Nonfatal Drug Overdoses

Michigan 2018

MDHHS
Michigan Department of Health & Human Services
GRETCHEN WHITMER, GOVERNOR | ELIZABETH HERTEL, DIRECTOR

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This report would not have been possible without the data provided by the Michigan Health & Hospital Association.

This publication was supported by grant number
1 NU17CE925006-01-00
from the U.S. Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC

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Contents

Executive Summary

During 2018, Michigan hospitals and emergency departments treated 25,419 nonfatal unintentional and undetermined intent drug overdoses among residents. Opioid overdoses accounted for 11,521 (45.3 percent) of these visits. Throughout this report, the term "nonfatal overdose" refers only to unintentional and undetermined intent, as intentional (self-harm) overdoses and overdose assaults are excluded. This report details geographic patterns, healthcare treatment characteristics, and demographic and socioeconomic characteristics of individuals experiencing nonfatal overdose.

Key findings include:

- There was a slight decline in the age-adjusted rate of inpatient admissions for nonfatal overdoses from 2016 to 2018.
- Emergency department (ED) data, which are only available beginning in 2018, indicate that EDs treat and release approximately four times as many nonfatal drug overdoses as inpatient settings.
- Calhoun and Genesee counties had the highest age-adjusted rates of nonfatal all-drug and opioid-involved overdoses. Both rural and urban counties throughout the state demonstrated high rates of nonfatal drug overdoses.
- Adults aged 25-44 years, males, and Black residents had the highest rates of all-drug and opioid-involved nonfatal unintentional overdoses. Children under the age of five years accounted for 6.7 percent of all nonfatal overdoses, but less than 1 percent of nonfatal opioid overdoses.
- Medicaid was the expected primary payer for 48.8 percent of all-drug and 55.9 percent of opioid-involved nonfatal overdoses.
- As the percent of residents experiencing unemployment, poverty, and low educational-attainment in a census tract increases, age-adjusted rates of all-drug and opioid-involved nonfatal overdoses also increase. Census tracts in the highest quintile for unemployment, poverty, and percent of residents without a high school diploma had an age-adjusted rate of all-drug nonfatal overdoses 3.3 – 3.7 times higher than census tracts with the lowest quintile.
- Almost half (45.3 percent) of all nonfatal drug overdose visits involved one or more opioids and 13.8 percent involved more than one drug. Nonopioid drugs commonly in nonfatal overdoses included benzodiazepines, cocaine, and nonopioid analgesic (e.g., aspirin, acetaminophen), antipyretic, and antirheumatic drugs.
- Although in the majority (80.9 percent) of hospital visits for nonfatal overdoses the patient was discharged home, in 8.1 percent the patient left against medical advice. Comparatively, patients left against medical advice in only 1.5 percent of non-overdose related hospital visits in 2018.
- Nonfatal overdose visits were almost twice as likely as other visits to include documentation of a co-occurring non-mood psychotic disorder, mood disorder, or other nonpsychotic mental disorder, such as anxiety or a stress-related disorder (28.4 percent of overdose visits compared to 14.3 percent of other visit types). The most commonly documented mental health diagnoses were major depressive disorders.

Limitations:

- The unavailability of ED data prior to 2018 and the transition from International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) to International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM) in 2015 prevent analysis of long-term trends of nonfatal overdoses in Michigan.
- Four hospitals (<3.0 percent of hospitals) did not submit ED and/or inpatient data for 2018. Based on a review of the Michigan Syndromic Surveillance System (MSSS), these four hospitals account for an estimate of 2.8 percent of hospital visits annually. Data for counties containing large nonreporting hospitals were suppressed.
- Standard diagnostic coding practices may vary by hospital and therefore may impact results.
- Visit-based inpatient and emergency department data could not be deduplicated by unique patients; therefore, the data may include multiple overdose visits for the same individual. A single individual with many overdose episodes may disproportionately weight estimates of demographic categories.
- The number of hospital visits for nonfatal overdoses likely underestimates the true number of nonfatal overdoses because some nonfatal drug overdoses may not receive care in a hospital setting, such as those that receive treatment from emergency medical services but decline transport to a hospital.

Conclusions and Public Health Implications:

- Young adults (aged 25-34 years), males, and Black residents are disproportionately experiencing nonfatal overdoses, including opioid overdoses.
- Polydrug use was present in roughly one in seven nonfatal overdoses, highlighting the potential need for treatment options that include therapies for both opioid and nonopioid use disorders.
- Co-occurring mental health disorders are present in a more than one in four nonfatal overdoses.
- Socioeconomic hardship of a community, including high unemployment rates, should be considered a potential indication that the underlying community is at higher risk of unintentional overdoses.
- Successful public health strategies aimed at preventing overdoses should address conditions that may act as a barrier to accessing harm-reduction services and substance use disorder treatment such as socioeconomic hardship, social stigma for specific demographic groups, and the need for comprehensive and effective mental health care in combination with treatment.

Background

Mortality data presents a stark picture of how the drug use epidemic has impacted Michigan over the past decade. In 2018, 2,599 Michigan residents died due to a drug overdose, representing an 83.5 percent increase since 2009.[1] Michigan's overdose mortality rate (25.9 overdoses per 100,000 residents) ranked seventeenth in the nation, and among the 39 states which met data quality standards for reporting drug-specific mortality rates, Michigan had 12th highest opioid mortality rate.[1,2] The majority (83.8 percent) of drug overdose deaths in Michigan were unintentional or the intent was undetermined, and the majority (78.3 percent) of overdose deaths also involved one or more opioids.[1] However, less is known about the prevalence, impact, and characteristics of nonfatal overdoses in Michigan.

Although the drug overdose mortality rate alone is alarming, for each death there are almost 10 nonfatal overdoses treated at hospitals each year in Michigan. Nonfatal overdoses represent a large burden on individuals, families, communities, and the healthcare system at large. Previous studies have found that between one-quarter and one-third of nonfatal, nonmedicinal overdoses result in an inpatient hospital admission.[3] A study of opioid overdoses in occurring in Indiana from 2014 to 2017 found that more than one in 10 individuals who experienced a nonfatal overdose had a repeat nonfatal overdose during follow-up.[4] Research has also shown that there is a high risk of fatal opioid overdose in the 12 months following a nonfatal opioid overdose.[5] Individuals who have experienced a nonfatal overdoses are also at higher risk of death to other causes as well, including HIV, chronic respiratory diseases, viral hepatitis, and suicide.[6] Nonfatal overdoses can result in significant disability such as ataxia, incontinence, and paraplegia due to hypoxic brain injury.[7] Additional mental and physical consequences of nonfatal overdoses may include impaired memory, slower reaction time, and diminished motor skills.[7]

In addition to the impacts of nonfatal overdose on the physical health and social wellbeing of individuals, nonfatal overdoses also represent a large financial burden on communities and healthcare resources. In 2010, the estimated average inpatient medical treatment cost for an unintentional nonfatal drug overdose was $14,573, and the average cost of medical treatment for nonfatal unintentional overdoses treated and released from the emergency department (ED) was $1,587.[8] In addition to direct medical costs, nonfatal overdoses may also result in a loss of wages due to time away from work during recovery or even permanent disability. The estimated average work loss associated with a nonfatal unintentional overdose in 2010 was $6,645 for hospitalized cases and $666 for cases treated and released from the emergency department.[8] These figures represent a combined direct and indirect cost ranging from $2,253 to $21,218 for every nonfatal overdose, depending on the level of care needed.

These data underscore the importance of treating the prevention of nonfatal overdoses as a public health priority. Understanding more about the characteristics of and risk factors associated with nonfatal overdoses is crucial to designing, targeting, and implementing effective prevention efforts. This report aims to provide data on nonfatal overdose trends, geographic patterns, and demographic, socioeconomic, and clinical characteristics in Michigan.

Methods

Data Sources

The surveillance findings in this report are based on annual billing discharge data that non-federal, acute-care hospitals submit to the Michigan Health and Hospital Association (MHA). More than 98 percent of acute-care hospitals in Michigan are members of MHA and submit data on healthcare utilization, outcomes, and patient demographics annually. Annual inpatient data for the past 10-year period (2009 to 2018) were available for analysis; however, hospitals only began to submit ED data to MHA in October of 2015. Prior to 2018, ICD-10-CM procedure codes were used in conjunction with diagnosis codes to classify ED visits. In 2018, MHA changed the way they classified ED visits to include all visits discharged from the emergency department. This alteration of ED classification prevents the use of ED data prior to 2018 for surveillance purposes. From 2009 to 2018, 97.1 percent of all acute care hospitals in Michigan submitted inpatient data and 57.0 percent provided inpatient data every year from 2009 to 2018. Some acute care hospitals were ineligible to provide inpatient data for the entire 10-year period because they were not in operation or did not provide inpatient services during some years. In 2018, 97.8 percent of acute care hospitals submitted ED data. For a list of hospitals that did not report data, see Appendix A. Although nonacute-care hospitals, such as long-term care, rehabilitation, psychiatric, and cancer treatment hospitals do submit inpatient data to MHA, records from these types of facilities were excluded from the analysis because they are more likely to represent treatment of chronic complications related to overdose rather than acute overdose events. The dataset contains a deidentified record for each inpatient discharge that occurred from 2009 to 2018 and each ED discharge that occurred in 2018. It is therefore possible that an individual may be represented more than once in the dataset if they had multiple hospital visits within the surveillance period.

Case Definitions

ED discharges include visits where the patient was treated and released from the ED. Inpatient discharges include visits where the patient was admitted for inpatient care and may include patients that originated in the ED. Observation and outpatient procedure visits were excluded. Drug overdose fatalities, identified by a discharge status of "expired," were excluded. Unintentional and undetermined intent overdoses were combined for consistency with the CDC's Drug Overdose Surveillance and Epidemiology (DOSE) System standardized syndrome definition.[9] The intent of drug overdoses may be classified as undetermined in cases where the healthcare provider has insufficient information to determine if the overdose was intentional, unintentional, or more rarely, due to an assault. However previous research has shown that the characteristics of nonfatal undetermined intent injuries differ from intentional injuries in demographics and exhibit a much lower risk of subsequent self-harm injuries.[10]

Overdoses are classified by the International Classification of Disease, Clinical Modification (ICD-CM) diagnostic codes included in each discharge record according to the standardized ICD-9-CM and ICD-10-CM definitions established by the CDC, National Center for Injury Prevention and Control.[11] Beginning on October 1, 2015 the diagnostic classification system transition from ICD-9-CM to ICD-10-CM, resulting in significant changes to the underlying methodology used to describe and classify illnesses, injuries, and clinical encounters and procedures. The ICD-10-CM system contains roughly 56,000 additional

diagnostic codes, providing greater detail and specificity than ICD-9-CM. Due to the extensive changes to the diagnostic coding system, the ICD-9-CM case definition for unintentional and undetermined intent drug overdose cannot be made equivalent to the ICD-10-CM case definition and comparisons should not be made in data before 2015 to data after 2015. Data for 2015 are excluded due to the change in ICD-CM system during the surveillance year.

Prior to October 1, 2015, unintentional and undetermined intent overdoses from all drugs were identified by a first-listed external cause of injury ICD-9-CM code E850 through E858 (unintentional) or E980.0 through E980.5 (undetermined intent). Unintentional and undetermined intent opioid overdoses were identified by either a primary diagnosis of poisoning by opiates and related narcotics (ICD-9-CM 965.0) accompanied by a first-listed external cause ICD-9-CM code of E850-E858 or a first-listed external cause ICD-9-CM code of E850.0-E850.2. Unintentional and undetermined intent unspecified drug overdoses include records with a primary diagnosis code of 977.9 or a first-listed external cause ICD-9-CM code of E858.9 or E980.5 and no other drug-overdose code present.

Beginning October 1, 2015, unintentional and undetermined intent overdoses from all drugs were identified by the presence of an ICD-10-CM code in the range T36-T50 with a sixth digit of '1' or '4' (with the exception of T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9 which required a fifth digit of '1' or '4') as either the principal or any secondary diagnosis code. Unintentional and undetermined intent opioid overdoses were identified by the presence of an ICD-10-CM code of T40.0-T40.4, T40.6, and T40.69 with a sixth digit of '1' or '4' in any listed diagnosis code. Unintentional and undetermined intent unspecified overdoses required a diagnosis code of T50.901 or T50.904 in the absence of any other drug poisoning code. Only initial visits, signified by a last character of 'A' in the ICD-10-CM code, were included.

Census Tract Socioeconomic Characteristics

Census tracts are relatively small geographic areas that are contained within a county boundary and have an average of 4,000 residents and a minimum of 1,200 residents.[12] Census tract-level socioeconomic characteristics have been shown to be strongly correlated with many health outcomes including preterm births, depression in middle age and older adults, and social functioning in young children.[13–15] To evaluate the relationship between community-level socioeconomic characteristics and the prevalence of nonfatal drug overdoses, age-adjusted rates and 95 percent confidence intervals (CI) were calculated for census tracts classified by selected socioeconomic characteristics. Census tract socioeconomic characteristics were derived from the 2014-2018 American Community Survey Five-Year Estimates. Census tracts were classified by the quintile distribution of:

1) The percent of census tract residents aged 16 years and older that were unemployed[1]
2) The percent of census tract residents with an annual individual or family income below the federal poverty level[2]
3) The percent of census tract residents aged 25 years and older who have not attained a high school diploma or equivalent credential (e.g., GED)[3]

[1]U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S2301.

[2]U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1701.

[3]U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1501.

Inpatient and ED visit records were geocoded by MHA to the census tract level based on the patient's reported address of residence at the time of discharge. All geocoding was completed by Geolytics, Inc. (Somerville, NJ). Geocoding was performed using U.S. Census TIGER/Line® Shapefiles as the reference dataset. Approximate street abbreviation matches (i.e., allowing matches between similar addresses with discordant street descriptors; '123 First Street' may match with '123 First Ave') were allowed, however, less than 1 percent of geocoded addresses were approximate street matches.

Statistical Notes

Age-adjusted overdose rates were calculated via direct standardization method by applying age-specific overdose rates to the 2000 U.S. Census standard population age distribution. To account for potential violations to the normal approximation resulting from the calculation of rates based on a small number of events, an exact 95 percent confidence interval for each rate was calculated using the γ distribution.[16] Annual rates were calculated by visit type (i.e., inpatient and ED) and by opioid involvement. Inpatient and emergency department visits were combined to calculate the total number of nonfatal overdoses. Age-adjusted rates of total all-drug and opioid-involved nonfatal overdoses were stratified by county of residence, sex, and race. Age-group specific rates of total all-drug and opioid-involved nonfatal overdoses were also calculated.

The visit length of stay (LOS) was compared by discharge disposition for inpatient hospital visits. LOS was calculated as the number of days between admission to care and discharge from care. The LOS for visits that were admitted and discharged on the same day was classified as one (1) day. Due to the non-normal distribution of LOS, the Kruskal–Wallis test was used to determine if the median LOS statistically differed by discharge disposition. Extreme outliers, defined as having a z-score above 3.5 were excluded from analysis.

