

## A Survey of Residency Directors in Academic Trauma Centers for Policies on Airway Management in the Trauma Ward

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### Abstract

**Background:** Despite its presence as a critical procedure in the trauma setting, airway management is not performed uniformly, varying between institutions, particularly with personnel involved in decision-making. Past literature has noted a trend in which emergency medicine physicians assumed greater responsibility for primary management of airways in the trauma ward. Many institutions have adopted tiered activation systems for traumas in order to improve patient care, deploying resources more effectively.

**Methods:** In this study, a survey of residency directors was deployed to assess trends in airway management. A validated survey was distributed to residency directors in anesthesiology, general surgery and emergency medicine in 190 Level I trauma centers in the United States. Questions assessed personnel management, complication tracking and difficult airway prediction factors, amongst other considerations for airway management in the trauma bay.

**Results:** Respondents completed the survey at a rate of 23.8% of those solicited. A majority of respondents indicated that emergency medicine physicians are primary airway managers in the trauma bay and that their institutions utilize tiered trauma activation systems at 77.4% and 95.6% respectively. Anesthesia providers were immediately available in 81% of respondent institutions with inconclusive data regarding protocols for delineating anesthesia involvement in difficult airways. More than a third of respondents indicated their institution either does not track airway complications or they did not know if complications were tracked. Finally, nine different criteria were used in varying degrees by respondents' institutions to predict the presence of a difficult airway, including such factors as head/face trauma, airway fluid and obesity.

**Conclusions:** Emergency medicine physicians are the primary airway managers in many trauma centers, although they are often supported by the presence of anesthesiology for advanced airway interventions. Delineation of anesthesia involvement is unclear, and criteria to determine a difficult airway varies amongst institutions.

**Keywords:** Airway management; Trauma anesthesia; Emergency intubations; Trauma intubations; Emergency department airways

### Background

Emergency airway intubation is a critical resuscitative procedure in the trauma setting. Failure to secure the airway in an acutely unstable patient greatly increases patient morbidity and mortality. Factors such as airway

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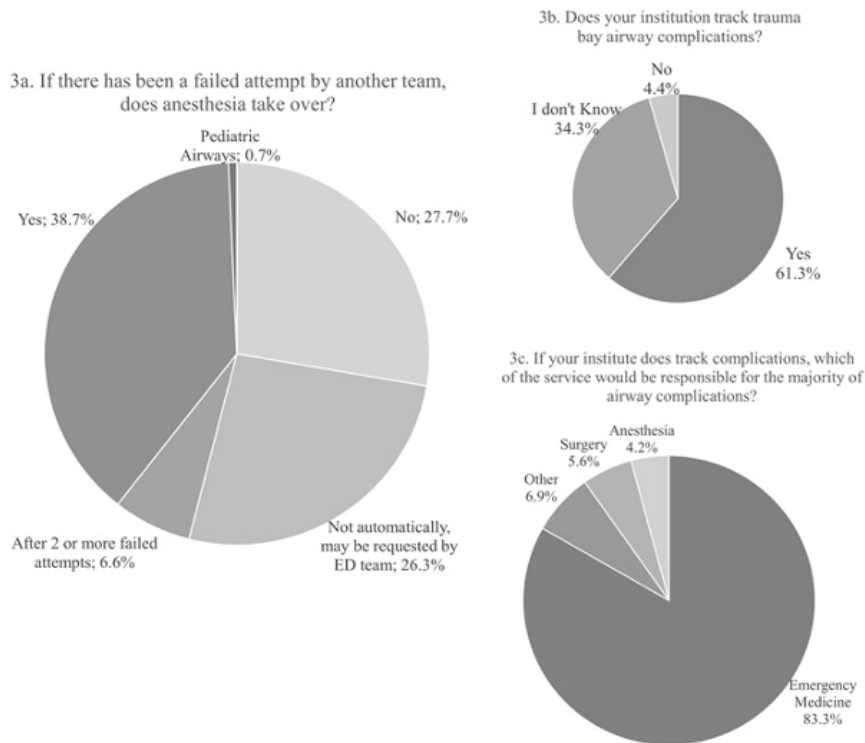


encountered in the trauma bay (Figure 3b). However, 34.3% indicated that their institution does not track such complications, and 4.4% of respondents did not know if trauma bay airway complications were tracked or not.

