



An assessment of the novel, disposable, i-view video laryngoscope for far-forward endotracheal intubation

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AN ASSESSMENT OF THE NOVEL, DISPOSABLE, IVIEW VIDEO LARYNGOSCOPE FOR FAR-FORWARD ENDOTRACHEAL INTUBATION

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14. ABSTRACT- Introduction: Video laryngoscope (VL) technology improves first-pass success. The novel i-view VL device is inexpensive and disposable. We sought to determine the first-pass intubation success with the i-view VL device versus the standard reusable VL systems in routine use at each site. Methods: We performed a prospective, pragmatic study at two major emergency departments (EDs) when VL was used. We rotated i-view versus reusable VL as the preferred device of the month based on an a priori schedule. An investigator-initiated interim analysis was performed. Our primary outcome was a first-pass success with a non-inferiority margin of 10% based on the per-protocol analysis. Results: There were 93 intubations using the reusable VL devices and 81 intubations using the i-view. Our study was stopped early due to futility in reaching our predetermined non-inferiority margin. Operator and patient characteristics were similar between the two groups. The first-pass success rate for the i-view group was 69.1% compared to 84.3% for the reusable VL group. A non-inferiority analysis indicated that the difference (-15.1%) and corresponding 90% confidence limits (-25.3% to -5.0%) did not fall within the predetermined 10% non-inferiority margin. Conclusions: The i-view device failed to meet our predetermined non-inferiority margin when compared to the reusable VL systems with the study stopping early due to futility. Significant crossover occurred at the discretion of the intubating operator during the i-view month.					
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1.0 EXECUTIVE SUMMARY

The US Military is rapidly transitioning into preparing for multi-domain operations. Previous data demonstrates that the most common airway replaced in the prehospital combat setting is endotracheal intubation. Previous studies have suggested that video laryngoscopy (VL) is superior to direct laryngoscopy (DL), which is most prominently noted in novice users. However, the current durable equipment video laryngoscopes are very expensive and cost prohibitive for dispersion around the battlefield. The i-view is a novel video laryngoscope that is marketed for VL and is inexpensive and disposable. Both the durable VL and the i-view are already in use in our emergency department (ED). We are also already collecting data using these devices as part of an approved protocol for an airway registry. We are seeking to utilizing a clinical rotating protocol to compare these two devices in the emergency department.

2.0 INTRODUCTION

Video laryngoscopy (VL) has changed intubation methodology, especially in the emergency setting. Recently published data suggested that VL is superior to direct laryngoscopy (DL), especially in the hands of novice intubation operators.^{1,2} Current VL technology is cost-prohibitive for dispersion around the battlespace, yet many of the intubation operators in far-forward areas are relatively novice.³⁻⁵ The i-view™ (figure 1) is a novel single-use VL device produced by Intersurgical™ (Wokingham, United Kingdom). The i-view device costs 1/60th the cost of the currently military-fielded GlideScope system and is designed for single use. This device is hand-held with a built-in screen and a blade that generally mirrors a standard geometry (Macintosh blade) laryngoscope. This technology is potentially advantageous to the US military as it does not require ongoing maintenance and is cost-friendly for wide-dispersion.⁶ Thus, it may fill the gap in needed technology to these forward staged areas.

The device also has substantial potential benefit to the civilian setting. First, the low cost of the device would allow for dispersion throughout hospitals, ensuring rapid access to video laryngoscopy during an emergency. Second, the disposable technology is advantageous in the setting of highly contagious respiratory diseases, such as the SARS-CoV-2 virus.^{7,8} Such technology would ensure that cross-contamination does not occur and obviate the need to rapidly clean laryngoscopes between intubations when departments are inundated with high volumes of patients. The low-cost also makes it an attractive tool for the prehospital setting, where cost may serve as a barrier to the broad uptake of video laryngoscopy.^{9,10} Despite these potential benefits, this novel technology has not gained widespread use. The clinical performance of this disposable laryngoscope compared to reusable devices remains unclear.

Importance

Airway obstruction is the second leading cause of potentially survivable death on the battlefield.¹¹ Previous studies have demonstrated that intubations remain the primary airway performed in the prehospital combat setting.^{12,13} These findings suggest that better technology and training may be necessary for far-forward medical personnel to improve outcomes. This includes technology targeted at intubations, but also surgical airways and supraglottic airways. Many of these intubations occur at semi-fixed structures such a battalion aid station (BAS).¹⁴ A

BAS is a military treatment facility forward positioned in a combat zone and staffed by a physician assistant or a non-residency trained physician (e.g. general medical officer) and loosely resembles the mobile emergency medical services structures. As such, bringing VL technology to far-forward areas is of great importance to the military emergency medicine mission.