Exact binomial 95 percent confidence intervals were calculated for proportions. Chi-square tests of association were used to compare the distribution of discreet counts of ED visits and inpatient visits by patient demographic characteristics. Independent, two-sample t-tests were used to compare the mean patient age by type of visit (ED or inpatient). All statistical tests were two-sided and considered significant where the corresponding p-value was less than 0.05. Counts and corresponding rates and percentages have been suppressed when the number of overdoses is between one and five due to statistical unreliability and to protect the confidentiality of individuals. County-level rates were suppressed for counties that contain hospitals with 100 or more licensed beds that did not report ED or inpatient data for 2018 to reduce potential non-response bias.

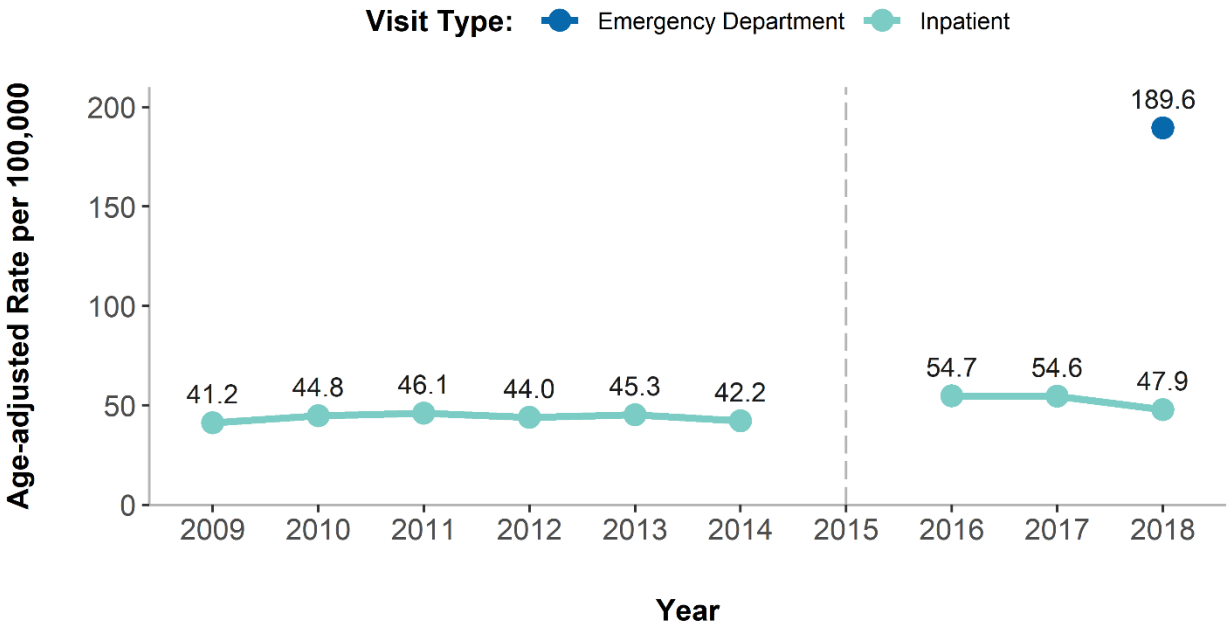
All data presented in figures and associated confidence intervals, if applicable, are included in Appendix B tables.

Results

Annual Trends in Nonfatal Drug Overdose Rates

From 2009 to 2014, the age-adjusted rate of inpatient hospitalizations for nonfatal overdoses remained relatively stable, with an age-adjusted rate ranging from 41.2 to 46.1 per 100,000 residents (Figure 1). These data likely underestimate the true number of drug overdoses because prior to ICD-10-CM, discharge records required an additional external cause of injury code in order to be classified by intent (e.g., intentional, unintentional, assault, or undetermined intent), and 24.7 percent of inpatient admissions for drug poisoning were missing an external cause code. Data is not shown for the year 2015 due to the change in ICD-CM coding system that occurred on October 1, 2015. Although inpatient admissions for drug overdoses were relatively stable from 2016 to 2017, rates declined 12.2 percent in 2018 to 47.9 per 100,000 in 2018. The rate of ED visits for drug overdoses was about four times higher than the inpatient admission rate during 2018, at 189.6 per 100,000 residents. Figure 1 excludes inpatient admission data from hospitals that did not report for every year from 2009 through 2018.

Figure 1: Age-Adjusted Rate (per 100,000) of Emergency Department Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Drug Overdoses[1] among Michigan Residents by Year, 2009-2018[2, 3, 4]



[1] From 2009-2014, unintentional and undetermined intent overdoses included visits with a first-listed external cause of injury ICD-9-CM code E850 through E858 or E980.0 through E980.5. From 2016-2018, unintentional and undetermined intent overdoses included initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] 2009-2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

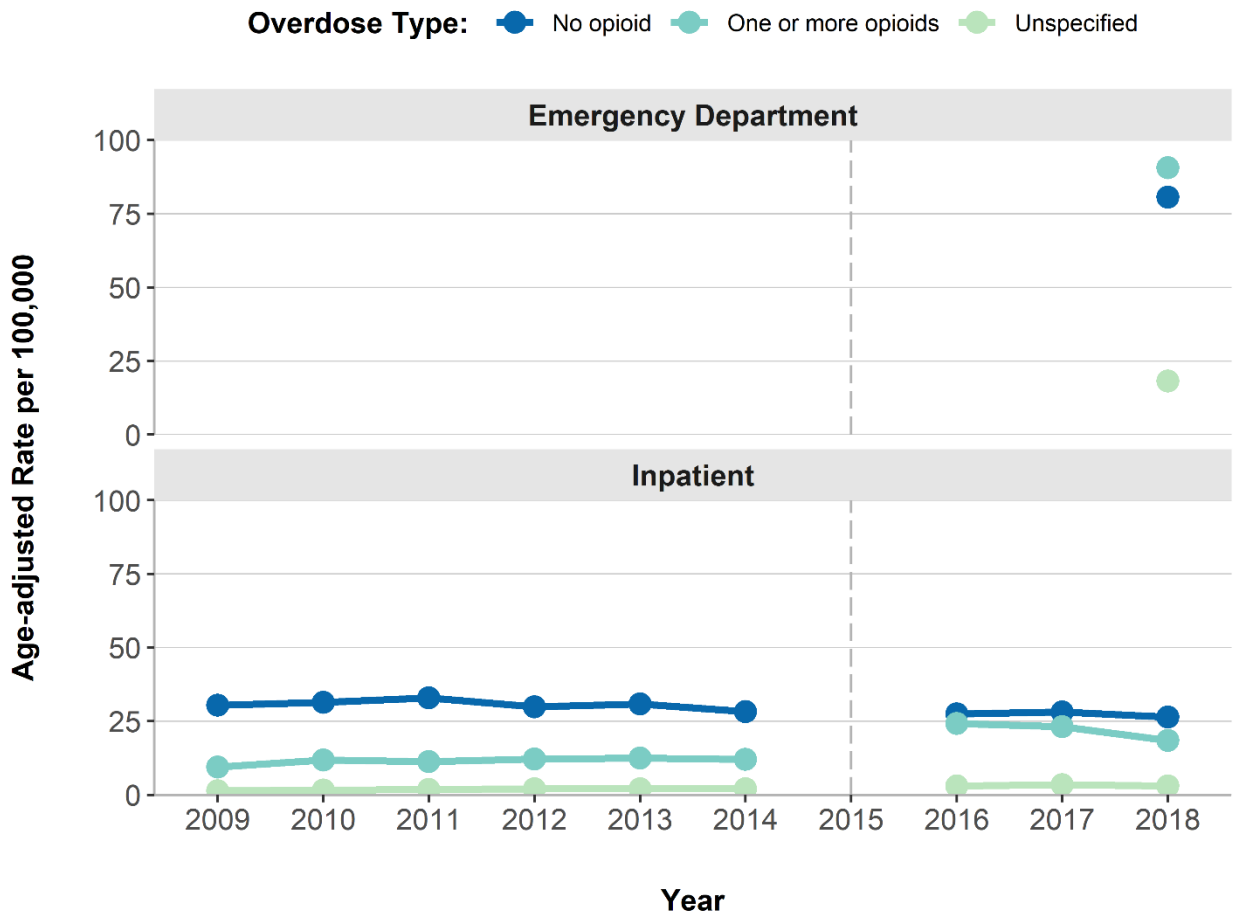
[3] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics. Intercensal estimates of the resident population (July 1, 2009), National Center for Health Statistics.

Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Data for 2015 are not shown due to the transition from ICD-9-CM to ICD-10-CM on October 1, 2015. Rates for 2009-2014 are not comparable to rates for 2016-2018, thus only the trends within each time period can be compared.

Rates of inpatient admissions for nonfatal drug overdoses not involving opioids were higher than rates of both opioid-involved overdoses and unspecified overdoses from 2009 to 2018 (Figure 2). The age-adjusted rate of inpatient admissions for nonfatal opioid-involved drug overdoses demonstrated a 27.7 percent increase from 9.4 per 100,000 in 2009 to 12.0 per 100,000 in 2014. The age-adjusted rate of inpatient admissions for nonfatal opioid-involved drug overdoses declined 23.6 percent from 24.2 per 100,000 in 2016 to 18.5 per 100,000 in 2018. Prior to 2016, the age-adjusted inpatient admission rate for unspecified nonfatal drug overdoses ranged from 1.4 to 2.0 per 100,000, representing an average of 4.0 percent of all nonfatal drug overdoses per year. From 2016 to 2018, the inpatient admission rate for unspecified nonfatal drug overdoses was between 3.0 and 3.4 per 100,000, representing an average of 5.8 percent of all nonfatal drug overdoses per year. Figure 2 excludes inpatient admission data from hospitals that did not report for every year from 2009 through 2018.

In contrast to inpatient admissions, the highest age-adjusted rate of ED visits for nonfatal drug overdoses was for opioid-involved drug overdoses at 90.7 per 100,000 in 2018. The age-adjusted rate of ED visits for nonfatal drug overdoses not involving opioids was 80.6 per 100,000. Unspecified drugs accounted for 9.5 percent of ED visits for nonfatal drug overdoses.

Figure 2: Age-Adjusted Rate (per 100,000) of Emergency Department Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Drug Overdoses among Michigan Residents by Opioid[1] Involvement, Visit Type, and by Year, 2009-2018[2, 3, 4]



[1] From 2009-2014, unintentional and undetermined intent opioid overdoses included visits with either a primary ICD-9-CM code of 965.0 accompanied by a first-listed external cause ICD-9-CM code of E850-E858 or a first-listed external cause ICD-9-CM code of E850.0-E850.2; unintentional and undetermined intent unspecified overdoses included visits with a primary ICD-9-CM code of 977.9 or a first-listed external cause ICD-9-CM code of E858.9 or E980.5 and no other drug-overdose code present; unintentional and undetermined intent overdoses not involving opioids included all other visits with a first-listed external cause of injury ICD-9-CM code E850.3 through E858 or E980.0 through E980.5, without a primary diagnosis of 965.0. From 2016-2018, unintentional and undetermined intent opioid overdoses included initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis; unintentional and undetermined intent unspecified overdoses included visits with an ICD-10-CM code of T50.901 or T50.904 listed as a primary or any secondary diagnosis in the absence of any other drug poisoning code; unintentional and undetermined intent overdoses not involving opioids included initial visits with an ICD-10-CM code of T36-T39.9, T40.5, T40.7-T50.8, T50.99, T50.A, T50.B, or T50.Z and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis without the presence of an opioid overdose diagnosis code.

[2] 2009-2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[3] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics. Intercensal estimates of the resident population (July 1, 2009), National Center for Health Statistics.

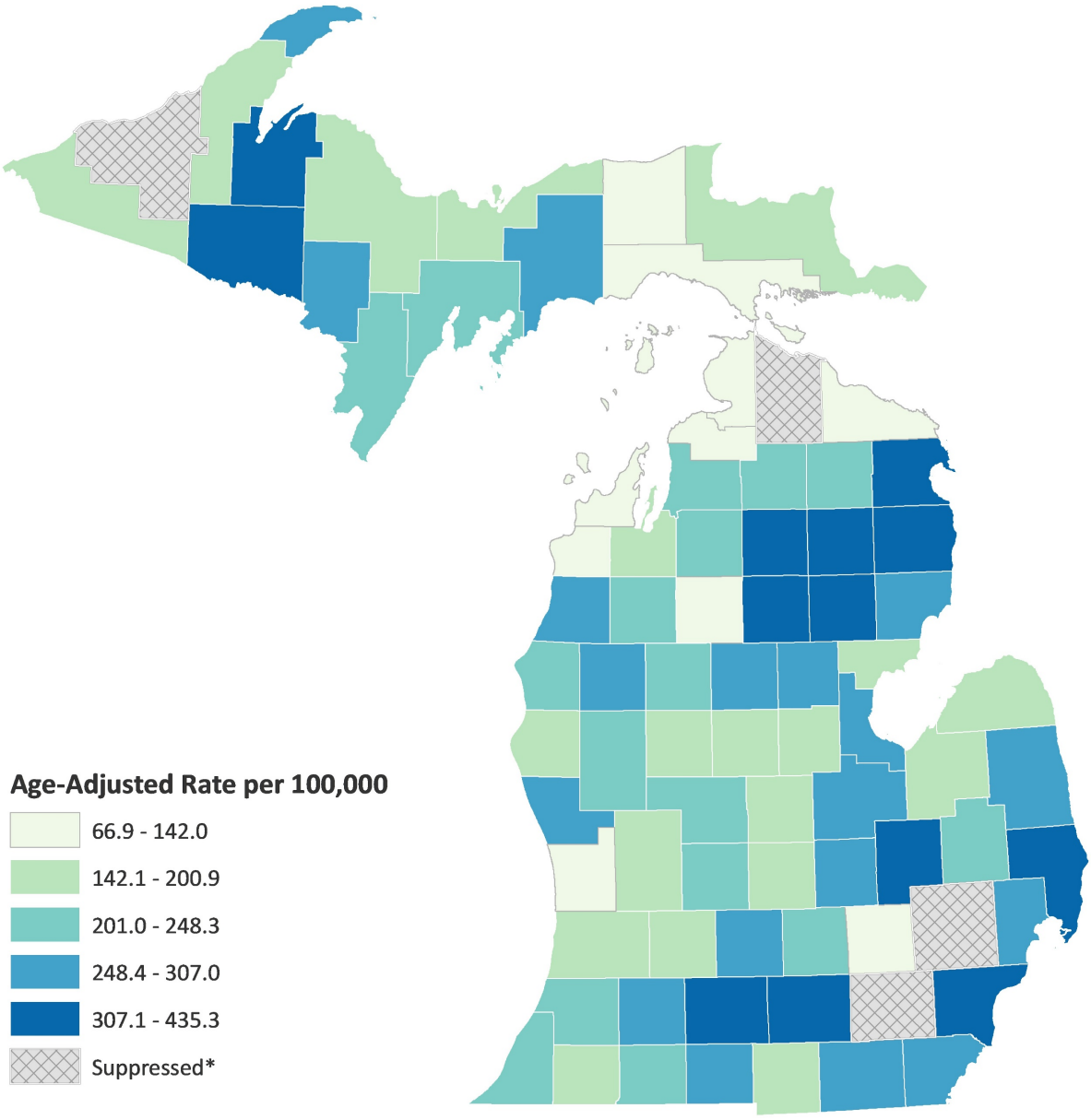
Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Data for 2015 are not shown due to the transition from ICD-9-CM to ICD-10-CM on October 1, 2015. Rates for 2009-2014 are not comparable to rates for 2016-2018, thus only the trends within each time period can be compared.

