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Opioid-related Overdose Deaths in Massachusetts by Industry and Occupation, 2016-2017

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Opioid-related Overdose Deaths in Massachusetts by Industry and Occupation, 2016-2017

Summary and Key Findings

Massachusetts death certificates were used to analyze opioid-related overdose deaths (ORODs) from 2016 to 2017, by industry and occupation. Occupation describes the kind of work an individual does to earn a living (i.e., job title), while industry describes the activities the individual's employer is engaged in. Data was also compared to a previous analysis of opioid-related deaths from 2011-2015. Additional factors that may contribute to the differences in OROD rates among workers within different industries and occupations were examined. Key findings are:

- The overall statewide rate of ORODs for all workers increased from 25.1 deaths per 100,000 workers in the period 2011 to 2015 to 46.1 in 2016-2017. This rate was in line with the overall increase in rate for all Massachusetts residents during this time period; however, some industries in particular saw a greater increase.

- Two notable *industries* are: the (1) Construction industry and the (2) Agriculture, Forestry, Fishing, and Hunting industry. The Construction industry had a high rate of ORODs (228.9 deaths/100,000 workers) during 2016-2017, an 83% increase over the 2011-2015 rate (124.9 in 2011-2015). The Agriculture, Forestry, Fishing, and Hunting industry also showed a high rate of ORODs—its rate more than doubled (107.5 in 2011-2015 vs. 220.8 in 2016-2017).

- Workers in nine *occupation groups* had OROD rates that were significantly higher than the average annual rate for all workers (46.5/100,000 workers) in 2016-2017. The rates among Farming, Fishing, and Forestry occupations was seven times higher than the average annual rate (345.8/100,000) and the rate among Construction and Extraction occupations was six times higher (282.4/100,000). The number of deaths in Construction and Extraction occupations represented 27% of total ORODs in 2016-2017.

- The trend in rates of OROD across different occupational groups varied over time. For example, between 2011 and 2017, the average annual percent change in OROD rates for Farming, Fishing, and Forestry occupations and Food Preparation and Serving Related occupations increased 17.9% ($p<0.01$) and 23.6% ($p<0.01$), respectively, while the average annual percent change for OROD rate for Construction and Extraction occupations increased 30.8% ($p<0.01$) from 2011 to 2015 but has since plateaued from 2015 to 2017.

- Hispanic worker OROD rate increased between 2011 and 2016 but decreased in 2017. However, it is notable that in 2011, the rate among Hispanic workers was about half the rate of white, non-Hispanic workers but, beginning in 2012, the Hispanic rate increased sharply each year as to be on par with the white, non-Hispanic rate by 2016. The rate among Black, non-Hispanics has continued to increase through 2017.

Toxicology reports have shown that fentanyl was present in a majority of opioid-related overdoses between 2015 and 2017, and that the relative proportion of fentanyl as a contributing factor has increased over time, in line with findings from data on all Massachusetts residents. Heroin listed as a contributing factor to cause of death has increased among workers in Farming, Fishing, and Forestry occupations and Healthcare Practitioners and Technical occupations has increased, despite a decreasing trend state-wide seen since 2014. Food Preparation and Serving Related occupations, with the second highest number of ORODs in this

study, had similar percentages of drugs present at death to those observed in the Construction and Extraction occupations.

These findings demonstrate the continued need for education and interventions that are aimed at high-risk worker populations in order to prevent opioid-related overdose morbidity and mortality. The workplace provides a venue for the primary prevention of injuries, as well a place where workers can receive education on safer alternatives for the treatment of pain and evidence-based treatment for opioid use disorders. Furthermore, workplace policies that support individuals seeking treatment and returning to the workplace, as well as post-substance use disorder workplace practices, such as recovery-friendly workplace initiatives, employee assistance/peer support programs, and naloxone training as appropriate are critical to reducing opioid-related overdoses. Prevention efforts targeting high-risk worker groups are underway at the Massachusetts Department of Public Health and in collaboration with partners state-wide.

Introduction

Massachusetts has been greatly impacted by the nationwide epidemic of opioid-related overdose and death, with the annual rate of opioid-related overdose deaths (OROD) in MA more than doubling between 2011 and 2017.[1] The annual rate in Massachusetts is also estimated to be higher than the annual rate for the U.S. for this same time period.[2] While numbers and rates in Massachusetts stabilized and even decreased among some subpopulations in more recent years, a better understanding of the populations that are most affected by this epidemic is needed in order to provide effective prevention efforts and ensure that deaths continue to decline.

One group that has been especially adversely impacted by the opioid epidemic is workers in occupations and industries that are at high risk for injury and illness. A previous report published in 2018 by the Massachusetts Department of Public Health found that the average annual rate of fatal opioid-related overdose from 2011 through 2015 varied significantly by industry and occupation of the decedents, and that certain occupational groups (e.g., Construction and Extraction workers and Farming, Fishing, and Forestry workers) had rates much higher than the rate for all workers.[3] In particular, the report found that the rate of fatal opioid-related overdose was higher among workers employed in industries and occupations known to have high rates of work-related injuries and illnesses. This finding is consistent with previous research that has documented the prevalent use of prescribed opioids for pain management following work-related injury.[4-6] The rate of fatal opioid-related overdose was also higher among workers in occupations with lower availability of paid sick leave and less job security, two factors which may increase a worker's likelihood that they will work in pain and rely on medication, including opioids, for pain relief.

The purpose of this report is to update the previously published 2018 report (hereafter referred to as "2011-2015 data") to include findings from 2016 and 2017, a period that represents a peak in both count and rate of fatal opioid-related overdose in Massachusetts. This report will highlight new findings from 2016-2017 (including, for the first time, toxicology data), as well as provide trends over time and patterns by race/ethnicity for the period of 2011 to 2017.

Specifically, this report seeks to understand affected populations by:

- Characterizing ORODs among Massachusetts residents by industry and occupation of decedents, and by sex.
- Characterizing race/ethnicity of decedents overall and within select occupation groups.
- Analyzing trends in OROD rates over time by occupation.
- Re-examining factors that may contribute to differences in rates of OROD among different industries and/or occupations.
- Examining patterns over time (2015 - 2017) of the type of drug(s) contributing to death by select occupation groups, using toxicology information in the death certificates.

Methods

Opioid-related overdose deaths were identified by the causes of death listed on death certificates, which were available electronically through a file provided by the Massachusetts Registry of Vital Records. The following International Classification of Diseases – 10th edition (ICD-10) codes were selected from the underlying cause of death field to identify all fatal poisonings/overdoses, regardless of intent: X40-X49 (unintentional), X60-X69 (self-harm/suicide), X85-X90 & Y35.2 (assault/homicide/other) and Y10-Y19 (undetermined intent). Additionally, multiple cause of death fields were searched to identify fatal poisonings in which the substance involved was an opioid: T40.0 (opium), T40.1 (heroin), T40.2 (other opioids), T40.3 (methadone), T40.4 (synthetic narcotics), and T40.6 (other unspecified narcotics).[7] Additional information obtained from the death certificates included decedents' age, sex, race/ethnicity, residence, and usual industry and occupation, as well as toxicology information. Occupation describes the kind of work an individual does to earn a living (i.e., job title), while industry describes the activities the individual's employer is engaged in. Using the National Institute for Occupational Safety and Health Industry and Occupation Computerized Coding System (NIOCCS),[a] industry and occupation were assigned North American Industry Classification System (NAICS) codes and the Standard Occupation Classification System (SOC) codes,[b] respectively, and were further classified by manual review. See Appendix for examples of groups within industry and occupation classifications.

The distribution and rate of OROD among Massachusetts residents was presented by industry and occupation, and within sex, age, and racial/ethnic groups. Analyses focused primarily on deaths occurring in 2016 and 2017, although deaths that occurred prior to 2016 (deaths from 2011-2015) were included to examine trends over time. Thus, as appropriate, two-year average annual OROD rates among workers were calculated as the number of deaths per 100,000 workers. 95% confidence intervals were calculated for all rates. For brevity in this report, all *average annual rates*, whether two-year or six-year, are referred to as just *rates*. Rate differences are considered statistically significant if the confidence intervals for the compared rates did not overlap. Data on the average annual number of workers employed in Massachusetts between 2011 and 2017 were obtained from the American Community Survey, 2011 - 2017 and served as the denominator for rates.[8] It is assumed that decedents who had an industry and/or occupation reported on their death certificates were employed in that industry and/or occupation in the years prior to death. Since the death certificates contain information about the usual, not current, industry and/or occupation, this assumption may not be true if the decedents' usual industry and occupation were different from the industry and occupation they were working in during the period prior to death. However, research has shown high rates of concordance between current and usual industry and occupation, including the reporting of industry and occupation listed on death certificates.[9,10] Additionally, the assumption may be invalid if the decedent had retired. A sensitivity analysis was conducted that excluded decedents over the age of 55 years old, who accounted for 12.8% of the deaths among those assumed to be working in this study. With and without the age restriction, the overall distributions of opioid-related overdose deaths by industry and occupation were found to be similar; therefore, findings presented in this report are based on deaths among workers of all ages.

Joinpoint regression[c] was used to identify segments of time when the rate of ORODs by occupation changed from 2011 to 2017.[11] Negative binomial regression was used to determine that these changes in trend (as measured by the annual percent change and the average annual percent change) were statistically significant. The percent of ORODs showing the presence of specific drugs through toxicology screens was presented annually by occupation group over the period 2015 - 2017. Drugs listed on the death certificate as a contributing cause of death were categorized as follows: fentanyl; heroin; cocaine; benzodiazepine; amphetamine; prescribed opioid; and alcohol.

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[a] National Institute for Occupational Safety and Health, NIOSH Industry and Occupation Computerized Coding System. https://wwwn.cdc.gov/nioccs3/

[b] The 2010 Standard Occupational Classification Manuals are available from http://www.bls.gov/soc/.

[c] Joinpoint is a statistical software program that is used for the analysis of trends by using regression models.

To examine how two work factors, incidence of work-related injury and the availability of paid sick leave, may be contributing to high OROD rates among certain industries and occupations, OROD data were re-categorized according to findings from two surveys. Data on non-fatal injuries and illnesses from the Bureau of Labor Statistics' 2014 Massachusetts Survey of Occupational Injuries and Illnesses were used to categorize both industry and occupation groups. Occupation categories, for example, were based on the number of injuries and illnesses per 10,000 full-time workers in Massachusetts; the four ranges were 0-49, 50-99, 100-199, and 200+. Using national data from the BLS Employee Benefits Survey from 2011 - 2017, occupation groups were categorized according to the availability level (high or low) of paid sick leave. An occupation was considered to have high availability of paid sick leave if 70% or more survey respondents within that occupation reported having access to paid sick leave. Findings presented in this report are not evidence that these factors cause opioid-related overdose deaths, but rather suggest these factors may contribute to these deaths.

