Emergency Medical Dispatch Identification of Opioid Overdose and Frequency of Naloxone Administration on Scene

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ABSTRACT

Introduction: Opioid overdoses have reached crisis proportions. One response has been to increase the availability of naloxone HCl (commonly referred to by the generic name naloxone), which reverses the effects of opioid overdose. The Medical Priority Dispatch System (MPDS®) includes instructions by which the Emergency Medical Dispatcher (EMD) can prompt the caller to find and use naloxone on overdose victims. However, these instructions are only provided on dispatch Chief Complaint (CC) Protocols on which overdoses are expected to be handled.
Objectives: The primary objective of this study was to determine the distribution of CC Protocols and determinant codes on which overdose (or likely overdose) cases were handled. The secondary objective was to characterize the frequency of naloxone administration on scene by Emergency Medical Services (EMS) providers and relate this to patient acuity.
Methods: This was a retrospective, descriptive, and uncontrolled study of de-identified EMD and EMS data, from two US Emergency Communications Centers: Richmond Ambulance Authority (RAA), Richmond, VA, and EMS Authority (EMSA), Oklahoma City and Tulsa, Oklahoma. The study sample included all EMS and dispatch cases in which naloxone was administered. A convenience sample of about 4.5 years of ProQA® (software version of MPDS) and corresponding electronic patient care report (ePCR) datasets were collected, from July 2013 to December 2017. The ProQA (dispatch) dataset comprised patient/caller call triage data and ePCR dataset comprised patient/caller data collected on scene by the EMS provider.
Results: A total 5,843 calls where naloxone was administered by EMS were collected during the study period, of which 1,081 (18.5%) were outliers; 4,762 (81.5%) were therefore included in the study. Overall, naloxone was administered by EMS in 0.53% of total cases (0.46% in EMSA and 1.28% in RAA), and the results showed an increasing trend over the years. Naloxone was administered most frequently on five CC Protocols: *Unconscious/Fainting* (30.0%), *Overdose/Poisoning* (18.4%), *Cardiac or Respiratory Arrest/Death* (16.3%), *Sick Person* (8.1%), and *Unknown Problem* (6.9%). Overall, the condition of most patients to whom naloxone was administrated improved (52.7%) or remained unchanged (44.6%).
Conclusions: Suspected overdoses are frequently not reported as overdoses. Understanding how opioid overdoses are initially reported to 911 can inform dispatch protocol development, so as to improve identification of opioid overdose and increase the provision of naloxone instructions.

INTRODUCTION

Opioid overdoses have reached critical proportions in the United States and worldwide. The US Centers for Disease Control and Prevention report that over 115 Americans die every day from opioid overdose,[1] and the US President recently declared the epidemic a national public health emergency—and directed the creation of a "Crisis Next Door" website, where Americans can share their own stories about the dangers of opioid addiction.[2] One response to the crisis has been to increase the availability of naloxone HCl (commonly referred to by the brand name Narcan), a treatment that reverses the effects of opioid overdose when injected or inhaled.[3,4]

As early as 1997, the rising death toll drove some in the medical and public health communities to call for public access to naloxone, including calls to allow users and/or

their associates to keep naloxone on hand, much like epinephrine syringes are kept by those with severe allergies.[5] The US Health Departments are distributing naloxone to the public, but further research should assess this phenomenon to determine the effectiveness of this strategy and make further recommendations.

In Europe, take-home naloxone programs currently exist in 10 European countries. A recent systematic review of the effectiveness of the take-home naloxone, by the European Monitoring Centre for Drugs and Drug Addiction, found evidence that its provision in combination with educational and training interventions reduces overdose-related mortality.[6] Additionally, research[7] has shown that many opioid overdoses occur to victims in the presence of other people. However, anecdotally, there is a mistaken belief that drug users do not help each other in overdose situations. In a naloxone feasibility survey among opioid users,[8] 89 percent of those who had witnessed an overdose death said they would have administered naloxone to the victim if they had access to the antidote. Drug users are thus willing to help, but in many cases, they do not know what actions to take. Therefore, an opportunity for potentially life-saving action may exist if bystanders can be empowered to act. Unfortunately, often this does not happen, either because there is a failure to recognize the seriousness of the situation, there is fear of police involvement, or emergency services are called late or not at all.

