ASPE
Data BRIEF

# Research to Address the Opioid Crisis: Approaches to Data Linkage

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To combat the significant public health crisis associated with the opioid overdose epidemic, the Department of Health and Human Services (HHS) has identified five specific strategies:[1]

- Improving access to prevention, treatment, and recovery services;
- Targeting availability and distribution of overdose-reversing drugs;
- Strengthening our understanding of the crisis through better public health data and reporting;
- Providing support for cutting edge research on pain and addiction; and
- Advancing better practices for pain management.

Numerous efforts are underway to implement HHS' five strategies; and such efforts are informed by research that evaluates factors associated with opioid overdose and the effectiveness of interventions being employed across the United States. This body of research can analyze data to improve understanding about opioid addiction, overdoses, and the populations that are affected by the opioid crisis. The purpose of this *Data Brief* is to present an initial overview of the types of data sources that are currently being used or could potentially be leveraged to study the opioid crisis within each of the five HHS Strategic Areas, highlight some of the key research questions within these areas, and summarize data linking strategies that can be used to support research on opioids. This brief is based on a forthcoming ASPE report[2] that will provide expanded details and examples of data sources and linkages for studying the opioid crisis.

## Data Linkage for Research

Data linkages refer to analyses that combine data from two or more data sources to study the same individual, event, or geographic area. This definition includes studies whereby data contains unique individual identifiers such that information from different sources can be linked at the level of the individual. Linkages at the more aggregate level include analyses that merge two or more datasets at the state or county level. For the purposes of this brief, studies that analyze multiple complementary data sources (e.g., conducting geographic spatial analysis of heroin-related emergency department visits and heroin-related deaths) are also included.[3] Each of these methods has strengths and

limitations, but all can contribute toward informing evidence-based decisionmaking.[4] Individual-level linkages and analyses offer advantages in that they support the unit of analysis most appropriate for inferring individual-level relationships, and longitudinal data can support analyses of individual-level prescribing or treatment trajectories as well as pathways that precede opioid harms (e.g., overdose) or entry into treatment. However, very few national datasets are linked at the person level. Efforts to develop such linked datasets and make them more accessible must balance the potential benefits from individual-level analyses with the potential privacy concerns and statistical issues in generating matches. Linking or analyzing datasets at more aggregate levels is far less resource-intensive, but such analyses may be more limited in their potential to explain many of the key dynamics of the opioid crisis.

There are several difficulties that complicate linking data across multiple sources, and most arise in linking data at the individual level. The general steps for conducting data linkages are to identify the necessary data sets; select the data elements that will be used to link across datasets; determine the most appropriate method and matching algorithms for linking; and assess match quality through metrics such as sensitivity, specificity, positive predictive value, and negative predictive value. There are substantial statistical challenges in conducting the linkages and analysts will need to adhere to data access policies of data providers.[5] To implement linkages, analysts must decide how to define unique person identifiers and the best method(s) for linking (e.g., deterministic or probabilistic matching), which will in turn influence the quality of matches. Errors that may occur during this process influence the rigor of subsequent analyses.

Overall, there are a variety of areas in which resources and time may be invested to enhance data linkages in opioid research. This *Data Brief* describes common types of data and linkages that researchers are using to study factors associated with the opioid crisis.

## Strategy #1: Improving Access to Prevention, Treatment, and Recovery Services

In the area of treatment and recovery services, recent research identified in the forthcoming report predominantly studied policies intended to expand the number of buprenorphine providers and buprenorphine prescribing, as well as the factors that predict the availability of waivered physicians (i.e., physicians with waivers of certain DEA registration requirements), and factors that are associated with the monthly patient censuses of waivered physicians (the number of patients a waivered physician is treating with buprenorphine in a month). Some studies also investigated patterns of buprenorphine use among those receiving treatment. The most commonly used variables and data sources that appeared in relevant research, by research aim, included:

<u>Describe national and state trends in treatment need for opioid use disorder</u>

- Measures of opioid use disorder from the Substance Abuse and Mental Health Administration's (SAMSHA) National Survey on Drug Use and Health (NSDUH)

<u>Describe national trends and geographic variation in buprenorphine physician supply</u>