Geographic Patterns

Genesee and Calhoun counties had the highest age-adjusted rates of nonfatal drug overdoses during 2018 with rates of 435.3 overdoses per 100,000 residents and 405.2 overdoses per 100,000 residents, respectively (Figure 3). Mackinac and Leelanau counties had the lowest age-adjusted rates of nonfatal drug overdoses. Similar to the pattern observed for all nonfatal drug overdoses, the counties with the highest rate of nonfatal opioid-involved overdoses during 2018 include Genesee and Calhoun counties, with 227.1 and 218.4 overdoses per 100,000 residents, respectively (Figure 4). Keweenaw and Ontonagon counties had the lowest rates of nonfatal opioid overdoses, both with 0.0 overdoses per 100,000 residents.

Data are not shown for counties with between one and five overdoses and for counties that contain one or more hospitals with 100 or more beds that did not submit inpatient or ED data. Rates are calculated by county of residence in Figures 3 and 4. Counties were classified based on the natural breaks of the age-adjusted rate.

Figure 3: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Drug Overdoses[1] by County of Residence, Michigan 2018[2, 3]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

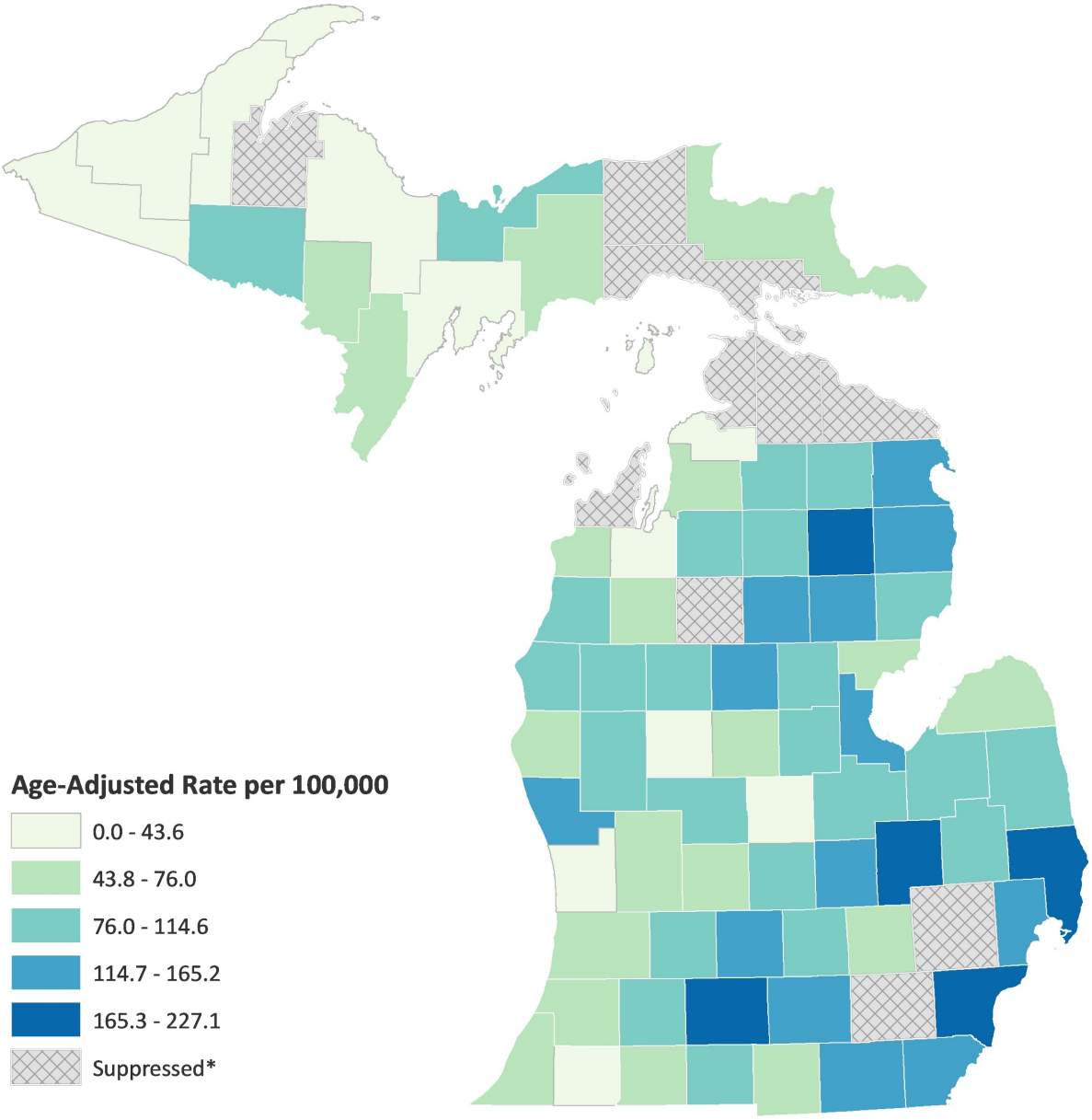
[2] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[3] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

*Rates are not displayed for counties with between one and five drug overdoses and counties that contain hospitals with 100 or more licensed beds that did not report ED or inpatient data.

Note: Rates were age-adjusted to the 2000 US population by the direct standardization method.

Figure 4: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Opioid Overdoses[1] by County of Residence, Michigan 2018[2,3]



[1] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.
[2] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.
[3] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.
*Rates are not displayed for counties with between one and five drug overdoses and counties that contain hospitals with 100 or more licensed beds that did not report ED or inpatient data.
Note: Rates were age-adjusted to the 2000 US population by the direct standardization method.

Demographic Characteristics

In 2018, hospitals treated Michigan residents for 25,419 nonfatal drug overdoses, including 18,336 overdoses treated and released from the ED and 7,083 overdoses that were admitted for inpatient care (Table 1). The distribution of sex and race significantly varied by visit type, based on the Pearson chi-square test of association. Compared to ED visits, inpatient visits were more likely to involve female patients and Black patients. Inpatient visits were less likely than ED visits to involve White patients and patients of "other" race. There were no significant differences observed in the distribution of patients of American Indian and Alaska Native (AI/AN) race or patients of Asian and Pacific Islander race by visit type. The mean age for each visit type was compared using an independent, two-sided t-test. Results showed that the average age of patients admitted for inpatient care was 13.7 years older than the average age of patients treated and released from the ED ($p<0.0001$).

Table 1: Number and Percent of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Overdoses[1] among Michigan Residents by Demographics and Level of Care, 2018[2]

	ED Care Only Number	ED Care Only Percent	Inpatient Care Number	Inpatient Care Percent	Total Number	Total Percent	*P value (χ^2 test)*
Total	18,336	100.0%	7,083	100.0%	25,419	100.0%	
Sex							<0.0001
Male	10,422	56.8%	3,566	50.4%	13,988	55.0%	
Female	7,911	43.2%	3,516	49.6%	11,427	45.0%	
Race							<0.0001
AI/AN*	111	0.6%	40	0.6%	151	0.6%	
Asian/PI**	89	0.5%	29	0.4%	118	0.5%	
Black	3,733	21.1%	1,911	27.0%	5,644	22.8%	
White	13,396	75.7%	4,998	70.6%	18,394	74.3%	
Other	360	2.0%	98	1.4%	458	1.8%	

	Mean	SD	Mean	SD	Mean	SD	*P value (t test)*
Age (Years)	36.7	20.1	50.4	19.7	40.5	20.9	<0.0001

[1] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[2] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

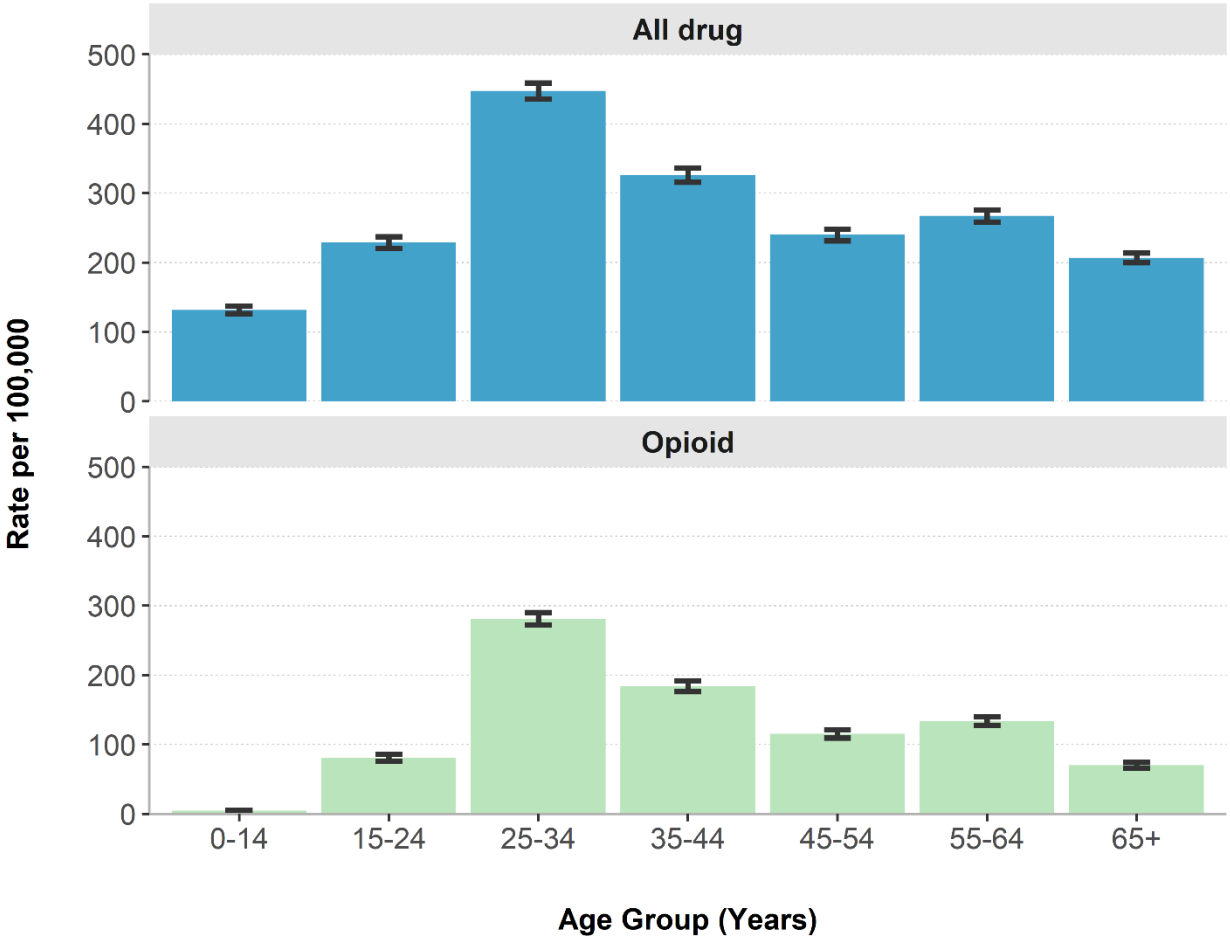
Notes: Sex was unknown in four visits. Race was unknown in 654 visits. Age was unknown in four visits.

*American Indian or Alaska Native

**Asian or Pacific Islander

The rate of all hospital visits (inpatient and ED combined) for nonfatal drug overdoses was highest among individuals aged 25 to 34 years at 447.5 visits per 100,000 residents and lowest among individuals aged zero to 14 years at 131.6 visits per 100,000 residents (Figure 5). Likewise, the rate of hospital visits for opioid overdoses was highest among individuals aged 25 to 34 years (281.2 visits per 100,000 residents) and lowest among individuals aged zero to 14 years (4.4 visits per 100,000 residents). The hospital visit rate for both all drug and opioid overdoses among individuals 65 years of age and older was less than half the rate among individuals aged 25-34 years.

Figure 5: Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Age Group, 2018[3, 4]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

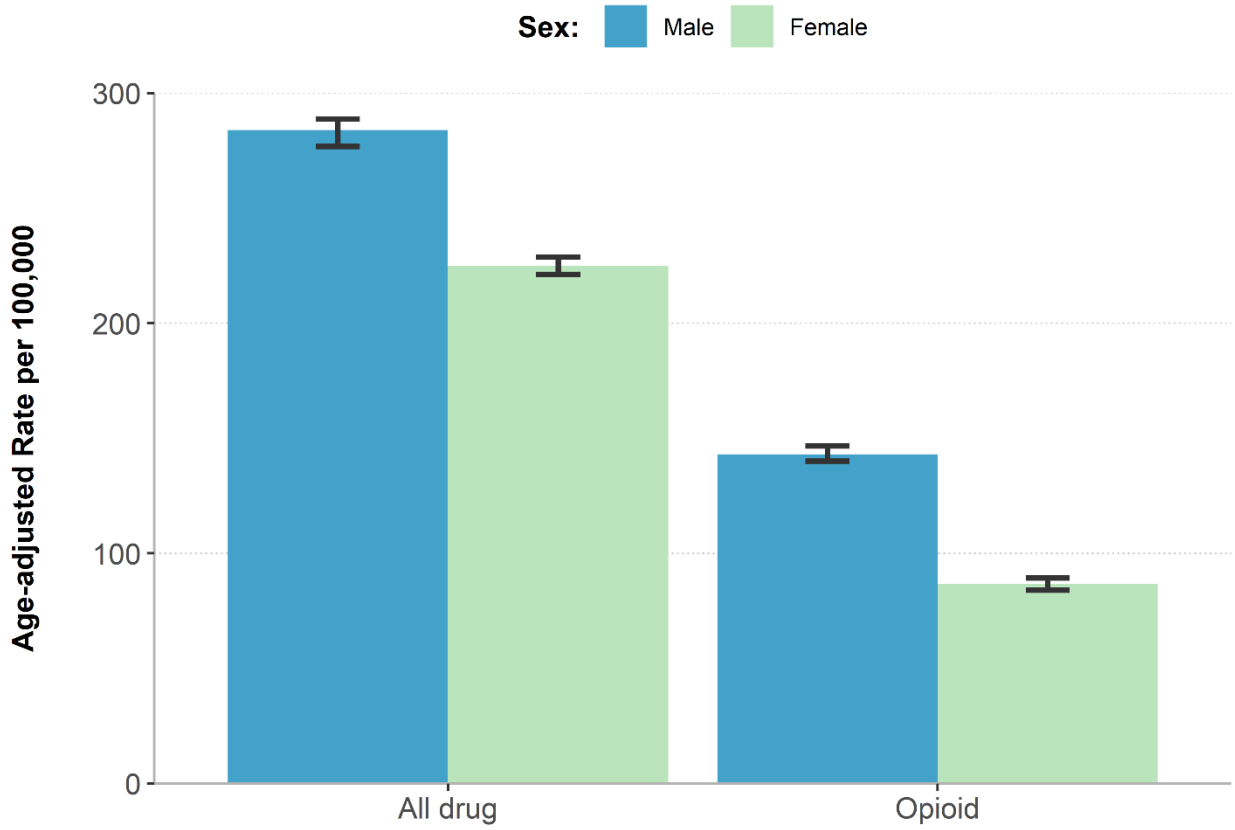
[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

Note: Age was unknown in four visits.

