

Nearcasting the Overdose Crisis: Key Insights from US Drug Dynamics

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SUBMISSION DETAILS

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Summary After five decades of uninterrupted exponential growth, US overdose mortality started dropping suddenly in 2023. We employ short-term forecasting (“nearcasting”) methods to illustrate the implications, should recent trends continue in a similar fashion. We analyzed US overdose mortality occurring 1999–2024, stratified by substance, region, and race/ethnicity, and employed logistic-transformed autoregressive integrated moving average models to forecast trends through 2030 with 95% confidence intervals. From a peak in 2022 of 32.7 per 100,000, overdose mortality fell to 23.7 in 2024 and is projected to fall to 15.59 (95% CI: 7.87–32.54) by 2030. Fentanyl-involved deaths fell 35.6% between 2022–2025 and are projected to fall a further 69.2% by 2030. Conversely, deaths involving stimulants (without fentanyl) are projected to overtake those involving fentanyl by 2026 and represent over twice as many deaths as fentanyl by 2030. Regional trends sharply flipped between 2022–2024 as the US West shifted from the least-affected to the most-affected region by the overdose crisis and is projected to remain in this position through 2030. Although Native, Black, and African Americans have experienced the largest decreases in absolute terms, disparities for these groups relative to the national total are projected to persist past 2030. The US overdose crisis is in the midst of a historic moment. Stimulants are on track to overtake opioids as the defining addiction-related public health challenge. Given the West Coast's new status as the epicenter of this crisis, regional innovation is needed in the psychiatric service response. Racial inequalities require tailored interventions.

The questions following the above will ask you to breakdown your summary.

Background The United States is currently confronting a uniquely severe and rapidly evolving public health emergency driven by substance-related mortality. The burden of disease from drug overdose in the US far exceeds that of other highly affected nations. For five decades, the trajectory of this crisis in the US was defined by an uninterrupted exponential growth in overdose deaths, described by the Jalal-Burke exponential growth curve.

Despite this decades-long pattern of exponential escalation, the landscape of US drug dynamics recently experienced a sudden and historic shift. In 2023, for the first time, US overdose mortality departed from its exponential growth curve and began dropping suddenly. Overall overdose mortality reached a historical peak of 32.7 per 100,000 population in 2022, but subsequently fell to 23.7 per 100,000 by 2024.

To understand these patterns, a focus on drug-specific trends is key. Historically, the epidemiology of the US overdose crisis has been understood through a framework of four distinct, overlapping waves that reflect the changing and increasingly lethal composition of the illicit drug supply: Wave 1 began in the early 2000s, initially driven by a significant surge in prescription opioid-related fatalities. Wave 2 emerged around 2010, characterized by a sharp, subsequent rise in deaths involving heroin (without fentanyl). Wave 3 commenced in 2013, marking a catastrophic escalation in deaths driven by synthetic opioids, specifically fentanyl occurring without the co-involvement of stimulants. Wave 4 started in 2015 and represents the current, highly complex phase defined by the lethal co-use of fentanyl in polysubstance mixtures, especially together with stimulants.

While the aggregate decline marks a critical public health milestone, it obscures rapidly shifting underlying vulnerabilities. The drug market is witnessing a rapid rise in stimulant-involved mortality and the increasing integration of novel synthetic additives, such as the veterinary sedative xylazine, which drastically complicate the risk profile of polysubstance use. Furthermore, the overdose crisis has seen dramatic shifts by geography, race, and ethnicity.

Navigating this highly dynamic and transitioning crisis presents significant epidemiological challenges. Traditional public health surveillance is inherently delayed, with the most recent, comprehensive overdose death data typically lagged by 6 to 18 months. These systemic reporting delays are driven by the necessary time required to conduct thorough forensic autopsies, perform complex toxicological testing, and cleanly aggregate mortality records at the national level. Consequently, relying purely on lagged, retrospective data hinders rapid, contemporary public health responses.

To bridge this temporal gap, our "best guess" about the near future becomes the most actionable information available for policymakers, researchers, and clinicians. Therefore, we employ short-term forecasting—termed "nearcasting"—methods to map these epidemiological shifts. By utilizing nearcasting to project mortality patterns through the year 2030, we aim to illustrate the profound public health implications and operational realities we can expect should recent trends continue in a similar fashion into the near future.

Educational Learning Objectives

Learning Objective 1 Describe key frameworks for understanding the epidemiology of the US overdose crisis.

Learning Objective 2 Evaluate the latest trends in US overdose deaths.

Learning Objective 3 Use short-term forecasts ("nearcasts") to understand the implications if recent trends continue into the near future.

Methods We conducted a short-term forecasting ("nearcasting") study drawing on comprehensive United States overdose mortality records from 1999 through 2024, from CDC WONDER. Measures included annual overdose mortality rates per 100,000 population, stratified by substance involvement, race/ethnicity, and geographic region. We utilized logistic-transformed autoregressive integrated moving average (ARIMA) models, optimized via the corrected Akaike Information Criterion (AICc), to forecast mortality trends through 2030. Monte Carlo simulations (1,000 draws) were used to propagate uncertainty and generate 95% prediction intervals. Finally, demographic and regional forecast models were proportionally raked to maintain internal consistency with aggregate national totals.

Results From a historic peak of 32.7 per 100,000 in 2022, total US overdose mortality fell to 23.7 in 2024, breaking decades of exponential growth, and is projected to decline to 15.6 by 2030. Fentanyl-involved fatalities decreased by 35.6% between 2022 and 2025, with further declines forecasted. Conversely, mortality involving stimulants without fentanyl is projected to surpass fentanyl-related deaths by 2026, becoming more than double that of fentanyl by 2030. Regionally, the US West transitioned from the least to the most affected area between 2022 and 2024 and will likely remain the epicenter through 2030. While absolute deaths are dropping, severe racial disparities for Native, Black, and African American communities are projected to persist beyond 2030.

Conclusion Our findings highlight key emerging challenges relevant to clinical practice and public health policy. As stimulants overtake opioids as the key addiction-related challenge, clinical systems must rapidly adapt to address the chronic psychiatric, cardiovascular, and pulmonary complications associated with stimulant use. With the West Coast emerging as the new crisis epicenter, policymakers must redirect resources and foster regional innovations in psychiatric service delivery. Furthermore, persistent racial disparities require tailored interventions. As stimulants cause a greater burden of disease from chronic and nonfatal processes compared to opioids, beyond focusing on overdose deaths, other nonfatal metrics are needed. Early warning systems are needed to detect emerging synthetic additives to the illicit drug supply that have the potential to cause a return to exponential growth in drug deaths.

Scientific Significance The US overdose crisis is experiencing the first departure from the fifty-year Jalal-Burke exponential growth curve. In this context, we develop a set of short-term forecasts ("nearcasts"), which illustrate likely near futures, including several fundamental transitions in US drug dynamics that have not been previously demonstrated in the scientific literature, to our knowledge. These include: 1) stimulants projected to overtake opioid-involved mortality rates in the near future 2) the continued rise of xylazine and other novel additives and synthetics 3) the West projected to remain the most affected region by the overdose crisis, 4) minimal projected progress on the very wide racial disparities among Black and Native American communities.

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