Short Communication

Analysis of trends and usage of ICD-10-CM discharge diagnosis codes for poisonings by fentanyl, tramadol, and other synthetic narcotics in emergency department data

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A B S T R A C T

Synthetic opioids, including illicitly manufactured fentanyl, are driving recent increases in US overdose deaths. Beginning October 2020, the International Classification of Diseases, 10th revision, Clinical Modification (ICD-10-CM) code for poisonings involving synthetic narcotics (T40.4X) was split into three codes: fentanyl (T40.41), tramadol (T40.42), and other synthetic narcotics (T40.49). Emergency department data from October 2019–September 2021 in the Centers for Disease Control and Prevention’s National Syndromic Surveillance Program BioSense platform were queried for synthetic opioid codes in the chief complaint and discharge diagnosis fields. Trend analyses assessed average monthly percent change overall and by sex and age. Emergency department visits for overdoses involving synthetic narcotics increased on average 3.2 % each month before the code split and 4.8 % after. Visits with fentanyl codes drove this increase after the split, accounting for most visits among males, females, and every age group except ≥ 65 years. The average monthly percent increase for ED visits for fentanyl-involved overdoses was greater than for all synthetic narcotics combined (i.e., T40.41, T40.42, and/or T40.49), suggesting that the old code (T40.4X) masked the full extent of the increase in ED visits for fentanyl overdoses. Usage of these new codes can improve tracking of non-fatal synthetic opioid overdose trends.

1. Introduction

Synthetic opioids, specifically illicitly manufactured fentanyl (IMF) (including fentanyl analogs), continue to drive increases in drug overdose morbidity and mortality (Mattson et al., 2021; O’Donnell et al., 2021; Palamar et al., 2022; Rezaeihari & Fairman, 2022) and may be displacing heroin in the illicit drug market in some communities (Pardo et al., 2019). The increasing availability, geographic dispersion, mixing or co-use of fentanyl with other drugs, and presence of IMF in counterfeit prescription pills resembling commonly misused prescription drugs underscore the need to not only better track fentanyl overdoses, specifically, but also to tailor prevention approaches (Centers for Disease Control and Prevention [CDC], 2020).

Tracking nonfatal drug overdoses involving fentanyl has been a noted challenge (Vivolo-Kantor et al., 2021), in part due to the lack of point of care testing. Traditional nonfatal injury surveillance systems have relied on standardized discharge diagnosis codes (i.e., International Classification of Diseases, 10th Revision, Clinical Modification [ICD-10-CM]) to assist in developing case definitions, yet up until October 2020, no specific fentanyl overdose ICD-10-CM code existed. A single T-code from the injury chapter—T40.4X (Poisoning by, adverse effect of and underdosing of other synthetic narcotics)—had been used as a proxy to estimate fentanyl overdoses; however, this code also included other manufactured narcotics such as tramadol and buprenorphine. The fiscal year 2021 ICD-10-CM specifications were released on October 1, 2020, and for the first time, included three new codes to replace the broad T40.4X code: poisoning by, adverse effect of and underdosing of fentanyl or fentanyl analogs (T40.41); poisoning by,
adverse effect of and underdosing of tramadol (T40.42); and poisoning by, adverse effect of and underdosing of other synthetic narcotics (T40.49) (Centers for Medicare and Medicaid Services [CMS], 2020).

To date, no studies have explored the use of these new codes and the transition from the older ICD-10-CM code. The present study seeks to better understand monthly emergency department (ED) synthetic narcotic overdose trends overall and by sex and age group prior to and after the transition to the new codes on October 1, 2020 using data from the CDC National Syndromic Surveillance Program (NSSP).

2. Methods

Data from NSSP were used for analysis and queried from the BioSense platform using the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) (CDC, 2021). NSSP is a collaboration of public health partners (e.g., the CDC, other federal, local and state health departments) to collect and analyze data from EDs and other healthcare settings (e.g., urgent care) in 50 states, DC, and Guam. Access to NSSP data was granted by participating states/jurisdictions. These data, captured in near real-time, can provide an early warning of possible overdose spikes and clusters (CDC, 2021).