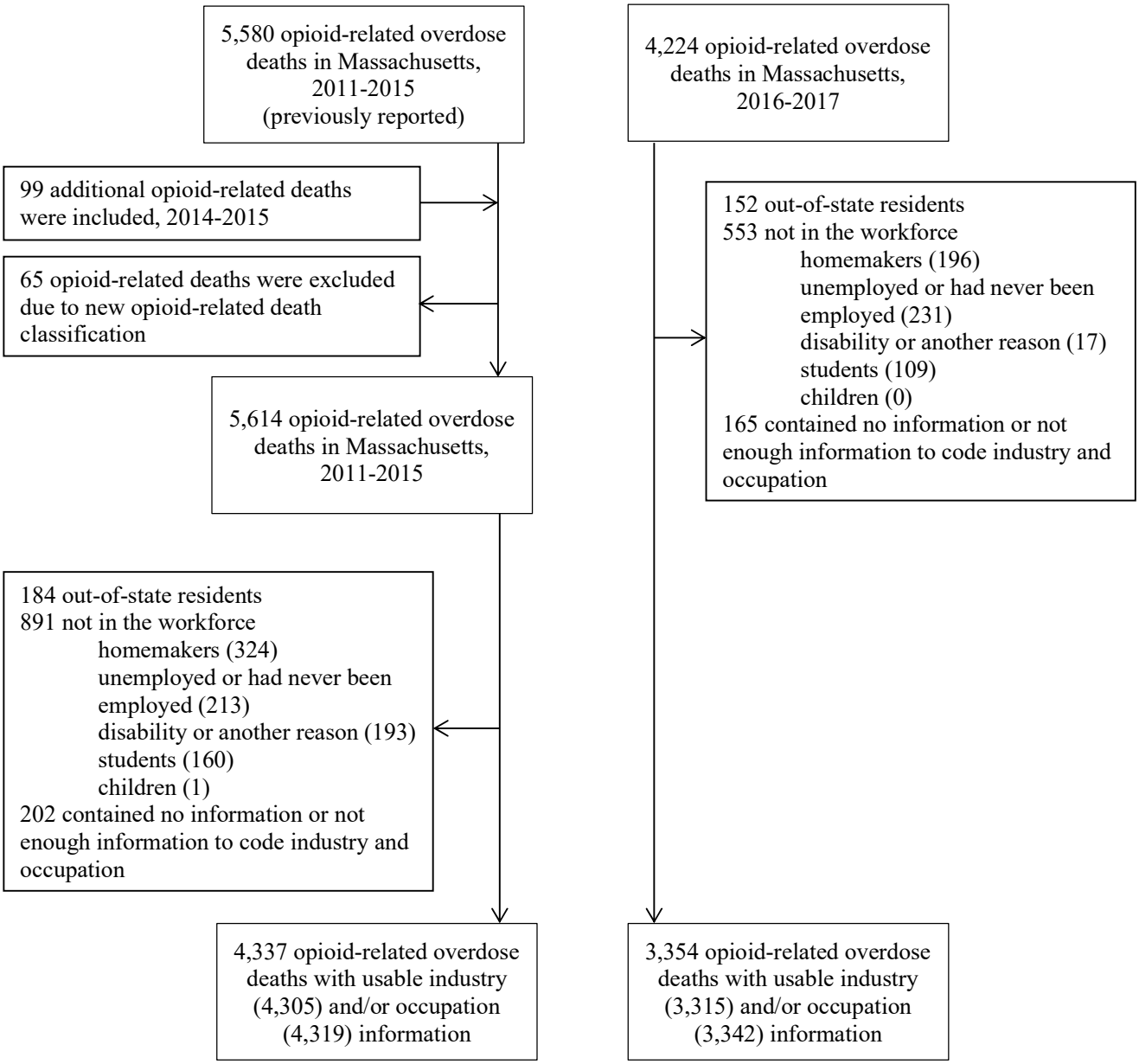
Findings

Study Group

A total of 4,224 opioid-overdose related deaths occurred in Massachusetts in 2016-2017 (Figure 1).[d] For some analyses, we also examined data from 2011-2015, which included 5,580 opioid-related overdose deaths.[3] Since this report focuses on ORODs between 2016 and 2017 among Massachusetts residents who are employed, deaths among out-of-state residents (152) were excluded as were an additional 553 deaths of individuals who were not in the workforce either because they were homemakers (196), unemployed or had never been employed (231), unable to work due to disability or another reason (17) or students (109). An additional 165 deaths were excluded because the corresponding death certificates lacked enough information to code either industry or occupation. A total of 3,354 deaths between 2016 and 2017 with usable industry and /or occupation codes assigned were analyzed. The 165 deaths that were excluded due to missing industry and occupation information were similar to those in the final dataset with respect to sex, age, and race/ethnicity. For some analyses, we used comparable data from 2011-2015, which represented 4,337 decedents after excluding the nonworkers and those with un-codable industry and occupation.

[d] Death files were prepared on the following dates: 2011 and 2012: January 13, 2017, 2013: May 4, 2017, 2014: June 1, 2017, 2015: June 1, 2017 with an update on August 22, 2017, 2016 and 2017: June 12, 2019.

Figure 1: Development of opioid overdose files for study



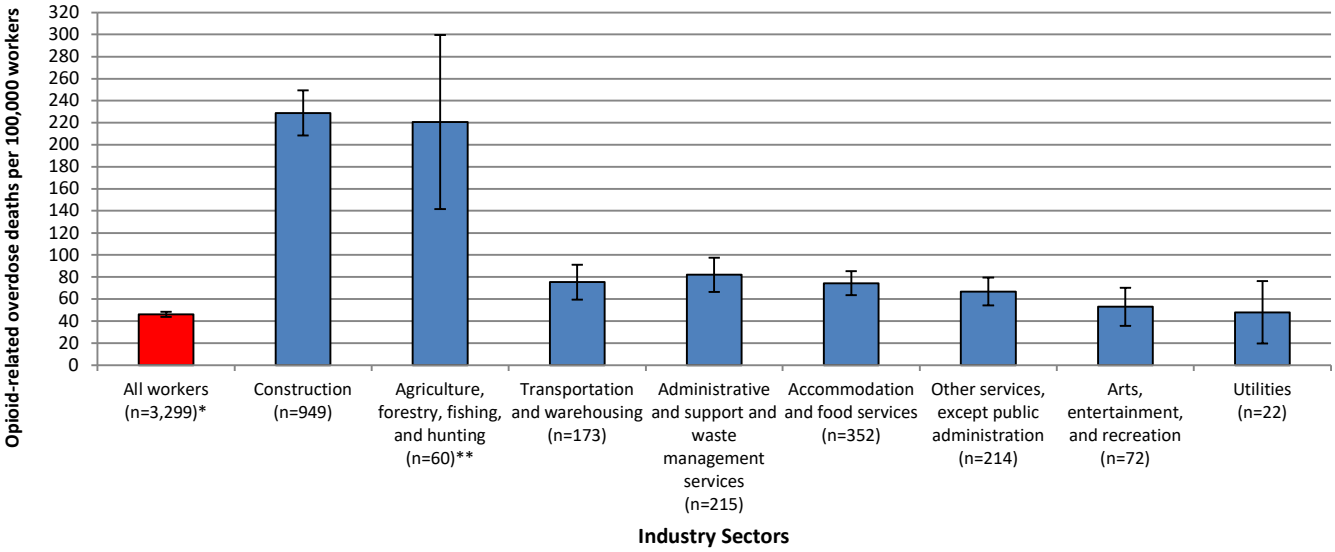
All Deaths by Industry

The overall rate of ORODs for all workers increased from 25.1 deaths per 100,000 workers in the period 2011 to 2015 to 46.1 in 2016-2017, a difference that is statistically significant (Figure 2). The rates in 10 out of 21 industry sectors have increased since the 2011-2015 data, and many have nearly doubled. Two notable industries that saw large jumps in the death rate were the Construction industry and the Agriculture, Forestry, Fishing, and Hunting industry. The Construction industry continued to have a high rate of ORODs (228.9 deaths/100,000 workers) during 2016-2017 which represents an 83% increase over the 2011-2015 rate (124.9 in 2011-2015) as did the Agriculture, Forestry, Fishing, and Hunting industry— this group's rate more than doubled from 107.5 in 2011-2015 to 220.8 in 2016-2017.

In 2016 and 2017, workers within eight industry sectors had OROD rates (deaths per 100,000 workers) that were higher than the rate for all workers within all industry sectors (46.1). Those industries with a statistically significant higher rate compared to the rate for all workers are denoted with an asterisk (*):

- Construction (228.9)*
- Agriculture, Forestry, Fishing, and Hunting (220.8)*[e]
- Administrative and Support and Waste Management Services (82.0)*[f]
- Transportation and Warehousing (75.3)*
- Accommodation and Food Services (74.45)*
- Other Services, Except Public Administration (66.8)*[g]
- Arts, Entertainment, and Recreation (52.9)
- Utilities (47.9)

Figure 2. Industry sectors with opioid-related overdose death rates that are higher than the rate for all workers, Massachusetts workers, 2016-2017, N=3,354



* This category excluded 16 deaths among those working in the military or military specific occupations due to lack of denominator information.
** 75.0% of these deaths occurred among workers employed in Fishing occupations.
Numerator source: Occupational Health Surveillance Program, 2016-2017
Denominator source: American Community Survey, 2016-2017

Findings for all industry sectors are presented in Table 1. As shown, there were ORODs among workers in every industry sector. Compared to the previous report, the five industry sectors with the highest rates of ORODs has fluctuated, but only slightly. In the previous report, Transportation and Warehousing occupations ranked just higher than Administrative and Support and Waste Management Services occupations.

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[e] 75.0% of the deaths in this sector occurred among workers employed in fishing occupations.
[f] This industry sector includes landscaping services; services to buildings and dwellings (except cleaning during construction and immediately after construction); business support services; investigation and security services; waste management and remediation services; employment services, which include temporary staffing agencies; and travel arrangements and reservation services.
[g] This industry sector includes automotive repair and maintenance; beauty salons, nail salons, barber shops and other personal care services; civic, social, and advocacy organizations, and grant making and giving services; car washes; religious organizations; personal and household goods repair and maintenance; funeral homes, and cemeteries and crematories; commercial and industrial machinery and equipment repair and maintenance; business, professional, political, and similar organizations; dry cleaning and laundry services; electronic and precision equipment repair and maintenance; labor unions; and private households employing individuals.

Table 1. Rate, number, and percent of opioid-related overdose deaths by industry sector, Massachusetts workers, 2016-2017, N=3,354

Industry	Rate of opioid-related overdose deaths/100,000 workers Mean (95% CI)	Opioid-related overdose deaths N (%)
Construction	228.9 (208.3, 249.5)[1]	949 (28.3)
Agriculture, forestry, fishing and hunting	220.8 (141.8, 299.8) [1]	60 (1.8)
Mining, quarrying, and oil and gas extraction	—[2]	—[2]
Administrative and support and waste management services	82.0 (66.5, 97.5) [1]	215 (6.4)
Transportation and warehousing	75.3 (59.4, 91.2) [1]	173 (5.2)
Accommodation and food services	74.4 (63.4, 85.4) [1]	352 (10.5)
Other services, except public administration	66.8 (54.2, 79.5) [1]	214 (6.4)
Arts, entertainment, and recreation	52.9 (35.6, 70.2)	72 (2.2)
Utilities	47.9 (19.6, 76.2)	22 (0.7)
Retail trade	39.6 (33.2, 45.9)	296 (8.9)
Manufacturing	39.0 (32.1, 45.9)	247 (7.4)
Real estate and rental and leasing	30.4 (16.9, 43.9)	39 (1.2)
Information	29.9 (18.0, 41.7)	49 (1.2)
Wholesale trade	29.2 (17.4, 41.0)	47 (1.4)
Health care and social assistance	26.1 (22.0, 30.2)	310 (9.2)
Professional, scientific, and technical services	14.8 (10.9, 18.8)	106 (3.2)
Finance and insurance	14.8 (9.5, 20.2)	60 (1.8)
Public administration	11.9 (6.2, 17.6)	33 (1.0)
Educational services	6.0 (3.6, 8.4)	49 (1.5)
Management of companies and enterprises	—[2]	—[2]
Military	—[3]	16 (0.5)
Unknown	—[3]	39 (1.2)
All Industries	46.1 (43.8, 48.3)	3,354 (100)

[1] Rate significantly higher than rate for all industries combined
[2] Suppressed due to cell size restriction
[3] Unable to calculate rate due to lack of denominator
Numerator source: Occupational Health Surveillance Program, 2016-2017
Denominator source: American Community Survey, 2016-2017

When prioritizing industries for prevention, it is important to consider both the number of deceased workers and their 'risk' of dying (rate of death). As seen in Table 1, many of the industries with the highest rates of OROD rates also have the highest numbers. For example, the Construction industry has the highest rate of ORODs and accounts for more than one-quarter (28.3%) of all deaths from 2016-2017. Of the nine industries with fatality rates higher than the overall rate, five had more than 150 deaths in the two-year period.

