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Population Health: The Translation of Research to Policy

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Case Studies and Commentary

Robert Wood Johnson Foundation Health & Society Scholars

The Robert Wood Johnson Foundation Health & Society Scholars (HSS) program was designed to build the nation's capacity for research, leadership, and policy change, while addressing the multiple determinants of population health. One of its goals was to produce a cadre of scientific leaders who could contribute to this research and spearhead action to improve overall population health and eliminate health inequities.

This report, edited by Robert A. Hiatt, MD, PhD, University of California, San Francisco, takes a case study approach, using six diverse examples of science to policy translation generated by Scholars in the HSS program from 2003 to 2016. Because the HSS program was discontinued in 2017, the Milbank Memorial Fund published these case studies in 2018 in hopes that many audiences, including students, would use them to learn about the connections between research, decision making, and policy.

Case Study 3

Medical Marijuana as a Strategy to Reduce Opioid Overdose Deaths? Lessons from a Study of State Medical Marijuana Laws

Is legalizing medical marijuana an effective policy to reduce the rising tide of drug overdose deaths?

Authors

Brendan Saloner, PhD
Assistant Professor
Department of Health Policy and Management
Johns Hopkins Bloomberg School of Public Health

Marcus Bachhuber, MD, MSHP
Assistant Professor
Division of General Internal Medicine
Department of Medicine
Montefiore Medical Center/Albert Einstein College of Medicine

Synopsis

This case study describes a collaborative project that combined our backgrounds in addiction medicine and health policy. We were led to this project through a shared interest in policy strategies to reduce opioid overdose mortality, which has more than quadrupled in the United States since the late 1990s. We hypothesized that access to medical marijuana, an alternative treatment for chronic pain, might reduce use of opioid painkillers at a population level and decrease overdose deaths. Using a quasi-experimental study design, we compared trends in overdose death rates in states that implemented medical marijuana laws to states that did not pass such laws. We found that enactment of a medical marijuana law was associated with a mean 24.8% lower opioid painkiller overdose mortality rate, relative to pre-enactment trends and trends in states without such laws. In 2013, when this study was conducted, it was the first study to link access to medical marijuana through changes in state laws to reduced mortality from opioid painkillers. In the following case study, we present the collaboration that facilitated this study, the process of developing our study design, and the dissemination and policy impact of our findings.

Learning Objectives

- Describe the epidemic of opioid misuse, addiction, and overdose and the hypothesized relationship between medical marijuana and use of opioid painkillers.
- Compare the benefits of using natural experiments versus other potential study designs to measure the impact of medical marijuana on population health outcomes.
- Explain some of the challenges in communicating study findings to the news media, and present some strategies that may be effective in improving communication.
- Identify future directions for research on medical marijuana and opioid painkillers, and describe how current research can inform federal, state, and local policy.

Introduction

What are effective public policies to reduce the rising tide of opioid drug overdose deaths?

