Trends in US Methamphetamine-related Mortality by Census Division, 2005–2023

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Objectives: We examine temporal trends in methamphetamine-related mortality across the 9 US Census Divisions from 2005 to 2023.

Methods: We leveraged data from the CDC WONDER multiple causes of death database to identify methamphetamine-related deaths among US residents aged older than or equal to 15 years from 2005 to 2023. Mortality rates were calculated per 100,000 population and stratified by Census Division. We used Joinpoint regression to estimate annual percent changes in mortality and identify statistically significant inflection points in mortality rates over time.

Results: From 2005 to 2023, methamphetamine-related deaths increased across all divisions, with the highest cumulative deaths in the Pacific, South Atlantic, and Mountain divisions. Mortality rates were lowest in New England and Middle Atlantic but grew rapidly in recent years. Several divisions demonstrated sharp increases during the 2010s (eg, East North Central and East South Central), followed by stabilization in some regions after 2021. By 2023, the highest mortality rates were observed in the Pacific, East South Central, and Mountain divisions.

Conclusions: Methamphetamine-related mortality has intensified nationally, with pronounced geographic variation in timing and magnitude. Recent indications of stabilization in some divisions have occurred at historically high levels. These patterns underscore the need for regionally tailored harm reduction, treatment, and prevention strategies.

Key Words: methamphetamine, overdose, mortality, prevention, health promotion, addiction

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The epidemiology of methamphetamine use has shifted significantly in the context of the evolving US overdose crisis. Recent discourse has described the current phase of the epidemic as characterized by rising stimulant-involved mortality, particularly methamphetamine, often in combination with illicitly manufactured fentanyl and related analogs.[1–3] The drug supply continues to evolve, with emerging adulterants such as xylazine increasingly detected in combination with fentanyl and other substances, further compounding overdose risk and complicating surveillance and treatment efforts.[4] This dynamic of polysubstance use complicates treatment, prevention, and surveillance efforts and contributes to historically high levels of overdose deaths across the country.[5]

Methamphetamine use and its associated health consequences have re-emerged as a pressing public health issue in the United States, making it the target of several government initiatives,[6] although there has been little progress in curbing overdose and mortality. Methamphetamine is a highly addictive central nervous system stimulant associated with numerous adverse health outcomes,[7] including psychosis, cardiovascular complications, infectious disease transmission, and elevated risk of mortality.[8] Although $<1\%$ of the US population reports use of methamphetamine,[9] poisonings and hospitalizations associated with methamphetamine use have increased in recent years.[10,11]

Once largely concentrated in Western regions during the early 2000s, methamphetamine use has expanded nationally, affecting a broader demographic and geographic range.[12] Methamphetamine availability and use were initially most prominent in the Pacific and Mountain states, where domestic production and trafficking routes likely facilitated widespread distribution.[13] However, over the past decade, increased drug trafficking may have contributed to a surge in methamphetamine availability across the Midwest, South, and even parts of the Northeast, in regions that previously reported relatively low rates of stimulant use.[14] Recent epidemiologic data show sharp increases in methamphetamine use and related mortality in areas historically impacted by opioid use, especially the East North Central (ie, Illinois, Indiana, Michigan, Ohio, and Wisconsin), West South Central (ie,

Arkansas, Louisiana, Oklahoma, and Texas), and South Atlantic Census Divisions (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia).[2] This geographic diffusion reflects a shifting drug market driven by greater methamphetamine purity and potency,[13] lower cost, and increasing contamination or co-use with potent synthetic opioids, such as illicitly manufactured fentanyl.[15] As a result, regions with limited resources to address methamphetamine-related harms may now be experiencing a rise in the burden of stimulant-related mortality, straining already overburdened public health and behavioral health systems. Available services addressing methamphetamine use fall short of meeting treatment needs as both supply and demand expand into areas with previously low levels of use.[16]