The age-adjusted rate of hospital visits for nonfatal all drug and opioid drug overdoses were higher among males than females (Figure 6). For all drug nonfatal drug overdoses, the age-adjusted rate among males was 26.2 percent higher than females. For opioid-involved nonfatal drug overdoses, the age-adjusted rate among males was 65.1 percent higher than the rate among females.

Figure 6: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Sex, 2018[3, 4]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

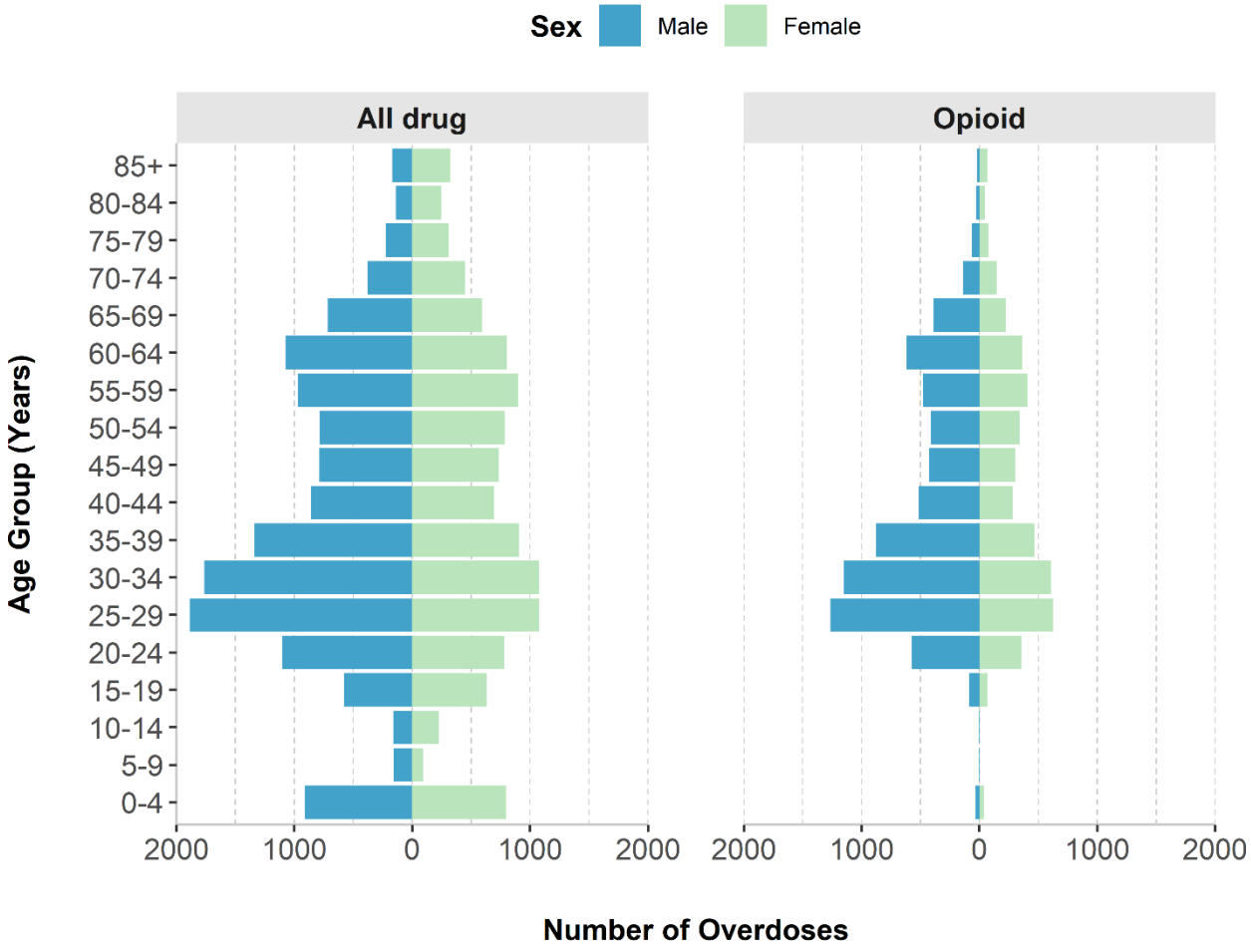
[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Sex was unknown in four visits.

The highest number of nonfatal drug overdoses was observed in males aged 25 to 34 years for both all drugs and opioids specifically (Figure 7). There was a sizable number of all drug overdoses among individuals aged zero to four years (males: 909 visits, females: 800 visits), accounting for 6.7 percent of all visits in this category. There were only 69 visits for opioid overdoses among individuals aged zero to four years, however, less than 1 percent of all opioid overdoses.

Figure 7: Distribution of Emergency Department and Inpatient Discharges for Nonfatal All Drug[1] and Opioid[2] Unintentional and Undetermined Intent Overdoses among Michigan Residents by Age Group and Sex, 2018[3]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

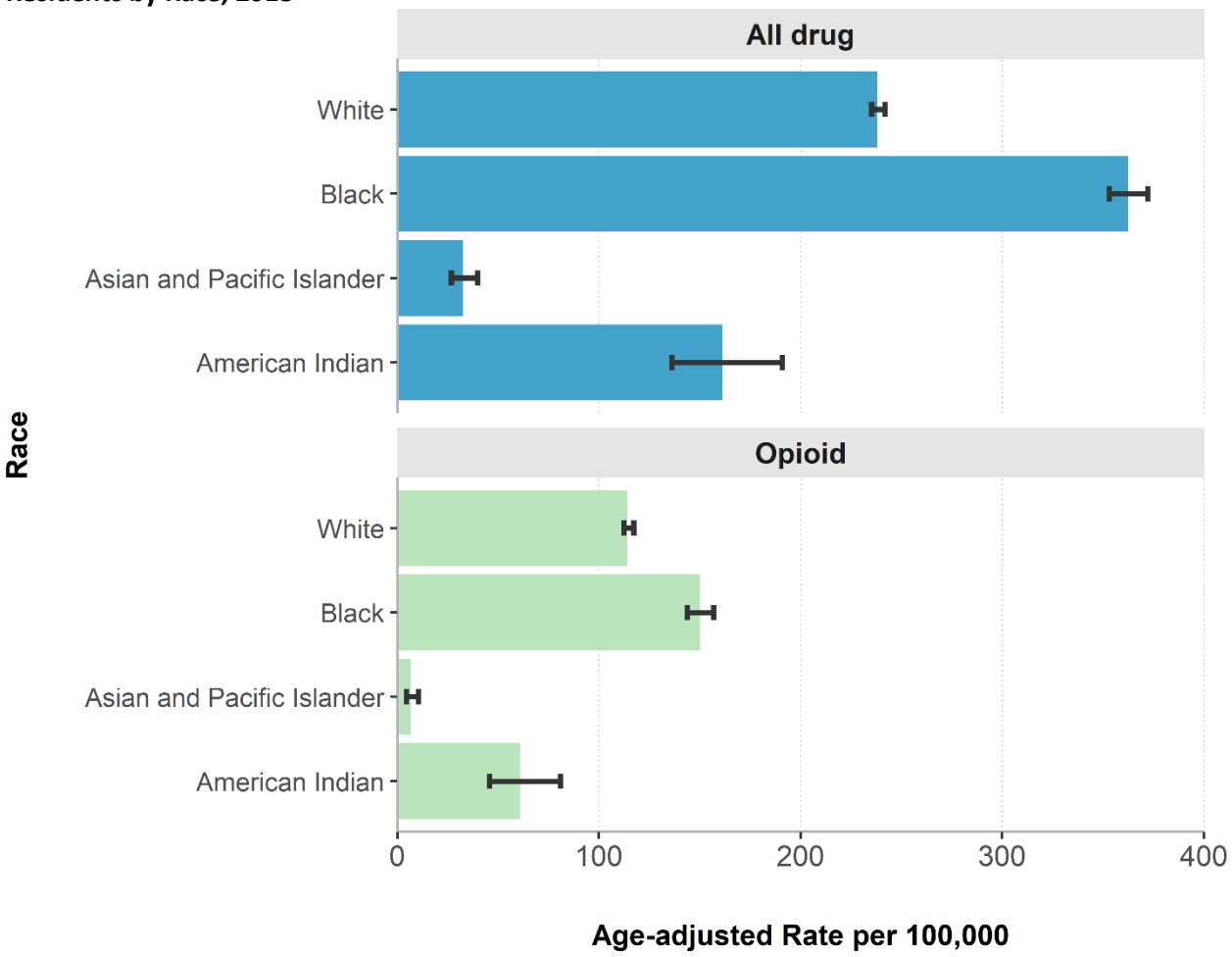
[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

Note: Age was unknown in four visits and sex was unknown in four visits.

Black Michigan residents had the highest age-adjusted rate of hospital visits for nonfatal all drug and opioid overdoses (Figure 8). For all nonfatal overdoses, the age-adjusted rate among Black residents was 52.2 percent higher than White residents and for nonfatal opioid overdoses, the rate was 31.7 percent higher among Black residents compared to White residents. Asian and Pacific Islander patients had the lowest rate of all nonfatal drug and opioid overdose hospital visits.

Figure 8: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Race, 2018[3]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

Note: Race was unknown in 654 visits.

Socioeconomic Characteristics

Medicaid, a public insurance program that provides coverage to eligible low-income adults, children, pregnant women, elderly adults, and people with disabilities, was the expected primary payer in almost half (48.8 percent) of all drug overdoses and over half (55.9 percent) of opioid-involved overdoses (Table 2). Medicare, which typically is available to adults aged 65 and older, younger people who have disabilities, and individuals with end stage renal disease, was the expected primary payer in slightly over one in four (25.1 percent) drug overdose visits. Among opioid-involved overdoses only, Medicare was the expected payer for slightly over one in five visits (21.7 percent). Commercial insurance was the expected payer for 4,347 visits (17.1 percent), of 1,334 were for opioid overdoses. Less than 9 percent of drug overdoses had an expected primary payer listed as another public insurance programs, other insurance, or self-pay and less than 0.1 percent had an unknown expected primary payer. The payers shown in Table 2 are the primary expected payers at the time of discharge but may not be the final payers of the health care claim. Individuals may have more than one source of health insurance (e.g., Medicare and Medicaid coverage), however Table 2 only includes the primary expected payer.

Table 2: Number and Percent of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Expected Primary Payer, 2018[3]

	All Drug Overdose Number	All Drug Overdose Percent	Opioid Overdose Number	Opioid Overdose Percent
Commercial	4,347	17.1%	1,334	11.6%
Medicaid	12,397	48.8%	6,435	55.9%
Medicare	6,368	25.1%	2,495	21.7%
Other Public Insurance[4]	121	0.5%	36	0.3%
Self-Pay	1,576	6.2%	934	8.1%
Other[5]	585	2.3%	272	2.3%
Unknown	25	<0.1%	15	0.1%

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Other public insurance includes Title V, state mental health contract, and unspecified public insurance.

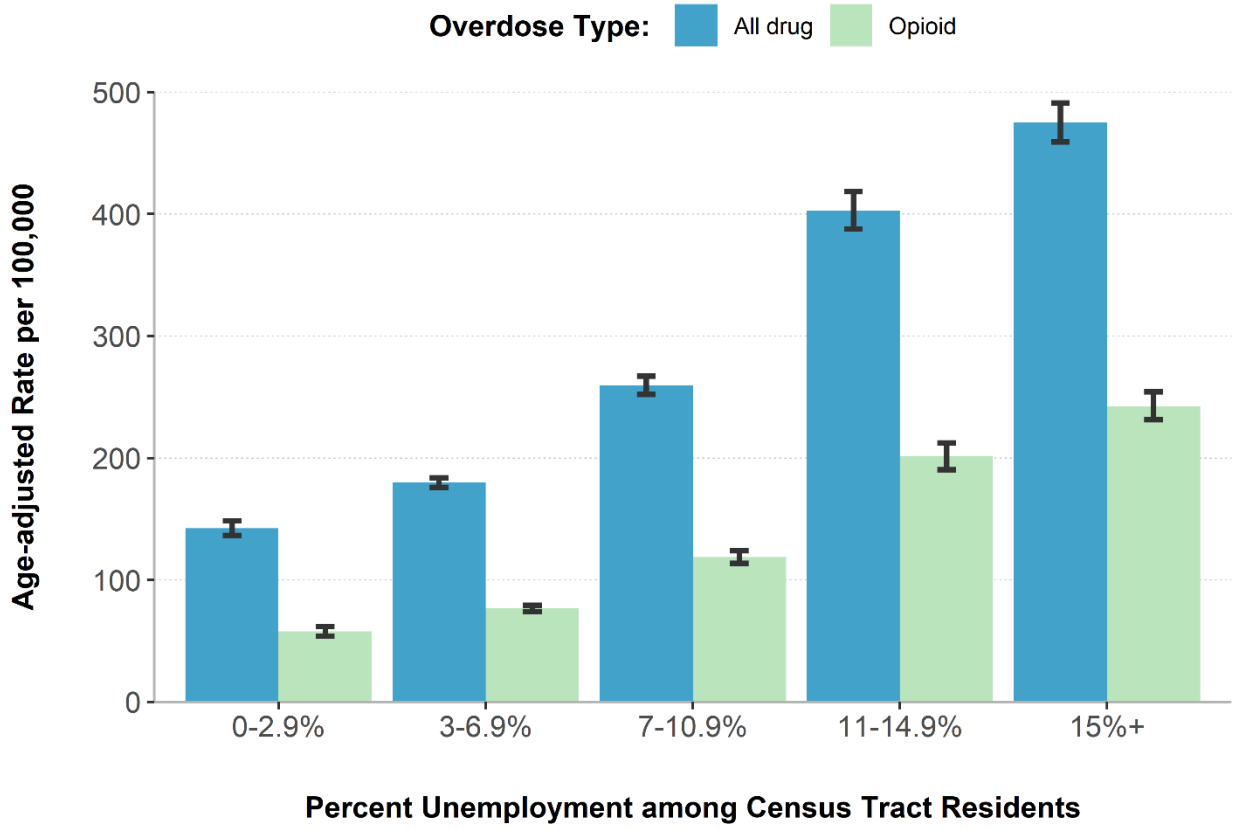
[5] Other insurance includes workers' compensation, corrections, auto insurance, charity care, and other unspecified insurance.