All Deaths by Occupation

As shown in Figure 3, workers in nine occupation groups had OROD rates (deaths per 100,000 workers) that were higher than the rate for all workers (46.5) in 2016-2017. Those occupations with a statistically significant higher rate compared to the rate for all workers are denoted with an asterisk (*):

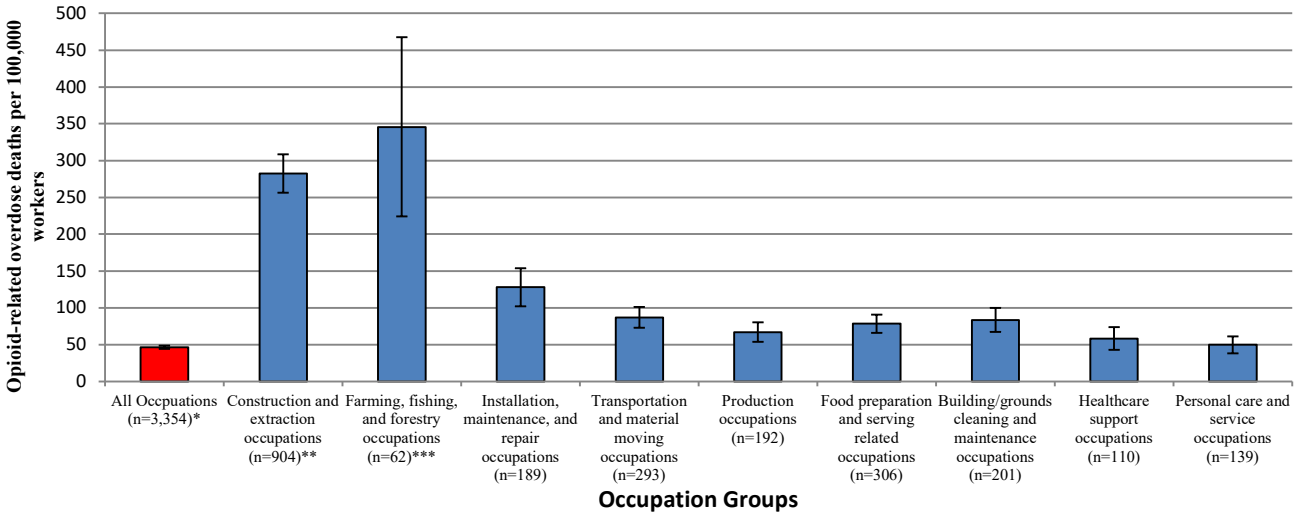
- Farming, Fishing, and Forestry occupations (345.8)*[h]
- Construction and Extraction occupations (282.4)*[i]
- Installation, Maintenance, and Repair occupations (128.1)*
- Transportation and Material Moving occupations (87.1)*[j]
- Building and Grounds Cleaning and Maintenance occupations (83.5)*
- Food Preparation and Serving Related occupations (78.4)*
- Production occupations (67.1)*
- Healthcare Support occupations (58.2)
- Personal Care and Service occupations (49.7)

When comparing OROD rates among occupational groups in the 2011-2015 data to those in the period 2016-2017, workers in 12 occupational groups had a significantly higher opioid-related overdose death rate in the more recent period compared to the previous period. In many cases, the rate more than doubled between the two periods (groups where the rate has doubled or more are indicated with an asterisk [*]):

- Farming, Fishing, and Forestry occupations*
- Construction and Extraction occupations
- Installation, Maintenance, and Repair occupations*
- Building and Grounds Cleaning and Maintenance occupations*
- Food Preparation and Serving Related occupations
- Production occupations
- Healthcare Support occupations
- Personal Care and Service occupations*
- Sales and Related occupations
- Arts, Design, Entertainment, Sports and Media occupations
- Office and Administrative Support occupations
- Business and Financial Operations occupations

[h] 75.4% of these deaths occurred among workers employed in Fishing occupations.
[i] At least 89.4% of these deaths occurred among workers employed in Construction occupations.
[j] In the 2011-2015 data, this occupation was broken out into two groups.

Figure 3. Occupation groups with opioid-related overdose death rates that are higher than the rate for all workers, Massachusetts workers, 2016-2017, N=3,354



* This category excluded 26 deaths among those working in the military or military specific occupations due to lack of denominator information.
** At least 89.4% of these deaths occurred among workers employed in Construction occupations.
*** 75.4% of these deaths occurred among workers employed in Fishing occupations.
Numerator source: Occupational Health Surveillance Program, 2016-2017
Denominator source: American Community Survey, 2016-2017

Findings for all occupational groups are included in Table 2. As shown, there were ORODs among workers in every occupation group. Compared to the previous report, the order of occupation groups from highest to lowest rate of ORODs has slightly shifted. Farming, Fishing, and Forestry occupations now have the highest rate of ORODs, with the Construction and Extraction occupation group having the second highest rate of ORODs. The rate among Building and Grounds Cleaning and Maintenance occupations has increased, while the rate for Production occupations has decreased, irrespective of the increased number of ORODs.

Table 2. Rate, number, and percent of opioid-related overdose deaths by occupation group, overall and by sex, Massachusetts workers, 2016-2017, N=3,354

Occupation	Rate of opioid-related overdose deaths/100,000 workers Rate (95% CI)			Opioid-related overdose deaths N (%)		
	Overall	Males	Females	Total	Males	Females
Farming, fishing, and forestry	345.8 (224.1, 467.5) [1]	444.3 (286.6, 602.0) [1]	[4]	62 (1.9)	[2]	[2]
Construction and extraction	282.4 (256.4, 308.4)[1]	284.5 (258.1, 310.9) [1]	186.9 (43.2, 330.6) [1]	904 (26.9)	891 (33.6)	13 (1.9)
Installation, maintenance, & repair	128.1 (102.3, 153.9) [1]	128.7 (102.4, 155.0) [1]	[4]	189 (5.6)	184 (6.9)	5 (0.7)
Transportation and material moving	87. 1 (73.0, 101.3) [1]	99.1 (82.5, 115.7) [1]	31.9 (11.6, 52.1) [1]	292 (8.7)	273 (10.3)	19 (2.7)
Building/grounds cleaning & maintenance	83.5 (67.2, 99.8) [1]	124.2 (99.2, 149.3) [1]	13.6 (2.7, 24.4)	201 (6.0)	189 (7.1)	12 (1.7)
Food preparation and serving related	78.4 (66.0, 90.9) [1]	105.9 (84.8, 127.0) [1]	54.1 (39.9, 68.3) [1]	306 (9.1)	194 (7.3)	112 (15.9)
Production	67.1 (53.6, 80.5) [1]	87.6 (69.2, 106.0) [1]	20.5 (7.1, 33.9) [1]	192 (5.7)	174 (6.6)	18 (2.6)
Healthcare support	58.2 (42.8, 73.6) [1]	66.7 (20.5, 113.0)	57.0 (40.7, 73.3) [1]	110 (3.3)	16 (0.6)	94 (13.4)
Personal care and service	49.7 (38.0, 61.4) [1]	71.7 (43.0, 100.4) [1]	42.8 (30.4, 55.2) [1]	139 (4.1)	48 (1.8)	91 (12.9)
Sales and related	38.9 (32.3, 45.5)	50.0 (39.7, 60.3)	26.8 (18.9, 34.7) [1]	268 (8.0)	180 (6.8)	88 (12.5)
Arts, design, entertainment, sports, & media	36.5 (23.5, 49.6)	57.8 (33.9, 81.6)	17.4 (4.9, 29.8)	60 (1.8)	45 (1.7)	15 (2.1)
Community and social services	25.0 (13.7, 36.2)	60.9 (27.8, 94.0)	11.0 (2.2, 19.7)	38 (1.1)	26 (1.0)	12 (1.7)
Protective service	20.6 (10.3, 30.9)	22.2 (10.6, 33.8)	[4]	31 (0.9)	[2]	[2]
Architecture and engineering	18.8 (9.6, 28.0)	22.1 (11.1, 33.1)	[4]	32 (1.0)	[2]	[2]
Office & administrative support	20.0 (15.7, 24.3)	26.9 (17.8, 35.9)	17.0 (12.3, 21.8)	165 (5.0)	67 (2.5)	98 (14.1)
Healthcare practitioner and technical	17.0 (11.8, 22.1)	21.4 (9.3, 33.5)	15.7 (10.0, 21.8)	83 (2.5)	24 (0.9)	59 (8.4)
Management	12.5 (9.2, 15.9)	18.7 (13.2, 24.1)	4.6 (1.5, 7.7)	106 (3.2)	89 (3.4)	17 (2.4)
Business and financial operations	13.3 (8.4, 18.2)	20.6 (11.6, 29.6)	7.3 (2.4, 12.2)	57 (1.7)	40 (1.5)	17 (2.4)
Life, physical, and social science	14.7 (5.6, 23.8)	24.0 (7.9, 40.1)	[4]	20 (0.6)	[2]	[2]
Computer and mathematical	11.7 (6.2, 17.1)	14.8 (7.6, 21.9)	[4]	35 (1.0)	[2]	[2]
Legal	[4]	[4]	[4]	7 (0.2)	[2]	[2]
Education, training, and library	5.9 (2.9, 8.9)	9.6 (2.5, 16.8)	4.4 (1.4, 7.5)	30 (0.9)	14 (0.5)	16 (2.3)
Military specific	[3]	[3]	[3]	15 (0.5)	[2]	[2]
Unknown	[3]	[3]	[3]	7 (0.2)	[2]	[2]
All Occupations	**46.5 (44.3, 48.7)**	**72.3 (68.4, 76.2)**	**19.8 (17.8, 21.9)**	**3,354 (100)**	**2,651 (100)**	**703 (100)**

[1] Rate significantly higher than rate for all occupation categories
[2] Suppressed due to cell size restriction
[3] Unable to calculate rate due to lack of denominator
[4] Rates not calculated due to N's < 10
Numerator source: Occupational Health Surveillance Program, 2016-2017
Denominator source: American Community Survey, 2016-2017

Similar to the 2011-2015 data, the number of ORODs was higher among workers in Construction and Extraction occupations compared to all other occupation groups. Table 3 provides the distribution of OROD deaths by detailed occupations within this group. Note that in the two-year period of 2016-2017, there were almost as many deaths in the Construction and Extraction occupations (N=904) as in the previous five-year period of 2011-2015 (N=1,096). The number of deaths in the Construction and Extraction occupations represented approximately 27% of total opioid-related overdose deaths in 2016-2017.

Table 3. Number and percent of opioid-related overdose deaths by detailed occupation within the Construction and Extraction occupations group, Massachusetts workers, 2016-2017, N=904

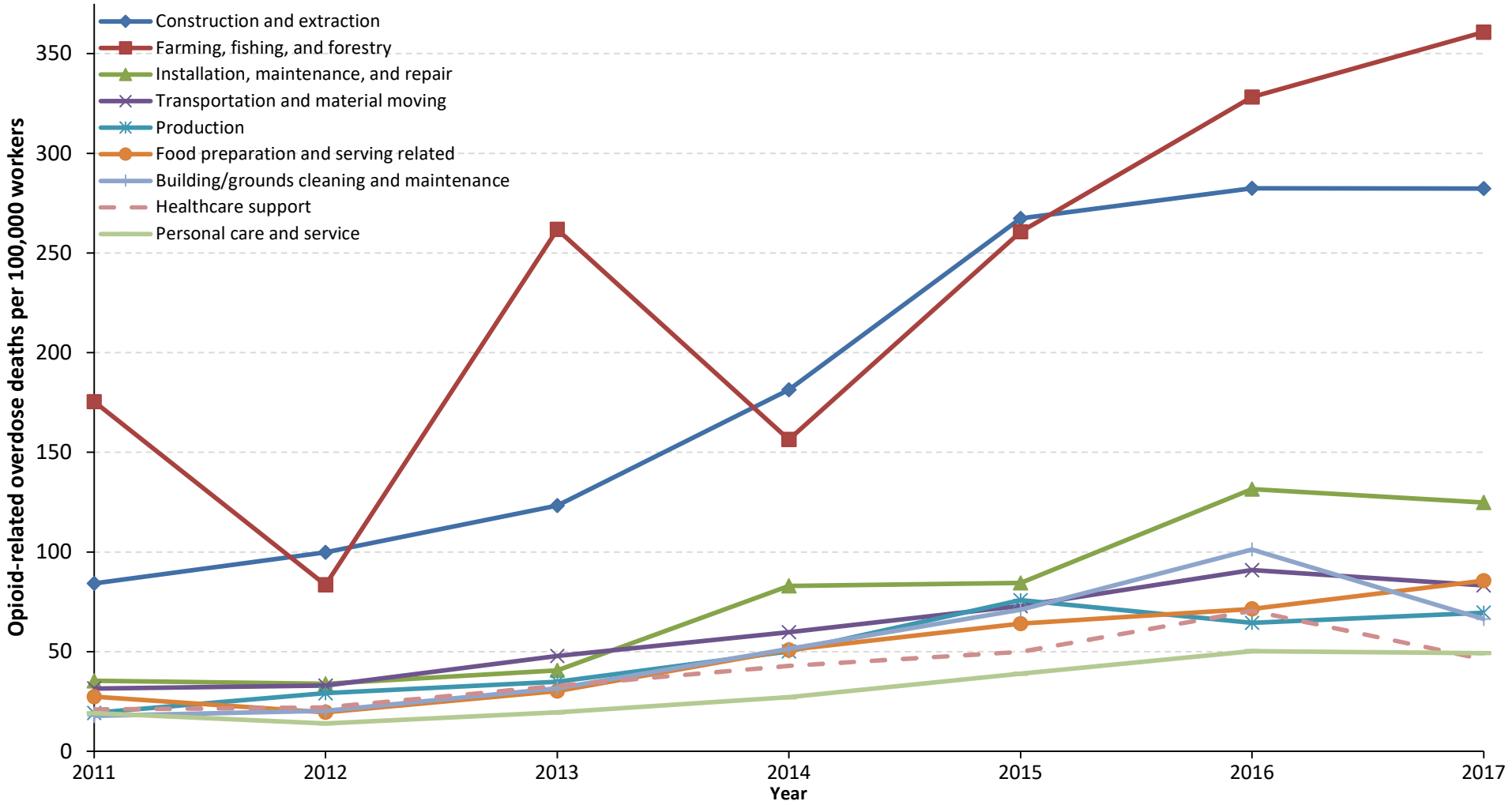
Occupation	Opioid-related overdose deaths N (%)
Construction laborers	303 (33.5)
Carpenters	185 (20.5)
Painters, construction and maintenance	69 (7.6)
Electricians	61 (6.8)
Pipe layers, plumbers, pipefitters, and steamfitters	53 (5.9)
Roofers	46 (5.1)
First-line supervisors of construction trades and extraction workers	41 (4.5)
Brick masons, block masons, and stone masons	31 (3.4)
Operating engineers and other construction equipment operators	15 (1.7)
Carpet, floor, and tile installers and finishers	12 (1.3)
Sheet metal workers	11 (1.2)
All others	77 (8.5)
Total	**904 (100)**