- Number of buprenorphine providers from SAMHSA's Buprenorphine Waiver Notification System or from the DEA's Active Controlled Substances Act Registrants Database (DEA ACSA)

Describe national trends and patient trajectories in treatment for opioid use disorder

- Buprenorphine prescriptions or patient censuses of buprenorphine prescribers from commercial data providers or from state-specific prescription drug monitoring program (PDMP) data
- Buprenorphine prescriptions among the Medicaid population from Medicaid claims data
- Measures of opioid use disorder treatment from the National Survey on Drug Use and Health (NSDUH)
- Substance abuse treatment services from SAMSHA's National Survey of Substance Abuse Treatment Services (N-SSATS)
- Treatment admissions for opioid use disorder from SAMSHA's Episode Data Set (TEDS)

Examine factors associated with buprenorphine physician supply

- Number of buprenorphine providers from SAMHSA's Buprenorphine Waiver Notification System or from the DEA's Active Controlled Substances Act Registrants Database (DEA ACSA)
- State Medicaid reimbursement policies for buprenorphine from the RAND/National Conference of State Legislators (NCSL) Survey; county characteristics (e.g., urban-rural status, unemployment rate, number of hospital beds per capita) from the Bureau of Economic Analysis (BEA) or Area Health Resources File (AHRF)

*Linking Approaches for Strategy #1*

The most commonly used data linking strategies entail merging multiple data sources at the state or county level. For example, studies identified in this area used state- or county-level factors such as unemployment rate and income per capita from the Bureau of Economic Analysis (BEA) or Area Health Resources Files (AHRF) or information on physician density, the number of hospital beds per capita, and urbanicity from the AHRF. These contextual factors have been linked at the state- or county-level to outcome data on buprenorphine access or utilization to understand factors associated with buprenorphine treatment capacity and use.

## Strategy #2: Targeting Availability & Distribution of Overdose-Reversing Drugs

The most commonly studied interventions promoting the use of overdose reversing drugs are community-based overdose education and naloxone distribution (OEND) programs, with emerging evidence studying state Naloxone Access Laws and state Good Samaritan Laws. The most commonly used variables and data sources utilized in relevant research, by research aim, included:

Examine the effects of community-based OEND programs on overdose knowledge and outcomes

- Reported overdose reversals, number of naloxone administrations, and knowledge about how to respond to a witnessed overdose and administer naloxone from surveys of OEND program participants or other data collected by OEND programs (e.g., program data from the

Massachusetts Opioid Overdose Prevention Pilot Program and the Harm Reduction Coalition survey of community-based organizations providing naloxone)

Understand the evolution of state laws governing access to and use of naloxone

- Information on state policies related to naloxone access and use for community bystanders, emergency medical services personnel, and other first responders is generally drawn from original review of legal databases

Examine the effects of state naloxone policies on opioid overdose

- Opioid overdose mortality from the Centers for Disease Control and Prevention's (CDC) National Vital Statistics System Multiple Cause of Death (NVSS MCOD) microdata or CDC WONDER
- Information on state policies is generally drawn from original review of legal databases or the Prescription Drug Abuse Policy System (PDAPS)

*Linking Approaches for Strategy #2*

The most commonly used data linking strategies included state-level mortality data merged with state-level policy, demographic, and socioeconomic variables; or analyses presented using multiple complementary datasets. Analysis using multiple complementary datasets has entailed, for instance, state-specific analyses of trends in emergency department visits for substance abuse and accidental poisonings, fatal accident poisonings, and outpatient-dispensed controlled substances over the same time period to understand whether trends changed with the implementation of a community-based OEND program. Individual- or case-level data linking strategies are not commonly used in recent research relevant to this strategy.

The Prescription Drug Abuse Policy System (PDAPS) is a federally funded national database that tracks key state laws related to prescription drug abuse. PDAPS provides detailed information about policies including state laws designed to promote the safe use of controlled medicines and reduce the toll of drug overdose including: access to naloxone, Good Samaritan 911 Immunity, PDMPs administration, regulation and reporting. For more information, go to http://www.pdaps.org.

