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The Effect of Incomplete Death Certificates on Estimates of Unintentional Opioid-Related Overdose Deaths in the United States, 1999-2015

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Abstract

Objectives: A complete and accurate count of the number of opioid-related overdose deaths is essential to properly allocate resources. We determined the rate of unintentional overdose deaths (non–opioid-related, opioid-related, or unspecified) in the United States and by state from 1999 to 2015 and the possible effects of underreporting on national estimates of opioid abuse.

Methods: We abstracted unintentional drug overdose deaths (*International Classification of Diseases, 10th Revision,* codes X40-X44) with contributory drug-specific T codes (T36.0-T50.9) from the Mortality Multiple Cause Micro-Data Files. We assumed that the proportion of unspecified overdose deaths that might be attributed to opioids would be the same as the proportion of opioid-related overdose deaths among all overdose deaths and calculated the number of deaths that could be reallocated as opioid-related for each state and year. We then added these reallocated deaths to the reported deaths to determine their potential effect on total opioid-related deaths.

Results: From 1999 to 2015, a total of 438 607 people died from unintentional drug overdoses. Opioid-related overdose deaths rose 401% (from 5868 to 29 383), non–opioid-related overdose deaths rose 150% (from 3005 to 7505), and unspecified overdose deaths rose 220% (from 2255 to 29 383). In 5 states (Alabama, Indiana, Louisiana, Mississippi, and Pennsylvania), more than 35% of unintentional overdose deaths were coded as unspecified. Our reallocation resulted in classifying more than 70 000 unspecified overdose deaths as potential additional opioid-related overdose deaths.

Conclusions: States may be greatly underestimating the effect of opioid-related overdose deaths because of incomplete cause-of-death reporting, indicating that the current opioid overdose epidemic may be worse than it appears.

Keywords

death, drug overdose, death certificates, epidemics, opioids

The recent increase in overdose deaths in the United States is well documented.[1-3] This increase has been attributed to opioids, both prescription opioid pain relievers and heroin.[1] For example, in 2010, opioid pain relievers were reported in 75% of overdose deaths involving a medicinal drug.[4] Although 28 states reported that heroin deaths doubled from 1779 in 2010 to 3635 in 2012, during that same period, the same 28 states reported that deaths from opioid pain relievers decreased 6.6%, from 10 427 to 9869.[5] From 2013 to 2014, deaths from opioid pain relievers increased 9%, deaths from heroin increased 26%, and deaths from synthetic opioid pain relievers increased 80%.[6] Data from 2015 suggest that rates continue to rise,[7] with 63% of overdose deaths involving an opioid.[6]

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In the United States, cause-of-death codes are assigned by the National Center for Health Statistics in accordance with international rules set forth by the World Health Organization.[8] Since 1999, the *International Classification of Diseases, 10th Revision* (ICD-10) has been used to classify causes of death. Unintentional drug poisoning or overdose deaths are assigned an underlying ICD-10 code of X40-X44. Drug-specific overdose deaths are identified by the contributory causes of death indicated by "T" codes. Drug-specific T codes are assigned as contributory causes based on the drugs recorded by the coroner or medical examiner completing the death certificate.

The drug-specific contributory causes of death are assigned ICD-10 codes of T36.0-T50.9 ("poisoning by drugs, medicaments and biological substances"). Within these codes, non-opioid drugs (eg, cocaine and benzodiazepines) are coded as T36.0-T39.9, T40.5, or T40.7-T50.8. Opioid-related deaths are coded as T40.0-T40.4 and T40.6:

T40.0: opium
T40.1: heroin
T40.2: other opioids (ie, opioid pain relievers)
T40.3: methadone
T40.4: other synthetic narcotics (eg, fentanyl)
T40.6: other and unspecified narcotics

Code T50.9 ("other and unspecified drugs, medicaments and biological substances") can be combined with other T codes to indicate drugs that do not have specific codes (eg, bath salts) or used alone to indicate that no drug was reported on the death certificate. When the death is classified only by the drug-related T code T50.9 (meaning a drug is not specified), the missing information on drug types leads to underestimating deaths from specific drugs, such as opioid-related deaths.[9,10] This underreporting problem has been addressed by the Council of State and Territorial Epidemiologists, which has advocated for more accurate drug reporting on death certificates,[11] and by the American College of Medical Toxicology and the National Association of Medical Examiners, which also have recommended listing all responsible and contributing substances on death certificates.[12]

We sought to determine the proportion of unintentional overdose deaths coded as unspecified (ie, codes X40-X44: drug overdose deaths containing only ICD-10 code T50.9 as the contributory cause of death) and the extent to which this code likely underreports opioid-related, unintentional overdose deaths nationally and by state from 1999 through 2015.

