Assessing Advanced Airway Management Performance in a National Cohort of Emergency Medical Services Agencies

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Study objective: Although often the focus of quality improvement efforts, emergency medical services (EMS) advanced airway management performance has few national comparisons, nor are there many assessments with benchmarks accounting for differences in agency volume or patient mix. We seek to assess variations in advanced airway management and conventional intubation performance in a national cohort of EMS agencies.

Methods: We used EMS data from ESO Solutions, a national EMS electronic health record system. We identified EMS emergency responses with attempted advanced airway management (conventional intubation, rapid sequence intubation, sedation-assisted intubation, supraglottic airway insertion, and cricothyroidotomy). We also separately examined cases with initial conventional intubation. We determined EMS agency risk-standardized advanced airway management and initial conventional intubation success rates by using mixed-effects regression models, fitting agency as a random intercept, adjusting for patient age, sex, race, cardiac arrest, or trauma status, and use of rapid sequence or sedation-assisted intubation, and accounting for reliability variations from EMS agency airway volume. We assessed changes in agency advanced airway management and initial conventional intubation performance rank after risk and reliability adjustment. We also identified high and low performers (reliability-adjusted and risk-standardized success confidence intervals falling outside the mean).

Results: During 2011 to 2015, 550 EMS agencies performed 57,209 advanced airway management procedures. Among 401 EMS agencies with greater than or equal to 10 advanced airway management procedures, there were a total of 56,636 procedures. Median reliability-adjusted and risk-standardized EMS agency advanced airway management success was 92.9% (interquartile range 90.1% to 94.8%; minimum 58.2%; maximum 99.0%). There were 56 advanced airway management low-performing and 38 high-performing EMS agencies. Among 342 agencies with greater than or equal to 10 initial conventional intubations, there were a total of 37,360 initial conventional intubations. Median reliability-adjusted and risk-standardized EMS agency initial conventional intubation success was 77.3% (interquartile range 70.9% to 83.6%; minimum 47.1%; maximum 95.8%). There were 64 initial conventional intubation low-performing and 45 high-performing EMS agencies.

Conclusion: In this national series, EMS advanced airway management and initial conventional intubation performance varied widely. Reliability adjustment and risk standardization may influence EMS airway management performance assessments. [Ann Emerg Med. 2017;■:1-11.]

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INTRODUCTION

Background

Airway management is one of the most important lifesaving interventions performed by emergency medical services (EMS) personnel.[1] In the United States and other countries with developed EMS systems, the customary approach to advanced airway management entails a range of techniques, including conventional (unassisted) intubation, rapid sequence intubation, sedation-assisted intubation, supraglottic airway insertion, and cricothyroidotomy.

Numerous studies highlight the pitfalls of EMS advanced airway management. For example, intubation complications include intubation failure, endotracheal tube misplacement and dislodgement, and repeated intubation attempts.[1-6] Other studies underscore the unintended effects of intubation, such as iatrogenic oxygen desaturation and bradycardia, and unintended interruptions in cardiopulmonary resuscitation chest compressions.[2,7] Given these factors, EMS agency directors often pay considerable attention to the performance quality of EMS

Editor's Capsule Summary

What is already known on this topic

Advanced airway management is a critical focus of emergency medical services (EMS) performance improvement.

What question this study addressed

This 5-year, retrospective, national cohort study assessed agency-level variation in airway performance among 550 EMS agencies and 57,209 advanced airway management cases.

What this study adds to our knowledge

Unadjusted success rates for advanced airway management and initial conventional intubation were 89.1% and 77.1%, respectively. Reliability adjustment and risk standardization identified high- and low-performing EMS agencies.

How this is relevant to clinical practice

Variations in practice may inform performance improvement efforts.

Research we would like to see

Specific characteristics of high- and low-performing agencies and data at the provider level are necessary to optimize airway management.

advanced airway management, monitoring provider and agency experience, success rates, and complications. Fundamental metrics used in the assessment of advanced airway management performance include airway management and intubation success.[8,9]

Importance

The comparison of medical care performance between peer providers or institutions is a fundamental strategy in quality improvement efforts.[10-12] Previous and current consensus efforts have proposed performance metrics for evaluating the quality of EMS care, including measures related to airway management.[13-15] The comparison of advanced airway management performance between EMS agencies or providers could identify opportunities for quality improvement and provide the foundation for defining airway management performance benchmarks. However, there have been few efforts comparing advanced airway management performance between peer EMS agencies or providers. Furthermore, performance assessments must consider important analytic factors that may influence comparisons, such as sample size and patient mix.[16-19]

Goals of This Investigation

In this study, we sought to assess variations in advanced airway management performance in a national cohort of EMS agencies.

MATERIALS AND METHODS

Study Design

We conducted a retrospective analysis of advanced airway management cases performed by EMS agencies using the ESO Solutions (Austin, TX) electronic health record system. The institutional review boards of the University of Alabama at Birmingham and the University of Texas Health Science Center at Houston approved the study.

Methods of Measurement

ESO is one of the nation's largest EMS electronic health record providers.[20] Designed for use on mobile or desktop computer systems, the software facilitates collection and integration of comprehensive patient clinical information, including event dispatch data, patient demographics, and clinical presentation and course, interventions, and episode outcomes. The system transmits data through encrypted Internet connections to a central data repository. All database elements are structured in compliance with the National Emergency Medical Services Information System (NEMSIS) standard 3.0.[21]

EMS personnel provide all entries for the electronic health record system. Although individual EMS agencies may choose to omit the completion of select variables, the individual data variables and values are standardized across all EMS agencies. The software uses definitions provided by NEMSIS 3.0 standard. To mitigate missing or invalid entries, the software contains data validation (forcing) options to require or constrain user entries for select data elements. Although EMS agencies may customize this feature, data validation entries for procedures (eg, procedure type, success, complications) are required systemwide.

More than 2,000 EMS agencies use the ESO electronic health record software system. This analysis was limited to the 550 EMS agencies allowing use of clinical data for research purposes. We extracted data for this analysis from the central electronic health record data warehouse.

Selection of Participants

We selected all patients receiving successful or failed advanced airway management attempts during January 1, 2011, to December 31, 2015. Advanced airway management included conventional (unassisted) intubation (orotracheal, nasotracheal, and retrograde intubation, and