NSSP receives data from approximately 71% of ED facilities in the US (CDC, 2021).

Monthly counts of ED visits that occurred from October 1, 2019–September 30, 2021 were queried from all ED facilities in NSSP ESSENCE and visits were included if the chief complaint or discharge diagnosis fields contained the ICD-10-CM code for T40.4X, T40.41, T40.42, or T40.49 (CMS, 2020; National Center for Health Statistics, 2022); only codes utilized during the expected time period were used in analysis (i.e., T40.4X from October 1, 2019–September 30, 2020 and T40.41, T40.42, and T40.49 from October 1, 2020–September 30, 2021). All intents and encounters were included. To control for facility-level inconsistency in data reporting and quality throughout the study period, we restricted our analysis to data from facilities with a coefficient of variation (CoV) ≤ 45 and a discharge data informative value of ≥ 75% to account for the average weekly submission of visits containing informative diagnosis codes. This subset of included facilities came from 33 states and DC representing approximately 33% of ED facilities in the US. Hereafter, year one refers to the period before the code split (October 1, 2019–September 30, 2020), and year two refers to the period after (October 1, 2020–September 30, 2021).

Analysis was conducted in R (R Core Team, 2019) and figures were created using the ggplot2 package v3.3.2 (Wickham, 2016). Counts were stratified by sex and age group (15–24, 25–34, 35–44, 45–54, 55–64, and ≥ 65 years); data for those < 15 years old were excluded from the stratified analysis due to small counts and data for figures were suppressed for months where counts were < 10. Joinpoint regression was used to assess the average monthly percent change (AMPC) with 95% confidence intervals (CIs) in ED visits for each ICD-10-CM code (National Cancer Institute, Bethesda, MD); monthly percent change (MPC) estimates are footnoted where significant changes in trend (e.g., increase to decrease) were found.

3. Results

During year one, there were 9,787 ED visits for overdoses involving synthetic narcotics (T40.4X); during year two, there were 13,551 visits (T40.41, T40.42, and/or T40.49). During year two, approximately 76% (n = 10,281) of ED visits for overdoses from synthetic narcotics involved fentanyl, 14% (n = 1,859) involved tramadol, and 11% involved other synthetic narcotics (n = 1,467) (these categories are not mutually exclusive, as some visits had multiple codes for synthetic narcotics). The overall number of ED visits for overdoses involving synthetic narcotics increased on average 3% each month during year one (AMPC = 3.2; 95% CI: 1.7, 4.7) and nearly 5% each month during year two (AMPC = 4.8; 95% CI: 3.6, 6.0) (Table 1 and Fig. 1). ED visits for overdoses involving fentanyl were the primary driver of the increases during year two, with an average 6% increase each month (AMPC = 6.1; 95% CI: 4.8, 7.4); no significant monthly changes were observed for overdose visits involving tramadol or other synthetic narcotics.

During year one, there was a significant increase in ED visits for overdoses involving synthetic narcotics only for males (AMPC = 4.9; 95% CI: 3.2, 6.6) (Table 1 and Supplementary Figures). During year two, both males and females had significant increases in ED visits for overdoses involving synthetic narcotics; this was driven by overdoses involving fentanyl, with an average monthly percent increase of more than 6% among males (AMPC = 6.5; 95% CI: 5.0, 7.9) and 5% among females (AMPC = 5.1; 95% CI: 3.2, 7.1). Monthly ED visits involving tramadol and other synthetic narcotics remained stable among males and females.

