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Examining Opioid and Heroin-Related Drug Overdose in Colorado

Allison Rosenthal, MPH

*SAMHSA/CSTE Applied Epidemiology Fellow, Violence and Injury Prevention
- Mental Health Promotion Branch;*

Kirk Bol, MSPH

Registries and Vital Statistics Branch;

Barbara Gabella, MSPH

Violence and Injury Prevention - Mental Health Promotion Branch.

Background

Nationally and in Colorado, opioid use disorders have emerged as a significant public health concern. Starting in the 1990s, opioid prescriptions (or, pain medications such as oxycodone, hydrocodone, and their combination with acetaminophen) began to rise nationwide partially due to the promotion of extended-release tablets and a change in prescriber culture to recognize the needs of patients with chronic pain (Okie, 2010). The dramatic increase in use has been associated with dependency, addiction, and other adverse health events including, but not limited to: heroin use disorders, spread of hepatitis infections and HIV, and fatal drug overdose (Bonhert et al, 2011; Garland et al, 2014; Paulozzi et al, 2006; Peters et al, 2016; Suryaprasad et al, 2014; and Young & Havens, 2011).

The National Survey on Drug Use and Health estimates that from 2013-2014, 4.9 percent of the Colorado population of ages 12 years and older used prescription pain relievers non-medically (95% CI: 4.0-6.1%), which is similar to the national rate (4.1%, 95% CI: 3.9-4.2%). The Colorado Department of Public Health and Environment (CDPHE) is monitoring the severity of the epidemic using a variety of available data, including mortality data from death certificates registered in Colorado. This report will highlight trends in drug overdose deaths related to opioid use and heroin use and describe associated health disparities.

Methods

CDPHE's Registries & Vital Statistics Branch manages the analysis of mortality data collected through the registration of death certificates in Colorado. Mortality data representing deaths among individuals who resided in Colorado from 2000-2015 were analyzed for this report. International Classification of Disease, 10th Revision (ICD-10) codes for underlying cause of death were used to identify drug overdoses, using published definitions from the Centers for Disease Control and Prevention's

4300 Cherry Creek Drive South
Denver, Colorado 80246-1530
(303)692-2160
(800)886-7689

cdphe.healthstatistics@state.co.us
www.colorado.gov/cdphe

National Center for Health Statistics, as shown in Appendix 1 (Chen et al, 2014; World Health Organization, 2016). Drug overdose deaths (also referred to as drug overdoses in this report) were further classified according to manner (intent) of the overdose, including unintentional (accidental) and intentional self-harm (suicide). The report will also describe the epidemiology of opioid-related and heroin-related overdoses. Drug-type classifications were found in the multiple causes of death fields in death records. Deaths were classified as opioid-related if the individual had a positive test for either semi-synthetic opioids (e.g. morphine, hydrocodone, oxycodone), methadone, or synthetic opioids (e.g. fentanyl), and/or as a heroin-related overdose if the individual had a positive test for heroin. If the record marked both, this death was counted in both opioid and heroin categories.

All death rates are presented as deaths per 100,000 population. Unless otherwise marked, all rates are age-adjusted to ensure comparability between occurrence of deaths over time, across geographic areas and between demographic groups. All age-adjusted rates were computed using the direct method and applying the the 2000 U.S. Standard Population (Klein & Schoenborn, 2001).

Drug overdoses were further examined for geographic and demographic variability. Demographic characteristics explored include gender, age, race/ethnicity of the decedent, and area-based poverty. Area-based poverty status is measured by calculating the percent of the

population in each decedent's census tract of residence that is living at or below the federal poverty level (CDPHE, 2015). These population data come from the 2010-2014 five-year American Community Survey estimates made available by the U.S. Census Bureau. The poverty level categories used in this report include 0-9.9 percent of the population in a decedent's community living at or below the federal poverty level, 10-19.9 percent, 20-29.9 percent and 30 percent or greater. Counties in Colorado were categorized into Health Statistics Region (HSR), a method often used to examine regional differences for various health indicators within Colorado and ensure that rates can be presented for rural and frontier regions with smaller populations.

