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Clinical paper

Advanced airway management success rates in a national cohort of emergency medical services agencies☆

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Abstract

Objective: Despite its important role in care of the critically ill, there have been few large-scale descriptions of the epidemiology of Emergency Medical Services (EMS) advanced airway management (AAM) and the variations in care with different patient subsets. We sought to characterize AAM performance in a national cohort of EMS agencies.

Methods: We used data from ESO Solutions, Inc., a national EMS electronic health record system. We analyzed EMS emergency patient encounters during 2011–2015 with attempted AAM. We categorized AAM techniques as conventional endotracheal intubation (cETI), neuromuscular blockade assisted intubation (NMBA-ETI), supraglottic airway (SGA), and cricothyroidotomy (needle and open). Determination of successful AAM was based on EMS provider report. We analyzed the data using descriptive statistics, determining the incidence and clinical characteristics of AAM cases. We determined success rates for each AAM technique, stratifying by the subsets cardiac arrest, medical non-arrest, trauma, and pediatrics (age ≤12 years).

Results: AAM occurred in 57,209 patients. Overall AAM success was 89.1% (95% CI: 88.8–89.3%) across all patients and techniques. Intubation success rates varied by technique; cETI (n = 38,004; 76.9%, 95% CI: 76.5–77.3%), NMBA-ETI (n = 6768; 89.7%, 88.9–90.4%). SGAs were used both for initial (n = 9461, 90.1% success, 95% CI: 89.5–90.7%) and rescue (n = 5994, 87.3% success, 95% CI: 86.4–88.1%) AAM. Cricothyroidotomy success rates were low: initial cricothyroidotomy (n = 202, 17.3% success, 95% CI: 12.4–23.3%), rescue cricothyroidotomy (n = 85, 52.9% success, 95% CI: 41.8–88%). AAM success rates varied by patient subset: cardiac arrest (n = 35,782; 91.7%, 95% CI: 91.4–92.0), medical non-arrest (n = 17,086; 84.7%, 84.2–85.2%); trauma (n = 4341; 84.3%, 83.1–85.3%); pediatric (n = 1223; 73.7%, 71.2–76.2%).

Conclusion: AAM success rates varied by airway technique and patient subset. In this national cohort, these results offer perspectives of EMS AAM practices.

Keywords: Intubation (intratracheal), Airway management, Emergency medical services, Paramedics, Pediatrics, Cardiac arrest, Trauma, Rapid sequence intubation

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Introduction

Advanced airway management (AAM) is a cornerstone of resuscitation care provided by Emergency Medical Services (EMS) personnel.[1] Common techniques for EMS AAM include endotracheal intubation, sedation assisted intubation, neuromuscular blockade assisted intubation, supraglottic airway, and cricothyroidotomy.

Airway placement success is a commonly used measure of EMS airway management quality. Meta-analyses of published studies have reported success rates with EMS endotracheal intubation and supraglottic airway insertion.[2,3] However, intubation success rates likely vary with the technique used as well as the patient population. For example, intubation success rates are higher using neuromuscular blockade assisted intubation than conventional techniques.[4] Intubation success rates are also higher for cardiac arrest patients but lower for medical non-arrest and trauma patients.[4] United States national guidelines suggest structured reporting of airway management performance stratified by airway management technique and patient population.[5] However, there have been few large-scale descriptive studies systematically characterizing airway insertion success rates in these populations. Furthermore, the broadening use of supraglottic airways in both primary and rescue capacities has influenced airway management and the resulting success rates.

In this study we sought to provide contemporary estimates of reported AAM success rates in a large United States national EMS cohort.

Methods

Study design

We performed a retrospective analysis of EMS electronic health record (EHR) data from ESO Solutions, Inc. (Austin, Texas). The study was approved by the Institutional Review Boards of the University of Alabama at Birmingham and the University of Texas Health Science Center at Houston.