During year one, ED visits for overdoses involving synthetic narcotics increased for persons aged 15–24, 25–34, 35–44, and 55–64 (Table 1 and Supplementary Figures). During year two, all age groups except those ≥ 65 years had significant increases in ED visits for overdoses involving synthetic narcotics; this finding was consistent with visits for overdoses involving fentanyl. Additionally, during year two ED visits for overdoses involving tramadol increased only among persons aged 45–54 years and decreased only among persons aged 15–24 years, and visits for overdoses involving other synthetic narcotics increased only among those aged 15–24 years. Among all age groups except those ≥ 65 years, overdoses involving fentanyl were the primary driver of ED visits for overdoses involving synthetic narcotics; among those ≥ 65 years old, visits for overdoses involving tramadol were higher than those for fentanyl.

4. Discussion

This is the first study to analyze the impact of new, more granular T40.4 ICD-10-CM codes for synthetic narcotics in national ED data. Overall, we found that nonfatal synthetic opioid overdoses increased throughout the study period, but increases were greater in year two; this is similar to previous research that found ED visits for nonfatal opioid overdoses were greater in 2020 compared to 2019 (Holland et al., 2021). Several factors could explain the greater increase in nonfatal synthetic opioid overdoses in year 2 of this analysis, including: 1) an expansion of IMFs into new geographic areas (e.g., Western U.S.) (Ciccarone, 2021); 2) disproportionate increases in the rate of overdose deaths among racial and ethnic minority groups from 2019 to 2020 (Friedman & Hansen, 2021).
3) an acceleration in overdoses during the start of the COVID-19 pandemic, potentially due to increased social isolation and mental health impacts (Tanz et al., 2022). Based on findings after the code split, fentanyl was likely the primary driver of nonfatal synthetic opioid overdoses before the new codes were implemented for use in October 2020. This finding is consistent with data documenting mortality trends related to IMFs and other synthetic opioids (O'Donnell et al., 2017). After the code change, fentanyl was the most common synthetic opioid with significant increases overall, for both sexes and for all age groups except ≥65 years. The average monthly percent increase in ED visits for fentanyl-involved overdoses was greater than for all synthetic narcotics combined (i.e., T40.4X, T40.42, and/or T40.49), suggesting that the old code (T40.4X) masked the full extent of the increase in ED visits for fentanyl overdoses. Our analyses demonstrated the potential usefulness of monitoring these codes in near real-time ED data systems to capture fentanyl-involved overdose visits.

This study was subject to at least three limitations. First, this analysis is not nationally representative. Approximately 33% of ED facilities in the US were included as part of this analysis to ensure continuity in data coverage and completeness over the study period for assessment of trends; it is possible that included facilities are systematically different than those not included, thus biasing these findings. Second, this study relied on the use of diagnosis codes to categorize synthetic narcotic-involved overdoses treated in EDs; however, variability exists in how facilities determine assignment of diagnosis codes for patients. For example, point-of-care testing for fentanyl is inconsistently performed and confirmatory testing is limited (Bhalla, 2014); consequently, self-

Table 1
Average monthly percent change in emergency department visits for overdoses involving synthetic narcotics (T40.4X), fentanyl (T40.41), tramadol (T40.42), and other synthetic narcotics (T40.49), overall, by patient sex, and by age, National Syndromic Surveillance Program, 33 States and DC, October 2019–September 2021.