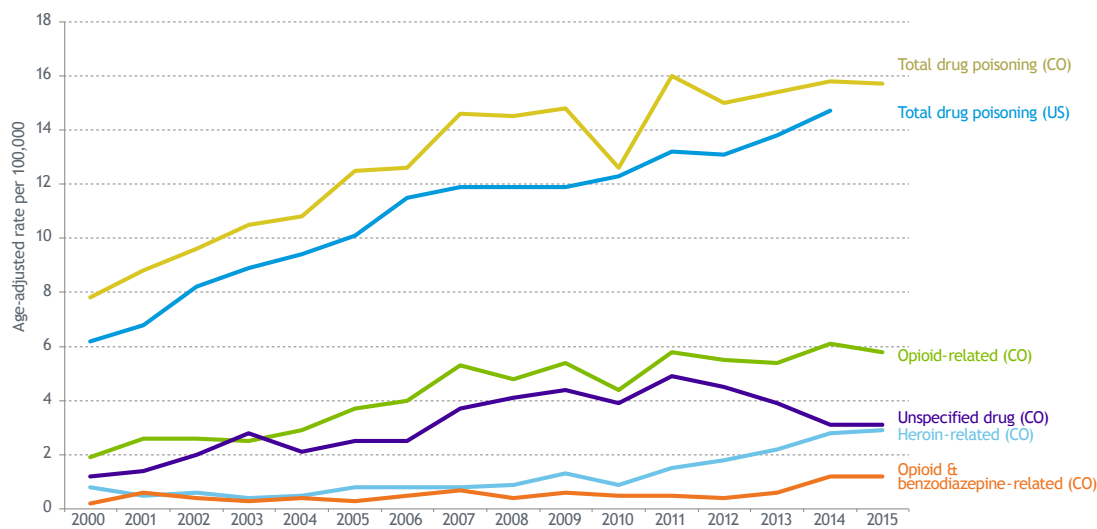
Differences between rates are described as statistically significant if the 95 percent confidence intervals (95% CI) of two rates being compared do not overlap, or the p-value of a formal comparison test is less than 0.05.

Results

Trends by Time

From 2000-2015, there have been 10,552 drug overdose deaths among Colorado residents with rates rising in almost every year. In 2000, the number of overdose deaths was 351 and the age-adjusted rate was 7.8 deaths per 100,000 population (95% CI: 7.0, 8.6). In 2015, there were 880 deaths, and the rate increased to 15.7 (95% CI: 14.6, 16.7). In nearly every year, Colorado's rate of drug overdose was significantly higher than the national rate.

Figure 1: Age-adjusted rates of drug overdose deaths in Colorado and in the U.S., 2000-2015.



Data Source: Vital Statistics Program, CDPHE; Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2014 on CDC WONDER Online Database.

Drug-type categories are not mutually exclusive; cases are counted more than once if they were positive for multiple substances.

While Colorado's drug overdose rates show signs of leveling from 2013 to 2015, the U.S. rates between 2012-2014 (the last year of data available at the national level) were still increasing.

As seen in Table 1, opioid-related overdose deaths, which comprise a significant proportion of total drug overdose deaths, also rose dramatically in that fifteen-year period. Opioid-related overdoses tripled from 2000 (87 deaths; 1.9 per 100,000, 95% CI: 1.5-2.4) to 2015 (329 deaths; 5.8 per 100,000, 95% CI: 5.2-6.5) among Colorado residents, but also showed signs of stabilizing from 2013-2015. In that three-year period, the age-adjusted death rates were not significantly different and ranged from 5.4 to 6.1.

Benzodiazepines (a family of prescribed medications used as sedatives and anxiety treatments) are often prescribed simultaneously with opioids and can increase the toxicity of opioids when taken concurrently (White & Irvine, 1999). Drug overdoses noting the presence of both substances doubled from 2013 to 2015 (36 deaths to 64 deaths), and the age-adjusted rate in 2015 was 1.2 (95% CI: 0.9, 1.2).

Table 1: Age-adjusted drug overdose death rates per 100,000 in Colorado by drug type and other demographic categories, 2000 vs. 2013-2015.