Methods

We abstracted data on deaths using ICD-10 codes by state and year (1999-2015) from the Mortality Multiple Cause Data Files of the National Vital Statistics System of the National Center for Health Statistics.[13] Each record in the micro-data files is based on information abstracted from death certificates filed in vital statistics offices of each state and the District of Columbia.

We abstracted data on overdose deaths (ICD-10 codes X40-X44 for unintentional drug overdose), along with all of the contributory cause-of-death T codes for each death. We did not include drug overdose deaths with other intents, including intentional self-harm (suicide, X60-X64), assault (homicide, X85), and undetermined intent (Y10-Y14). We categorized overdose deaths as opioid-related if they contained 1 or more of codes T40.0-T40.4 or T40.6. Opioid-related deaths could also include non-opioid drugs if both were reported together. We categorized overdose deaths as non–opioid-related if they contained 1 or more of codes T36.0-T39.9, T40.5, or T40.7-T50.8 and none of codes T40.0-T40.4 or T40.6. We categorized overdose deaths as unspecified if they were coded only as T50.9 and had no other drug-specific T code (T36.0-T50.8). Generally, unintentional overdose deaths coded only as T50.9 are from unspecified drugs, although code T50.9 has recently been used for deaths involving drugs with no other appropriate T code, such as bath salts. However, this practice would affect only a tiny proportion of deaths evaluated in this study.

We counted overdose deaths by state and year. We calculated the percentages of overdose deaths by state and year coded as opioid-related, non–opioid-related, and unspecified. We also calculated the change in the percentage of opioid-related overdose deaths and the percentage of unspecified overdose deaths from 1999-2015 for each state.

We expressed the number of opioid-related unintentional overdose deaths as a proportion of specified drug overdose deaths (any death coded as T30.6-T50.9) by state and year. We multiplied this proportion by the number of unspecified unintentional overdose deaths by state and year and reallocated this proportion as potential additional opioid-related, unintentional overdose deaths. In other words, we assumed that the proportion of unspecified overdose deaths that might be attributed to opioids would be the same as the proportion of opioid-related overdose deaths among all overdose deaths.

We calculated actual and reallocated opioid-related unintentional overdose mortality rates by state for 2015. We ranked states from highest to lowest by their actual and reallocated opioid-related unintentional overdose mortality rates. We also calculated the changes from the reallocation in rates and ranks. We analyzed data using SAS version 9.4.[14]

Results

From 1999 through 2015, a total of 438 607 people died from an unintentional drug overdose (Table 1). Most opioid-related overdose deaths were coded as X42, and most unspecified overdose deaths were coded as X44. Of 438 607 overdose deaths, 255 527 (58%) were coded as opioid-related, 85 608 (20%) were coded as non–opioid-related, and 97 159 (22%) were coded as unspecified. Opioid pain relievers (41.5%) were the most commonly reported, followed by heroin (25.4%), methadone (20.3%), other and unspecified narcotics (14.4%), synthetic opioids other than methadone (14.2%), and opium (0.01%) (categories are not mutually

Table 1. Unintentional drug overdose deaths in the United States, by underlying (X) codes and all combinations of contributory (T) codes, 1999-2015

T Codes Present			ICD-10 Codes for Unintentional Drug Overdose Deaths					
Opioid-Related (T40.0-T40.4; T40.6)	Non–Opioid-Related (T36.0-T39.9; T40.5; T40.7-T50.8)	Unspecified (T50.9)	X40[a] No. (%)	X41[b] No. (%)	X42[c] No. (%)	X43[d] No. (%)	X44[e] No. (%)	Total[f] No. (%)
Yes	No	No	3 (<0.1)	37 (<0.1)	94 907 (99.4)	6 (<0.1)	514 (0.5)	95 467 (100.0)
Yes	Yes	No	25 (<0.1)	248 (0.4)	20 167 (33.9)	7 (<0.1)	38 963 (65.6)	59 410 (100.0)
Yes	No	Yes	1 (<0.1)	26 (<0.1)	40 177 (89.5)	1 (<0.1)	4663 (10.4)	44 868 (100.0)
Yes	Yes	Yes	7 (<0.1)	219 (0.4)	9902 (17.7)	10 (<0.1)	45 644 (81.8)	55 782 (100.0)
No	Yes	No	2891 (4.7)	19 070 (31.1)	27 085 (44.1)	220 (0.4)	12 151 (19.8)	61 417 (100.0)
No	Yes	Yes	850 (3.5)	9847 (40.7)	7264 (30.0)	109 (0.5)	6121 (25.3)	24 191 (100.0)
No	No	Yes	5 (<0.1)	108 (0.1)	422 (0.4)	2 (<0.1)	96 622 (99.4)	97 159 (100.0)
No	No	No	36 (11.5)	13 (4.1)	31 (9.9)	3 (1.0)	230 (73.5)	313 (100.0)
Total			3818 (0.9)	29 568 (6.7)	199 955 (45.6)	358 (0.1)	204 908 (46.7)	438 607 (100.0)

Abbreviation: ICD-10, *International Classification of Diseases, 10th Revision*.[8]

[a]Accidental poisoning by and exposure to non-opioid analgesics, antipyretics, and antirheumatics.

