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Data Exchange Practices of Medicolegal Death Investigation

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- Medical examiner system
- Coroner system
- Death scene investigation
- Forensic sciences (e.g., toxicology, pathology)
- Specialty areas (e.g., informatics, epidemiology)
- Research/academia
- First response
- Government (i.e., federal/state/local)
- Clinical health services
- Public health

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Table of Acronyms

Abbreviation	Expansion
API	Application Programming Interface
CDC	Centers for Disease Control and Prevention
CMS	Case Management System
DOJ	Department of Justice
FTCoE	Forensic Technology Center of Excellence
MDI	Medicolegal Death Investigation
MDI-Data-WG	Medicolegal Death Investigation Data Exchange Working Group
MEC	Medical Examiners and Coroners
NIJ	National Institute of Justice
NPS	Novel Psychoactive Substances
ODMAP	Overdose Detection Mapping Application Program
OIFS	Office of Investigative and Forensic Sciences
OSAC	Organization of Scientific Area Committees for Forensic Science

Foreword

The National Institute of Justice (NIJ)—in partnership with its Forensic Technology Center of Excellence (FTCoE) (Award 2016-MU-BX-K110) at RTI International and the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC)—convened a virtual Medicolegal Death Investigation Data Exchange Working Group (MDI-Data-WG) over a 12-month period, beginning in September 2020. This working group was formed to:

- Document the types of data that are commonly exchanged with public health and public safety partners and determine collective usage points for medicolegal death investigations (MDIs);
- Provide recommendations on how to improve the naming process for emerging drugs;
- Guide the drug mapping/classification process; and
- Recommend needed enhancements to the operation of exchanging forensic data with other organizations.

The MDI-Data-WG convened 40 collaborators, including data providers (e.g., medical examiners and coroners) and data users (e.g., federal and state agencies, forensic scientists). The MDI-Data-WG focused on needs related to improving data exchange in medical examiners and coroner systems and potential future practices for data collection. Discussion topics included (1) standardization of frequently used MDI data elements, (2) methods of capturing and disseminating information about the types of drugs—including drug taxonomy and drug categorizations and classification needs involved in deaths, and (3) descriptions of the ideal exchange of data by medical examiners and coroner information management systems with other data users and providers and the data types and systems used. The MDI-Data-WG also collected additional information, such as various data sources available to medical examiners and coroners from public safety, public health, and forensic science service providers.

Glossary of Commonly Used Words and Phrases

For the purposes of this document, the following terms are defined:

Analog: A compound that has a chemical structure similar to another compound.[1]

Automation: The process of updating data programmatically on an open data portal rather than manually.

Cause of Death: A medical opinion of the disease or injury that resulted in a person's death.[2]

Consensus-Based: The process by which participants decide collectively on the acceptance of a proposal or measure.

Data Authorization: A process that ensures users at multiple levels (federal, state, local) can only access the data they need and are authorized to access.[3]

Data Exchange: The process of sending and receiving data such that the meaning or content assigned to the data is not altered during transmission.

Data Consumers: A system, tool, or user interface that uses data.

Data Modernization: The process of creating a modern, integrated, and real-time data infrastructure that relates to partner across different sectors.[3]

Data Producers: A system or user that provides data.

Death Data Element: A descriptor for a basic unit of information that has a unique meaning and subcategories (data items) of distinct value for death investigations.

Drug Taxonomy: The system of categorization or classification of drugs.

Interoperability: The ability of two or more systems to connect and exchange information with one another.

Manner of Death: A classification system based on the circumstances under which death occurred; usually consists of accident, homicide, natural, suicide, and undetermined. These manners of death are then used for public health and vital statistics purposes.[2]

Medicolegal Death Investigation: A formal inquiry into the circumstances surrounding the death of a human being; investigative information is considered with autopsy findings and adjunctive studies (if performed) to determine the cause and manner of death.[2]

Metabolite: A byproduct of the body metabolizing (i.e., breaking down) a drug into a different substance.

Novel Psychoactive Substances (NPS): An unscheduled narcotic or psychotropic drug that may pose a threat to public health, comparable to Scheduled substances. NPS generally mimic the effects of traditional drugs of abuse (e.g., opioids, benzodiazepines, cannabinoids) and are not yet nationally or internationally controlled.[4]

Precursor: A chemical primarily used for drug production.

Surveillance: The continuous or prolonged observation of real-time data to gather information relative to a decision-making process.

Scope

Developing a deeper understanding of data exchange needs and processes—and communicating those needs and processes—is critical for improving processes, standardizing data, and implementing common language for the MDI system in the United States.[5,6] When informed by the community of practice, efforts to address the opportunities and challenges related to using and exchanging data among medical examiners, coroners, death investigators, forensic toxicologists, and other collaborators can be fruitful.

This document describes an effort to help MDI system data providers and data users move toward consistency, data standardization, and best practices for improving data exchange processes. This document also identifies opportunities, challenges, and considerations for MDI data exchange; identifies needed additional research; and develops potential solutions to advance information and data exchange within the medicolegal community of practice and its collaborators. Finally, this document provides observations for further research and resources to (1) improve data sharing, (2) encourage consistency with the reporting of identified drugs in fatalities, and (3) provide a better understanding of the data sharing and workflow processes among MDI system collaborators.

Overview

Background

Medical examiners and coroners (MECs) do not currently collect consistent information during death investigations. Although the medicolegal death investigation (MDI) community has established guidelines about how to conduct MDIs, it has not fully developed consensus on policies, processes, and standards related to collecting, storing, or exchanging data. Other clinical and criminal justice settings have faced similar challenges (e.g., patient history in health care, fingerprints in law enforcement) and arrived at solutions.[7–9] This is exacerbated by the fact that in 2018, 57% of MEC offices did not have a computerized case management system (CMS).[10] More than 40% of our nation's deaths are referred to MEC offices, considering that nearly 1 million and more than 1.3 million deaths were referred to MEC offices in 2004 and 2018, respectively.[10-11] Developing standardized and automated approaches for classifying, collecting, and exchanging data among MECs, forensic toxicologists, and other collaborators will improve workflow and efficiencies within MEC offices, facilitate forensic science research, and streamline data requests. Crucially, strengthening data exchange will also inform public health and safety policies and resource needs.[3, 6]

This work on data exchange was carried out by the Medicolegal Death Investigation Data Exchange Working Group (MDI-Data-WG), which was developed by the Forensic Technology Center of Excellence (FTCoE) at RTI International, with the support of the National Institute of Justice (NIJ) and the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC). This report provides the findings and recommendations of the MDI-Data-WG from September 2020 to September 2021, when the working group convened. This working group is a collaborative, continued effort to support the MDI system's needs, as shared in the FTCoE's *Final Report: Strengthening the Medical Examiner–Coroner System Through NIJ-funded Programs: 2018 Medicolegal Death Investigation Stakeholders' Meeting*,[12] *the National Science and Technology Council's Strengthening the Medicolegal-Death-Investigation System: Improving Data Systems*,[13] *NIJ's Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices*,[6] and other recent reports.

Purpose and Impact

This document summarizes the opportunities for and challenges of increasing standardization and automation in approaches to collecting and exchanging data among MECs, investigators, forensic scientists, and other MDI collaborators identified by the MDI-Data-WG. It also identifies high-priority needs that, if fulfilled, will build a foundation toward implementing best practices and standards, promoting improved data collection and surveillance, and supporting data exchange for MDI.

The information collected in this document will impact MDI and forensic science communities in the United States by (1) defining, updating, and establishing the most frequently exchanged data elements that are necessary components of a comprehensive and modernized data exchange in MDI; (2) laying the framework for how drugs are named and how these names are communicated to others; and (3) documenting workflow processes, data exchange needs and processes, data standardization methods, and common language for the MDI systems and its stakeholders.

Goals and Objectives

The MDI-Data-WG's overarching goals and objectives were to identify the following:

- Data that are frequently exchanged across the disciplines for all MEC-investigated deaths.
- Ways that data—including drug data—are captured and shared in other forensic science disciplines.
- MDI methods to collect, store, and exchange death investigation data that could be executed in a standardized manner.
- Promising practices, challenges, and barriers that must be overcome to implement such data modernization methods.

Outputs and Outcomes

In this document, outputs and outcomes are (1) summarized by focus area and (2) structured as challenges and considerations, potential solutions, and resources. **Outcomes**—or what the MDI and stakeholder communities want and need to achieve—are identified in the potential solutions sections. **Outputs** are the quantifiable actions or items that the MDI-Data-WG has (1) documented for the MDI and other interested communities as challenges and considerations and (2) created as resources that will contribute to achieving desired outcomes for the advancement and modernization of MDI data exchange.

Focus Areas for MDI-Data-WG

The MDI-Data-WG focused on three areas that are briefly described below. The MDI-Data-WG included subject matter experts in each of the identified areas:

- *Frequently Used Data Elements*—Focused on information during every MDI investigation; standardizing fields and definition of elements allows data exchange among community member who need timely data, such as public health/surveillance and "nonfatal" data systems (e.g., prescription drug monitoring programs, Overdose Detection Mapping Application Program [ODMAP]).
- *Taxonomy of Drugs Identified in Fatalities*—Focused on the methods of capturing and disseminating information to all relevant community members about the types of drugs involved in deaths; this information includes (1) drug toxicology taxonomy and other categorizations and (2) classification needs around drug naming, drug terms, drug mappings, and drug classification. Capturing and disseminating these details facilitates information exchange of data related to drug overdose mortality.
- *Forensic Science Data Exchange*—Focused on gathering information about the integration, analysis, and reporting processes between MDI offices and others who either use or contribute to MDI data; this group also identified data commonly exchanged across multiple disciplines.

Frequently Used Data Elements

Background/Description

Most MECs are not currently using modern standards-based methods to exchange data. Implementing modern data-sharing methods across jurisdictions would help ensure that multiple parties reliably obtain needed information with fewer workflow disruptions, and future consensus on what data elements should be collected

during an MDI investigation and how terminology and descriptions can be standardized will ultimately improve MDI data exchange.

In general, there are several broad categories of data collected for a death investigation—including demographics, location, circumstances, timing, medical history, toxicology, exam/autopsy, and cause and manner of death. The amount, type, and specification of data collected during a death investigation can vary.[5] For decades, the need to increase standardization and automation in approaches to data collection and exchange among MECs, forensic toxicologists, and other groups has been discussed and documented by the MEC community and in governmental and scientific reports.[5, 6, 11, 12]

These MDI data can be exchanged with other data users—such as public health analysts, first responders, public safety officers, fatality review teams, government agencies, and forensic scientists—to assist with users' respective roles in serving the public. Variability in the level of detail, structure, coding, and terminology in MDI information complicates comparisons or aggregation of information across jurisdictions.[11, 14]

The modernization of data, including automation, interoperability, and use of consensus-based MDI data terminology and elements, remains a critical need because of the importance of data exchange. MEC systems in the United States investigate suspicious, unexpected, unexplained, or unattended deaths. Although an MEC's primary role is to determine the cause and manner of death, the information and data collected and stored for each fatality are important beyond this primary role. These investigations have broad societal importance for criminal justice and public health. Numerous data entities rely on MDI information (see *Forensic Science Data Exchange* on page 18). For example, improved MEC access to "nonfatal" data systems (e.g., prescription drug monitoring programs, ODMAP) can improve data entry, surveillance, and cause and manner of death determinations in regional overdose tracking and trend analysis to support public safety and public health decision-making.

Working Questions to Address:

1. Does the information provided historically[5, 15] include all frequently exchanged data elements?
2. Are all frequently exchanged data elements used today included in historical reports on what information to collect during a death investigation?
3. Are any important elements missing?
4. How can these elements be collected, stored, and reported?
5. What are some of the more problematic data elements captured (i.e., degree of variability in the data element)?
6. Are there specific data standards associated with any of the data elements? If yes, what are they?

To address MDI data exchange opportunities and concerns, the MDI-Data-WG continued the efforts and goals of the Organization of Scientific Area Committees for Forensic Science (OSAC) MDI Subcommittee to achieve standards-based approaches to data exchange. The OSAC MDI Subcommittee report, "Medicolegal Death Investigation Data Commonly Collected and Exchanged,"[16] outlines the needs and process of identifying and prioritizing MDI frequently used data elements.

In addition, death certificates and historical reports such as the "1995 Medical Examiner/Coroner Death Investigation Data Set"[15] provide valuable information when determining frequently exchanged data elements. In fact, the Medical Examiner/Coroner Death Investigation Data Set provides historical descriptions of MDI data elements used in practice over 25 years ago.[15] The community may better understand frequently used data elements by categorizing them and agreeing on terminology and definitions for the most commonly used data

elements, with standardization being the highest priority. The MDI-Data-WG focused on commonly exchanged data elements indicated in the OSAC reports[16, 17] as well as additional elements.

Challenges and Considerations

The MDI-Data-WG reviewed titles and descriptions from the 1995 Medical Examiner/Coroner Death Investigation Data Set[15] for use and availability in today's MEC community. Specifically, they reviewed each data element to determine how it is collected and stored and the challenges faced in doing so. Finally, they determined whether data elements were specific to death certificates or to MEC CMS.

