9000, J9015, J9017, J9019, J9020, J9022, J9023, J9025, J9027, J9030, J9031, J9032, J9033, J9034, J9035, J9036, J9039, J9040, J9041, J9042, J9043, J9044, J9045, J9047, J9050, J9055, J9057, J9060, J9065, J9070, J9098, J9100, J9118, J9119, J9120, J9130, J9145, J9150, J9151, J9153, J9155, J9160, J9165, J9171, J9173, J9175, J9176, J9177, J9178, J9179, J9181, J9185, J9190, J9198, J9199, J9200, J9201, J9202, J9203, J9204, J9205, J9206, J9207, J9208, J9209, J9210, J9211, J9212, J9213, J9214, J9215, J9216, J9217, J9218, J9219, J9225, J9226, J9227, J9228, J9229, J9230, J9245, J9246, J9250, J9260, J9261, J9262, J9263, J9264, J9266, J9267, J9268, J9269, J9270, J9271, J9280, J9285, J9293, J9295, J9299, J9300, J9301, J9302, J9303, J9304, J9305, J9306, J9307, J9308, J9309, J9311, J9312, J9313, J9315, J9320, J9325, J9328, J9330, J9340, J9351, J9352, J9354, J9355, J9356, J9357, J9358, J9360, J9370, J9371, J9390, J9395, J9400, J9600, J9999, Q0083, Q0084, Q0085, S2060

Measure	Code system	Codes
Received an aggressive life-prolonging treatment after enrollment (or pseudo-enrollment)	**Revenue Center**	0331, 0332, 0335
	ICD-9-CM	3350, 3351, 3352, 3796, 9925
	ICD-10-PCS	3E03305, 3E04305, XW03351, XW033B3, XW033C3, XW04351, XW043B3, XW043C3 0JH608Z, 0JH638Z, 0JH808Z, 0JH838Z, 0JH638Z, 0JH838Z 0BYK0Z0, 0BYK0Z1, 0BYK0Z2, 0BYL0Z0, 0BYL0Z1, 0BYL0Z2, 0BYC0Z0, 0BYC0Z1, 0BYC0Z2, 0BYD0Z0, 0BYD0Z1, 0BYD0Z2, 0BYF0Z0, 0BYF0Z1, 0BYF0Z2, 0BYG0Z0, 0BYG0Z1, 0BYG0Z2, 0BYH0Z0, 0BYH0Z1, 0BYH0Z2, 0BYJ0Z0, 0BYJ0Z1, 0BYJ0Z2, 0BYK0Z0, 0BYK0Z1, 0BYK0Z2, 0BYL0Z0, 0BYL0Z1, 0BYL0Z2, 0BYM0Z0, 0BYM0Z1, 0BYM0Z2

Appendix D:

Supplemental Results

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A. Complete results from the main impact analyses

1. Impact estimates for the full sample

In this appendix, we report regression-adjusted intervention and comparison group means and impact estimates for the full sample of MCCM enrollees and matched comparison beneficiaries, including confidence intervals and *p*-values. We discussed these results in Chapters III, IV, and V. We describe how we obtained these estimates in Appendix A. Table D.1 shows the estimated impacts on Medicare expenditures from enrollment (or pseudo-enrollment) to death (corresponding to Figures III.1 and III.2). In addition, we include estimated impacts on Medicare expenditures (with and without MCCM payments) *per day*.

Table D.1. Regression-adjusted differences in Medicare expenditures between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare expenditures (dollars per beneficiary)						
Medicare Part A and B expenditures plus MCCM payments	45,976	53,229	-7,254	-14	< .001	[-8,525, -5,983]
Medicare Part A and B expenditures	44,149	53,229	-9,080	-17	< .001	[-10,352, -7,809]
Inpatient expenditures	15,325	25,225	-9,900	-39	< .001	[-10,753, -9,046]
Hospice expenditures	8,159	3,960	4,199	106	< .001	[3,857, 4,542]
Skilled nursing facility expenditures	2,509	3,235	-726	-22	< .001	[-967, -486]
Home health expenditures	2,235	2,217	18	1	0.79	[-93, 129]
Part B drug expenditures	5,803	6,190	-387	-6	0.25	[-937, 163]
Durable medical equipment expenditures	788	634	153	24	0.03	[40, 266]
Other expenditures	9,331	11,945	-2,615	-22	< .001	[-2,992, -2,237]
MCCM payments	1,827	n/a	n/a	n/a	n/a	n/a
Medicare expenditures per day (dollars per beneficiary per day)						
Medicare Part A and B expenditures plus model payments per day	376	514	-138	-27	< .001	[-152, -124]
Medicare Part A and B expenditures per day	359	514	-155	-30	< .001	[-169, -141]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. "Other expenditures" include expenditures for outpatient emergency department visits, ambulatory care visits and other medically necessary services.

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Table D.2, we report impact estimates on health care use for the inpatient and outpatient categories shown in Figures III.4 and III.5. We also split up the outcome measures "number of outpatient emergency department visits and observation stays" and "number of ambulatory visits with primary care providers and specialist physicians" into their respective components, which are not shown in the figures in Chapter III.

Table D.2. Regression-adjusted differences in health care service use between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Number of inpatient admissions	1,187	1,608	-421	-26	< .001	[-467, -375]
Number of days admitted to hospital	7,776	11,578	-3,802	-33	< .001	[-4,193, -3,411]
Number of days in hospital intensive care unit	2,520	4,070	-1,550	-38	< .001	[-1,760, -1,340]
Number of days in hospital without intensive care unit	5,256	7,510	-2,255	-30	< .001	[-2,547, -1,963]
Number of 30-day all-cause readmissions	286	397	-112	-28	< .001	[-137, -86]
Number of outpatient emergency department visits and observation stays	839	970	-131	-14	< .001	[-177, -86]
Number of outpatient emergency department visits	826	959	-134	-14	< .001	[-179, -88]
Number of observation stays	157	177	-20	-11	0.04	[-35, -4]
Number of emergency medical service ambulance transports	901	1,046	-145	-14	< .001	[-199, -90]
Number of ambulatory visits with primary care providers and specialist physicians	11,640	13,463	-1,823	-14	< .001	[-2,164, -1,481]
Number of ambulatory visits with primary care providers	6,051	6,836	-786	-11	< .001	[-1,032, -539]
Number of ambulatory visits with specialist physicians	5,590	6,639	-1,049	-16	< .001	[-1,245, -854]
Number of post-acute care days	15.9	18.3	-2.4	-13	< .001	[-3.2, -1.6]
Number of home health visits	10.1	10.4	-0.2	-2	0.50	[-0.8, 0.3]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model.