[b]Accidental poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism, and psychotropic drugs, not elsewhere classified.

[c]Accidental poisoning by and exposure to psychodysleptics (hallucinogens) not elsewhere classified.

[d]Accidental poisoning by and exposure to other drugs acting on the autonomic nervous system.

[e]Accidental poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances.

[f]The subtotal for opioid-related deaths is 255 527 (58% of total); the subtotal for non–opioid-related deaths is 85 608 (20% of total); the subtotal for unspecified deaths is 97 159 (22% of total); and the subtotal for deaths with no code is 313 (<0.1% of total).

exclusive and could sum to more than 100%). The most common non–opioid-related drug codes were for cocaine, psychostimulants with abuse potential, benzodiazepines, and other and unspecified antidepressants. Non–opioid-related overdose deaths rose 150%, from 3005 in 1999 to 7505 in 2015, and unspecified overdose deaths rose 220%, from 2255 in 1999 to 7227 in 2015, with a peak in the number of unspecified deaths in 2011 at 8145 (Figure 1). Opioid-related overdose deaths rose 401% during that period, from 5868 in 1999 to 29 383 in 2015.

In 2015, Hawaii had the lowest percentage of opioid-related overdose deaths (36.0%), and New Hampshire had the highest (97.0%) (Figure 2). The percentage of non–opioid-related overdose deaths ranged from 2.4% in New Hampshire to 56.8% in Hawaii. In 5 states, more than 35% of overdose deaths were coded as unspecified (from highest to lowest: Pennsylvania, Louisiana, Alabama, Indiana, and Mississippi), and 17 states had fewer than 5% of overdose deaths coded as unspecified. The District of Columbia had no unspecified overdose deaths, whereas Pennsylvania had the highest unspecified overdose deaths (50.8%).

During the study period, the percentage of opioid-related overdose deaths decreased in 9 states (California, Hawaii, Idaho, Montana, Nevada, New Jersey, New Mexico, Oklahoma, and Washington State) and ranged from 0.1% to 16.9%. The percentage of unspecified overdose deaths decreased in 35 states, ranging from 0.2% in Louisiana to 42.2% in North Dakota, and increased in 16 states, ranging from 0.2% in New Mexico to 12.8% in New Jersey.

States with a high percentage of unspecified overdose deaths were most affected by reallocation (Figure 3). In total, reallocation reclassified more than 70 000 unspecified overdose deaths to opioid-related overdose deaths, ranging from 9 in Vermont to 11 152 in Pennsylvania. The number of opioid-related overdose deaths more than doubled in Alabama, Indiana, Louisiana, Mississippi, and Pennsylvania with reallocation. California, Florida, and Pennsylvania each added more than 5000 opioid-related overdose deaths through reallocation, bringing their totals to 30 813, 25 144, and 20 521, respectively.

The state-specific 2015 actual and reallocated opioid-related unintentional overdose mortality rates in Connecticut, the District of Columbia, New Hampshire, Maine, and Rhode Island changed by less than 1% (Table 2). The rates in Alabama, Indiana, Mississippi, Louisiana, and Pennsylvania increased by more than 50%. Pennsylvania's rate increased 103%, from 9.9 to 20.1 per 100 000 population.

West Virginia ranked highest both before and after reallocation, with opioid-related overdose mortality rates of 31.2 and 31.6 deaths per 100 000 population, respectively (Table 2). Eight states had no change in rank. The ranks of 17 states increased using the reallocated opioid-related overdose mortality rates, with 4 states moving up at least 10 places (Indiana, Louisiana, New Jersey, and Pennsylvania). Indiana had the largest change in rank, going from 34th to 15th after reallocation. The ranks of 5 states (Oklahoma, South Carolina, Utah, Virginia, and Washington State) decreased by 7 places. South Dakota had the lowest rank both before and after reallocation.