Data source

ESO Solutions, Inc is a provider of EMS electronic health records in the United States. The system allows for real-time collection and storage of clinical care data. Data elements collected on ESO include patient demographics, clinical presentation, interventions, and patient outcomes. All the data elements in the electronic health record system are organized in compliance with the National Emergency Medical Services Information System (NEMSIS) standard.[6] While EMS agencies can customize the selection of data elements, the data variable and values are standardized across all participating EMS agencies.

From over 2000 EMS agencies using ESO, this analysis was limited to the 552 EMS agencies that allowed the use of anonymous clinical data for research purposes. Data was extracted from the central ESO electronic health record data warehouse. These data have been used in prior studies.[7,8]

Selection of subjects

We included all emergency patients receiving attempted AAM between 2011 and 2015.[3] Advanced airway management included conventional endotracheal intubation (cETI - orotracheal, nasotracheal, video laryngoscopy, retrograde), neuromuscular blockade assisted intubation (NMBA-ETI), supraglottic airway (SGA - King LT, Combitube, laryngeal mask airway (LMA), and supraglottic airway laryngopharyngeal tube (SALT)), and cricothyroidotomy (needle and open). Patients receiving bag-valve-mask ventilation only were excluded from the study.

We defined NMBA-ETI cases as attempted intubation and concurrent neuromuscular blocking agent (e.g., succinylcholine, rocuronium) administration. Due to potential inconsistences, we opted not to use medication administration times to differentiate sedatives given prior to or after intubation attempts.

Outcomes

The primary outcome was overall AAM insertion success, defined on a per-patient basis. Airway insertion success was reported by EMS personnel; we did not use information on airway placement confirmation. If there were multiple attempts with a given technique, we used the outcome of the last insertion attempt. For cETI and NMBA-ETI we defined intubation success as instances where the last intubation attempt was successful. Conversely, we defined unsuccessful cETI or NMBA-ETI as instances where the last intubation attempt was unsuccessful. For cETI and NMBA-ETI we also defined overall airway management success encompassing the outcomes of both initial intubation as well as any rescue supraglottic airway or cricothyroidotomy attempts.

We could not identify cases of extubation followed by reintubation. We also did not include bag-valve mask ventilation in the definition of overall AAM success.

Data analysis

We analyzed the data using descriptive statistics, calculating success rates using binomial proportions with exact 95% confidence intervals. We determined the characteristics of patients undergoing AAM. We also determined the frequency of use of each AAM technique. We determined AAM success rates for each technique. For cETI and NMBA-ETI we determined the overall success rates for each initial intubation method as well as intubation followed by rescue SGA or cricothyroidotomy. For SGA and cricothyroidotomy, we differentiated initial from rescue use.

We also stratified the analysis by the following patient types: cardiac arrest, medical non-arrest, trauma non-arrest and pediatrics. EMS personnel indicated cardiac arrests through a dedicated “cardiac arrest” variable. We did not use electrocardiogram rhythm or delivery of chest compressions to define cardiac arrest. Similarly, EMS personnel identified trauma cases through a separate “trauma” variable. We did not identify the presence of trauma through injury patterns. Medical non-arrests consisted of patient records that were not flagged as cardiac arrest or trauma. We defined pediatric patients as those $\leq$12 years old.

We cross-tabulated airway technique by patient type to identify AAM success for each airway and patient combination. We performed all analyses using Stata v.15 (Stata, Inc. College Station, Texas).

Results

During the study period, there were 6,918,217 emergency “911” EMS responses among 552 EMS agencies representing 39 states. There were 57,209 AAM patients, reflecting an incidence of 8.27 AAM per 1000 EMS 911 events (95% CI 8.20−8.34). Patients receiving AAM had a mean age of 60.7 ± 20.3 years and were more often male (60.2%) and white (69.5%) (Table 1). The most common primary impressions associated with AAM were cardiac arrest, respiratory emergencies, trauma/electrical injuries, and altered mental status.

