

Hospital-Treated Overdose and Acute Substance Misuse In MNDOSA

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“Hospital-Treated Overdose and Acute Substance Use in MNDOSA”

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MNDOSA program

The Minnesota Department of Health (MDH) developed the **Mi**nnesota **D**rug **O**verdose and **S**ubstance Use Surveillance **A**ctivity (**MNDOSA**) to understand substance misuse and drug overdose patterns in close to real-time. MNDOSA illuminates the types of substances being used in Minnesota, helps identify clusters of substance misuse/overdose, and can inform clinicians, community partners and the public about substance use trends to guide prevention efforts. Six participating sites in Northeast MN and the Minneapolis-St. Paul metropolitan area currently report patients treated in the emergency departments as a result of substance misuse. Demographic information and data on what substance(s) the patient may have taken, based on patient report and clinician observation of symptoms, is collected by MNDOSA. When sites see patients with severe or unusual symptoms of substance misuse (e.g., the patient was hospitalized, was part of an overdose cluster, or had symptoms not typically caused by the substance used) or where a death is attributable to substance misuse, MNDOSA collects further narrative information and data on linkage to care after discharge, if available. Participating sites can also send clinical samples for toxicology testing to the MDH Public Health Laboratory to identify the substances involved. MNDOSA uses a high-resolution testing method that can identify over 1,000 substances. Findings from MNDOSA contextualize statewide trends on fatal and nonfatal drug overdose and offer insight into circumstances of substance misuse/drug overdose, as well as the substances involved.

Why this report is needed

Traditional surveillance of nonfatal drug overdose identifies cases of nonfatal overdose in hospital discharge data. Toxicology testing to determine the substances involved in a hospital-treated nonfatal overdose is not typically required for clinical care, and not included in traditional surveillance. However, accurate information on which substances are involved in nonfatal overdoses is crucial for developing effective prevention strategies on a population level. The MNDOSA program provides critical data on substances involved in cases of overdose and substance misuse treated in select hospitals through toxicology testing conducted at the Minnesota Public Health Laboratory. As MNDOSA includes cases of nonfatal overdose, as well as cases of acute substance misuse which are missed through traditional surveillance, this report describes both types of cases, highlights the substances involved and symptoms associated with acute substance misuse cases, and provides insight into improving hospital-treated overdose surveillance.

Methods

Nonfatal drug overdose surveillance relies on statewide hospital discharge data, which includes hospital visits from 95% of Minnesota hospitals, to identify cases of hospital-treated overdose. A person treated in an ED who is diagnosed with any type of drug or substance poisoning (see Appendix C for the full definition) at the time of discharge is considered a nonfatal overdose case. However, this definition does not include cases of acute substance misuse which, despite requiring treatment in an ED and sometimes hospitalization, were not diagnosed with any type of substance poisoning. The MNDOSA program provides insight into these cases. The program operates through active reporting from participating EDs of cases where the primary reason for treatment is attributable to acute substance misuse. Additionally, MNDOSA provides detailed toxicology findings for patients of special interest (e.g. the patient died, was hospitalized or in the ED for 12+ hours, had symptoms not typical for the substance used, or were part of an overdose cluster). This testing can identify a wide variety of licit and illicit substances present at the time of ED visit, which may have contributed to the patient's symptoms. Pairing case reports of substance misuse cases with toxicology data makes MNDOSA a useful validation tool for hospital data-based surveillance methods.

Statewide hospital discharge data is used to identify cases of hospital-treated nonfatal overdoses. In contrast, MNDOSA data reflect participation from five EDs in Northeast Minnesota during the study period of January 2020 – December 2021. The system relies on ED staff to identify all patients who are being treated in the ED as a result of substance use; thus, cases of acute substance misuse which were not diagnosed as an overdose are included in MNDOSA.

This report classifies each MNDOSA case as one of the following case types:

1. **Nonfatal overdose cases:** A patient who is treated in an ED for a reason primarily related to acute substance misuse, and is diagnosed with one or more ICD-10-CM codes indicating drug or substance poisoning (see Appendix C for included ICD-10-CM codes).
2. **Acute substance misuse cases:** A patient who is treated in an ED for a reason primarily related to acute substance misuse, but is **not** diagnosed with an ICD-10-CM code indicating drug or substance poisoning (see Appendix C for ICD-10-CM codes absent among these cases).