Discussion

Several reports on rates of opioid-related overdose deaths have used the opioid-related T codes without accounting for deaths in which a specific drug was not reported.[1,5-7] Drug-specific reporting from the use of contributory T codes reflects the effect of specific drugs on mortality more

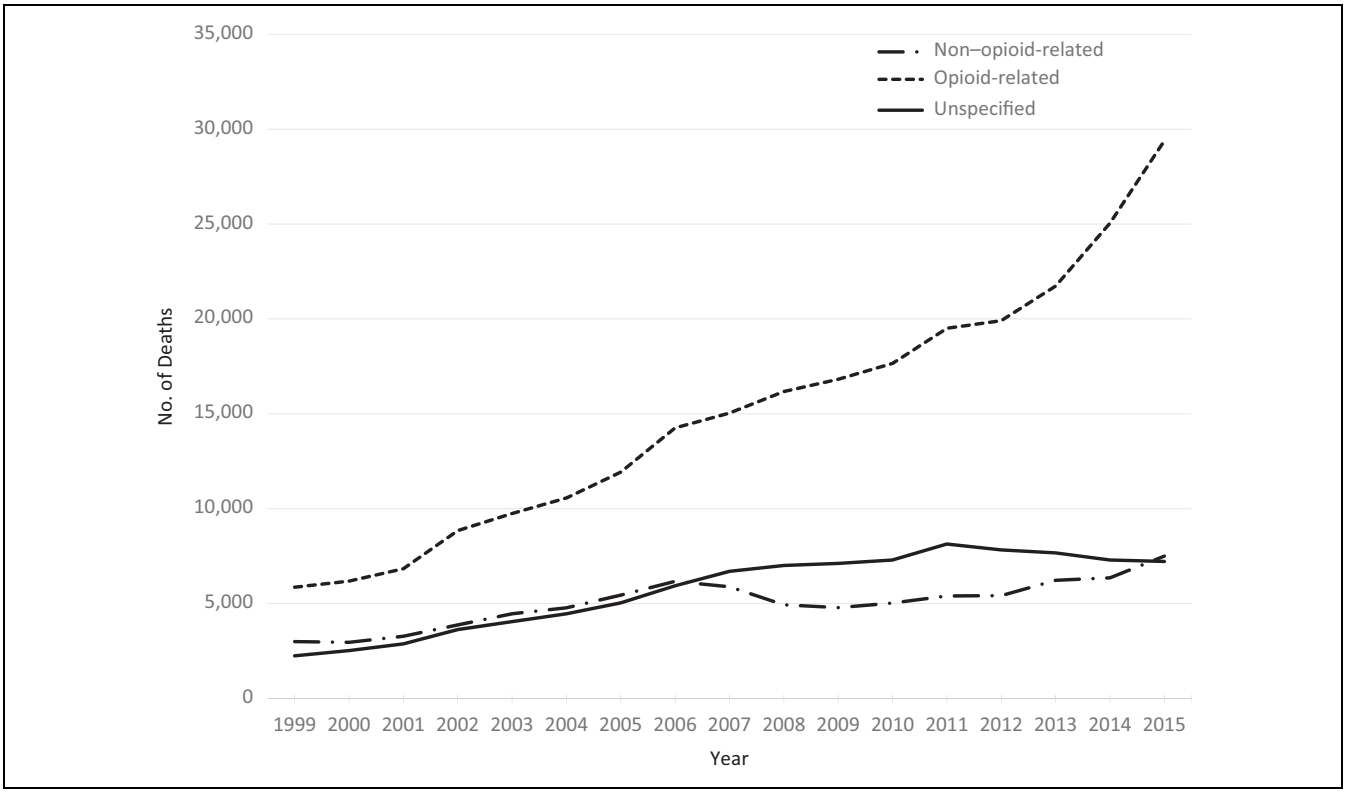

Figure 1. Unintentional opioid-related and non–opioid-related unintentional drug overdose deaths in the United States, 1999-2015, using *International Classification of Diseases, 10th Revision* (ICD-10) codes X40-X44.[8]

accurately than does the overall overdose mortality rate. However, drug-specific overdose death counts are clearly underestimates because death certificates with no drug specified cannot be attributed to a specific drug. Our analyses indicated that potentially more than 70 000 unspecified, unintentional overdose deaths in the past 17 years, including more than 5600 in 2015, could be categorized as opioid-related unintentional overdose deaths. However, complete cause-of-death reporting was disproportionate by state. The 5 states with the highest number of reallocated opioid-related overdose deaths (California, Florida, Ohio, Pennsylvania, and Texas) accounted for nearly half (46.4%, 15 247 of 32 860) of the reallocated unintentional overdose deaths. Alabama, Indiana, Louisiana, Mississippi, and Pennsylvania had much higher rates when overdose death rates were adjusted for lack of specificity.

