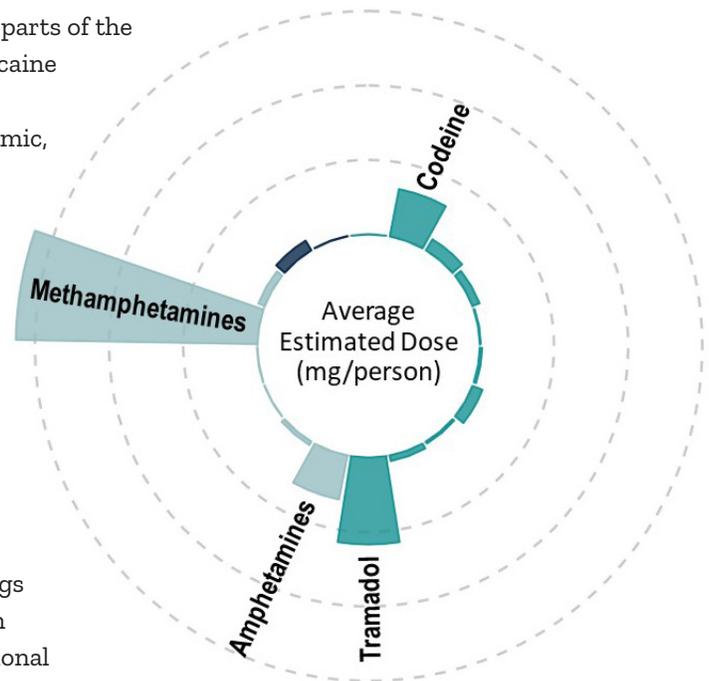# Public Health

Aparna Keshaviah, Cindy Hu, and Marisa Henry

Testing Municipal Wastewater to Flexibly Monitor Health and Safety

Drug misuse is shifting across the United States. In parts of the country, stimulants like methamphetamines and cocaine are resurging. Yet because federal funding and data monitoring have largely focused on the opioid epidemic, state and local officials are struggling to keep up with such shifts in drug diversion, abuse, and addiction. Compounding the issue is the fact that many widely used data sources, such as national population surveys, have a two-year lag before the data are available, and they underestimate drug use prevalence because they rely on self-reported information about a stigmatized behavior. To better address the ever-changing landscape of substance use, a more comprehensive monitoring strategy is needed—one that goes beyond siloed approaches focused on individual drugs or interventions. Municipal wastewater testing is an innovative approach that can be used alongside national and local data sources to provide cost-effective and objective measures of drug use in near real-time. When combined with data on prescriptions filled at local pharmacies, drug overdose calls to emergency medical services, and drug seizures by law enforcement, wastewater testing can yield insights into the extent of black-market activity, policing impact on community drug use, and where and when drug overdoses might occur.

Mathematica has been working with public health, safety, and water monitoring officials in Montana, Wisconsin, and Tennessee to analyze:

Snapshots of the mix of drugs being used, to provide a warning on new drug threats

Trends in drug use over time, which can be used to evaluate program effectiveness

Hotspots Hotspots of drug use, which offers a data-driven strategy to target resources

Value of unbiased, scalable community health measures for policymaking

Early warning for emerging drug threats

Because a single wastewater sample can be tested for up to two dozen compounds, wastewater testing can shed light on multiple drugs of abuse simultaneously and provide snapshots of how drug use changes over time. When Mathematica compared trends in community drug use based on wastewater data to the timing of calls placed to emergency medical services for a drug overdose in Montana, we found that calls involving a particular drug surfaced soon after use of that drug was high in the community (Figure 2a).

A broad indicator of public health

Americans today face unprecedented exposure to deadly drugs, viruses, and antibiotic-resistant bacterial strains. These evolving public health threats, coupled with existing chronic disease epidemics, provide one of the strongest arguments for wastewater testing, which can flexibly measure and monitor a range of compounds circulating through a population. Unlike medical data, wastewater testing cannot reveal who is using a particular drug, thus mitigating privacy concerns. Even when wastewater testing may not reliably detect a drug—which is commonly the case with heroin detection—spikes in use may indicate when heroin-involved overdoses are likely (Figure 2b).