Hospital discharge data contain unique records for each hospital visit, which includes information on the patient, such as age, race, sex, medical record number, and date of visit. Hospital discharge data also include information about the patient's hospital visit, such as the length of visit, encounter type (e.g., whether the patient was treated only in the ED or was later hospitalized), what diagnoses the patient received when they left the ED/hospital, and billing information. MNDOSA collects similar fields through case reports sent to MDH and through review of electronic health records. Additionally, for patients of special interest (described above), MNDOSA collects data on the patient's clinical course and linkage to care after discharge, and records toxicology testing results for cases in which there are biological specimens available. To link the hospital discharge data to MNDOSA reports, four data fields

were used: 1) patient medical record number; 2) patient date of birth; 3) date of patient visit; and 4) facility at which the visit occurred.

Key findings

- From January 2020 through December 2021, 561 cases were reported through MNDOSA; 463 (82%) of these cases were matched to hospital discharge records.
- Of 463 matched MNDOSA cases, 153 (33%) cases were nonfatal overdoses (of unintentional or undetermined intent) and 310 (67%) were acute substance misuse cases.
- Almost half (47%) of matched cases had a stimulant-related discharge diagnosis; 35% of all cases had an opioid-related discharge diagnosis.
- 51% of matched MNDOSA cases had at least one mental health disorder documented in the medical record; mental health disorders were twice as common among acute substance misuse cases compared to nonfatal overdose cases.
- Nonfatal overdose cases were almost five times as likely to have opioid use diagnosed as acute substance misuse cases, while acute substance misuse cases were twice as likely to have stimulant use reported.
- Diagnosed substance use was frequently confirmed through toxicology testing:
 - Among cases with diagnosed opioid use, 88% had opioid use detected through toxicology.
 - Among cases with stimulant use, 94% had stimulant use detected through toxicology.
- Substance use was often undiagnosed at the time of ED visit: toxicology data showed that 48% of cases with confirmed opioid use did not have diagnosis of opioid use; similarly, 43% of cases with confirmed stimulant use did not have a diagnosis of stimulant use.
- High-resolution toxicology testing provided valuable insights into substance exposures; among cases with confirmed opioid exposure, 73% had fentanyl detected, 49% had a fentanyl analog detected, and 7% had novel opioids detected.

Overview

Fatal and nonfatal drug overdoses have been steadily rising, but toxicology data are rarely available for nonfatal overdose and substance misuse hospital visits. Effective prevention strategies rely on accurate identification of substances involved in these nonfatal events and tailored approaches for populations at risk. This report describes nonfatal overdose and acute substance misuse cases reported through MNDOSA and linked with hospital discharge data.

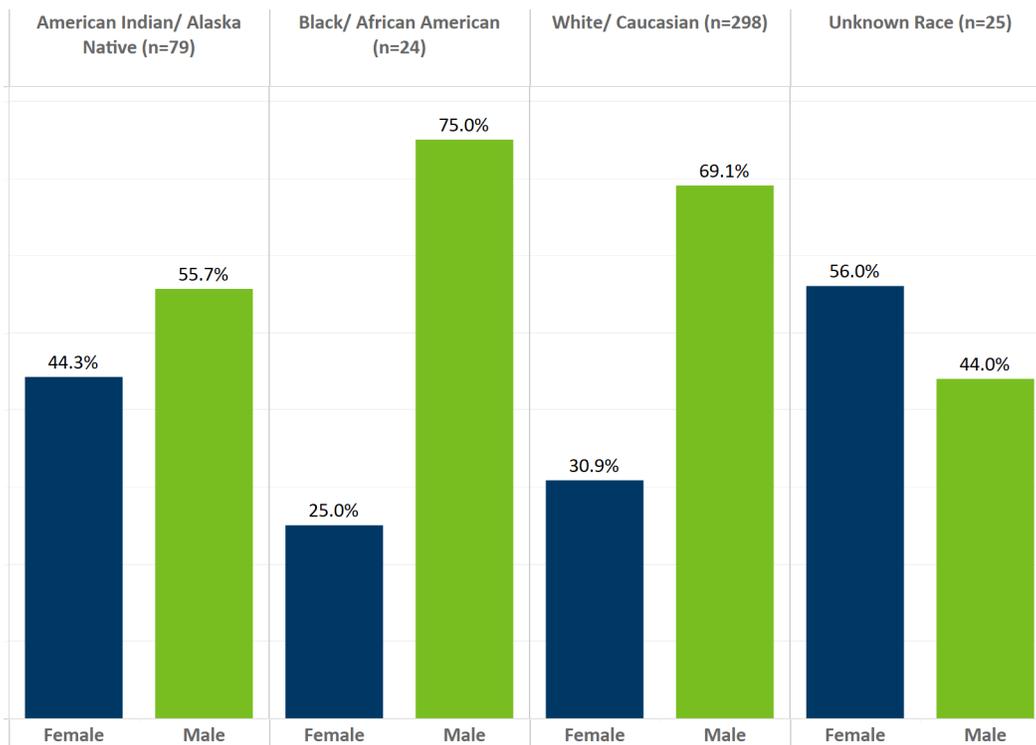
Of 561 ED visits reported through MNDOSA from January 2020 through December 2021, 463 (82%) visits were matched to the corresponding visit in the hospital discharge data. Of 463 matched MNDOSA cases, 153 (33%) were cases of nonfatal overdose (i.e., cases with one or more ICD-10-CM discharge diagnoses indicating acute drug or substance poisoning, as described in Appendix C); 310 (67%) were cases of acute substance misuse (i.e., cases without an ICD-10-CM discharge diagnosis indicating acute drug or substance poisoning, as described in Appendix C) representing visits that did not include a discharge diagnosis for overdose.