| Year 1 | Year 2 | T40.41, T40.42, and/or T40.49 | T40.41 (Fentanyl) | T40.42 (Tramadol) | T40.49 (Other synthetic narcotics) |
|--------|--------|-------------------------------|------------------|------------------|-----------------------------------|
| 3.2% (1.7, 4.7) | 4.8% (3.6, 6.0) | 6.1% (4.8, 7.4) | 0.5% (-1.3, 2.2) | 1.6% (-0.3, 3.5) |
| Male | 4.9% (3.2, 6.6) | 5.6% (4.2, 6.9) | 6.5% (5.0, 7.9) | 0.5% (-3.1, 2.3) | 2.1% (-0.3, 4.5) |
| Female | 1.1% (-0.6, 2.7) | 3.4% (1.9, 4.9) | 5.1% (3.2, 7.1) | 1.0% (-1.1, 3.1) | 0.9% (-1.4, 3.2) |
| 15–24 | 4.5% (2.2, 6.9) | 4.4% (2.3, 6.5) | 5.3% (3.0, 7.5) | 5.1% (-0.6, -1.4) | 7.1% (0.3, 14.4) |
| 25–34 | 4.7% (3.5, 5.9) | 5.4% (4.0, 6.7) | 6.0% (4.7, 7.3) | -0.3% (-4.0, 3.6) | 2.5% (-2.1, 7.3) |
| 35–44 | 4.6% (0.1, 9.4) | 6.9% (4.8, 9.1) | 8.0% (5.9, 10.1) | 0.6% (-4.3, 5.7) | 3.2% (-1.6, 8.3) |
| 45–54 | 1.2% (-1.6, 4.1) | 5.6% (3.6, 7.6) | 6.4% (3.9, 9.0) | 5.4% (1.5, 9.5) | 0.3% (-3.5, 4.3) |
| 55–64 | 3.8% (1.5, 6.1) | 3.4% (1.6, 5.3) | 5.5% (2.9, 8.1) | 0.3% (3.0, 3.7) | -1.3% (-6.8, 4.5) |
| ≥65 | -2.3% (-5.4, 0.9) | 0.8% (-1.3, 2.9) | 1.2% (-1.5, 3.9) | 0.5% (-2.1, 3.3) | 5.5% (-8.5, 21.6) |

† Average monthly percent change in ED visits for overdoses involving synthetic narcotics calculated using Joinpoint regression.
* Time period included October 1, 2019 through September 30, 2020.
† Time period included October 1, 2020 through September 30, 2021.
‡ The best fitting models for most analyses identified zero joins, with the exception of T40.4X among those 35–44 years old [decreased from October 2019–December 2019 (MPC = -13.4 (95% CI: -34.1, 13.9)); increased from December 2019–September 2020 (MPC = 9.1 (95% CI: 6.4, 11.9)) and T40.49 among those ≥65 years [increased from October 2020–December 2020 (MPC = 63.6 (95% CI: -31.7, 292.1)); decreased December 2020–September 2021 (MPC = -4.3 (95% CI: -11.7, 3.6))].

Fig. 1. Monthly emergency department visits for overdoses involving synthetic narcotics (T40.4X), fentanyl (T40.41), tramadol (T40.42), and other synthetic narcotics (T40.49), National Syndromic Surveillance Program, 33 States and DC, October 2019–September 2021.
reports, bystander reports, and/or clinical presentations often are used to determine the drugs involved with overdoses. Unfortunately, reliance on this information can be problematic, leading to misclassification and underreporting of the drugs involved, especially if the patient was unaware the drug was adulterated (e.g., with fentanyl) (Ciccarone et al., 2017). More consistent and comprehensive drug testing methods in EDs can improve identification of substances involved in overdoses (Schwartz et al., 2022) and could help determine the reliability of Traceable Opioid Material (TOM) kits, which include reference materials for 250 synthetic opioid compounds, including 210 fentanyl analogs (CDC, 2022). Third, individuals are increasingly refusing transport to EDs following treatment by emergency medical services in the field (Bergstein et al., 2021; Slavova et al., 2020); thus, reliance on ED visits alone to assess trends in narcotic-involved overdoses may underestimate the true burden. Nevertheless, assessing the occurrence of these codes using ED data can lead to better and more timely tracking of fentanyl overdose trends, as demonstrated in this analysis.

Monitoring ED data for nonfatal fentanyl overdoses can help inform public health response and prevention efforts. Rapid identification of overdose spikes, including increases in ED visits for overdoses, can lead to increased and tailored naloxone distribution; initiation of treatment with medication for opioid use disorder; linkage to follow-up treatment and harm reduction services; and alerting of at-risk communities (Houry et al., 2018). Ultimately, having a reliable way to track fentanyl trends is critical, and these more granular ICD-10-CM codes, when backed by consistent and quality diagnostic methods, could be an effective way to do this.