Source: Occupational Health Surveillance Program, 2016-2017

Opioid-Related Overdose Death among Massachusetts workers by occupational trends, 2011-2017

While this report only covers deaths through 2017, recent state-wide reports from the Massachusetts Department of Public Health (MDPH) show an estimated 4% decrease in the number of ORODs among Massachusetts residents from 2016 to 2019 (and this trendline is projected to decrease or stabilize over time).[12] While the overall rate of ORODs among Massachusetts residents declined slightly from 2016-2017,[12] in this study the rate of ORODs among residents in certain occupations has not. Rates of OROD among occupational groups by year are shown in Figure 4. Only occupations with 2016-2017 OROD rates higher than the overall statewide OROD rate are presented. Occupational groups, other than (1) Construction and Extraction, (2) Farming, Fishing, and Forestry, and (3) Food Preparation and Serving Related, show similar trends compared to the overall decrease in the number of ORODs. From 2011 to 2017, the average annual percent change of OROD rates for Farming, Fishing, and Forestry occupations and Food preparation and Serving Related occupations have increased on average by 17.9% and 23.6% (p's<0.01), respectively, while the rate for Construction and Extraction occupations has increased on average 30.8% from 2011 to 2015 (p<0.01) but has plateaued from 2015 to 2017 (p=0.44).

Figure 4. Rate of opioid-related overdose deaths among Massachusetts workers by occupation, N=7,691*



* The figure excludes 28 deaths among those working in the military or military specific occupations due to lack of denominator information
**Occupation groups with rates greater than the overall opioid-related overdose death rate are presented
Numerator source: Occupational Health Surveillance Program, 2011-2017
Denominator source: American Community Survey, 2011-2017

Deaths by Sex and Occupation, 2016-2017

The majority of ORODs occurred among males (79.0%, n=2,651) compared to females (21.0%, n=703), similar to findings among all Massachusetts residents.[13] Findings for all occupation groups by sex are shown in Table 2, and results for the five occupation groups with the highest rates by sex are shown in Table 4. The OROD rate was significantly higher among male workers (72.3 per 100,000 workers) compared to female workers (19.8). As shown in Table 2, although the rates of OROD were higher among males than females for all occupation groups, there were some occupations groups that had a higher number of female workers experiencing a fatal overdose compared to males:

- Healthcare Support occupations
- Personal Care and Service occupations
- Office and Administrative Support occupations
- Healthcare Practitioner and Technical occupations
- Education, Training, and Library occupations

Table 4. Rate, number, and percent of opioid-related overdose deaths by occupation groups with five highest rates by sex, Massachusetts workers, 2016-2017, N=3,354

Opioid-related overdose deaths					
Male			**Female**		
Occupation	**Rate per 100,000 workers (95% CI)**	**N (%)**	**Occupation**	**Rate per 100,000 workers (95% CI)**	**N (%)**
Farming, fishing, and forestry	444.3 (286.6, 602.0)[1]	61 (2.3)	Construction and extraction	186.9 (43.2, 330.6)[1]	13 (1.9)
Construction and extraction	284.5 (258.1, 310.9)[1]	891 (33.6)	Installation, maintenance, & repair	109.4 (-26.2, 245.1)[1]	5 (0.7)
Installation, maintenance, & repair	128.7 (102.4, 155.0)[1]	184 (6.9)	Healthcare support	57.0 (40.7, 73.3)[1]	94 (13.4)
Building/grounds cleaning & maintenance	124.2 (99.2, 149.3)[1]	189 (7.1)	Food preparation and serving related	54.1 (39.9, 68.3)[1]	112 (15.9)
Food preparation and serving related	105.9 (84.8, 127.0)[1]	194 (7.3)	Personal care and service	42.8 (30.4, 55.2)	91 (12.9)
All Occupations	**72.3 (68.4, 76.2)**	**2,651 (100)**	**All Occupations**	**19.9 (17.8, 22.0)**	**703 (100)**

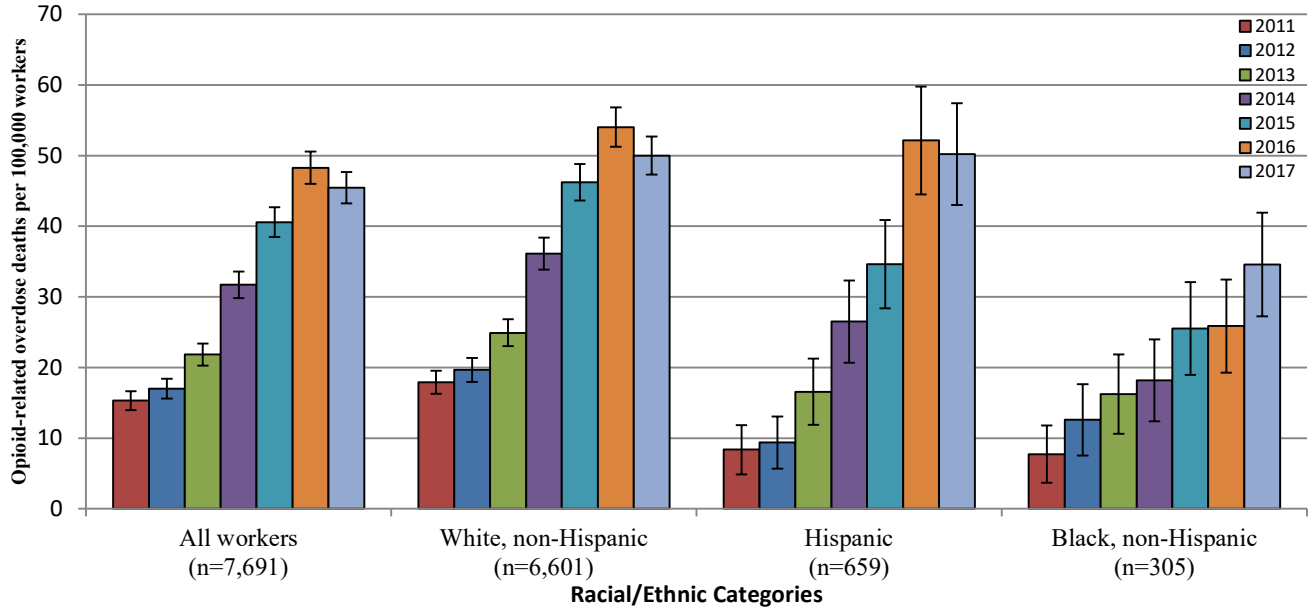
[1]Rate significantly higher than rate for all occupation categories
Numerator source: Occupational Health Surveillance Program, 2016-2017
Denominator source: American Community Survey, 2016-2017

Deaths by Race/Ethnicity and Occupation

Similar to findings for all ORODs by race/ethnicity among all Massachusetts residents, the overall rate of OROD was significantly higher among white, non-Hispanic workers (35.4 per 100,000 workers) compared with Hispanic (30.0), and Black, non-Hispanic (20.4) workers (data not shown).[13] It is important to note, using data from 2011-2017, the rates for Hispanic, and Black, non-Hispanic workers may be underestimated because the death certificates among these racial/ethnic groups were more likely to have missing industry and occupation information and therefore, as mentioned above in the Methods section, these death certificates were excluded from the analysis.

All seven years of available data (2011-2017) were examined (Figure 5). The rate for all workers, as well as the rates for both white, non-Hispanics and Hispanics, has increased between 2011 and 2016, with a slight decrease in 2017. However, the rate among Black, non-Hispanics continued to increase in 2017. While none of these changes in 2017 are statistically significant, this data does mirror that of the overall statewide trend showing that the OROD rate among Black, non-Hispanics continued to rise in Massachusetts, despite rates in other racial and ethnic groups decreasing.[14] The rate for Hispanics in 2011 was about half the rate of white, non-Hispanics; however, beginning in 2012 Hispanics experienced such a steep increase in their rate of fatal opioid overdoses that by 2016, it was similar to the rate for white, non-Hispanics.

Figure 5. Rate of opioid-related overdose deaths by race/ethnicity, Massachusetts workers, 2011-2017, N=7,691



Numerator source: Occupational Health Surveillance Program, 2011-2017
Denominator source: American Community Survey, 2011-2017

As shown in Table 5, the occupation groups with the five highest opioid-related overdose deaths differed slightly by race/ethnicity, although Construction and Extraction occupations and Transportation and Material Moving occupations were among the leading occupations for all racial/ethnic categories. Within the Construction and Extraction occupation group, white non-Hispanic workers had much higher death rates than both Hispanic and Black non-Hispanic workers. Additionally, among Installation, Maintenance, and Repair occupations, Hispanic workers had a significantly higher OROD rate compared to white, non-Hispanic workers (110.0 versus 77.3, respectively), which were both higher than the overall rate for all workers (31.6).

While the numbers of opioid-related overdose deaths among Black, non-Hispanic, and Hispanic workers are much less than for white, non-Hispanic workers, there are a few important differences in the distribution of deaths by leading occupation that are important to point out for prevention reasons. For example, among Hispanics, approximately 12% of all overdose deaths occurred among production workers, whereas production was not a leading occupation among other racial/ethnic groups.