A subset of matched cases (174 of 463; 38%) met criteria for toxicology testing. Among cases meeting criteria for toxicology testing, 31% were nonfatal overdose cases; among cases which did not meet criteria for toxicology testing, 34% were nonfatal overdose cases. Nonfatal overdose was not associated with whether the case qualified for toxicology testing ($p=0.65$).

Cases by race and sex

Most matched MNDOSA cases were white patients ($N = 298$; 65%); 17% ($N = 79$) of cases were American Indian/Alaska Native, and 5% ($N = 24$) of cases were Black (Chart 1). Overall, 67% of cases were male and 33% were female. Within race groups, the sex breakdown was different among American Indian/Alaska Native patients: 44% of American Indian/Alaska Native patients were female and 56% were male. Significant disparities in fatal and nonfatal overdose rates exist for American Indian Minnesotans, which is also reflected in MNDOSA data. In Northeast Minnesota (Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis counties) American Indian Minnesotans make up 3.1% of the population; in MNDOSA, American Indians represent 17% of reported cases during the time period of this report. Finally, 5.4% of matched cases had missing race data; among these cases, female cases represented the majority.

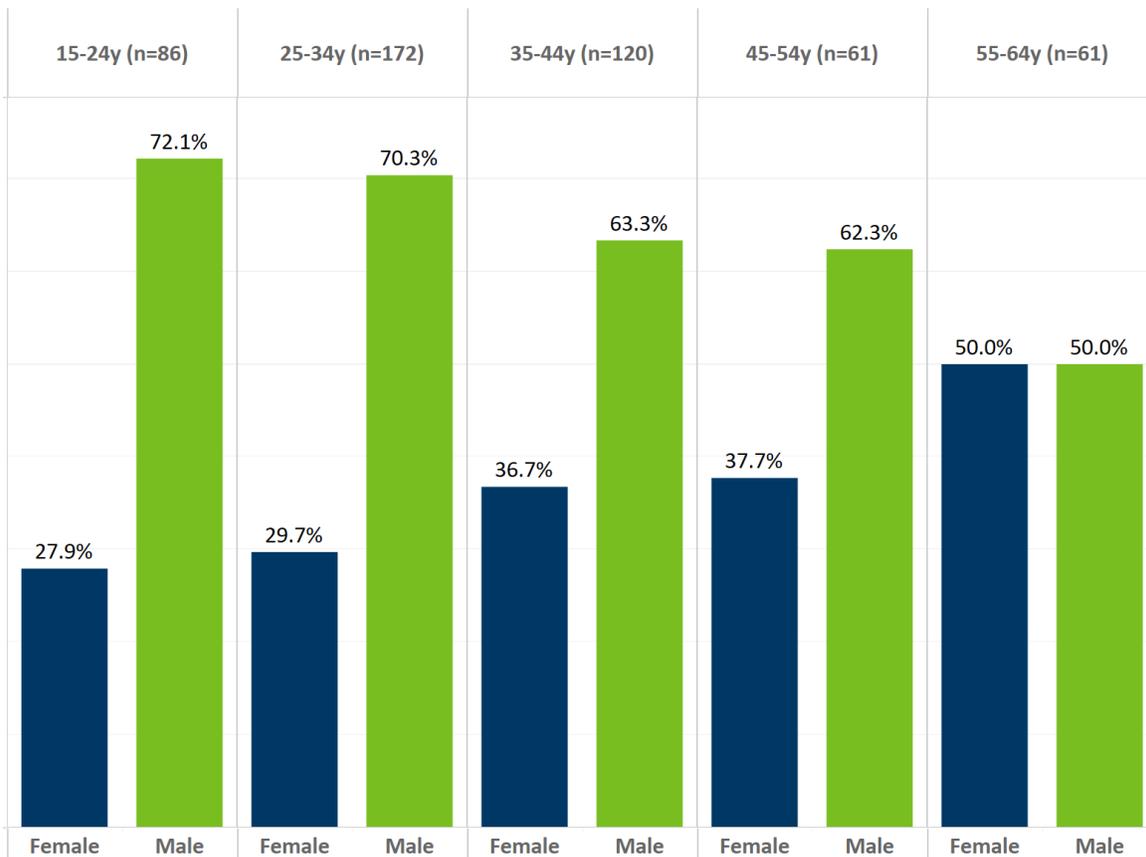
Chart 1. Most MNDOSA cases are male.