	2000		2013		2014		2015	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Drug Type (a)								
Total poisoning deaths - US	6.2	(6.1, 6.3)	13.8	(13.7, 13.9)	14.7	(14.5, 14.8)	N/A	N/A
Total poisoning deaths - CO	7.8	(7.0, 8.6)	15.4	(14.3, 16.5)	15.8	(14.7, 16.8)	15.7	(14.6, 16.7)
Colorado Specific								
Opioid-related	1.9	(1.5, 2.4)	5.4	(4.8, 6.0)	6.1	(5.4, 6.8)	5.8	(5.2, 6.5)
Heroin-related	0.8	(0.5, 1.1)	2.2	(1.8, 2.7)	2.8	(2.4, 3.3)	2.9	(2.5, 3.4)
Opioid & benzodizeipine-related	0.2	(0.1, 0.4)	0.6	(0.4, 0.9)	1.2	(0.9, 1.5)	1.2	(0.9, 1.5)
Unspecified	1.2	(0.9-1.5)	1.1	(0.8, 1.4)	0.7	(0.5, 0.9)	0.5	(0.3, 0.7)
Manner of death								
Accidental	4.8	(4.2-5.5)	11.1	(10.2, 12.0)	12.0	(11.1, 13.0)	12.7	(11.8, 13.7)
Suicide	1.3	(1.0, 1.7)	3.4	(2.9, 3.9)	3.0	(2.5, 3.5)	2.5	(2.0, 2.9)
Undetermined manner/intent	1.6	(1.2, 1.9)	0.9	(0.6, 1.1)	0.7	(0.5, 1.0)	0.5	(0.3, 0.7)
Sex								
Male	10.0	(8.7, 11.4)	16.8	(15.3, 18.4)	18.2	(16.6, 19.8)	18.8	(17.2, 20.5)
Female	5.5	(4.5, 6.4)	13.9	(12.5, 15.3)	13.2	(11.8, 14.6)	12.4	(11.1, 13.8)
Age-specific rates by category (b)								
15-24	3.2	(1.8, 4.7)	12.7	(10.1, 15.3)	9.4	(7.1, 11.6)	8.4	(6.4, 10.5)
25-34	10.5	(8.0, 12.9)	21.4	(18.1, 24.7)	25.1	(21.5, 28.7)	28.0	(24.2, 31.7)
35-44	16.8	(13.9, 19.8)	21.8	(18.4, 25.2)	25.4	(21.7, 29.0)	24.2	(20.7, 27.8)
45-54	15.1	(12.0, 18.1)	29.4	(25.4, 33.3)	28.5	(24.6, 32.4)	27.8	(24.0, 31.7)
55-64	5.8	(3.3, 8.4)	22.9	(19.2, 26.5)	23.7	(20.1, 27.4)	23.2	(19.6, 26.7)
65 & older	4.3	(2.3, 6.3)	9.6	(7.2, 12.0)	8.4	(6.2, 10.6)	8.1	(6.0, 10.2)
Race								
Non-Hispanic White	7.5	(6.6, 8.4)	16.9	(15.6, 18.2)	17.0	(15.7, 18.3)	16.7	(15.4, 18.0)
Hispanic/Latino(a)	10.0	(7.5, 12.6)	12.4	(10.1, 14.7)	13.3	(10.9, 15.6)	14.2	(11.8, 16.5)
Black/African American	9.7	(5.0, 14.3)	13.5	(8.8, 18.3)	17.3	(11.9, 22.8)	13.6	(9.0, 18.1)
Asian/Pacific Islander	N/A	N/A	5.7	(2.8, 9.6)	4.0	(1.7, 7.3)	4.7	(2.2, 8.2)
American Indian	8.0	(2.6, 16.3)	10.9	(5.2, 18.8)	20.1	(11.0, 29.2)	10.4	(4.9, 17.8)

Data Source: Vital Statistics Program, CDPHE; Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2014 on CDC WONDER Online Database.

Drug-type categories are not mutually exclusive; cases are counted more than once if they were positive for multiple substances.

Rates are per 100,000 population, except age-specific rates for the 15 and under age category are not displayed due to small numbers and in order to protect confidentiality of these decedents.

Demographic statistics in bold indicate that the rates are statistically higher than the Colorado rate.

The number and rate of heroin-related deaths steadily increased from 2000 (37 deaths, 0.8 per 100,000, 95% CI: 0.5-1.1) to 2015 (160 deaths, 2.9 per 100,000, 95% CI: 2.5-3.4). In contrast to opioids, from 2013-2015, the age-adjusted death rate for heroin-related overdoses clearly increased.