Among the 57,209 patients undergoing AAM, 38,985 (68.1%) received conventional endotracheal intubation attempts; the majority of these efforts entailed orotracheal intubation (Table 2). There were 6893 (12.1%) NMBA-ETI and 2958 (5.2%) SAI. SGA attempts occurred in 15,455 (27.0%) patients. The Laryngeal Tube comprised 80% of SGA cases. Cricothyroidotomy was attempted in 287 (0.5%) cases. For NMBA-ETI, the most common sedatives were etomidate and midazolam, and the most common neuromuscular blocking agent was succinylcholine (Table 3). The proportion of primary SGA increased over the 5 year study period (test of trend $p < 0.001$) (Fig. 1). Intubation and SGA insertion success rates did not change during the study period (Fig. 2).

The 57,209 AAM cases included cardiac arrests (62.6%), medical non-arrests (29.9%), and trauma non-arrests (7.6%) (Table 4). Children ≤12 years comprised 2.1% of AAM cases. Overall AAM success was 89.1% (95% CI: 88.8−89.3%) across all patients and methods. Intubation success rates varied with technique: cETI 76.9%, NMBA-ETI 89.7%. For the cETI subset, success rates were 86.1% for video laryngoscopy and 58.5% for nasotracheal intubation. For intubation cases, airway management success was higher with the additional use of rescue SGA or cricothyroidotomy: cETI 87.8%, NMBA-ETI 95.9%. AAM success rates varied by patient subset: cardiac arrest 91.7%, medical non-arrest 84.7%, trauma non-arrest 84.3%, and pediatric 73.7%.

SGA cases included 9461 (61.2%) as the initial airway and 5994 (38.8%) cases as a rescue airway. SGAs were used in 32.3% of cardiac arrests, 18.4% of medical non-arrests, and 17.6% of trauma non-arrests. Success rates for initial and rescue SGA insertion were 90.1% and 87.3%, respectively.

Among the 287 cricothyroidotomies, initial (17.3%) and rescue (52.9%) success rates were low. Open cricothyroidotomy was successful in 80 of 224 (35.7%) cases. Needle cricothyroidotomy was successful in 1 of 64 cases (1.6%).

Discussion

Airway insertion success is a common measure of advanced airway management quality.[4] Our study provides estimates of AAM insertion success rates in a national cohort of EMS agencies. Consensus statements have recommended variables that should be reported in AAM.[5,9] Our study provides one of the first presentations of data based upon these guidelines. We also depicted AAM success rates stratified by important subsets including AAM technique and patient condition. Furthermore, we highlighted the role of SGA insertion in AAM success. Our observations provide key perspectives of EMS AAM practices in a broad sample of EMS agencies.

Our results contrasts with prior descriptions of AAM performance. Hubble et al. conducted a meta-analyses of intubation success rates, reporting success rates for cETI (87.5%) and NMBA-ETI (94.8%) across 117 studies.[2] In contrast, in our study of 57,209 AAM patients across 552 EMS agencies, we observed insertion success rates of cETI (76.9%) and NMBA-ETI (89.7%). Furthermore, Hubble et al. also

Table 1 – Characteristics of patients undergoing advanced airway management. Includes 57,209 AAM patients cared for by 552 EMS agencies during 2011−2015.