Table 5. Rate, number, and percent of opioid-related overdose deaths by occupation groups with five highest rates by race/ethnicity, Massachusetts workers, 2011-2017, N=7,691

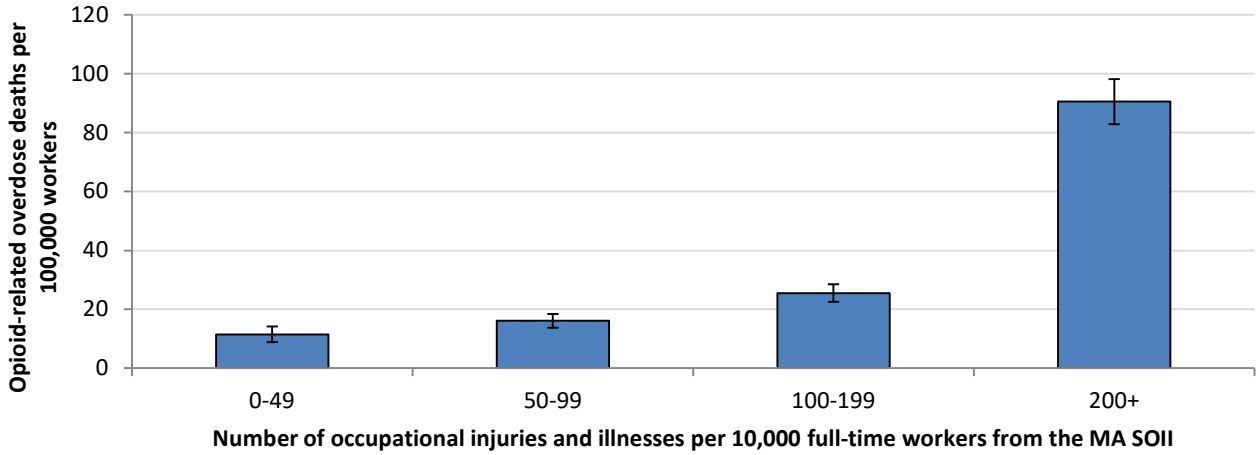
Opioid-related overdose deaths								
White, non-Hispanic			Black, non-Hispanic			Hispanic		
Occupation	**Rate per 100,000 workers (95% CI)**	**N (%)**	**Occupation**	**Rate per 100,000 workers (95% CI)**	**N (%)**	**Occupation**	**Rate per 100,000 workers (95% CI)**	**N (%)**
Farming, fishing and forestry	314.5 (161.7, 467.2)[1]	114 (1.7)	Construction and extraction	161.4 (53.4, 269.5)[1]	60 (19.7)	Construction and extraction	111.6 (60.3, 163.0)[1]	127 (19.3)
Construction and extraction	211.6 (185.7, 237.5)[1]	1,794 (27.2)	Farming, fishing, and forestry	—[3]	—[2]	Installation, maintenance, & repair	110.0 (28.5, 191.5)[1]	49 (7.4)
Installation, maintenance & repair	77.3 (56.1, 98.5)[1]	357 (5.4)	Arts, design, entertainment, sports and media	—[4]	7 (2.3)	Farming, fishing, and forestry	—[4]	7 (1.1)
Transportation and material moving	70.6 (54.6, 86.6)[1]	525 (8.0)	Transportation and material moving	32.0 (5.4, 58.6)	39 (12.8)	Transportation and material moving	56.8 (26.3, 87.3)[1]	93 (14.1)
Building/ grounds cleaning and maintenance	69.3 (50.0, 88.5)[1]	348 (5.3)	Food preparation and serving related	28.7 (-1.1, 58.5)	25 (8.2)	Production	42.1 (17.2, 67.0)	77 (11.7)
All Occupations	**35.4 (33.1, 37.7)**	**6,601 (100)**	**All Occupations**	**20.4 (14.3, 26.5)**	**305 (100)**	**All Occupations**	**30.0 (23.9, 36.1)**	**659 (100)**

[1] Rate significantly higher than rate for all occupation categories within each race/ethnicity group
[2] Suppressed due to cell size restriction
[3] Results not shown due to unstable data
[4] Rates not calculated due to N's < 10
[5] The overall rate for opioid-related overdose deaths for workers from 2011-2017 was 31.6 per 100,000 workers (29.7, 33.5)
Numerator source: Occupational Health Surveillance Program, 2011-2017
Denominator source: American Community Survey, 2011-2017

Occupational Health/Safety and Socioeconomic Factors

An association between fatal opioid-related overdose and workplace injury was found in the 2011-2015 data. The new data from 2016-17 was incorporated to see if higher OROD rates continue to occur in occupation groups that also have the highest rates for work-related injury and illness from the Massachusetts Survey of Occupational Injuries and Illnesses (MA SOII) (as described above in the Methods). [15] As in the previous report, a similar but more pronounced association was demonstrated when deceased workers were categorized according to the MA SOII injury and illness rate of their respective occupation group (Figure 6). Workers within occupation groups with fewer than 50 work-related injuries/illnesses per 10,000 full-time workers had an OROD rate of 11.5 per 100,000 workers, while workers within occupation groups with 200 or more injuries/illnesses per 10,000 full-time workers had an OROD rate of 90.5 per 100,000 workers. The trend observed in Figure 6 cannot be explained solely by Construction and Extraction workers' inclusion in the highest injury/illness category (200+), because a similar trend persisted even after Construction and Extraction workers were removed from this analysis (data not shown).

Figure 6. Rate of opioid-related overdose deaths among Massachusetts workers by occupation-specific injury and illness rate category, 2011- 2017, N= 7,508*

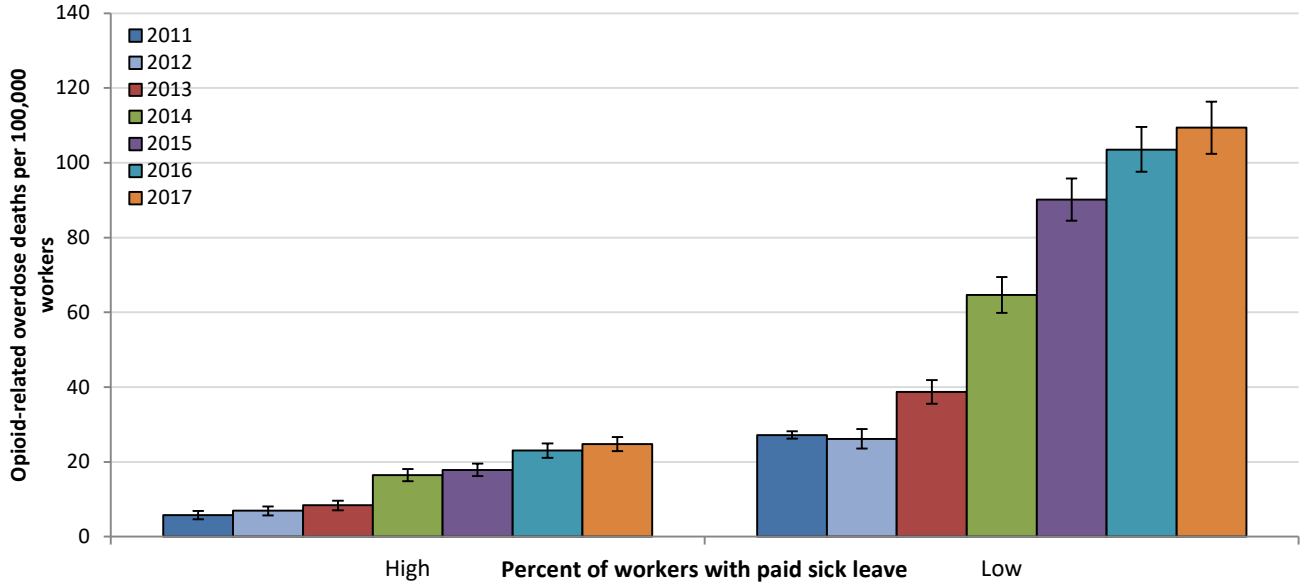


* Excluded from the OROD rate calculation are the following: deaths (and the corresponding workforce denominator estimates) among those working in the military or military-specific occupations (27), with unknown occupation information (25), or in occupations for which a SOII rate was not available or publishable (131 including the 125 deaths in the Farming, Fishing, & Forestry occupation group).
Numerator source: Occupational Health Surveillance Program, 2011-2017
Denominator source: American Community Survey, 2011-2017
Occupation groups with injury/illness rates that fall in the X-axis categories are from the 2014 Massachusetts Survey of Occupational Injuries and Illnesses (SOII), Bureau of Labor Statistics.

OROD rates were also examined in relation to another factor: access to paid sick leave. If paid sick leave is unavailable, a worker may decide to work while in pain, which may increase reliance on pain medication, including opioids. As shown in Figure 7, occupation groups were categorized as having either a high or low percentage of workers with paid sick leave, based on national data from the Bureau of Labor Statistics Employee Benefits Survey.[16] In each year (from 2011-2017), OROD rates were significantly higher among workers in occupation groups with lower percentages of workers covered by paid sick leave than among workers in occupation groups with higher percentages of workers covered by paid sick leave. It is notable that while opioid-overdose rates have increased steadily in both groups of workers over time, the highest rate of opioid-overdose among the "high % with sick leave" group of workers (24.7 in 2017) is still lower than the lowest rate of opioid-overdose among the "low % with sick leave" group of workers (26.2 in 2012).

The paid sick leave data in Figure 7 represents the United States as a whole and is not specific to Massachusetts. It should be noted that the Massachusetts Earned Sick Time Law went into effect in July 2015 and was implemented in 2016, so this law did not have a measurable impact on estimates of national sick leave for the period covering this report.

Figure 7. Rate of opioid-related overdose deaths among Massachusetts workers by availability of paid sick leave, N=7,691*



* Excluded from the OROD rate calculation were 28 deaths among those working in the military or military-specific occupations which lacked information about paid sick leave.
Paid sick leave categories (High, Low) were derived from national data from the Bureau of Labor Statistics' Employee Benefits Survey. An occupation group was considered to have high availability of paid sick leave if 70% or more of Survey respondents within that occupation reported having access to paid sick leave. All other occupation groups were categorized as having low availability of paid sick leave.
Numerator source: Occupational Health Surveillance Program, 2011-2017
Denominator source: American Community Survey, 2011-2017

Contributing Factor to Cause of Death

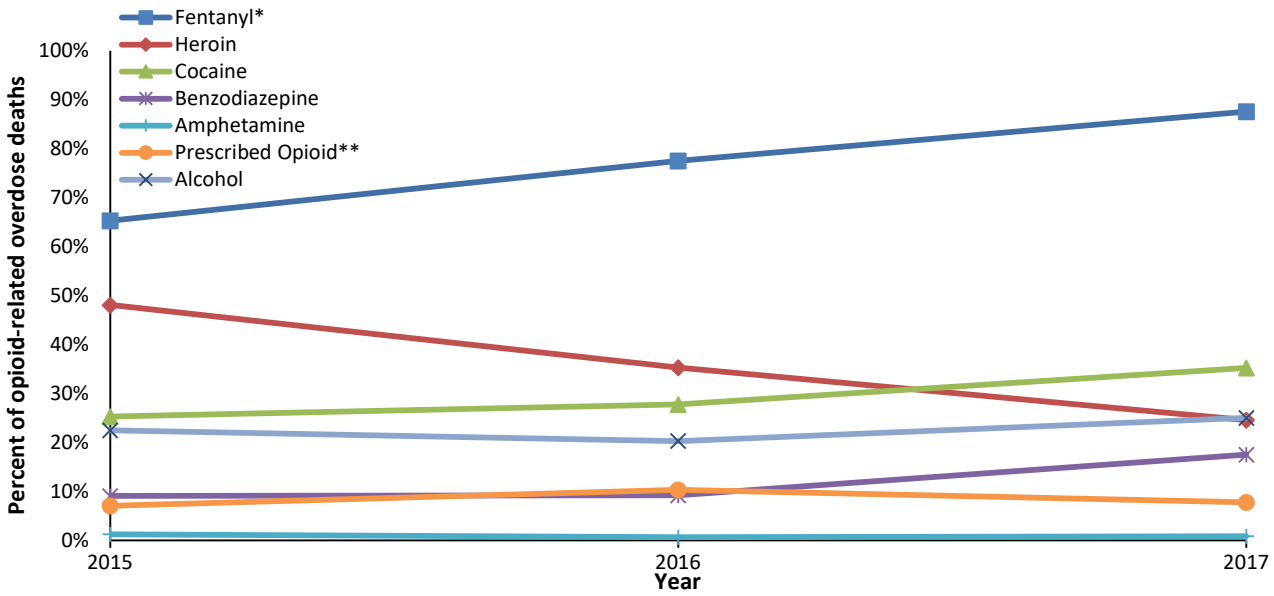
Toxicology reports were analyzed among select occupational groups for various reasons:

- Construction and Extraction occupations along with Farming, Fishing, and Forestry occupations were selected due to the overall high opioid-related overdose death rate as noted in Figure 4 (Toxicology data shown in Figures 8-9).
- Food Preparation and Serving Related occupations were selected because unlike most other occupational groups, the average annual percent change in the rate of opioid-related overdose deaths increased from 2011 to 2017 (see Figure 4, most other groups showed a decrease or plateauing in death rate between these years) (Toxicology data shown in Figure 10).
- We had *a priori* hypotheses about the trends in toxicology being different in certain groups. For example, among healthcare workers, based on literature and past experience, it was hypothesized that there would be a greater overall proportion of prescribed opioids compared to other occupational groups. Thus, we included 1) Healthcare Support occupations and 2) Healthcare Practitioners and Technical occupations in this analysis (Toxicology data shown in Figures 11-12).
- Production occupations were selected because, while not significant, there was an observed increase in the rate of opioid-related overdose deaths from 2016-2017 as noted in Figure 4. (Toxicology data shown in Figure 13).