The Medical Priority Dispatch System (MPDS®) version 13.0 (Priority Dispatch Corp., ©2015, Salt Lake City, Utah, USA) is a set of protocols used by the Emergency Medical Dispatcher (EMD) to determine an initial Chief Complaint (CC), as well as a Priority Level and Determinant Descriptor, all of which make up the assigned Determinant Code—an alphanumeric code used to initiate a specific, locally assigned response based on patient condition and scene circumstances. For suspected opioid overdose cases, the MPDS includes instructions by which the EMD can prompt the caller to find and use naloxone. However, a prompt (direct protocol link) to use these instructions is currently only provided on two Chief Complaint Protocols: *Overdose/Poisoning (Ingestion)* (Protocol #23), and *Unconscious/Fainting (near)* (Protocol #31).

Connecting all cases in which Emergency Medical Services (EMS) responders determined naloxone administration to be necessary with the originating Determinant Codes could help identify the range of caller-reported symptoms with which opioid overdoses are presenting, as well as the range of Chief Complaint Protocols on which naloxone instructions might be applicable.

OBJECTIVES

The primary objective of the study was to determine the distribution of CC Protocols on which overdose (or likely overdose) cases were handled. The secondary objective was to characterize the frequency of naloxone administration on scene by EMS providers and relate it to patient outcomes.

METHODS

Design and Setting

This retrospective, descriptive, and uncontrolled study analyzed de-identified EMD and EMS data from two US Emergency Communications Centers, accredited as Centers of Excellence by the International Academies of Emergency Dispatch, Salt Lake City, Utah: Richmond Ambulance Authority (RAA), Richmond, VA, and EMS Authority (EMSA), Oklahoma City and Tulsa, Oklahoma.

RAA has provided EMS to the citizens and visitors of Richmond, Virginia, since 1991. It covers an area of approximately 63 square miles, for a population of nearly 250,000, and it averages about 70,000 responses and over 50,000 transports (emergency and non-emergencies combined) per year.

EMSA is Oklahoma's largest provider of prehospital emergency medical care. It provides ambulance service to more than 1.1 million residents in central and northeast Oklahoma—13 communities and surrounding areas. EMSA was established in Tulsa in 1977 and later expanded to include other cities/regions in Oklahoma. EMSA began providing service to Oklahoma City in 1990. In fiscal year 2017, EMSA responded to over 215,000 requests for service and transported more than 155,000 patients between the Eastern (Tulsa Metro) and Western (Oklahoma City Metro) Divisions.

Study Sample

The study sample included all the EMS and dispatch cases available at the time of the study in which naloxone was administered by EMS responders. A convenience sample of about 4.5 years of ProQA® (software version of MPDS) and corresponding electronic patient care report (ePCR) datasets were collected, from July 2013 to February 2018. The ProQA dataset comprised patient/caller call triage data, and the ePCR dataset comprised patient/caller data collected on scene by the EMS provider.

Outcome Measures

The endpoints in this study included the distribution of cases per CC where naloxone administration was performed, and the percentage of all calls in which naloxone was administered, both overall and by study site.

Data Analysis

R for statistical computing software (version 3.5.1)[9] was used for data analysis. Data preprocessing (for analysis) involved extracting dispatch data (in XML format) into an SQL Server database and filtering out potential test/outlier calls. The clean dispatch dataset was then linked with ePCR field records. Transformations and splitting of the merged dataset for different criteria were performed before applying relevant R functions to obtain the final study results.

Descriptive statistics such as frequencies and percentages were used to characterize the distributions of naloxone administration, categorizing by the Chief Complaint Protocols, Priority Levels, and determinant codes on which each EMS-identified naloxone administration or recorded overdose case was handled. Similar statistics were also presented on the patient's condition: improved, unchanged, or worsened. Final analysis described the naloxone administration trends over time.

RESULTS

A total 5,843 cases of naloxone administration by EMS were collected during the study period, of which 1,081 (18.5%) were excluded since they could not be matched to a specific dispatch-initiated incident or Chief Complaint (Table 1). Therefore, 4,762 (81.5%) cases were included in the study (3,847 from EMSA and 915 from RAA). Overall, naloxone was administered by EMS responders in 0.53% of total cases, and the results showed an increasing trend over the years.