There is a greater need to understand trends in mortality across different geographic regions, specifically, across the 9 US Census Divisions (ie, multistate groupings defined by the US Census Bureau; Supplemental Figure, Supplemental Digital Content 1, http://links.lww.com/JAM/A748), to bolster targeted interventions and harm reduction efforts. Although national trends in methamphetamine-related mortality have been documented, none of these studies have systematically examined regional differences using a longitudinal, census division-level approach spanning nearly 2 decades. The purpose of this descriptive epidemiologic study is to examine trends in methamphetamine-related mortality across US Census Divisions by leveraging national mortality data. Understanding where and how methamphetamine-related mortality is increasing can inform the allocation of resources and the design of regionally tailored prevention and response strategies. Findings from this study may also help providers contextualize patient needs within regional drug use patterns, enabling them to anticipate local trends in polysubstance use, tailor screening practices, and advocate for region-specific resources and training.

METHODS

Data Source

We examined death certificate data from the CDC Wide-ranging ONline Data for Epidemiologic Research (WONDER) multiple causes of death database[17] for methamphetamine poisoning deaths occurring from 2005 through 2023. Nearly all deaths in the US are recorded, and these data are compiled annually by the National Center for Health Statistics using death certificate data for United States residents, including all 50 states and Washington, DC. Death certificates include the underlying cause of death, and up to 20 potentially contributing conditions are listed as multiple causes of death and are coded using the International Classification of Diseases, Tenth Revision (ICD-10).[18]

We obtained data for deaths involving methamphetamine and the overdose mortality rates per 100,000 population among US residents aged 15 years and older by querying CDC WONDER by first restricting to deaths in which the underlying cause of death was drug poisoning using following categories (ICD-10 codes): accidental/unintentional poisoning (X40–X44), intentional self-poisoning/suicide (X60-X64), assault/homicide (X85), and undetermined intent (Y10–Y14). We then identified those deaths in which methamphetamine was listed as a contributing cause, using the multiple cause-of-death code for poisoning by psychostimulants with abuse potential (T43.6), which is thought to primarily indicate methamphetamine.[19] The primary geographic unit of analysis was the US Census Division, a standard multistate classification used by the US Census Bureau for presenting regional data. This level of aggregation was selected to balance geographic specificity with population stability and data availability in CDC WONDER. These data were then stratified into 9 geographic divisions according to the US Census Bureau: (1) New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont); (2) Middle Atlantic (New Jersey, New York, Pennsylvania); (3) East North Central (Indiana, Illinois, Michigan, Ohio, Wisconsin); (4) West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota); (5) South Atlantic (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia); (6) East South Central (Alabama, Kentucky, Mississippi, Tennessee); (7) West South Central (Arkansas, Louisiana, Oklahoma, Texas); (8) Mountain (Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming); and (9) Pacific (Alaska, California, Hawaii, Oregon, Washington). We restricted to individuals aged at least 15 years, as younger groups have historically low rates of methamphetamine use and mortality.

Analytic Plan

We first examined the annual number and rate of deaths per 100,000 population involving methamphetamine from 2005 to 2023 in each US Census Division, separately. We then plotted these data over time and mapped quintiles of mortality for 2023, representing the most recent year of final (ie, not provisional or partial) data available in CDC WONDER. We quantified division-specific trends in the methamphetamine-related mortality using Joinpoint regression.[20] This analytic approach uses permutation to fit a series of straight lines on a logarithmic scale to aggregated data connected at "joinpoints" to identify significant inflection points or shifts in trends. Each analysis begins with zero joinpoints (ie, a straight line) and model tests fit up to a maximum of 4 joinpoints, each indicating statistically significant shifting points in the model. We estimated annual percent change (APC) trends of variable length, where the start and end of each segment are determined to best fit the given data. The APC represents the average annual rate of change in methamphetamine-related mortality within each statistically significant time segment identified by the Joinpoint model, rather than across the entire study period. Positive APC values indicate increasing mortality, whereas non-

significant or negative APCs reflect stable or declining trends, respectively. Because segment boundaries are determined statistically, recent visual changes in mortality (eg, plateaus or slight declines) may not generate additional joinpoints if those changes do not meet permutation-based significance thresholds. All tests were 2-sided. We considered the APC statistically significant if the *P*-value was < 0.05. We used Joinpoint Regression Program version 5.4.0.0 to conduct our regression analyses. The Institutional Review Board at the University of Illinois Urbana-Champaign determined that this secondary data analysis of publicly available, aggregated, and de-identified mortality data was exempt.