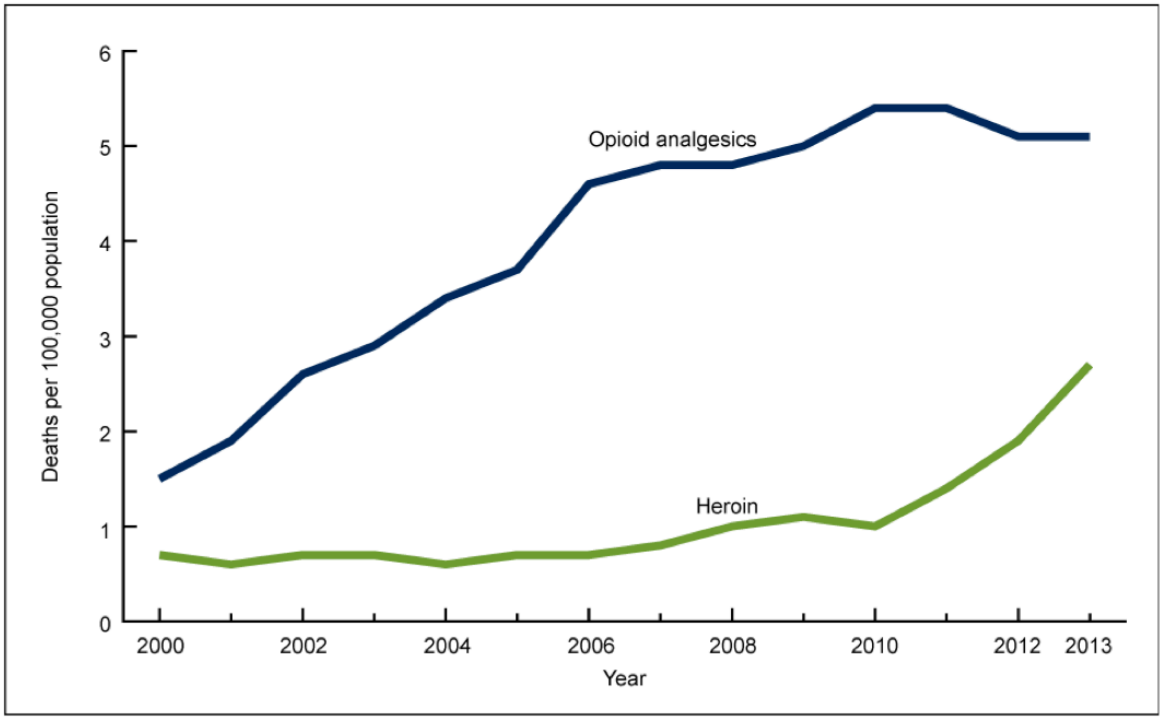
Our shared interest in answering this seemingly straightforward question led us to collaborate during our time as postdoctoral fellows at the University of Pennsylvania. When we met, Brendan Saloner was in his second year of the Robert Wood Johnson Foundation Health & Society Scholars (HSS) program and Marcus Bachhuber was in his first year of the Robert Wood Johnson Foundation Clinical Scholars Program. During our training, we had both developed interests in substance use disorder treatment policy and in contextualizing the

problems of drug and alcohol use within population health. We realized we not only shared a research interest but also brought together complementary skill sets. Marcus is a primary care physician with training in addiction medicine and has firsthand experience treating patients with substance use disorders. Brendan has a PhD in health policy and has experience evaluating how state and federal policies affect health and health care outcomes. We both have a passion for data analysis and for unusual study design.

Our starting point was the rising epidemic of opioid overdose deaths. The term "opioids" generally refers to both natural and synthetic derivatives of opium (from poppies), formulations that have been used to relieve pain since antiquity. Common modern prescription opioid painkillers (also called "opioid analgesics") include morphine, hydrocodone, and oxycodone. Heroin, which was marketed in the late 19th and early 20th centuries as a pain reliever and cough suppressant, is also an opioid.

Between 1999 and 2013, the number of people who died of drug overdoses involving opioid painkillers more than quadrupled, from 4,030 to 16,235 (Figure 1). Addiction to prescription opioids is intertwined with heroin addiction for many individuals, especially as individuals addicted to opioid painkillers seek an inexpensive means to sustain their addictions. In recent years, rates of heroin overdose have also been increasing rapidly (Figure 1).[1]

Figure 1. Age-adjusted rates for drug-poisoning deaths, by type of drug: United States, 2000–2013



NOTES: The number of drug-poisoning deaths in 2013 was 43,982, the number of drug-poisoning deaths involving opioid analgesics was 16,235, and the number of drug-poisoning deaths involving heroin was 8,257. A small subset of 1,342 deaths involved both opioid analgesics and heroin. Deaths involving both opioid analgesics and heroin are included in both the rate of deaths involving opioid analgesics and the rate of deaths involving heroin. Access data table for Figure 1 at: http://www.cdc.gov/nchs/data/databriefs/db190_table.pdf#1.
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality.