Of the 4,762 cases, naloxone was administered by EMS most frequently on cases from five CC Protocols: *Unconscious/Fainting* (30.0%), *Overdose/Poisoning* (18.4%), *Cardiac or Respiratory Arrest/Death* (16.3%), *Sick Person* (8.1%), and *Unknown Problem* (6.9%) (Fig. 1). The distribution pattern was quite similar in the two agencies studied.

Cases		EMSA n (%)*	RAA n (%)*	Overall n (%)*
All emergency dispatch (ProQA)		832,175	71,558	903,733
Naloxone-administered (EMS ePCR)	All	4,240 (0.51)	1,603 (2.2)	5,843 (0.65)
	Matched†	3,847 (0.56)	915 (1.3)	4,762 (0.53)

EMSA: Emergency Medical Services Authority
RAA: Richmond Ambulance Authority
*The percentage is calculated out of all ProQA dispatch cases.
†EMS naloxone-administered cases that had corresponding dispatch cases.

Table 1. Profile of sampled datasets

Categorizing by dispatch priority levels, overall, the administration of naloxone was highest for the higher-acuity patients who were handled under the DELTA (58.6%), ECHO 725(15.2%), and CHARLIE 697 (14.6%) dispatch Priority Levels (Fig. 2). A similar pattern was observed in RAA, where of the 915 cases, naloxone was administered 68.4% of the time on DELTA-, 20.3% of the time on ECHO-, and 8.4% of the time on CHARLIE-level cases. However, in EMSA, of the 3,847 calls, the order was DELTAs (56.3%), CHARLIEs (16.1%), and ECHOs (14.0%).

The top three determinant codes on which naloxone was administered overall were 31-D-2 [Unconscious – Effective breathing] (17.4%, n=828), 9-E-1 [Cardiac Arrest: Not breathing at all] (11.8%, n=561), and 23-D-1 [Overdose: Unconscious] (10.5%, n=498) (Fig. 3). A similar trend was observed in EMSA (17.0% for 31-D-2, 10.6% for 9-E-1, and 8.8% for 23-D-1), but not for RAA, where the order was 19.1% for 31-D-2, 17.4% for 23-D-1, and 16.7% for 9-E-1.

Overall, the condition of most patients improved (52.7%) or remained unchanged (44.6%) (Table 2). A similar pattern was observed at each of the agencies, where the condition of a significant majority (99.7% for EMSA and 87.4% for RAA) either improved or remained unchanged. The patient's condition deteriorated in less than half of one percent of cases.

The study results demonstrated that the use of naloxone by providers is on an upward trend, overall and at each of the study

