

# An Assessment of the EMS Drug Overdose to Death Pathway from 2011 to 2017

Samir T. Parmar<sup>1</sup>, Timothy D. McFarlane<sup>2</sup>

<sup>1</sup>Epidemiology, Marion County Public Health Department, Indianapolis, Indiana, United States, <sup>2</sup>Indiana University Richard M Fairbanks School of Public Health, Indianapolis, Indiana, United States

## Objective

To characterize the appropriateness of naloxone administration, causes of death, and history of Indianapolis Emergency Medical Services (I-EMS) service utilization among the drug overdose population in Marion County, Indiana between 2011 to 2017.

## Introduction

Drug overdoses are now the leading cause of accidental death in the United States, with an estimated 60,000 deaths in 2016 [1]. Nationally, EMS overdose responses with naloxone administration have nearly doubled from 2012 to 2016 from 573.6 to 1004.4 per 100,000 EMS events [2]. Resuscitation using the opioid antagonist, naloxone is recommended in cases of suspected opioid ODs, and has been increasingly used by EMS agencies, law enforcement, healthcare providers, and Good Samaritans [3]. While naloxone can save lives, it is not clear how often its use is appropriate; delivering the right care to the right patient at the right time. It has been suggested that community paramedic programs teamed with recovery services may help link OD patients to recovery and rehabilitation services and establish mechanisms for follow-up care [4]. Prior to implementing community EMS programs, it is important to understand the EMS utilization patterns of the OD population. I-EMS interactions may present an opportunity for behavioral intervention and linkage to services to prevent future OD and death in the opioid-using population. Accurately documenting substances involved in drug overdose deaths has been of increasing interest to Marion County and Indiana with a recent law requiring toxicology testing [5,6]. This project linked individual-level data across public health information systems to assess the appropriateness of naloxone administration, the frequency of I-EMS service utilization until final death outcome among the I-EMS OD deceased cohort, and underlying causes of death among the cohort.

## Methods

The study setting is Marion County, Indiana, in which the state capital, Indianapolis is located. The population size at the 2010 census was 903,393. We performed individual-level data linkage between I-EMS overdose run data from January 1, 2011 to December 17, 2017, Marion County coroner toxicology data from 2011 to 2017, and Marion County death certificate data from 2011 to 2017. Observations were linked according to first name, last name, and date of birth. The appropriateness of naloxone administration was assessed by quantifying the following: the probability of naloxone administration given opioid positive toxicology (sensitivity); and probability of opioid toxicology given naloxone administration (positive predictive value). Primary exposure of history of OD (via I-EMS) and the outcomes of all-cause mortality, non-OD, and OD mortality were assessed. The following ICD10 drug overdose coding was utilized: X40-X44, X60-X64, X85, Y10-Y14 to identify mortality type. Standardized mortality ratios (SMR) were calculated for the cohort based on Marion County census population-level estimates and Marion County death data with sex and age adjustment on exposure. Additionally, we investigated repeat OD frequencies and time to death among the cohort.

## Results

Of 8,384 individuals who utilized I-EMS for drug overdose, 6,590 (78.6%) individuals were administered naloxone on at least one I-EMS run, 850 (10.1%) died, and 260 (3.1%) of the deceased had a toxicology report conducted after death from 2011 to 2017. Among the 260 individuals who had a toxicology report, 92% were administered naloxone given they tested positive for opioid and 87.7% tested positive for opioids given they were administered naloxone (Table 1).