RESULTS

From 2005 to 2023, there was a total of 199,413 methamphetamine-related deaths, spread across each Census Division as follows: 3855 in New England; 10,267 in Middle Atlantic; 20,721 in East North Central; 11,829 in West North Central; 32,982 in South Atlantic, 17,450 in East South Central; 22,434 in West South Central; 25,555 in Mountain; 54,320 in Pacific. In 2023, the lowest rates of methamphetamine-related mortality were observed in New England and Middle Atlantic (Fig. 1), followed by East North Central, West North Central, West South Central, and South Atlantic. The highest rates of methamphetamine-related mortality in 2023 were observed in the Pacific, East South Central, and Mountain divisions.

Joinpoint regression analyses revealed varying trends in methamphetamine-related mortality across the 9 Census Divisions. Although many divisions experienced relatively low methamphetamine-related mortality through the late 2000s, increasing in the mid-2010s and peaking in the early 2020s, some exhibited a leveling off or slight decline between 2021 and 2023 (Fig. 2). These recent changes were generally not statistically significant, indicating that mortality has remained at historically high levels despite modest declines in some regions. Overall (across all Census Divisions), methamphetamine-related mortality rates decreased by 8.0% annually from 2005 to 2008, then increased by 20.7% from 2008 to 2014, accelerated to a 32.2% annual increase from 2014 through 2021, then leveled off through 2023 (Table 1).

In Division 1 (New England), methamphetamine-related mortality rates remained stable from 2005 to 2010 and then increased 30.9% annually from 2010 to 2021, followed by stabilization through 2023. The methamphetamine-related mortality rate in Division 2 (Middle Atlantic) also remained relatively flat from 2005 to 2009, increasing 27.3% annually from 2009 to 2015, accelerating 49.1% annually from 2015 to 2021, and then leveling off through 2023. In Division 3 (East North Central), the methamphetamine-related mortality rate remained stable from 2005 to 2008, then increased 28.6% annually from 2008 to 2013. This increased to 56.0% annually from 2013 to 2020 before leveling off through 2023. In Division 4 (West North Central), the methamphetamine-related mortality rate declined 13.5% every year from 2005 to 2008. There was a sharp increase of 29.9% annually from 2008 to 2021, followed by flattening through 2023. In Division 5 (South Atlantic), rates decreased 12.3% annually from 2005 to 2007, then rose 16.6% annually from 2007 to 2012. Mortality rates increased 42.5% annually from 2012 to 2021, stabilizing through 2023. The methamphetamine-related mortality rate in Division 6 (East South Central) did not significantly change from 2005 to 2007, followed by a 24.8% annual increase from 2007 to 2013. Mortality increased 48.4% annually from 2013 to 2021 before plateauing through 2023. In Division 7 (West South Central), mortality rates remained relatively stable from 2005 to 2008, then increased 23.2% annually from 2008 to 2023. Division 8 (Mountain) had declining rates of 6.1% annually from 2005 to 2009, then increased by 21.7% annually from 2009 to 2021 before leveling off through 2023. Lastly, in Division 9 (Pacific), mortality rates declined 6.9% annually from 2005 to 2008, increased 17.2% annually from 2008 to 2018, and accelerated to 34.5% annually from 2018 to 2021 before slowing down to a 10.7% annual increase from 2021 to 2023.