Notably, from 2011-2015, the number and rate of overdose deaths with unspecified drug type decreased. This decrease suggests that some of the increases observed among drug-specific categories are being driven by better classification of drug overdose deaths and incorporation of greater drug-related detail in the cause of death portion of Colorado death certificates.

Intent and Demographic Characteristics Associated with Drug Poisoning

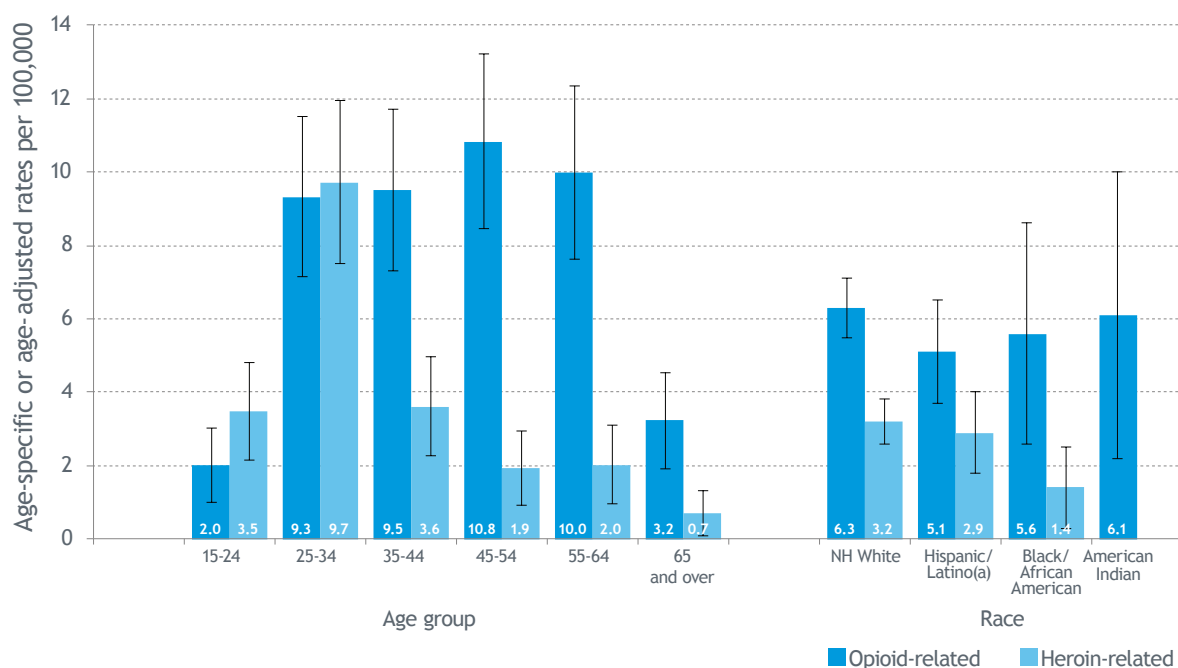
Table 1 shows that from 2000-2015, overall drug overdose deaths classified as accidental (or unintentional) increased by 165 percent (4.8, 95% CI: 4.2-5.5 in 2000 to 12.7, 95% CI: 11.8-13.7 in 2015). In 2015, approximately 80 percent of drug poisoning deaths were categorized as accidental (708 deaths), 16 percent (144 deaths) were determined to be related to suicide, and 3 percent (28 deaths) were of undetermined intent.

In the years examined, males consistently had higher rates of drug overdose; however, overdose rates in females have increased more between 2000 and 2015 (125% increase among females compared to an 88% increase among males).

In Colorado, the highest rates of drug overdose deaths have historically been observed in the 35-45 and the 44-54 age groups; more recently, the burden of drug poisoning mortality has widened, affecting those from ages 25-64 nearly equally, as seen in Table 1. Compared to 2000, drug overdose death rates increased across all age groups, with the greatest increases among those ages 55-64 (300% increase), 15-24 and 25-34 (both rose by nearly 170%). In 2013-2015, the rates in age groups between 25-64 were all above 20 drug overdose deaths per 100,000 population.

While drug overdose has affected all racial and ethnic groups, rates among non-Hispanic Whites have increased the most between 2000 (7.5, 95% CI: 6.6-8.4) and 2015 (16.7, 95% CI: 15.4-18.0). In 2000, non-Hispanic Whites had the lowest rates of drug overdose, and from 2013-2015 have consistently had the highest rates.