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Table D.3, we report the estimated impacts on enrollment in the Medicare hospice benefit and time spent time in hospice, which correspond to Figures IV.2 and IV.3 in the Chapter IV.

Table D.3. Regression-adjusted differences in hospice use between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Elected the Medicare hospice benefit	83.1	64.5	18.6	29	< .001	[17.4, 19.9]
Number of days in hospice	40.5	17.9	22.5	126	< .001	[20.5, 24.6]
Admitted to hospice less than three days before death	19.6	18.6	1.0	5	0.15	[-0.2, 2.2]
Average percentage of days between enrollment and death the beneficiary was enrolled in hospice	27.7	15.4	12.4	80	< .001	[11.5, 13.2]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Table D.4 contains impact estimates that disentangle regression-adjusted difference in total expenditures (with and without payments to hospices participating in the model), inpatient admissions, and emergency department visits and observation stays into estimated impacts that can be attributed to beneficiaries enrolling in the Medicare hospice benefit more often and earlier than beneficiaries in comparison group. The remainder of the impact is, by definition due to effects of MCCM that happen through other channels, which may include, for example, impacts of symptom management and care coordination that affect beneficiary outcomes before enrollees transition to hospice (Figures IV.4 and IV.5). We describe our method to disentangle these estimated impacts in Appendix A, Section D.3.

Table D.4. Regression-adjusted differences in expenditures and hospital service use between deceased MCCM enrollees and matched comparison beneficiaries that operate through enrollment in hospice versus other channels

Channel	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare Part A and B expenditures plus MCCM payments						
Overall	45,773	52,915	-7,142	-13	< .001	[-8,413, -5,871]
Through hospice			-5,021		< .001	[-5,405, -4,637]
Other channels[a]			-2,121		.004	[-3,325, -917]
Medicare Part A and B expenditures						
Overall	43,946	52,889	-8,943	-17	< .001	[-10,210, -7,676]
Through hospice			-5,039		< .001	[-5,423, -4,655]
Other channels[a]			-3,904		< .001	[-5,108, -2,700]
Number of inpatient admissions per 1,000 beneficiaries						
Overall	1,179	1,593	-414	-26	< .001	[-460, -368]
Through hospice			-170		< .001	[-182, -157]
Other channels[a]			-245		< .001	[-287, -202]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries						
Overall	829	959	-130	-14	< .001	[-175, -85]
Through hospice			-95		< .001	[-103, -87]
Other channels[a]			-35		0.17	[-77, 7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,555) and matched comparison beneficiaries (N = 13,484 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. The estimated overall impacts are slightly different from those reported in Tables D.1 and D.2 because of different sample restrictions (this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit) and we use net expenditures (including MCCM payments) as the dependent variable (in the first panel).

[a] Other channels refer to impacts of MCCM operating before enrollees transition into hospice; see text for examples.

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Table D.5, we report complete impact estimates, including confidence intervals and *p*-values corresponding to the estimated impacts on the quality-of-care measures (receipt of an aggressive life-prolonging treatment, days at home, and health services use at the very end of life) corresponding to Table V.1.

Table D.5. Regression-adjusted differences in quality of care between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	46.1	62.4	-16.3	-26	< .001	[-17.8, -14.9]
Number of days at home	167.5	161.4	6.1	4	< .001	[5.3, 6.9]
Average percentage of days between enrollment and death the beneficiary was at home	90.1	82.2	7.8	10	< .001	[7.3, 8.4]
Percentage with more than one outpatient emergency department visit in last 30 days of life	2.6	3.2	-0.7	-21	0.02	[-1.1, -0.2]
Percentage with more than one hospitalization in last 30 days of life	5.2	9.6	-4.3	-45	< .001	[-5.1, -3.6]
Percentage with an intensive care unit admission in last 30 days of life	17.4	32.1	-14.7	-46	< .001	[-16.0, -13.5]
Percentage who died in an acute care hospital	10.1	22.2	-12.1	-54	< .001	[-13.2, -11.0]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. As described in Appendix A, even after matching, the regression models controlled for residual differences in beneficiary characteristics, differences in baseline outcomes, and hospice market area fixed effects.

[a] Days at home counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long term care hospital, or skilled nursing facility. Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 comparison beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

2. Subgroup-specific impact estimates

In this section, we report full results for subgroup analyses that appear in Chapters III and VIII in this report. We estimated model impacts by survival time and report the results in Table D.6. In addition to estimated impacts on total Medicare expenditures for MCCM enrollees who survived less than 30 days, 31 to 90 days, 91 to 180 days, 181 to 365 days, and more than 365 days (Figure III.3), Table D.6 presents impact estimates for other primary outcome measures.

Table D.6. Regression-adjusted differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by survival time

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Medicare Part A and B expenditures plus MCCM payments					
All decedents	45,976	53,229	-7,254	-14	[-8,525, -5,983]
1 to 30 days	9,505	13,250	-3,745	-28	[-5,078, -2,412]
31 to 90 days	21,907	30,957	-9,050	-29	[-10,441, -7,659]
91 to 180 days	39,552	52,224	-12,672	-24	[-14,702, -10,641]
181 to 365 days	64,496	74,152	-9,657	-13	[-12,632, -6,682]
365+ days	120,655	119,333	1,322	1	[-4,481, 7,125]
Medicare Part A and B expenditures					
All decedents	44,149	53,229	-9,080	-17	[-10,352, -7,809]
1 to 30 days	9,066	13,250	-4,184	-32	[-5,521, -2,847]
31 to 90 days	21,144	30,957	-9,813	-32	[-11,208, -8,418]
91 to 180 days	38,180	52,224	-14,044	-27	[-16,078, -12,009]
181 to 365 days	62,016	74,152	-12,136	-16	[-15,119, -9,154]
365+ days	115,385	119,333	-3,948	-3	[-9,760, 1,865]
Number of inpatient admissions					
All decedents	1,187	1,608	-421	-26	[-467, -375]
1 to 30 days	396	601	-205	-34	[-256, -154]
31 to 90 days	667	1,040	-373	-36	[-425, -320]
91 to 180 days	1,054	1,594	-540	-34	[-618, -463]
181 to 365 days	1,605	2,113	-508	-24	[-619, -398]
365+ days	2,775	3,298	-523	-16	[-727, -318]
Number of outpatient emergency department visits and observation stays					
All decedents	839	970	-131	-14	[-177, -86]
1 to 30 days	182	157	26	17	[-23, 75]
31 to 90 days	355	442	-87	-20	[-135, -38]
91 to 180 days	714	899	-184	-21	[-258, -111]
181 to 365 days	1,123	1,278	-155	-12	[-258, -53]
365+ days	2,342	2,656	-314	-12	[-529, -100]