The rising tide of opioid overdose deaths is a complicated problem, but one important driver has been a change in physicians' treatment decisions for patients with chronic pain. Over the past few decades, health care providers, researchers, and policymakers have increasingly recognized chronic pain to be common and a significant public health problem.[2,3] While medical providers almost universally recognized the importance of treatment of pain due to cancer and pain at the end of life, the idea that chronic pain from other causes (e.g., arthritis or low back pain) should be aggressively diagnosed and treated (as opposed to simply considered a predictable consequence of aging) is relatively new.

Improving the identification of non-cancer chronic pain through routine assessments in all patients and reducing "undertreatment" of chronic pain (i.e., not providing sufficient medical treatment to alleviate pain) have become cornerstones of medical care and are promoted by professional societies and organizations that accredit hospitals and clinics, as well as state medical licensing boards.[4]

In practice, prescription opioid painkillers for the treatment of chronic non-cancer pain proved both much less effective and riskier than originally believed. Up to two-thirds of patients who initially experience pain relief discontinue treatment for reasons such as side effects, lack of benefit, or both.[5] Nevertheless, as these medications became more commonly used, medical providers and public health officials began seeing significant increases in opioid painkiller misuse, addiction, and overdose. By 2013, more than 4.5 million Americans reported using opioid painkillers nonmedically (i.e., without a prescription, at higher than prescribed doses, or for purposes other than treating pain).[6]

Marijuana (frequently called "cannabis" outside the United States) is currently most well known as a recreational drug, but its medical use for pain relief has been documented for thousands of years. In the United States, marijuana was legal and used medically until the 1930s, after which the federal government outlawed its use.[7]

Many modern clinicians and researchers advocate for marijuana's medical use in the management of chronic pain. The potential application of marijuana for pain management led us to wonder whether enactment of state legislation providing access to marijuana for medicinal purposes might lead some patients to move away from opioid painkillers and ultimately result in reduced opioid overdose mortality. As of 2015, 23 states and the District of Columbia have legalized marijuana for medicinal purposes.[8] Specifically, most of these states have legalized medical marijuana for use in treating chronic pain, and in states for which information is available, the majority of patients enrolled in medical marijuana programs report chronic pain as the reason for use.[9–11]

The relationship between medical marijuana and opioid painkillers has not been widely studied. Anecdotally, many health care providers hear from patients that marijuana is more effective than opioid painkillers in relieving pain, and, sometimes, that marijuana is the only treatment that helps. Surveys of people applying for medical marijuana cards or filling prescriptions at marijuana dispensaries have found that up to two-thirds (51%-66%) reported substituting marijuana for prescription drugs; however, the proportion who substituted marijuana for opioid painkillers is unclear.[12-14] There is also evidence of a link between marijuana use and opioid painkiller or heroin misuse. Over one-quarter (26%-30%) of patients reported substituting marijuana for an illicit drug.[12-14] In addition, a study of people who inject heroin found a link between marijuana use and less frequent heroin use.[15]

Study Design and Execution

In clinical research, the gold standard for determining the causal effect of a treatment (e.g., medical marijuana) on an outcome (e.g., opioid overdose) is the randomized clinical trial. While incredibly valuable, these studies take years to plan and conduct and require enormous budgets, and findings are not disseminated until a long time later. In the case of marijuana, its classification by the U.S. government as a schedule I controlled substance with "no currently accepted medical use in the United States, a lack of accepted safety for use under medical supervision, and a high potential for abuse" makes research even more difficult to conduct.

Although a randomized clinical trial to examine our research question was not feasible, medical marijuana laws were passed in different states at different times, presenting a clear natural experiment. These laws have varied in their scope (e.g., whether individuals are permitted to grow their own medical marijuana or must obtain it from a registered dispensary), but they all include state-regulated programs permitting uses of marijuana for medical treatment. Observational studies of such natural experiments are common in policy research where randomized controlled trials are not possible for ethical, logistical, or financial reasons. One advantage of this study design is that by comparing trends in states that passed medical marijuana laws with those that did not, we could identify changes in the outcome that are likely to be caused by the legislation, independent of other changes occurring at the same time.