Figure 2: Age-adjusted rates per 100,000 of opioid-related and heroin-related overdose deaths by age & race, 2015.



Data Source: Vital Statistics Program, CDPHE.

Error bars represent the 95% confidence interval of the age-specific or age-adjusted rate.

Drug-type categories are not mutually exclusive; cases are counted more than once if they were positive for multiple substances.

Rates for Asian/Pacific Islander, and heroin-related rates for American Indian, are not displayed due to small numbers of events (fewer than three).

Demographic Characteristics Associated with Opioid- and Heroin-Related Deaths

In 2015, the rate of opioid-related drug poisoning death in men was not significantly different from that among women (6.3, 95% CI: 5.3-7.2 compared to 5.4, 95% CI: 4.5-6.3). However, the heroin death rate among men was significantly higher, and more than triple the rate among women in 2015 (4.5, 95% CI: 3.7-5.3 compared to 1.3, 95% CI: 0.9-1.7).

In 2015, the age groups with the highest rates of drug overdose (ages 25-64) all had correspondingly high rates of opioid-related overdose deaths. The 45-55 age category had the highest rate of opioid-related drug overdose (10.8, 95% CI: 8.4-13.2). The rates of heroin-related overdose skewed younger, peaking in the 25-34 year-old age group (9.7, 95% CI: 7.5-11.9) (Figure 2).

Opioid-related overdose rates in all races were similar to the Colorado rate in 2015. However, heroin-related overdoses were nearly double among Non-Hispanic Whites (3.2, 95% CI: 2.6-3.8) and Hispanic/Latino(a)s (2.9, 95% CI: 1.8-3.9) compared to Black/African Americans in Colorado in 2015 (1.4, 95% CI: 0.3-3.3).

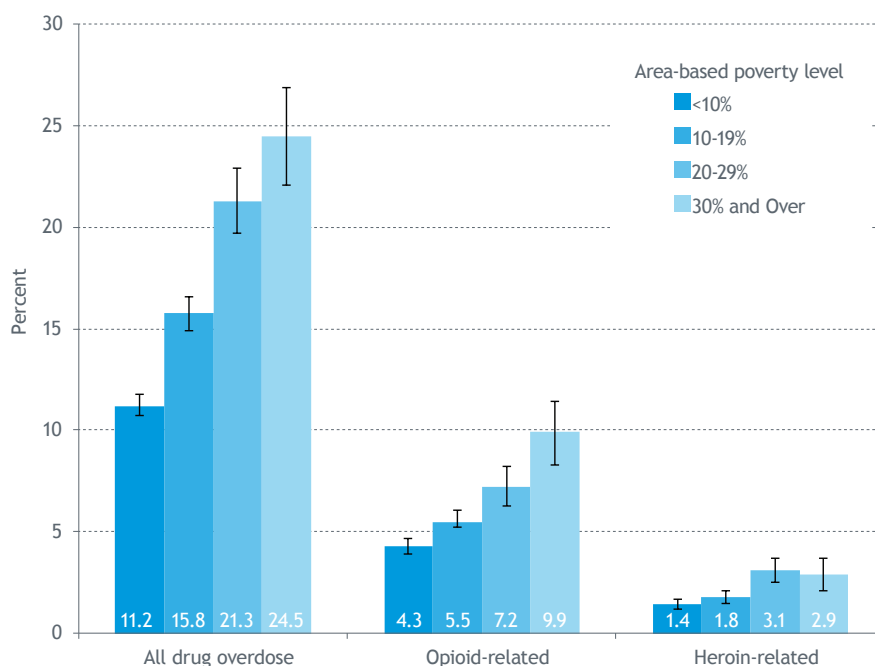
As seen in Figure 3, areas with higher proportions of poverty had higher rates of all three drug overdose categories (total drugs, opioids, and heroin) from 2010-2014. Communities with 30 percent or more residents who lived in poverty experienced drug overdose rates that were more than twice those of communities where fewer than 10 percent of residents lived in poverty (24.5, 95% CI: 22.1-26.9 compared to 11.2, 95% CI: 10.6-11.7). This relationship was consistent in opioid-related and heroin-related deaths as well.