Analysis of community-level socioeconomic factors revealed that age-adjusted rates of both all drug and opioid nonfatal overdoses increased with increasing levels of census tract-based unemployment, poverty, and low educational attainment (see figures 9-11). It is important to note that although a positive correlation was observed between the socioeconomic factors at the census tract level and the rate of overdoses, it should not be inferred that an analogous correlation exists at the individual level. The data available for this analysis only provide information on the socioeconomic conditions of the

communities in which individuals live, not the socioeconomic characteristics of individuals themselves. It is possible that individuals overdosing in census tracts characterized by high levels of unemployment, poverty, or low educational attainment do not experience these conditions individually. Therefore, results presented in the following figures should only be interpreted at the community level.

The age-adjusted rates of nonfatal all drug and opioid overdoses increased with increasing community unemployment (Figure 9). Census tracts with the highest unemployment rate (15 percent or higher) had an age-adjusted rate of nonfatal overdoses 3.3 times higher than census tracts with the lowest unemployment rates (0-2.9 percent). The age-adjusted rate of nonfatal opioid overdoses in census tracts with the highest unemployment rates was 4.2 times higher than the rate in census tracts with the lowest unemployment rates.

Figure 9: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Unemployment Rate in Census Tract of Residence, 2018[3, 4]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

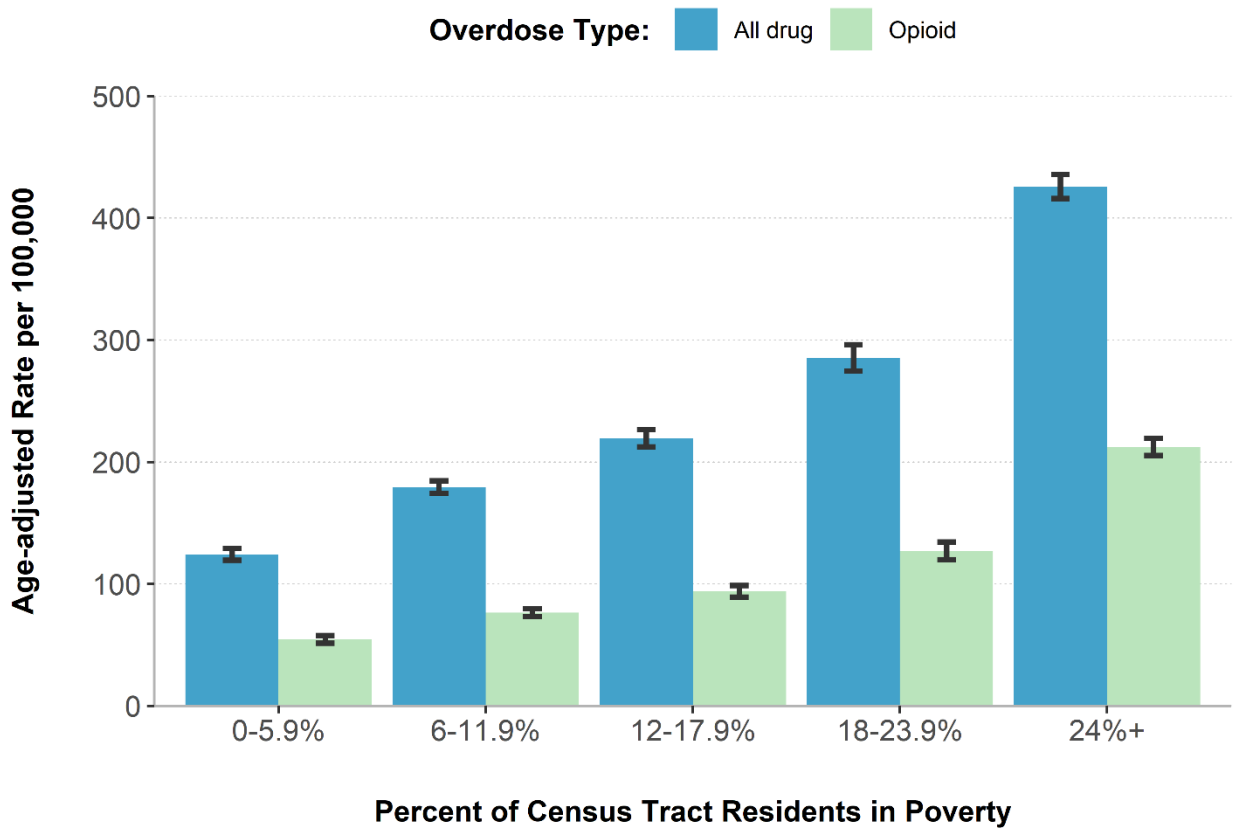
[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S2301.

* There were 3,201 records with an unknown census tract of residence and six records that had a census tract of residence for which the unemployment rate could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract unemployment rate but did not have age recorded.

A similar pattern was observed with age-adjusted rates of nonfatal all drug and opioid overdoses by census poverty (Figure 10). Census tracts with the highest poverty rates (24 percent or higher) had an age-adjusted rate of nonfatal overdoses 3.4 times higher than census tracts with the lowest poverty rates (0-5.9 percent). The age-adjusted rate of nonfatal opioid overdoses in census tracts with the highest poverty rates was 3.9 times higher than the rate in census tracts with the lowest poverty rates.

Figure 10: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Poverty Rate in Census Tract of Residence, 2018[3, 4]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

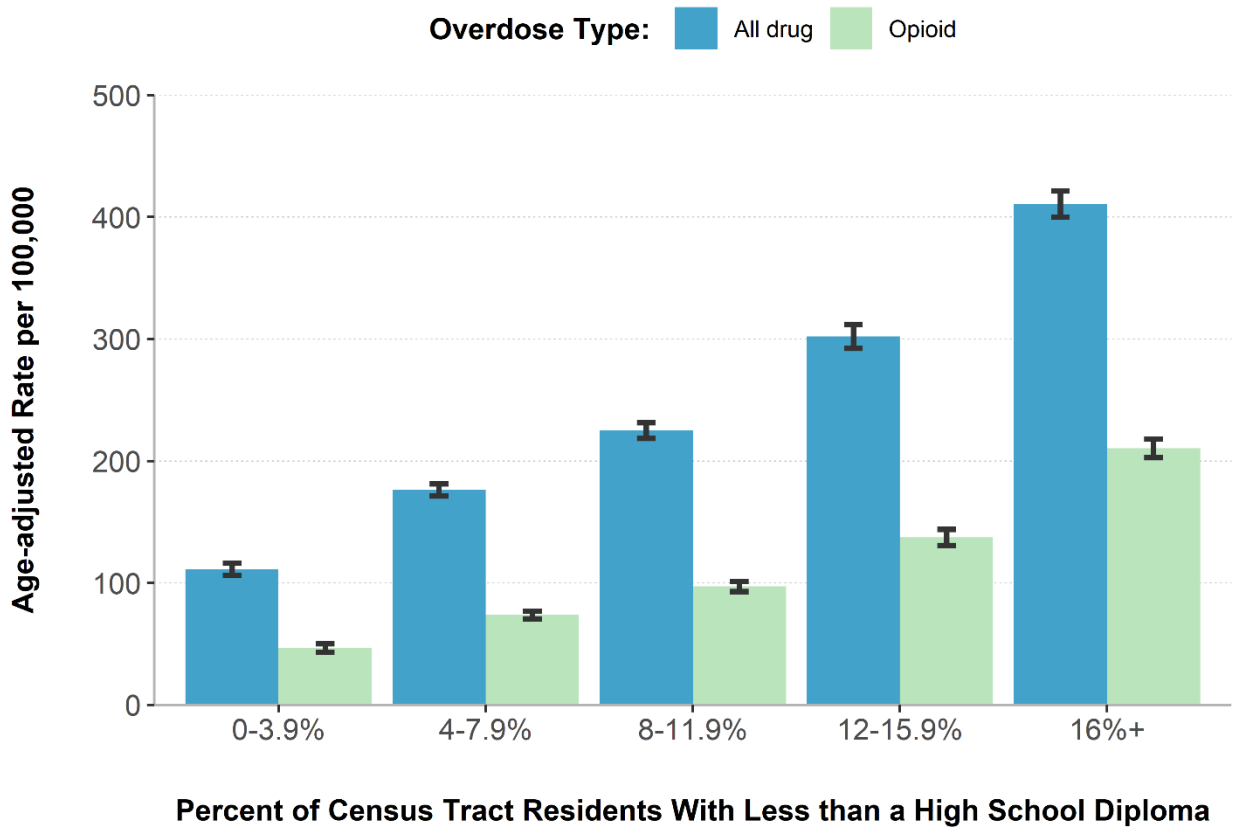
[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1701.

*There were 3,201 records with an unknown census tract of residence and six records that had a census tract of residence for which the poverty rate could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract poverty rate but did not have age recorded.

Nonfatal overdose rates were also compared by census tract-level educational attainment. Age-adjusted rates of nonfatal all drug and opioid overdoses were higher in census tracts with a larger percent of residents aged 25 years and older who had less than a high school diploma or equivalent (Figure 11). Census tracts with the highest percent of adults (aged 25 years and older) without a high school diploma or equivalent (16 percent or higher) had an age-adjusted rate of nonfatal overdoses 3.7 times higher than census tracts with the lowest percent of adults without a high school diploma or equivalent (0-3.9 percent). The age-adjusted rate of nonfatal opioid overdoses in census tracts with the highest percent of residents without a high school diploma or equivalent was 4.5 times higher than the rate in census tracts with the lowest percent of adult residents without a high school diploma or equivalent.

Figure 11: Number and Age-Adjusted Rate of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Educational Attainment among Adults 25 Years and Older in Census Tract of Residence, 2018[3,4]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1501.

*There were 3,201 records with an unknown census tract of residence and three records that had a census tract of residence for which the educational attainment could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract educational attainment rate but did not have age recorded.

Nonfatal Overdoses by Specified Drug and Alcohol Involvement

Almost half (45.3 percent) of all nonfatal drug overdose visits involved one or more opioids. Roughly one in 12 visits (8.4 percent) involved drugs not specified. Opioid-involved drug overdoses were significantly more likely to involve more than one drug than nonopioid drug overdoses ($\chi^2 = 54.236$, $p < 0.001$). Overall, 13.8 percent of nonfatal drug overdose visits involved more than one drug. Among opioid overdose visits, 16.5 percent involved more than one drug and 13.3 percent of nonopioid overdose visits involved more than one drug.

Almost two out of three (62.1 percent) opioid overdoses involved heroin (Table 3). Only 2.9 percent of opioid overdoses involved methadone and 3.9 percent involved synthetic opioids other than methadone. Approximately one-third (33.0 percent) of opioid-involved overdoses were attributed to other and unspecified opioids. The class of nonopioid drug most commonly involved in opioid-involved polysubstance overdoses was benzodiazepine; however, benzodiazepines were only present in 5.5 percent of opioid overdoses. Psychostimulants such as amphetamines and ecstasy were present in less than 2 percent of opioid overdoses.

Among nonopioid nonfatal overdoses, the drugs most commonly involved were benzodiazepine (12.3 percent) and nonopioid analgesics, antipyretic, and antirheumatic drugs (11.7 percent). Nonopioid analgesics, antipyretic, and antirheumatic drugs include both over the counter (OTC) drugs such as aspirin, acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAID) and prescription drugs used to treat rheumatism. Other drugs commonly present in nonopioid overdoses include antidepressants, antipsychotics, cocaine, and marijuana.

A single overdose visit may involve more than one type of drug poisoning; therefore, a single visit may be represented in more than one row in Table 3. Table 3 does not include the 2,128 nonfatal drug overdose visits that did not specify any drugs involved.

Table 3: Number and Percent of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Overdoses among Michigan Residents by Drug Class Involvement, 2018[1]

	Opioid-Involved Overdose[2] Number (n=11,521)	Opioid-Involved Overdose Percent	Nonopioid-Involved Overdoses[3] Number (n=11,770)	Nonopioid-Involved Overdose Percent
Antidepressant[4]	45	0.4%	839	7.1%
Antiepileptic, Sedative- Hypnotic and Antiparkinsonism				
Barbiturate[5]	22	0.2%	48	0.4%
Benzodiazepine[6]	636	5.5%	1,448	12.3%
Other/Unspecified Antiepileptic, Sedative- Hypnotic and Antiparkinsonism[7]	178	1.5%	1,128	9.6%
Antipsychotic[8]	32	0.3%	695	5.9%
Cannabis[9]	167	1.4%	914	7.8%
Cocaine[10]	546	4.7%	993	8.4%
Nonopioid Analgesic, Antipyretic, and Antirheumatic[11]	99	0.9%	1,375	11.7%
Skeletal Muscle Relaxant[12]	32	0.3%	142	1.2%
Specified Opioids				
Heroin[13]	7,151	62.1%	n/a	n/a
Methadone[14]	331	2.9%	n/a	n/a
Other Synthetic Opioid[15]	444	3.9%	n/a	n/a
Other and Unspecified Opioid[16]	3,800	33.0%	n/a	n/a
Specified Psychostimulants				
Amphetamine[17]	140	1.2%	521	4.4%
Ecstasy[18]	0	0.0%	*	*
Other Psychostimulant[19]	*	*	158	1.3%

[1] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

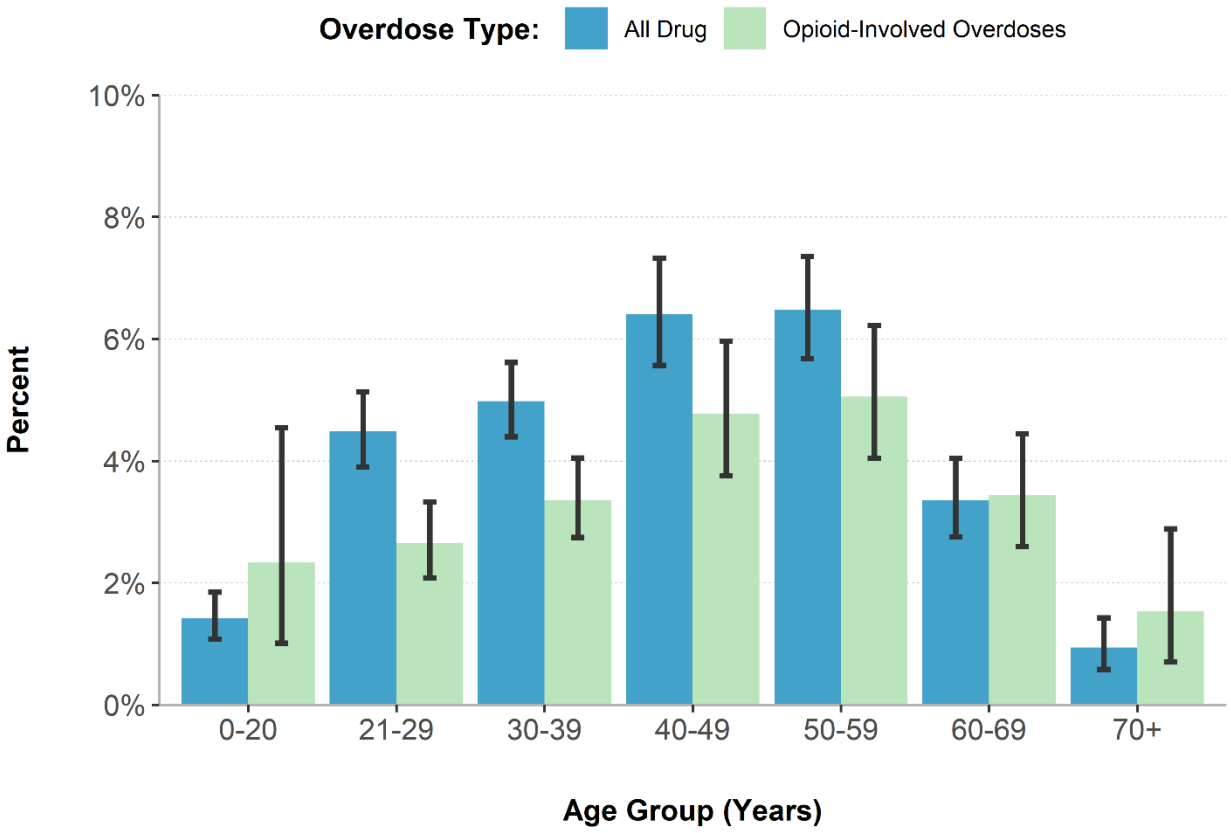
[3] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 or 4 listed as a principal or any secondary diagnosis, excluding opioid overdose codes and visits with only unspecified overdose codes (T50.901A, T50.911A, T50.902A, T50.912A).