Our findings for states with a high percentage of unspecified overdose deaths are consistent with the findings of previous evaluations. Ruhm[9] corrected opioid- and heroin-involved drug-poisoning death rates for 2014 and found the largest difference between reported and corrected rates in Pennsylvania. For opioid-involved death rates, the next 4 states affected by reallocation were Indiana, Louisiana, Alabama, and Kentucky. For heroin-involved death rates, the next 4 most affected states were Indiana, Louisiana, New Jersey, and Delaware. In our study, with reallocation based on any mention of an opioid, Delaware was the 11th and Kentucky was the 17th most affected state. The absolute change in rate, not the percentage change, would make Kentucky the 5th most affected state. Although Ruhm used a different methodology from ours to reallocate cases and included all intentions (suicide, homicide, and undetermined), the similarity of those findings with ours supports the conclusion that we correctly identified the states in which opioid-related accidental overdoses were most underestimated.[9] Another evaluation by Ruhm[15] found that the largest difference from correcting rates of opioid-involved mortality occurred in 2011 for any opioid and in 2015 for heroin and synthetic opioids. Ruhm recommended imputing drugs on death certificates on which none are reported.

Warner et al[10] indicated that "states with centralized state medical examiner systems had a higher percentage (92%) of drugs specified than did those with decentralized county coroner systems (62%)." Although we determined the percentage of unspecified overdose deaths without regard to the medicolegal death investigation system in a state, we also found that states with a decentralized or hybrid system had a low percentage of overdose deaths from a specified drug. Of the 5 states with the highest percentage of unspecified overdose deaths in our study, 3 had a hybrid coroner–medical examiner death investigation system (Alabama, Mississippi, and Pennsylvania), and 2 had a decentralized county coroner system (Indiana and Louisiana). Coroners are less likely than medical examiners to be physicians and do not necessarily