Characteristic	N	(%)
Age		
≤5 years	959	(1.7)
6−10	183	(0.3)
11−17	606	(1.1)
18−30	3666	(6.4)
31−50	9192	(16.1)
51−70	21,518	(37.6)
>70	19,529	(34.1)
Unknown	1556	(2.7)
Sex		
Female	22,398	(39.1)
Male	34,433	(60.2)
Unknown	378	(0.7)
Race		
White	39,778	(69.5)
Black	8221	(14.4)
Asian or Pacific Islander	519	(0.9)
American Indian or Alaskan	113	(0.2)
Unknown	8578	(15.0)
Ethnicity		
Not Hispanic	42,214	(73.8)
Hispanic	2889	(5.0)
Unknown	12,106	(21.2)
Primary impression		
Acute life threatening event and sudden infant death syndrome	155	(0.3)
Altered mental status	4446	(7.8)
Abdominal	102	(0.2)
Anaphylaxis	69	(0.1)
Cardiac arrest	36,484	(63.8)
Cardiac — other emergencies	953	(1.7)
Dead on arrival	140	(0.2)
Environmental	36	(0.06)
Infection	26	(0.05)
Metabolic	241	(0.4)
Neurological — cerebrovascular accidents	698	(1.2)
Neurological — seizures	460	(0.8)
Neurological — other	80	(0.1)
Obstetric and gynecological	5	(0.01)
Psychiatric	49	(0.09)
Respiratory	6134	(10.7)
Shock/bleeding	166	(0.3)
Toxicological	1214	(2.1)
Trauma/electrical injury	4737	(8.3)
None	88	(0.2)
Other	1004	(1.6)
Cardiac arrest		
Yes — before EMS arrival	30,922	(54.1)
Yes — after EMS arrival	4860	(8.5)
No	21,427	(37.5)
Medical vs. trauma		
Medical	39,252	(68.6)
Trauma	4502	(7.9)
Medical and trauma	2297	(4.0)
Unknown	11,158	(19.5)

Table 2 – Advanced airway management techniques. Number of patients receiving attempts for each airway device type. Total of n = 57,209 patients. Because one patient may undergo multiple techniques, the total number of techniques may exceed total number of patients. For NMBA-ETI the total number of techniques do not sum up to 100% because the route of intubation was not consistently reported.

Procedure	N	(%)
Conventional endotracheal intubation (ETI)	38,985	(68.1)
Orotracheal intubation (OTI)	37,426	(96.0)[a]
Nasotracheal intubation (NTI)	998	(2.6)[a]
Video laryngoscopy (VL)	504	(1.3)[a]
Retrograde intubation	15	(0.04)[a]
Neuromuscular blockade assisted intubation (NMBA-ETI)	6893	(12.1)
Orotracheal intubation (OTI)	3,440	(49.9)[b]
Nasotracheal intubation (NTI)	30	(0.4)[b]
Video laryngoscopy (VL)	215	(3.2)[b]
Retrograde intubation	2	(0.03)[b]
Supraglottic airway (SGA)	15,455	(27.0)
Laryngeal tube (LT)	12,405	(80.3)[c]
Combitube	1737	(11.2)[c]
Laryngeal mask airway (LMA)	911	(5.9)[c]
i-Gel	374	(2.4)[c]
Supraglottic airway laryngopharyngeal tube (SALT)	58	(0.4)[c]
Cricothyroidotomy	287	(0.5)
Needle cricothyroidotomy	64	(22.3)[d]
Other cricothyroidotomy	224	(78.1)[d]

[a] Percentage of conventional ETI.
[b] Percentage of NMBA-ETI.
[c] Percentage of SGA.
[d] Percentage of cricothyroidotomies.

Table 3 – Medications associated with neuromuscular blockade assisted intubations (N = 6893).

Medication	n (%)
Sedatives	
Etomidate only	1617 (23.5)
Ketamine only	335 (4.9)
Midazolam only	1283 (18.6)
Diazepam only	69 (1.0)
Etomidate + ketamine	16 (0.2)
Etomidate + midazolam	2551 (37.0)
Etomidate + diazepam	178 (2.6)
Ketamine + midazolam	317 (4.6)
Ketamine + diazepam	10 (0.2)
Midazolam + diazepam	36 (0.5)
None	481 (7.0)
Neuromuscular blocking agents	
Succinylcholine only	3648 (52.9)
Rocuronium only	779 (11.3)
Vecuronium only	449 (6.5)
Pancuronium only	1 (0.1)
Succinylcholine + rocuronium	780 (11.3)
Succinylcholine + vecuronium	1224 (17.8)
Succinylcholine + pancuronium	5 (0.07)
Rocuronium + vecuronium	6 (0.09)
Succinylcholine + rocuronium + vecuronium	1 (0.01)