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Percentage who elected the Medicare hospice benefit					
All decedents	83.1	64.5	18.6	29	[17.4, 19.9]
1 to 30 days	76.1	55.5	20.6	37	[17.8, 23.5]
31 to 90 days	85.6	67.9	17.7	26	[15.6, 19.8]
91 to 180 days	86.4	67.7	18.7	28	[16.5, 21.0]
181 to 365 days	84.6	66.6	18.0	27	[15.5, 20.6]
365+ days	81.2	63.4	17.8	28	[14.8, 20.8]
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life					
All decedents	46.1	62.4	-16.3	-26	[-17.8, -14.9]
1 to 30 days	48.1	63.5	-15.3	-24	[-18.5, -12.1]
31 to 90 days	52.3	69.2	-16.9	-24	[-19.6, -14.3]
91 to 180 days	42.9	62.2	-19.3	-31	[-22.3, -16.3]
181 to 365 days	43.4	58.0	-14.6	-25	[-17.9, -11.3]
365+ days	40.5	55.3	-14.8	-27	[-18.3, -11.3]
Number of days at home					
All decedents	167.5	161.4	6.1	4	[5.3, 6.9]
1 to 30 days	14.0	12.4	1.6	13	[0.9, 2.2]
31 to 90 days	50.2	45.5	4.7	10	[4.0, 5.5]
91 to 180 days	119.5	111.0	8.5	8	[7.2, 9.8]
181 to 365 days	238.5	230.5	8.0	3	[6.0, 10.0]
365+ days	567.3	558.2	9.1	2	[5.6, 12.7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. “Other expenditures” include expenditures for outpatient emergency department visits, ambulatory care visits and other medically necessary services.

[a] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

This report analyzes outcomes for beneficiaries who enrolled in MCCM from January 1, 2016, to September 30, 2020, so this period overlaps with the COVID-19 pandemic. Table D.7 shows the results from estimating impacts separately for beneficiaries were enrolled in MCCM through August 31, 2019 (the pre-COVID-19 cohort), and on or after September 1, 2019 (the COVID-19 cohort). Select results from this table also appear in Chapter VIII.

Table D.7. Regression-adjusted differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, for beneficiaries in the pre-COVID-19 and COVID-19 cohorts

Outcome	Pre-COVID-19 cohort					COVID-19 cohort					Difference in estimate between COVID-19 and pre-COVID-19 cohorts [90 percent CI]	
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	48,952	55,315	-6,363	-12	[-7,831, -4,896]	34,903	45,428	-10,525	-23	[-12,694, -8,355]	4,162	[1,624, 6,699]
Medicare Part A and B expenditures	47,002	55,315	-8,314	-15	[-9,781, -6,846]	33,537	45,428	-11,891	-26	[-14,069, -9,713]	3,577	[1,032, 6,123]
Number of inpatient admissions	1,263	1,696	-433	-26	[-487, -380]	904	1,279	-375	-29	[-451, -299]	-59	[-149, 32]
Number of outpatient emergency department visits and observation stays	920	1,065	-146	-14	[-200, -91]	539	617	-79	-13	[-144, -13]	-67	[-149, 15]
Percentage who elected the Medicare hospice benefit	82.8	64.7	18.1	28	[16.7, 19.5]	84.1	63.6	20.5	32	[18.1, 22.9]	-2.4	[-5.0, 0.3]
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	46.6	62.5	-15.9	-26	[-17.6, -14.3]	44.4	62.1	-17.7	-29	[-20.8, -14.7]	1.8	[-1.6, 5.1]
Number of days at home	182.0	175.8	6.2	4	[5.3, 7.1]	113.5	107.9	5.6	5	[4.5, 6.7]	0.6	[-0.8, 2.0]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. "Other expenditures" include expenditures for outpatient emergency department visits, ambulatory care visits and other medically necessary services.

[a] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

B. Sensitivity analyses using *E*-values

Our analysis achieved excellent balance between MCCM enrollees and comparison beneficiaries for all the variables we included in matching (and especially close balance for matching variables deemed the most important). In addition, we included a similarly wide range of covariates in the regression analysis to increase the precision of the impact estimates and adjust for any residual differences that remained after matching. The doubly robust approach of matching and regression adjustment using an extensive list of baseline characteristics makes it less likely that important characteristics, that could spuriously affect estimates of model effects (that is, unobserved confounders), remain unaccounted for.[88] However, the possibility of bias from unobserved imbalances between the two groups cannot be ruled out absent a randomized trial. Unobserved confounders might be correlated with enrollment in MCCM and with outcomes such as whether a beneficiary elects the Medicare hospice benefit. For example, although we observe services and the associated diagnoses that a beneficiary received during the year before enrollment or pseudo-enrollment, we cannot directly observe other information about disease severity or the beneficiary's long-term prognosis that might be available to beneficiaries and clinicians. MCCM enrollees could have had, on average, more (or less) severe illnesses or worse (or better) prognoses than those beneficiaries who were eligible but who did not enroll, even after matching on observable service use, diagnoses, and Medicare expenditures. This type of unobserved differences between the two groups might have caused MCCM enrollees to be more likely to forgo aggressive medical treatment and enroll in hospice more often than (and sooner after enrollment) than those in the comparison group. As another example, beneficiaries who chose to enroll in MCCM could have been more accepting of their prognosis and more willing to consider receiving hospice benefits than those in the comparison group, which could lead to impact estimates that are biased by self-selection.[89,90] Selection bias and other unobserved confounding could make our impact estimates appear larger or smaller in magnitude than the true effects of the model. In more extreme cases, biases could make it appear that there are large and policy-relevant impacts of the model when, in fact, there are none.