Cases by sex and age group

Patients aged 25-44 years made up the majority of MNDOSA matched cases (N = 292; 63%) (Chart 2); 37% (N = 172) of cases were aged 25-34 and 26% (N = 120) of cases were aged 35-44. Generally, male cases were younger than female cases: male cases represented 71% of cases aged 15-34, but 63% of cases aged 35-54. This finding aligns with statewide trends of nonfatal overdoses, where younger patients (aged <65 years) are more likely to be male and older patients (aged ≥ 65 years) are more likely to be female. Patients under 15 or over 64 were excluded from this analysis due to a small number of visits. Supplemental tables by sex and age group, and race and sex are included in Appendix E.

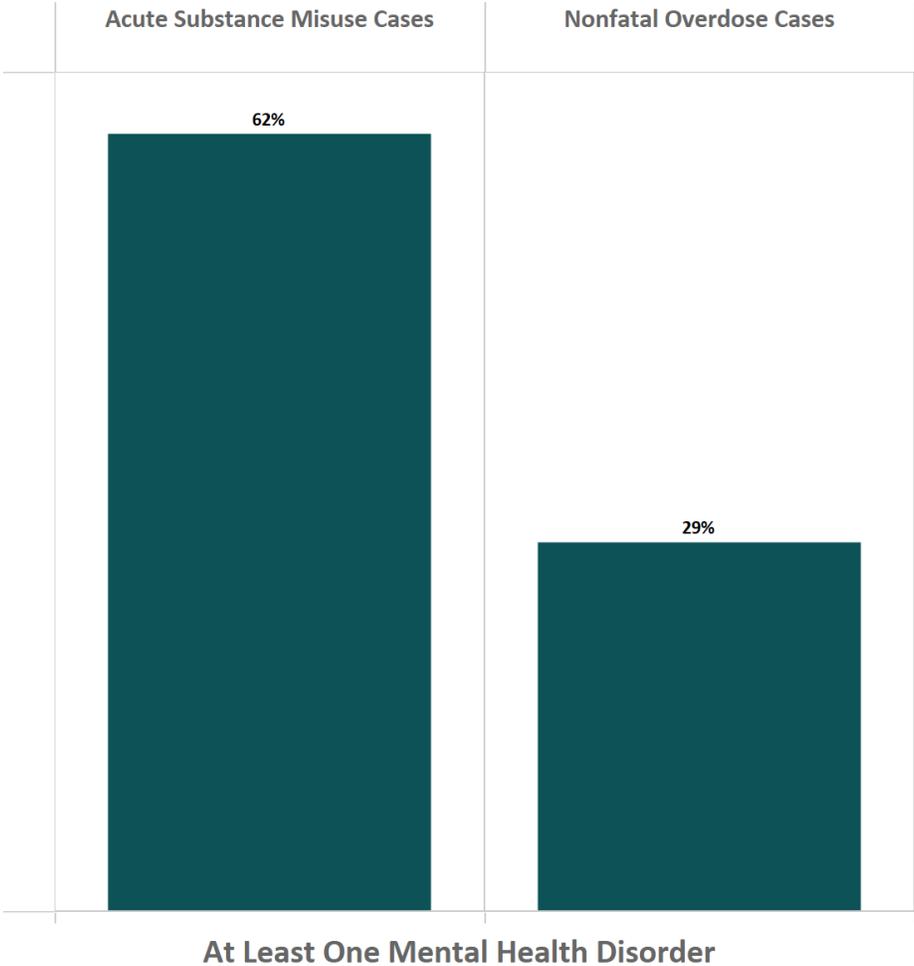
Chart 2. Males are more common than females among MNDOSA cases aged 54 and younger.



Mental health disorders

Mental health disorders are associated with increased risk of drug overdose¹, and can present barriers to accessing and completing treatment for substance use disorders. Overall, 51% of MNDOSA cases had at least one diagnosed, mental health disorder, in addition to any diagnosed substance use disorders (Chart 5). Acute substance misuse cases were more likely to have a mental health disorder than nonfatal overdose cases (62% compared to 29% of nonfatal overdose cases).

Chart 3. Acute substance misuse cases were much more likely than nonfatal overdose cases to have at least one diagnosed mental health condition.