We focused on overdose mortality as our outcome of interest. We identified death certificates as a potential source of data for our study because they are publicly available for research purposes from the U.S. Centers for Disease Control and Prevention. Death certificates include

a probable cause of death, allowing us to identify cases where a person likely died from opioid overdose (a cause that coroners often confirm with toxicology). Death certificate data are released in aggregate, meaning that we could focus on the overall rate of overdose mortality for each year and state. We reasoned that an increase in the overall overdose mortality rate provides a clear signal that there is a problem of underlying misuse within a population.

We began with state-level mortality data for all 50 states from 1999 to 2010 and identified all deaths due to drug overdose that involved ingestion of prescription opioid painkillers. During this period, 13 states implemented medical marijuana laws, and we were able to compare changes in overdose death rates before and after implementation. To learn about our data, we conducted extensive descriptive analysis, creating line graphs to show changes in overdose death rates in states with and without medical marijuana laws. We also learned about our data by determining if there were any states that were "outliers," i.e., states that deviated substantially from other states in their overdose mortality trends. For our main statistical analysis, we used regression models to account for repeated measures and to adjust for several confounders, such as other state policies aimed at improving opioid safety (e.g., prescription monitoring programs).

Results

Early in the analysis process, we identified a strong link between medical marijuana laws and overdose mortality. As we moved forward, we asked two senior colleagues with extensive clinical and analytical insight to join our project. These colleagues (Dr. Chinazo Cunningham and Dr. Colleen Barry) provided valuable feedback about how to refine our analysis and describe our findings.

We found that states that had enacted medical marijuana laws had a mean 24.8% lower opioid overdose mortality rate, after adjusting for several confounders. In a secondary analysis of opioid overdose deaths in each year following medical marijuana law enactment, we found that opioid overdose rates decreased over time: year one, -19.9%; year two, -25.2%; year three, -23.6%; year four, -20.2%; year five, -33.7%; and year six, -33.3%. This could suggest that as medical marijuana programs become more established and enroll more people, the benefits increase. These results were robust in several sensitivity analyses (i.e., we could confirm the findings using alternative statistical procedures).

Our findings that medical marijuana laws are associated with significantly lower state-level opioid overdose mortality rates has several implications. First, medical marijuana laws can potentially play a role in addressing a significant population health challenge beyond treatment of specific disorders. Second, and relatedly, our findings provided an intriguing new angle to dealing with opioid misuse: Most efforts to reduce harms from opioids have focused

on simply decreasing access to this class of medications; our findings suggest that increasing access to alternatives may also be successful. Third, some policymakers have suggested that medical marijuana laws may increase misuse and addiction to other drugs (the gateway hypothesis), however, we did not find any evidence of this in the case of opioids.

We are cognizant that both marijuana use and opioid abuse are politically charged topics and were concerned that our findings could be distorted or manipulated to fit the agendas of special-interest groups or media organizations eager to "spin" the story. We therefore carefully considered how to present our findings so as to avoid misinterpretation. As much as we wanted to tell what our findings could contribute to policy decisions, we felt compelled to also communicate what they could not establish. For example, our study was not designed to determine whether medical marijuana is beneficial or harmful to health overall, nor could we definitively answer whether marijuana use leads to other drug problems. We did not address whether there are public health implications related to medical marijuana being diverted for recreational purposes or whether medical marijuana use is a risk factor for injuries or accidents (concerns that have been raised by public health researchers).

