

Title: Evaluating the Michigan Opioid Overdose EMS Response Case Definition Using Data Linkage

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Introduction: The Michigan Emergency Medical Services (EMS) Information System (MiEMSIS) is a timely and comprehensive surveillance system. The Michigan Overdose Data to Action program developed an EMS opioid overdose case definition that considers narrative and clinical data fields for overdose surveillance purposes.

Objective: To evaluate this definition, MiEMSIS data were linked to drug-related emergency department (ED) data. The purpose was to assess the accuracy of the case definition to better understand the utility of EMS data for overdose surveillance.

Methods: A geographically representative sample of 13 hospitals was chosen for linkage based on hospital size and record completeness. Records of patients transported by EMS (n=105,661) to or treated in the ED (n=14,878) of sample hospitals in 2020 were passed through the linkage procedure, performed utilizing the R RecordLinkage package.

After the linkage, to assess potential “false positives” (EMS records designated as probable opioid overdose responses that were not found with drug overdose or opioid overdose diagnosis codes in ED records), the Opioids & Emerging Drugs (OED) unit conducted a manual review of a random sample of 100 “false positive” cases. Two reviewers considered EMS patient care narratives, primary impressions, vital signs, medications, and response to medication; designated each case as true positive, false positive, or needing subject matter expert judgement; and compared results.

Sensitivity and positive predictive value (PPV) were calculated for the EMS case definition compared to opioid overdose International Classification of Disease, 10th Revision, Clinical Modification codes assigned in the ED (T40.0-T40.4/T40.6). The case definition was also compared to a broader group of drug overdose ED codes due to drug type often being unspecified in the ED data. Results additionally were compared to the sensitivity/PPV of utilizing EMS naloxone administration as an opioid overdose indicator.

Results: Of 123,857 EMS responses from sample hospitals in 2020, 4,685 were linked to an identifiable ED data source. Among these EMS responses, 2,168 were categorized as probable opioid overdoses by the case definition, and 1,328 were linked to ED records. That left 840 EMS responses to probable opioid overdoses that were not found in the ED data source – “false positives” (Table 1).

Compared to an opioid overdose ED diagnosis, the sensitivity of the opioid overdose EMS case definition was 78.8% (95% CI: 75.9%-81.7%) and the PPV was 35.6% (95% CI: 33.3%-37.9%). Using an opioid/unspecified overdose ED diagnosis, the sensitivity was 56.9% (95% CI: 54.5%-59.3%) and PPV was 55.8% (95% CI: 53.4%-58.2%). Comparing naloxone administration to an opioid overdose ED diagnosis yielded a sensitivity 17.7 percentage points lower (95% CI: 13.1%-22.3%) and a PPV 5.6 percentage points lower (95% CI: 2.3%-8.8%) than that of the case definition.

In manually reviewing 100 “false positive” EMS records, raters agreed that 72/100 “false positive” cases were true probable opioid overdose EMS responses; 10/100 were actual false positives; and 18/100 called for subject matter expertise to discern. OED worked with MDHHS Bureau of EMS, Trauma, & Preparedness (BETP) to

categorize these difficult cases; as a result, 9/18 difficult cases were considered true positives, and 9/18 were considered false positives. This resulted in 81 of the 100 reviewed designated as true positives.

If we assume the manual review sample was reflective of all EMS records deemed “false positives” by the linkage, the PPV would be approximately 80.1% (95% CI: 78.1%-82.0%) based on opioid overdose diagnosis, and 57.6% (95% CI: 55.2%-60.6%) based on opioid/unspecified overdose diagnosis.

Conclusion: Sensitivity of the EMS opioid overdose case definition was acceptable, while PPV was considered low when compared to drug overdose ED diagnoses. Manual review, however, revealed that most (81% of random sample) un-linked opioid overdose EMS responses were true positives, suggesting a much higher PPV. The ED data source’s lack of drug specificity, individual behavior not captured in the medical record, and differences in ICD-10-CM coding may play a role in EMS opioid overdose records not matching with ED overdose diagnoses. The case definition additionally performed significantly better than using naloxone administration as a proxy for opioid overdose.

The record linkage process has encouraged collaboration between BETP and OED in case definition improvement. This joint discernment process uncovered areas for case definition improvement (i.e., how to exclude cases of cardiac arrest and hypoglycemic emergencies without evidence of drug overdose) and increased understanding of EMS data (i.e., how to make sure medication and response fields are linked when multiple medications are given). BETP and OED continue to partner in exploring ways to improve the Michigan definition for probable opioid overdose EMS response, and MiEMESIS continues to be an important tool for overdose surveillance in Michigan. Next steps to improve the case definition include testing possible changes on sensitivity and PPV in linked dataset.

These findings have important implications for other jurisdictions seeking to use EMS data for opioid overdose surveillance.

Table 1. Data Linkage Results: 2020 EMS Responses that Were Transported to Select Emergency Departments in Michigan (n=13)

	EMS Response to Probable Opioid Overdose	Any Other EMS Response	Total
Linked to ED Records	1,328	3,357	4,685
Not Linked to ED Records	840	118,332	119,172
Total	2,168	121,689	123,857