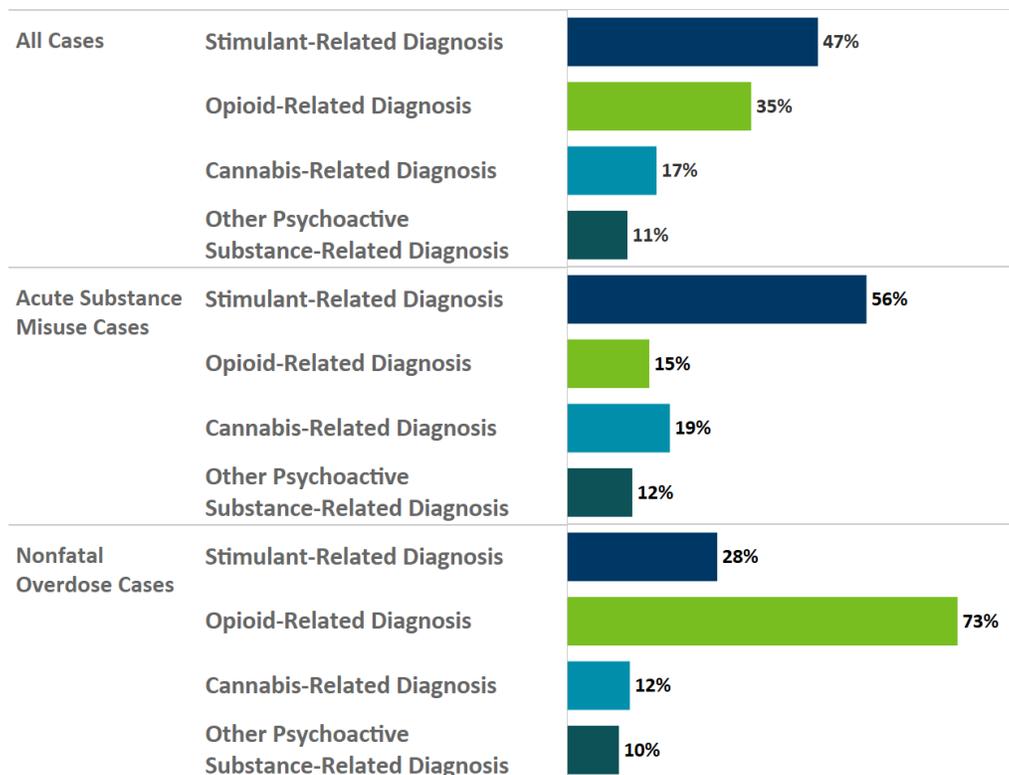


Diagnosed substance use

Diagnosed substance use is rarely based on confirmatory testing, but rather on a patient's self-reported use and/or the clinician's observation of the patient's signs and symptoms. Through the use of ICD-10-CM codes, visits from hospital discharge data may indicate that one or more substance was involved in the hospital visit. While ICD-10-CM codes can be used to reflect misuse of many common substances, they do not include the full range of substances that can be detected through toxicology testing. For a list of ICD-10-CM codes included in each substance misuse diagnosis category, see Appendix D. The substance categories defined by diagnosis codes are not mutually exclusive.

Based on the diagnoses given when a patient is discharged from the ED or hospital, stimulant use and opioid use were the most-common substance use-related diagnoses: 47% of MNDOSA cases had diagnosed stimulant use and 35% had diagnosed opioid use (Chart 4). Seventeen percent of cases had diagnosed cannabis use and 11% of cases had diagnosed use of other psychoactive substances. Most nonfatal overdose cases had diagnosed opioid use (73%) while only 15% of acute substance misuse cases had diagnosed opioids use. Acute substance misuse cases were more likely to have diagnosed stimulant use than nonfatal overdose cases (56% compared to 28%, Chart 4). Similar trends were also observed for visits with a cannabis-related diagnoses and other psychoactive substance use-related diagnoses.

Chart 4. Among nonfatal overdose cases, opioid-related diagnoses were more common, while among acute substance misuse cases, stimulant-related and cannabis-related diagnoses were more common.



Bar chart describing the proportion of all cases, acute substance misuse cases and nonfatal overdose cases with stimulant-related diagnoses, opioid-related diagnoses, cannabis-related diagnoses, and other psychoactive substance-related diagnoses.

MNDOSA toxicology findings

Discharge diagnoses from hospital data can be used to understand which substances were suspected to be involved in a patient’s symptoms. However, confirmatory toxicology testing is not typically needed to inform immediate clinical care in cases of nonfatal overdose and acute substance misuse. Toxicology data from MNDOSA can be used to compare the substances reported to be involved (from discharge diagnoses) to the substances which are confirmed to be present through toxicology testing. Among matched MNDOSA cases where toxicology testing was performed (n=139), diagnoses from hospital discharge data were compared to toxicology findings to identify cases where substance use is diagnosed **and** detected through toxicology testing.

