Original

Crit Care Shock (2018) 21:151-167

Intubation practices at Wellington Hospital Emergency Department: an eight month retrospective observational study

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Abstract

***Objective*: To determine the rate of intubations carried out in Wellington Hospital Emergency Department (tertiary hospital), New Zealand, to provide a description of intubating habits of clinicians including operator experience and methods, and to determine the rate of complications.**

***Design*: Eight month, retrospective, observational study.**

***Setting*: Wellington Hospital Emergency Department (WHED).**

***Location*: New Zealand.**

***Patients and participants*: All patients intubated in the Emergency Department were included.**

***Interventions*: None. Audit related activity.**

***Measurements and results*: Over the eight months 57 intubations occurred. The most common indications for intubation were head injury with reduced Glasgow Coma Scale (GCS) and overdose (both 18.9%) followed by stroke, seizure and cardiac arrest (9.4-11.3%). Most intubations (46%) occurred between 8 a.m.-5 p.m. Eighty-two point seven percent of patients were intubated by ED doctors where seniority of team leader and intubating doctor varied according to the time of day. Intubation was consultant led 68.4% of the time before 5 p.m. and 40% of the time overnight. Airway checklist use was reported in 54.5% with formal airway assessment documented in 50%. Successful first pass occurred in 77.2% of cases. Difficult laryngoscopy (grade 3-4) was reported in 16.6% using direct laryngoscopy and 18.8% using videolaryngoscopy. All patients were successfully intubated orally in 3 attempts or less. Etomidate was drug of choice (54.7%). Seventeen point five percent experienced one or more complications. Trends towards less complications related to direct laryngoscopy compared to videolaryngoscopy and use of cricoid pressure associated with a higher complication rate were noted. However there were low numbers and statistical significance was not reached.**

***Conclusion*: The first pass success rate for intubation was lower in comparison to other studies although adverse event rate was also lower. As a high-risk procedure, an incidence of seven intubations per month highlights the need for more diverse training opportunities for skills maintenance.**

Key words: Emergency medicine, intubation, incidence, airway management, complication.

Introduction

Advanced airway management is a core skill of emergency physicians. (1)

Emergency Department (ED) patients who present unscheduled with unstable physiology and have unknown airway anatomy are more likely to have difficult to control airways compared to those who are intubated in theatre. (2) The experience of the ED primary operator, familiarity of other ED staff in airway management, limitations in ED airway equipment and the complexities of managing a chaotic ED environment are possible factors. (2) The National Audit Project 4 (NAP4) UK (3) reviewed severe complications associated with airway management and found that at least one in four major airway events reported to NAP4 were from the Intensive Care Unit (ICU) or the ED. The authors also found a large proportion of events occurred out of hours, without consultant supervision, with operators failing to follow standard airway management algorithms and 'failing to plan

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for failure'. (3) Several studies from Europe and America (4-6) have been published that describe intubations in ED, but to date, only one study of 295 intubations has been performed in an Australasian ED. This study by Fogg et al (7) prompted significant changes in the practice of intubation in that ED (8) and an increased educational focus on the subject in order to improve clinical management.

The objectives of this observational study are to identify the incidence of intubation events carried out in the ED, to provide a description of the intubating habits of clinicians, and to identify all adverse events from those intubations. The results will be used to identify gaps in knowledge or accepted best practice, and to help guide future clinician training. The ultimate goal of ongoing data collection is to contribute data towards the New Zealand Emergency Medicine Network-Australian New Zealand Emergency Department Airway Registry (NZEMN-ANZEDAR) (**Appendix 1**) and to provide a baseline from which to work towards better airway processes in the Wellington Hospital Emergency Department (WHED).

Materials and methods

This was a retrospective observational study carried out in WHED between August 2014 and March 2015 but audit data collection remains ongoing. All patients who were intubated in the ED were included. Patients intubated in the pre-hospital environment were excluded.

Prior to undertaking this study, a one-month pilot audit was conducted in order to establish methods required to achieve full capture of intubations.

In this study, patients were identified using several methods:

- Self reporting by any team member, using the study data collection forms (**Appendix 2**)
- A review of electronic ED notes (EDIS) for all patients admitted to the ICU from the ED. Admission data was accessed via a monthly report generated by a District Health Board Senior Reporting Analyst from the Decision Support Unit. Patients discharged from the ED to theatre were recorded on the ICU admission list as this was their expected destination after attending theatre
- A review of electronic ED notes of all deaths in the ED. This data is already generated as a monthly report
- A review of ED electronic notes for presentations coded on EDIS as "subarachnoid haemorrhage", "intracranial haemorrhage", and "intracerebral haemorrhage"

Once patients were identified, data about the intubation episode were collated by the investigating team from data collection forms (**Appendix 2**). If these were not initially completed, the clinician was identified from the patient notes, contacted via email and asked complete the form. If forms remained partially complete/incomplete, the investigating team gathered data from the clinical notes.

This internal audit of practice was designed to provide a site specific sustainable process through which ongoing data collection and analysis within WHED can occur. With the ultimate goal of facilitating participation in external research conducted by the NZEMN-ANZEDAR (**Appendix 1**). To this end, the NZEMN-ANZEDAR data collection form was used (**Appendix 2**) to record information to allow future submission of data to the Registry in a standardised format. Data collection was part of the standard documentation expected in ED during any resuscitation and intubation.

Application was made for ethics approval as a local site through the existing NZEMN-ANZEDAR Ethics submission. The study was an audit related activity. It was approved by Wellington Hospital's Research Service Leader and ED Clinical Leader, registered and given locality approval.