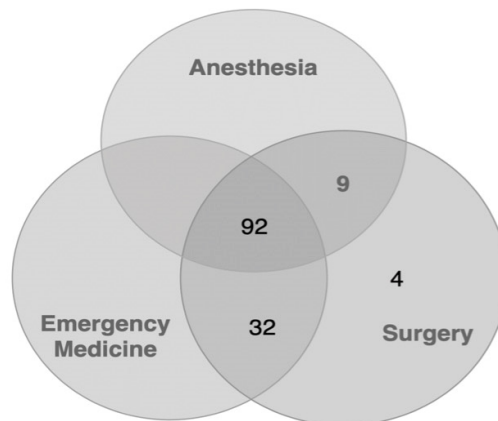
Those surveyed were additionally asked which service specifically would be responsible for the majority of airway complications, to which 72 respondents that found the question applicable (Figure 3c). Of these respondents, 83.3% of respondents indicated that Emergency Medicine is responsible for the majority of airway complications in the

trauma bay. 4.2% felt that anesthesia was responsible for the majority of such complications, and 5.6% indicated the surgical service. The remaining 6.9% indicated that none of these three services would be primarily held responsible for the majority of trauma bay airways complications.

When asked to select from residency programs - anesthesia, emergency medicine, surgery - that their institution has, most (67.2%) have all three (Figure 4). 23.4% have emergency medicine and surgery residencies without an anesthesia residency. A minority have surgery only (2.9%) or



**Figure 3:** Answers to trauma intubation practice patterns survey (continued). 3a- Assessment of anesthesia involvement following failed attempt at securing airway. 3b- Tracking of airway complications. 3c- Service most often responsible for complications in the trauma bay.



**Figure 4:** The presence of residency programs at respondents' trauma institutions. Most respondents (92) had all 3 residency programs. Very few had only a surgical residency, or only anesthesia and surgery without emergency medicine.

anesthesia and surgery without emergency medicine (6.6%). No institution of those surveyed had only anesthesia, only emergency medicine, or emergency medicine and anesthesia residencies without a surgery residency.

Respondents were asked to select, from a list of nine criteria (Mallampati Score; Presence of a C - Collar; Trauma to head/face; Fluid in Airway; Thyromental Distance; Neck Mobility; Obesity; Incisor Distance; Unsuccessful Intubation by paramedics) those factors that are incorporated into their institution’s protocol for defining a difficult airway (Figure 5). 114 of respondents’ institutions (83.2%) have a known, defined criteria for determining a difficult airway in the trauma bay that incorporates at least one of these nine criterium listed. The most often used criterium from these nine was ‘Trauma to head/face’ with 82.5% having this among their criteria, followed by ‘Fluid in the airway’ at 65.7%. ‘Obesity’ and ‘Unsuccessful intubation by paramedics’ each had 64.2% of respondents reporting these as included in their criteria. 58% of respondents’ institutions’ criteria incorporate the presence of a C-collar, followed by 51.1% for limited neck mobility and 39.4% for high Mallampati score. Of the nine criteria given, thyromental distance (32.1%) and incisor distance (26.3%) were least used. A minority of respondents (2.9%) used additional criteria not given (three respondents) or had a defined criteria that included none of the nine given (one respondent). For additional criteria not listed, one respondent each reported that their criteria include ‘King airway’, ‘difficult/unsuccessful intubation by surgery’, or ‘supraglottic airway’.

Figure 5 also indicates that, of survey respondents, 5.8% indicated that they did not know if their institution has a defined criteria for trauma bay difficult airways, while 10.2% indicated that their institution lacks a standard set of criteria, which may reflect in variation in practice according to each physician. The responses were additionally analyzed according to how many criteria from the nine given, that each respondent selected, including any additional criteria provided by respondents in the three cases mentioned above.