Overall, in examining patterns of toxicology over a three-year period among six occupational groups, the following trends were noted:

- The presence of fentanyl in postmortem toxicology screens among those who suffered a fatal opioid-related overdose has *increased* between 2015 and 2017 in each of the six occupational groups examined (Figures 8-13).
- The presence of heroin or likely heroin has *decreased* between 2015 and 2017 among the following occupational groups:
    - Construction and Extraction occupations
    - Food Preparation and Serving Related Occupations
    - Healthcare Support occupations
    - Production occupations.
- For all occupations, except Production occupations, the percentage of ORODs with cocaine and/or benzodiazepines present increased from 2015-2017.
- The overall proportion of the percentage of ORODs with prescribed opioids is higher in Healthcare Support occupations and Healthcare Practitioners and Technical occupations compared to the other groups examined. The proportion of ORODs with prescribed opioids is decreasing or plateauing between 2015 and 2017 in all groups examined.

Figure 8. Percent of Opioid-related Overdose Deaths with Specific Drugs Present [§] among Construction and Extraction Occupations, N=1,299

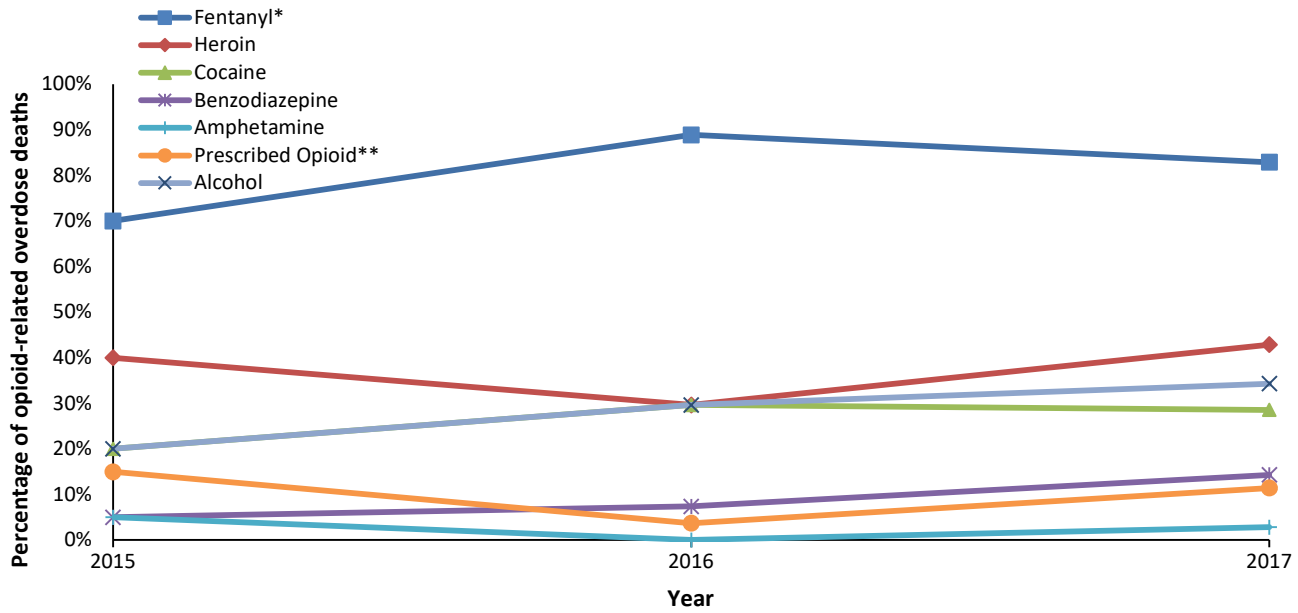


[§] Substances listed as a contributing factor to cause of death.

*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.

**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol.

Figure 9. Percent of Opioid-related Overdose Deaths with Specific Drugs Present[§] among Farming, Fishing and Forestry Occupations, N=82



[§] Substances listed as a contributing factor to cause of death.
*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.
**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol.

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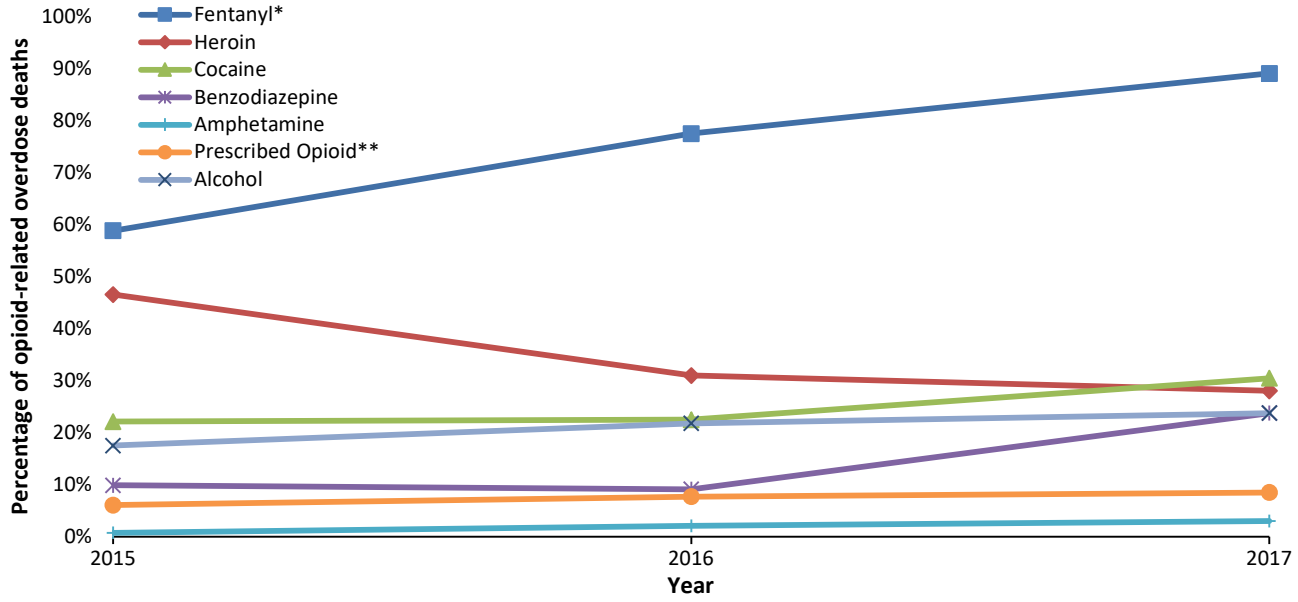
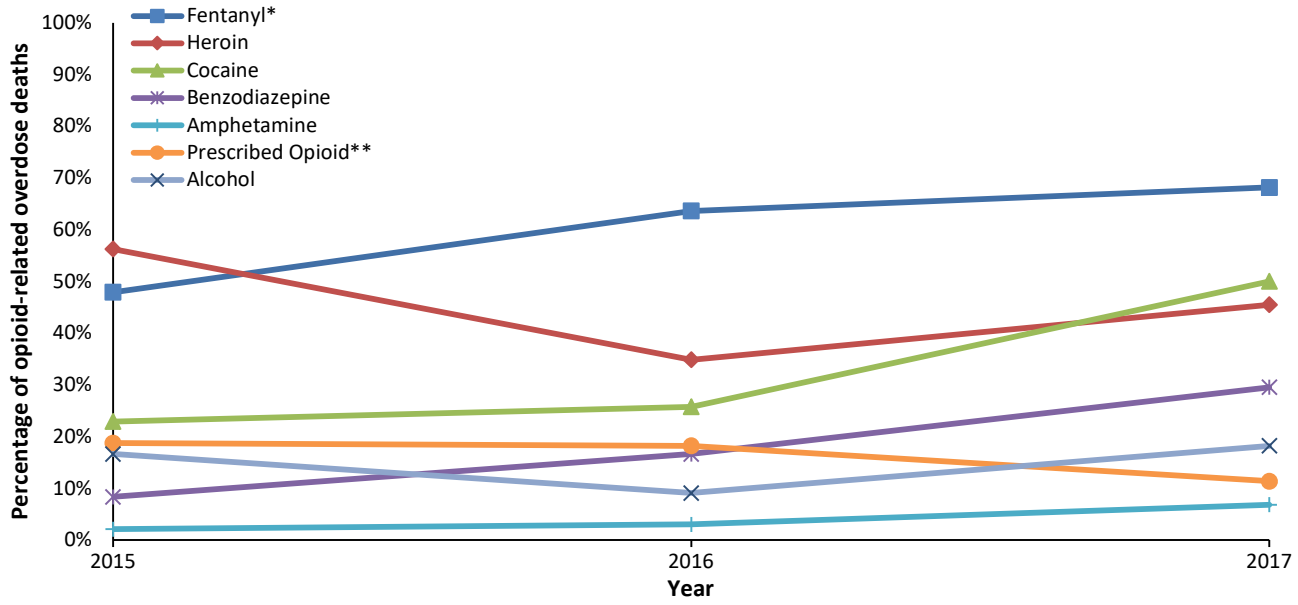
Figure 10. Percent of Opioid-related Overdose Deaths with Specific Drugs Present[§] among Food Preparation and Serving Related Occupations, N=437



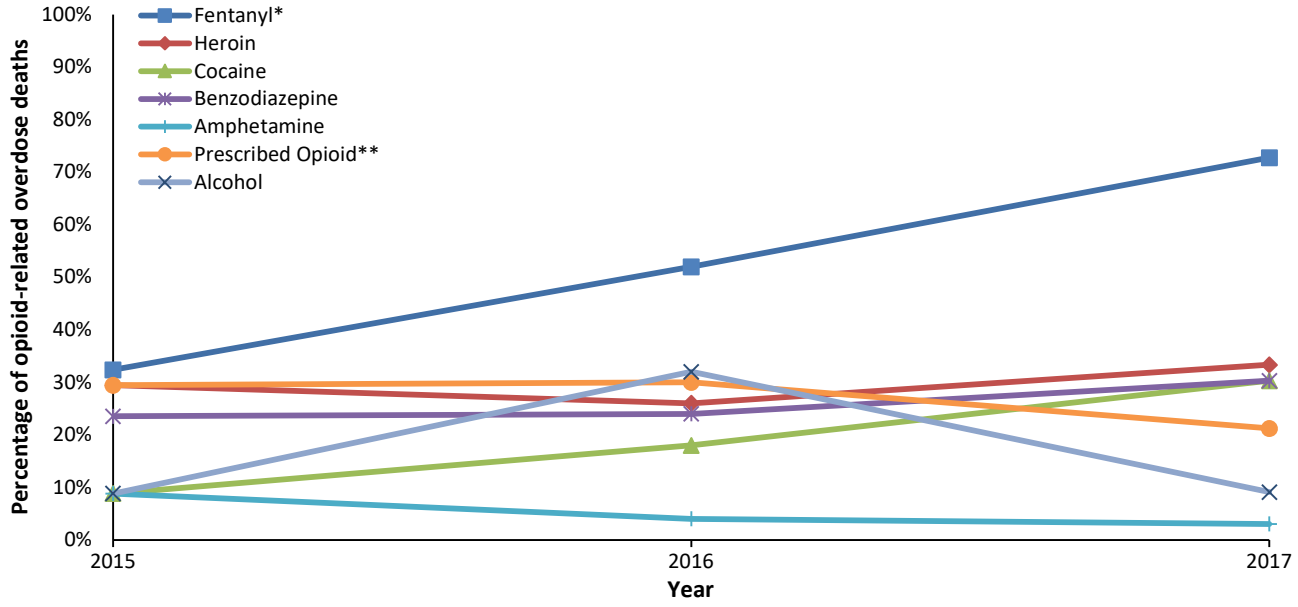
[§] Substances listed as a contributing factor to cause of death.
*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.
**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol.