Goal of this Investigation

We sought to determine the first-pass intubation success with the i-view VL device versus the standard reusable VL systems in routine use at each site.

3.0 METHODS, ASSUMPTIONS AND PROCEDURES

Study Setting

We conducted our study in parallel at two sites – Brooke Army Medical Center (BAMC) and the UHealth University of Colorado Hospital (UCH). Both facilities are Level 1 trauma centers and tertiary care hospitals in urban settings. We conducted our study through parallel but independent protocols at each site. The BAMC site operated under US Army Institute of Surgical Research protocol H-21-022x. The UCH site operated under Colorado Multiple Institutional Review Board protocol 20-2040. Both sites requested and were granted a waiver of informed consent. We registered our study with clinicaltrials.gov (NCT04907695). We adhered to the CONSORT guidelines.

Selection of Participants

Study participants were selected by the intubating operator that elected to perform intubation using VL on the first attempt. The intubating operator would then perform the intubation as usual with the preferred device of the month and complete the intubation form in near real-time and drop it into a lockbox. Any patient in which the intubating operator chose to use DL on the first attempt was not included in this analysis regardless of whether they completed a form. The intubating operators (primarily resident trainees and the staff physicians) were notified of the device of the month through regularly occurring department emails, department meetings such as staff meetings and grand rounds, signage placed in the clinician work areas, and occasional reminders at shift change huddles by study team members.

Interventions

We hypothesized that first-pass success with the i-view VL device would have similar clinical performance characteristics versus the standard reusable VL systems. Prior to the introduction of the device of interest, both sites performed a series of run-in events including simulation model training. First, we introduced a device to the staff and resident physicians in a simulated setting allowing for unlimited practice with the device. Second, we introduced the device into the stable of available laryngoscopes within the ED for physicians to freely use at will for at least 6 months prior to the introduction of study protocol.

We introduced an a priori rotating protocol of the “preferred” video laryngoscope device of the month on an alternating basis – i-view versus the reusable devices – when the intubating operator

chose to use VL on the first intubation attempt. At BAMC the reusable devices consisted of the GlideScope and the Storz C-MAC systems. At UCH, the reusable devices consisted of the Storz C-MAC system. During the i-view preferred months signage was placed around the department and on the airway kits along with reminders disseminated through staff, residency, and nursing meetings reminding them to use the preferred device. During the non-i-view months, the i-view devices were removed from the department and unavailable for use. During the i-view months, to ensure the study was in keeping with minimal risk, the standard devices were kept available should the attending physician opt to “override” the preferred device of the month.

The study team held regular meetings to discuss the progress of the study through regular contact among the study coordinators on a monthly to bimonthly basis and quarterly update calls among the whole investigative team. Unstructured feedback was obtained from the end-users on an informal basis throughout the i-view months.

Measurements

Hard copy forms were used to capture the intubation specific data which were completed by the intubating operator within 2 weeks of the intubation. Daily admission logs were checked for intubations and dedicated study staff tracked the intubation forms to ensure they were filled out within the timeframe and ensure compliance. The hardcopy data were then entered into a database. Patient demographic and outcome data was obtained through review of the medical records and extracted into the database. Data were extracted from the medical records by dedicated study team members. Encounters were checked for errors throughout the study by a different study team member to ensure accuracy.

Outcomes

The primary endpoint for this study was first-pass intubation success which is commonly used in airway studies. First-pass was defined as a single insertion of the laryngoscope into the mouth followed by endotracheal tube placement. We also evaluated the glottic view achieved with each device, usage of a bougie or stylet, duration of intubation, reasons for failure on the first attempt, clinical complications, and adverse events. Safety assessments were at the direction of the investigators given the open-label design.

4.0 MAJOR EVENTS/MILESTONES/SUCCESS

In preparation for the execution of this project,

- Kick Off Meeting – October 01, 2020
- IRB/IACUC Approval – June 14, 2021
- All experimental procedures completed – August 09, 2022
- Data Analysis – February 01, 2023
- Poster presentation – provide location and date: Multiple
- Manuscript submitted to – name of journal and date: Transfusion, December 13, 2023
- Dissemination of Results – March 14, 2024

5.0 RISK ASSESSMENT

5.1 Risk Analysis:

The primary risk currently lies within acquisitions for device purchase. The device we have tested is already FDA cleared for use and currently available on the open market.