The largest portion of respondents selected all nine criteria (15.3%), while 10.2% of respondents selected all but one of the criteria given. 8.0% of respondents selected 7/9 criteria while a similar portion (8.8%) selected 5/9 criteria. 13.1% selected 6/9 criteria and, similarly, 11.7% selected 4 criteria. One respondent that indicated 4 criteria as part of their institution’s protocol selected, including 3 of 9 from the given criteria, adding ‘difficult intubation/unsuccessful by surgery’ as an additional defined criterion. In addition, 2 other respondents, both selecting 2/9 from the given criteria, described supplementary criteria of a ‘King airway’ or the presence of a previously placed ‘supraglottic airway’. Including these two respondents, 10.9% of total respondents selected 3 criteria. A minority indicated only 2 criteria (1.5%), none of the given criteria (0.7%), or selected only one criterion (3.6%).

## Discussion

This investigation sought to characterize current trends in the approach to airway management in Level I trauma centers.

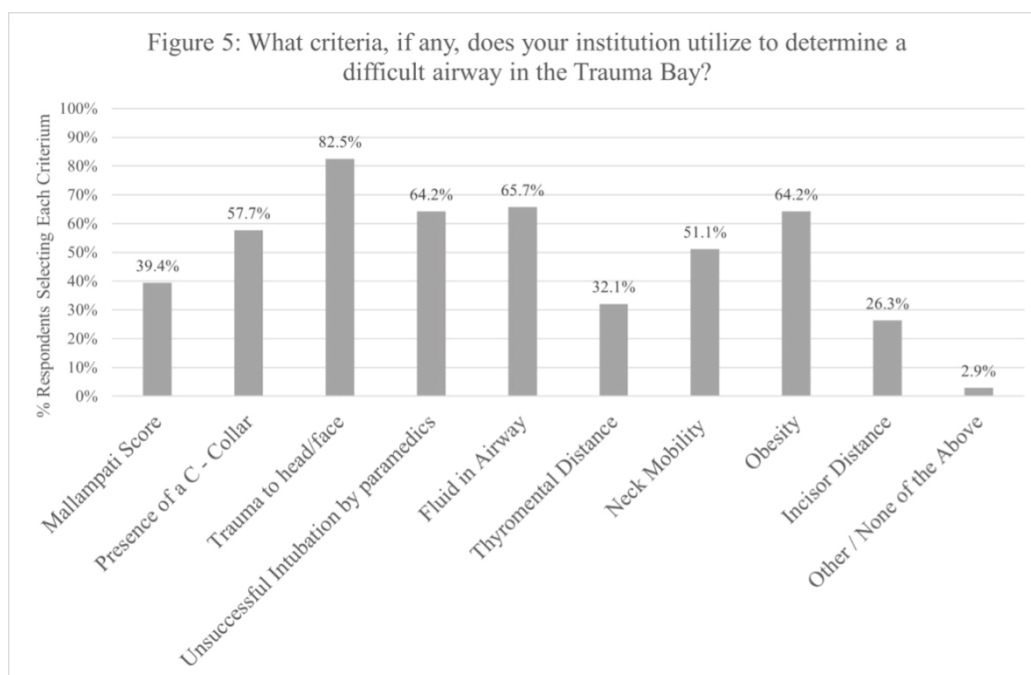


Figure 5: Assessment of criteria utilized by respondents to determine if patient has a difficult airway

Specific elements of interest were the way that responsibilities pertaining to this duty were delegated to particular services and the different ways of defining the difficult airway. Additionally, we sought to contextualize this inquiry within the framework of current established institutional guidelines and protocols. The institutions of those surveyed may be generally described as using a tiered trauma activation system (95.6%, Figure 1b) and maintaining residency programs in Emergency Medicine and Surgery (90.5%), with (67.1%) or without (23.4%) Anesthesia (Figure 4).