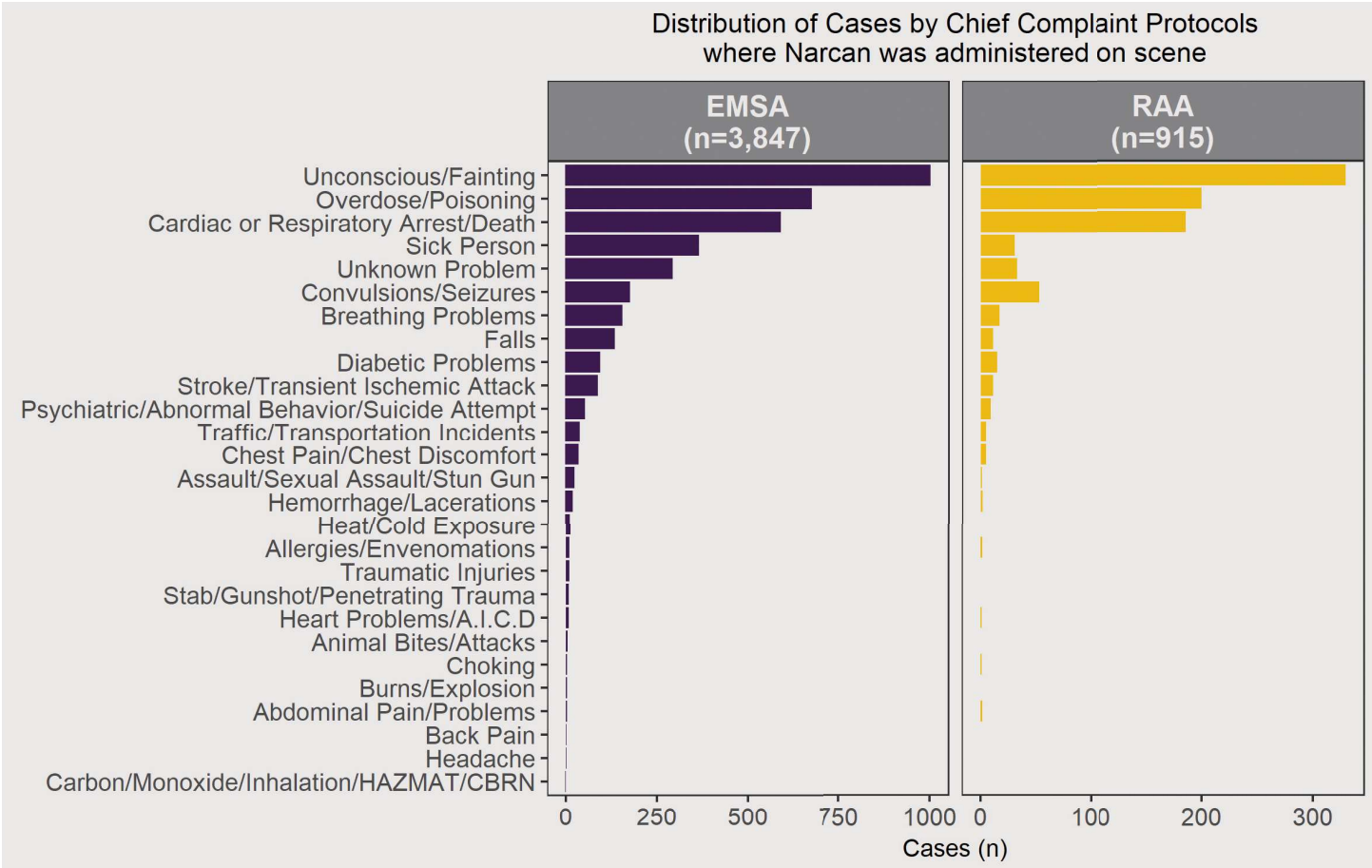


Figure 1. Naloxone-administered cases categorized by Chief Complaint Protocol

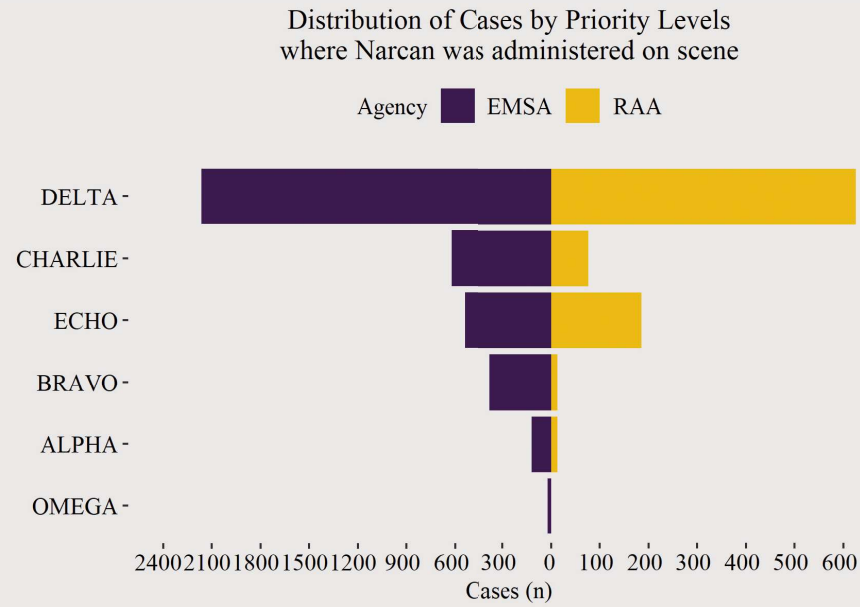
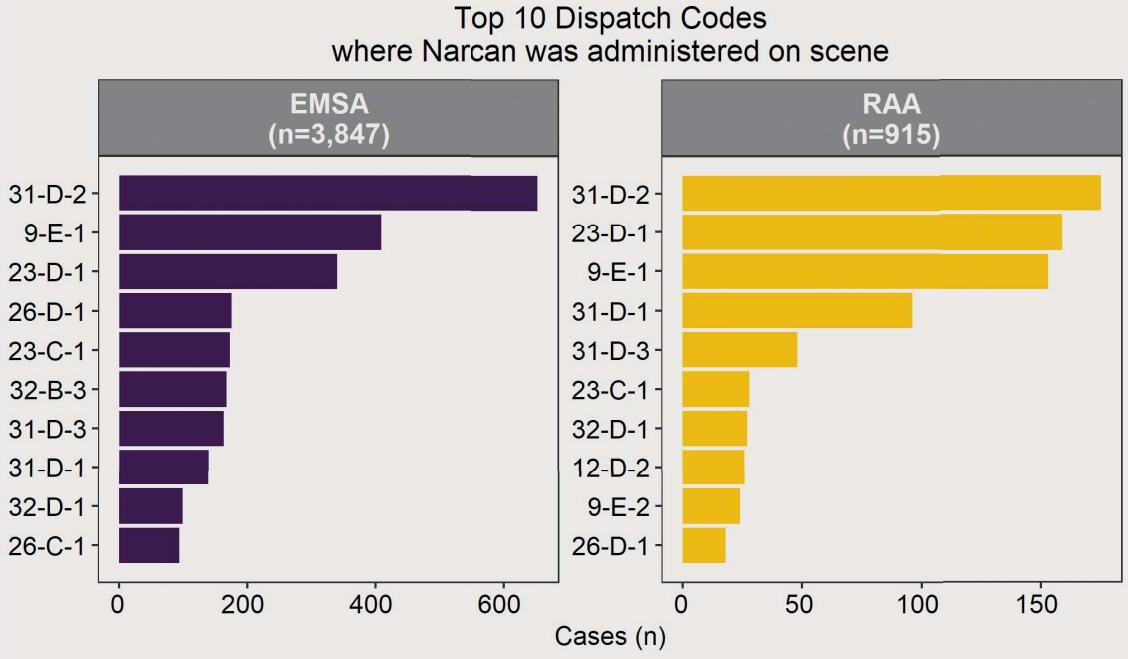