Geographic Variability

Across Colorado from 2013-2015, drug overdose rates varied considerably, ranging from 7.4 deaths per 100,000 population in Douglas County, to 29.7 in Pueblo County. Three regions in Colorado had statistically higher rates than the aggregated state rate: Pueblo County (Region 7), Region 6 (comprised of Baca, Bent, Crowley, Huerfano, Kiowa, Las Animas, Otero, and Prowers Counties), and El Paso County (Region 4).

Similar to all drug overdoses, the Southeast corner of the state had elevated rates of both opioid-related and

Figure 3: All drug overdose, opioid- and heroin-related overdose rates (age-adjusted) by area-based poverty and select demographics in Colorado, 2010-2014.



Data Sources: Vital Statistics Program, CDPHE; U.S. Census Bureau, 2010-2014 Five-Year American Community Survey. Error bars represent the 95 percent confidence interval of the age-specific or age-adjusted rate. Drug-type categories are not mutually exclusive; cases are counted more than once if they were positive for multiple substances.

heroin-related overdose deaths from 2013-2015; however, the highest rates tended to occur in more urban regions, as defined by the Colorado Health Statistics Regions. As seen in Figure 4, the regions with the highest rates for opioid-related overdose deaths from 2013-2015 were: Pueblo (9.6, 95% CI: 6.7-12.5), Adams (9.2, 95% CI: 7.6-10.8) and Denver (8.0, 95% CI: 6.7-9.2). All three had rates that were statistically higher than the state aggregated rate

for opioid-related overdose deaths (5.8, 95% CI: 5.4,6.1). Two of these three counties also had higher age-adjusted death rates for heroin. Pueblo County had the highest age-adjusted rate of heroin-related overdose (8.7, 95% CI: 5.9 to 11.6), which was over three times the state-level rate (shown in Figure 5). Denver county (4.2, 95% CI: 3.3-5.1) also had a rate that was statistically higher than the state's rate (2.7, 95% CI: 2.4-2.9).

Figure 4: Age-adjusted opioid-related overdose death rates by health statistics region, Colorado residents, 2013-2015.