DISCUSSION

Between 2005 and 2023, methamphetamine-related mortality rose substantially across all 9 US Census Divisions, with notable geographic disparities in both absolute numbers and trends over time. The highest cumulative number of methamphetamine-related deaths occurred in the Pacific Division, followed by the South Atlantic and Mountain Divisions. In contrast, the lowest cumulative deaths were observed in New England. Moreover, in 2023, the Pacific, East South Central, and Mountain Divisions exhibited the highest methamphetamine-related mortality rates, whereas New England, Middle Atlantic, and East North Central reported the lowest rates.

Methamphetamine poisoning has evolved from a primarily Western regional concern into a national crisis, deeply affecting both urban and rural communities across all Census Divisions. Although earlier waves of methamphetamine use were concentrated in the Pacific and Mountain Divisions,[21] this study suggests that methamphetamine-related harms have expanded dramatically since the mid-2000s. Clinicians in regions with rising methamphetamine-related mortality may benefit from training in stimulant use disorder management and should consider incorporating routine screening for stimulant use, even in areas previously dominated by opioid-related morbidity.

The Pacific Division, a growing area for methamphetamine production and use, not only had the highest number of cumulative deaths but also showed a sharp acceleration in mortality from 2018 to 2021. This surge was likely driven by the increasing contamination of methamphetamine with illicitly manufactured fentanyl and other potent synthetic opioids, such as carfentanil,[22] which significantly elevate the risk of overdose. Research indicates that the addition of fentanyl to non-opioid drug supplies has become a critical factor in the rising death

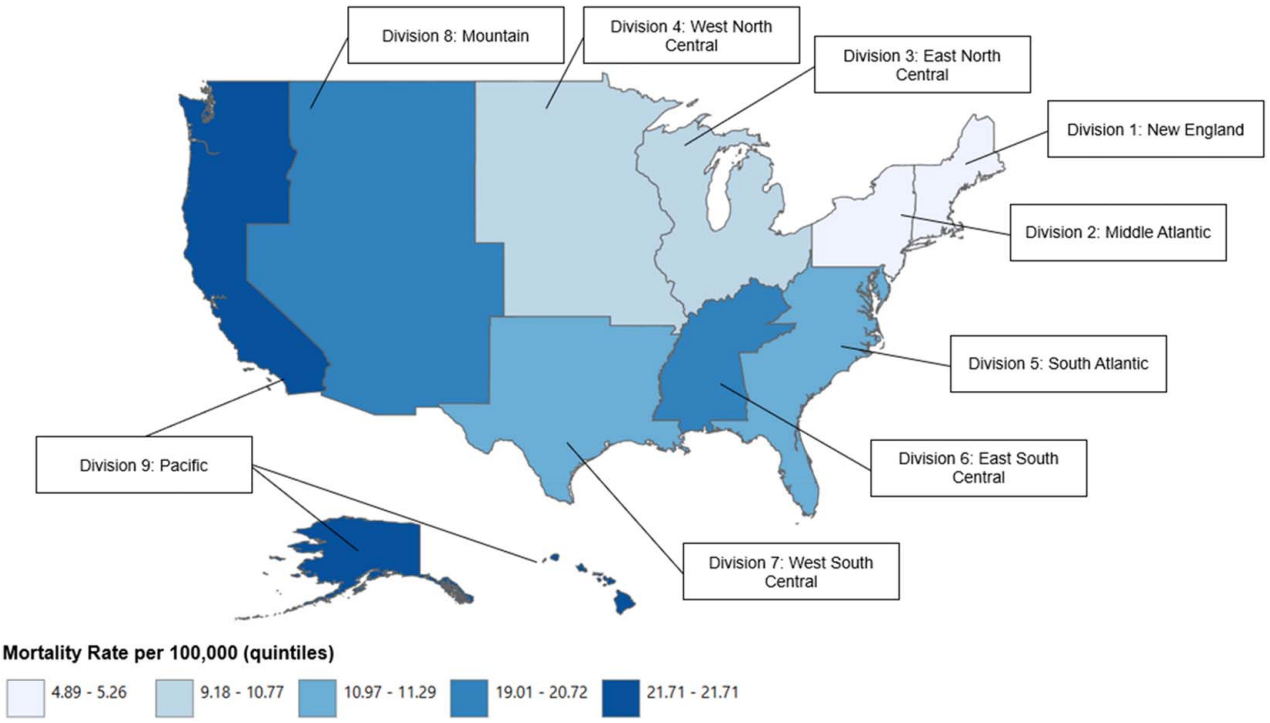

FIGURE 1. Methamphetamine-related mortality rate per 100,000 population by Census Division, CDC WONDER 2023.