Figure 2. Naloxone-administered cases categorized by dispatch Priority Level



Chief Complaint Protocols:
9, Cardiac or Respiratory Arrest/Death
12, Convulsions/Seizures
23, Overdose/Poisoning (Ingestion)
26, Sick Person (Specific diagnosis)
31, Unconscious/Fainting (Near)
32, Unknown Problem (Person down)

Determinants:
9-E-1, Not breathing at all
9-E-2, Uncertain breathing
12-D-2, Continuous or Multiple seizures
23-C-1, Not alert
23-D-1, Unconscious
26-C-1, Altered level of consciousness
26-D-1, Not alert
31-D-1, Unconscious—Agonal/ineffective breathing
31-D-2, Unconscious—Effective breathing
31-D-3, Not alert
32-B-3, Unknown status/Other codes not applicable
32-D-1, Life status questionable

Figure 3. Naloxone-administered cases for top 10 dispatch determinant codes

sites (Fig. 4). Specifically, high peaks of naloxone administration were evident during the October – December period (in EMSA and RAA) and March – June (in RAA). The lower peaks were March/April and July – October for EMSA, and July/August in RAA.

DISCUSSION

The findings in this study demonstrate that naloxone administration by EMS has generally increased over time. These findings are consistent with the opioid report put forth by the US Centers for Disease Control and Prevention (CDC), showing two key interconnected trends that appear to be driving the opioid epidemic in America: "a 17-year increase in deaths from prescription opioid overdoses, and a recent surge in illicit opioid overdoses driven mainly by heroin and illegally-made fentanyl. Both of these trends continued in 2016."[2]

In mid-2017, the US Department of Health and Human Services (HHS) Secretary, in his speech to the National Rx Drug Abuse and Heroin Summit, identified five priorities to help combat the opioid crisis. The findings in this study can influence the realization of one of the priorities: "Promoting use of overdose-reversing drugs".[10]

The study results confirm what has long been suspected: opioid overdoses are frequently not reported initially by the 911 caller as opioid overdoses. Therefore, understanding how opioid overdoses are initially reported to 911 can inform dispatch protocol development, so as to improve identification of opioid overdose and increase the provision of naloxone instructions to callers.