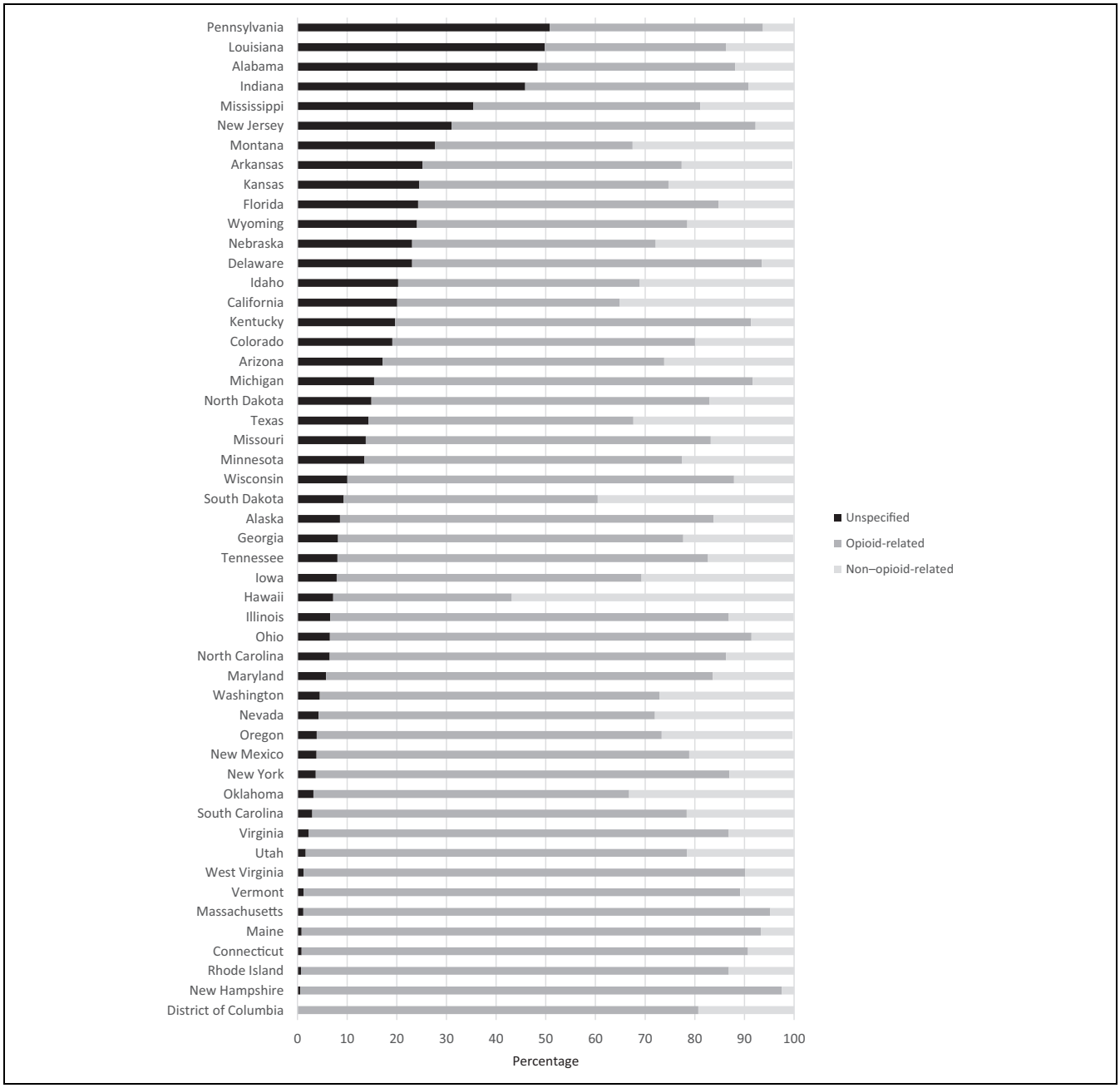

Figure 2. Percentage of non–opioid-related, opioid-related, and unspecified unintentional drug overdose deaths in the United States in 2015, using *International Classification of Diseases, 10th Revision* (ICD-10) codes T36.0-T39.9 and T40.5-T50.8 (opioid-related), T40.0-T40.4 (non–opioid-related), and T50.9 (unspecified).[8] Sum may not equal 100.0%; a small number of X40-X44 deaths had no T36.0-T50.9 code.

have the medical training needed to complete drug information for death certificates based on toxicology reports.[16-18] States with a decentralized system, including those with hybrid coroner–medical examiner systems, are likely to have less standardization than those with a centralized system, leading to greater variation in reporting accuracy in states with a decentralized system.[10] We examined the percentage of unintentional overdose deaths from unspecified drugs in 2015 and found that states with centralized medical examiner systems (as classified by Warner et al[10]) had lower percentages of unspecified drugs than did the other 3 systems (decentralized county or district medical examiner, hybrid, or decentralized county coroner), although the differences were not significant.

In 2016, the Council of State and Territorial Epidemiologists issued a lessons-learned report from state-specific efforts to improve drug-specific reporting in overdose deaths.[19] States such as Kansas and Kentucky recognized