Given these concerns, we assessed the threat of selection bias in our impact estimates by using the *E*-value approach described in Ding and VanderWeele (2016) and VanderWeele and Ding (2017). The approach assesses how strong unobserved confounding would need to be to fully explain the estimated impact estimate. Specifically, the approach uses minimal assumptions to quantify an *E*-value—the threshold for the weakest correlations (measured on a risk ratio scale) between (1) a hypothetical

[88] All else equal, using a more extensive the list of matching/control variables decreases the number of factors that remain unaccounted for in the analysis. In addition, limiting the comparison group to a matched subsample that closely matches the intervention group on an array of observed characteristics will also reduce differences between the two groups on unobserved characteristics that are correlated with the matching variables (Stuart 2010). See Technical Appendix A for more details about our methods.

[89] This issue is partially addressed because we excluded from the potential comparison group beneficiaries who were referred to MCCM but chose not to enroll. (None of the comparison beneficiaries were referred to the model according to MCCM program data.) The potential for selection bias remains, however, because our intervention group only includes beneficiaries who were referred to MCCM *and chose to enroll in* MCCM.

[90] We considered addressing potential selection bias by using an intent-to-treat evaluation design, in which everyone who qualifies for (targeted by) the model is included in the "intervention" group (not just those that enroll). This would avoid the potential problem in which people who enroll in the model might have different unobserved characteristics than those in the comparison group, biasing impact estimates. Unfortunately, we were not able to use an intent-to-treat approach to evaluate MCCM because the number of beneficiaries who enrolled in the model is small relative to the number who were eligible for MCCM and lived in the market of a participating hospice. Including so many non-participants in the intervention group would severely dilute the impact estimate, making it nearly impossible to detect an impact that might truly exist.

unmeasured confounder and enrollment and (2) the confounder and the outcome variable of interest that would lead to the observed impact estimate if the model truly had no effect. Larger *E*-values indicate that larger unobserved differences between the intervention and comparison groups, on variables strongly related to outcomes, would be necessary to produce the observed impact estimate if the true impact of the model is zero; meanwhile, *E*-values close to 1 (the minimum) indicate the observed differences could be explained by very small (or negligible) differences between the intervention and comparison groups. In other words, this *E*-values captures the degree of confounding that, if removed, would cause the estimated impact of the model to go to zero effect. In another test for selection, if we assume that the unmeasured confounder is perfectly correlated with enrollment (for example, a binary measure that equals one for 100 percent of MCCM enrollees and 0 percent of comparison beneficiaries), we can calculate the correlation required for an unobserved confounder to have with the outcome variable in order to fully explain the observed impact. These two estimates describe the strength of confounding required to move the point estimate of the impact to zero. We also estimate the correlation required of a hypothetical confounder that, if removed, would move the 90 percent confidence interval around the impact estimate to include zero.

Table D.8 reports the *E*-values and relative risk ratios described above. Each row represents a different outcome variable. Column 2 shows the *E*-value that would cause the point estimate of the impact estimate to be zero and column 4 shows the *E*-value that would cause the 90 percent confidence interval around the point estimate of the impact estimate to include zero (or for the odds ratio or hazard ratio to include one). Column 3 shows the relative risk ratio required, when the unmeasured confounder is perfectly correlated with enrollment, that would cause the point estimate of the impact estimate to be zero effect, and column 5 shows the relative risk ratio required, when the unmeasured confounder is perfectly correlated with enrollment, that would cause the 90 percent confidence interval around the point estimate of the impact estimate to include zero (or for the odds ratio or hazard ratio to include one). Details on the derivation of the formulas used to calculate these values for binary outcomes, continuous outcomes, and in hazard models are available in Ding and VanderWeele (2016), VanderWeele and Ding (2017), and Linden et al. (2020).

Table D.8. *E*-values and relative risk bounds for unmeasured confounders

Outcome measure	Confounding that, if removed, would change the impact estimate to zero		Confounding that, if removed, would change the 90 percent confidence interval to include zero	
	E-value	Confounder perfectly correlated with enrollment	*E*-value	Confounder perfectly correlated with enrollment
Medicare Part A and B expenditures plus MCCM payments	1.48	1.12	1.41	1.10
Medicare Part A and B expenditures	1.56	1.15	1.49	1.13
Number of inpatient admissions	1.75	1.23	1.68	1.20
Number of outpatient emergency department visits and observation stays	1.33	1.06	1.23	1.04
Percentage who elected the Medicare hospice benefit	2.85	1.73	2.70	1.66
Electing the Medicare hospice benefit (time-to-event analyses)	1.89	1.43	1.81	1.38
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	2.20	1.42	2.09	1.37
Days at home[a]	1.20	1.03	1.18	1.02

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: *E*-values and other bounds are calculated using impact estimates on regression-adjusted differences between MCCM enrollees and matched comparison beneficiaries. The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model.

[a] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 comparison beneficiaries) met this criterion.

MCCM = Medicare Care Choices Model.

After we establish the threshold for an unobserved confounder to explain away out impact results, we benchmark these values against observed associations in our regression models and with other estimates found in the literature to assess whether it is likely an unobserved confounder exists with the required correlation with both enrollment and the outcome. For example, if the unobserved confounder must be more strongly correlated with enrollment and the outcome than all other covariates in the model, including those known in the literature to be strongly and robustly correlated with the outcome, it would be unlikely that such unobserved confounders or selection bias exists that can fully explain away the estimated impacts. On the other hand, if an unobserved confounder that is only weakly correlated with enrollment or the outcome variable would be enough to explain away the observed impacts, then we would have less confidence in our estimated impacts. Intuitively, a higher *E*-value means that an

unobserved confounder would have to have a stronger correlation with enrollment and the outcome to explain away the estimated impacts and is therefore less likely to exist; an *E*-value closer to one means a relatively small level of selection bias could have produced the observed impact estimate if the impact of the model was truly zero, and an *E*-value or relative risk of 1 (the smallest possible value these statistics can take) means that no residual confounding would be necessary to fully explain away the impact regression results.