[4] Includes initial visits with any ICD-10-CM code of T43.0- T43.2 with a sixth digit of 1 or 4.

[5] Includes initial visits with any ICD-10-CM code of T42.3 with a sixth digit of 1 or 4.
[6] Includes initial visits with any ICD-10-CM code of T42.4 with a sixth digit of 1 or 4.
[7] Includes initial visits with any ICD-10-CM code of T42.0-T42.2 or T42.5-T42.8 with a sixth digit of 1 or 4.
[8] Includes initial visits with any ICD-10-CM code of T43.3-T43.5 or T43.59 with a sixth digit of 1 or 4.
[9] Includes initial visits with any ICD-10-CM code of T40.7 with a sixth digit of 1 or 4.
[10] Includes initial visits with any ICD-10-CM code of T40.5 with a sixth digit of 1 or 4.
[11] Includes initial visits with any ICD-10-CM code of T39.0-T39.4 or T39.8-T39.9 with a sixth digit of 1 or 4.
[12] Includes initial visits with any ICD-10-CM code of T48.1 with a sixth digit of 1 or 4.
[13] Includes initial visits with any ICD-10-CM code of T40.1 with a sixth digit of 1 or 4.
[14] Includes initial visits with any ICD-10-CM code of T40.3 with a sixth digit of 1 or 4.
[15] Includes initial visits with any ICD-10-CM code of T40.4 with a sixth digit of 1 or 4.
[16] Includes initial visits with any ICD-10-CM code of T40.0, T40.2, T40.6, T40.69 with a sixth digit of 1 or 4.
[17] Includes initial visits with any ICD-10-CM code of T43.62 with a sixth digit of 1 or 4.
[18] Includes initial visits with any ICD-10-CM code of T43.64 with a sixth digit of 1 or 4.
[19] Includes initial visits with any ICD-10-CM code of T43.60, T43.61, T43.63, T43.69 with a sixth digit of 1 or 4.
Note: Excludes 2,128 unspecified unintentional and undetermined intent drug overdose visits.
* Suppressed due to the count being between one and five.

Alcohol use can heighten the risk of overdose and other adverse health effects when consumed in combination with certain prescription or illicit drugs by either interfering with the metabolism of the drug or by enhancing the effects of the drug.[17] Alcohol consumption is known to enhance sedative effects of opioids and central nervous system depressants such as barbiturates and benzodiazepines as well as increase the toxic effects of common OTC pain medications such as acetaminophen.[3] Among all 25,419 nonfatal drug overdose visits, 1,059 (4.2 percent) had an alcohol intoxication diagnosis code. Nonopioid overdoses were more likely to include an alcohol toxicity code than opioid overdoses (4.7 percent vs. 3.5 percent, $\chi^2 = 21.2$, $p<0.001$). Nonfatal overdoses among individuals aged 40-59 years were the most likely to involve alcohol intoxication (Figure 12).

Figure 12: Percent of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Overdoses[1] Involving Alcohol Intoxication[2] by Age Group among Michigan Residents, 2018[3]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 or 4 listed as a principal or any secondary diagnosis, excluding opioid overdose codes and visits with only unspecified overdose codes (T50.901A, T50.911A, T50.902A, T50.912A).

[2] Includes ICD-10-CM codes F10.12, F10.22, and T51.0X1 or T51.0X4 with a sixth character of 'A'.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

Note: Age was unknown in four visits.

Healthcare Characteristics of Nonfatal Overdose Hospital Visits

Approximately one in 12 overdoses, including both those treated and released from the ED (8.1 percent) and those that were treated in an inpatient (8.3 percent) setting resulted in the patient leaving against medical advice (Table 4). Overdoses treated in an inpatient setting were more likely than those treated and released from the ED to be discharged to another medical facility, such as a skilled nursing facility or intermediate care facility and were more likely to be discharged to a psychiatric care facility. The majority of nonfatal drug overdoses treated and released from the ED and those that required inpatient care resulted in a discharge to the patient's home (84.8 percent and 70.6 percent, respectively).

Table 4: Disposition of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Drug Overdoses[1] among Michigan Residents 2018

	Emergency Department Number (n=18,322)	Emergency Department Percent	Inpatient Number (n=7,083)	Inpatient Percent
Court or Law Enforcement	202	1.1%	50	0.7%
Home	15,536	84.8%	5,004	70.6%
Hospice	*	*	77	1.1%
Left Against Medical Advice	1,480	8.1%	587	8.3%
Transferred to Medical Facility	752	4.1%	1,028	14.5%
Transferred to Psychiatric Care	347	1.9%	337	4.8%

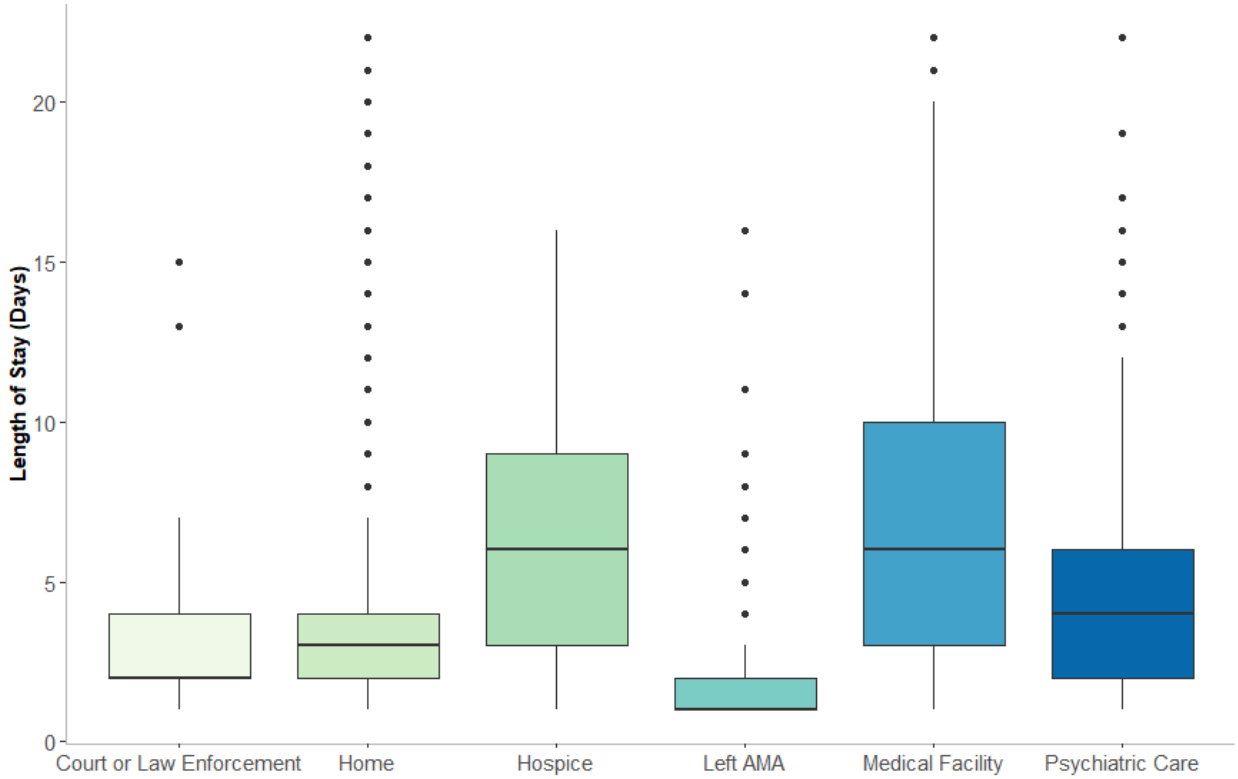
[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

* Suppressed due to the count being between one and five.

Note: Fourteen emergency department visits were discharged with an unknown disposition or invalid discharge disposition code.

After removing 107 extreme outliers, the median LOS for nonfatal drug overdoses treated in an inpatient setting was three days (interquartile range (IQR): 3.0). The results of the Kruskal-Wallis test indicated that the median LOS significantly varied by discharge disposition ($p < 0.001$). Inpatient visits that were discharged to another medical facility (median=six days, IQR=seven days) and inpatient visits that were discharged to hospice (median=six days, IQR=six days) had the longest median LOS. Inpatient visits discharged to psychiatric care had an average LOS of four days (IQR=four days). Visits that were discharged against medical advice (AMA) had the shortest median LOS at one day (IQR=one day). The distribution of inpatient LOS for each discharge disposition is presented in Figure 13. Each box represents the IQR (i.e., visits with a LOS between the 25th and 75th percentile), and the line bisecting each box represents the median LOS.

Figure 13: Distribution of Length of Stay (LOS) for Nonfatal Unintentional and Undetermined Intent Overdose Inpatient Visits[1] among Michigan Residents by Discharge Disposition, 2018[2]



[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 or 4 listed as a principal or any secondary diagnosis, excluding opioid

[2] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association. Note: 107 extreme outliers (z-score above 3.5) were removed.

Concurrent Mental and Behavioral Health Diagnoses

Previous research has shown a high prevalence of certain mental health disorders among individuals who experience drug overdose.[4, 5] This finding may be explained by a number of factors, including increased risk of adverse drug interactions involving drugs commonly used to treat mental health disorders, a high prevalence of depression among persons with chronic pain disorders for which opioids may are often prescribed, and an increased prevalence of risk-taking behaviors among individuals with certain mental health disorders.[6, 7, 8]

Among all nonfatal drug overdoses, 7,112 (28.4 percent) had at least one of the specified mental health diagnoses listed in Table 5 concurrently documented on the administrative billing record at the time of the overdose. Among nonfatal opioid overdoses, 2,628 (22.8 percent) had at least one of the specified mental health diagnoses in Table 5 concurrently documented. Only 14.3 percent of inpatient and emergency department visits not involving nonfatal overdoses had a mental health diagnosis code listed in Table 5 documented on the administrative billing record. The most frequently listed mental health diagnosis category among all drug overdoses and opioid-involved overdoses was major depressive disorders.

Table 5: Number and Percent of Concurrent Mental Health Diagnoses among Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Overdoses[1], Michigan Residents 2018[2]

	All Drug Overdose Number	All Drug Overdose Percent	Opioid Overdose Number	Opioid Overdose Percent
Schizophrenia, Schizotypal, Delusional, and Other Non-Mood Psychotic Disorders[3]	799	3.1%	234	2.0%
Mood Disorders				
Bipolar Disorder[4]	1,731	6.8%	684	5.9%
Major Depressive Disorders[5]	3,482	13.7%	1,293	11.2%
Other and Unspecified Mood Disorders[6]	203	0.8%	60	0.5%
Anxiety, Dissociative, Stress-Related, Somatoform and Other Nonpsychotic Mental Disorders				
Panic Disorder[7]	178	0.7%	50	0.4%
Generalized Anxiety Disorder[8]	346	1.4%	109	0.9%
Obsessive Compulsive Disorder[9]	51	0.2%	12	0.1%
Reaction to Severe Stress and Adjustment Disorders[10]	632	2.5%	211	1.8%
Other and Unspecified Anxiety Disorders[11]	3,235	12.7%	1,249	10.8%

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 or 4 listed as a principal or any secondary diagnosis.

[2] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[3] Includes any diagnosis of F20-F25 or F28-F29.

[4] Includes any diagnosis of F31.

[5] Includes any diagnosis of F32-F33.

[6] Includes any diagnosis of F30, F34 or F39.

[7] Includes any diagnosis of F41.0.

[8] Includes any diagnosis of F41.1.

[9] Includes any diagnosis of F42.

[10] Includes any diagnosis of F43.

[11] Includes any diagnosis of F40, F41.3, F41.8, F41.9, F44, F45, or F48.

Discussion

Trends and Characteristics of Nonfatal Overdoses

The age-adjusted rate of inpatient admissions for all types of nonfatal overdoses was relatively stable in 2016 and 2017; however there was a 12.2 percent decline in 2018, outpacing the decline in overdose deaths during the same year (2.7 percent decline). Due to the change in ICD-CM coding system in 2015, it is unfortunately not possible to evaluate long-term trends in inpatient admission rates. However, during the period before the change in coding systems (2009-2014), the age-adjusted rate increased by an average of only 0.6 percent annually.

The magnitude of the observed decline in inpatient visits for nonfatal overdose rates between 2016 and 2018 was larger for opioid-involved overdoses (-23.6 percent) than nonopioid overdoses (-4.0 percent). These data suggest that strategies aimed at reducing prescription opioid access, such as mandating the use of prescription drug monitoring programs for prescribers and limiting the amount of opioids prescribed for acute pain, may have been successful in reducing the burden of opioid overdoses. However, in 2018 there was a roughly equal number of nonfatal overdoses that did not involve opioids than those that did involve opioids. Nonopioid overdoses involving antidepressants, antiepileptics, sedative-hypnotics, antiparkinsonism, and nonopioid pain medication, such as common OTC drugs like aspirin and acetaminophen, accounted for almost one-in-five nonfatal overdoses (19.0 percent). These data underscore the need for more diverse strategies that can reach individuals at risk of unintentional overdose who do not fit the traditional paradigm of opioid-dependent patients.

Geographic and Demographic Patterns

High-risk areas included both urban counties such as Wayne, Calhoun, and Genesee and remote, rural counties such as Oscoda and Alcona in the northern Lower Peninsula. There were clear demographic patterns, with individuals between the ages of 25 and 34 years exhibiting the highest risk for all drug and opioid-involved nonfatal overdoses. Males are particularly at high risk, with a total overdose age-adjusted rate 26.2 percent higher than females and an opioid overdose age-adjusted rate 65.1 percent higher than females. Males between the ages of 20 and 39 years accounted for almost one-in-four (24.0 percent) nonfatal overdoses in 2018. Age-adjusted rates of overdoses also varied by race, with Black residents experiencing the highest rates of both all drug and opioid-involved overdoses. The observed age-adjusted overdose rate among AI/AN residents was below that for White residents. However, it is possible that the rate among AI/AN residents is an underestimate in light of research that has shown AI/AN individuals are frequently misclassified in administrative and health records as another race.[18,19] Caution should be exercised when interpreting race-stratified data, particularly because vital records data has demonstrated that the AI/AN population is at an increased risk of unintentional and undetermined drug overdose mortality compared with other racial groups, in contrast to the results of the nonfatal drug overdose analysis[1].