When asked which service is the primary team for airway management in the trauma bay at their institution, the majority of respondents (77.4%) selected Emergency Medicine (Figure 1a). This finding is paralleled by the 83.3% of respondents that believe Emergency Medicine would be held responsible for the majority of airway complications (Figure 3c). These figures are reflected in the way that the responsibility for airway management in the emergency and trauma settings has shifted over the last several decades from the anesthesia service to that of emergency medicine [3]. Indeed, a variety of literature has demonstrated that such a shift in responsibilities does not significantly impact intubation complication or failure rates [4,11,12], even when applied specifically to resident physicians, or in systems that utilize an alternating schedule between these two services [13], the latter of which was indicated in this study by 1.5% of respondents (Figure 1a). Nonetheless, despite a variety of literature evidencing this transition, this survey demonstrates that there continues to be a lack of a uniform approach in delegating the main responsibility for trauma bay airway management to a specific service.

A lack of uniformity was also revealed in this survey with respect to institutions' approaches to establishing airway management protocols; 30.7% of respondents' institutions have no protocol to delineate responsibilities for trauma bay intubations to various providers (Figure 2a) while 33.6% did not have a protocol to specify when anesthesia should become involved for an intubation/airway management (Figure 2c). In 2009, Casey et al. demonstrated the safety and efficacy of implementing a trauma airway protocol, which allowed a maximum of two failed attempts by emergency medicine to establish an airway before anesthesia was automatically called to assist within 5-10 minutes [14]. Further investigations have also demonstrated the high levels of success that an algorithmic or protocol-driven approach to emergency airway management can impart [2,15]. Conversely, disadvantages to such an approach that have been considered include the possible detriment to the individualization of patient care and departure from the 'practice' of medicine. Perhaps in an effort to synthesize these approaches, 32.8% of respondents indicated that their institutions established protocols to specify the obligation for anesthesia involvement as according to the judgement of emergency medicine or trauma surgeon

physicians (Figure 2c). In this way, an established guideline clarifies what necessarily elicits anesthesia to become involved, while also leaving the option for clinical judgment and situationally driven care individualized to the patient.

While the paradigm of Emergency Medicine assuming airway management in the trauma bay from Anesthesia has been well established and studied, the role of the surgery service in this setting has been less standardized and reviewed. It is less clear in the literature the effect of placing the primary responsibility for airway management, or liability for related complications, with trauma surgeons, although their role as primary airway manager was only reported by 1.5% of respondents (Figure 1a) and only 5.6% (Figure 3c) of respondents indicated that surgical services were responsible for the majority of complications in airway management.

Moreover, it was clear that the surgery service consistently contributes to airway management, beyond surgical airways. Despite not being the principal managers of the airway, they play a role in determining when to request anesthesia's involvement for 32.8% of respondents (Figure 2c). In addition, the surgical services participate in a collaborative approach for primary airway management with all services for 13.9% of respondents (Figure 1a).

While airway management outcomes have been analyzed with respect to variables such as the primary service responsible (discussed above), the effect of other elements, such as implementation of criteria to standardized assessment of the difficult airway, are less clear. Out of nine criteria provided, each of them were instituted in 26.3% - 82.5% of surveyed institutions' protocols (Figure 5a).

However, the value of these criteria is indeterminate. In an investigation evaluating Cormack-Lehane grade, modified LEMON score, and Glasgow Coma Scale score versus intubation difficulty, only a thyroid-to-hyoid distance of <2 fingers was found as an independent variable to predict difficult intubation [16]. Notably, this study further determined the Mallampati classification as "not a useful tool in classifying the difficult intubation in the ED". This reasoning may explain why 10.2% of those surveyed indicated that their institution lacked a standard set of criteria to define a difficult airway (Figure 5b), leaving more clinical discretion to individual providers.

Beyond predictive value, the utility of set criteria for airway assessment should also consider the relative ease with which it can be applied in practice. In one study, Mallampati score, neck mobility, and thyromental distance were only able to be measured in one third of non-cardiac arrest ED intubations [17]. These findings parallel, and perhaps explain, how these same three criteria constituted three out of the four least used criteria among surveyed institutional protocols (Figure 5a: 39.4% Mallampati, 51.1% Neck Mobility, 32.1% Thyromental Distance). An additional element to consider



in evaluating the use of these criteria is the observed lack of consistent knowledge of the tracking of trauma bay airway complications. In this survey, 34.3% of respondents indicated that they were unaware if their institutions tracked complications. This phenomenon complicates efforts to correlate the effects of protocol implementation on airway management outcomes.