conducted a meta-analysis of SGA insertion success, finding success rates range of 85.4%, 87.4% and 96.5% for the esophageal-tracheal Combitube, laryngeal mask airway and Laryngeal Tube airway, respectively.[3] In the current study we observed SGA success rates of 90% for initial insertion and 87% for rescue insertion. Hubble's meta-analysis incorporated results from multiple smaller studies, each of which were limited in scope and specific geographic regions. The meta-analysis relied on published studies that are over 10 years old and are vulnerable to secular trends and publication bias. Hubble et al. also did not stratify by important patient subgroups. In contrast, our effort is based upon more recent clinical data from a wide range of EMS agencies from across the United States and provide AAM estimates for the cardiac arrest, trauma, medical non-arrest and pediatric subsets.

Our study has many findings relevant to EMS practice. As expected, we observed heterogeneity in AAM success that varied with AAM technique and patient subset. While the observed NMBA-ETI (89.7%) success rate is consistent with prior reports, the cETI success rate of 76.9% is lower than previously reported.[2] When limited to cardiac arrests, the cETI success rate was only 79.4%, lower than the 87.5% reported by Hubble et al.[2] In the recent Airways-2 trial, the intubation success within 2 attempts was 69.4%.[10] The recent Pragmatic Airway Resuscitation Trial (PART) reported an intubation

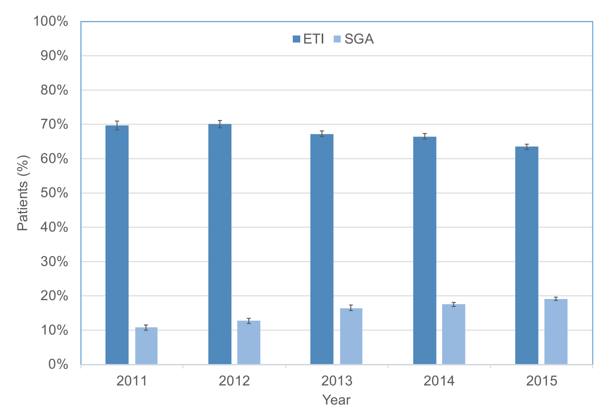

Fig. 1 – Percentage of ETI and SGA for each year of the study period. The percentage of SGA increased over time (test of trend p < 0.001).

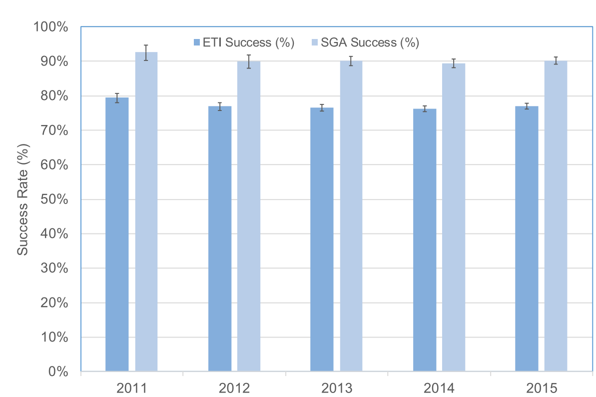

Fig. 2 – Success rates for ETI and SGA during the study period.

Table 4 – Advanced airway management success stratified by airway management technique and patient type. Percentages reflect proportion of patients — not individual airway insertion attempts.