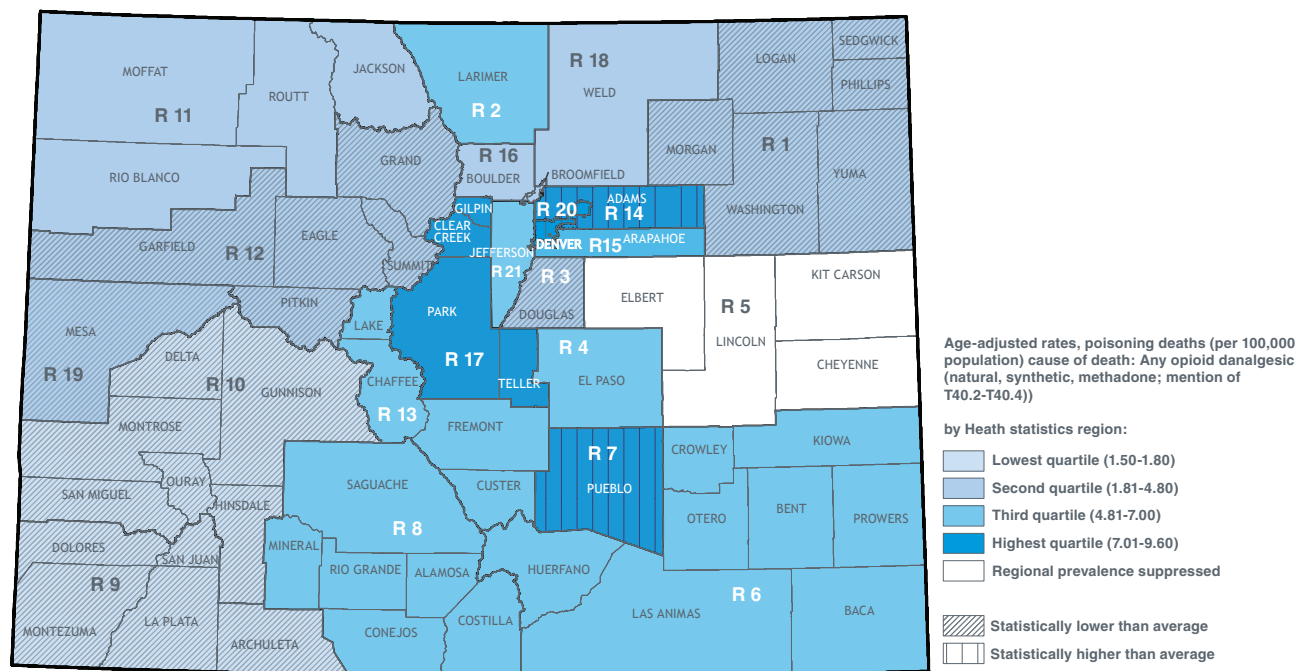
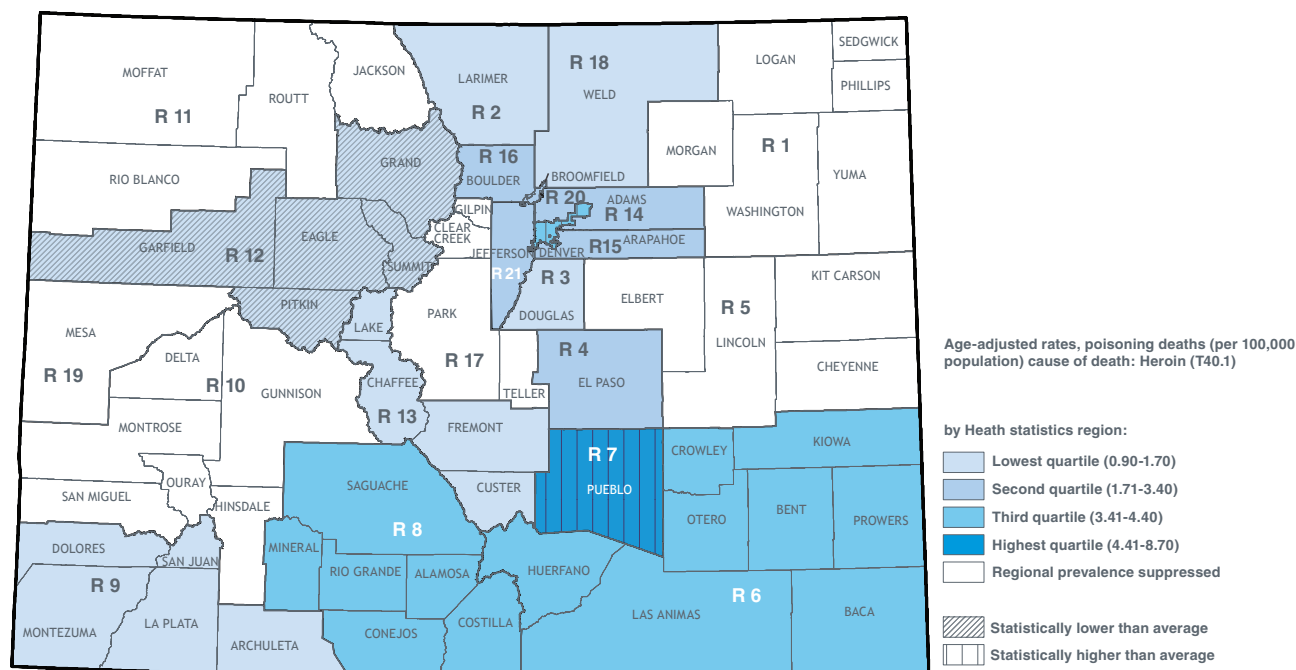


Figure 5: Age-adjusted heroin-related overdose death rates by health statistics region, Colorado residents, 2013-2015.




Discussion

Drug overdose deaths have doubled since 2000; however, the rates at the state level have not changed significantly from 2013-2015. Compared to females, males had higher rates of drug poisoning, opioid-related deaths, and especially heroin-related deaths in this fifteen-year period. Drug poisonings and opioid-related deaths were high among ages 25-64, while heroin-related deaths peaked earlier in those of age 25-34. The heroin-related death rate among ages 25-34 was as high as the corresponding opioid-related death rate. Poverty was also associated with higher rates of drug overdose, which suggests that there are underlying environmental factors behind this epidemic.