Translating Research to Policy

Our findings were published in *JAMA Internal Medicine* in October 2014.[16] Timed to the publication of our findings in this high-impact journal, we carefully crafted a press release that would communicate our message (especially knowing that many journalists only read press releases and not final publications). Almost immediately after the press release was distributed, we received requests for comment from media organizations. Our article was covered in national media such as the *Los Angeles Times*, the *Boston Globe,* the *Philadelphia Inquirer,* and the *Chicago Tribune*, and was featured on national nightly television news programs (e.g., CNN and ABC News).

In speaking to the media, we were careful to emphasize the novelty of our findings while stressing the need for further research and the reality that even our carefully designed study could not independently establish causality. As the lead author, Marcus spoke extensively with reporters and was careful to walk them through our study findings. We believe that this improved the quality of those news articles. On the other hand, we also found that media reports that did not seek comment from our study team tended to sensationalize our findings, often making it seem as though our study could prove that medical marijuana reduced overdose deaths.

As a companion piece and to give our message a broader voice, Marcus and Colleen authored an op-ed detailing the study design and key findings for a general audience, which

was published in the *New York Times* ("Of Pot and Percocet," August 29, 2014).[17] The exercise of writing this piece was valuable as it encouraged us to focus on the aspects of the study that were most important for the public to understand and describe the further research we believed would be helpful. In crafting the op-ed, we were guided by a few simple principles: use numbers to illustrate key ideas and to focus readers' attention, explain both what we did and why it mattered, and conclude with a call to action (in our case, greater engagement among clinicians and researchers).

Our study's dissemination via multiple professional and mainstream channels directly contributed to the public conversation about medical marijuana legalization. For example, our report was directly referenced in the Florida news media during debates over Florida's Amendment 2, a ballot initiative to legalize medical marijuana in the state.[18] We have seen our research referenced in policy briefs written by major policy organizations and in editorials.[19,20] At the invitation of the Medical Society of Delaware, we wrote a commentary for the state medical journal, published to coincide with the opening of the state's first medical marijuana dispensary.[21]

Two members of our study team (Marcus and Colleen) provided testimony to Pennsylvania legislators related to a proposed medical marijuana law. The bulk of the testimony was from clinicians, patients, and caregivers, but we were asked to comment specifically on our study findings. As with writing the op-ed, preparing testimony required us to carefully consider the most important aspects of the study and how to communicate our findings directly to policymakers. In addition, we had to anticipate and prepare answers to possible questions that lawmakers might ask.

Successes and Challenges

Our study has made a contribution to national policy conversations concerning medical marijuana. We have received strong interest from both colleagues and policymakers and their staffers. It remains to be seen what specific effects this research will have on population health. Our study comes at a time when there is renewed pressure from the American Medical Association and major research entities to improve the research evidence base for prescribing medical marijuana. We are hopeful that our findings will prompt federal policymakers to facilitate funding of more randomized clinical trials on the clinical effects of marijuana and ultimately to generate more evidence-based guidelines.

We have also learned from criticism leveled at our study. Because our analysis relies on aggregated data (an "ecological analysis"), it is not possible to determine what the impact

of these policies is on actual individuals who are at risk of overdose.[22] Indeed, a concern has been raised that aggregated analyses may be misleading about individual-level relationships. For example, if a study shows that high-income countries have higher rates of heart disease, it is tempting to conclude that high-income individuals have higher rates of heart disease (termed the ecological fallacy). However, within countries, higher-income individuals may actually have lower rates of heart disease if they have access to healthier foods or better medical care. In our specific case, a finding that medical marijuana laws are associated with changes at the state level cannot necessarily conclude anything about health conditions or risks of individuals using medical marijuana.

However, these state-level relationships do reveal associations between medical marijuana laws and opioid overdoses averaged over the population. This finding remains of interest to policymakers and even voters deciding whether or not to support medical marijuana ballot initiatives. Moreover, whereas ecological studies are criticized for making generalizations across areas at a point in time (i.e., they are "cross-sectional"), our study takes advantage of the fact that we were able to observe changes within states over time, before and after the enactment of a medical marijuana law. This is inherently a much stronger study design, and one that is more likely to indicate a possible causal relationship.[23] Although we believe that our study provides a valid representation of a population-level effect, the ecological critique of our study has reaffirmed our care in choosing terminology to describe the meaning of our findings. It has also encouraged us to emphasize the importance of over-time comparisons, which is one of the key design features of our study.