5.2 Technical Challenges

There are several limitations of our study. We used a pragmatic design rather than true randomization. We used this method because of the logistics associated with true randomization, and more specifically this was the first prospective airway study launched in the ED at the primary site (BAMC). As such, we needed to maintain a minimal risk profile with the study by utilizing practices consistent with routine clinical care. Such an example includes the operator choice in selection of the blade angle for the standard device. However, given that there is such a substantial difference noted between the devices, and the device of interest within the study failing to meet the non-inferiority margin, it is unlikely that with a true randomized control trial we would have found a substantial difference from the study we performed. Despite this, the devices are advertised as being used for the same indication and therefore should be assessed for clinical efficacy before one device potentially replaces another device. We must also note that both centers include residency training program. As such, most intubations are performed by trainees, which better mirrors the deployed military medical system, but also results in more challenges with implementation of new technology. We must also highlight that our interim analysis resulting in early stoppage was not planned, and thus we had not set a predetermined criterion. We were not expecting consistent feedback from the end-users regarding device performance as they appeared to perform well in mannequins. Future studies would benefit from a run-in phase to ensure the end-users provide sufficient feedback prior to starting. Lastly, we did have a preplanned rotating protocol, though clinicians were able to override the protocol when indicated based on their judgment, which may have led to selection bias. However, if this was the case, we believe that the physicians would have likely opted to use the study device in the "easy" airways, which would have thus skewed our results towards the device meeting our non-inferiority margin. For example, the reusable VL system was used more in patients with facial trauma.

6.0 TRANSITION PLAN

6.1 Military Relevance

Airway obstruction is cited as the second leading cause of potentially preventable death on the battlefield.[4] Relative to hemorrhage, there has been relatively little scientific development for airway management on the battlefield. Direct laryngoscopy is a challenging skill to develop and maintain which is a primary reason why it is not in the combat medic armamentarium. However, the advent of video laryngoscopy has significantly improved intubation success, likely side-stepping some of the skills required for direct laryngoscopy. Until now, dispersion of video laryngoscopes across the battlefield into the combat medic aid bags has been cost prohibitive. A new video laryngoscope, the i-view, is single-use and inexpensive – a potentially feasible technology for the far forward medical provider.

6.2 Transition Strategy

We have transitioned this knowledge product by way of a peer-reviewed publication in an open access journal, publication on the DTIC website, and wide dissemination on social media.

7.0 RESULTS

Characteristics of Study Subjects

We enrolled 189 patients over the course of six months (80 at BAMC, 109 at UCH) with 119 of those assigned to the i-view device (i.e., seen during i-view months) and the remaining 70 assigned to the standard reusable VL devices (Figure 2). The main per-protocol analysis included 81 intubations using the i-view and 108 intubations using the reusable VL devices. Patient characteristics were generally similar across the two groups with regards to age, sex, body mass index (BMI), ethnicity, intubation operator specialty and training, and indications for intubation (Table 1). Hypercarbic respiratory failure was more common among patients who received the i-view than the reusable VLs (17.3% vs. 4.6%, difference 12.7%, 95% CI 3.5% to 21.8%) and facial trauma was more common in patients who were intubated with a reusable VL compared to the i-view (13.9% vs. 3.7%, difference -10.2%, 95% CI -17.9% to -2.5%).

Main Results

We decided on early termination of this study after analyzing our primary outcome (first-pass intubation success) using the most current data and subsequently conducting a futility analysis. The first-pass success rate for the i-view group was 69.1% compared to 84.3% for the reusable VL group (Table 2). A non-inferiority analysis indicated that the difference (-15.1%) and corresponding 90% confidence limits (-25.3% to -5.0%) did not fall within the predetermined 10% noninferiority margin (Figure 3); rather, the per-protocol data suggest that the reusable VLs were superior to the i-view. The futility analysis showed a conditional power of 1.1% and futility index of 98.9%.

Secondary Outcomes

The i-view group was more likely to have a grade 4 glottic view (7.4% vs. 0%, difference 7.4%, 95% CI 1.7% to 13.1%) and less likely to obtain a glottic view via video (95.1% vs. 100%, difference -4.9%, 95% CI -9.7% to -0.2%) compared to the reusable VL group (Table 2). Providers in the i-view group were less likely to use a bougie than those in the reusable VL group (21.0% vs. 34.3%, difference -13.3%, 95% CI -25.9% to -0.7%). They were also more likely to cite an inadequate view of cords as the reason for failure (19.8% vs. 5.6%, difference 14.2%, 95% CI 4.5% to 23.9%). There were no significant differences in complications and no reported adverse events in this study.

Intention-to-Treat Analysis

The intention-to-treat analysis compared the 119 patients assigned to the i-view device (i.e., seen during i-view months) and the 70 who were assigned to the standard reusable VL devices. The two groups were similar with regards to age, sex, body mass index (BMI), ethnicity, and comorbidities (supplemental table 1). We also found no clinically significant differences in indications for intubation, difficult airway characteristics, and intubation operator specialty and training between the groups.