Outcome	Priority Level	EMSA n (%*)	RAA n (%*)
Improved	OMEGA	11 (0.55%)	**
EMSA (n=2002)	ALPHA	64 (3.2%)	7 (1.4%)
RAA (n=507)	BRAVO	189 (9.4%)	4 (0.79%)
	CHARLIE	348 (17.4%)	43 (8.5%)
	DELTA	1174 (58.6%)	365 (72%)
	ECHO	216 (10.8%)	88 (17.4%)
Unchanged	OMEGA	11 (0.6%)	**
EMSA (n=1833)	ALPHA	55 (3%)	3 (1%)
RAA (n=293)	BRAVO	192 (10.5%)	6 (2%)
	CHARLIE	271 (14.8%)	24 (8.2%)
	DELTA	981 (53.5%)	203 (69.3%)
	ECHO	323 (17.6%)	57 (19.5%)
Worse	ALPHA	2 (16.7%)	**
EMSA (n=12)	CHARLIE	1 (8.3%)	3 (33.3%)
RAA (n=9)	DELTA	9 (75%)	5 (55.6%)
	ECHO	**	1 (11.1%)
No Information Provided	ALPHA	**	3 (2.8%)
RAA (n=106)	BRAVO	**	3 (2.8%)
	CHARLIE	**	7 (6.6%)
	DELTA	**	53 (50%)
	ECHO	**	40 (37.7%)

EMSA – Emergency Medical Services Authority
RAA – Richmond Ambulance Authority
* Calculated out of each agency's outcome total
** No data available

Table 2. Naloxone-administered cases categorized by dispatch Priority Level

The frequency distribution of CC Protocols where naloxone was administered on scene was not unexpected—the top 3 chief complaints were Protocol 31 [*Unconscious/Fainting*], Protocol 23 [*Overdose/Poisoning*], and Protocol 9 [*Cardiac or Respiratory Arrest/Death*], although one would expect Protocol 23 [*Overdose/Poisoning (ingestion)*] to be the highest, instead of second-highest. However, at the time of this study, a cardiac arrest code did not exist on Protocol 23, which may account for the selection of the less specific cardiac arrest protocol in order to initiate a maximal response. These three CC Protocols represented approximately 65.0% of patients to whom EMS administered naloxone on scene. Of these top three CCs where naloxone was administered, only two (*Unconscious/Fainting* and *Overdose/Poisoning*) provide EMD instructions for the caller to find and use naloxone on overdose victims. These data show the need to incorporate EMD instructions for potential administration of naloxone onto several other Chief Complaint Protocols appearing frequently in our data—possibly both the *Cardiac/Respiratory Arrest* and *Sick Person* protocols.

The findings here also suggest at least one possible modification to the MPDS protocols to allow the EMD to better identify opioid overdose patients and subsequently provide caller instructions for using naloxone prior to EMS arrival: add a specific Key Question (protocol question) on Protocol 31 (Unconscious/Fainting) that queries whether the patient has taken any drugs or medications recently. This modification seems likely to generate overdose identifications, given the high frequency of naloxone administration in Protocol 31 cases.

The high number of cases with a Chief Complaint of Protocol 9 (*Cardiac or Respiratory Arrest/Death*) has important implications as well. The MPDS has two CPR instruction pathways for patients determined to be not breathing: Chest Compressions First/Only and Ventilations First CPR. The default pathway is Chest Compressions First/Only, since a typical arrest not due to asphyxia (such as choking, drowning, or toxic inhalation), blunt force trauma, severe hemorrhage, or suicide, is suspected to be cardiac in nature—and potentially reversible with early chest compressions to get oxygenated blood circulating rapidly. Conversely, an opioid-induced arrest is respiratory in nature (at least in the early stages), requiring a Ventilations-First CPR pathway so as to get more oxygen into the bloodstream. A reported arrest due to a potential opioid overdose, in previous versions of the MPDS, prompted the EMD to select Protocol 9 (Cardiac/Respiratory Arrest/Death), which could lead the EMD to the less effective CPR treatment pathway (Compressions First/Compressions Only), due to the ambiguities of selecting the arrest protocol. To mitigate this, an arrest code has been added to Protocol 23 in the latest MPDS protocol version (13.1), and EMDs are now being trained to use this Protocol for suspected opioid-caused arrests.

Additionally, the study showed that naloxone is being administered by EMS personnel more frequently to patients triaged at higher acuity levels (ECHO and DELTA, and some CHARLIE). This finding generally affirms the assignment of higher-acuity codes to overdose situations requiring medication-aided reversal.

Limitations

This study had notable limitations, including a relatively small data sample when considering the national and international scope of the problem—the two study agencies cover only a small percentage of the United States population. Therefore, further research can expand the sample size, providing for a more balanced analysis both nationally and internationally.