We have learned several important lessons that we believe pertain broadly to policy analysis and population health research:

1. Know your audience. There is a need to tailor presentation of research to the concerns and knowledge of different groups. Thus, when we speak to the news media, we always keep in mind the question, "What would a person who has not encountered this issue before need to know in order to be well-informed?" We want our research to prompt conversations (such as conversations between patients and their doctors about treatment choices). When we speak to research colleagues, we emphasize study design and research methodology, since we hope that others will seek to replicate or refine our findings. When we speak to policymakers, such as state legislators, we try to provide evidence that they can use to evaluate whether a policy proposal is likely to improve population health. We want to help policymakers understand the relative risks of different clinical practices (especially the risks of opioid prescribing without regard to long-term consequences).

2. Be open to alternative explanations. Research is durable and does not end when a study is published. For example, other investigators encouraged us to consider the possibility that medical marijuana laws may have the greatest impact on populations that are using illicit drugs for recreational purposes rather than on patients with chronic pain who are using opioids prescribed by clinicians (since non-patients may also gain greater access to marijuana after the passage of these laws). Our findings do not definitively reach this question; however, future studies designed to answer this question will be useful in developing better policies, as policy should be concerned with positively impacting all individuals at risk of opioid overdose.

3. Partner with policymakers for greatest impact. As academic researchers, our greatest assets are our credibility and expertise. These are incredibly valuable to policymakers with portfolios that cover dozens of issues and limited staff resources to carefully delve into the research. When we interact with policymakers, we try to convey our respect for their expertise in the policymaking process. Policymakers, such as state legislators, have a nuanced understanding of potential constraints on how research informs the process. We also keep in mind that the development of policy is iterative over time; participating in early stage activities such as providing comments or testimony can build relationships that will prove valuable later, when drafting proposed legislation or partnering with policymakers to evaluate its impact.

Conclusions

We return to the original question that inspired our research. Is legalizing medical marijuana an effective policy to reduce the rising tide of opioid drug overdose deaths? Our study provides some promising preliminary evidence that expanded access to medical marijuana could reduce overdose deaths, but our evidence is not definitive. We are heartened that others are now exploring this question, bringing to bear further evidence and robust methodologies.[24]

We have become especially interested in the possible linkage of state databases that track opioid prescribing with registries that identify individuals authorized to use medical marijuana. Such research is useful because it can help establish the connection between entering a medical marijuana program and changing one's use of opioid painkillers. We also have widened our focus beyond medical marijuana to investigate other complementary tools to reduce harmful use of opioid medications. We have begun an examination of clinician opioid prescribing practices as another policy target. As we move forward, our research continues to be informed by the idea that even incremental interventions can make an important difference in the effort to reduce opioid overdose deaths.

Discussion Questions

1. Why is the use of opioid painkillers a public health problem, and why might policymakers want to explore medical marijuana for pain management?

2. What public health concerns would you have about expanding access to medical marijuana? How could these concerns be addressed through public policy?

3. Beyond medical risks and benefits, what are some social or philosophical issues raised by medical marijuana laws and how might these influence policymakers and voters?

4. One critique of the Bachhuber et al. study (reference #16) is that it does not necessarily tell us about the effect of medical marijuana on individuals. Explain this criticism. Since the results apply at a state level, what we can learn from these state-level results?

Assignment

Pick a state that has not yet implemented a medical marijuana law (http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx). Imagine that there is a proposed state law to create medical marijuana dispensaries that will provide access to medical marijuana for individuals with chronic pain.