The first-pass success rate for the i-view group was 74.8% compared to 82.9% for the reusable VL group. A non-inferiority analysis indicated that the difference (-8.1%) and corresponding 90% confidence limits (-17.9% to 1.7%) did not fall within the predetermined 10% noninferiority margin. The i-view group was more likely to have a grade 4 glottic view (5% vs. 0%, difference 5%, 95% CI 1.1% to 9.0%) and less likely to obtain a glottic view via video (96.6% vs. 100%, difference -3.4%, 95% CI -6.6% to -0.1%) compared to the reusable VL group (supplemental table 2). Providers in the i-view group were also more likely to cite an inadequate view of cords as the reason for failure (15.1% vs. 5.7%, difference 9.4%, 95% CI 1.0% to 17.8%). However, the rate of complications was higher in the reusable VL-assigned group than in the i-view-assigned group (17.1% vs. 6.7%, difference -10.4%, 95% CI -20.3% to -0.5%). There were 58 successes in the i-view group and 89 successes in the reusable VL group

8.0 CONCLUSION/DISCUSSION DISCUSSION

In this prospective pragmatic study comparing the novel, disposable i-view device to standard VL systems, we found that the disposable i-view device failed to meet our preset non-inferiority margin. The study was stopped early after we determined that futility was likely. We found that a substantial number of users noted challenges associated with the screen resolution, screen brightness and the ability to navigate the device through airway condensation, airway secretions, and vomit. These observations may account for the difference in clinical performance characteristics in our trial. We must further highlight that due to the large amount of crossover, the true difference would have been larger should the assignments been rigidly maintained. In the cases of the crossovers, the intubating operator likely felt the reusable systems were going to provide more reliable intubating conditions. Conversely, if the operator had a previous poor experience with the device for that particular month, they may have opted to try DL first, which also underscores the amount of cross-over we experienced.

Other studies have compared various VL technology devices against each other.^{15,16} Many of these studies were conducted in environments not generalizable to the emergency department, such as the operating theater. Since we started the study development process, there have been other studies assessing the i-view device, most of which were in non-ED settings. Nakanishi et al. performed a randomized cross-over study comparing the Macintosh laryngoscope to the i-view and C-MAC.¹⁷ This study used a manikin model, whereas we used real human subjects in the emergency setting. Similarly, Moritz et al. conducted a study comparing the i-view to the GlideScope, KingVision, Dahlhausen VL, and the Macintosh laryngoscope using a manikin model.¹⁸ Gaszynski conducted a randomized controlled trial in super obese patients comparing

the i-view to the MacGrath Mac VL system, finding better views were noted with the McGrath system.¹⁹ This study took place in the operating room, which limits the ability to extrapolate their findings into the emergency setting where the procedures are not preplanned in patients are not consentable.

Our finding that this low-cost disposable video laryngoscope performed inferiorly to standard equipment indicates the need for pursuing a broader market analysis for potential devices and the opportunity for technological improvement of such devices. Similarly, the i-view seemed promising on initial review and in the simulation setting, but this study proved that such findings may not translate into the emergency, *in vivo* clinical setting. Broader caution and rigorous clinical evaluation may be warranted when adopting devices that seem, at face value, to provide similar features. Specifically, the clinical evaluation needs to happen in a setting that best mirrors the intended environment for application. As such, studies in the operative setting may not yield an adequate assessment of the expected performance in the emergency setting. Perhaps future studies could initially focus on end-user feedback using qualitative methods to identify device shortcomings before launching into a study of this design.^{20,21} Moreover, based on a recent study comparing VL versus DL, we should note that a future study could be aimed at comparing the use of this device versus DL, which better mirrors the current operational environment.¹ Existing data does not adequately quantify first-pass success in the deployed setting. Future studies would also benefit from physiological end-point measurements in addition to first-pass success.²²

CONCLUSIONS

The i-view device failed to meet our pre-determined non-inferiority margin when compared to the reusable VL systems with the study stopping early due to futility. Significant cross-over occurred at the discretion of the intubating operator during the i-view month.

9.0 DELIVERABLES

9.1 Publications:

Manuscript:

Schauer SG, Long BJ, April MD, Resnick-Ault D, Mendez J, Arana AA, Bastman JJ, Davis WT, Maddry JK, Ginde AA, Bebart VS. A prospective, pragmatic non-inferiority study of emergency intubation success with the single-use i-view versus standard reusable video laryngoscope. *Transfusion*. 2024 Mar 28. doi: 10.1111/trf.17790. Epub ahead of print. PMID: 38545924.