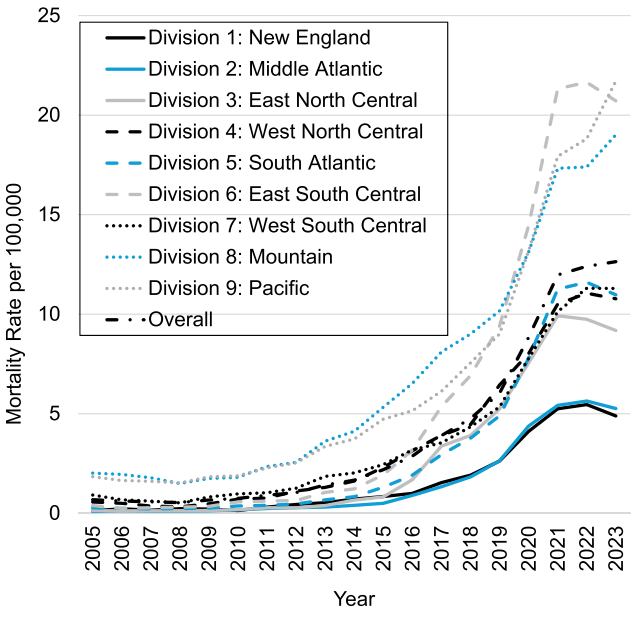

FIGURE 2. Methamphetamine-Related Mortality Rate per 100,000 Population by Census Division and Year, CDC WONDER 2005–2023. Apparent decreases or plateaus in 2021–2023 reflect nonsignificant changes identified in Joinpoint regression and may represent early indications of stabilization rather than true declines. APC values represent statistically significant trend segments only. Visual changes not producing a joinpoint did not meet permutation-based significance criteria.

toll, particularly in western states.[23] In addition, structural factors like limited access to harm reduction services and regional variations in drug policy may have exacerbated these trends.[22] Compounding these challenges, the COVID-19 pandemic led to high unemployment rates and economic instability, likely limiting recovery networks and increasing community-level vulnerability to methamphetamine use in recent years.[24]

Neighboring the Pacific, the Mountain Division reported similar trends, shifting from a brief decline in the mid-2000s to consistent annual increases in methamphetamine-related mortality from 2008 onward. The region's predominantly rural profile may contribute to heightened vulnerability, as rural communities often face significant barriers to health care access, substance use treatment, and harm reduction services. These challenges include fewer medical facilities, limited availability of naloxone, and reduced access to syringe service programs.[25] Moreover, the stigma surrounding drug use in smaller communities can discourage individuals from seeking help, compounding the risks associated with contaminated drug supplies and delayed intervention.[26]

In the southern United States, the East South Central and West South Central Divisions displayed large and sustained increases in methamphetamine-related mortality. The rapid growth in East South Central regions may reflect the movement of methamphetamine into areas previously dominated by prescription opioids.[27] Meanwhile, in the Midwest, East North Central and West North Central experienced more complex patterns. After initial stability or decline, both regions faced steep in-

TABLE 1. Trends in Methamphetamine-related Deaths by Census Division, CDC WONDER 2005–2023