Figure 11. Percent of Opioid-related Overdose Deaths with Specific Drugs Present[§] among Healthcare Support Occupations, N=158



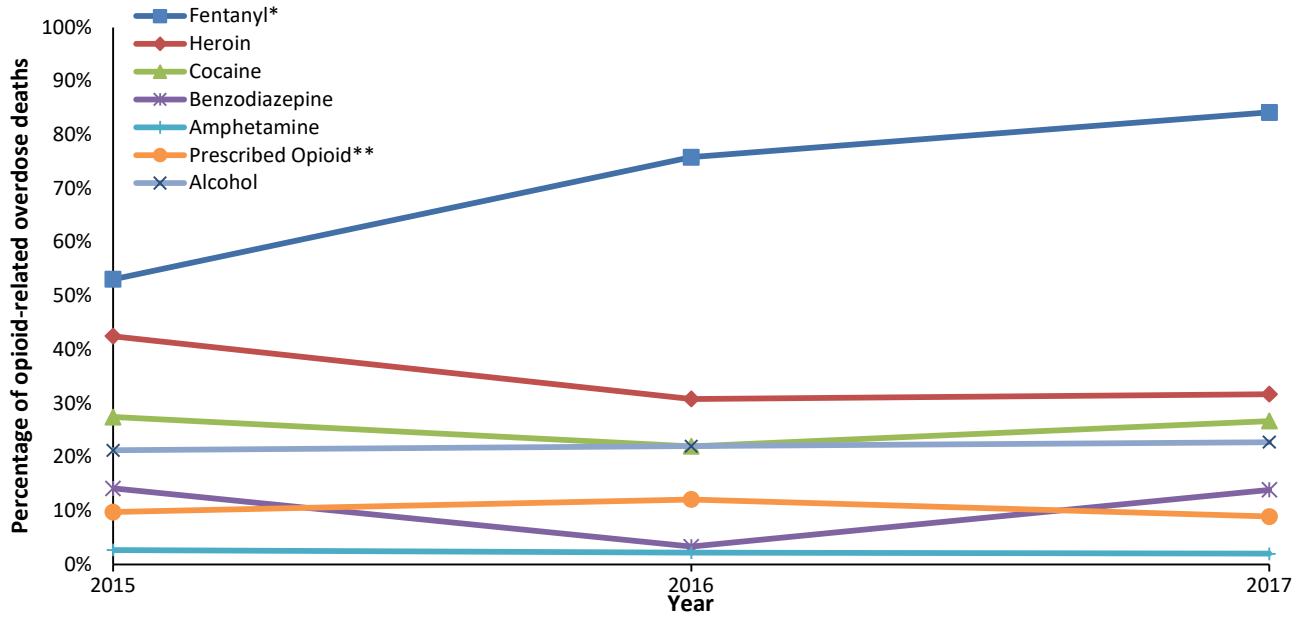
[§] Substances listed as a contributing factor to cause of death.
*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.
**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol.

Figure 12. Percent of Opioid-related Overdose Deaths with Specific Drugs Present[§] among Healthcare Practitioners and Technical Occupations, N=117



[§] Substances listed as a contributing factor to cause of death.
*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.
**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol.

Figure 13. Percent of Opioid-related Overdose Deaths with Specific Drugs Present[§] among Production Occupations, N=305



[§] Substances listed as a contributing factor to cause of death.
*Fentanyl is most likely illicitly produced and sold, not prescription fentanyl.
**Prescription opioids include: hydrocodone, hydromorphone, oxycodone, oxymorphone, and tramadol

Discussion

As noted above throughout this report, the opioid epidemic continues to have a negative impact on Massachusetts residents who work in physically demanding industries and occupations. To further explore this association, we analyzed state death certificate data among decedents for whom valid industry and/or occupation information was collected. This report updates findings from a previous period (2011-2015 data) with two additional years of data (2016-2017).[3] The goal of this report was to contribute updated and additional findings about deaths among the working population in Massachusetts, especially those employed in high-risk occupations; these groups must be considered in strategic efforts to reverse the harmful effects of this epidemic in Massachusetts. Information about prevention initiatives taking place statewide and locally can be found in the *Prevention* section below.

This report found that the average annual rate of opioid-related overdose deaths (OROD) for all workers almost doubled from 25.1 deaths per 100,000 in 2011-2015 to 46.1 deaths per 100,000 in 2016-2017. This increase in rate is consistent with what has been observed among all Massachusetts residents statewide.[12]

Similar to the previous period (2011-2015 data), OROD rates varied by industry and occupation of the decedents in this new period (2016-2017), although these more recent rates were higher, suggesting an increased risk in some industry and occupation groups during 2016-2017.[3] The rates for certain industries have more than doubled: 1) Agriculture, Forestry, Fishing, and Hunting; 2) Accommodation and Food Services; 3) Other Services, except Public Administration[k]; 4) Arts, Entertainment, and Recreation; and 5) Utilities. The following occupation groups also experienced OROD rates that doubled or more: 1) Farming,

[k] Other services (except public administration) include autobody shops, computer repair services, funeral homes, labor unions, charitable organizations, laundromats, to name a few. For a more complete list, see Appendix Table 2.

Fishing and Forestry; 2) Installation, Maintenance, and Repair; 3) Food Preparation and Serving Related; and 4) Building and Grounds, Cleaning and Maintenance. Stratifying by industry and occupation allowed us to consider what specific hazards these 'high rate' groups may be exposed to in the workplace. Notably, workers in many of these 'high rate' industries and occupations are involved in demanding physical work, which may include repetitive tasks, heavy lifting, activities that require "awkward" body postures for prolonged periods of time, etc., that are known to contribute to debilitating injury and musculoskeletal strain in the workplace.[17-19]

This link between workplace injury and opioid overdose in MA was found in the previous period (2011-2015 data) and is supported more recently by studies using statewide data from workers' compensation systems and other data sources.[3, 20-22] There is also evidence from a concurrent study of ORODs in the MDPH Public Health Data warehouse (PHD) – which linked data from multiple state administrative datasets – that a large percentage of the individuals who died of an opioid overdose between 2011 and 2015 had a prior diagnosis of pain (unpublished). Despite the declining utilization of prescription opioids in MA, there is evidence that injured workers continue to be prescribed opioids at higher doses and for longer durations which may enable them to continue working or to return to work prematurely following a work injury.[23,24]

The Construction and Extraction occupation group continued to stand out as having a very high OROD rate – over 6 times that for all workers – and the highest number of OROD, accounting for 27% of all ORODs in the two-year period 2016-2017. In addition to the rates, the number of individuals with an OROD employed as construction workers also increased; notably, in the two-year period 2016-2017 there were almost as many deaths in the Construction and Extraction occupations (N=904) as in the previous five-year period of 2011-2015 (N=1,096). Construction workers, like workers in the other 'high OROD rate' occupations discussed above, often experience high rates of occupational injuries and a high prevalence of debilitating musculoskeletal pain and emotional distress, given the physically demanding and dangerous nature of their jobs.[25,26] Nationally, construction workers were also more likely to receive opioids when receiving a prescription for pain medication, compared with workers in other industries, according to a study of opioid dispensing using workers' compensation insurance claim data from 27 states (including MA).[27] Not surprisingly, within the construction industry itself, construction workers suffering work-related injuries were more likely, on average, to report using prescribed opioids compared with their non-injured counterparts (25.3% vs. 8.9%) over the same time period as this report (2011-2017).[28] Notably in this study, the experience of sustaining a work-related injury was the strongest predictor of prescription opioid use compared with all the other covariates examined.[28]

Although white, non-Hispanic workers continued to have the highest OROD rates compared with both Black, non-Hispanic and Hispanic workers in 2016-2017, there was a rapid rise in OROD rates among Hispanic workers from 2011 to 2017. In 2011, the rate among Hispanics was about half that of white, non-Hispanics but by 2017, the rates were about the same. In 2018, Massachusetts had the highest age-adjusted OROD rate for Hispanic residents compared with all other U.S. states, at 30.4 deaths per 100,000.[29] Looking beyond the top industries and occupations of *all* workers affected by fatal overdoses, to understand the types of jobs that Hispanic and Latinx individuals are employed in, may shed some light on why the burden of fatal overdoses due to opioids may be on the rise in this population of workers and not among other racial/ethnic groups. In this report, the inclusion of additional years of death data (seven years in total) made it possible to generate OROD percent distributions as well as rates by occupation among three race/ethnicity strata (Table 5). For example, 12% of all ORODs among Hispanics occurred among Production workers, but this occupation group was not among the top five groups in terms of rate for either white, non-Hispanics or Black, non-Hispanics. Also, for Installation, Maintenance and Repair workers, one of 'high rate' occupation

groups identified in Table 5, Hispanics experienced a higher rate of ORODs than white, non-Hispanic workers, suggesting that Hispanic workers in this job may not have equitable access to 1) a safe workplace free of hazards, 2) benefits to which they are entitled (e.g., workers' compensation), 3) appropriate pain management, and 4) culturally responsive substance use disorder treatment and recovery supports, to name just a few.

In this report, we examined the toxicology information from the workers' death certificates in Massachusetts and reported annual percentages of the drugs present at death, by select occupation groups (this information is presented for the first time here, as it was not examined or reported on in the previous report on data from deaths occurring from 2011-2015). While the proportions of the specific drugs present in overdose deaths from opioids varied by occupation group and by year, for decedents in all of these occupations, we see a precipitous rise in the proportion of overdose deaths with fentanyl present over time. Among most of the occupation groups examined, fentanyl, a synthetic, mostly illicitly-produced, very potent opioid, was present most often, followed by heroin, an illegal, highly addictive opioid processed from morphine. In Construction and Extraction occupations, the percent of deaths involving fentanyl increased from 65.3% in 2015 to 87.6% in 2017, while the percent of deaths involving heroin decreased from 48.1% in 2015 to 24.6% in 2017. These findings add to the growing evidence that fentanyl is driving the current epidemic of opioid overdoses in MA.[12] Among MA residents in general, the age-adjusted rate of fatal overdose with synthetic opioids other than methadone (i.e., fentanyl, fentanyl analogs, and tramadol) was close to three times the rate of the total U.S. resident population in 2017.[2]

Another interesting finding is that among the two occupation groups of (1) Healthcare Support and (2) Healthcare Practitioners and Technical occupations, prescribed opioid 'pain relievers' such as hydrocodone and oxycodone were present in a larger percentage of deaths than in other industries examined, which is in line with findings observed nationally.[30] With funding from CDC, MDPH provided support to develop industry-specific opioid overdose prevention trainings. One of the groups highlighted in this previous prevention work was nurses, as described in the *Prevention* section below.

More work on examining the trends in toxicology patterns over time is needed. With additional years of data to be available soon for further analysis, we will be able to examine larger sample sizes within these occupational groups, as well as examine additional occupational groups.

Limitations

While this report highlights many important findings about the extent and magnitude of ORODs among workers in Massachusetts, there are some limitations that must be acknowledged. We assumed that decedents who had an industry and/or occupation reported on their death certificate were employed in that industry or occupation at the time of death or just preceding death. If decedents were retired, not employed, or working in another type of business or job at the time of death, the OROD rates may be over- or under-estimated. As noted earlier, under the Methods section, we tested our assumptions about the data and determined that any misclassification of deaths would likely have a minimal effect on the magnitude of the rates and other measures presented in this report. Also, while all opioid-related overdose deaths, whether intentional, unintentional, or of undetermined intent, were included in this study, it has been determined that between ~ 97 and 99% of all opioid-related overdose deaths are unintentional in any given year.[1] In addition, similar to the previous study published in 2018, this study lacked individual data on work-related factors, such as the incidence of work injury and availability of paid sick leave, both found to be associated with

[1] Confirmed by the Injury Surveillance Program, MDPH

rates of fatal opioid overdose. Therefore, we cannot draw conclusions about causal links between these factors and ORODs. Finally, decedents in this study may have had a baseline/background rate or prevalence of drug use that independently contributed to their risk of OROD.

Ongoing Prevention Efforts to Support Workers

Across the state, there are prevention initiatives and activities that are designed for workers and address the complex associations between work and opioid use. As this report has underscored how workplace injuries and their related health sequela, the demands of work, etc., can lead to problematic use of opioids, having safe work in a steady job can also be a protective factor for workers in Massachusetts, vital to both the prevention of opioid use initiation and the recovery from opioid dependence.[31]

Training efforts in local communities and unions have advanced awareness of the connections between opioid use and work. For example, both the Mystic Valley Public Health Coalition and the Barnstable County Substance Abuse Prevention Council have sponsored educational trainings and other activities such as public service announcement campaigns and focus groups for worker groups most affected in their communities – those employed in the building trades and other manual labor jobs and young people entering the job market directly from high school. MDPH has also been involved in similar efforts, providing funding to the Center for the Promotion of Health in the New England Workplace (CPH-NEW) at UMass Lowell and to the Massachusetts Coalition for Occupational Safety and Health (MassCOSH) to work with union peer leaders to develop and pilot job-specific opioid awareness trainings. The three union groups involved were: Teamsters Local 25, Ironworkers Local 7, and the Massachusetts Nurses Association.[32]

In addition to learning about the effects of opioids and alternative treatments for pain, union members were reminded of their workplace rights and benefits under the law and were given strategies to advocate for themselves before an injury occurs and in navigating a safe return to work. They also learned how to navigate the stigma associated with accessing addiction treatment services. These educational trainings all laid the groundwork for current MDPH-funded work that involves the development and implementation of new trainings that focus on both union and non-unionized workers in 'high-risk' industries. This work, conducted with Health Resources in Action (HRiA), will produce general opioid awareness trainings for employers and employees. Although Massachusetts workers are the focus of these efforts to prevent or reduce opioid use, the engagement of employers is vital to make the workplace serve as a supportive environment that promotes early intervention and recovery.[19] Thus, the work with HRiA to develop and pilot employer-focused online training modules will empower Massachusetts employers to implement policies and practices that build capacity for 'upstream' prevention among their employees with initiatives such as: 1) stronger health and safety measures that can prevent injury at the worksite; 2) compassionate drug free workplace policies; 3) stay at work/return to work accommodations; 4) improved employee benefits (e.g., access to health insurance options that cover alternative pain treatments; and, 5) organizational supports for their employees' treatment for and recovery from substance use/opioid dependency. These trainings and an accompanying website with related resources (currently in progress) have a planned launch date in early 2022. There will also be a series of related outreach and dissemination activities associated with the website launch.