9.2 Presentations:

SOMSA 2022: A comparison of the novel, single-use i-view video laryngoscope versus the standard durable video laryngoscope in the emergency department –A preliminary analysis
MHSRS 2022- A comparison of the novel, single-use i-view video laryngoscope versus the standard durable video laryngoscope in the emergency department – A preliminary analysis
DAS 2022- A prospective, quasi-experimental non-inferiority study of first-pass emergency intubation success with the single-use i-view versus standard reusable video laryngoscope
*Cleared Via USAISR PAO as this was an MRDC study being presented by USAISR Personnel.

10.0 COST

Our study was supported by Defense Health Program 6.7 grant DS19EC01.

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12.0 TABLES AND FIGURES

Figure 1. The i-view device.



Figure 2. CONSORT diagram.

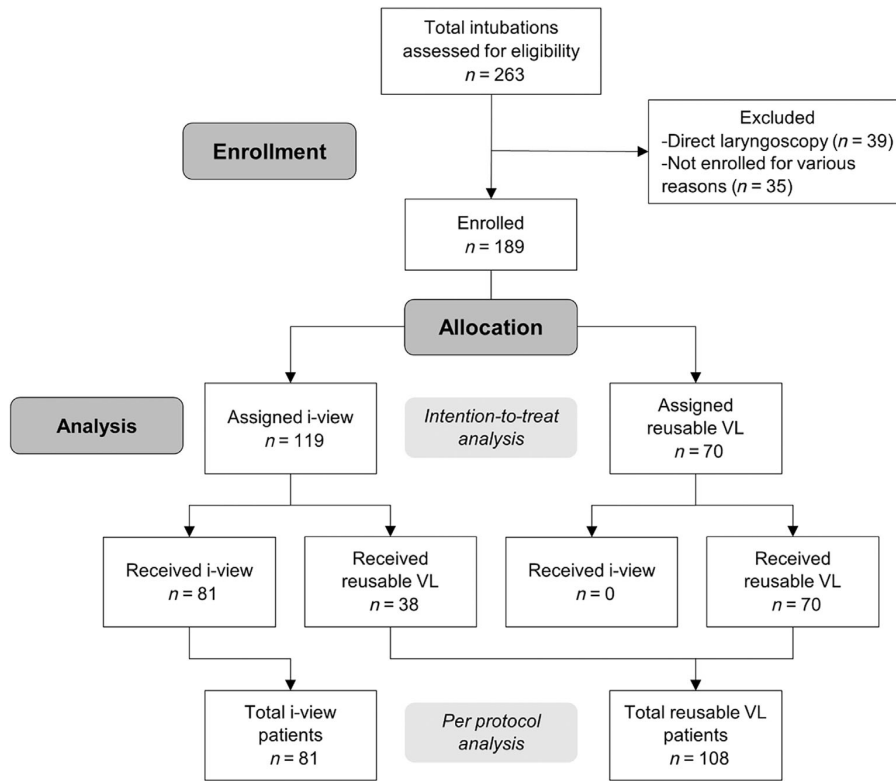


Figure 3. Forest plot showing first-pass intubation success for i-view (circle) vs. reusable video laryngoscopy (square) with 95% confidence intervals for each proportion. An additional symbol (triangle) shows the difference with the 90% confidence interval and 10% non-inferiority margin (shaded gray area). The difference and its confidence interval does not fall within the non-inferiority margin.