For the eight outcomes listed in Table D.8, we found the following:

- **Total Medicare Part A and B expenditures, including MCCM payments.** We calculated an *E*-value of 1.48, which means that the estimated impact of MCCM enrollment on expenditures (-$7,280) could be explained away by an unmeasured confounder that was associated with both enrollment and expenditures with a relative risk ratio of 1.48, but weaker confounding would not fully explain away the finding.[91] To put this in perspective, we found that the association between hierarchical condition category scores and total Medicare expenditures had a relative risk of 1.06, which means that a hypothetical unmeasured confounder would have to have a stronger association with Medicare expenditures including MCCM payments than a 5.6 point change in hierarchical condition category score. Further, this confounder would have to have an equally strong association with MCCM enrollment (even though we already matched on hierarchical condition category scores and other variables that are strong predictors of future expenditures).

  If the confounder were perfectly correlated with enrollment (completely imbalanced between intervention and comparison beneficiaries), the unmeasured confounder could be less strongly correlated with the outcome variable and explain away our impact estimates in comparison to the *E*-values scenario (in which the confounder is assumed to be partially, but not completely, correlated with enrollment). If perfectly correlated with enrollment, the observed association between MCCM enrollment and decreased expenditures could be explained away by an unmeasured confounder that was associated with expenditures by a risk ratio of 1.12. To put this in perspective, the unmeasured confounder would require a stronger association with Medicare Part A and B expenditures than a 0.9 percentage point change in hierarchical condition category scores.
- **Medicare Part A and B expenditures, not including MCCM payments.** We calculated an *E*-value of 1.56. As a benchmark for this outcome, we estimated a relative risk ratio of 1.06 for the association with hierarchical condition category scores. We calculated an *E*-value of 1.56. For this outcome, we estimated a relative risk ratio of 1.06 for the association with hierarchical condition category scores.
- **Inpatient admissions.** We calculated an *E*-value of 1.75. Other observed covariates less strongly predict inpatient admissions than this. For example, the relative risk ratios between inpatient admissions during the follow-up period and inpatient hospitalizations in the last quarter of the baseline period was only 1.16.
- **Emergency department visits and observation stays.** We calculated an *E*-value of 1.33. The low *E*-value for emergency department visits and observation stays compared with the relative risk for lagged emergency department visits and observation stays indicates that a lower level of unobserved confounding could explain away this estimated impact than for other outcomes such as expenditures or inpatient admissions. The main reason for this is that the model's estimated effect on emergency

[91] For mean differences, we obtain an approximate *E*-value by using methods developed in Lipsey and Wilson (2001), which use the approximation: RR ≈ e[0.91 * d], where *d* represents the effect size (impact estimate of the intervention divided by standard deviation of the outcome variable)

department visits and observation stays is relatively small compared with the model's effect on the other expenditure and service use outcomes.

- **Electing the Medicare hospice benefit.** We calculated an *E*-value of 2.85. In comparison, this confounder would have to be fairly imbalanced and more strongly predict electing hospice than other strong predictors in the literature. For example, Obermeyer et al. (2015) found that a physician's practice style was the strongest predictor in claims data for whether a terminally ill cancer patient would elect hospice. The *E*-value in our analysis is larger than the relative risk ratio for electing hospice that is associated with switching from a doctor in the bottom decile of referring patients to hospice to a doctor in the top decile (Obermeyer et al. 2015).
- **Electing the Medicare hospice benefit (time-to-event analysis).** We calculated an *E*-value of 1.89. The unmeasured confounding would require a stronger relationship with this outcome variable and with enrollment than was observed in any of the expenditures and utilization outcomes in Chapter III.
- **Receipt of an aggressive life-prolonging treatment in the last 30 days of life.** For receiving an aggressive life-prolonging treatment, we calculated an *E*-value of 2.20. The unmeasured confounding would require a stronger relationship with this outcome variable and with enrollment than was observed in any of the expenditures and utilization outcomes in Chapter III.
- **Days at home.** We calculated an *E*-value of 1.2. By comparison, we found a relative risk ratio of 1.02 for days at home and inpatient hospitalizations in the last quarter of the last quarter of the baseline period.

C. Robustness checks

Table D.9 presents results from several robustness checks we conducted to assess the sensitivity of the impact analysis results to alternative methodologies. The results are organized by outcome measure and include the results from our main impact analyses for comparison (labeled "main analysis"). In the following paragraphs, we describe each check; some checks were relevant to some, but not all, of the outcomes.

Unadjusted regression models. We estimated regression models without control variables to assess the influence of regression adjustment. These models relied entirely on matching to adjust for any observable differences between the intervention and comparison groups. We found little difference between the adjusted and unadjusted impact estimates, which is unsurprising because our analysis sample was well matched on most observable characteristics, especially those we anticipated were most important.

Adjusting for COVID-19 diagnosis in the follow-up period. We assessed the rates of COVID-19 diagnoses in the enrolled and matched comparison groups. COVID-19 diagnoses can lead to expensive emergency department visits or hospitalizations, so any imbalance in rates of COVID-19 infections, even if not a direct effect of the model, could bias estimated impacts (see Chapter VIII for more discussion). Even after matching and controlling for a number of observable differences between the two groups at baseline, we found that MCCM enrollees alive after the COVID-19 pandemic began had somewhat lower rates of COVID-19 than those in the comparison group (Table D.10): 61 enrollees who were alive during the pandemic (5 percent) were diagnosed with COVID-19 versus 121 comparison beneficiaries who were alive during the pandemic (9 percent). Adjusting for COVID-19 diagnoses caused our impact estimates to attenuate slightly, but it did not meaningfully change the results (Table D.9).

Winsorizing continuous outcome measures. We winsorized the following continuous outcome measures at the 98th percentile: (1) total Medicare expenditures, including MCCM payments; (2) total

Medicare expenditures excluding MCCM payments; (3) emergency department or observation stay visits; (4) inpatient stays; and (5) days at home. Winsorizing is a method that replaces values above a certain threshold (here, the 98th percentile of the pooled treatment and comparison populations) with the value of the outcome variable at that threshold. This method reduces the influence of extreme outliers on the impact estimates, especially when the outcome variable is highly skewed, as can be the case with expenditures outcomes. The estimated impacts were similar when winsorizing outcomes, alleviating concerns that our main findings might have been driven by outliers.