Among 49 cases with an opioid-related diagnosis, the majority had opioid use confirmed through toxicology at the time of their visit most had opioid¹ use confirmed through toxicology (88%, Chart 5). However, only 52.4% of cases of opioid use confirmed through toxicology (n=82) had opioid use diagnosed at the time of their visit. A similar association between diagnosis and detection was observed among cases with diagnosed and/or detected stimulant use: Among 67 cases where stimulant² use was diagnosed, 94% had stimulants detected through toxicology. Conversely, only 56.8% of cases with stimulant use confirmed through toxicology (n=110) had diagnosed stimulant use at the time of their visit.

Among 26 cases diagnosed with both opioid use *and* stimulant use, 85% had opioids *and* stimulants detected, while among 67 cases with both opioids *and* stimulants detected, 33% were diagnosed with both opioid use *and* stimulant use. This finding suggests that among cases with opioid *and* stimulant use confirmed through toxicology, only one of three was diagnosed with both opioid use and stimulant use.

Six cases had diagnosed opioid use and no opioid detection; of these, four cases had stimulant detection. Four cases had diagnosed stimulant use and no stimulant detection; of these, 2 cases had opioid detection.

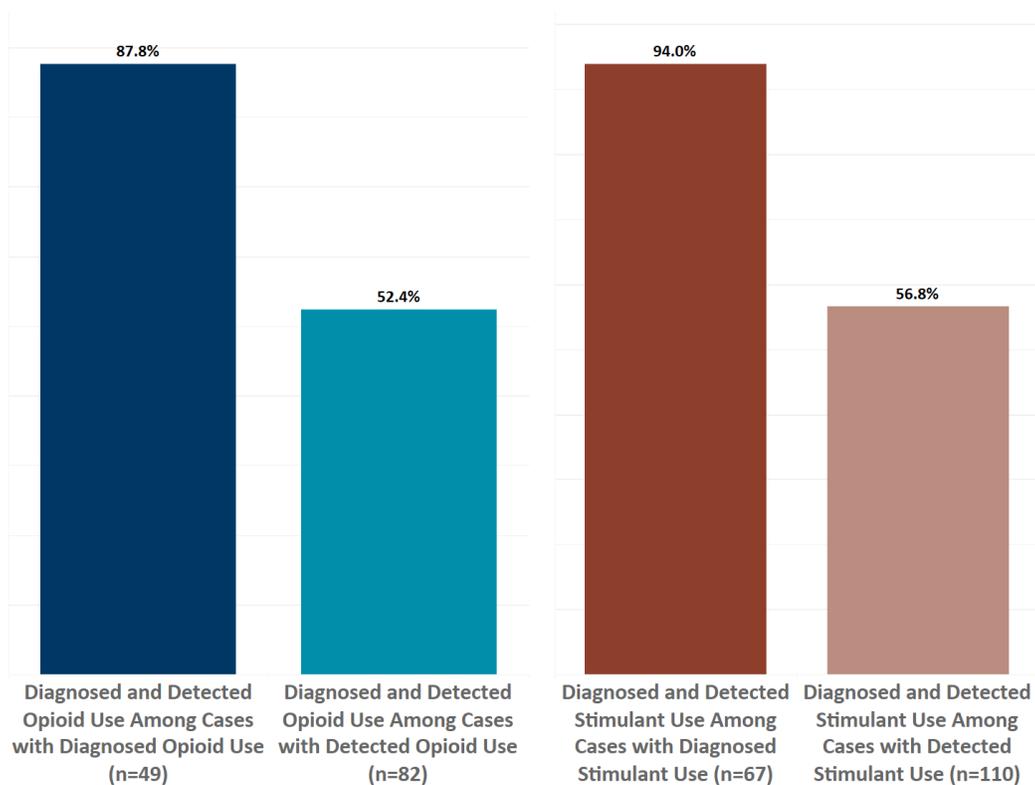
Among cases with opioids detected (n=82), 13% had heroin detected. Synthetic opioid detections were common: 73% had fentanyl detected, and 49% had a fentanyl analog detected. Additionally, 7% had a novel opioid detected. Appendix F lists the fentanyl analogs and novel opioids detected through MNDOSA during the study period.

These findings suggest that individuals treated in EDs for reasons related to substance misuse are often exposed to substances which may not be suspected by either the patient or their clinician. Furthermore, these cases were sometimes exposed to novel opioids which may be emerging, or which may not be detected in clinical drug screening. Toxicology testing available through the MNDOSA program provides more accuracy in determining the substances to which someone was exposed, but importantly it is a snapshot of exposures and cannot describe exactly which substances resulted in signs and symptoms of drug overdose or substance use resulting in a hospital visit.