Census Division	Time Segments Defined by Joinpoint Regression (Y)	APC (95% CI)
Division 1: New England	2005–2010	7.5 (−20.1, 21.3)
	2010–2023	30.9* (26.9, 40.4)
Division 2: Middle Atlantic	2005–2009	7.7 (−10.5, 20.1)
	2009–2015	27.3** (14.9, 42.8)
	2015–2021	49.1* (42.5, 71.2)
	2021–2023	−6.3 (−25.4, 15.3)
Division 3: East North Central	2005–2008	−3.6 (−21.6, 11.8)
	2008–2013	28.6** (15.6, 47.1)
	2013–2020	56.0* (48.6, 79.2)
	2020–2023	1.8 (−19.0, 18.2)
Division 4: West North Central	2005–2008	−13.5* (−18.1, −7.2)
	2008–2021	29.9* (28.7, 31.5)
	2021–2023	0.7 (−7.3, 15.1)
Division 5: South Atlantic	2005–2007	−12.3*** (−18.0, −2.7)
	2007–2012	16.6* (11.5, 22.2)
	2012–2021	42.5* (40.6, 45.0)
	2021–2023	0.9 (−6.1, 13.9)
Division 6: East South Central	2005–2007	−15.7 (−26.3, 5.0)
	2007–2013	24.8* (16.2, 35.8)
	2013–2021	48.4* (44.4, 63.2)
	2021–2023	−2.6 (−16.8, 20.6)
Division 7: West South Central	2005–2008	−11.6 (−28.7, 3.9)
	2008–2023	23.2* (21.3, 25.7)
Division 8: Mountain	2005–2009	−6.1*** (−15.8, −0.4)
	2009–2021	21.7* (20.3, 29.5)
	2021–2023	6.8 (−3.7, 19.6)
Division 9: Pacific	2005–2008	−6.9*** (−16.3, −1.5)
	2008–2018	17.2* (15.3, 18.9)
	2018–2021	34.5** (25.3, 39.0)
	2021–2023	10.7** (2.7, 21.8)
Overall (all divisions)	2005–2008	−8.0** (−12.9, −3.8)
	2008–2014	20.7* (16.7, 23.3)
	2014–2021	32.2* (30.2, 36.0)
	2021–2023	5.5 (−0.9, 15.0)

*$P < 0.001$.
**$P < 0.01$.
***$P < 0.05$.
APC indicates annual percent change.

creases through the 2010s, likely driven by changes in drug supply chains and increased methamphetamine availability,[28] including crystal meth, a lower-cost yet more potent form of methamphetamine.[29] This shift has impacted many rural communities.

In contrast, the northeastern United States, particularly New England and the Middle Atlantic, was relatively unaffected during the early years of the study period. However, both divisions experienced rapid and recent upswings. In New England, annual mortality increases of over 30% since 2010 suggest a delayed but now entrenched wave of methamphetamine use, often with existing opioid crises.[30] Although some regions exhibited a leveling off in mortality in the early 2020s, the overall burden remains historically high. This plateauing may reflect the initial impact of expanded harm reduction, treatment, and public health interventions,[31] but likely reflects a complex interplay of factors.

These may include differential mortality among individuals at highest overdose risk, shifts in the demographic or cohort composition of people using methamphetamine, and service expansions associated with COVID-19–era public health investments that increased the availability of naloxone, syringe services, and community outreach. It is also possible that patterns of stimulant and polysubstance use are shifting among younger cohorts. In addition, changes in the illicit drug supply may also contribute to recent stabilization in some divisions. For example, surveillance of drug samples and toxicology data suggest that although contamination of methamphetamine and stimulants with synthetic opioids like fentanyl remains a concern, the prevalence and potency of such adulteration vary by region and drug form.[32] This may mean that overdoses driven by unexpectedly potent mixtures may be becoming less common or more predictable than in earlier years. These mechanisms remain insufficiently understood and warrant further investigation. Nevertheless, persistent high rates and regional disparities underscore the ongoing urgency of tailored strategies.

Access to effective treatment also remains limited. Contingency management, the strongest evidence-based treatment for methamphetamine use disorder,[33] is not widely available due to reimbursement and implementation barriers. Stigma toward methamphetamine use further restricts care access, as individuals are sometimes excluded from detoxification programs, shelters, and other services.[34] Expanding contingency management and reducing structural stigma are critical to improving treatment engagement and outcomes.