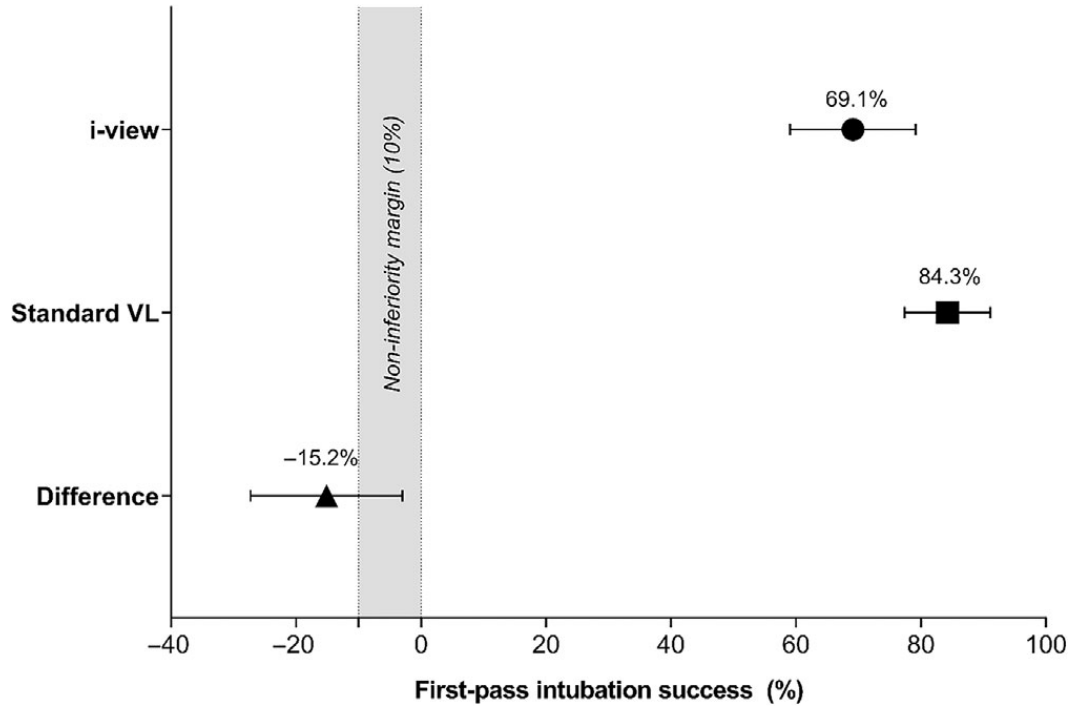


Table 1. Patient characteristics

Variable	All (n=189)	i-view (n=81)	Reusable VL (n=108)	Difference (95% CI)
Male gender	68.3	67.9	68.5	-0.6 (-14.0 to 12.8)
Age, years	54 [36-65]	55 [33-68]	53 [36-63]	1 [-5 to 7]
BMI				
<18.5	7.4	6.2	8.3	-2.2 (-9.6 to 5.2)
18.5-24.9	24.9	30.9	20.4	10.5 (-2.1 to 23.1)
25-29.9	25.4	19.8	29.6	-9.9 (-22.1 to 2.3)
30-39.9	22.2	19.8	24.1	-4.3 (-16.2 to 7.5)
≥40	4.2	3.7	4.6	-0.9 (-6.6 to 4.8)
Unspecified	15.9	19.8	13	6.8 (-3.9 to 17.5)
Race				
White	40.2	45.7	36.1	9.6 (-4.6 to 23.7)
Black/African-American	15.3	14.8	15.7	-0.9 (-11.3 to 9.4)
Asian	1.6	1.2	1.9	-0.6 (-4.1 to 2.9)
American Indian or Alaska native	0.5	0	0.9	-0.9 (-2.7 to 0.9)
Unspecified	38.6	34.6	41.7	-7.1 (-21.0 to 6.8)
Hispanic or Latino ethnicity	21.2	18.5	23.1	-4.6 (-16.2 to 7.0)
Common comorbidities				
Altered mental status	61.4	64.2	59.3	4.9 (-9.0 to 18.9)
Hypoxemic respiratory failure	36.5	44.4	30.6	13.9 (0.0 to 27.8)
Hypertension	27.5	29.6	25.9	3.7 (-9.2 to 16.6)
CNS bleeding	21.2	22.2	20.4	1.9 (-10.0 to 13.7)
Diabetes mellitus	21.2	19.8	22.2	-2.5 (-14.2 to 9.2)
Traumatic brain injury	16.4	13.6	18.5	-4.9 (-15.4 to 5.5)
Cardiac arrest	15.3	14.8	15.7	-0.9 (-11.3 to 9.4)
Seizure	15.3	16	14.8	1.2 (-9.2 to 11.7)
Pneumonia	12.7	14.8	11.1	3.7 (-6.0 to 13.4)
ARDS	10.1	12.3	8.3	4.0 (-4.8 to 12.9)
Hypercarbic respiratory failure	10.1	17.3	4.6	12.7 (3.5 to 21.8)
Indication				
Altered mental status	37	37	37	0.0 (-13.9 to 13.9)
Hypoxemic respiratory failure	16.9	19.8	14.8	4.9 (-6.0 to 15.9)
Cardiac arrest	11.6	13.6	10.2	3.4 (-6.0 to 12.8)
Agitation	6.3	4.9	7.4	-2.5 (-9.3 to 4.4)
Any difficult airway characteristic	64	64.2	63.9	0.3 (-13.5 to 14.1)
Obesity (BMI >30)	26.5	23.5	28.7	-5.2 (-17.8 to 7.3)

C-Collar	23.8	18.5	27.8	-9.3 (-21.2 to 2.7)
Glottic view obscured by body fluid	19	21	17.6	3.4 (-8.0 to 14.8)
Facial trauma	9.5	3.7	13.9	-10.2 (-17.9 to -2.5)*
Operator specialty: emergency medicine	96.3	97.5	95.4	2.2 (-3.0 to 7.4)
Operator training level				
Resident	92.6	93.8	91.7	2.2 (-5.2 to 9.6)
Attending	4.2	4.9	3.7	1.2 (-4.7 to 7.1)
Other	1.1	1.2	0.9	0.3 (-2.7 to 3.3)

Values given are column percentage or median [interquartile range]. Columns are divided by actual device utilized according to per protocol analysis.