CRediT authorship contribution statement

Shannon M. Casillas: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Visualization. Lawrence Scholl: Conceptualization, Data curation, Validation, Methodology. Desiree Mustaquim: Conceptualization, Methodology. Alana Vivolokantor: Conceptualization, Methodology.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Data Sharing

The data underlying this article may be shared on reasonable request to the corresponding author.

Author disclosures

None.

Contributors

SC was responsible for project administration, study design, statistical analysis, data visualization, and leading the writing and editing of the manuscript. LS contributed to study design, statistical analysis, data validation, and writing and editing the manuscript. DM contributed to study design and writing and editing the manuscript. AVK contributed to study design and writing and editing the manuscript. All authors have approved the final manuscript.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.j.abrep.2022.100464.

References

Bhalia, A. (2014). Beside point of care toxicology screens in the ED: Utility and pitfalls. International journal of critical illness and injury science, 4(3), 257–260. https://doi.org/10.4103/2215-14471
Bergstein, R. S., King, K., Melendez-Torres, G. J., & Latimore, A. D. (2021). Refusal to accept emergency medical treatment following opioid overdose, and conditions that may promote connections to care. The International journal on drug policy, 97, Article 102296. https://doi.org/10.1016/j.drugpo.2021.102296
Centers for Disease Control and Prevention. (2020, December 17). Increase in Fatal Drug Overdoses Across the United States Driven by Synthetic Opioids Before and During the COVID-19 Pandemic. https://emergency.cdc.gov/han/han00438.asp.
Centers for Disease Control and Prevention. (2021, August 19). National Syndromic Surveillance Program (NSSP): Overview. https://www.cdc.gov/nssp/mapoverview.html.
Centers for Disease Control and Prevention. (2022, July 1). Traceable Opioid Material® Kits to Improve Laboratory Detection of Synthetic Opioids in the U.S. https://www.cdc.gov/meb/disf/opioid_kits.html.
Centers for Medicare and Medicaid Services. (2020). Final FY2021 ICD-10 Code Updates - Summary of Changes – IPF-PPS. https://www.cms.gov/files/document/fy-2021-addendum-b-ipp-pps-final-rule-icd-10-code-first-update.pdf.
Ciccarone, D., Ondoschin, J., & Mars, S. G. (2017). Heroin uncertainties: Exploring users’ perceptions of fentanyl-adulterated and substituted ‘heroin’. The International journal on drug policy, 46, 146–155. https://doi.org/10.1016/j.drugpo.2017.06.004
Ciccarone, D. (2021). The rise of illicit fentanyl, stimulants and the fourth wave of the opioid overdose crisis. Current opinion in psychiatry, 34(4), 344–350. https://doi.org/10.1097/YCO.0000000000001717
Friedman, J. R., & Hansen, H. (2022). Evaluation of Increases in Drug Overdose Mortality Rates in the US by Race and Ethnicity Before and During the COVID-19 Pandemic. JAMA psychiatry, 79(4), 379–381. https://doi.org/10.1001/jamapsychiatry.2022.0004
Holland, K. M., Jones, C., Vivolokantor, A. M., Idaiikkadar, N., Zwald, M., Hoots, B., … Houry, D. (2021). Trends in US Emergency Department Visits for Mental Health, Overdose, and Violence Outcomes Before and During the COVID-19 Pandemic. JAMA psychiatry, 78(4), 372–379. https://doi.org/10.1001/jamapsychiatry.2020.4402
Houry, D. E., Haegerich, T. M., & Vivolokantor, A. (2018). Opportunities for Prevention and Intervention of Opioid Overdose in the Emergency Department. Annals of emergency medicine, 71(6), 688–690. https://doi.org/10.1016/j.annemergmed.2018.01.052
Karissa, M., Davis, N. L., Kumar, S., Seth, P., Mattson, C. L., Chowdhury, F., & Jones, C. M. (2022). Vital Signs: Drug Overdose Deaths, by Selected Socioeconomic and Social Determinants of Health Characteristics - 25 States and the District of Columbia, 2019–2020. MMWR. Morbidity and mortality weekly report, 71(29), 940–947. https://doi.org/10.15585/mmwr.mm7129e2.
Mattson, C. L., Tzan, L. J., Quinn, K., Kariisa, M., Patel, P., & Davis, N. L. (2021). Trends and Geographic Patterns in Drug and Synthetic Opioid Overdose Deaths - United States, 2013–2019. MMWR. Morbidity and mortality weekly report, 70(6), 202–207. https://doi.org/10.15585/mmwr.mm7006a4.
National Center for Health Statistics. (2021). International classification of diseases, 10th revision, clinical modification (ICD-10-CM). (2022, April 6). https://www.cdc.gov/nchs/ncis/icd-10-cm.htm.
O’Donnell, J. K., Halpin, J., Mattson, C. L., Goldberger, B. A., & Gladden, R. M. (2017). Deaths Involving Fentanyl, Fentanyl Analog, and U-47700 - 10 States, July-December 2016. MMWR. Morbidity and mortality weekly report, 66(43), 1197–1202. https://doi.org/10.15585/mmwr.mm6643e1.
O’Donnell, J., Tzan, L. J., Gladden, R. M., Davis, N. L., & Bitting, J. (2021). Trends in and Characteristics of Drug Overdose Deaths Involving Illicitly Manufactured Fentanyl - United States, 2019–2020. MMWR. Morbidity and mortality weekly report, 70(50), 1740–1746. https://doi.org/10.15585/mmwr.mm7050e3.
Palamar, J. J., Cottler, L. B., Goldberger, B. A., Severtson, S. G., Grundy, D. J., Iwaniick, J. L., & Ciccarone, D. (2022). Trends in characteristics of fentanyl-related poisonings in the United States, 2015–2021. The American journal of drug and alcohol abuse, 1–10. https://doi.org/10.1080/00952902.2022.2081923. Advance online publication.