Additionally, 82.8% of individuals were administered naloxone given they tested negative for opioids. Thus, up to 8% of opioid ODs patients were not provided naloxone when potentially necessary and 17% were provided naloxone when potentially unnecessary. One-hundred-fifteen (13.5%) died on the same day of their last EMS overdose run, yet only 61 (53%) of these individuals had a toxicology report, with a 90.7% administered naloxone given they tested positive for opioids and 87.5% tested positive for opioids given they were administered naloxone (Table 1). Of 850 individuals that died, 13.5% died on the same day of their last EMS run, 5.6% died next day, 12.4% died within 2 to 7 days, 9.8% within 8 to 30 days, 18.5% within 31 to 181 days, and



ISDS Annual Conference Proceedings 2019. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 Unported License (<http://creativecommons.org/licenses/by-nc/3.0/>), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

10.8% within 181 to 365 days, 29.4% greater than 365 days. Based on ICD10 drug overdose coding 293 (34.5%) individuals had drug overdose deaths, with 161 (18.9%) having X44 (accidental poisoning by other and unspecified drugs) and 112 (13.2%) having X42 (accidental poisoning by narcotics and psychodysleptics). Five-hundred-fifty-seven (65.5%) individuals had non-drug overdose deaths. After accidental poisoning due to drugs, heart, lung, and brain complications related to drug use appeared as common underlying causes of death. Of 850 deceased individuals, 86.4% only had one overdose EMS run, 13.7% had two or more EMS runs, and 759 (89.3%) had at least one EMS run where naloxone was administered. The SMR for drug-related utilizers of EMS was 4.04 compared to the general Marion County population, after adjustment for sex and age.

## Conclusions

This work looked at deceased individuals with I-EMS overdose interactions during the period 2011 through 2017. Our results described two important features of EMS naloxone administration, providing the right care at the right time and maximizing available resources. For deceased individuals with known toxicology and same-day I-EMS interaction, the sensitivity of I-EMS naloxone administration was 90.7%. Of the deceased I-EMS overdose cohort, 70.6% died within one year of their last I-EMS overdose interaction and 13.7% had two or more ambulance runs for drug overdose. Although the most common cause of death in the I-EMS overdose cohort was related to drug poisoning, we observed over 65% died from other causes.

## Acknowledgement

The authors would like to thank Brad Ray of Indiana University Purdue University-Indianapolis and Joe Gibson of the Marion County Public Health Department for their support.

## References

1. Opioid Overdose [Internet]. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention; 2017 [cited 2018 Oct 8]. Available from: <https://www.cdc.gov/drugoverdose/data/index.html>
2. Cash RE, Kinsman J, Crowe RP, Rivard MK, Faul M, et al. 2018. Naloxone Administration Frequency During Emergency Medical Service Events—United States, 2012–2016. *Morbidity and Mortality Weekly Report*. 67(31), 850.
3. Adams J. Surgeon General's Advisory on Naloxone and Opioid Overdose [Internet]. SurgeonGeneral.gov. [cited 2018 Oct 8]. Available from: <https://www.surgeongeneral.gov/priorities/opioid-overdose-prevention/naloxone-advisory.html>
4. 5 things community paramedics need to know about the opioid epidemic [Internet]. 5 things community paramedics need to know about the opioid epidemic. EMS1; 2018 [cited 2018 Oct 8]. Available from: <https://www.ems1.com/opioids/articles/383830048-5-things-community-paramedics-need-to-know-about-the-opioid-epidemic>
5. Ray B, Quinet K, Dickinson T, Watson DP, Ballew A. 2017. Examining fatal opioid overdoses in Marion County, Indiana. *J Urban Health*. 94(2), 301-10.
6. Indiana General Assembly. Senate Bill 139 - Investigation of overdose deaths [Internet]. Indiana Code 2017 - Indiana General Assembly, 2018 Session. Indiana General Assembly; 2018 [cited 2018 Oct 8]. Available from: <http://iga.in.gov/legislative/2018/bills/senate/139#digest-heading>

**Table 1: Sensitivity and Specificity of Naloxone Administration by Time to Death**

Time to death	Sensitivity of naloxone administration	Positive Predictive Value of naloxone administration
Same day	90.7%	87.5%
Within 1 day	90.2%	87.3%
Ever	92.0%	87.7%



ISDS Annual Conference Proceedings 2019. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 Unported License (<http://creativecommons.org/licenses/by-nc/3.0/>), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.