BMI = Body mass index

CNS = Central nervous system

ARDS = Acute respiratory distress syndrome

Table 2. Intubation outcomes

Variable	All (n=189)	i-view (n=81)	Reusable VL (n=108)	Difference (95% CI)
Glottic view				
Grade 1	56.1	50.6	60.2	-9.6 (-23.8 to 4.7)
Grade 2	31.2	29.6	32.4	-2.8 (-16.1 to 10.5)
Grade 3	7.9	11.1	5.6	5.6 (-2.5 to 13.6)
Grade 4	3.2	7.4	0	7.4 (1.7 to 13.1)
Glottic view obtained via video	97.9	95.1	100	-4.9 (-9.7 to -0.2)
Assist device				
Stylet	50.3	54.3	47.2	7.1 (-7.3 to 21.5)
Bougie	28.6	21	34.3	-13.3 (-25.9 to -0.7)
Neither	21.2	24.7	18.5	6.2 (-5.7 to 18.1)
Duration of intubation, seconds	120 [75-180]	120 [65-180]	120 [113-180]	-9 [-45 to 5]
First-pass intubation success	77.8	69.1	84.3	-15.1 (-27.3 to -2.9)
Reason for failure on first attempt				
Inadequate view of cords	11.6	19.8	5.6	14.2 (4.5 to 23.9)
Difficulty passing ETT	5.8	7.4	4.6	2.8 (-4.2 to 9.7)
Difficulty passing bougie	1.6	0	2.8	-2.8 (-5.9 to 0.3)
Any complications	10.6	8.6	12	-3.4 (-12.1 to 5.3)
Cardiac arrest	3.2	2.5	3.7	-1.2 (-6.1 to 3.7)
Airway trauma	2.1	3.7	0.9	2.8 (-1.7 to 7.3)
Aspiration	2.6	2.5	2.8	-0.3 (-4.9 to 4.3)
Hypotension	2.6	2.5	2.8	-0.3 (-4.9 to 4.3)
Esophageal intubation	1.6	1.2	1.9	-0.6 (-4.1 to 2.9)
Heart rate <40	0.5	1.2	0	1.2 (-1.2 to 3.6)

Values given are column percentage or median [interquartile range].

ETT = Endotracheal tube

Supplemental Table 1. Patient characteristics based on intention-to-treat analysis

Variable	All (n=189)	i-view (n=119)	Reusable VL (n=70)	Difference (95% CI)
Male gender	68.3	68.1	68.6	-0.5 (-14.2 to 13.2)
Age, years	51.2 (19.0)	50.6 (19.9)	52.2 (17.5)	-1.0 (-7.0 to 4.0)
BMI				
<18.5	7.4	5	11.4	-6.4 (-14.8 to 2.0)
18.5-24.9	24.9	26.9	21.4	5.5 (-7.0 to 17.9)
25-29.9	25.4	23.5	28.6	-5.0 (-18.1 to 8.0)
30-39.9	22.2	22.7	21.4	1.3 (-10.9 to 13.5)
≥40	4.2	2.5	7.1	-4.6 (-11.3 to 2.0)
Unspecified	15.9	19.3	10	9.3 (-0.7 to 19.3)
Race/ethnicity				
White	40.2	38.7	42.9	-4.2 (-18.7 to 10.3)
Black/African-American	15.3	16.8	12.9	3.9 (-6.4 to 14.3)
Asian	1.6	1.7	1.4	0.3 (-3.4 to 3.9)
American Indian/Alaska native	0.5	0	1.4	-1.4 (-4.2 to 1.4)
Unspecified	38.6	38.7	38.6	0.1 (-14.3 to 14.5)
Hispanic/Latino ethnicity	21.2	21	21.4	-0.4 (-12.5 to 11.7)
Comorbidities				
Altered mental status	61.4	59.7	64.3	-4.6 (-18.9 to 9.6)
Hypoxemic respiratory failure	36.5	41.2	28.6	12.6 (-1.2 to 26.4)
Hypertension	27.5	29.4	24.3	5.1 (-7.8 to 18.1)
CNS bleeding	21.2	20.2	22.9	-2.7 (-14.9 to 9.5)
Diabetes mellitus	21.2	18.5	25.7	-7.2 (-19.6 to 5.2)
Traumatic brain injury	16.4	18.5	12.9	5.6 (-4.9 to 16.1)
Cardiac arrest	15.3	16	14.3	1.7 (-8.8 to 12.2)
Seizure	15.3	15.1	15.7	-0.6 (-11.3 to 10.1)
Pneumonia	12.7	15.1	8.6	6.6 (-2.6 to 15.7)
ARDS	10.1	10.9	8.6	2.4 (-6.3 to 11.0)
Hypercarbic respiratory failure	10.1	12.6	5.7	6.9 (-1.2 to 15.0)
Indication				
Altered mental status	37	39.5	32.9	6.6 (-7.4 to 20.7)
Hypoxemic respiratory failure	16.9	16.8	17.1	-0.3 (-11.4 to 10.8)
Cardiac arrest	11.6	12.6	10	2.6 (-6.6 to 11.8)
Agitation	6.3	6.7	5.7	1.0 (-6.0 to 8.1)
Any difficult airway characteristic	64.0	63.0	65.7	-2.7 (-16.8 to 11.4)
Obesity (BMI >30)	26.5	25.2	28.6	-3.4 (-16.5 to 9.8)