## Strategy #3: Strengthening Our Understanding of the Crisis through Better Public Health Data & Reporting

Research related to this strategy generally concerns use and analysis of multiple complementary datasets to offer better evidence on trends and disparities related to the opioid crisis. Research has also focused on developing methods to improve monitoring through existing public health surveillance systems (e.g., electronic health records, emergency department encounter data), advancing strategies to identify patients at high risk of prescription opioid misuse or abuse, and promoting the need for improvement of opioid toxicosurveillance (i.e., rapid analysis of drug exposure data). The most commonly used variables and data sources utilized in relevant research, by research aim, included:

Evaluate trends in opioid prescribing, dispensing, and usage

- Opioid prescribing from state-specific prescription drug monitoring programs (PDMPs) data or from all-payer claims databases
- Opioid prescriptions (and indicators for opioid misuse) among the Medicaid or Medicare population from Medicaid or Medicare claims data

Assess the relationship of opioid prescribing patterns to risk of overdose

- Opioid overdose deaths from state or county death certificate data or from the NVSS MCOD microdata
- Nonfatal opioid overdose rates from state hospitalization or emergency department data
- Opioid prescribing from state-specific prescription drug monitoring programs (PDMPs) data or all-payer claims databases
- Opioid prescriptions (and indicators for opioid misuse) among the Medicaid or Medicare population from Medicaid or Medicare claims data

Describe trends and geographic variation in illicit opioid markets

- Drug seizures or arrests from local law enforcement databases

Use near-real time surveillance tools to understand product-specific abuse and emerging trends

- Three databases specifically designed to provide near-real-time surveillance data on opioid abuse are the Researched Abuse, Diversion and Addiction-Related Surveillance System (RADARS), the National Addictions Vigilance Intervention and Prevention Program (NAVIPPRO), and the Prescription Behavior Surveillance System (PBSS)
- Data collected through online social media to monitor illicit or problem opioid use

*Linking Approaches for Strategy #3*

A common data linking strategy is to merge or conduct complementary analyses of state- or county-level data from the various sources noted above. At the individual level, studies have linked data on prescription patterns from state PDMPs or Medicaid claims with state death certificate data to assess trends in prescribing behavior preceding overdose death. States are also implementing strategies to improve linkage and analysis of data across state agencies to better understand the opioid crisis. For example, with Chapter 55 of the Acts of 2015, Massachusetts' Department of Public Health has connected ten datasets managed by five state agencies to develop a data warehouse structure. These datasets include the state all-payer claims database, linked to data from the state's PDMP; death certificate records and toxicology results; substance abuse treatment information; hospital, emergency department, and outpatient records; incarceration and treatment records within the criminal justice system; emergency medical service incident data from licensed ambulance services; as well as other sources.

## Strategy #4: Providing Support for Cutting Edge Research on Pain & Addiction

Interventions studied in this strategic area are predominantly PDMPs, pain management education, and abuse-deterrent formulations of opioids. The most commonly used variables and data sources utilized in relevant research, by research aim, included:

Describe trends in treatment admissions for opioid use disorders

- Treatment admissions for prescription opioid and/or heroin misuse from SAMSHA's Treatment Episodes Data Set (TEDS)

Examine individual-level characteristics associated with opioid use disorder

- *Outcomes*: Rates of nonmedical prescription opioid use and opioid use disorder from NSDUH or the National Institute on Alcohol Abuse and Alcoholism's (NIAAA) Epidemiologic Survey on Alcohol and Related Conditions (NESARC)
- *Individual factors*: Other substance use disorders, mental health conditions, and demographic characteristics from NSDUH or NESARC

Assess associations between pain, opioid analgesic use, and diagnosis of an opioid use disorder

- Opioid use disorder diagnoses and diagnostic measures of pain from electronic health records or claims data collected through various integrated health systems
- Indicators of prescription opioid abuse or dependence, opioid prescriptions, and clinical diagnoses from patients in the Veterans Affairs Health Care System from national or regional Veterans Affairs data warehouses.

Assess whether different prescription characteristics or prescribing patterns are associated with overdose

- Opioid overdose deaths from death certificate data compiled in the National Death Index (NDI) or from state vital records data
- Opioid prescriptions from state-specific PDMP data

*Linking Approaches for Strategy #4*

Data linkages are not commonly used in studies of the relationship between pain and addiction. The primary example discovered in the relevant research is that the Veterans Affair data warehouses link individual-level data on demographics, diagnostic, and pharmacy records; and this information has been linked at the individual-level to mortality data from the NDI. Other studies have linked information from state PDMPs at the individual-level to mortality data to understand prescription characteristics (e.g., short-acting compared to extended-release opioids) associated with overdose deaths.