Airway management technique	Cardiac arrest		Medical (non-arrest)		Trauma (non-arrest)		Pediatric (age ≤12 years)		All patients	
	Successes/ patients	% (95% CI)	Successes/ patients	% (95% CI)	Successes/ patients	% (95% CI)	Successes/ patients	% (95% CI)	Successes/ patients	% (95% CI)
Conventional endotracheal intubation (cETI)										
cETI attempts only[b]	21,372/26,932	79.4 (78.9–79.8)	6695/9348	71.6 (70.7–72.5)	1164/1724	67.5 (65.2–69.7)	728/1034	70.4 (67.5–73.2)	29,231/38,004	76.9 (76.5–77.3)
cETI or rescue[a,b]	24,597/26,932	91.3 (91.0–91.7)	7449/9348	79.7 (78.9–80.5)	1312/1724	76.1 (74.0–78.1)	741/1301	71.7 (68.8–74.4)	33,358/38,004	87.8 (87.4–88.1)
Neuromuscular blockade assisted intubation (NMBA-ETI)										
NMBA-ETI attempts only[b]	683/788	86.7 (84.2–89.0)	3847/4218	91.2 (90.3–92.0)	1538/1762	87.3 (85,6–88.8)	81/92	88.0 (79.6–93.9)	6068/6768	89.7 (88.9–90.4)
NMBA-ETI or rescue[a,b]	754/788	95.7 (94.0–97.0)	4067/4218	96.4 (95.8–97.0)	1667/1762	94.6 (91.1–97.1)	85/92	92.3 (84.9–96.9)	6488/6768	95.9 (95.4–96.3)
Supraglottic airway (SGA)										
Initial SGA	6716/7362	91.2 (90.6–91.9)	1513/1743	86.8 (85.1–88.4)	297/356	83.4 (79.1–87.1)	53/56	94.6 (85.1–98.9)	8526/9461	90.1 (89.5–90.7)
Rescue SGA	3709/4183	88.7 (87.7–89.6)	1185/1405	84.3 (82.3–86.2)	338/406	83.3 (79.3–86.8)	22/24	91.7 (73.0–99.0)	5232/5994	87.3 (86.4–88.1)
Cricothyroidotomy										
Initial cricothyroidotomy	11/40	27.5 (14.6–43.9)	10/128	7.8 (3.8–13.9)	14/34	41.2 (24.6–59.3)	0/8	0.0 (0.0–36.9)	35/202	17.3 (12.4–23.3)
Rescue cricothyroidotomy	24/46	52.2 (36.9–67.1)	6/13	46.2 (19.2–74.9)	15/26	57.7 (36.9–76.6)	0/2	0.0 (0.0–84.2)	45/85	52.9 (41.8–63.9)
All patients	32,817/35,782	91.7 (91.4–92.0)	14,472/17,086	84.7 (84.2–85.2)	3658/4341	84.3 (83.1–85.3)	909/1223	73.7 (71.2-76.2)	50,947/57,209	89.1 (88.8–89.3)

Conventional endotracheal intubation (cETI) includes orotracheal, nasotracheal and retrograde intubation, and video laryngoscopy, without use of sedative or paralytic medications.
Neuromuscular blockade assisted intubation (NMBA-ETI) includes intubation with use of neuromuscular blockade.
Supraglottic airway (SGA) includes King LT, Combitube, Laryngeal Mask Airway, i-GEL and Supraglottic Airway Laryngopharyngeal Tube. Cricothyroidotomy includes needle and open techniques.
[a] Includes rescue by SGA or cricothyroidotomy.
[b] Patients counted in both the initial intubation attempts and the combined [intubation + rescue].

success rate of approximately 53%.[11] The intubation success rates observed in Airways-2 and PART support the lower success rate observed in the current series. The reasons for these lower intubation success rates are unknown. ETI is a difficult intervention with multiple steps.[12] ETI skill acquisition remains an ongoing challenge for United States EMS providers, with training programs unable to provide more than minimal exposure to ETI in out-of-hospital, emergency department or operating room settings.[1,13] We previously found that paramedics have few (and often no) opportunities to perform ETI in clinical practice.[14] Thus, novel strategies to improve AAM skill acquisition and maintenance may play an important role in improving AAM success rates.