Matched set fixed effects. We added matched set fixed effects to the regression models for our continuous outcome measures: (1) total Medicare expenditures, including MCCM payments; (2) total Medicare expenditures excluding MCCM payments; (3) emergency department or observation stay visits; and (4) inpatient stays. A matched set comprises a single MCCM enrollee matched to one to three comparison beneficiaries. Matched set fixed effects account for any unobserved variation that is common within each matched set. Including the fixed effects should further control for unobserved confounders and, by explaining variation in outcomes, add precision to the impact estimates.[92] When we included matched set fixed effects, we did not find any meaningful differences in our impact estimates. Confidence intervals were somewhat narrower, and *p*-values were smaller.

Count data regression models. We estimated negative binomial regression models for the following count outcomes: (1) emergency department or observation stay visits and (2) inpatient stays. This allowed us to check the sensitivity of our estimated impacts to the functional form used in the main regression models (ordinary least squares). Negative binomial regression models can better fit the data when the outcome is non-negative and skewed, as we see with count data. We report all results from negative binomial regressions as marginal effects to make them more comparable to the results generated by linear models. When we used count data models, we did not find any meaningful differences in the estimated impacts.

Generalized linear models (logarithm link function). We used generalized linear models with a logarithm link function for the following outcomes: (1) total Medicare expenditures, including MCCM payments, and (2) total Medicare expenditures excluding MCCM payments. Using generalized linear models with a log link can reduce the influence of outliers or skewness in the data which is often the case with expenditures (Manning and Mullahy 2001). When we used this approach, we found that the estimated impacts on expenditures (with and without MCCM payments) were somewhat smaller in terms of percentage impact, but they had the same sign and were statistically significant.

Two-part regression models. We estimated two-part models for the following two count outcomes: (1) emergency department or observation stay visits and (2) inpatient stays. The two-part model approach separately estimates the probability a beneficiary has greater than zero visits or stays using a logistic regression model, and then, conditional on there being more than zero visits, models the number of visits using a negative binomial count data model. The two-part model can account for cases in which there are many zero values for the outcome variable better than ordinary least squares and count data models that do not separately model the first stage. All results are reported as marginal effects to make them more comparable to the main models. When we used two-part models, we did not find any meaningful differences in our impact estimates (compared with the main approach).

[92] The fixed effects address unobserved confounding if potential unobserved confounders are shared among beneficiaries (that is, correlated) among beneficiaries in the same matched sets.

Binary outcomes. We created binary outcomes that identified whether a beneficiary had any of the following events in the follow-up period: (1) inpatient admissions and (2) emergency department visits and or observation stays. We used binary outcomes to assess the impact of MCCM at the extensive margin (that is, whether the model influenced whether an enrollee would have any service use) to supplement the main approach. When we examined the outcomes as binary indicators, we found large reductions in the percentage of beneficiaries with an inpatient stay and the percentage with an emergency department visit or observation stay. Impacts on the extensive margin (whether a beneficiary had any visits) help explain impacts on the main outcome measure (the average number of visits).

Table D.9. Impact analysis robustness checks for the primary outcome measures

Robustness Check	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare Part A and B expenditures plus MCCM payments						
Main analysis	45,976	53,229	-7,254	-14	< .001	[-8,525, -5,983]
Estimate impacts on net expenditures using a separate regression model[a]	45,978	53,253	-7,275	-14	< .001	[-8,551, -6,000]
Unadjusted regression models[a]	45,978	53,390	-7,413	-14	< .001	[-9,101, -5,724]
Adjusting for COVID-19 diagnosis in the follow-up period	45,976	52,941	-6,965	-13	< .001	[-8,231, -5,698]
Winsorize at 98th percentile[a]	44,222	51,310	-7,088	-14	< .001	[-8,124, -6,052]
Matched set fixed effects[a]	45,978	52,778	-6,801	-13	< .001	[-8,122, -5,480]
Generalized linear models (logarithm link function)[a]	48,425	51,909	-3,484	-7	0 .02	[-5,871, -1,098]
Medicare Part A and B expenditures excluding MCCM payments						
Main analysis	44,149	53,229	-9,080	-17	< .001	[-10,352, -7,809]
Unadjusted regression models	44,149	53,390	-9,241	-17	< .001	[-10,905, -7,577]
Adjusting for COVID-19 diagnosis in the follow-up period	44,149	52,941	-8,791	-17	< .001	[-10,058, -7,525]
Winsorize at 98th percentile	42,485	51,271	-8,785	-17	< .001	[-9,823, -7,748]
Matched set fixed effects	44,149	52,736	-8,587	-16	< .001	[-9,902, -7,272]
Generalized linear models (logarithm link function)	46,602	51,900	-5,298	-10	< .001	[-7,723, -2,874]
Number of inpatient admissions, per 1,000 beneficiaries						
Main analysis	1,187	1,608	-421	-26	< .001	[-467, -375]
Unadjusted regression models	1,187	1,616	-429	-27	< .001	[-481, -376]
Adjusting for COVID-19 diagnosis in the follow-up period	1,187	1,599	-412	-26	< .001	[-458, -366]
Winsorize at 98th percentile	1,130	1,548	-418	-27	< .001	[-457, -379]
Matched set fixed effects	1,187	1,581	-394	-25	< .001	[-442, -346]
Count data regression models	1,201	1,766	-565	-32	< .001	[-623, -508]
Two-part regression models	1,185	1,610	-424	-26	< .001	[-469, -379]
Binary outcomes (percent of beneficiaries)	55.4	74.4	-19.0	-26	< .001	[-20.3, -17.6]
Number of outpatient emergency department visits and observation stays, per 1,000 beneficiaries						
Main analysis	839	970	-131	-14	< .001	[-177, -86]
Unadjusted regression models	839	986	-147	-15	< .001	[-200, -95]
Adjusting for COVID-19 diagnosis in the follow-up period	839	967	-128	-13	< .001	[-174, -82]
Winsorize at 98th percentile	758	874	-116	-13	< .001	[-149, -82]
Matched set fixed effects	839	958	-119	-12	< .001	[-168, -69]

