

Title: Enhancing nonfatal overdose surveillance using Emergency Medical Services records: A comparison of 2022 CSTE guidance and a local probabilistic algorithm

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Background: Overdose is the leading cause of accidental death nationally and in Marin County, California. Non-fatal opioid overdose (NFOO) surveillance can provide valuable information to prevent fatal overdoses. In 2019, Marin County Public Health (MCPH) developed an algorithm using machine learning to identify probable NFOO in Emergency Medical Services (EMS) 911 response records. In 2022, the Council of State and Territorial Epidemiologists (CSTE) released guidance for EMS NFOO surveillance using a deterministic algorithm. We applied CSTE's definition to Marin County EMS records to test for improvement in performance compared to the existing probabilistic algorithm.

Methods: We applied CSTE's NFOO Standard Guidance and MCPH's algorithm (records with calculated probability ≥ 0.50 identified as suspect NFOO) to EMS records from January 1, 2021 to September 30, 2023. 628 records that were identified either by CSTE or MCPH's algorithm were manually reviewed by an epidemiologist to make NFOO determinations (gold standard). We calculated an estimated sensitivity and specificity for each surveillance definition. The characteristics of people experiencing NFOOs identified by each definition were compared by age and year of overdose.

Results: Of 628 total records identified by either method, 136 (22%) were determined by manual review to be suspect NFOOs. From 2021-2023, MCPH's algorithm had a sensitivity and specificity of 25% (95%CI: 18-33%) and 73% (69-77%), respectively. CSTE's algorithm had a higher sensitivity (86%, 95%CI: 79-91%) and lower specificity (22%;95%CI: 19-26%). MCPH's algorithm sensitivity was lower in 2023 (16%) compared to 2021 (27%) and 2022 (30%); while specificity increased in 2023 (82%) vs. 2021 (70%) and 2022 (66%). The age distribution of NFOO victims identified by CSTE standards (median: 45 years, 23% of NFOOs among those 65+) trended older than MCPH's algorithm (median: 40 years, 9% of NFOOs among 65+). Updating MCPH's definition to include criteria from CSTE's NFOO standards (overdose primary impression with at least one opioid-related keyword + non-fatal and emergent filters) and increasing the probability threshold to ≥ 0.62 markedly increased sensitivity (63%;95%CI: 54-70%) and specificity remained the same (74%;95%CI: 70-78%).

Conclusion: The performance of MCPH's algorithm was found to have decreased between establishment in 2019 and 2023; CSTE's NFOO 2022 definition had a high sensitivity but low specificity. Including components from CSTE standards and increasing the 50% probability cutpoint to 62% improved sensitivity while maintaining specificity. Existing overdose surveillance tools should be continuously re-evaluated to ensure capture of desired outcomes to enable effective preventive public health action.

Keywords: overdose; EMS; substance use