Community-Level Socioeconomic Characteristics

This report provides evidence of a correlation between community-level socioeconomic characteristics, including unemployment, poverty, and low educational attainment, and the incidence of nonfatal

overdoses. Although the data used in this report cannot tell us about the socioeconomic status of the individuals experiencing overdose, it does reveal information about the environment in which they live.

Census tracts were used as a proxy for communities; however administrative boundaries like census tracts may not perfectly align with socially constructed boundaries. Additionally, in sparsely populated counties, census tracts may need to encompass a wide geographic area in order to reach the minimum population of 1,200 residents. Nonetheless, census tracts maintain the benefit of covering a relatively small geographic area while maintaining an underlying population size sufficient for statistical analysis.

Census tracts experiencing the most socioeconomic hardship consistently had the highest age-adjusted rates of nonfatal overdoses. For example, census tracts in the highest quintile for unemployment had an age-adjusted rate 3.3 times higher for all overdoses and an age-adjusted rate 4.2 times higher rate for opioid overdoses than census tracts in the lowest quintile for unemployment. These findings are in line with other studies that have shown increases in overdose rates in areas affected by rising joblessness.[20,21] Although this relationship is not fully understood, researchers have theorized that overdoses are one of many outcomes linked to diminished mental health resulting from economic hardship.[20]

Overdose prevention programs should consider the impact of socioeconomic factors on their target areas and populations and how these factors affect individuals' ability to access and engage with prevention resources. For example, unemployment could result in disruptions to insurance coverage for substance use disorder treatment stigma surrounding the disclosure of one's drug use may be perceived as an impediment to finding employment.

Alcohol Use and Polydrug Use

Polydrug use was documented in 13.8 percent of all nonfatal drug overdoses. However, given the limited capacity of many hospitals to perform comprehensive toxicology testing, this is likely an underestimate of the true extent of polydrug use among nonfatal overdoses.[22] Common drug combinations among polydrug overdoses included heroin and cocaine (12.2 percent of polydrug overdoses) and benzodiazepines and opioids of all types (20.7 percent of polydrug overdoses). Alcohol intoxication was only documented in 4.2 percent of nonfatal overdoses.

Disposition and Length of Stay

Slightly more than four-in-five (80.8 percent) nonfatal drug overdoses treated in an ED or inpatient setting resulted in a discharge to the patient's home. The remaining overdoses were either discharged to another facility or care setting, such as a medical care or psychiatric care facility (11.1 percent) or left against medical advice (AMA) (8.1 percent). Leaving AMA was slightly more prevalent in overdoses admitted for inpatient care compared to those released from the EDs. Although a minority of overdose visits resulted in an AMA discharge, the percentage was much higher compared to non-overdose hospital visit AMA discharges (1.5 percent).

Opioid overdose patients who are discharged AMA have been shown to have a greater likelihood of being readmitted within 90 days for both opioid overdose and all-causes.[23] Reasons for leaving AMA may include personal or financial obligations, drug-seeking behaviors, patient anxiety and emotional

distress, and the length of treatment/hospitalization exceeding the patient's expectations.[24] Research has demonstrated that initiation of medication-assisted treatment (MAT) with buprenorphine or methadone and/or residential treatment shortly after discharge reduces the risk of behavioral-health related readmissions.[23] These findings underscore the importance of providing post-overdose outreach and follow-up to patients, especially those who are discharged from medical treatment AMA.

Mental Health Conditions

Mental health disorders were documented in more than one-in-four (28.4 percent) nonfatal overdoses. The most commonly documented mental health diagnoses included major depression and other/unspecified anxiety disorders. Mental health diagnoses may be underestimated in hospital discharge records if the patient had a previous diagnosis and did not disclose that information in the course of treatment.

Previous research has found that individuals with psychiatric disorders often engage in drug use as a means to alleviate symptoms associated with the underlying mental health condition.[25] Among individuals who use drugs, those with depression are more likely to experience an overdose compared to those without depression.[26] Although the underlying mechanism that increases the risk of overdose among individuals with mental health conditions is not fully understood, it is hypothesized that the increased risk may be due to a decreased likelihood of practicing protective behaviors such as ensuring access to overdose reversal medications, such as Naloxone.[26]

Conclusions

This report demonstrates that nonfatal overdoses continue to present a significant public health issue in Michigan, with certain populations disproportionately affected. Although the available data do not indicate that nonfatal overdoses are increasing in frequency, they remain a relatively common occurrence with more than 25,000 overdoses being treated in Michigan hospitals annually. The lack of historical ED data precludes a comprehensive evaluation of trends in nonfatal overdose in Michigan, especially considering that the majority of nonfatal overdoses are treated and released from the ED. Prospective analysis of ED data in future years will be critical to understanding trends and risk factors associated with drug overdoses.

Young adults, males, Black residents, and individuals living in areas of low socioeconomic status are disproportionately experiencing nonfatal overdoses. Polydrug use and co-occurring mental health disorders are present in a substantial percent of all nonfatal overdoses. Successful public health strategies aimed at preventing overdose should address conditions that may act as a barrier to harm-reduction and substance use disorder (SUD) treatment such as socioeconomic hardship, heightened social stigma for specific demographic groups, and the need for comprehensive and effective mental health care in tandem with SUD treatment.

Limitations

Several limitations to this analysis should be considered when interpreting results. First, the unavailability of ED data prior to 2018 precludes a comprehensive evaluation of trends in nonfatal overdose. Inpatient data, which are available from 2009 through 2018, only comprise about 28 percent

of nonfatal overdoses treated in a hospital setting. Second, due to the significant differences between the ICD-9-CM and ICD-10-CM coding systems and case definitions, comparisons of the data prior to and after 2015 cannot be made. The ICD-10-CM standardized case definition includes any listed diagnosis for unintentional or undetermined intent overdose, whereas the ICD-9-CM case definition required the appropriate diagnosis codes to be present as a first-listed external cause code or as a primary diagnosis with an accompanying first-listed external cause code.[11] Additionally, under ICD-9-CM, the intent of the overdose could only be determined by the inclusion of an external cause code. However, the ICD-9-CM system allowed documentation of drug overdoses (960-979) without an external cause code. In fact, nearly one-in-five inpatient admissions for drug poisoning from 2009 to 2014 were missing an external cause code. Under ICD-10-CM, the intent of a drug overdose is embedded in the diagnosis code for the overdose, preventing documentation of a drug overdose with ambiguous intent. Furthermore, under ICD-10-CM, overdose hospital visits are classified as either an initial visit, a follow-up visit, or a sequalae visit. For the purposes of this report, only initial visits were included in the case definition for unintentional and undetermined intent overdoses. There was no distinction made for follow-up visits under ICD-9-CM, so it was not possible to exclude these from the case definition for unintentional and undetermined intent drug overdoses from 2009 to 2014. Third, about 3 percent of hospitals did not report ED and/or inpatient data for 2018. This resulted in the suppression of data for certain geographical areas. Fourth, coding practices may also vary by hospital and therefore may impact results. Specifically, hospitals that tend to code overdoses using "F" codes (for drug abuse and dependence) would appear to have fewer overdose cases than hospitals that do not have this coding practice. This could result in biased results both geographically and demographically. Fifth, ED and inpatient visits included unique events, not unique persons, and might reflect multiple visits for a single person. Lastly, the true number of nonfatal unintentional and undetermined intent overdoses is likely underestimated because not all nonfatal drug overdoses receive care in a hospital setting.

Appendix A: Non-Reporting Hospitals

Hospital	County	Total Inpatient Beds	Years Not Reporting Emergency Department Data	Years not Reporting Inpatient Data
University of Michigan Health System	Washtenaw	1,000	2018	No years of missing data
Sheridan Community Hospital	Montcalm	22	2018	2016 - 2018
Pontiac General Hospital	Oakland	306	No emergency department	2016 - 2018
McLaren Northern Michigan, Cheboygan	Cheboygan	202	None	2013- 2018
Baraga County Memorial Hospital	Baraga	15	None	2016 - 2017

Appendix B: Tables for Figures 1-13

Table 1a: Age-adjusted Rate of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents, 2018[3, 4]

	Inpatient Visit Number	Inpatient Visit Rate	95% CI	ED Visit Number	ED Visit Rate	95% CI
Year						
2009	4,243	41.2	40.0-42.5	n/a	n/a	n/a
2010	4,617	44.8	43.5-46.1	n/a	n/a	n/a
2011	4,788	46.1	44.7-47.4	n/a	n/a	n/a
2012	4,607	44.0	42.7-45.4	n/a	n/a	n/a
2013	4,787	45.3	44.0-46.7	n/a	n/a	n/a
2014	4,466	42.2	40.9-43.5	n/a	n/a	n/a
2015	n/a	n/a	n/a	n/a	n/a	n/a
2016	5,900	54.7	53.3-56.2	n/a	n/a	n/a
2017	5,929	54.6	53.2-56.1	n/a	n/a	n/a
2018	5,237	47.9	46.5-49.2	18,336	189.6	187.3 -191.8

[1] From 2009-2014, unintentional and undetermined intent overdoses included visits with a first-listed external cause of injury ICD-9-CM code E850 through E858 or E980.0 through E980.5.

[2] From 2016-2018, unintentional and undetermined intent overdoses included initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2009-2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics. Intercensal estimates of the resident population (July 1, 2009), National Center for Health Statistics.

Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Data for 2015 are not shown due to the transition from ICD-9-CM to ICD-10-CM on October 1, 2015. Rates for 2009-2014 are not comparable to rates for 2016-2018, thus only the trends within each time period can be compared

Table 2a: Age-Adjusted Rate (per 100,000) of Emergency Department Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Drug Overdoses among Michigan Residents by Opioid[1] Involvement, Visit Type, and by Year, 2009-2018[2, 3, 4]

	No Opioid Involvement Number	No Opioid Involvement Rate	95% CI	One or More Opioids Number	One or More Opioids Rate	95% CI	Unspecified Number	Unspecified Rate	95% CI
Inpatient									
2009	3,114	30.4	29.3-31.5	992	9.4	8.86-10.1	137	1.4	1.2-1.6
2010	3,221	31.4	30.3-32.5	1,229	11.8	11.1-12.5	167	1.6	1.4-1.9
2011	3,400	32.9	31.8-34.1	1,202	11.3	10.7-12.0	186	1.8	1.6-2.1
2012	3,111	29.9	28.8-31.0	1,293	12.1	11.5-12.8	203	2.0	1.7-2.3
2013	3,235	30.8	29.7-31.9	1,343	12.5	11.8-13.2	209	2.0	1.7-2.3
2014	2,976	28.2	27.2-29.3	1,287	12.0	11.3-12.7	203	2.0	1.7-2.3
2015	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2016	2,935	27.5	26.5-28.6	2,643	24.2	23.2-25.2	322	3.0	2.7-3.4
2017	3,041	28.1	27.1-29.2	2,538	23.1	22.2-24.1	350	3.4	3.0-3.8
2018	2,875	26.4	25.4-27.4	2,046	18.5	17.7-19.4	316	3.0	2.7-3.4
ED									
2018	7,760	80.6	80.6	8,827	90.7	88.7-92.6	1,749	18.3	17.4-19.2

[1] From 2009-2014, unintentional and undetermined intent opioid overdoses included visits with either a primary ICD-9-CM code of 965.0 accompanied by a first-listed external cause ICD-9-CM code of E850-E858 or a first-listed external cause ICD-9-CM code of E850.0-E850.2; unintentional and undetermined intent unspecified overdoses included visits with a primary ICD-9-CM code of 977.9 or a first-listed external cause ICD-9-CM code of E858.9 or E980.5 and no other drug-overdose code present; unintentional and undetermined intent overdoses not involving opioids included all other visits with a first-listed external cause of injury ICD-9-CM code E850.3 through E858 or E980.0 through E980.5, without a primary diagnosis of 965.0. From 2016-2018, unintentional and undetermined intent opioid overdoses included initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis; unintentional and undetermined intent unspecified overdoses included visits with an ICD-10-CM code of T50.901 or T50.904 listed as a primary or any secondary diagnosis in the absence of any other drug poisoning code; unintentional and undetermined intent overdoses not involving opioids included initial visits with an ICD-10-CM code of T36-T39.9, T40.5, T40.7-T50.8, T50.99, T50.A, T50.B, or T50.Z and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis without the presence of an opioid overdose diagnosis code.

[2] 2009-2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[3] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

[4] Intercensal estimates of the resident population (July 1, 2009), National Center for Health Statistics.

Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Data for 2015 are not shown due to the transition from ICD-9-CM to ICD-10-CM on October 1, 2015. Rates for 2009-2014 are not comparable to rates for 2016-2018, thus only the trends within each time period can be compared. Emergency department data are only available for 2018.