The MDI-Data-WG discussed each data element at length using the following two questions:

- Is this element essential to document in every case or is it case-specific (e.g., sudden unexpected infant death, motor vehicle death)?
- How could the name and descriptions of a data element be improved to promote data standardization and modernization?

Many issues stem from the differences among MDI jurisdictions in terminology, collection process, and policies for using and exchanging a death investigation data element. For example, some offices currently depend on the mortuary to complete selected items like ethnicity on a death certificate and therefore do not currently capture that information in their files. An MEC office that does not report ethnicity in their jurisdiction may not currently have fields for this frequently used data element in its CMS. This MEC office would either need to begin collecting these data or obtain the data from the mortuary or the state electronic death registration system for its CMS.

Other difficult data elements to collect for MEC offices include sex and gender and time of death. For example, California specifies that "sex" as requested on the death certificate shall be listed as gender identity. Jurisdictions also define data elements differently, such as time of death. Some MEC offices use an estimated time based on postmortem changes while others list the time pronounced by emergency medical services. Yet others use time pronounced by MEC, time discovered deceased, or estimated time based on splitting the time last known alive and time discovered deceased.

Data origin may also differ because MEC offices receive reports of deaths differently. Mortuaries might fax information whereas hospitals might use phone calls, law enforcement reports via radio, and fire dispatch or internal dispatch contacts the MEC office. Resources to confirm information can also vary, such as access to criminal history or medical records. Some jurisdictions have more technology available to them, so offices without a computerized CMS may capture data on paper while offices with computerized CMS can access emergency medical service or medical records through portals and health information exchange systems that provide on-demand access to information.

As a solution, the MDI-Data-WG discussed how some data elements should be considered cultural and religious in nature and accommodations, such as completing an examination within a specified time frame or being allowed to perform rites on the remains for a certain number of hours before transport to the morgue, should be considered and observed/supported by the MEC when possible.

Potential Solutions

Throughout a death investigation, MDI professionals will see variety in collected and reported data because of jurisdictional and workflow dissimilarities, statutes, and nuances of each case. The MDI community needs a well-

developed, current, and adoptable set of data elements with standardized definitions to help address accuracy and completeness of data collected in death investigations.

The MDI-Data-WG identified the following potential areas for standardization to address the MDI community's primary needs regarding frequently used data elements.

- **9 broad categories** of data collected: demographics, location, circumstances, date and timing, medical history, narrative, toxicology, exam/autopsy, and cause and manner of death.
- **Appendix A represents all frequently used data elements that should be collected for every death investigation when available**. Frequently used data elements are linked to overarching categories of death investigation and indicate how these elements are integrated into the death investigation process. These data elements also represent examples of information that could be provided during an investigation. This information can be used for agency training to ensure all data are collected. Additionally, **Appendix A** can be used to develop checklists for death investigators, develop programming requirements for data developers to code MDI information, or assist with standardization and consistency among data exchange as part of other resources.

The working group provided **data elements descriptions** for all frequently used elements that should be collected for every case, including suggested data element titles and descriptions (see **Appendix B**). The potential solutions summarize considerations and issues surrounding a specific data element, like process changes, legal and jurisdictional distinctions, data origin, technology advancements, and family and religious considerations. Many issues stemmed from the variance between MDI jurisdictions. The following frequently used data elements were the most problematic:

- Sex and gender
- Ethnicity
- Duration of cause of death
- Qualification of time of death
- How injury occurred

Resources

The MDI-Data-WG developed two primary resources to assist in MDI data exchange: a Frequently Used Data Elements graphic (**Appendix A**) and a Medicolegal Death Investigation Frequently Used Data Elements Descriptions graphic (**Appendix B**).

Taxonomy of Drugs Identified in Fatalities

Background/Description

Drug monitoring is important both for population health and public safety, including a need to monitor drugs involved in deaths. Inconsistencies in drug taxonomy present a challenge when information across jurisdictions and between the forensic science disciplines are compared. Understanding current practices around drug terms, naming, and classification would take the burden off individual MEC offices and would allow community members to report and exchange information about drugs identified in a fatality more easily and consistently. The development of a system that would allow the forensic community and other community members to determine which drug terms are synonymous and to establish the relationship between drugs (e.g., metabolite, precursor, analog) is needed. This this drug naming system would benefit the death investigation, public health, public safety communities, and forensic science research.

Working Questions to Address:

1. How are drug data exchanged with other entities?
2. How are issues resolved with different names and naming conventions?
3. What are some challenges experienced in naming or exchanging information for current and emerging drugs?
4. What are the resources used for naming and classifying emerging and illicit drugs?
5. What are some questions received regarding emerging and illicit drugs from downstream community members?
6. When focusing on the pieces of information for illicit drugs in a database system (such as National Institutes of Health's Inxight), how can each system be a useful resource for data exchange?

Challenges and Considerations

Drug taxonomy remains a critical component for communicating and sharing information within the MDI system. Forensic data are often queried and reported based on findings listed on death certificates, toxicology reports, and other data streams. However, the naming of novel psychoactive substances (NPS) included in these data sources present many challenges, including the following:

- Several names and synonyms exist for a single drug.
- Multiple drugs may be referred to by the same name.
- Existing names may not always imply information regarding a drug's structure or behavior.
- Misuse of and inconsistencies or exceptions to existing naming systems cause problems.
- Descriptive (long) chemical names are cumbersome and not understood by MDI collaborators.

To facilitate proper data exchange and communication, the forensic community needs standardized data and a common drug language—especially one that is adaptable and can be revised in real time as emerging drug threats appear.[3, 18, 19]

Potential Solutions

The MDI-Data-WG identified the following solutions to address the MDI community's primary needs regarding drug taxonomy:

- A comprehensive resource that lists and links all names and synonyms for drugs.
- A consistent (but dynamic) method for categorizing drugs based on chemical structure or pharmacological and pharmacokinetic effects.
- A naming scheme that makes the categorization similarities clear to MDI collaborators.
- An ongoing committee or body that establishes naming conventions, takes ownership of future naming decisions, and maintains the comprehensive resource previously listed as a primary need.
- An ongoing committee to support naming conventions and future naming decisions and maintain a comprehensive resource in a publicly accessible drug portal system. This committee would have national representation and should also seek input from the international community.

Resources

The MDI-Data-WG developed and now recommends the following resources to help others address challenges with naming and develop a strategy for implementing naming conventions in practice:

- Novel Psychoactive Substance Naming Conventions and Challenges—Presented on July 22, 2021, by focus area members Dr. Donna Iula and Dr. Alex Krotulski, this FTCoE webinar addressed the complex NPS landscape, naming conventions, and challenges.
- Currently Applied Naming Conventions for Various Subclassifications of NPS—This FTCoE Technical Note outlines existing naming conventions for several popular NPS subclassifications; however, this is not an all-inclusive list. NPS classes are separated into commonly encountered subclassifications, which are defined by core structural features. The note provides examples of drugs in each subclass along with existing names to illustrate the existing naming conventions in practice and instructions for which naming conventions should be used.
- Framework for NPS Subclassification and Naming Graphic (**Appendix C**)—The framework tool can assist forensic scientists seeking to better understand how drugs are classified by structural components. It is broken down by NPS classes (e.g., opioids) and then further subdivided by subclassifications of each NPS class (e.g., fentanyl analogs). This framework provides potential names for a substance, a figure with a drug structure from the subclass (with core components highlighted), and an example substance that fits within this subclassification. Users of this framework can easily follow this layout to understand how NPS are subclassified and how those drug molecules could be named. The framework was created to be a standalone poster to use as a reference. This alleviates scientists of the need to check multiple sources and allows for quicker association with naming convention and nomenclature. Although **Appendix C** helps users understand the drug-naming process, it does not provide a means to predict and name future unknown substances by simply following this subclassification scheme and framework.

Forensic Science Data Exchange

Background/Description

Data collected during MDIs are used to monitor the nation's health, safety and much more. These data are drawn from a variety of sources, including toxicology reports, emergency medical systems, and prescription drug monitoring program information and are used to assist in the investigation and determination of cause and manner of death. Conversely, many different groups use MDI data in their systems, such as the National Violent Death Reporting System, state vital records systems, and organ procurement organizations. Moreover, MDI data are a critical component of CDC's data modernization initiative "to create modern, integrated, and real-time public health data and surveillance that can protect us from any health threat."[3]

Data integration is the practice of consolidating data from disparate sources into a unified view, with the ultimate goals of (1) providing users with consistent access and delivery of data across the spectrum of subjects and infrastructure types and (2) meeting the information needs of multiple applications and collaborators. As a first and ongoing effort to understanding the overall interplay of data entities that rely on death data, the MDI-Data-WG cataloged and discussed current workflows and data exchange among MECs and other collaborators, including organizational entities related to public health, law enforcement, and research. The MDI-Data-WG gathered information on details about the integration, analysis, and reporting process associated with MDI and public safety, public health, and other forensic science data to help answer working questions (**Challenges and Considerations**) to guide and identify potential actions for advancing data exchange.

Because this focus area is broad, this section requires a description of the process and details for classifying, collecting, and exchanging data. Developing standardized and automated approaches among MECs, forensic toxicologists, and other collaborators will support workflow within offices; facilitate forensic science research; streamline data requests; and facilitate data coding, structure, and analytics.

Challenges and Considerations

Systematic challenges that impede data exchange can adversely affect death investigations and subsequent reporting. Improving or eliminating these systematic challenges will enable (1) the generation of death certificates in a quality and timely manner, (2) organized comprehensive death investigation, and (3) complete fulfillment of all responsibilities of the medicolegal jurisdiction.

Working Questions to Address:

1. What data are being collected by a given entity?
2. What are the current data flow pathways for these data interactions?
3. What is the timeline on which the data are needed?
4. What else should be collected?
5. What are the processes that are occurring for data collection and exchange and system integration?

A key aspect to data exchange is understanding the distinction between **data entities as data providers** and **data entities as data users**. To help with this distinction, it is important to link data terms used in MDI to those used in data software and data modernization efforts.[3, 18] A data provider (i.e., data producer) collects data relevant to an organization (e.g., MEC systems are data providers/producers for information surrounding a death investigation). A data user (i.e., data consumer) employs

data to inform their program or system (e.g., the National Vital Statistics System is a "data user/consumer" within CDC that collects data related to U.S. deaths as reported through state vital records offices).[20]

To demonstrate the data relationships that MECs possess with other entities, the MDI-Data-WG developed data user and data provider categories to model their discussion of workflow processes and how MDI data are exchanged among data entities (i.e., collaborating organizations). Using this proof-of-concept model (**Appendix D**) helped the MDI-Data-WG determine which organizations to include and how community members are affected by data exchange, or lack thereof. The working group used data provider and data user roles to document the current processes of data exchange with community members, the primary "direction" of data exchange among community members, and special case information for organizations.

The MDI-Data-WG mapped out data exchange processes for various data providers and users with secondary and tertiary providers. **Appendix D** demonstrates how potential data exchange entities can be categorized and discussed based on workflow processes and data exchange in relation to MDI. There are 13 primary data entities/organizations and various levels of secondary and tertiary data entities in this model; however, it does not include all data entities discussed by the MDI-Data-WG, and it is not an exhaustive list of all MDI data users and providers.

The MDI-Data-WG identified numerous data entity types that exchange MDI data, including public health organizations, MEC offices, forensic laboratories, legal systems, first responders, policy makers, researchers, family/social services/public hospitals/clinical services, other healthcare providers (e.g., organ and tissue procurement, inpatient/outpatient care, nursing homes), and other contributors (e.g., databases, medical professional boards, military). **Appendix E** depicts the ideal state of MDI data exchange among data users and producers.

The working group compared data exchange processes to see the similarities and differences in each. They then developed representative data exchanges, including a description and examples of data types and data exchange systems, for each entity (**Appendix F**). For most community members, the type of data collected includes demographic information (e.g., age, gender) and information that is most pertinent to MDI (see **Frequently Used Data Elements**). In some instances, entities report additional case data.

The data exchange relationship between the organization and the MEC involved information primarily going from the MECs to the respective stakeholder, data primarily going to the MECs from a respective stakeholder, or with both entities providing and receiving data from one another in some form (e.g., statistics, death certificates). However, special case data are collected for many of the entities and would be useful to know as an MEC.

Although this process is representative of most community members, there are some outliers. Special cases for some organizations differ from the identified generic processes for data exchange. Unidirectional cases also existed for some stakeholder-to-MEC data sharing processes. For instance, MECs can report data by phone, mail, fax, email, or online through the Consumer Product Safety Commission's Medical Examiner Coroners Alert Project but cannot get data back directly.

The working group discussed the Overdose Detection Mapping Application Program as a system that does not follow the usual data exchange pattern. Although most MECs manually enter data, some can electronically input data through application programming interfaces (APIs). Partners at CDC, state agencies, and other public health groups can also access the data if they sign a memorandum of understanding. This is one model where multiple collaborators are invested in the data, and data exchange is more free-flowing because reporting is meant to be in real time. By using this model for data exchange, where there are APIs already in place, information can be better shared.