Our observations regarding SGA insertion also offer information that complement the ETI findings. The primary use of SGA has increased substantially in the out-of-hospital setting.[15] In the current series, 1 of 5 cardiac arrests entailed initial SGA insertion. Initial SGA insertion success was 90%. However, the use of SGA in a rescue capacity also comprised over 10% of the total AAM encounters. When applied in a rescue capacity, SGA were effective; for example, in cardiac arrests, the AAM success rate rose from 79% with cETI alone to over 91% with the incorporation of rescue SGA insertion. These latter findings may reflect evolving clinical approaches to AAM. While not specifically indicated by these results, some EMS medical directors advocate curtailing initial intubation attempts with low thresholds for moving to rescue SGA insertion. This strategy is supported by data indicating the increasing futility of successive ETI attempts.[8] Our study offers one of the first illustrations of this integration of ETI and SGA in AAM. Because of the results of the recent PART and Airway-2 trials, SGA use may broaden in the future.[10,11]

The AAM subsets also merit comment. As expected, NMBA-ETI was associated with higher AAM success than conventional techniques, and these differences were most prominent in the medical non-arrest and trauma subsets. Enhancement of AAM success in these subgroups may require broadening the use of adjunctive paralytic agents. Twenty years ago, Gausche et al. conducted a clinical trial finding no benefit from pediatric intubation.[16] However, pediatric intubation cases comprised only 2.1% of the patients in this series with a success rate of approximately 74%. Other studies similarly indicate the continued use of ETI for AAM in children, with Prekker et al. observing a pediatric intubation success rate of 97% in one series.[17–20] Pediatric SGA sizes are now available in the US. As with adults, the increased use of SGA may play an important role in pediatric AAM. Finally, cricothyroidotomy use and success were low, reinforcing concerns about the role of this technique in EMS practice.[21,22]

Limitations

This retrospective study used a large data set from a single electronic health record system. Only a quarter of client EMS agencies allowed use of their data for research. The number of observations in each year increased as additional clients contributed data to the data set. We did not perform independent confirmation of information appearing in each record. EMS personnel self-reported AAM placement success; we did not confirm placement using other clinical information in the medical record. Data on tube confirmation technique were not available for this analysis. In a separate report, we characterized the relationship between the number of attempts and airway insertion success.[8] We do not have information on the techniques for airway management after both failed intubation and SGA insertion, but we surmise that EMS personnel used bag-valve-mask ventilation.

Due to limitations with the data set, we were unable to ascertain the timing and sequence of medication administration; future study must ascertain these parameters. We observed several instances of NMBA-ETI use on cardiac arrests; while not indicated by these data, in our practical experience, some EMS agencies use these techniques on cardiac arrest.[11] Medication dosage data were not available. Because we could not differentiate sedation administration before or after intubation, we could not infer the number of sedation assisted intubations.

We did not determine the associations and/or relationship between intubation techniques and patient outcome. We also did not determine airway management complications. Prior studies have described airway management complications such as tube misplacement or dislodgement, multiple insertion attempts, hypoxia, and iatrogenic injuries.[4,23–25] Information on the EMS personnel performing each intubation were not available including their credentials, education level, and clinical experience. To simplify the presentation, we used simple stratification techniques rather than multivariable adjustment. We only included data from EMS agencies that consented to the use of their data; AAM techniques and performance may have varied between included and non-included EMS agencies. We do not have information on variations in EMS agency airway management protocols. Finally, we included data from only one prehospital EMR. It is possible agencies using other systems may have different performance. Future study with more granular data elements may be useful to illuminate additional aspects of airway management.

Conclusions

In this national cohort, AAM success rates varied by airway technique and patient subset. These results offer perspectives of EMS AAM practices.

Author contributions

HEW and TN conceived the study. HEW and DB obtained the data. HEW and JPD conducted the analysis. TN drafted the manuscript and all authors contributed to its critical review. HEW assumes overall responsibility for the paper.

Conflict of interest statement

The authors declare no conflicts of interest.

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ESO Solutions, Inc. provided the data for this study. ESO Solutions had no formal role in the analysis of the data or the reporting of the results.

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