Another limitation to this study is the limited data regarding hospital diagnosis and discharge outcomes. Most EMS providers simply do not have access to this important outcome data.

CONCLUSION

The study results show that EMS dispatch and response are dealing with an increasing volume of opioid overdose calls. The use of naloxone by field providers is also increasing. Continued research and subsequent dispatch protocol evolution can enable the EMD to identify and treat suspected opioid overdoses prior to the arrival of responders. Changes to the MPDS protocol may assist in identifying overdose patients when the originating caller does not specifically state that the patient has overdosed. Adding a Key Question concerning recent drug/medication use to applicable protocols where the patient is unconscious or not alert has the potential to have a positive impact on outcomes for opioid overdose patients.

Further, the findings in this study may assist public safety administration to better understand opioid overdoses in their communities and supply non-traditional personnel with naloxone, i.e., law enforcement or fire/rescue.

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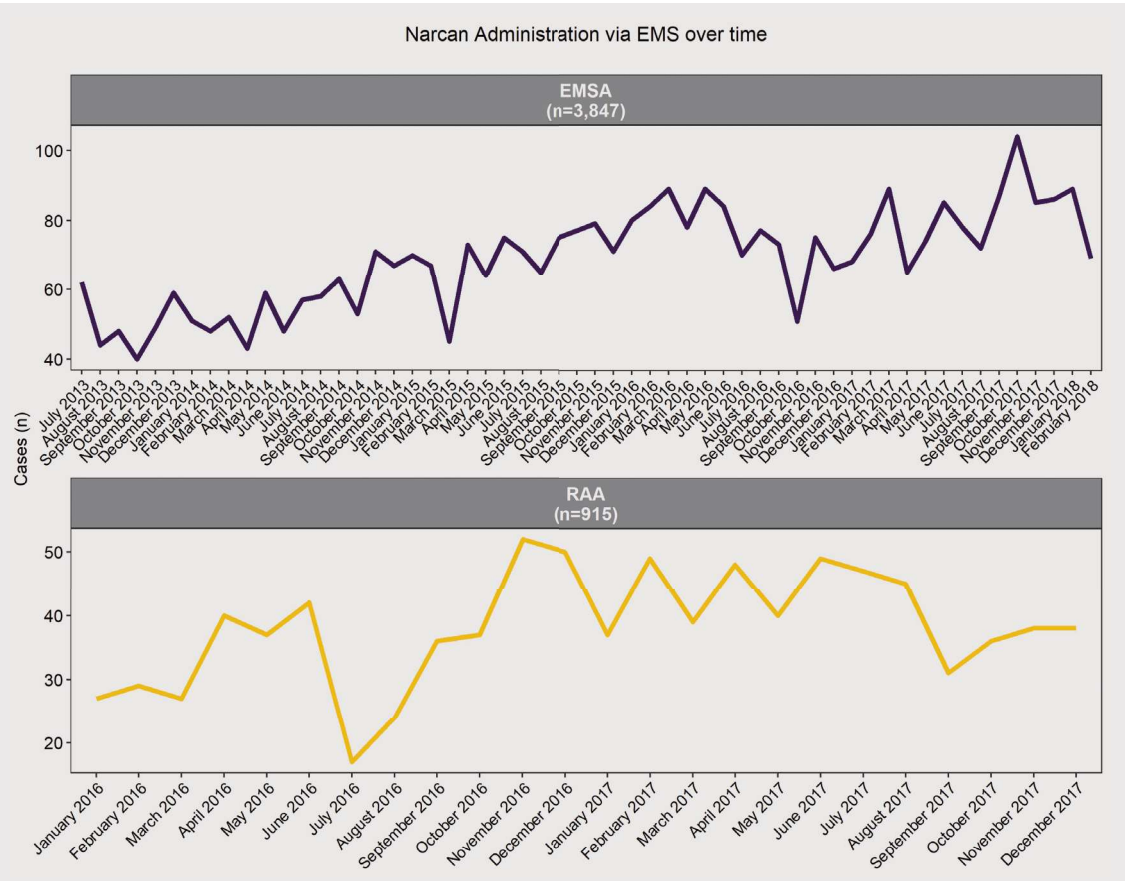

Figure 4. Trend of naloxone-administered cases over time