Potential Solutions

Data Interactions with MEC Systems

The MDI-Data-WG used the five working questions (see **Challenges and Considerations**, page 18) to guide the determination of the information collected during the data exchange process. This information helped identify problems and prioritize the providers/users to offer knowledge and practices of the data exchange process for MDI. By taking a holistic view and considering all data entity types and the MDI data exchange that occurs, data exchange gaps became more apparent and could be documented and producers/users who are most prepared to develop plans for actionable topics for advancing data integration in MDI could be identified.

Actionable Topics for Advancing Data Integration in MDI

The working group categorized potential solutions to improve data exchange for MDI by data providers and users into a list of actionable topics for advancing data integration in MDI (see **Appendix G**). These topics guide efforts into short-term (less than 2 years), near-term (2 to 5 years), and long-term (greater than 5 years) strategies that MDI data providers/users can use to develop better understanding, knowledge, and future action plans of advancement and modernization of MDI data exchange processes. Only community members with which MECs have frequent or critical interactions would be considered to offer actionable topics for advancing data integration in MDI. This list is not meant to be exhaustive, and some interactions may not be representative or may be duplicative. The working group developed additional questions to help identify the most meaningful, needed, and useful data exchange to the MEC community and the data users who seek their information.

Data Provider Questions

- What is the importance of the data received from these providers to your death investigation?
- Which providers have the most difficult data to obtain from a functional perspective?
- What is each provider's readiness or maturity to support new development to improve data sharing?

Data User Questions

- Which data users are actively seeking MDI information?
- What is the data user entity's readiness or maturity to support newly developed data-sharing efforts?
- What is the importance of providing data to these data user entities as part of your death investigations?
- Which data user entities are the most difficult to provide information to or are the most behind in technology implementation to allow 'data push' or information to be received by the data user?

In total, this report suggests 34 actions or efforts for advancing data integration in MDI. Not all data entities have action items. The working group has not provided recommendations to data entities (i.e., data providers and users) such as legal systems, policy makers, family/social/public service providers, and other contributors at this time. Although recommendations are provided by the data entity, collaboration and support at local and national levels will be key to enhancing data exchange for MEC systems so they can complete their missions and fully serve the public. The data entity associated with an action or effort is a primary contributor to inform and implement the needed action or effort but is not expected to complete the effort alone. Each data entity has actionable topics:

- MECs—15 actionable topics

- Forensic Services—3 actionable topics
- Hospital/Clinical Services—5 actionable topics
- First Responders—6 actionable topics
- Research—3 actionable topics
- Public Health—2 actionable topics

Informing Other Initiatives

CDC Data Modernization

To modernize core data and surveillance infrastructure across the federal and state public health landscape, the CDC created the Data Modernization Initiative, whose priorities are as follows:[3]

- Build the right foundation: Strengthen and unify critical infrastructure for a response-ready public health ecosystem.
- Accelerate data into action to improve decision-making and protect health.
- Develop a state-of-the-art workforce.
- Support and extend partnerships.
- Manage change and governance to support new ways of thinking and working.

The vision for MDI data modernization is to make it easier for MECs to provide current and more specific mortality information.[3] The output of the MDI-Data-WG offers the community a better understanding of high-priority needs within the MDI and forensic science community and the challenges they face in gathering the information they need to perform their service provider roles.

Forensic Science Technical Standards

In 2009, the National Academy of Sciences recommended the need to "adhere to robust performance standards" as one significant way to improve and strengthen forensic science practice and further ensure quality, reliability, efficiency, rigor, and consistency among practitioners.[5] A professional standard is instrumental to evidence-based practice because it "sets objectively verifiable requirements, provides for common and repeated uses, rules or characteristics for activities or their results, and is aimed at the achievement of the optimum degree of order in a given context" and is designed to "reflect the level of agreement, expressed by interested parties, on what is required for a given activity, process, product or result."[21] Today, there are various entities that contribute to the development of forensic science standards: OSAC (National Institute of Standards and Technology), standards development organizations, technical working groups (various federal agencies), and scientific working groups.

The MDI-Data-WG developed standard terminology, common data elements, drug categorization and naming methods, and actionable topics that can be incorporated into forensic standards to improve consensus, consistency, and standardization in data collection and exchange for MDI systems. The MDI-Data-WG could collaborate with the forensic science standards organizations listed previously to further advance forensic science and ensure communication among MECs, death investigators, forensic scientists, and other community members.

Furthermore, the OSAC MDI Subcommittee's research needs—which discuss or require better data collection, storage, and exchange—support the need for MDI data modernization. At least 8 of 12 2021 OSAC MDI research needs[16, 17] require improved and consistent information for MDI and better data exchange and research funding. OSAC research needs could benefit from improved data, which can then support the following:

- Assessing the utility of autopsy in contentious medicolegal categories of death.
- Quantifying contextual decedent identification criteria.
- Analyzing medicolegal death investigator workload.
- Modeling mass fatality incident missing person and victim data.
- Partnering with hospitals in delayed drug-related deaths.
- Conducting pediatric forensic pathology to improve the accuracy of cause.
- Certifying manner of death.
- Using radiologic imaging technology.
- Understanding the genetic risks of sudden death.
- Engaging MDI stakeholders.

Research needs specific to data modernization and data accuracy and standardization could also directly benefit the MDI system.

Data Standards for Interoperability

The MDI-Data-WG informed early iterations of the Health Level 7® Fast Healthcare Interoperability Resources® (HL7 FHIR) Data Standards that are being developed as another CDC initiative to improve how information are exchanged electronically as a way toward advancing interoperability. This effort will allow data to be represented in a standard way regardless of how it is collected and stored at the local source. The benefits of HL7 FHIR are to (1) provide faster, real-time access to quality data; (2) reduce burden for reporting quality measures by aligning CMS reporting with an industry data exchange framework; (3) enable automated data retrieval from various data producers and exchange of data through use of standards-based APIs; and (4) promote interoperability to inform decision-making processes.[8]

Policy and Practice

Data interoperability encourages greater connection and collaboration among researchers, practitioners, technology developers, and other forensic scientists, which can result in important new findings within the field. In a time of reduced monetary investment in science and research, data interoperability offers efficiency. Further outreach and dissemination about data exchange modernization among policymakers and MDI system community members is yet another effort with which the MDI-Data-WG could assist.

Conclusion

In its short 1 year of effort, the MDI-Data-WG has greatly advanced improvements in MDI data exchange, contributed foundational knowledge, and documented opportunities and challenges for increasing standardization and automation in collecting and exchanging data. The MDI-Data-WG developed numerous resources that directly address priority needs, which will help MECs, investigators, forensic toxicologists, data exchange developers, and other community members collaborate, allowing them to harness the wealth of information that death investigation can provide for the good of society.

In addition, the MDI-Data-WG has already offered resourceful information to other data exchange and modernization initiatives that are underway. The FTCoE will continue to disseminate the MDI-Data-WG's products and findings to the MDI community as part of its efforts to support the implementation of evidence-based best practices and new forensic technologies—specifically, data and information management that promotes sharing among the MDI community and ancillary professionals.

This report will assist four initiatives (see **Informing Other Initiatives**) that have and will benefit from the MDI-Data-WG's efforts:

1. CDC Data Modernization Initiative
2. Forensic Science Technical Standards
3. Data Standards for Interoperability
4. Policy and Practice for Forensic Science and MDI

The MDI-Data-WG has impacted the MDI and forensic science communities within the United States by working toward its goals to (1) update, define, and establish commonly exchanged data elements that are necessary components of a comprehensive and modernized MDI data exchange of data; (2) develop a framework for how drugs are named and communicated and ultimately how the information effects forensic sciences' data exchange and stakeholder processes; and (3) document MDI stakeholder workflow processes and systems data exchange needs to seek improved data authorization methods, standardize data, and establish a common language for the MDI system.

Future activities and continued observations will inform research, policy, and practice by providing additional resources to improve data modernization and advance the understanding of MDI system workflows.

Appendix A. Medicolegal Death Investigation Frequently Used Data Elements

This appendix provides a graphic on frequently used data elements in medicolegal death investigation (adapted from Parish and Hanzlick[15]).

This graphic shows the final list of data elements that should be collected for every case. This graphic also links these frequently used elements to overarching categories of death investigation and indicates how these elements are integrated into the death investigation process. Italicized items are examples of information that could be provided during an investigation, and standard information is represented in normal text. This graphic can be downloaded and used in agency training to ensure all data are collected. Additionally, the graphic can be used to develop checklists for death investigators, develop programming requirements for data developers to code MDI information, or assist with standardization and consistency among data exchange as part of other resources.

Medicolegal Death Investigation Data Elements

Demographic

- Decedent's marital status
- Usual occupation
- Decedent
  - Full name
    - If unidentified, putative name—if available
  - Birth date
    - Age
    - Age unit that clarifies decedent's age
  - Race
    - Ethnicity
  - Gender
  - Sex
- Social security number
- Next of kin
  - Name
  - Relationship
  - Contact information
    - Email
    - Phone number(s)
    - Address

Circumstances

- Person who last knew decedent to be alive or okay
- Safety issues/ mechanisms identified at scene
  - *Chemical exposure*
  - *Electrocution*
  - *Smoke/carbon monoxide detector*
- Person who found decedent (if decedent was found dead or unconscious)
- Number of other persons known to be dead from same incident
- Death scene investigation findings
- How decedent was last known to be alive or okay
- Social history
  - *Tobacco*
  - *Drug use*
  - *Prison record*
- Case-specific information
  - *Seatbelt*
  - *Type of weapon*
  - *Unsafe sleep environment*
- Address where found dead, unconscious, or in distress
- Events leading to death occurred at work
  - *Occupational Safety and Health Administration investigation*
- Drugs at scene
  - *Medication*
  - *Paraphernalia*
  - *Loose powder*
- Informants/ witnesses
  - Names
  - Emails
  - Addresses
  - Phone numbers
- Potential referrals
  - *Child abuse*
  - *Elder abuse*
  - *Overdose*
  - *Domestic violence*
  - *Organ/tissue donation*
- Death associated with legal intervention/ in custody

Narrative

- Evidence at the scene
- Description of circumstances
- Jurisdiction accepted
- Relevant investigating agencies
- Explanation of how injury occurred
- Date found dead, unconscious, or in distress (if found)
- Follow up (any information added as case proceeds)
- Digital evidence
  - *Social media*
  - *Smartwatch*
  - *Cell phone*
  - *Computer*
- Death scene investigation findings
- Medications
  - *Name of person prescribed to*
  - *Details*
- Referral for autopsy/ examination

Exam/ Autopsy

- Ancillary procedures
  - *Forensic anthropology*
  - *Genetics studies*
  - *Medical imaging*
  - *Histology/laboratory studies*
- Organ weights
- Specific autopsy findings—autopsy report
- Limited autopsy
  - Religious accommodations
  - Cultural accommodations

Cause & Manner

- Cause of death statement: Lines 1–4
- Other significant conditions
- Explanation of how injury occurred
- Manner of death
- Duration of condition(s) on all lines that list a cause of death

Toxicology

- Specimen for which result is reported
- Specific toxicology test performed
- Results
  - Concentrations
- Samples retained
  - Hospital samples
    - Details
  - Organ procurement organization/tissue recovery date and time samples
    - Details

Location

- Name of hospital where decedent was first taken
- Type of place where events leading to death occurred
- Categorization of place of death (e.g., dead on scene)
- Where decedent was last known to be alive or okay
- Type of residence (e.g., nursing home, halfway house)
- Address at which scene investigation was conducted
- Place where found dead, unconscious, or in distress
- Last address of decedent
  - *Unhoused*
- Name of place where death was pronounced
- Type of place where injury occurred
- Address where death was pronounced
- Address of injury or onset of natural fatal events

Date & Time

- Death reported to the medical examiner/ coroner
- Year by which case is categorized
- Qualification/ clarification of injury, as known
- Qualification of death
  - Estimated
  - Found
- Death pronounced
- Found dead, unconscious, or in distress
- Last known alive or alert
- Injury or onset of natural events leading to death
- Decedent arrived at hospital
- Qualification/ clarification of injury
- Examinations
- Case reviews
  - Type of reviews
  - Reviewers

Medical History

- Type of agonal treatment or therapy
- Details of medical history
  - *Antemortem testing*
- Healthcare providers
- Family medical history
  - *History of suicide*
  - *Sudden and premature deaths*
  - *Seizures*
- Recent trauma
  - *Falls*
  - *Hip fracture*
  - *Subdural hematoma*
- Pregnancy history
- Procedures preformed
  - *Date*
  - *Location*
  - *Type*
  - *Implanted medical device*
- Prescriptions
  - *Inventory*
  - *Correlate with prescription monitoring database*

Note: Items represented as small, closed, and colored circles are data elements that should be recorded in every case. Items represented in italics after black dots are examples of data and are not an exhaustive list.