Robustness Check	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Count data regression models	930	1112	-181	-16	< .001	[-232, -130]
Two-part regression models	841	986	-145	-15	< .001	[-189, -102]
Binary outcomes (percent of beneficiaries)	38.6	43.5	-4.9	-11	< .001	[-6.2, -3.6]
Percentage who elected the Medicare hospice benefit						
Main analysis	83.1	64.5	18.6	29	< .001	[17.4, 19.9]
Unadjusted regression models	83.1	64.0	19.1	30	< .001	[18.0, 20.2]
Adjusting for COVID-19 diagnosis in the follow-up period	83.1	64.7	18.4	28	< .001	[17.2, 19.7]
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life						
Main analysis	46	62	-16	-26	< .001	[-17.8, -14.9]
Unadjusted regression models	46	63	-17	-27	< .001	[-18.3, -15.5]
Adjusting for COVID-19 diagnosis in the follow-up period	46	62	-16	-26	< .001	[-17.7, -14.7]
Number of days at home[b]						
Main analysis	167	161	6	4	< .001	[5, 7]
Unadjusted regression models	167	160	8	5	0.03	[2, 14]
Adjusting for COVID-19 diagnosis in the follow-up period	167	162	6	4	< .001	[5, 7]
Winsorize at 98th percentile	164	157	6	4	< .001	[6, 7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: Each row represents a different regression model. We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model.

[a] These robustness checks use a single regression model to estimate impacts of MCCM on Medicare Part A and B expenditures plus MCCM payments. This differs from the main approach described in footnote 61 in Appendix A.

[b] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 99 percent of beneficiaries (3,977 MCCM beneficiaries and 11,513 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Table D.10. Percentage of deceased MCCM enrollees and matched comparison beneficiaries with a COVID-19 diagnoses

Sample	MCCM enrollees	Comparison group	Difference	90 percent CI
COVID-19 period: January 1, 2020, to March 31, 2021	5.2	8.4	-3.2	[-4.5, -1.9]
Full evaluation period: January 1, 2016, to March 31, 2021	1.3	2.2	-0.9	[-1.3, -0.6]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to March 31, 2021.

Notes: Each section represents a different time period. The "COVID-19" period represents the time period from January 1, 2020, to March 31, 2021, when we would expect to see beneficiaries diagnosed with COVID-19, and the second section represents the full evaluation period from January 1, 2016, to March 31, 2021, to put the rates in context of the overall evaluation time period. In the COVID-19 period, there were 1,174 MCCM enrollees and 4,760 comparison beneficiaries (before weighting). Overall, there were 4,574 MCCM enrollees and 13,575 matched comparison beneficiaries (before weighting) who enrolled through September 30, 2020.

CI = confidence interval; MCCM = Medicare Care Choices Model.

D. Additional analyses

In addition to the robustness checks described in Section C, we conducted three analyses using different samples of Medicare beneficiaries. Specifically, we (1) used approximately the sample that the previous MCCM evaluation contractor used in its report, (2) split the sample into beneficiaries enrolled in MCCM at cohort 1 and 2 participating hospices, and (3) split the sample into beneficiaries enrolled at the five MCCM hospices accounting for 45 percent of all enrollees versus all other participating hospices.

1. Repeat the analysis, focusing on the period included in previous evaluation reports

We restricted beneficiaries enrolled in MCCM to those who enrolled before April 1, 2019. This redefined sample should align with the sample of enrolled beneficiaries that the previous MCCM evaluation contractor used in its most recent report (Abt Associates 2020b). We chose this sample to make it easier to compare how differences between our and Abt Associates' methods influenced the impact estimates. Importantly, the methods used for this report sought to achieve better balance between MCCM enrollees and comparison beneficiaries, especially on (actual or expected) survival times and patterns of service use in the period before enrollment. In addition, we (1) did not exclude MCCM enrollees who survived more than 365 days; (2) produced a single estimate of the average impact of MCCM on each outcome measure, following all beneficiaries in the analysis sample from enrollment to death (instead of multiple estimates over different time periods); and (3) abandoned the previous difference-in-differences approach, which we judged to be unviable. Other differences between our and Abt Associates' approaches include (4) drawing comparison beneficiaries from the market areas served by MCCM hospices (that is, comparison beneficiaries were matched to intervention group beneficiaries in the same geographic areas);[93] (5) using matching (with stratification, exact matching, and requiring tight balance on survival times other

[93] In contrast, Abt Associates (2020b) used external comparison market areas. It (1) identified matched comparison hospices similar to MCCM hospices, (2) identified zip codes that comprise the market areas of these hospices, and then (3) excluded zip codes also served by MCCM hospices.

matching variables) instead of inverse propensity score reweighting; and (6) regression adjusting for beneficiaries' pre-enrollment (or pseudo-enrollment) Medicare expenditures and service use, general and disease-specific health measures, and demographics and market characteristics. Appendix A in this report and Abt Associates (2020b) contain detailed descriptions of the two approaches.

Table D.11 shows estimated impacts of MCCM enrollment on primary outcomes for a sample of beneficiaries who enrolled in MCCM before April 1, 2019. Overall, we estimated smaller regression-adjusted differences in Medicare expenditures and health care service use between MCCM enrollees and comparison beneficiaries than Abt Associates. For example, we estimated a reduction of 12 percent in total Medicare expenditures, and Abt Associates estimated a decline of 25 percent. We also found that MCCM enrollees had 27 percent fewer inpatient admissions and 16 percent fewer emergency department visits and observation stays, but Abt Associates estimated reductions of 36 percent and 28 percent, respectively. On the other hand, our impact estimates for hospice enrollment were similar to Abt Associates' results. Finally, Abt Associates did not estimate impacts on receipt of aggressive life-prolonging treatments or days at home.

Table D.11. Regression-adjusted differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries who enrolled before April 1, 2019

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI	Percentage impact from previous annual report
Medicare Part A and B expenditures plus MCCM payments	49,527	56,050	-6,522	-12	< .001	[-8,230, -4,815]	-25
Medicare Part A and B expenditures	47,522	56,050	-8,528	-15	< .001	[-10,238, -6,817]	NA
Number of inpatient admissions	1,271	1,742	-471	-27	0.02	[-534, -408]	-36
Number of outpatient emergency department visits and observation stays	929	1,103	-174	-16	< .001	[-238, -110]	-28
Percentage who elected the Medicare hospice benefit	83	64	19	29	< .001	[17.1, 20.3]	32
Percentage who received an aggressive life-prolonging treatment in the last 30 days of life	46	63	-17	-27	< .001	[-18.6, -14.9]	NA
Number of days at home[b]	189	182	7	4	< .001	[5.5, 7.6]	NA

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 2,935) and matched comparison beneficiaries (N = 11,694 before weighting). The estimates cover beneficiaries who enrolled through March 31, 2019, and their experiences in the model. The estimated overall impacts are slightly different from those reported in Tables D.1 and D.2 because of different sample restrictions. This

analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit.