This investigation also provides information on how different institutions may dictate the availability of physician anesthesiologists for airway management, even when they are not the primary service responsible. In nearly half of respondents' surveys (48.1%), an anesthesia team member was reported to automatically come to the trauma bay for the highest priority traumas (Figure 1c). This lies in contrast to the 19.0% of respondents that reported that the anesthesia service is not always immediately available in their respective institutions (Figure 2b). The availability of the anesthesia team may explain different institutions' handling of guidelines for when anesthesia need take over in the event of failed airway management by another service. In 38.7% of respondents' institutions, anesthesia automatically takes over a failed airway and another 26.3% report that anesthesia may take over at the request of the emergency medical team (Figure 3a).

However, those contexts reported where anesthesia is not always readily available may relate to the 27.7% of respondents that report anesthesia does not take over in the event of a failed intubation by another team (Figure 3a). Putting the availability of anesthesia in the context of previously described literature, trauma patients with difficult airways presenting at off-hours has been found to independently correlate with endotracheal intubation-related adverse events [18].

Ono et al. attributed these findings to differences in staffing - at the institution of study, 'back-ups' for airway management, head and neck surgeons and anesthesiologists, are available immediately in-house during business hours, but are off-site during after regular operating hours [18].

Interestingly, the 2014 The American College of Surgeons Committee on Trauma requires Level I trauma centers to have the anesthesia service readily available at all times [19]. As such, this study may raise concerns for not delineating that anesthesiologists should also be available for emergent airway management, in addition to providing anesthesia services for the operating room.

## Conclusion

This investigation has given insight into different components of airway management in the contemporary trauma setting. Given the unique emphasis on airway management in their training, physician anesthesiologists assume responsibility for such oversight in the operating

room according to standardized protocols. While a similar reasoning traditionally placed airway management in the hands of anesthesiologists in the trauma bay as well, institutions have recently remodeled the role of anesthesiologists in this setting according to varied approaches. This survey confirmed that Emergency Medicine has taken on a great deal of responsibility in airway management in the trauma ward, consistent with other recent literature.

Future inquiry may benefit from further exploring these issues within a greater sample of physicians and institutions as well as expanding the context of investigation, such as to Level II and III trauma centers. Future investigation may also seek to correlate institutions' different approaches to airway management outcomes, with the goal of isolating any possible factors contributing to differences in quality of healthcare. It is critically important to track airway complications, especially in a hospital location that often sees the most difficult intubating conditions due to the critical nature of patients in the trauma bay. Continuous assessment of the efficacy of protocols such as airway management is a necessary tool for quality improvement.

## Abbreviations

ACGME- Accreditation Council for Graduate Medical Education; ED- Emergency Department; C- Collar- cervical collar; LEMON- Look, Evaluate the 3-3-2 rule, Mallampati score, Obstruction, and Neck mobility

## Declarations

Ethics approval and consent to participate: Study approved by the Rutgers Newark Health Sciences IRB (Ref. Pro2018000849); Written informed consent obtained from all participants.

## Consent for publication

Not applicable

## Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Competing interests

The authors declare that they have no competing interests.

## Funding

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## Authors' contributions

GT and MG contributed to the concept of this study. GT, MG, JS, NB, MZ, and GG contributed to the distribution of surveys, collection of data, analysis of data, interpretation of data, writing the paper and editing the manuscript.



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## Summary statement

This study involves the use of a survey of residency directors for anesthesiology, general surgery and emergency medicine to assess trends in airway management for patients presenting in the trauma ward.

## Funding statement

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## Conflicts of interest

The authors declare no competing interests.

## Additional files

Survey Supplemental file 1. This file contains the survey utilized and distributed for this study via email and the use of Google Forms.

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