From Ropero-Miller, Jeri, Nichole Bynum, Kelly Keyes, Erica Fornaro, and Micaela Ascolese. *Data Exchange Practices of Medicolegal Death Investigation.* U.S. Department of Justice, National Institute of Justice, Office of Investigative Sciences, December 2022.

Appendix B. Medicolegal Death Investigation Frequently Used Data Elements Descriptions

This appendix provides descriptions on medicolegal death investigation (adapted from Parish and Hanzlick[15]).

This table includes a final description about frequently used data elements that should be collected for every case. This table includes suggested data element titles and descriptions. The potential solutions summarize considerations and issues surrounding a specific data element. For example, this focus area discussed and considered process changes, legal and jurisdictional distinctions, data origin, technology advancements, family, and religious considerations. Many issues stemmed from the variance between MDI jurisdictions. For example, some offices currently depend on the mortuary to complete selected items on a death certificate, like ethnicity, and therefore do not currently capture that information in their files. Their case management system may not currently have fields for those elements. These offices would either need to begin collecting the data themselves or obtain the data from the mortuary or via an electronic death registration system and would also need to update their case management system to capture the data.

MDI Common Elements

Demographic

New Data Element	2021 Description	Comments*
Legal first name of decedent	For non-human remains, use this field to indicate "non-human remains," "animal bones," "unidentified tissue" and enter an "X" in the **LASTNAME** and **MIDNAME** fields. If unidentified human remains are to be given a John Doe or Jane Doe name, use the **FIRSTNAME** field to enter John Doe, Jane Doe or UnknownDoe. This will allow differentiation from persons whose real last name may be Doe, as the name "Doe" will appear in the **LASTNAME** field.	Add "legal" first name. **Definition** - unidentified human remains.
Legal middle name of decedent	Enter the middle name or initial if known. This item may be left blank, but should contain an "X" if the remains are non-human.	Add legal
Legal last name of decedent	Enter the last name for an identified human decedent. Otherwise, an "X" should be entered in this field. If remains are non-human, use the **FIRSTNAME** field to indicate "non human remains" or similar descriptors such as "Jane Doe" (*See **FIRSTNAME***). Space, hyphen, and apostrophes may be used for names such as Mc Donald, Smith-Jones, or O'Henry. Another field (*see next row*) should be added for legal suffix, such as Jr. or III.	Add legal; define how names like McDonald or O'Shannon are captured (*Mc Donald, Mc_Donald, McDonald Mcdonald, etc.*) Space, hyphen, apostrophe should be able to be used. Add a specific field for suffix.
Legal suffix	Enter the legal suffix associated with the name, such as Jr. or III. This is not intended for designations like MD or Sr. which are rarely a legal part of the name.	Add legal; clarify how things like Jr. and III are captured.
Age of decedent	Enter the numerical value (*whole number*) for the age of the decedent in minutes (*if less than an hour of age*), hours (*if less than 24 hours of age*), days (if less than 28 days of age), months (*if less than 1 year of age*), or years (*if 1 year of age or older*). If the age is unknown, enter Unk. If the decedent is a fetus or stillborn infant, enter "0" (*zero*). The **AGEUNIT** field (*see below)* is used to specify which of these conditions applies.	1. Change to 12 months. 2. Remove non-human. 3. If age unknown, it is unknown. 4. **Fetus/stillborn** = "0" (zero)
Age unit that clarifies decedent's age	This field is used to indicate the unit that applies to the number expressing the decedent's age. The following are the options: **Minutes (MI)** = less than 1 hour **Hours (HR)** = (*up to and including 23 hours and 59 minutes*) **Days (DA)** = (*up to and including 27 days*) **Months (MO)** = (*28 days up to and including 11 months*) **Years (YR)** = (*12 months or older*) **SB** = stillbirth/fetus **AU** = Adult, unknown **CU** = Child, unknown **IU** = Infant, unknown	Stillbirth/fetus combined.
Birth date of decedent	Enter the date of birth in **MM/DD/YYYY** format. If Unknown, enter "Unk." If this is not possible, leave **BIRTHDATE** blank if the date of birth is not known or the item is not applicable.	If database does not allow "Unk," or "X", create a separate field? **Preferred Format:** MM/DD/YYYY
Gender of the decedent	Enter the decedent's gender identity at death.	1. Case management system (CMS) may have more information: a. Sex assigned at birth. b. Gender identity at death. 2. DCs usually list male or female 3. **Unknown** - possibly used in unidentified skeletal remains. 4. **T:** Non-binary/other

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Demographic

New Data Element	2021 Description	Comments*
Sex of decedent	Enter the decedent's sex at birth.	1. Case management system (CMS) may have more information: a. Sex assigned at birth. b. Gender identity at death. 2. DCs usually list male or female 3. **Unknown** - possibly used in unidentified skeletal remains. 4. **T:** Non-binary/other
Race of decedent	This item must be completed in all cases. You should select all that apply and options should match the U.S. Census option or map into U.S. Standard DC. Options of other or unknown as well. a. **White** – A person having origins in any of the original peoples of Europe, the Middle East, or North Africa. b. **Black or African American** – A person having origins in any of the Black racial groups of Africa. c. **American Indian or Alaska Native** – A person having origins in any of the original peoples of North and South America (*including Central America*) and who maintains tribal affiliation or community attachment. d. **Asian** – A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. e. **Native Hawaiian or Other Pacific Islander** – A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands. "	1. Ability to check all that apply. 2. Match Census option or map into U.S. Standard DC. a. **White** – A person having origins in any of the original peoples of Europe, the Middle East, or North Africa. b. **Black or African American** – A person having origins in any of the Black racial groups of Africa. c. **American Indian or Alaska Native** – A person having origins in any of the original peoples of North and South America (*including Central America*) and who maintains tribal affiliation or community attachment. d. **Asian** – A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. e. **Native Hawaiian or Other Pacific Islander** – A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands. 3. Option of other or unknown. 4. Remove "X." **U**: unknown. **O**: other.
Ethnicity of decedent	This field may be used to augment the entry made in the **RACE** field. Example entries are Cuban, Ethiopian, Filipino, Navajo Nation, Irish. Multiple options may be selected, and Unk can be used.	1. Important data element, when able to be obtained. 2. Unknown can still be used. 3. Multiple can be listed. 4. Often collected by funeral home.
Social security number	Enter the **social security number**, or enter "Unk" if the social security number is not known. It may be used to link the case to other documents.	Add if MEC and/or EDRS system allows.

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Demographic

New Data Element	2021 Description	Comments*
Decedent's marital status at time of death	Enter the decedent's marital status at the time of death.	
Next of kin	Name, contact details (*to include email, phone numbers, and address*) and relationship for next of kin.	
Usual occupation of decedent	This should contain the decedent's occupation or job title, whether or not they are currently employed. "Carpenter," "Administrator," "Physician," and "Clerk" are just a few examples of job titles. May be left blank if unknown.	More of a funeral home data point. (*Case specific*) MEC does not usually put on a DC.
If unidentified, putative name if available	List the suspected name(s) of a decedent who has not yet been identified.	

Location

New Data Element	2021 Description	Comments*
Name and address where found dead, unconscious, or in distress	This item should contain the name and address of where the person was found dead, or if transported, unconscious or in distress.	
Type of place where injury occurred	If an injury or poisoning caused death, enter the type of place where the injury occurred, such as "decedent's home," "wooded area," "restaurant."	
Certified street address of injury	If an injury or poisoning resulted in death, enter the address and street name of the place where the injury leading to death occurred, or significant descriptors to locate the place. It may be necessary to include a partial address or other clarifiers such as "400 block, Sweet Road," "In front of 123 Main St," "Intersection of East Rd and North St," or "West of Bird Creek."	
Certified city of injury	If an injury resulted in death, enter the name of the city in which the injury occurred. If outside an incorporated area, use the name of the city that would be used by the post office.	
Certified county of injury	If an injury resulted in death, enter the county in which the injury occurred. If outside the United States, use standard identifiers from that country.	
Certified country of injury	If an injury resulted in death, enter the country in which the injury occurred.	
Certified state of injury	If an injury resulted in death, enter the official post office abbreviation for the state in which the injury occurred. If outside the United States, use standard identifiers from that country.	
Certified zip code where injury occurred	If an injury resulted in death, enter the zip code that applies to the area where the injury occurred. If outside the United States, use standard identifiers from that country.	
Name of or specifics of decedent's residence	If the decedent's actual place of residence has a name, such as Arbor Apartments, The Snake Hotel, Tender Loving Care Home, enter the name here. If a specific name does not exist, enter the type of place such as "private home," "shelter," "underpass," "abandoned car"; will allow for people without housing to be captured. If not applicable, enter "X," or "Unk" if unknown.	
Type of residence (*e.g., nursing home, halfway house*)	If the decedent is living at other than a private residence, specify the type of residence, such as nursing home, halfway house, room and board home, or sober living facility.	
Address at which scene investigation was conducted	If a scene visit/investigation was conducted by an investigator or representative of the MEC, enter the address where the visit was conducted. **This is case-specific and should be included as applicable.** "Same as home" and "same as event site" are acceptable, if applicable.	This may be left blank if not applicable.

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Location

New Data Element	2021 Description	Comments*
Last address of decedent (*street number and name*)	Enter the street name, number, and apartment or unit number, if applicable, of their last known address. Also include applicable qualifying words such as "Person without housing vacant building at 325 King St." If the address of residence is unknown, enter "Unk," updating the entry at a later time, if possible. This item should indicate the actual place of residence at the time of death, not necessarily the decedent's legal place of residence. Should allow for variance for international residents.	
Residence of decedent, city	If the decedent lived in an incorporated area, enter the name of the city or town. If the residence is in an unincorporated area, enter the city or town that appears in the decedent's residential mailing address for the actual place of residence. If unknown, enter "Unk." Should allow for variance for international residents.	Address descriptors need to allow variance for international residents.
Residence of decedent, county	Enter the name of the county in which the decedent's actual place of residence was located at the time of death. Enter "Unk" if unknown. This item must be completed. Should allow for variance for international residents.	
Residence of decedent, country	Enter the name of the country in which the decedent's actual place of residence was located at the time of death. Enter "Unk" if unknown.	
Residence of decedent, state	Enter the postal code abbreviation for the state of actual residence for the decedent at the time of death. Enter "Unk" if unknown. Should allow for variance for international residents.	
Residence of decedent, zip	Enter the zip code for the decedent's actual place of residence at the time of death. Enter "Unk" if unknown. Zip code may be needed for geocoding. Should allow for variance for international residents.	
Categorization of place of death (*e.g., dead on scene*)	This item should contain an entry to indicate if death (*actual death, not where death pronounced*) occurred at one of the following: **S** = The scene **D** = Enroute to a hospital or the person was dead on arrival **E** = Emergency room **O** = Operating room (in surgery) **I** = Inpatient area There needs to be an option to select "Found" to clarify this location in the instance of re-located remains. Local vital statistics requirements or death certificate needs may require that this item apply to where death was pronounced, rather than where death actually occurred. However, indicating the actual place of death is preferred because the location of pronouncement is captured in other fields."	
Name of place where death was pronounced	Enter the name of the hospital or place where official pronouncement of death occurred. May list decedent's residence of type of place, such as wooded area if it is an unnamed place.	
Address where death was pronounced (*street name and number*)	Enter the street number and name for the place where official pronouncement of death occurred. Should be able to have a clarifier if found.	
City where death was pronounced	Enter the name of the city in which official pronouncement of death occurred. If outside city limits, use the city or town that is used for the mailing address.	
County where death was pronounced	Enter the name of the county in which official pronouncement of death occurred.	
State where death was pronounced	Enter the name of the state (*using official post office state abbreviations*) in which official pronouncement of death occurred.	
Zip code where death was pronounced	Enter the zip code for the address where official pronouncement of death occurred.	
Type of place where events leading to death occurred	This item should contain a brief description of the type of place where the events leading to the death occurred or, for bodies found dead or for non-human remains, the type of place where the body or remains was found. A few examples include "vacant building," "wooded lot adjacent to airport," "shelter for the unhoused," "abandoned car in strip mine."	

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Location

New Data Element	2021 Description	Comments*
Where decedent was last known to be alive or okay	If the decedent was found dead, unconscious, or in distress, enter the place where the decedent was last known to be alive. Include the address (*fields should be specified for street, city, state, and zip*) and type of place (*e.g., "restaurant Denny's"*), if possible. Words such as "at home" are acceptable. If unknown, enter "Unk."	Can break out into address fields
Name of hospital where decedent was first taken	If the decedent was taken to the hospital prior to being pronounced dead, indicate the name of the first hospital to which the decedent was taken.	