[a] Abt Associates (2020b)

[b] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 96 percent of beneficiaries (2,880 MCCM beneficiaries and 11,244 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model; NA = not available.

2. Beneficiaries enrolled in MCCM cohort 1 and 2 hospices

CMS randomly assigned hospices participating in MCCM to two cohorts. Cohort 1 started enrolling Medicare beneficiaries on January 1, 2016, and Cohort 2 started enrolling beneficiaries on January 1, 2018. Because enrollment in the model started slowly and Cohort 2 hospices might have benefitted from changes in the model or the experience of their Cohort 1 counterparts, we assessed to what extent estimated impacts differed between beneficiaries enrolled in Cohort 1 and 2 hospices. Table D.12 shows estimated impacts of MCCM enrollment on the study's primary outcomes for beneficiaries who enrolled in MCCM at Cohort 1 and 2 hospices. Overall, we did not find statistically significant differences in estimated impacts between Cohorts 1 and 2. The only exception was emergency department visits and observation stays, where we estimated a larger reduction for enrollees at Cohort 1 hospices (a 17 percent reduction versus an 8 percent reduction). However, we recommend exercising caution when interpreting these results, because some differences in impacts between the two cohorts would be expected from chance alone.

Table D.12. Regression-adjusted differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries by hospices in Cohorts 1 and 2

Outcome	Cohort 1					Cohort 2					Difference in impact estimates between cohorts 1 and 2 [90 percent CI]	
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	47,823	55,555	-7,732	-14	[-9,511, -5,953]	43,529	49,802	-6,273	-13	[-8,080, -4,465]	1,459	[-1,077, 3,995]
Medicare Part A and B expenditures	45,870	55,555	-9,685	-17	[-11,468, -7,902]	41,870	49,802	-7,932	-16	[-9,745, -6,118]	1,753	[-790, 4,296]
Number of inpatient admissions	1,254	1,696	-442	-26	[-508, -376]	1,098	1,490	-392	-26	[-454, -329]	50	[-40, 141]
Number of outpatient emergency department visits and observation stays	843	1,019	-176	-17	[-236, -116]	834	910	-76	-8	[-146, -6]	100	[8, 192]
Elected the Medicare hospice benefit	83.2	64.9	18.3	28	[16.6, 19.9]	83.0	63.4	19.6	31	[17.7, 21.6]	1.3	[-1.2, 3.9]
Received an aggressive life-prolonging treatment in the last 30 days of life	45.7	63.3	-17.6	-28	[-19.5, -15.6]	46.6	61.4	-14.7	-24	[-17.0, -12.5]	2.9	[-0.1 ,5.8]
Number of days at home	180.7	174.3	6.4	4	[5.3, 7.4]	149.9	144.3	5.7	4	[4.6, 6.7]	-0.7	[-2.2, 0.8]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. The estimated overall impacts are slightly different from those reported in Tables D.1 and D.2 because of different sample restrictions: this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit.

[a] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

3. Top 5 hospices with the highest MCCM enrollment versus all other participating hospices

Although 141 hospices participated in MCCM, just five participating hospices accounted for more than 45 percent of enrollees. We assessed whether estimated impacts were different for beneficiaries who enrolled in MCCM at one of these top five hospices. Table D.13 shows estimated impacts on the primary outcomes for beneficiaries who enrolled in MCCM at top five hospices versus at all other participating hospices. Although we estimated larger reductions in Medicare expenditures and inpatient admissions among beneficiaries enrolled at top five hospices, none of the differences in estimated impacts were statistically significant. This is a positive finding, suggesting that the model's impacts were widespread—not completely driven solely by the experience of the five hospices with the highest enrollment.

Table D.13. Regression-adjusted differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries for enrollees at top 5 versus all other participating hospices

Outcome	Top 5 hospices					Other participating hospices					Difference in estimate between top five and other hospices [90 percent CI]	
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	43,465	53,045	-9,580	-18	[-11,358, -7,803]	48,348	53,328	-4,980	-9	[-6,796, -3,165]	-4,600	[-7,141, -2,059]
Medicare Part A and B expenditures	41,678	53,045	-11,367	-21	[-13,152, -9,583]	46,484	53,328	-6,844	-13	[-8,663, -5,026]	-4,523	[-7,071, -1,975]
Number of inpatient admissions	1,089	1,531	-442	-29	[-504, -380]	1,279	1,689	-410	-24	[-478, -342]	-32	[-124, 60]
Number of outpatient emergency department visits and observation stays	698	798	-100	-13	[-156, -44]	972	1,138	-166	-15	[-238, -94]	66	[-26, 157]
Elected the Medicare hospice benefit	84.1	64.4	19.7	31	[17.9, 21.5]	82.2	64.1	18.1	28	[16.3, 19.8]	1.6	[-0.9, 4.1]
Received an aggressive life-prolonging treatment in the last 30 days of life	43.5	62.0	-18.5	-30	[-20.7, -16.4]	48.6	62.8	-14.2	-23	[-16.3, -12.2]	-4.3	[-7.3, -1.4]
Number of days at home	155.8	149.2	6.6	4	[5.6, 7.5]	178.6	172.9	5.7	3	[4.5, 6.9]	0.9	[-0.6, 2.4]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to March 31, 2021.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 4,574) and matched comparison beneficiaries (N = 13,575 before weighting). The estimates cover beneficiaries who enrolled through September 30, 2020, and their experiences in the model. The estimated overall impacts are slightly different from those reported in Tables D.1 and D.2 because of different sample restrictions: this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit.

[a] Number of days at home is only calculated for those beneficiaries who are fully observable in Medicare fee-for-service enrollment and claims data for the entirety of the follow-up period. About 97 percent of beneficiaries (4,499 MCCM beneficiaries and 13,049 beneficiaries) met this criterion.

CI = confidence interval; MCCM = Medicare Care Choices Model.

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