While the Construction and Extraction occupations group experienced OROD risks higher than most other occupation groups each year over the period 2011-2017, the rate for this occupation group increased only 5% from 2015 to 2016 and appears to have leveled off in 2017. Statewide and locally in Massachusetts, union stakeholder groups such as the Massachusetts Building Trades Council have focused on construction

workers for outreach and prevention efforts with the goal of educating workers about the risks of opioids as painkillers, non-stigmatizing accommodations for a safe return to work after injury, and available prevention, treatment, and recovery supports. Fishing workers in Massachusetts are another group that has experienced increasing rates of OROD in recent years, and are subject to many of the same workplace factors as construction workers – physically exhausting, repetitive, intermittent work, with the added unpredictable time at sea (e.g. irregular days/hours at sea, for durations of time that can be unpredictable).[33] This has led to a New Bedford initiative that tailors substance use training to the needs and schedules of fishers and to the Fishing Partnership's support services' inclusion of opioid awareness and naloxone administration in all safety trainings offered to fishers.[34]

The Commonwealth is also intervening to prevent opioid overdose among workers in other novel ways. The agency that oversees the state's workers' compensation system, the Massachusetts Department of Industrial Accidents (DIA), has instituted a relatively new program called the Opioid Alternative Treatment Pathway (OATP). Injured workers who have been prescribed opioids for pain and are facing a lengthy litigation process with insurers can voluntarily enter the OATP.[35] Through the OATP, these workers gain immediate access to care coordinators who work with them and their medical providers to safely taper/reduce their use of opioids and to use alternative pain management strategies, with a goal of helping them regain functionality for an improved quality of life, or a return to work. Additionally, the Fatality Assessment and Control Evaluation (FACE) Project at MDPH has drafted a protocol for onsite investigation of worksites where a fatal overdose has occurred. This FACE protocol will allow for the identification of factors that precede or happen during the emergency response at the worksite; information obtained will help guide the development of comprehensive recommendations for employers to prevent similar deaths and provide organizational supports for their employees. Plans are underway to begin to pilot the protocol in 2022.

At a community level, MDPH-funded prevention initiatives, such as Hampshire HOPE, has been working to educate local employers about opioids and the workplace. This work involves developing a toolkit for employers to support a recovery-friendly workplace.

Conclusion

The findings in this report provide evidence of a heightened 'risk' of ORODs among Massachusetts working residents in recent years; this burden is felt more acutely among workers in physically demanding and strenuous jobs. These findings also underscore the need for educational and policy interventions that engage not only the workers employed in 'high risk' industries and occupations, but the companies that employ them. Opioid-related overdose deaths are just the tip of the iceberg; more information is needed to understand the burden of other opioid-related morbidities among workers in Massachusetts, including non-fatal overdose and opioid use disorder.

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Appendix: Examples of Industry and Occupation Groups

Appendix Table 1: Examples of Jobs within the Standard Occupational Classification (SOC) Coding System		
SOC Occupation Group[1]	**Example occupations[2]**	**SOC Occupation Code Series**
Management	governor, legislator, sales manager, chief technology officer, comptroller, warehouse manager, fish hatchery manager, general contractor, postmaster, school principal, family service center director	11-0000
Business & Financial Operations	merchandise buyer, insurance adjuster, HR specialist, finance officer, bank examiner, accountant, loan officer, IRS agent, financial analyst	13-0000
Computer and mathematical	computer systems architect, software developer, applications programmer, web designer, database security administrator, help desk technician, insurance actuary, biostatistician	15-0000
Architecture and Engineering	building architect, landscape designer, land surveyor, plastics engineer, civil engineer, computer hardware designer, water treatment plant engineer, industrial hygienist, mechanical Engineer, electrical systems drafter	17-0000
Life, physical, and social science	horticulturalist, biochemist, cancer researcher, economist, school psychologist, city planner, GIS geographer, political consultant, crime scene technician, laboratory research assistant	19-0000
Community and social services	alcohol and drug counselor, vocational rehabilitation counselor, social worker, health educator, probation officer, community health worker, clergy	21-0000
Legal	public defender, judge, paralegal, court stenographer, title officer	23-0000
Education, Training, & Library	preschool teacher, high school teacher, tutor, librarian, professor, athletic coach, art conservator, law librarian	25-0000
Arts, design, entertainment, sports, & media	tattoo artist, florist, graphic designer, actor, baseball player, swim coach, choreographer, songwriter, newscaster, sports writer, translator, video production assistant, camera operator	27-0000

Healthcare Practitioner & Technical	pharmacist, physician, nutritionist, speech pathologist, EMT, veterinary tech, x-ray tech, registered nurse, licensed practical nurse, physical therapist, dental hygienist, optician, medical records specialist, athletic trainer	29-0000
Healthcare Support	home health aide, nurse's aide, medical/dental assistant, pharmacy assistant, massage therapist, hospital orderly, phlebotomist	31-0000
Protective Service	corrections officer, police officer, fire fighter, bailiff, animal control worker, security guard, lifeguard, parking enforcement worker, school crossing guard	33-0000
Food Preparation & Serving Related	cook, waiter, bar tender, dishwasher, host/hostess	35-0000
Building and Grounds Cleaning & Maintenance	janitor, housekeeper, landscaper, tree trimmer, window washer, pest control worker, pesticide applicator	37-0000
Personal Care & Service	barber, hairdresser, manicurist, cosmetologist, daycare worker, personal care attendant, flight attendant, animal trainer, recreation assistant, theatre usher, ski lift operator, funeral home attendant, hotel concierge, tour guide, camp counselor, valet	39-0000
Sales & Related	cashier, store clerk, car salesman, art dealer, travel agent, insurance agent, realtor, telemarketer	41-0000
Office & Administrative Support	bookkeeper, payroll supervisor, receptionist, customer service agent, library clerk, hotel clerk, mail carrier, courier, messenger, debt collector, municipal clerk, loan processor, freight shipping agent, 911 operator, warehouse clerk, legal secretary	43-0000
Farming, Fishing & Forestry	cranberry bog supervisor, egg grader, berry picker, orchard hand, log cutter, timber faller/cutter, aquaculture worker, lobsterman, fishing boat captain, tractor operator, forestry laborer	45-0000
Construction & Extraction	carpenter, stonemason, roofer, electrician, insulation worker, asphalt worker, construction laborer, floor finisher, mason, bulldozer operator, drywall installer, house painter, plumber, iron worker, elevator mechanic, hazardous materials removal worker, highway maintenance worker, oil/gas driller, quarry worker	47-0000
Installation, Maintenance, & Repair	locksmith, auto body/automotive worker, HVAC mechanic, cable TV/internet installer, vending machine servicer, ATM servicer, telecom	49-0000

	equipment installer, marine mechanic, farm equipment repair, subway car repair, lawn mover repairer, bike mechanic, industrial machinery mechanic, electric utility line worker, piano tuner, commercial diver	
Production	electronics assembler, coat maker, furniture refinisher, printing press operator, butcher, distiller, assembly line supervisor, vending machine assembler, engine turbine assembler, boat builder, baker, fish processing worker, machine automator, injection molding operator, automotive machinist, pipe welder, dry-cleaning worker, tailor, wastewater plant operator, machine quality inspector, eyeglass maker, aircraft painter, semiconductor assembler	51-0000
Transportation & Material Moving	bus driver, taxi driver, air traffic controller, flight attendant, railway switch operator, parking attendant, warehouse supervisor, cargo handler, boom crane operator, forklift operator, aircraft cleaner, trash/waste collector, pumping station operator	53-0000
Military Specific	National Guardsperson, military police officer, active duty service member of the Air Force, Navy, Army, Marine Corps	55-0000

1. Occupation groups based on the Standard Occupational Classification (SOC) System : https://www.bls.gov/soc/2010/home.htm. See https://www.bls.gov/soc/soc_2010_definitions.pdf for detailed descriptions of each SOC code as well as additional example jobs.

Appendix Table 2: Examples of Industries within the North American Industry Classification System (NAICS)		
NAICS Industry Group[1]	**Examples of Industries**	**NAICS Industry Code Series**
Agriculture, Forestry, Fishing & Hunting	apple orchard, tree nursery, dairy farm, vineyard, aerial spraying, vegetable packing, animal breeding, oyster farm, lobstering, fishery	11
Mining, Quarrying, & Oil & Gas Extraction	blasting services for mining, limestone quarry, copper milling, gravel crushing, oil well drilling, petroleum production, natural gas compressing	21
Utilities	electric utility, wind farm, gas works, city water works, wastewater treatment plant	22
Construction	general contractor, highway construction, asphalt paving, drywalling, excavating contractor, floor laying, underground cable laying, building demolition	23
Manufacturing	fruit canning, seafood processing, commercial bakery, sawmill, book printing, cement manufacturing, plastic bottle manufacturing	31-33
Wholesale Trade	lumber wholesaler, furniture & home furnishing merchant wholesaler, paper and paper product wholesaler, chemical wholesaler, business-to-business electronic market company	42
Retail Trade	supermarket/grocery store, bookstore, gasoline station, electronic shopping network, used car dealer, hardware store, nursery/garden center	44-45
Transportation & Warehousing	airline, commuter rail system, taxi service, courier service, postal service, city port, commercial trucking, furniture moving, general storage, cold storage plant	48-49
Information	associated press, newspaper office, internet sports site, radio program producer, cinema, film studio, internet provider, software publishing, book publishing	51
Finance & Insurance	credit union, loan broker, savings bank, auto insurance agency, health insurer	52
Real Estate & Rental & Leasing	real estate firm, building management, car rental agency, clothing rental company	53
Professional, Scientific, & Technical Services	law office, payroll service, accounting firm, surveying service, graphic design firm, website development, advertising agency, animal clinic, photo studio	54
Management of Companies & Enterprises	corporate headquarters, district and regional offices, bank holding company	55
Administrative, Support, & Waste Mgmt. Services	employment services (including temporary employment agency), credit bureau, travel agency, security service, packaging service, landscaping business, trash collection, recycling center, septic cleaning service	56

Educational Services	elementary school, vocational high school, state university, veterinary school, cosmetology school, soccer camp, dance academy, educational testing service	61
Health Care & Social Assistance	medical clinic, dental office, drug treatment center, visiting nurse/home health association, city hospital, nursing home, adoption agency, homeless shelter, child care center, crisis intervention/counseling center, food bank	62
Arts, Entertainment, & Recreation	modeling agency, baseball stadium, casino, orchestra, music club, city museum, state park, zoo, amusement park, bowling alley, marina/pier, golf course, health club, ski resort	71
Accommodation & Food Services	hotel, motel, bed and breakfast, recreational camp, bagel shop, fast food restaurant, concession stand, ice cream truck vendor, school cafeteria, cocktail lounge	72
Other Services (except Public Administration)	auto body shop, computer repair service, shoe repair shop, barbershop, nail salon, car wash, laundromat, parking lot, funeral home, city animal shelter, civic organization, labor union, place of religious worship, charitable organization, private household employing gardeners, cooks, chauffeurs etc., medical association	81
Public Administration	statehouse, city tax office, city inspectional service, state court, federal prison, city police and fire departments, state department of environmental protection, city board of health, state motor vehicle registry, US Army post	92
Military	Air Force, Navy, Army, Marine Corps, military police, National Guard	928110

1. Industry groups based on the 2012 North American Industry Classification System (NAICS) codes: https://www.census.gov/naics/ See https://www.census.gov/naics/#q7?58967?yearbck=2012 for detailed descriptions of each NAICS industry code as well as additional example industries.