Circumstances

New Data Element	2021 Description	Comments*
Cause-specific information (seatbelt, unsafe sleep environment, type of weapon)	List specific details relevant to the case, such as information about seatbelt, unsafe sleep environment, or type of weapon (as relevant to the specifics of the case).	This is case-specific and should be included as applicable.
Safety issues/ mechanisms identified at scene	Some examples include chemical exposure, electrocutions, smoke/carbon monoxide detector.	This is case-specific and should be included as applicable.
Social history, such as drug use, prison record, tobacco usage	List details of the decedent's social history, such as drug use, prison records, and tobacco usage.	This is case-specific and should be included as applicable.
Does an injury constitute OSHA injury at work?	If death resulted from an injury and the circumstances meet the NIOSH criteria for being an injury at work, enter yes; otherwise, enter no or "unknown."	Add unknown
Death scene investigation findings	This is narrative and should be included in the **MEC report**.	
Who last knew decedent to be alive	Add the name(s), relationship(s) to the decedent, and contact details for all persons able to provide information on how the decedent was last known to be alive.	Add contact info in **MEC report database**. (*multiple persons, contact info, etc.*). If not applicable may be left blank
Number of other persons known to be dead from same incident	This item should indicate the number of people who are known to have died from the same incident as the decedent. This number indicates the number in addition to the decedent. It reflects information at the time the death is first reported to the medical examiner/coroner. This is for MDI offices to be able to link companion cases. For cases related to a disaster, the death certificate should also include specifics to link the cases in how injury occurred (*e.g., Hurricane Maria, Clarksville Tornado*).	1. For use in CMS in MDI offices to link companion cases. 2. Regarding DC, list event in how injury occurred (*e.g., Hurricane Maria, Clarksville Tornado*).
Who found the decedent dead, unconscious, or in distress	Add the name(s), relationship(s) to the decedent, and contact details for all persons who found the decedent dead, unconscious, or in distress.	Add contact info in **MEC report database** (*multiple persons, contact info, etc.*).
Deaths associated with legal intervention/in custody	List any information about the involvement of legal intervention/in custody.	**Broaden field**: "Deaths associated with legal intervention/in custody."

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Circumstances

New Data Element	2021 Description	Comments*
Informants/witnesses	Name, contact details (emails, addresses, and phone numbers) and relationship for all witnesses/ informants.	
Did the events leading to death occur while decedent was working?	Indicate if the events leading to death occurred while the decedent was at work or on the job, even if the cause of death appears to have been due to natural causes.	
How decedent was last known to be alive	This is narrative and should be included in the **MEC report**.	
Potential referrals	This is related to referral to different agencies, death review teams, or internal groups related to specific policies on specific types of cases. Some examples include child deaths, elder abuse, overdose, domestic violence, or organ/tissue donation.	
Drugs found at scene	This item should contain any information related to findings at scene indicative of medication or substance use or abuse such as medications, paraphernalia, or loose powder. May be in case narrative.	

Date & Time

New Data Element	2021 Description	Comments*
Case reviews	For all case reviews, indicate the type of review, date and time of review, and who the reviewer was.	
Date death was pronounced	Enter the date on which death was officially pronounced.	
Time death was pronounced	Enter the military time at which death was officially pronounced.	
Qualification of date of death	If the certified date of death is approximate or estimated, enter "Est." If the certified date of death indicated when the body was found, enter "Fnd."	
Certified date of death	Enter the date on which death is actually thought to have occurred. This represents the date that the certifier of death wishes to state on the death certificate. If the date needs to be qualified as "estimated" or "found," use one of those for clarification.	A date must be entered for every case that is certified by the MEC.
Certified time of death	Enter the military time at which death is thought to have occurred. This represents what the certifier wishes to state on the death certificate. "Unk" is acceptable. If the time is an approximation, use "Est." If the time represents when the body was found, enter the time with "Fnd."	
Certified time of injury	If an injury resulted in death, enter the military time at which the injury occurred. This item represents what the certifier of death wishes to place on the death certificate. If the time is approximate, "Est" should be included. If the time of injury is unknown, enter "Unk."	
Year by which case is categorized	This is a field related to the year in which the office will categorize the case for statistical purposes.	
Date death reported to the MEC	This item should contain the date on which the death was first reported to the MEC office.	
Date found dead, unconscious, or in distress (*if found*)	This can be part of the narrative, but is best as a Case Management System field, and should contain the date when a person was found dead, unconscious, or in distress. If witnessed death, a date should not be entered.	

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Date & Time

New Data Element	2021 Description	Comments*
Time found dead, unconscious, or in distress	This item should contain the military time when the decedent was found dead, unconscious, or in distress.	
Dates of all examinations, inspections and/or case reviews, and by whom	Enter the dates on which any inspections, autopsy, limited autopsy, external examinations, or reviews of case were conducted and by whom.	
Date of injury/onset of events leading to death	If an injury (*including poisoning*) is thought or known to have caused death, enter the date or partial date/date range of the injury. If no injury or poisoning is known or suspected, enter the date of onset of the fatal events. For example, if a person has chest pain and dies, enter the date of onset of the chest pain.	Could be a partial date (*e.g., 01/25-26/2025*)
Time of injury or onset of natural events leading to death	If an injury (*or poisoning*) is known or suspected as having caused death, enter the military time corresponding to the time when the injury occurred. If no injury or poisoning is suspected, enter the time of onset of the events that lead to death. An approximate time may be indicated by including "Est." Enter "Unk" if unknown.	
Qualification/ clarification of injury date	To indicate that the certified date of injury is unknown, enter "Unk." If the certified date of injury is approximate, enter "Est." If the certified date of injury indicates the date a person was found, enter "Fnd."	
Date last known alive or alert	If the decedent was found dead, unconscious, or in distress, enter the date on which the decedent was last known to be alive.	
Time last known alive or alert	If the decedent was found dead, unconscious, or in distress, enter the military time when the decedent was last known to be alive.	If not applicable, this item may be left blank.
Date on which decedent arrived at hospital	If the decedent was taken to the hospital dead or alive, indicate the date at which the decedent arrived at the first hospital (*if transferred*).	
Time at which decedent arrived at hospital	If the decedent was taken to the hospital dead or alive, indicate in military time the time at which the decedent arrived at the first hospital (*if transferred*).	

Narrative

New Data Element	2021 Description	Comments*
Narrative description of circumstances and follow-up notes	Case notes should include a narrative description of the circumstances leading to and surrounding death, that is, a description of what is thought or known to have occurred prior to death. This includes, as applicable to each investigation, details about medications, any physical and digital evidence at the scene, an explanation of how any injury occurred and any additional details supporting information on when and how the decedent was found, death scene investigation findings, referral for autopsy/ examiner details, relevant investigative agencies and information about accepting jurisdiction. This item may also be used to enter narrative notes as the case investigation proceeds. Each entry should include the date of the entry and the name or initials of the person who made the entry (or who prepared the original addendum for entry, such as the investigator). Any additional information from the case not otherwise captured in a specified field should be included here.	

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Medical History

New Data Element	2021 Description	Comments*
Pregnancy history	**For females of child-bearing age:** Pregnant at time of death, or within 0-42 days, 43 days to 1 year, unknown and not pregnant within 1 year. Only use unknown if unable to determaine.	
Details of medical history	If the medical history was investigated, indicate the diseases or abnormalities known to afflict the decedent. Include information on all antemortem testing. Additional comments or explanations may be entered in case notes.	
Name of decedent's personal physicians or health providers	Enter the name of the decedent's personal physician or health care provider, including a phone number. Indicate if "Unk," "no known provider," or "not obtained."	With contact info This is a tracking field and should not be left blank if included in the database.
Type of agonal treatment or therapy	List what treatments were done, such as resuscitation (*if CPR was performed*), blood transfusions were given, IV fluids were administered, or if a surgery was performed. Narrative comments regarding medical procedures may be entered in the case	
Recent trauma	List any recent trauma, such as falls, fractures, or subdural hematomas. Include date of injury (*may be expanded upon in the case notes*).	
Family medical history	List any potentially relevant medical history of biological relatives.	
Procedures performed	If surgery was performed within 30 days of death for any reason, or at any time for the condition that possibly resulted in death, enter name(s) of the surgery here. Include dates (*partial dates are ok*), locations, and types of surgeries. This should also include details on implanted medical devices.	
Prescriptions	Include information on prescriptions, including inventory. Correlate with prescription monitoring databases.	

Exam/Autopsy

New Data Element	2021 Description	Comments*
Specific autopsy findings - autopsy report	Narrative in the autopsy report.	
Organ weights	Enter all organ weights as recorded at autopsy.	
Ancillary procedures performed	Additional testing ordered by the MEC. Some examples include histology, laboratory studies, medical imaging, genetic studies, forensic anthropology. Narrative comments regarding such procedures may be entered in the case notes or case management system.	
Limited autopsy	This item should indicate if a complete autopsy was done, or what level (*partial or external*) was completed. This would also be where to document any religious or cultural accommodations that dictated the type of autopsy performed.	

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Toxicology

New Data Element	2021 Description	Comments*
Toxicology results	Enter all toxicology results including all specimen types, and quantitative results with concentrations, if performed.	
What specific tox tests performed	Enter information about what toxicology tests were performed, even if negative.	
Samples retained for toxicology	List all specimens retained that could be used for toxicology. This includes details about hospital samples and details about samples retained by organ procurement/tissue organizations, including recovery dates and times.	

Cause & Manner

New Data Element	2021 Description	Comments*
Top line of cause of death statement	Enter the top line that appears in the cause of death statement. This must be completed if the office will officially determine the cause of death.	
Second line of cause of death statement	Enter the condition that appears on the second line of the cause of death statement.	
Third line of cause of death statement	Enter the condition listed on the third line of the cause of death statement.	
Fourth line of cause of death statement	Enter the condition listed on the fourth line of the cause of death statement.	
Other significant conditions	Enter the conditions listed in the "other significant conditions" area of the cause of death statement.	
Manner of death	Homicide, suicide, accidental, natural, and undetermined or could not be determined or unclassified. At least one jurisdiction currently allows Therapeutic Complication "T" as a manner.	Few jurisdictions (e.g., NYC) have/ may have Therapeutic Complication as a manner of death. Not consistent on a national basis.
Duration of condition on top line of cause of death	Enter the duration that applies to the condition listed on the top line of the cause of death statement. "Minutes," "hours," "20 days," and "unknown" are just a few examples.	Unknown to be used if/when it is truly unknown. **This is a death certificate item for classification.**
Duration of condition on second line of cause of death	Enter the duration of the condition listed on the second line of the cause of death statement.	Unknown to be used if/when it is truly unknown. **This is a death certificate item for classification.**
Duration of condition on third line of cause of death	Enter the duration of the condition listed on the third line of the cause of death statement.	Unknown to be used if/when it is truly unknown. **This is a death certificate item for classification.**
Duration of condition on fourth line of cause of death	Enter the duration of the condition listed on the fourth line of the cause of death statement.	Unknown to be used if/when it is truly unknown. **This is a death certificate item for classification.**

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Cause & Manner

New Data Element	2021 Description	Comments*
Certified explanation of how injury occurred	Use this field to enter a narrative description of the circumstances leading to and surrounding death, that is, a description of what is thought or known to have occurred prior to death. Must be completed on all unnatural deaths. Examples: 1. Fall from standing height while using walker. 2. Seatbelted operator of minivan struck by tractor trailer. 3. Fall from ladder from second story at construction site. 4. Hanged from rafter with belt in college dorm room. Examples related to drug-related deaths: 1. Injected heroin and ingested diverted alprazolam. 2. Used meth (*route unknown*). 3. Ingested excessive prescribed oxycodone.	For cases related to a disaster, the death certificate should also include specifics to link the cases in how injury occurred (e.g., *Hurricane Maria, Clarksville Tornado*).

* Comments by the subcommittee are thoughts on the data element, often as relevant to the initial data element list.