You have been asked to testify before a committee of the state legislature as a scientific expert. The committee has asked you to provide short testimony, written in clear, layperson's language, addressing these questions:

1. How many people die from opioid overdose in our state? How does that compare to national rates? (See box on the next page, "A Tutorial on Using the CDC Wonder Data," to identify the mortality rate from opioid painkillers in the state and compare that with the national rate.)
2. How might access to medical marijuana affect the opioid overdose rate? Summarize the available evidence, indicating what issues still need to be studied (i.e., gaps in the evidence).
3. Provide a recommendation about how the state should evaluate health impacts of the medical marijuana program.
4. Other than opioid overdose deaths, what health impacts are you concerned about tracking?

Here are five tips for writing and presenting effective testimony:

1. Be succinct! Keep your remarks to about two single-spaced pages when making oral presentations. Reserve time for questions and answers.
2. Immediately present your qualifications or background to establish your credibility.
3. Pick a few statistics that illustrate the breadth/depth of the problem and how different policy proposals might address them. (Note: Be very specific; policymakers want to know what is happening in their own communities.)
4. Connect the dots: do not assume that presenting evidence will be persuasive. Rather, be explicit as to how a policy will affect the underlying problem.
5. Exhibit an awareness of the other participants in the conversation; know their positions and be prepared to address alternative perspectives or policy strategies they may present. (Note: Aim to provide analysis for different policy proposals without necessarily advocating for which policy should be adopted.)

A Tutorial on Using the CDC Wonder Data

Multiple causes of death data can be found at this link:
http://wonder.cdc.gov/mcd.html.

You will be prompted to complete a query form. Here is some guidance about how to complete the sections of this form.

Section 1:
Select "Group Results By":
Box 1: State
Box 2: Year

Section 2:
Select your state(s) of interest.

Section 7:
Under "Select Records"
In the first box, copy the following:

X40 (Accidental poisoning by and exposure to non-opioid analgesics, antipyretics, and antirheumatics)

X41 (Accidental poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism, and psychotropic drugs, not elsewhere classified)

X42 (Accidental poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified)

X43 (Accidental poisoning by and exposure to other drugs acting on the autonomic nervous system)

X44 (Accidental poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances)

X60 (Intentional self-poisoning by and exposure to non-opioid analgesics, antipyretics, and antirheumatics)

X61 (Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism, and psychotropic drugs, not elsewhere classified)

X62 (Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified)

X63 (Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system)

X64 (Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances)

X85 (Assault by drugs, medicaments, and biological substances)

Y10 (Poisoning by and exposure to nonopioid analgesics, antipyretics, and antirheumatics, undetermined intent)

Y11 (Poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism, and psychotropic drugs, not elsewhere classified, undetermined intent)

Y12 (Poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified, undetermined intent)

Y13 (Poisoning by and exposure to other drugs acting on the autonomic nervous system, undetermined intent)

Y14 (Poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances, undetermined intent)

And in the second box, copy:

T40.1 (Heroin)

T40.2 (Other opioids)

T40.3 (Methadone)

T40.4 (Other synthetic narcotics)

Section 8:
If you want to compare overdose rates between states (as opposed to just numbers of overdoses), make sure to select "Use standard age-adjusted rates" with the "2000 U.S. Std. Population."

Section 9:
Check "Show Zero Values" and "Show Suppressed Values" to see missing data.

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About the Milbank Memorial Fund

The Milbank Memorial Fund is an endowed operating foundation that works to improve the health of populations by connecting leaders and decision makers with the best available evidence and experience. Founded in 1905, the Fund engages in nonpartisan analysis, collaboration, and communication on significant issues in health policy. It does this work by publishing high-quality, evidence-based reports, books, and *The Milbank Quarterly*, a peer-reviewed journal of population health and health policy; convening state health policy decision makers on issues they identify as important to population health; and building communities of health policymakers to enhance their effectiveness.

Milbank Memorial Fund
645 Madison Avenue
New York, NY 10022
www.milbank.org