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# Improving risk factor identification for opioid overdose deaths in Tennessee

**Sarah J. Nechuta, Jenna Moses, Molly Golladay, Adele Lewis, Julia Goodin, Melissa McPheeters**

Tennessee Department of Health, Nashville, Tennessee, United States

## Objective

To examine specific drugs present based on postmortem toxicology for prescription opioid, heroin, and fentanyl overdoses classified based on ICD-10 coding. To compare drugs identified from postmortem toxicology with those listed on the death certificate for opioid overdoses.

## Introduction

Using death certificates alone to identify contributing substances in drug overdose deaths may result in misclassification and underestimation of the burden of illicit and prescription opioids and other drugs in drug-related deaths. To enable timely and targeted prevention in Tennessee (TN), the identification and monitoring of new drugs and trends in use should utilize toxicology and medicolegal death investigation data directly, as recommended by others [1-3]. These data can inform mortality outcome definitions for improved surveillance and risk factor identification [4-7]. To our knowledge, this is the first analysis to use statewide linked toxicology and death certificate data in TN.

## Methods

We identified 615 opioid involved overdose deaths in TN of unintentional (underlying ICD-10 codes: X40-X44) or undetermined (underlying ICD-10 codes: Y10-Y14) intent during June 1$^{st}$ to December 31$^{st}$ 2017. Utilizing the Interim Medical Examiner Database (I-MED), we identified postmortem toxicology reports for 454 cases, which were from one of three national laboratories used by a state Regional Forensic Center. Toxicology data were abstracted and independently verified by two co-authors and linked to the TN death statistical file that included cause of death information (literal text and ICD-10 codes) and demographics. The analysis focuses on cases with an available toxicology report.

## Results

We identified 171 prescription opioid overdoses, 221 fentanyl overdoses, and 113 heroin overdoses. **Table 1** displays postmortem toxicology profiles for major drugs/classes. For prescription opioid deaths (excluding fentanyl and heroin), positive toxicology results for prescription opioids were as follows: methadone (11%), buprenorphine (14%), hydrocodone (14%), oxycodone (36%) and oxymorphone (also a metabolite, 47%). Benzodiazepines were present in close to 58% of prescription opioid overdoses; stimulants (cocaine, amphetamines, methamphetamines) in about 25%. For fentanyl and heroin deaths, prescription opioids were detected in about 26% and 34%, respectively; stimulants in about 57.9% and 52.2%, respectively, and benzodiazepines 36-37%. Fentanyl was present on toxicology in about half of heroin overdoses, and 6–monoacetylmorphine in 72.6%.**Table 2** displays a comparison between death certificate (DC) listed drugs and drugs identified via toxicology. Close to all fentanyl deaths identified from the DC were identified via toxicology (98.7%). Benzodiazepines were involved in 34% of deaths based on DC, and 46% based on toxicology. Stimulants were involved in about in 39% of deaths based on DC, and 45% based on toxicology. Based on toxicology, about 20% of decedents were using antihistamines at overdose and 10% were using antidepressants.

## Conclusions

Using medical examiners' data, including toxicology data, improves estimation of contributing drugs involved in opioid deaths. This analysis provides jurisdiction-specific data on drugs that can help with monitoring trends and informs risk factor identification. Future work includes adding information on prescribed opioid and benzodiazepines using TN's Prescription Drug Monitoring Database and evaluating demographic variation in contributing drugs between toxicology and DC data to identify susceptible populations.Acknowledgement

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**Table 1. Postmortem toxicology results among prescription opioid, fentanyl, and heroin overdose deaths in Tennessee, n (%)**

| | Prescription Opioid* (n = 171) | | Fentanyl * (n = 221) | | Heroin* (n = 113) | |
|---|---|---|---|---|---|---|
| | Positive Toxicology | | Positive Toxicology | | Positive Toxicology | |
| | Yes | No | Yes | No | Yes | No |
| **Fentanyl** | **3 (1.8)** | **168 (98.2)** | **217 (98.2)** | **4 (1.8)** | **58 (51.3)** | **55 (48.7)** |
| 6–monoacetylmorphine | 1 (0.6) | 170 (99.4) | 37 (16.7) | 184 (83.3) | 82 (72.6) | 31 (27.4) |
| Morphine alone | 32 (18.7) | 139 (81.3) | 89 (40.3) | 132 (59.7) | 112 (99.1) | 1 (0.9) |
| Morphine and codeine | 3 (1.8) | 168 (98.2) | 9 (4.1) | 212 (95.9) | 51 (45.1) | 62 (54.9) |
| Codeine | 5 (2.9) | 166 (97.1) | 9 (4.1) | 212 (95.9) | 52 (46.0) | 61 (54.0) |
| Oxycodone | 62 (36.3) | 109 (63.7) | 20 (9.1) | 201 (90.9) | 15 (13.3) | 98 (86.7) |
| Hydrocodone | 24 (14.0) | 147 (86.0) | 9 (4.1) | 212 (95.9) | 11 (9.7) | 102 (90.3) |
| Oxymorphone** | 81 (47.4) | 90 (52.6) | 17 (7.7) | 204 (92.3) | 5 (4.4) | 108 (95.6) |
| Methadone | 19 (11.1) | 152 (88.9) | 6 (2.7) | 215 (97.3) | 3 (2.6) | 110 (97.4) |
| Buprenorphine | 24 (14.0) | 147 (86.0) | 6 (2.7) | 215 (97.3) | 4 (3.5) | 109 (96.5) |
| Benzodiazepines | 99 (57.9) | 72 (42.1) | 80 (36.2) | 141 (63.8) | 42 (37.2) | 71 (62.8) |
| Cocaine | 18 (10.5) | 153 (89.5) | 74 (33.5) | 147 (66.5) | 34 (30.1) | 79 (69.9) |
| Other Stimulants | 25 (14.6) | 146 (85.4) | 54 (24.4) | 167 (75.6) | 25 (22.1) | 88 (77.9) |

*Defined using death certificate data.

**Also a pharmacologically active metabolite of oxycodone.

**Table 2. Comparing postmortem toxicology results with death certificate listed drugs for opioid-involved overdose deaths in Tennessee, n**

| | Death Certificate | Positive Toxicology |
|---|---|---|
| Fentanyl | 220 | 223 |
| Heroin* | 114 | 87 |
| Morphine alone | 56 | 178 |
| Morphine and codeine | 1 | 8 |
| Codeine | 6 | 59 |
| Oxycodone | 83 | 93 |
| Hydrocodone | 41 | 42 |
| Methadone | 23 | 26 |
| Buprenorphine | 28 | 32 |
| Oxymorphone** | 70 | 101 |
| Tramadol | 10 | 10 |
| Benzodiazepines | 155 | 201 |
| Cocaine | 91 | 108 |
| Amphetamines/Methamphetamine | 87 | 93 |
| Antihistamines | 14 | 90 |
| Antidepressants | 27 | 45 |

*Heroin or 6-monoacetylmorphine.
**Also a pharmacologically active metabolite of oxycodone.