Appendix C. Drug Taxonomy: Framework for Subclassification and Naming of Novel Psychoactive Substances

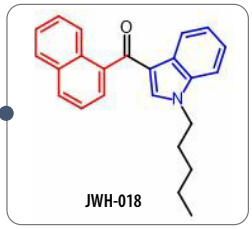
This framework tool can assist forensic scientists seeking to better understand how drugs are classified by structural components. It is broken down by NPS classes (e.g., opioids) and then further subdivided by subclassifications of each NPS class (e.g., fentanyl analogs). This framework provides potential names for a substance, a figure with a drug structure from the subclass (with core components highlighted), and an example substance that fits within this subclassification. Users of this framework can easily follow this layout to understand how NPS are subclassified and how those drug molecules could be named. The framework was created to be a standalone poster to use as a reference. This alleviates scientists of the need to check multiple sources and allows for quicker association with naming convention and nomenclature. **Although this framework tool helps users understand the drug-naming process, it does not provide a means to predict and name future unknown substances by simply following this subclassification scheme and framework.**

Drug Taxonomy: Framework for Subclassification and Naming of Novel Psychoactive Substances (NPS)

Synthetic Cannabinoids

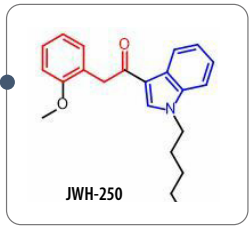
Naphthoylindoles
Naphthoylindazoles
Napthoylcarbazoles
Naphthylmethylindoles
Naphthylmethylindazoles
Naphthylmethylcarbazoles

Contain head naphthyl moiety (red) accompanied by either core indole, indazole, carbazole, or methyl moiety (blue)



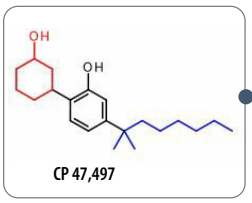
Phenylacetylindoles
Phenylacetylindazoles

Contain head/linker phenylacetyl moiety (red) accompanied by either core indole or indazole moiety (blue)



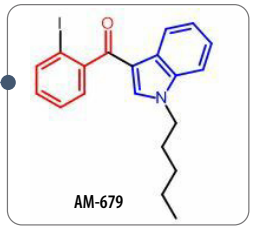
Cyclohexylphenols

Contain core cyclohexylphenol moiety (red) accompanied by a lipophilic tail moiety (blue)



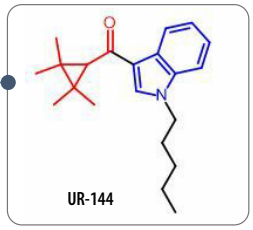
Benzoylindoles
Benzoylindazoles

Contain head/linker benzoyl moiety (red) accompanied by either core indole or indazole moiety (blue)



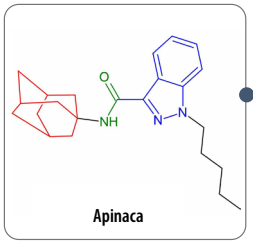
Tetramethylcyclopropanoylindoles
Tetramethylcyclopropanoylindazoles

Contain head/linker tetramethylcyclopropanoyl moiety (red) accompanied by either core indole or indazole moiety (blue)



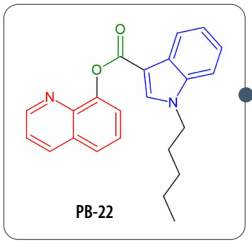
Adamantylindoles
Adamantylindazoles
Adamantylindole carboxamides
Adamantylindazole carboxamides

Contain head adamantyl moiety (red) accompanied by either core indole or indazole moiety (blue) with amide or ester linker (green)



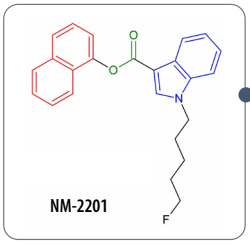
Quinolinylindolecarboxylates
Quinolinylindazolecarboxylates
Quinolinylindolecarboxamides
Quinolinylindazolecarboxamides

Contain head quinolinyl or isoquinolinyl moiety (red) accompanied by core indole or indazole moiety (blue) with amide or ester linker (green)



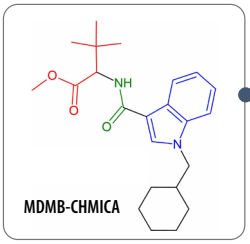
Naphthylindolecarboxylates
Naphthylindazolecarboxylates
Naphthylindole carboxamides
Naphthylindazole carboxamides

Contain head naphthyl moiety (red) accompanied by either core indole or indazole (blue) with amide or ester linker (green)



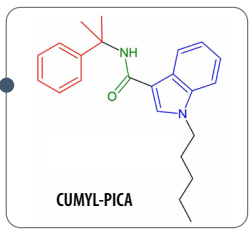
Alkylcarbonyl indole carboxamides
Alkylcarbonyl indazole carboxamides
Alkylcarbonyl indole carboxylates
Alkylcarbonyl indazole carboxylates

Contain head alkylcarbonyl moiety (red) accompanied by either core indole or indazole (blue) with amide or ester linker (green)



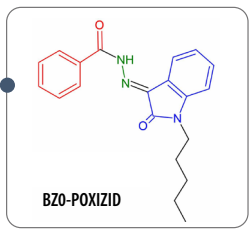
Cumylindolecarboxamides
Cumylindazolecarboxamides

Contain head N-(2-phenylpropan-2-yl) moiety (red) accompanied by either core indole, indazole, or other (blue) with amide or ester linker (green)



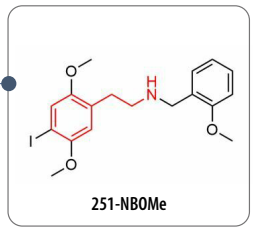
Oxidole Hydrazides

Contain head alkylcarbonyl moiety (red) accompanied by a core 2-oxindole (blue) and hydrazide linker (green)



Substituted Phenethylamines

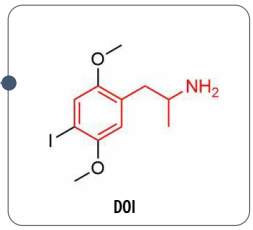
Contain the phenethylamine core structure (in red) but with no substitutions on the alpha or beta cargon; the amine may or may not have an alkyl group or groups



251-NBOMe

Simple Substituted Amphetamines

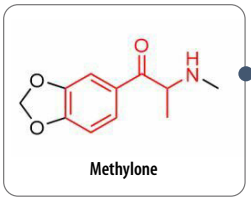
Contain the phenethylamine core structure and an alkyl substitution on the alpha, but no beta carbonyl (in red); the amine may or may not have an alkyl group or groups



DOI

Substituted Cathinones

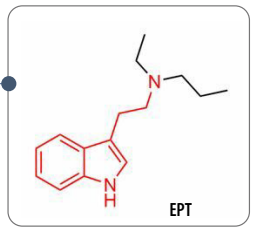
Contain the phenethylamine core structure, at least one-carbon- chain off the alpha carbon, and a beta carbonyl (in red); the amine may or may not have an alkyl group or groups



Methylone

Substituted Tryptamines

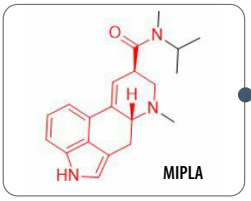
Contain tryptamine core structure (red); the amine may or may not have an alkyl group or groups



EPT

Lysergamides

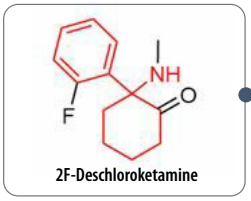
Contain core structure similar to LSD



MIPLA

Substituted Arylcyclohexylamines

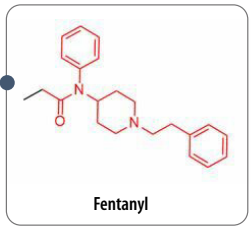
Contain arylcyclohexylamine core structure; there may or may not be a ketone in the 2-position on the cyclohexane ring



2F-Deschloroketamine

Fentanyl Derivatives

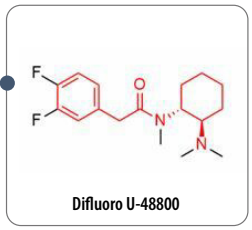
Contain core structure similar to fentanyl



Fentanyl

U-series Derivatives

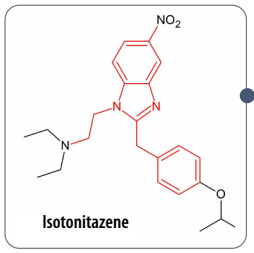
Contain cyclohexylamino group and benzyl or phenyl group connected by an amide



Difluoro U-48800

Benzimidazoles (Nitazenes)

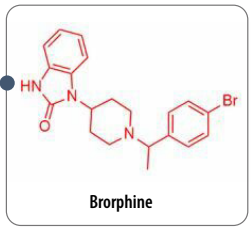
Contain benzimidazole core (with or without nitro group), substituted benzyl group, and substituted ethylamino group



Isotonitazene

Benzimidazolones

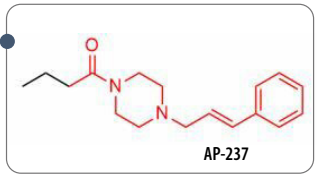
Contain benzimidazolone, piperidine, and benzyl group



Brorphine

Cinnamylpiperazines (APs)

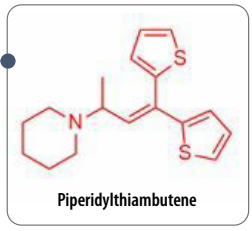
Contain cinnamylpiperazine and alkylcarbonyl



AP-237

Thiambutenes

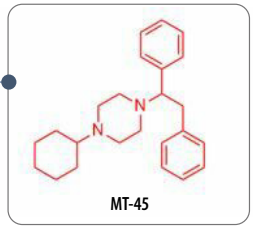
Substituted (RS)-4,4-dithiophen-2-yl-but-3-en-2-amine



Piperidylthiambutene

Benzimidazolones

1-substituted-4-(1,2-diphenylethyl)piperazine derivatives



MT-45

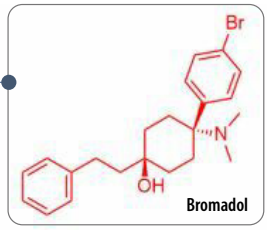
Viminols

Based on the core of viminol – 1-[1-[(2-Chlorophenyl)methyl]pyrrol-2-yl]-2-[di(butan-2-yl)amino]ethanol

2F-Viminol

Bromadol

Arylcyclohexylamine containing benzyl group and phenethyl group

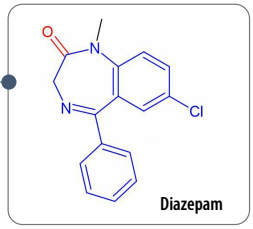


Bromadol

Benzodiazepines

2-Keto

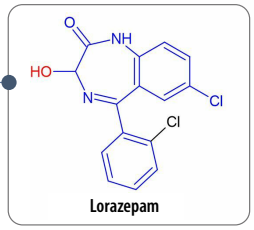
Contain a carbonyl (red) in position 2 of the benzodiazepine ring (blue)



Diazepam

3-Hydroxy

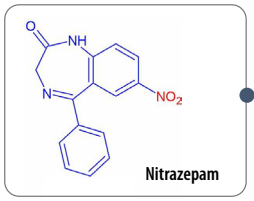
Contain a hydroxy group (red) in the third position of the benzodiazepine ring (blue)



Lorazepam

7-Nitro / 8-Nitro

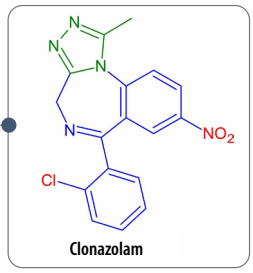
Contain a nitro group (red) in the 7 or 8 position of the benzodiazepine ring (blue)



Nitrazepam

Triazolo

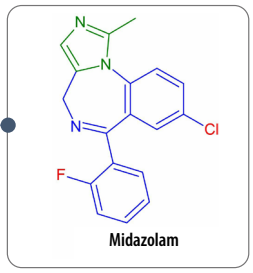
Tricyclic benzodiazepines that contain and additional fused triazole ring (green)



Clonazolam

Imidazo

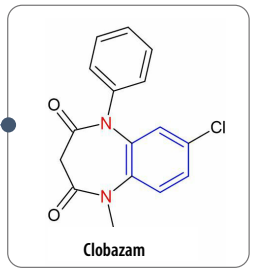
Contain a five-member ring with 2 nitrogens (imidazole group) (green)



Midazolam

1,5-Benzodiazepines

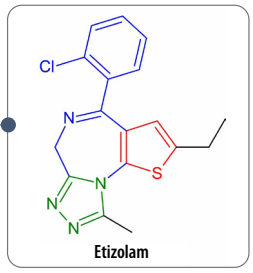
Bicyclic compounds with nitrogen atoms at 1 and 5 positions (red) in a seven-membered ring fused to a benzene (green), rather than the 1,4 positions



Clobazam

Thienodiazepine

Contains a diazepine ring (blue) fused to a thiophene ring (red) and a triazole group (green)



Etizolam

Appendix D: Examples Data Producers and Data Users Model for Data Exchange in Medicolegal Death Investigations

This table maps out data exchange processes for various data providers and users with secondary and tertiary providers to demonstrate how potential data exchange entities can be categorized and discussed based on workflow processes and data exchange in relation to MDI. There are 13 primary data entities/organizations and various levels of secondary and tertiary data entities (i.e., agencies within federal agencies) in this model; however, it does not include all data entities discussed by the MDI-Data-WG, and it is not an exhaustive list of all MDI data users and providers.

U.S. Data Exchange Entity		
Federal		
Primary	**Secondary**	**Tertiary**
Bureau of Justice Statistics		
Centers for Disease Control and Prevention		
	National Center for Chronic Disease Prevention and Health Promotion	
	National Center for Emerging and Zoonotic Infectious Diseases	
	National Center for Health Statistics	
		National Vital Statistics System
	National Center for Injury Prevention and Control	
		State Unintentional Drug Overdose Reporting System
		National Violent Death Reporting System
	National Institute for Occupational Safety and Health	
Consumer Product Safety Commission Consumer Protection		
	Medical Examiner Coroner Alert Project	
Office of National Drug Control Policy		
	High-Intensity Drug Trafficking Areas	
		Overdose Detection and Mapping Application Program
U.S. Food and Drug Administration		
National Institutes of Health		
U.S. Health and Human Services		
	Substance Abuse and Mental Health Services Administration	
Health Resources & Services Administration		
Maternal and Child Health Bureau		
State and Local		
State and Local Health Department		
State Occupational Safety and Health Administration		
MEC—Final Death Certificates		
Death Review Panels		

Note that this is not an exhaustive list.