Table 3-4a: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid Overdoses[2] by County of Residence, Michigan 2018[3, 4]

County	All Drug Number	All Drug Rate	95% CI	Opioid Number	Opioid Rate	95% CI
Alcona	27	350.4	212.8-550.0	11	159.4	71.8-312.3
Alger	19	198.3	112.7-337.1	10	94.0	40.0-204.5
Allegan	195	176.0	151.6-203.4	48	45.0	32.9-60.4
Alpena	76	314.3	244.5-399.2	31	126.1	84.0-183.4
Antrim	45	246.4	175.8-338.3	11	61.6	28.9-117.5
Arenac	28	179.0	113.5-274.1	10	65.0	28.5-133.6
Baraga	25	318.3	199.5-492.1	*	*	*
Barry	103	181.2	146.8-221.9	49	87.1	63.6-117
Bay	270	278.5	245.0-315.7	132	134.6	111.8-161
Benzie	26	140.5	87.2-219.1	10	52.3	23.3-107.9
Berrien	363	236.9	212.2-264.1	97	64.7	52.0-79.9
Branch	107	265.4	216.3-323.2	40	101.8	72.1-140.5
Calhoun	526	405.2	370.3-442.8	268	218.4	192.4-247.1
Cass	81	167.8	131.4-212.1	18	31.0	17.3-52.6
Charlevoix	29	125.1	81.7-186.0	7	30.2	11.2-68.4
Cheboygan	38	170.4	115.9-243.9	*	*	*
Chippewa	67	183.0	140.4-235.7	22	49.3	30.3-78.2
Clare	92	307.0	242.9-384.6	36	134.8	91.9-192.1
Clinton	123	161.4	133.4-193.9	63	84.1	64.2-108.8
Crawford	39	312.5	215.3-445.5	14	106.6	53.8-198.1
Delta	72	215.9	165.3-278.3	10	21.8	9.0-46.6
Dickinson	67	274.9	209.8-356.4	20	76.0	44.7-124.3
Eaton	291	275.0	243.4-310.0	128	124.1	103.1-148.5
Emmet	39	128.6	89.8-179.7	*	*	*
Genesee	1,707	435.3	414.2-457.3	867	227.1	211.8-243.4
Gladwin	64	260.9	196.1-343.2	23	89.9	53.4-145.1
Gogebic	22	159.6	96.2-254.1	6	43.7	15.3-105.4
Grand Traverse	140	152.0	126.9-181.0	40	40.8	28.6-57.0
Gratiot	61	154.2	116.7-201.1	15	32.9	18.1-57.1

Table 3-4a cont.	All Drug Number	All Drug Rate	95% CI	Opioid Number	Opioid Rate	95% CI
Hillsdale	77	194.8	152.3-246.1	27	73.8	47.9-109.2
Houghton	65	180.8	136.9-236.7	11	27.1	12.7-54.6
Huron	58	195.1	144.5-260.2	19	71.6	41.5-117.5
Ingham	709	248.3	229.6-268.3	330	114.6	102-128.5
Ionia	131	212.3	177.0-253.0	37	58.0	40.6-80.8
Iosco	57	270.5	199.6-361.3	22	100.3	60.3-160.6
Iron	27	313.4	197.8-475.7	8	100.2	40.1-210.8
Isabella	116	180.3	146.9-219.9	39	51.5	35.3-74.0
Jackson	521	347.2	317.2-379.4	236	159.0	138.8-181.4
Kalamazoo	660	256.5	236.7-277.6	278	108.0	95.3-122.2
Kalkaska	34	209.6	142.9-299.0	14	82.9	43.3-146.1
Kent	1,145	172.1	162.1-182.7	394	58.1	52.4-64.3
Keweenaw	7	282.0	91.4-794.2	0	0.0	0.0-0.0
Lake	30	295.8	188.9-445.1	9	85.8	33.6-183.7
Lapeer	168	214.9	182.6-251.7	73	97.5	75.9-123.7
Leelanau	16	66.9	33.5-123.9	*	*	*
Lenawee	276	303.3	267.6-342.8	144	165.2	138.9-195.5
Livingston	249	142.0	124.3-161.6	109	65.7	53.7-79.7
Luce	8	135.2	56.4-290.7	*	*	*
Mackinac	10	84.4	36.7-180.0	*	*	*
Macomb	2,468	287.0	275.4-298.9	1,306	153.0	144.6-161.8
Manistee	63	275.9	206.7-363.0	24	93.0	56.7-147.3
Marquette	109	178.1	144.8-217.4	23	36.7	22.7-57.2
Mason	67	247.1	188.7-319.9	25	83.3	51.9-129.5
Mecosta	85	200.9	157.9-254	17	37.7	20.7-65.5
Menominee	47	215.7	153.6-296.3	9	53.7	24.3-103.8
Midland	139	170.9	143.1-203.0	64	80.8	60.5-101.6
Missaukee	15	102.8	55.6-180.8	*	*	*
Monroe	351	257.6	230.6-287.1	167	125.3	106.5-146.5
Montcalm	148	233.3	196.2-275.9	54	83.6	62.3-110.7

Table 3-4a cont.	All Drug Number	All Drug Rate	95% CI	Opioid Number	Opioid Rate	95% CI
Montmorency	15	225.1	117.9-395.4	7	100.1	34.7-225.7
Muskegon	483	292.1	266.0-320.2	217	131.3	114.0-150.7
Newaygo	111	245.2	200.2-298.3	39	94.0	66.2-130.4
Oakland	*	*	*	*	*	*
Oceana	47	189.9	137.7-257.6	15	64.3	34.9-110.5
Ogemaw	67	339.3	255.5-444.8	25	142.3	88.2-219.9
Ontonagon	*	*	*	0	0.0	0.0-0.0
Osceola	50	233.9	171.3-314.4	19	81.2	47.3-133.3
Oscoda	25	335.9	207.3-529.0	12	186.6	91.2-352.1
Otsego	47	214.2	154.7-291.3	19	95.3	55.9-153.8
Ottawa	328	116.0	103.6-129.8	70	25.4	19.7-32.5
Presque Isle	16	135.0	69.4-243.0	*	*	*
Roscommon	64	327.7	243.2-435.0	26	137.2	83.8-214.7
Saginaw	532	273.5	249.6-299.2	204	108.4	93.4-125.4
St. Clair	469	324.9	295.1-357.1	245	178.3	156.1-203.1
St. Joseph	126	205.7	170.0-247.5	37	65.1	45.1-91.6
Sanilac	108	263.4	213.4-323.0	38	95.1	65.9-134.4
Schoolcraft	21	268.4	153.1-447.2	8	69.3	27.0-174.4
Shiawassee	171	265.6	225.8-310.9	74	117.7	91.5-149.7
Tuscola	90	195.7	156.0-243.0	36	84.1	58.3-117.9
Van Buren	172	247.0	210.3-288.7	44	64.6	46.3-88.3
Washtenaw	*	*	*	*	*	*
Wayne	6,694	366.2	357.2-375.4	3,383	180.4	174.2-186.9
Wexford	69	204.0	156.9-262.6	20	56.3	33.3-91.5

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

*Rates are not displayed for counties with between one and five drug overdoses and counties that contain hospitals with 100 or more licensed beds that did not report ED or inpatient data.

Note: Rates were age-adjusted to the 2000 US population by the direct standardization method.

Table 5a: Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Age Group, 2018[3, 4]

Age Group	All Drug Overdose Number	All Drug Overdose Rate	95% CI	Opioid Overdose Number	Opioid Overdose Rate	95% CI
0-14	2,341	131.6	126.4-137.1	78	4.4	3.5-5.5
15-24	3,087	228.9	220.9-237.2	1,089	80.8	76.0-85.7
25-34	5,802	447.5	436.0-459.1	3,646	281.2	272.1-290.5
35-44	3,793	326.1	315.8-336.6	2,141	184.1	176.3-192.0
45-54	3,096	240.0	231.6-248.6	1,487	115.3	109.5-121.3
55-64	3,748	267.2	258.7-275.9	1,874	133.6	127.6-139.8
65+	3,548	206.7	199.9-213.6	1,202	70.0	66.1-74.1

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

Note: Age was unknown in four visits.

Table 6a: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Sex, 2018[3, 4]

Age Group	All Drug Overdose Number	All Drug Overdose Rate	95% CI	Opioid Overdose Number	Opioid Overdose Rate	95% CI
Male	13,988	283.9	276.9-288.8	7,082	143.1	140.1-146.7
Female	11,427	225.0	221.3-228.9	4,437	86.7	84.1-89.4

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] Vintage 2018 postcensal estimates of the resident population (July 1, 2010-July 1, 2018), National Center for Health Statistics.

Notes: Rates were age-adjusted to the 2000 US population by the direct standardization method. Sex was unknown in four visits.

Table 7a: Emergency Department and Inpatient Discharges for Nonfatal All Drug[1] and Opioid[2] Unintentional and Undetermined Intent Overdoses among Michigan Residents by Age Group and Sex, 2018[3]

Age Group	All Drug Overdose Male	All Drug Overdose Female	Opioid Overdose Male	Opioid Overdose Female
0-4	909	800	32	37
5-9	156	93	*	*
10-14	159	224	*	*
15-19	577	630	90	68
20-24	1,100	780	574	357
25-29	1,888	1,074	1,264	625
30-34	1,763	1,076	1,151	606
35-39	1,337	904	877	468
40-44	855	697	514	282
45-49	788	734	426	307
50-54	787	785	411	342
55-59	966	903	478	410
60-64	1,076	803	620	366
65-69	715	593	391	224
70-74	379	450	139	146
75-79	226	310	62	78
80-84	137	246	27	46
85+	168	324	18	71

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

*Data are not displayed for age groups with between one and five drug overdoses.

Note: Age was unknown in four visits and sex was unknown in four visits.

Tale 8a: Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Race, 2018[3]

Race	All Drug Overdose Number	All Drug Overdose Rate	95% CI	Opioid Overdose Number	Opioid Overdose Rate	95% CI
American Indian	151	161.3	136.3-190.9	57	60.9	45.6-80.9
Asian and Pacific Islander	118	32.8	26.9-39.9	28	6.9	4.5-10.5
Black	5,644	362.5	353-372.1	2,422	150.2	143.9-156.7
White	18,394	238.1	235.2-241.9	8,597	114.1	112.3-117.2

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

Note: Race was unknown in 654 visits. Rates are not shown for other race (458 total overdoses and 160 opioid overdoses) due to a lack on an appropriate denominator.

Table 9a: Number and Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Census Tract of Residence Unemployment Rate, 2018[3, 4]

Percent of Census Tract Residents Aged 16 Years and Older Who Are Unemployed	All Drug Overdose Number	All Drug Overdose Rate	95 % CI	Opioid Overdose Number	Opioid Overdose Rate	95 % CI
0-2.9%	2,371	142.3	136.5-148.3	950	57.7	54.0-61.6
3-6.9%	8,434	179.9	176.0-183.9	3,540	76.7	74.1-79.3
7-10.9%	4,937	259.5	252.1-267.1	2,244	118.7	113.7-123.9
11-14.9%	2,817	402.9	387.7-418.5	1,403	201.3	190.5-212.5
15%+	3,650	475.1	459.3-491.3	1,875	242.5	231.3-254.2
Unknown*	3,210	n/a	n/a	1,509	n/a	n/a

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S2301.

* There were 3,201 records with an unknown census tract of residence and six records that had a census tract of residence for which the unemployment rate could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract unemployment rate but did not have age recorded.

Table 10a: Number and Age-Adjusted Rate (per 100,000) of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Poverty Rate in Census Tract of Residence, 2018[3, 4]

Percent of Census Tract Residents Below Federal Poverty Level	All Drug Overdose Number	All Drug Overdose Rate	95 % CI	Opioid Overdose Number	Opioid Overdose Rate	95 % CI
0-5.9%	2,762	124.3	119.6-129.2	1,139	54.5	51.3-57.8
6-11.9%	4,941	179.4	174.3-184.6	2,080	76.5	73.2-79.9
12-17.9%	3,952	219.4	212.4-226.6	1,687	93.8	89.3-98.6
18-23.9%	2,846	285.4	274.7-296.4	1,272	127.1	120.0-134.5
24%+	7,708	425.9	416.2-435.9	3,834	212.2	205.3-219.3
Unknown*	3,210	n/a	n/a	1,509	n/a	n/a

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1701.

*There were 3,201 records with an unknown census tract of residence and six records that had a census tract of residence for which the poverty rate could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract poverty rate but did not have age recorded.

Table 11a: Number and Age-Adjusted Rate of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent All Drug[1] and Opioid[2] Overdoses among Michigan Residents by Educational Attainment in Census Tract of Residence, 2018[3,4]

Percent of Census Tract Residents 25 Years and Older with Less than a High School Diploma or Equivalent	All Drug Overdose Number	All Drug Overdose Rate	95% CI	Opioid Overdose Number	Opioid Overdose Rate	95% CI
0-3.9%	2,059	111.1	106.2-116.2	829	46.6	43.4-50.0
4-7.9%	5,190	176.2	171.3-181.2	2,136	73.7	70.5-77.0
8-11.9%	5,022	224.9	218.5-231.4	2,167	97.1	92.9-101.4
12-15.9%	3,970	302.1	292.5-312.0	1,809	137.3	130.8-144.0
16%+	5,971	410.6	400.0-421.4	3,073	210.3	202.7-218.0
Unknown*	3,207	n/a	n/a	1,507	n/a	n/a

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis.

[2] Includes initial visits with an ICD-10-CM code of T40.0-T40.4, T40.6 or T40.69 and a fifth or sixth character of 1 (unintentional) or 4 (undetermined intent) listed as a principal or any secondary diagnosis**.**

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

[4] U.S. Census Bureau; American Community Survey, 2014-2018 American Community Survey 5-Year Estimates, Table S1501.

*There were 3,201 records with an unknown census tract of residence and three records that had a census tract of residence for which the educational attainment could not be calculated by the U.S. Census Bureau. Three additional overdoses had a known census tract educational attainment rate but did not have age recorded.

Table 12a: Percent of Emergency Department and Inpatient Discharges for Nonfatal Unintentional and Undetermined Intent Overdoses[1] Involving Alcohol Intoxication[2] by Age Group among Michigan Residents, 2018[3]

Age Group	All Drug Overdose Number	All Drug Overdose Percent	95% CI	Opioid Overdose Number	Opioid Overdose Percent	95% CI
0-20	55	1.4%	1.1%-1.8%	8	2.3%	1.0%-4.5%
21-29	203	4.5%	3.9%-5.1%	72	2.7%	2.1%-3.3%
30-39	253	5.0%	4.4%-5.6%	104	3.4%	2.7%-4.0%
40-49	197	6.4%	5.6%-7.3%	73	4.8%	3.8%-6.0%
50-59	223	6.5%	5.7%-7.4%	83	5.1%	4.0%-6.2%
60-69	107	3.4%	2.8%-4.0%	55	3.4%	2.6%-4.4%
70+	21	0.9%	0.6%-1.4%	9	1.5%	0.7%-2.9%

[1] Includes initial visits with an ICD-10-CM code of T36-T50 and a fifth digit (for codes T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9, and T49.9) or sixth digit (for all others) of 1 or 4 listed as a principal or any secondary diagnosis, excluding opioid overdose codes and visits with only unspecified overdose codes (T50.901A, T50.911A, T50.902A, T50.912A).

[2] Includes ICD-10-CM codes F10.12, F10.22, and T51.0X1 or T51.0X4 with a sixth character of 'A'.

[3] 2018 Michigan Resident Inpatient File and 2018 Michigan Resident Outpatient File, Michigan Health & Hospital Association.

Note: Age was unknown in four visits.

Data Sources

- 2009-2018 Michigan Resident Inpatient File, created using the 2009-2018 Michigan Inpatient Database, obtained with permission from the Michigan Health & Hospital Association.
- 2018 Michigan Resident Outpatient File, created using the 2018 Michigan Outpatient Database, obtained with permission from the Michigan Health & Hospital Association.
- Vintage 2018 postcensal estimates of the resident population of the United States (July 1, 2010-July 1, 2018), by year, county, single-year of age, bridged race, Hispanic origin, and sex. National Center for Health Statistics. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: http://www.cdc.gov/nchs/nvss/bridged_race.htm as of June 25, 2019.
- Intercensal estimates of the resident population of the United States for July 1, 2009, by year, county, single-year of age, bridged race, Hispanic origin, and sex. National Center for Health Statistics. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: http://www.cdc.gov/nchs/nvss/bridged_race.htm as of October 26, 2012.
- U.S. Census Bureau; American Community Survey, 2013-2017 American Community Survey 5-Year Estimates, Table S2301; generated using American FactFinder; <http://factfinder.census.gov>; (December 12, 2019).
- U.S. Census Bureau; American Community Survey, 2013-2017 American Community Survey 5-Year Estimates, Table S1701; generated using American FactFinder; <http://factfinder.census.gov>; (December 12, 2019).

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