Reporting bias does limit the analysis of death certificate data. CDPHE does not have access to the toxicology reports on deaths and cannot determine whether the drugs that were not indicated on the certificate represent negative test results or whether the drug was not part of the testing. However, compared to earlier years, a smaller proportion of drug overdose death certificates for 2011-2015 have not mentioned the specific drug results, which suggests that the data quality is improving. All partners in the Vital Statistics System nationwide should continue their efforts to improve the accuracy of this data, which would promote data-driven public health planning and interventions.

State agencies, local jurisdictions, policy makers, and community-based organizations have mobilized to respond to the opioid epidemic. In 2012, the Colorado legislature passed a good samaritan law (to allow individuals who report an overdose to avoid criminal charges), and in 2013, enacted legislation to expand access to naloxone, a drug that can be administered by non-healthcare workers to reverse the effects of an opioid overdose. During this period, the Colorado Governor co-chaired a year-long policy academy to reduce prescription drug abuse (hosted by the National Governors Association). State agencies

and policy advisors from the Colorado Governor's Office developed a state strategic plan. This work culminated with the Governor's Office establishing the Colorado Consortium for Prescription Drug Abuse Prevention in 2013, and which is made up of public-private partners and interested community members. The Consortium members and participating state agencies have worked to promote public awareness about safe use, safe storage and safe disposal of prescription medications through funding from the Colorado Attorney General's Office; expand access to medicine disposal sites and naloxone; and increase use of the Prescription Drug Monitoring Program (PDMP) by healthcare providers and pharmacists. Their website (<http://www.corxconsortium.org/>) provides more in-depth information about their specific activities. To further coordinate efforts, the Consortium is an official group of the long-standing, legislatively-mandated Substance Abuse Trends and Response Task Force convened by the state attorney general's office. The state, in concert with regional law enforcement, has also established a Heroin Response Task Force with representation from law enforcement, public health, and treatment services to coordinate services and interventions.

The Colorado Department of Public Health and Environment has also increased programs and services to address this statewide issue. In 2014, CDPHE received the statutory authority to conduct population-level analysis using data from the PDMP to assess trends in prescribing. As a result of a 2015 law, the chief medical officer of CDPHE may issue standing orders for Naloxone, so pharmacies and harm reduction organizations can provide Naloxone to those who need it most. (See <https://www.colorado.gov/cdphe/naloxoneorders> to request a standing order.) CDPHE is expanding its medication take-back program. New disposal collection sites will accept prescribed controlled substances, including prescription painkillers. (For a list of sites, see <https://www.colorado.gov/cdphe/colorado-medication-take-back-program>). 

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Appendix 1: ICD-10 Drug Overdose Codes Used in Report

Category	Definition	ICD-10 Codes
Drug Overdose	In the underlying cause of death, any one of these codes must be listed to identify drug overdoses. Includes opioids, heroin, methamphetamine, and other prescription and illicit drugs.	X40-X44, X60-X64, X85, Y10-Y14
Opioid-Related Overdose	If the underlying cause of death had a drug overdose code (see above), and in any of the multiple cause of death codes, there was a code indicating the presence of an opioid in the decedent's toxicology reports	X40-X44, X60-X64, X85, Y10-Y14 And any: T40.2-T40.4
Heroin-Related Overdose	If the underlying cause of death had a drug overdose code (see above), and in any of the multiple cause of death codes, there was a code indicating the presence of heroin in the decedent's toxicology reports	X40-X44, X60-X64, X85, Y10-Y14 And T40.1
Opioid & Benzodiazepine-Related Overdose	If the underlying cause of death had a drug overdose code (see above), and in any of the multiple cause of death codes, there was a code indicating the presence of an opioid and a benzodiazepine in the decedent's toxicology reports	X40-X44, X60-X64, X85, Y10-Y14 And any: T40.2-T40.4 And: T42.4
Unspecified Drug Overdose	If the underlying cause of death had a drug overdose code (see above), and in any of the multiple cause of death codes, there were no codes specifying drug type	X40-X44, X60-X64, X85, Y10-Y14 And: T50.9 Exclude records with T36-T50 codes
Accidental Overdose	If the underlying cause of death had any of the following drug overdose codes	X40-X44
Suicide Overdose	If the underlying cause of death had any of the following drug overdose codes	X60-X64
Overdose with Undetermined Manner/Intent	If the underlying cause of death had any of the following drug overdose codes	Y10-Y14

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