## Strategy #5: Advancing Better Practices for Pain Management

The most commonly studied policies in this strategy are PDMPs, with more limited research studying the effects of laws which counter "pill mills".[6] (A pill mill is a doctor's office, clinic, or health care facility that routinely conspires in the prescribing and dispensing of controlled substances outside the scope of the prevailing standards of medical practice in the community.[7]) More recent research has begun to evaluate the introduction of abuse-deterrent opioid formulations. The most commonly used variables and data sources utilized in relevant research, by research aim, included:

Examine effects of PDMP implementation on opioid-related consequences

- Sources for state PDMP policy enactment commonly include the PDAPS and National Alliance for Model State Drug Laws (NAMSDL) which is funded in part through a cooperative agreement from the Bureau of Justice Assistance, Office of Justice Programs, U.S. Department of Justice and a grant from the Office of National Drug Control Policy
- Opioid prescribing behavior from state-specific PDMPs
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) distributed through retail pharmacy sources from commercial data providers
- Rates of fatal opioid overdose from the NVSS MCOD microdata, CDC WONDER, or state-specific death certificate data

Describe trends in opioid analgesic prescribing patterns and assess associations with risky prescribing

- Opioid prescribing behavior from state-specific PDMPs
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) distributed through retail pharmacy sources from commercial data providers
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) among the Medicaid population from Medicaid State Drug Utilization files
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) among Medicare beneficiaries from the Medicare Prescription Drug Event data linked to the Medicare Beneficiary Summary File

Identify risky prescribing patterns and assess associations with opioid-related harms

- Opioid prescribing behavior from state-specific PDMPs
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) distributed through retail pharmacy sources from commercial data providers
- Opioid prescriptions (and prescription behavior indicative of opioid misuse) among the Medicaid population from Medicaid State Drug Utilization files

- Opioid prescriptions (and prescription behavior indicative of opioid misuse) among Medicare beneficiaries from the Medicare Prescription Drug Event data linked to the Medicare Beneficiary Summary File
- Rates of fatal opioid overdose from the NVSS MCOD microdata, CDC WONDER, or state-specific death certificate data

For policy evaluations, a common data linking strategy is to merge state- or county-level data from various sources. Outcomes generally include state- or county-level rates of opioid-related overdose mortality, total opioid analgesic prescriptions, or specific patterns of opioid prescribing. Analyses generally control for state- or county-level factors linked from alternative data sources such as:

- Unemployment rate and income per capita from the Bureau of Economic Analysis (BEA), Area Health Resources Files (AHRF), or American Community Survey (ACS)
- Information on physician density, county-level demographics, and urbanicity from AHRF
- Rates of Medicaid and/or Medicare coverage from the U.S. Census Bureau and the U.S. Bureau of Labor Statistics Current Population Survey (CPS) or Centers for Medicare & Medicaid Services (CMS)

*Linking Approaches for Strategy #5*

For studies analyzing trends in opioid prescribing patterns, data linking strategies at the individual level generally entail 1) linking state-specific PDMP data with other data sources (e.g., Medicaid administrative claims, hospital discharges, vital records), 2) using multiple linked Veterans Health Administration databases, or 3) linking Medicaid administrative claims records with state vital records data.

## Summary

This *Data Brief* provided an overview of data sources and data linking approaches to support research in the five strategic priorities identified by HHS in response to the opioid crisis in the United States. The brief is intended to encourage new studies that use existing data to generate information that improves the understanding of opioid addiction, overdoses, and the populations that are affected by the opioid crisis. While the brief is not a comprehensive inventory of all available data sources or all possible linkage strategies, it lists several relevant datasets and it illustrates potential methods for linking these data to support research and response to the opioid overdose epidemic. With a tremendous amount of work being done at the federal, state, and local level to combat the opioid crisis, there are increasing opportunities to use data to generate information that improves understanding about the complex and multi-dimensional nature of the opioid crisis, as well as advanced the evidence base regarding the effectiveness of opioid policies and initiatives toward reducing opioid-related harms.

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