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Pardo, B., Taylor, J., Caulkins, J. P., Kilmer, B., Reuter, P., & Stein, B. D. (2019). RAND Corporation: The Future of Fentanyl and Other Synthetic Opioids. https://www.rand.org/pubs/research_reports/RR3117.html.

Rezaeiahari, M., & Fairman, B. J. (2022). Impact of COVID-19 on the characteristics of opioid overdose deaths in Arkansas. The International Journal on Drug Policy, 109, Article 103836. https://doi.org/10.1016/j.drugpo.2022.103836. Advance online publication.

Schwartz, B. E., Dezman, Z., Billing, A. S., Heine, K., Massey, E., Artigiani, E. E., Motavalli, M., Burch, G., Gandhi, P., & Wish, E. D. (2022). Emergency Department Drug Surveillance (EDDS) hospital’s urinalysis results compared with expanded re-testing by an independent laboratory, a pilot study. Drug and Alcohol Dependence, 230, Article 109195. https://doi.org/10.1016/j.drugalcdep.2021.109195

Slavova, S., Rock, P., Bush, H. M., Quesinberry, D., & Walsh, S. L. (2020). Signal of increased opioid overdose during COVID-19 from emergency medical services data. Drug and Alcohol Dependence, 214, Article 108176. https://doi.org/10.1016/j.drugalcdep.2020.108176

Tanz, L. J., Dinwiddie, A. T., Snodgrass, S., O’Donnell, J., Mattson, C. L., & Davis, N. L. (2022). A qualitative assessment of circumstances surrounding drug overdose deaths during the early stages of the COVID-19 pandemic. SUDORS Data Brief, No 2.

Vivolo-Kantor, A., Pasalic, E., Liu, S., Martinez, P. D., Gladden, R. M., & Overdose Morbidity Team (2021). Defining indicators for drug overdose emergency department visits and hospitalisations in ICD-10-CM coded discharge data. Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention, 27(S1), i56–i61. https://doi.org/10.1136/injuryprev-2019-043521.

Wickham, H. (2016). Ggplot2: Elegant graphics for data analysis. Springer International Publishing.