Increases in methamphetamine-related mortality in specific Census Divisions may indicate a growing clinical burden for providers in those areas, underscoring the importance of preparedness to manage methamphetamine-related complications. Although national data previously suggested that overdose deaths were beginning to stabilize or decline, the most recent provisional estimates from the CDC indicate that drug-related mortality is once again increasing.[35] This reversal highlights the fragility of recent progress and reinforces the urgency of addressing evolving patterns of substance use. The findings from this study, which demonstrate a persistent and growing burden of methamphetamine-related deaths, are especially concerning in this context. More research is needed to re-examine trends in methamphetamine-related mortality across different geographic regions as more recent finalized data become available.

These findings constitute a critical component of the nation's epidemiologic surveillance infrastructure for monitoring methamphetamine-involved mortality. Continued public health surveillance is essential for characterizing the evolving epidemiology of methamphetamine

use, informing etiologically targeted prevention strategies, optimizing allocation of public health resources, and guiding evidence-based policy responses.[36] Expanded access to drug checking services and systematic monitoring of the illicit drug supply, including stimulant-opioid adulteration patterns, are also essential to improving real-time understanding of evolving overdose risks and tailoring regionally responsive public health strategies.

At the same time, the current surveillance infrastructure has important limitations. Most notably, current surveillance is limited by variability in toxicology testing practices and reliance on ICD-10 code T43.6, which may not fully differentiate methamphetamine from other psychostimulants. Improving surveillance will require more comprehensive and standardized toxicology testing in suspected overdose deaths, linkage of death certificate data with medical examiner and forensic toxicology records, and analysis of free-text cause-of-death fields to enhance identification of substance involvement. Development and adoption of more substance-specific coding practices could further strengthen comparability over time and across jurisdictions. Sustained investment in robust, high-resolution mortality surveillance systems will be essential to mitigate the public health impact of methamphetamine use.

Limitations

Several limitations should be considered when interpreting the findings from this analysis. First, death certificate data are subject to misclassification and underreporting.[37] The accuracy of reported causes of death depends on the certifying physician or medical examiner, and toxicology testing practices can vary across jurisdictions and over time. As such, some deaths involving methamphetamine may be missed or incorrectly attributed to other substances or causes. Second, we relied on the ICD-10 code T43.6 ("poisoning by psychostimulants with abuse potential") to identify methamphetamine-related deaths. Although T43.6 is widely used in surveillance research and in federal reporting to approximate methamphetamine involvement, it may also include other psychostimulants such as amphetamine or methylphenidate.[38] Moreover, the extent to which methamphetamine is tested for, recorded, or prioritized in cause-of-death certification is not standardized and may lead to under-identification or over-identification in certain regions. These considerations underscore the need for caution when interpreting absolute rates and geographic comparisons. Future studies would benefit from validation efforts linking death certificates to toxicology-confirmed data and medical examiner records, as well as from analytic strategies incorporating free-text cause-of-death fields. Further, it is possible that additional methamphetamine-related deaths may have been coded under different categories, such as "Other Stimulant" (F15x).

CONCLUSIONS

This study demonstrates that methamphetamine-related mortality has risen sharply across all US Census Divisions from 2005 to 2023, with significant variation in both the timing and magnitude of increases. Although some regions have seen signs of stabilization, mortality rates remain historically high. Addressing this evolving epidemic requires regionally tailored strategies that reflect local patterns of drug use, treatment capacity, and health care access. Expanding harm reduction and treatment services (eg, expansion of fentanyl testing strips, increasing contingency management programs), improving access to evidence-based treatments for stimulant use disorder, and enhancing public health surveillance of polysubstance involvement are critical. Without sustained and geographically responsive public health efforts, methamphetamine-related deaths are likely to remain a major contributor to the US overdose crisis.

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