C-Collar	23.8	22.7	25.7	-3.0 (-15.7 to 9.7)
Glottic view obscured by body fluid	19	20.2	17.1	3.0 (-8.4 to 14.4)
Facial trauma	9.5	8.4	11.4	-3.0 (-12.0 to 5.9)
Operator specialty				
Emergency medicine	96.3	95.0	98.6	-3.6 (-8.4 to 1.2)
Other	3.7	5.0	1.4	3.6 (-1.2 to 8.4)
Operator training level				
Resident	92.6	92.4	92.9	-0.4 (-8.1 to 7.3)
Attending	4.2	3.4	5.7	-2.4 (-8.7 to 4.0)
Other	1.1	0.8	1.4	-0.6 (-3.8 to 2.6)

Values given are column percentage or median [interquartile range].

BMI = Body mass index

CNS = Central nervous system

ARDS = Acute respiratory distress syndrome

Supplemental Table 2. Intubation outcomes based on intention-to-treat analysis

Variable	All (n=189)	i-view (n=119)	Reusable VL (n=70)	Difference (95% CI)
Glottic view				
Grade 1	56.1	52.9	61.4	-8.5 (-23.0 to 6.0)
Grade 2	31.2	29.4	34.3	-4.9 (-18.7 to 8.9)
Grade 3	7.9	10.1	4.3	5.8 (-1.4 to 13.0)
Grade 4	3.2	5	0	5.0 (1.1 to 9.0)*
Glottic view obtained via video	97.9	96.6	100	-3.4 (-6.6 to -0.1)*
Assist device				
Stylet	50.3	49.6	51.4	-1.8 (-16.6 to 12.9)
Bougie	28.6	26.1	32.9	-6.8 (-20.3 to 6.7)
Neither	21.2	24.4	15.7	8.7 (-2.8 to 20.2)
Duration of intubation, seconds	120 [75-180]	120 [67-180]	120 [112-180]	-3.0 (-45.0 to 2.0)
First-pass intubation success	77.8	74.8	82.9	-8.1 (-19.8 to 3.7)
Reason for failure on first attempt				
Inadequate view of cords	11.6	15.1	5.7	9.4 (1.0 to 17.8)*
Difficulty passing ETT	5.8	6.7	4.3	2.4 (-4.1 to 9.0)
Difficulty passing bougie	1.6	0	4.3	-4.3 (-9.0 to 0.5)
Any complications	10.6	6.7	17.1	-10.4 (-20.3 to -0.5)*
Cardiac arrest	3.2	1.7	5.7	-4.0 (-9.9 to 1.9)
Airway trauma	2.1	2.5	1.4	1.1 (-2.9 to 5.0)
Aspiration	2.6	2.5	2.9	-0.3 (-5.1 to 4.5)
Hypotension	2.6	1.7	4.3	-2.6 (-7.9 to 2.7)

Values given are column percentage or median [interquartile range].

ETT = Endotracheal tube

13.0 LIST OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

BMI = Body mass index

CNS = Central nervous system

ARDS = Acute respiratory distress syndrome

ETT = Endotracheal tube

Video laryngoscope (VL)

Emergency departments (ED)

Direct laryngoscopy (DL)

Battalion aid station (BAS)

Brooke Army Medical Center (BAMC)

UCHealth University of Colorado Hospital (UCH)