¹ Opioids included in MNDOSA's toxicology testing method were prescription opioids such as morphine, oxycodone, and buprenorphine; synthetic opioids such as heroin and fentanyl; and fentanyl analogs and novel opioids, including those listed in Appendix F.

² Stimulants included in MNDOSA's toxicology testing method were amphetamine, methamphetamine, cocaine, MDMA, methylphenidate, pseudoephedrine, or norephedrine.

Chart 5. Diagnosed opioid use or stimulant use was usually associated with confirmed opioid use or stimulant use.



Next steps

Linkage between MNDOSA data and hospital discharge data showed that many cases treated in EDs for reasons primarily related to substance misuse are not reflected in nonfatal overdose surveillance. Many of these missed cases (defined in this report as acute substance misuse cases) may involve stimulant use or co-occurring mental health conditions. Hospital-treated overdose surveillance methods can be augmented for greater sensitivity to these cases through:

1. Surveillance of hospital-treated cases diagnosed with substance use, abuse, or dependence with serious sequelae. For example, nonfatal overdose surveillance could be expanded to include cases diagnosed with substance use involving a psychotic disorder (e.g. F.12.951: Cannabis use, unspecified with psychotic disorder with hallucinations.)
2. Surveillance of hospital-treated case diagnosed with substance use, abuse, or dependence **and** one or more mental health condition (e.g. F19.10, Other psychoactive substance abuse, uncomplicated **and** F4.19, Anxiety disorder, unspecified)
3. Surveillance using chief complaint-based data on acute substance misuse (e.g. text based identification of terms related to overdose or acute toxicity, such as “overdose,” “loss of consciousness,” or “altered mental status.”)

References

1. Webster LR. Risk Factors for Opioid-Use Disorder and Overdose. *Anesth Analg*. 2017 Nov;125(5):1741-1748. doi: 10.1213/ANE.0000000000002496. PMID: 29049118.

Appendices

Appendix A: Hospital Discharge Data

The Minnesota Department of Health received approximately 95% of hospital discharge data from the Minnesota Hospital Association, including ED visits. These data cover 87 Minnesota counties and can include reports from all 132 acute care hospitals in the state.

Hospital discharge data were linked to cases reported through the MNDOSA program, using patient medical record number, date of birth, visit date and hospital where they were treated. Hospital records, referred to in this report as hospital discharge data, include the patient's diagnoses at the time they were discharged from the hospital.

Appendix B: MNDOSA Case Definition

The case definition for inclusion in the MNDOSA program is: any patient presenting to the emergency department where the principal diagnosis is attributable to substance misuse.

Appendix C: Unintentional or Undetermined Intent Overdose Case Definition

All unintentional or undetermined intent drug overdoses referenced in this report are suspected drug overdoses. The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes, used to create the case definition for unintentional or undetermined intent drug overdose, are as follows:

T36-T50 Poisoning by drugs, medicaments, and biological substances, accidental (unintentional) or undetermined, initial encounter.

Appendix D: Discharge Diagnoses

Definitions for diagnosis categories included in this report are listed below.

Opioid-Related Diagnoses

- **T401X[1-5]** Heroin Poisoning/Adverse Effects
- **T400X[1-5]** Opium Poisoning/Adverse Effects
- **T4041[1-5]** Fentanyl Poisoning/Adverse Effects
- **T403X[1-5]** Methadone Poisoning/Adverse Effects
- **T404X[1-5]** Synthetic Narcotic Poisoning/Adverse Effects
- **T4042[1-5]** Tramadol Poisoning/Adverse Effects
- **T4049[1-5]** Unspecified Narcotic Poisoning/Adverse Effects

- **T4060[1-5]** Other Synthetic Narcotic Poisoning/Adverse Effects
- **T4069[1-5]** Other Narcotic Poisoning/Adverse Effects
- **T402X[1-5]** Other Opioid Poisoning/Adverse Effects
- **F111[0-9]** Opioid Abuse
- **F112[0-9]** Opioid Dependence
- **F119[0-9]** Opioid Use

Stimulant-Related Diagnoses

- **T405X[1-5]** Cocaine Poisoning/Adverse Effects
- **T4360[1-5]** Unspecified Psychostimulant Poisoning/Adverse Effects
- **T4361[1-5]** Caffeine Poisoning/Adverse Effects
- **T4362[1-5]** Amphetamine Poisoning/Adverse Effects
- **T4363[1-5]** Methylphenidate Poisoning/Adverse Effects
- **T4364[1-5]** Ecstasy Poisoning/Adverse Effects
- **T4369[1-5]** Other Psychostimulant Poisoning/Adverse Effects
- **F141[0-9]** Cocaine Abuse
- **F142[0-9]** Cocaine Dependence
- **F149[0-9]** Cocaine Use
- **F172[0-9]; Z87891** Nicotine Dependence
- **F151[0-9]** Other Stimulant Abuse
- **F152[0-9]** Other Stimulant Dependence
- **F159[0-9]** Other Stimulant Use