Actionable intelligence for public safety

In a multi-site wastewater pilot study in Montana, Mathematica analyzed the timing of large seizures of amphetamines/methamphetamines in relation to wastewater-based estimate of trends in community drug use over time. Wastewater testing revealed that community use of amphetamines and methamphetamines decreased after each large seizure in the urban community studied (Figure 3).
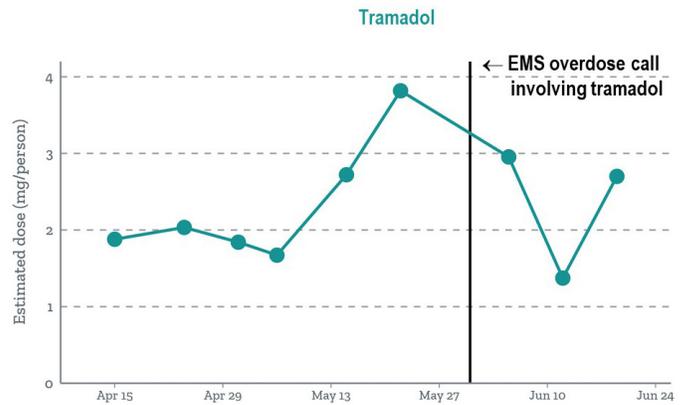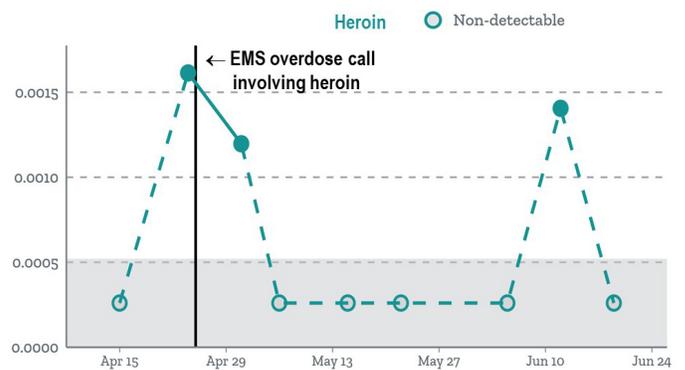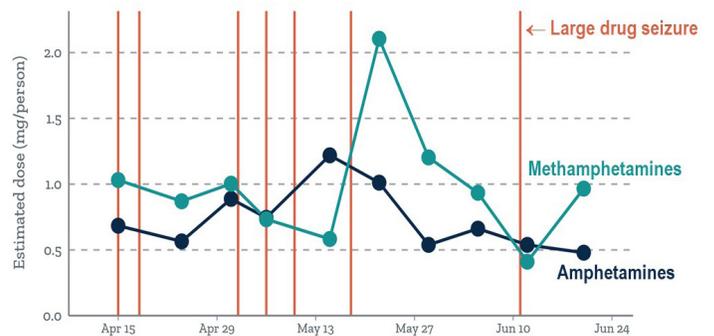
Figure 2a


Figure 2b

Figure 3

Moreover, in the rural community studied, comparing doses of methamphetamines excreted into the wastewater with doses of methamphetamines in filled prescriptions revealed a notable difference, which may estimate the size of black-market methamphetamine use (Figure 4).

Widespread coverage

A particular advantage of wastewater monitoring is that it can be fairly comprehensive—centralized wastewater treatment facilities serve 81 percent of U.S. households. Yet it can also provide spatially granular data, because almost 40 percent of treatment facilities serve fewer than 1,000 people. Moreover, because most wastewater plants are already collecting daily samples for environmental monitoring, as mandated by the Clean Water Act, the methodology is readily scalable and relatively inexpensive to adapt to monitor human health (costing $100 to $150 per sample to test for a panel of drug markers).

The European Monitoring Centre for Drugs and Drug Addiction is already using wastewater testing

Figure 4
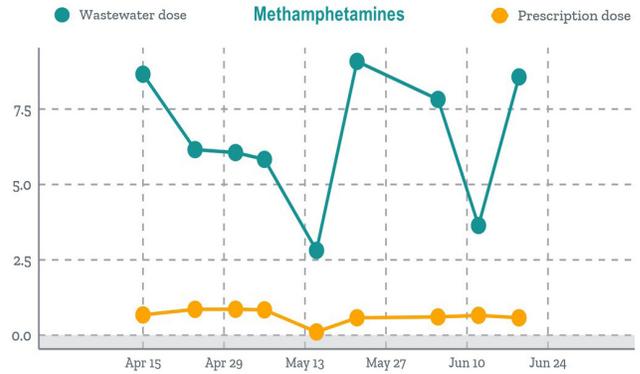
as part of a holistic multi-indicator monitoring and alert system. And the Australian Criminal Intelligence Commission routinely relies on the methodology to assess operational priorities.

As new waves of addiction emerge, it is essential that public safety and public health officials harness the rich, near real-time data available from wastewater testing to prevent the next drug epidemic.

Evolving public health threats provide one of the strongest arguments for wastewater testing, which can flexibly measure and monitor a range of compounds circulating through a population.

For more information, contact Aparna Keshaviah, Senior Statistician, Mathematica at akeshaviah@mathematica-mpr.com or (617) 588-6689. To learn more about wastewater testing, see Mathematica's research brief and special report.