Ropero-Miller, Jeri, and Nichole Bynum, Kelly Keyes, Erica Fornaro, and Micaela Ascolese. *Data Exchange Practices of Medicolegal Death Investigation*. U.S. Department of Justice, National Institute of Justice, Office of Investigative and Forensic Sciences, December 2022.

Appendix E: Ideal State Required for Successful Medicolegal Death Investigation Data Exchange Across Data Exchange Entities

This graphic shows the ideal state of medicolegal death investigation data exchange among data entities (i.e., data users and data producers). Data users and data producers are all data entities located in the outermost ring. Each data entity segment indicates specifically named data types or data exchanged systems within it. Arrows in the background indicate the primary (larger arrow), secondary (smaller arrow) or equivalent (equal arrow size) direction of data workflow either coming from the medicolegal death investigation system (i.e., medical examiner and coroner offices within the United States) or being provided to the medicolegal death investigation system indicated by the innermost ring. A middle ring indicates the "System of data programmers and technology developers" that play a professional role by assisting with modernization and digitization of data for the medicolegal death investigation system.

This graphic provides explanations, definitions, and acronyms in a footnote to assist readers' understanding. For example, MDI data exchange may not occur for all agencies or in some locations, or it may be incomplete. Thus, this graphic portrays an ideal state to document all potential data exchange pathways that can occur during and after an MDI to further educate MDI collaborators for public health and safety. This graphic does not provide the current state of data exchange for the medicolegal death investigation system within the United States.

IDEAL STATE REQUIRED FOR SUCCESSFUL MEDICOLEGAL DEATH INVESTIGATION DATA EXCHANGE ACROSS DATA EXCHANGE ENTITIES

*Terms: Automated Biometric Identification System (ABIS); Bureau of Justice Assistance (BJA); Bureau of Justice Statistics (BJS); Bureau of Prisons (BOP); Centers for Disease Control and Prevention (CDC); Combined DNA Index System (CODIS); Consumer Product Safety Commission (CPSC); Customs and Border Protection (CBP); Department of Defense (DOD); Department of Health and Human Services (HHS); Department of Homeland Security (DHS); Department of Interior (DOI), Department of Labor (DOL); Department of Transportation (DOT); Domestic Policy Council (DPC); Drug Enforcement Administration (DEA); Driving Under the Influence of Drugs (DUID); Electronic Death Registration System (EDRS); Emergency Department (ED); Electronic Health Record (EHR); Emergency Medical Services (EMS); Enhanced State Opioid Overdose Surveillance (ESOOS); Federal Bureau of Investigation (FBI); Food and Drug Administration (FDA); Federal Emergency Management Agency/Disaster Mortuary Operational Response Team (FEMA/DMORT); High Intensity Drug Trafficking Area (HIDTA) program; Integrated Automated Fingerprint Identification System/Next Generation Identification (IAFIS/NGI); Morbidity and Mortality Weekly Report (MMWR); National Missing and Unidentified Persons System (NamUs); National Association of State Alcohol and Drug Abuse Directors (NASADAD); National Death Index (NDI); National Forensic Laboratory Information System (NFLIS); National Highway and Traffic Safety Administration (NHTSA); National Institute of Justice (NIJ); National Institute of Standards and Technology (NIST); National Transportation Safety Board (NTSB); National Violent Death Reporting System (NVDRS); National Vital Statistics System (NVSS); Occupational Safety and Health Administration (OSHA); Office of Drug Policy (ODP); Office of Justice Programs (OJP); Office of Management and Budget (OMB); Office of National Drug Control Policy (ONDCP); Office of Science and Technology Policy (OSTP); Overdose Detection Mapping Application Program (ODMAP); Prescription Drug Monitoring (PDMP); Social Security Administration (SSA); State Board of Pharmacy (SBOP); State Unintentional Drug Overdose Report System (SUDORS); Strategic Prevention Framework for Prescription Drugs (SPX RX); Sudden Death in the Young (SDY); Sudden Unexpected Infant Death (SUID); United States Postal Services (USPS); Vaccine Adverse Event Reporting System (VAERS).

A "data producer" is an interface, system, or device that provides data that are relevant to an organization (i.e., Medical Examiner and Coroner Systems are "data producers" for information surrounding a death investigation). A "data user" is a interface, system, or tool within an organization that consumes data (i.e., The National Vital Statistics System is a "data user" within the Centers for Disease Control and Prevention that collect data surrounding U.S. deaths as reported through death certificates). While all MDI data exchange relationships are represented, data exchange may not occur for all agencies, or in some locations, or may be incomplete in others. Arrowhead sizes indicate the amount of data being received by each data entity. Larger arrowhead sizes indicate a larger amount of data flow, while smaller arrowhead sizes indicate a smaller amount of data flow.

Note: This graphic portrays an ideal state required to document all potential data exchange pathways that can occur during and after a medicolegal death investigation (MDI) to further educate MDI collaborators for public health and public safety, policymakers, and legal proceedings. From Ropero-Miller, Jeri, Nichole Bynum, Kelly Keyes, Erica Fornaro, and Micaela Ascolese. *Data Exchange Practices of Medicolegal Death Investigation.* U.S. Department of Justice, National Institute of Justice, Office of Investigative Sciences, December 2022.

Appendix F. Medicolegal Data Entities Descriptions and Examples of Data Types and Data Exchange Systems

This table describes the 11 data entities involved in data exchange workflow processes for medicolegal death investigations, including a description and examples of data types and data exchange systems.

Stakeholder	Description	Examples of Data Types or Data Exchange Systems
Public Health	Public health deals with the prevention and solution to health issues faced by individuals and their communities. Much of the information from medicolegal death investigations are reported to various public health agencies for statistics and general knowledge to inform surveillance, epidemiology, prevention, and safety. The primary flow of data exchange is from the MDI System to Public Health.	• Centers for Disease Control and Prevention (CDC): Electronic Death Registration System (EDRS), Enhanced State Opioid Overdose Surveillance (ESOOS), Morbidity and Mortality Weekly Report (MMWR), National Death Index (NDI), National Violent Death Reporting System (NVDRS), State Unintentional Drug Overdose Reporting System (SUDORS), National Vital Statistics System (NVSS) • Food and Drug Administration (FDA): Adverse Event Reporting System (FAERS) • Health and Human Services (HHS): Prescription Drug Monitoring Program (PDMP), Substance Abuse and Mental Health Services Administration's (SAMHSA) Strategic Prevention Framework for Prescription Drugs Program (SPF Rx) • State Health and Public Safety Departments
Medical Examiner/Coroner (MEC)	Medical examiners and coroners, to include their internal operations and external contracting and consulting services, collect information related to a death investigation. Death certificates and other information can be physically saved in documented reports or electronically saved in databases or reports. MEC stakeholders represent the data exchange from one MDI office to another MDI office or to their external services such as autopsy facilities located external to the MEC office. The flow of data exchange is equal between the MDI System and the MEC.	• Autopsy and Investigation Reports • Death Certificates • Death Scene Investigations • Internal Laboratory Reports (Forensic, Clinical)
Forensic Science Service Providers	Medicolegal death investigation often relies on evidence and information collected from public forensic science service providers and other forensic service providers. For instance, toxicology, odontology, and anthropology findings are often utilized by the MEC to determine the cause of death. The primary flow of data exchange is from forensic science service providers to the MDI System.	• Anthropology • Digital Evidence • Driving Under the Influence of Drugs (DUID) • Odontology • Toxicology
Legal Systems	Legal systems often get data from the MEC regarding the death investigation to inform the courts. Defense and the District Attorney/County Prosecutor may need information by a certain date, leading them to subpoena the information. The primary flow of data exchange is from the MDI System to Legal Systems.	• Attorneys • Court Records • Inquiry Panels
First Responders	Being the first to arrive at a death investigation, first responders have access to information that can be passed along to the MEC to assist in the investigation and next of kin identification. For instance, ambulance staff can relay medical treatment that was provided at the scene, in transport, or upon arriving at the hospital to the MEC. The primary flow of data exchange is from the First Responders to the MDI System.	• Ambulance/ Emergency Medical Services • Crime Intelligence Centers • Federal Emergency Management Agency (FEMA)/Disaster Mortuary Operational Response Team (DMORT) • Fire and Rescue • Law Enforcement
Policy Makers	Policy can affect the resources and funding provided to a medicolegal death investigation. Adversely, the trends found during medicolegal death investigations can affect policy. For instance, if a new drug is identified through multiple death investigations, new policy could be put in place to limit the distribution of the new drug or assist in substance abuse prevention and treatment. The primary flow of data exchange is from the MDI System to Policy Makers.	• Department of Transportation (DOT) • Federal Bureau of Prisons (BOP) • National Association of State Alcohol and Drug Abuse Directors (NASADAD) • Legislatures • Office of Justice Programs • Office of National Drug Control Policy (ONDCP)

Stakeholder	Description	Examples of Data Types or Data Exchange Systems
Research	Encompassing all types of research, this stakeholder influences new research data for public health, prevention, public safety, and investigative practice. MECs also contribute their own research to the field. The primary flow of data exchange is from the MDI System to Research.	• Academic Research • Non-profit Research • Private Research
Other Contributors	These stakeholders are those not falling under other categories. These entities can assist in providing and collecting death scene investigation data. The flow of data exchange is equal between the MDI System and Other Contributors.	• Databases: Combined DNA Index System (CODIS), High Intensity Drug Trafficking Area (HIDTA) program, National Forensic Laboratory Information System (NFLIS) • Medical Professional Boards • Military
Family/Social Network/ Public	MECs often provide information to next of kin, while the latter could provide data back to the MEC relating to the death investigation. Family, victim advocates, and the public can also provide reference samples as a verifiable/documented source which, when compared with evidence to help MDI system identify unknown human remains. The media also often requests death investigation information, which could be shared with the public. The flow of data exchange is equal.	• Media • Next of Kin • Reference Samples • Victim Advocate
Hospitals/Clinical Services	Hospitals/Clinical Services encompass various medical facets providing and receiving data. MECs rely heavily on medical records and electronic health records (EHRs). The primary flow of data exchange is from Hospitals/Clinical Services to the MDI System.	• State Board of Pharmacy (SBOP) • Prescription Drug Monitoring Programs (PDMP) • Electronic Health Records (EHR) and Medical Records
Other Health Care	Referring to other care not included under Hospital/Clinical services, inpatient/outpatient care and other long-term care treatments can be identified in this section. The primary flow of data exchange is from Other Health Care to the MDI System.	• Inpatient/Outpatient Care (Dialysis, Drug Treatment, Mental Health, Physical Rehabilitation) • Nursing Homes • Organ and Tissue Procurement • Subacute and Long-Term Care

Appendix G: Actionable Topics for Advancing Data Exchange

This table suggests 34 actions or efforts for advancing data exchange in medicolegal death investigation with short-term (less than 2 years), mid-term (2 to 5 years), and long-term (greater than 5 years) guidance. Not all data entities discussed in this report have actionable topics (i.e., legal systems, policy makers, family/social/public service providers, and other contributors) at this time. Although recommendations are provided by the data entity, collaboration and support at local and national levels will be key to enhancing data exchange for MEC systems so they can complete their missions and fully serve the public. The data entity associated with an action or effort is a primary contributor to inform and implement the needed action or effort but is not expected to complete the effort alone.

