Methods Report: Case Definition and Analysis of King County Emergency Medical Services (KCEMS) Data for Opioid Overdose

Updated May 2023

Background

Data recorded by King County Emergency Medical Services (KCEMS) agencies are important for monitoring overdose, especially non-fatal overdose. Data are available in near real-time and contain information that can be used to monitor spatial-temporal trends, detect overdose clusters and other emerging drug-related threats, and initiate referrals to care. KCEMS operates in a coordinated partnership with twenty-five (Basic Life Support) fire departments, five paramedic (Advance Life Support) provider groups, four 9-1-1 dispatch centers, private ambulance companies, and hospitals. All KCEMS agencies directly involved in incident response use a National Emergency Medical Services Information System (NEMSIS)-compliant electronic health record system to document detailed information relating to the incident. Completed and locked records are processed and compiled daily into a centralized data repository accessed by KCEMS for regional quality improvement purposes outlined by the 2020-2025 EMS / Medic One Strategic Plan. The data repository does not include records from private ambulance companies or other non-fire department EMS agencies in King County.

Data Pre-processing: Identification and Merging of Records Corresponding to Same Person-Incident

Each EMS unit that responds to a 9-1-1 call creates a record for each patient involved in the incident, oftentimes resulting in multiple records per patient and incident. We apply probabilistic linkage methods to identify and merge information corresponding to the same person-incident to better ensure that: 1) the number of person-incidents is accurately represented, and 2) measurement of overdose indicators is implemented on all available information corresponding to the person-incident. To merge KCEMS records to the patient-incident level, we implemented a Bayesian approach to probabilistic record linkage through the Multilink package in R (details described elsewhere[1]). This approach uses first name, last name, sex, incident time, incident coordinates, age, and date of birth for comparison between EMS unit records. Records corresponding to the same person-incident are merged into a single record that contains information combined across records.

Opioid Overdose Case definition in KCEMS data

To identify opioid overdoses in the KCEMS data, we implemented a query on the person-incident dataset that creates an overdose likelihood score. First, the query evaluates which of the following indicators and/or symptoms of opioid overdose (hereafter referred to as "criteria") were documented in the record:

1. Primary or Secondary Impressions indicative of overdose
2. Opioid* mentioned in chief complaint and/or narrative
3. Overdose* mentioned in chief complaint and/or narrative
4. Respiratory Rate <11 OR decreased respirations* mentioned in chief complaint and/or narrative

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[1] Aleshin-Guendel, S. & Sadinle, M. Multifile partitioning for Record Linkage and Duplicate Detection. *Journal of the American Statistical Association.* 2022.

* A number of terms indicative of this phrase were included in the query.

5. Glasgow Coma Scale <15 OR decreased level of consciousness* mentioned in chief complaint and/or narrative
6. Naloxone (Narcan) listed as an EMS-administered medication OR Naloxone administration* mentioned in chief complaint and/or narrative
7. Pinpoint pupils* mentioned in narrative or chief complaint
8. "Drug" mentioned in primary/secondary response type, narrative or chief complaint

We considered the incident a *probable* opioid overdose if:
- At least 5 of the criteria were met *or*
- At least 4 of the criteria were met, including Naloxone administration *or*
- At least 4 of the criteria were met, including mention of pinpoint pupils

We considered the incident a *possible* opioid overdose if:
- At least 3 of the criteria were met, including Naloxone administration *or*
- At least 3 of the criteria were met, including mention of pinpoint pupils

We applied additional exclusions for alcohol poisoning and other acute health issues (e.g., hypoglycemia, seizure) that were erroneously captured and reclassified them as not an overdose.

Evaluation of the Opioid Overdose Case Definition in EMS data

We evaluated[2] the accuracy of the opioid overdose case definition (described above) in a sample of KCEMS records from October 2021 that underwent manual review by trained data abstractors. The sample was composed of the following:

- All records that met the probable/possible opioid overdose case definition *or* mentioned pills, naloxone, or had a primary impression of overdose (n=572)
- Stratified random sample of 1% of remaining records (n=170; stratification based upon the provider's general impression of patient's primary reason for the 9-1-1 call and the incident disposition)

All records selected for manual review were reviewed by two staff members of the public health team and the first 225 records were reviewed by a third member. During the review process, the team read information in key fields and documented whether the incident constituted an overdose response. Any disagreements were reviewed by a third member and the final classification was determined by consensus.

We compared the case definition above for classifying incidents as probable and possible overdoses against the overdose classification indicated by the manual review team, which was assumed to better represent actual overdose status. After applying a weighted analysis, we estimated that the possible *and* probable opioid overdose definition will capture 83.8% of all opioid overdoses and that 80.2% of incidents flagged by the definition are actual opioid overdoses. The *probable* overdose definition on its own will capture a smaller percentage of true opioid overdoses in the data (75.6%), but a higher percentage of incidents identified by the definition will be true opioid overdoses (90.3%). All values for sensitivity, specificity, positive predictive value, and negative predictive are presented in Table 1.

[2] Evaluation was conducted in February 2022

Table 1: KCEMS opioid overdose query sensitivity, specificity, positive predictive value, and negative predictive value using data from October 2021				
	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Possible & probable	83.8%	99.6%	80.2%	99.7%
Probable only	75.6%	99.8%	90.3%	99.5%

EMS Overdose Dashboard

The EMS Overdose Dashboard displays trends in opioid overdoses treated by EMS. On the dashboard an opioid overdose is defined as an incident that meets the possible or probable overdose criteria. The dashboard is updated weekly. The dashboard presents information at a range of temporal and geographic units, which facilitates monitoring of spatial-temporal trends and detection of above-average overdose incidence.