Cannabis-Related Diagnoses

- **F121[0-9]** Cannabis Abuse
- **F122[0-9]** Cannabis Dependence
- **F129[0-9]** Cannabis Use

Other Psychoactive Substance-Related Diagnoses

- **F191[0-9]** Other Psychoactive Substance Abuse
- **F192[0-9]** Other Psychoactive Substance Dependence
- **F199[0-9]** Other Psychoactive Substance Use

- **F131[0-9]** Sedative, Hypnotic or Anxiolytic Abuse
- **F132[0-9]** Sedative, Hypnotic or Anxiolytic Dependence
- **F139[0-9]** Sedative, Hypnotic or Anxiolytic Use

Mental Health Disorders

- **F0[1-9]** Mental Health Disorder Due to Physiological Reason
- **F2[0-9]** Schizophrenia/Schizotypal/Non-Mood Psychotic Disorder
- **F3[0-9]** Mood (Affective) Disorders
- **F4[0-9]** Anxiety/Dissociative/Stress-Related/Somatoform/ Nonpsychotic Mental Disorders
- **F5[0-9]** Behavioral Syndromes Associated with Psychological Disturbances/Physical Factors
- **F6[0-9]** Disorders of Adult Personality and Behavior
- **F9[0-9]** Behavioral and Emotional Disorders with Onset Usually Occurring in Childhood/Adolescence

Appendix E: Supplemental Tables

Chart E.1. Race and Sex by Case Type.

Race	Case Type	Female	Male	All Cases
American Indian/ Alaska Native	Acute Substance Misuse Cases	25	30	55
American Indian/ Alaska Native	Nonfatal Overdose Cases	10	14	24
Black/ African American	Acute Substance Misuse Cases	3	13	16
Black/ African American	Nonfatal Overdose Cases	3	5	8
White/ Caucasian	Acute Substance Misuse Cases	69	132	201
White/ Caucasian	Nonfatal Overdose Cases	23	74	97
Unknown Race	Acute Substance Misuse Cases	8	6	14
Unknown Race	Nonfatal Overdose Cases	6	5	11

Chart E.2. Age and Sex by Case Type.

Age	Case Type	Female	Male
15-24y (n=86)	Acute Substance Misuse Cases	17	38
15-24y (n=86)	Nonfatal Overdose Cases	7	24
25-34y (n=172)	Acute Substance Misuse Cases	35	75
25-34y (n=172)	Nonfatal Overdose Cases	16	47
35-44 (n=140)	Acute Substance Misuse Cases	32	52
35-44 (n=140)	Nonfatal Overdose Cases	12	24
45-54y (n=61)	Acute Substance Misuse Cases	17	30
45-54y (n=61)	Nonfatal Overdose Cases	6	8
55-64y (n=61)	Acute Substance Misuse Cases	7	NR
55-64y (n=61)	Nonfatal Overdose Cases	NR	5

Groups with less than five cases are not reported (NR).

Chart E.3. Toxicology Testing Criteria by Case Type.

Toxicology Testing Criteria	Case Type	Total
Died	Acute Substance Misuse Cases	NR
Died	Nonfatal Overdose Cases	NR
Hospitalized/12+ Hrs in ED	Acute Substance Misuse Cases	95

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Toxicology Testing Criteria	Case Type	Total
Hospitalized/12+ Hrs in ED	Nonfatal Overdose Cases	44
Atypical Clinical Presentation	Acute Substance Misuse Cases	19
Atypical Clinical Presentation	Nonfatal Overdose Cases	8
Part of a Cluster	Acute Substance Misuse Cases	7
Part of a Cluster	Nonfatal Overdose Cases	7
Does Not Meet Toxicology Testing Criteria	Acute Substance Misuse Cases	191
Does Not Meet Toxicology Testing Criteria	Nonfatal Overdose Cases	98

Groups with less than five cases are not reported.

Appendix F: Fentanyl Analogs and Novel Opioids Detected Through MNDOSA

Substance Name:

- Despropionyl para-Fluorofentanyl
- para-Fluoro fentanyl
- Acetyl Fentanyl
- Acrylfentanyl
- Benzyl fentanyl
- Methoxyacetyl fentanyl
- Cyclopropyl fentanyl
- Tetrahydrofuran fentanyl
- 2-Methyl AP-237
- Brorphine
- U-47700
- Metonitazene
- AP-238
- AH 7921