Data Entity	Short-Term Guidance (Less Than 2 Years)	Mid-Term Guidance (2-5 Years)	Long-Term Guidance (Greater Than 5 Years)
Medical Examiner and Coroner (MEC) Case Management System Implementations/ Enhancements	**MEC-1:** Request budget to implement full digitization of records to include (1) computer and CMS resources; (2) training and technical assistance to implement; and (3) reliable, uninterrupted internet services. *Phase 1*—50% of MEC offices develop an Adoption Plan (Stages: awareness, interest, evaluation, trial, adoption, post-adoption refinement) to implement electronic reporting system. **MEC-2:** Develop a standard of data elements to be collected by a CMS. **MEC-3:** Collaborate and participate in relevant forensic and investigative national databases (e.g., NamUs, IAFIS/NGI, CODIS, NVDRS, SUDORS, NFLIS).	**MEC-4** *(Phase 2)*: Remaining MECs request budget to implement full digitization of records by developing an Adoption Plan to implement electronic reporting system. **MEC-5:** Develop an interface for family members to provide records and photographs to the MEC, if applicable (potential for allowing family members to receive certified records and be informed of applicable research). **MEC-6:** Develop an interface for funeral directors and organ procurement organizations to provide records and photographs, schedule pickups to the MEC, and receive records, if applicable.	**MEC-11:** Establish access to molecular diagnostics laboratories and genetic counseling services (cases of undetermined deaths and sudden infant and cardiac deaths, epilepsy, clotting disorders, other molecular or genetic-based conditions). **MEC-12:** Submit case information electronically in all human identification systems (e.g., NamUs, Multi-Biometric Identification System, NCMEC).
MEC Data Integration		**MEC-7:** Integrate laboratory information management systems (requisitioning, test selection, and reporting) with CMS (Toxicology, Seized Drugs/Drug Paraphernalia, Latent prints, Firearms, DNA, Molecular Diagnostics) electronically. **MEC-8:** Investigate administrative barriers for MECs contributing provisional data to real-time surveillance systems (e.g., ODMAP, HIDTA); work to eliminate the administrative barriers discovered and incentivize MECs to participate.	
MEC Data System Standards		**MEC-9:** Create data transfer and collection standards, including APIs, to implement those standards for data exchange with collaborators (e.g., LIMS, EDRS, HIE, LEA records, NVDRS, ODMAP).	
MEC Operations		**MEC-10:** Make a foundational shift to modernize data architecture through a stepwise process: Data discovery; Data architecture assessment; Design the overall architecture; Operationalize intelligence and reporting; and Build DataOps System with continuous improvement and innovation.	**MEC-13:** Collaborate and seek electronic access to consultant services and reports (e.g., anthropology, odontology). **MEC-14:** Contribute electronically to the HIE system. **MEC-15:** Integrate CMS with law enforcement evidence management systems including any accessioning (i.e., pre-log) function.
Forensic Services (Forensic)	**Forensic-1:** Integrate electronically into MEC CMS all requisition/ test requests or reports for forensic services (e.g., scene investigative information, laboratory analysis, consultations, postmortem examinations). **Forensic -2:** Participate and contribute to the appropriate state and federal surveillance systems and databases (e.g., NFLIS, ODMAP, FARS, NamUs), using electronic integration. Include data generated by private laboratories from outsourced cases. **Forensic-3:** Confirm and quantify postmortem toxicology drugs to at least the minimum national standards and conduct identification of seized drugs from the death scene.		

Note: Guidance to other data entities (i.e., data users and data producers) such as legal systems, policy makers, family/social/public, and other contributors is not provided at this time. While guidance is provided by data entity, collaboration and support at a local and national level will be key to enhancing data exchange for medical legal death systems to allow them to complete their mission and fully serve the public.

Data Entity	Short-Term Guidance (Less Than 2 Years)	Mid-Term Guidance (2-5 Years)	Long-Term Guidance (Greater Than 5 Years)
First Responder (FirstResponse)	**FirstResponse-1:** Authorize MECs to access pre-hospital care records/reports in real time from EMS for the purpose of receiving the information prior to MDI. Examine mechanisms such as enhancing the NEMSIS and HIEs as potential solutions. **FirstResponse-2:** Authorize MECs to obtain appropriate investigative information (e.g., scene investigative reports, medical reports) from LEA, first responders, civil support teams, and other appropriate public safety and public health agencies, and have access to those investigators to discuss scene observations. **FirstResponse-3:** Encourage HIDTA and other LEA criminal intelligence centers to consider ways to integrate with public health and MEC systems.	**FirstResponse-4:** Implement data sharing opportunities for MECs and First Responders (e.g., LEA, EMS, Fire and Rescue, Mass Disaster Teams). **FirstResponse-5:** Continue the implementation of automated entry of MEC data into ODMAP through API or other electronic data interface.	**FirstResponse-6:** Grant MECs timely access to federal LEA records and reports for investigations in the state or local jurisdiction.
Research Private, Non-Profit, Academic, Public, Foundation (Research)	**Research-1:** Adopt the OSAC MDI Subcommittee's Principles to Promote Research that are specific to data in Medicolegal Death Investigation to include: • Allow for the utilization of anonymized biospecimens and contextual information, including imagery, that are retained during an MDI to determine cause and manner of death. • Establish IRB oversight of research projects in compliance with Federal Regulations. • Ensure that an appropriate IRB is available to MDI offices to review, approve, and oversee research.	**Research-2:** Develop sample memoranda of understanding and other model templates to facilitate information sharing among and between MEC systems and research entities. **Research-3:** Build a national clearinghouse to enable MECs to be informed of current or proposed MDI and related medical research to allow researchers to identify cases pertinent to their areas of research (e.g., NIJ's Connecting Researchers with Forensic Laboratories; FTCoE's Grantee Needs, and the National Library of Medicine's ClinicalTrials.gov).	
Public Health (PubHealth) **Electronic Death Registration System** (EDRS)	**PubHealth-1** Implement a secure, web-based, statewide EDRS to register death certificates by all data producers—funeral homes, medical certifiers, and MECs.		
Public Health (PubHealth) Prescription Drug Monitoring Programs	**PubHealth-2** Authorize MEC access to PDMPs for the purposes of investigation into the decedent's prescription and medical history.		

Note: Guidance to other data entities (i.e., data users and data producers) such as legal systems, policy makers, family/social/public, and other contributors is not provided at this time. While guidance is provided by data entity, collaboration and support at a local and national level will be key to enhancing data exchange for medical legal death systems to allow them to complete their mission and fully serve the public.

Data Entity	Short-Term Guidance (Less Than 2 Years)	Mid-Term Guidance (2-5 Years)	Long-Term Guidance (Greater Than 5 Years)
Hospitals/Clinical Services (Clinical) Medical Records	**Clinical-1:** Authorize role-based MECs to access medical records for investigative purposes to include electronic records within HIE systems. **Clinical-2:** Provide resources, especially to rural areas, to digitize and allow electronic accessibility to local historic medical records (e.g., medical, dental).	**Clinical-3:** Establish laws, policy, practices, and responsibilities that integrate MECs into the HIE system as data producers and consumers.	**Clinical-4:** Examine existing resources to develop a system to database electronic records (e.g., X-rays, dental) and make accessible to MECs for individual identification in missing/unidentified persons or mass disaster/fatality situations. Entities such as hospitals, other medical facilities, medical imaging facilities, dental offices should be incentivized to participate in such a system. **Clinical-5:** Encourage commercial and hospital pharmacies to participate in the HIE for patient prescription information.

Note: Guidance to other data entities (i.e., data users and data producers) such as legal systems, policy makers, family/social/public, and other contributors is not provided at this time. While guidance is provided by data entity, collaboration and support at a local and national level will be key to enhancing data exchange for medical legal death systems to allow them to complete their mission and fully serve the public.

Terms: API = application programming interface; CMS = case management system; CODIS = Combined DNA Index System; EDRS = electronic death registration system; EMS= Emergency Medical Services; FARS = Fatality Analysis Reporting System; FTCoE = Forensic Technology Center of Excellence; HIDTA = High Intensity Drug Trafficking Area; HIE = Health Information Exchange; IAFIS = Integrated Automated Fingerprint Identification System; IRB = Institutional Review Board; LEA = law enforcement agency; LIMS = laboratory management information system; MDI = medicolegal death investigation; MEC = Medical Examiner and Coroner; NamUs = National Missing and Unidentified Persons System; NCMEC = National Center for Missing & Exploited Children; NEMSIS = National Emergency Medical Services Information System; NFLIS = National Forensic Laboratory Information System; NGI = Next-Generation Identification; NIJ = National Institute of Justice; NVDRS = National Violent Death Reporting System; ODMAP = Overdose Detection Mapping Applications Program; OSAC = Organization of Scientific Area Committees; PDMP = Prescription Drug Monitoring Program; SUDORS = State Unintentional Drug Overdose Reporting System.

Appendix H. References

1. Miller, Benjamin Frank, and Claire B. Keane. *Miller-Keane Encyclopedia & Dictionary Of Medicine, Nursing & Allied Health.* 7th ed. Philadelphia, PA: Saunders, 2003.
2. Organization of Scientific Area Committees (OSAC). *OSAC 2022-N-0026 Medicolegal Death Investigation: Terms and Definitions Medicolegal Death Investigation*. Gaithersburg, MD: National Institute of Standards and Technology, Organization of Scientific Area Committees, 2022. https://www.nist.gov/system/files/documents/2022/08/30/OSAC%202022-N-0026%20MDI%20Terms%20Definitions.REGISTRY%20VERSION.pdf
3. Centers for Disease Control and Prevention. "Data modernization initiative." Last modified December 7. Accessed March 14, 2022. https://www.cdc.gov/surveillance/data-modernization.
4. King, Les A., and Andrew Kicman. "A Brief History of New Psychoactive Substances." *Drug Testing and Analysis* 3 (2011): 401-03.
5. National Research Council of the National Academies, and Committee on Identifying the Needs of the Forensic Sciences Community. "Medical Examiner and Coroner Systems: Current and Future Needs." In *Strengthening Forensic Science in the United States: A Path Forward*. Washington, DC: The National Academies Press, 2009.
6. U.S. Department of Justice, Office of Justice Reports, and National Institute of Justice. *Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices.* Washington, DC: U.S. Department of Justice, Office of Justice Programs, 2019. https://www.ojp.gov/pdffiles1/nij/253626.pdf.
7. HealthIT.gov. "Standards and Technology: Health IT Standards." https://www.healthit.gov/topic/standards-technology/health-it-standards.
8. Benefits of FHIR. "Fast Healthcare Interoperability Resources® (FHIR®)" https://ecqi.healthit.gov/fhir.
9. Moses, K.R., P. Higgins, M. McCabe, S. Prabhakar, S. and Swann. "Automated Fingerprint Identification System (AFIS)." In *The Fingerprint Sourcebook*. Washington, DC: U.S. Department of Justice, Office of Justice Programs, n.d.
10. Brooks, C. *Report: Medical Examiners' And Coroners' Offices, 2018.* Washington, D.C.: U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics, 2021. https://bjs.ojp.gov/content/pub/pdf/meco18.pdf.
11. Hickman, M. J., K.A. Hughes, Kevin J. Strom, Jeri D. Ropero-Miller, RTI International, and Bureau of Justice Statistics. "Special Report: Medical Examiners' and Coroners' Offices, 2004." https://bjs.ojp.gov/content/pub/pdf/meco04.pdf.
12. Forensic Technology Center of Excellence and National Institute of Justice. "Strengthening The Medical Examiner–Coroner System Through NIJ-Funded Programs: 2018 Medicolegal Death Investigation Stakeholders' Meeting." Accessed August 9, 2022. National Institute of Justice, https://forensiccoe.org/medical-examiner-coroner-medicolegal-death-investigation-stakeholders-meeting-mdi/.
13. Executive Office of the President, and National Science and Technology Council. *Strengthening the Medicolegal-Death-Investigation System: Improving Data Systems.* Washington, D.C.: Office of Science and Technology Policy, National Science and Technology Council, 2016. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/strengthening_the_medicolegal_death_investigation_system_final.pdf.
14. Forensic Technology Center of Excellence. "Working Group On Data Exchange In Medicolegal Death Investigation." Accessed May 20, 2022. National Institute of Justice, https://forensiccoe.org/working-group-data-exchange-mdi/.
15. Parish, G., and R. H. Hanzlick. *Medical Examiner/Coroner Death Investigation Data Set, Medical Examiner/Coroner Information Sharing Program.* 1995. https://stacks.cdc.gov/view/cdc/117876.

16. Organization of Scientific Area Committees (OSAC). *Medicolegal Death Investigation Data Commonly Collected and Exchanged.* Gaithersburg, MD. 2020. https://www.nist.gov/system/files/documents/2021/07/14/MDI%20data%20commonly%20collected%20and%20exchanged_REFERENCE_07092021_0.pdf.
17. National Institute of Standards and Technology (NIST). "OSAC Research and Development Needs." Last modified August 16. Accessed March 14, 2022.
18. Morrow, J. B., Jeri D. Ropero-Miller, M. L. Catlin, A. D. Winokur, A. B Cadwallader, A. B., J. L. Staymates, S. R. Williams, *et al.* "The Opioid Epidemic: Moving Toward An Integrated, Holistic Analytical Response." *J Anal Toxicol* 43, no. 1 (Jan 1 2019): 1-9. https://doi.org/10.1093/jat/bky049.
19. Mohr, A. L. A., B. K. Logan, M. F. Fogarty, A. J. Krotulski, D. M. Papsun, S. L. Kacinko, M. A. Huestis, and J. D. Ropero-Miller. "Reports of Adverse Events Associated With Use Of Novel Psychoactive Substances, 2017-2020: A Review." *J Anal Toxicol* 46, no. 6 (Jul 14 2022): e116-e85. https://doi.org/10.1093/jat/bkac023.
20. John, Spacey. "Data Producer vs Data Consumer." Simplicable, November 07, 2016. https://simplicable.com/new/data-producer-vs-data-consumer.
21. International Organization for Standardization (ISO). "Standards." Accessed August 8, 2022. International Organization for Standardization, https://www.iso.org/standards.html.

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