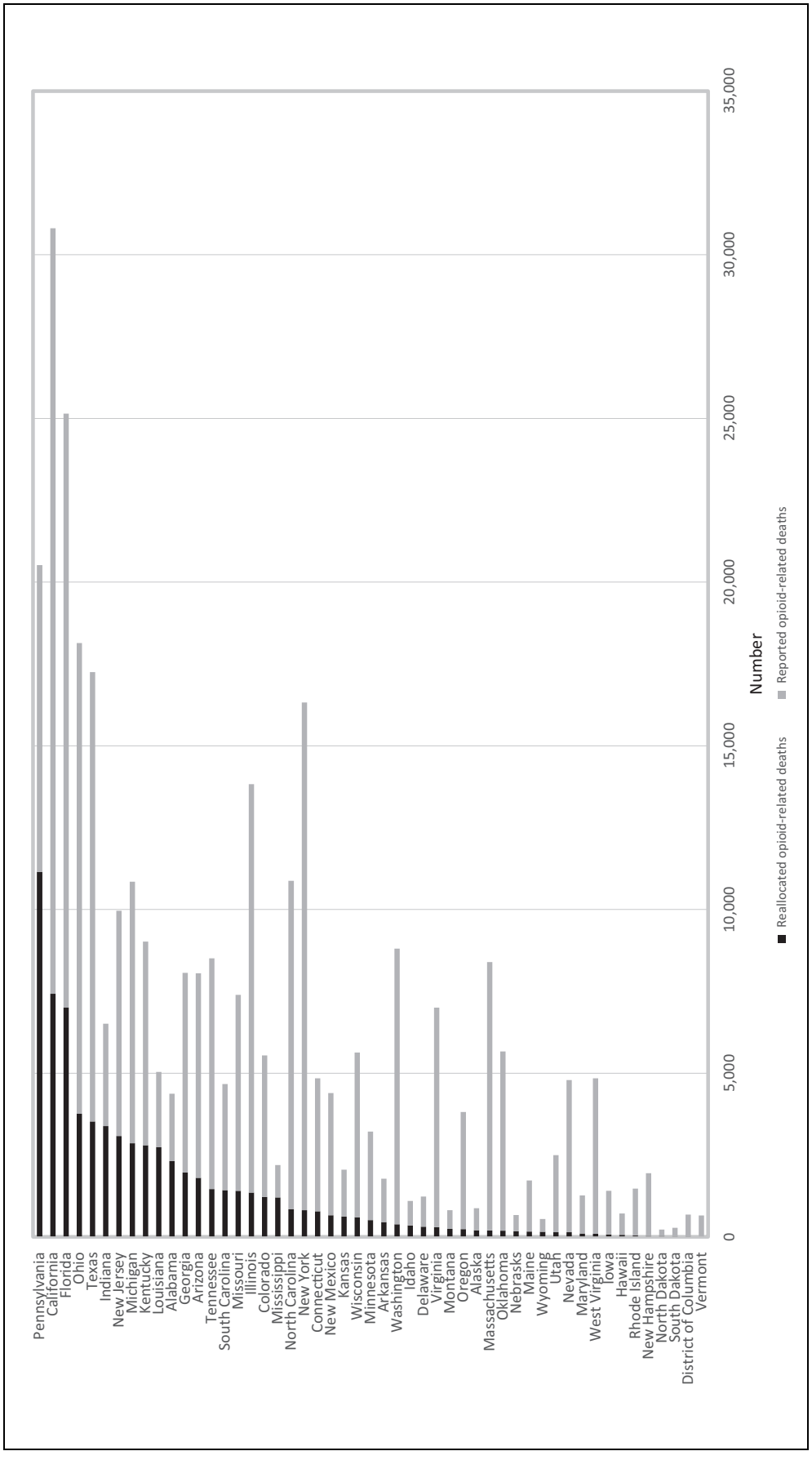

Figure 3. Reallocated and reported opioid-related unintentional drug overdose deaths in the United States, 1999-2015. The numbers of reallocated opioid-related unintentional overdose deaths were estimated by reallocating such deaths from unspecified drugs according to the number of known opioid-related overdose deaths as a percentage of all unintentional drug overdose deaths during the same period.

Table 2. Reported and reallocated mortality rates from opioid-related unintentional drug overdose, by state, 2015[a]

State	No. of Reported Opioid-Related Deaths	Opioid-Related Death Rate per 100 000 Population	Rate Rank	No. of Reallocated Opioid-Related Deaths	Opioid-Related Death Rate per 100 000 Population	Reallocated Rate Rank	% Change in Rate	Change in Rank
Alabama	261	5.37	37	245	10.41	29	94	8
Alaska	79	10.70	17	7	11.70	21	9	–4
Arizona	566	8.29	29	117	10.00	31	21	–2
Arkansas	143	4.80	39	48	6.43	39	34	0
California	1794	4.58	42	450	5.73	42	25	0
Colorado	431	7.90	31	102	9.76	32	24	–1
Connecticut	647	18.02	7	5	18.17	8	1	–1
Delaware	119	12.58	12	36	16.35	10	30	2
District of Columbia	92	13.69	11	0	13.69	14	0	–3
Florida	1676	8.27	30	538	10.92	24	32	6
Georgia	801	7.84	32	71	8.54	36	9	–4
Hawaii	50	3.49	48	4	3.76	49	8	–1
Idaho	72	4.35	45	18	5.46	43	25	–2
Illinois	1273	9.90	23	90	10.60	27	7	–4
Indiana	477	7.21	34	404	13.31	15	85	19
Iowa	148	4.74	40	13	5.14	44	9	–4
Kansas	129	4.43	44	42	5.87	41	32	3
Kentucky	820	18.53	6	201	23.07	5	24	1
Louisiana	276	5.91	36	274	11.77	19	99	17
Maine	221	16.62	8	2	16.77	9	1	–1
Maryland	271	4.51	43	17	4.79	47	6	–4
Massachusetts	1510	22.22	5	18	22.49	6	1	–1
Michigan	1186	11.95	14	216	14.13	13	18	1
Minnesota	294	5.36	38	46	6.19	40	16	–2
Mississippi	138	4.61	41	76	7.14	37	55	4
Missouri	617	10.14	20	98	11.76	20	16	0
Montana	33	3.19	49	13	4.42	48	38	1
Nebraska	51	2.69	50	15	3.50	50	30	0
Nevada	350	12.11	13	16	12.65	17	4	–4
New Hampshire	358	26.90	2	2	27.05	2	1	0
New Jersey	812	9.06	26	365	13.14	16	45	10
New Mexico	313	15.01	9	12	15.61	11	4	–2
New York	1937	9.78	25	74	10.16	30	4	–5
North Carolina	1059	10.54	18	73	11.28	22	7	–4
North Dakota	32	4.23	47	6	4.97	46	18	1
Ohio	2592	22.32	4	181	23.88	3	7	1
Oklahoma	396	10.12	21	13	10.46	28	3	–7
Oregon	250	6.21	35	10	6.46	38	4	–3
Pennsylvania	1268	9.90	22	1307	20.12	7	103	15
Rhode Island	242	22.91	3	2	23.07	4	1	–1
South Carolina	509	10.40	19	16	10.71	26	3	–7
South Dakota	22	2.56	51	2	2.83	51	10	0
Tennessee	947	14.35	10	83	15.60	12	9	–2
Texas	1186	4.32	46	198	5.04	45	17	1
Utah	328	10.95	16	5	11.13	23	2	–7
Vermont	73	11.66	15	1	11.80	18	1	–3
Virginia	745	8.89	27	17	9.09	34	2	–7
Washington	605	8.44	28	29	8.84	35	5	–7
West Virginia	575	31.18	1	7	31.57	1	1	0
Wisconsin	566	9.81	24	63	10.90	25	11	–1
Wyoming	43	7.34	33	14	9.66	33	32	0

[a]Reallocated rates were calculated assuming the proportion of reported opioid-related unintentional overdose deaths of all unintentional overdose deaths would estimate the proportion of unspecified overdose deaths that could be attributed to opioids.

that the lack of drug specificity in reporting overdose deaths prevents understanding the extent of the epidemic and may inhibit effective public health interventions. The report described extensive efforts by Kentucky to improve reporting. We found that from 1999 through 2015, the percentage of opioid-related drug codes in Kentucky increased 43%, whereas unspecified drug reporting decreased 28%, suggesting that state-based efforts can improve the accuracy of drug-specific reporting for overdose deaths. When we assessed the differences in the percentage of unspecified drug reporting on overdose mortality statistics for 11 states using 2010 data, we found the most variation and therefore the greatest potential to improve reporting in Kansas, Kentucky, and Michigan.[11] Using 2015 data, Kentucky and Michigan were still in the top 10 states with the most variability, but Kansas was not. However, several other states, including Pennsylvania, had greater differences than Kentucky or Michigan.

Our analysis emphasizes the importance of reporting complete drug information on overdose deaths. However, the ICD-10 has a set number of codes for drug classes. Overdoses are now being attributed to new drugs, such as fentanyl analogs, but the drug class codes have not changed (eg, acryl fentanyl would be coded as T40.4), meaning that even with complete drug reporting, death certificates lose some drug specificity during the coding process. The development of ICD-11 (currently planned for release in 2018) may help, but accurately capturing the effect on overdose mortality of designer drugs may continue to be problematic. In addition, coroners and medical examiners may not be able to accurately test for and identify newly developing synthetic opioids and other designer drugs in toxicological tests, meaning that these drugs will not be recorded on the death certificate.

Strengths and Weaknesses

We made several assumptions in these analyses, primarily that the proportion of reported opioid-related overdose deaths to all unintentional drug overdose deaths would be the same in all unspecified drug-related overdose deaths by state by year. We know that these data are state-specific and can change over time, but this rather strong assumption should be explored further by comparing characteristics and patterns of the deaths, such as age, race, sex, and geography, with and without specific drugs reported. We also assumed that no bias in death certificate reporting existed (ie, that coroners and medical examiners reported drug information for each death in their jurisdiction in the same way). However, drug reporting could be affected by the extent to which toxicological testing was conducted: by "post-mortem distribution," or the shift in detectable drug concentrations after a person dies; by coroner or medical examiner experience; and by the size of their jurisdiction.[10] This assumption could be evaluated more fully by comparing the completeness of reporting within jurisdictions.

We examined only unintentional or accidental overdoses. The American College of Medical Toxicology and the National Association of Medical Examiners expert panel recommend classifying opioid-related overdose deaths without an indication of self-harm as accidental deaths, specifically stating, "assigning 'undetermined' as the manner of death as a matter of course for deaths due to intoxication does not serve the public good, nor does this practice support efforts to intervene and prevent future intoxication deaths of a similar sort."[12] However, the proportion of drug-related deaths coded as undetermined varies by state.[20] States with a higher proportion of undetermined deaths would have been less affected by our reallocation calculations.

Identifying locations where residents are at high risk for opioid-related overdose death relies on having complete and accurate information about the types of drugs involved. Our findings indicate that incompletely reported unspecified deaths could have a substantial effect on the opioid-related, unintentional overdose mortality rates by state. Proper allocation of resources for the opioid epidemic depends on understanding the magnitude of the problem, and incomplete death certificate reporting prevents lawmakers, treatment specialists, and public health officials from doing so.

States differ widely in the completeness of overdose mortality reporting, making it difficult to identify communities most at risk. However, variation within states by county or parish is also likely, especially in states with decentralized or hybrid death investigation systems. Warner et al[10] noted that smaller counties "might perceive or experience more barriers to toxicological services to determine the types of drugs involved." Future research needs to identify which factors (eg, decedent age, race, or sex) influence whether an unintentional overdose death is reported as unspecified in various regions.

Conclusions

States may be markedly underestimating the effect of opioid-related overdose deaths because of incomplete cause-of-death reporting. Potentially 70 000 opioid-related, unintentional overdose deaths from 1999 through 2015 have been missed because of incomplete reporting, indicating that the opioid overdose epidemic may be worse than it appears.

Declaration of Conflicting Interests

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