The primary aim was to determine the rate of intubations within the ED.

Secondary descriptors aimed to provide a detailed description of intubating practices as outlined below:

- Indications
- Intubator experience
- Techniques used
- Equipment used
- Drugs used
- Number of attempts
- The use of the rapid sequence induction (RSI) checklist
- Rates of complication

Statistical analysis was conducted by a Senior Biostatistician from Otago University. SPSS statistics software was used. Descriptive statistics used to analyse the data are presented as percentages. A multivariate analysis compared complication rates against the secondary outcomes (**Figure 1**). Chi-squared and McNemar's tests were used to identify statistical significance. Statistically significant differences were considered at $p< 0.05$.

Results

Over eight months, 57 patients were intubated in WHED (average of 7.13 patients per month). Ninety-one percent were adults, half were women. Most patients were intubated by ED clinicians rather than ICU/anaesthetics clinicians. Fourteen percent of patients intubated weighed over 100 kg (**Table 1**).

Forty-six percent of intubations occurred during the day. Team leader seniority varied with the time of the day (**Table 2**). Sixty-eight point four percent of intubations were consultant led during the day compared to 40% overnight.

The most common indications for intubation were for head injury with a reduced GCS, and overdose followed by stroke, seizure, and cardiac arrest (**Table 3**). Eighty-one percent of intubated patients went directly to the ICU.

A formal airway assessment was documented in 50% of patients. A pre-intubation checklist was used in 54.5% of patients (**Table 4**). Half of patients assessed were predicted to have a difficult airway. Pre-oxygenation was carried out using mainly bag mask ventilation.

Thirty-four percent of patients did not receive apnoeic oxygenation. Only 10.4% were 'ramped' for intubation (the head and torso elevated such that the external auditory meatus and the sternal notch are horizontally aligned). (9)

Etomidate was used most frequently in the ED cohort of patients (54.7%). Only a small number of patients received an anaesthetic in combination with analgesia (**Table 5**). Forty-nine point one percent received suxamethonium and 54.7% received rocuronium as a neuromuscular blocking agent. Nine patients received both.

Characteristics of the intubation (**Table 6**)

Successful first pass occurred in 77.2% of patients; 19.3% of patients required a second attempt, and all patients were successfully intubated orally in three attempts or less (**Table 1**).

Attempt one

Eighty-two point seven percent of intubations were performed by ED clinicians, 92.3% were performed by registrars. Intubator experience level was spread evenly.

Two thirds of intubating clinicians used direct laryngoscopy (66.7%). Difficult (grade 3-4 Cormack-Lehane) laryngoscopy was reported in 16.6% of those using direct laryngoscopy and 18.8% using videolaryngoscopy (McGrath laryngoscope). Seventy-one point one percent of intubations included the use of a bougie or stylet. Manual in-line stabilisation during intubation was provided in 26% of patients.

Attempt two (**Table 7**)

All second attempts at intubation were carried out by ED physicians. Most (63.6%) intubators were experienced. Of those needing at least two attempts, 81.8% of intubators in the first attempt had done <100 intubations.

Ninety percent of the second attempts were under direct vision and 82% used a bougie or stylet. Twenty-seven point three percent maintained manual in-line stabilisation.

Complications were reported in 54% of second intubations: one patient had vomitus blocking the airway view, two patients had oesophageal intubations, one patient had unknown equipment failure and in another intubation the clinician switched from video to manual laryngoscopy due to unfamiliarity with the former.

Attempt three

Two patients were intubated on the third attempt. One was by an ED registrar who was inexperienced, with consultant presence throughout.

In eight months there were a total of 70 intubation attempts to achieve 57 successful intubations. All had a team leader and separate intubating doctor present. All team leaders were ED clinicians. One ED registrar performed seven intubations with success on first pass every time. Three clinicians performed three intubations each, nine clinicians performed two intubations each, and 18 clinicians performed only one intubation in the ED within the eight month study period. The speciality of five of these 18 clinicians were not recorded, the remaining 13 were ED clinicians.

All tube placements were confirmed by using waveform capnography.

Complications (**Table 8**)

Overall, 17.5% of patients (10/57) had a complication. The most frequent complications were desaturation (4/57) followed by hypotension, oesophageal intubation, and requirement for a second dose of neuromuscular blocking agent to be given (2/57).

One patient had two and another had four complications. The second patient was heparinised prehospital, had 30 minutes of CPR and required three attempts to successfully intubate.

Comparisons (**Table 9**)

The number of attempts did significantly correlate with increasing complication rates. However, study

numbers were low and other comparisons were unable to be made with any statistical certainty as a result.

Discussion

In this descriptive study 57 patients were intubated during a continuous eight month period, an average of 7.13 patients per month. This is similar to numbers that are quoted in previous studies. (6,7)

We identified several areas of good practice

All patients were pre-oxygenated and capnography was used to confirm endotracheal tube placement. This concurs with current recommendations (3) and ACEM policy. (10) Apnoeic oxygenation was used in two thirds of patients. Although recent data indicates that apnoeic oxygenation may not alter outcome (11) at the time of this data collection apnoeic oxygenation was regarded as a best practice. (12-14)

There was a high proportion of seniority amongst team leadership overnight. Forty percent of intubations performed were consultant led and the rest had a senior registrar as the team leader. Generally, intubators with less experience were carrying out the first attempt at intubation with more experienced intubators taking over for second attempts. This is highlighted by 62.5% of first attempts being carried out by those with <100 intubations, compared to 63.6% of second attempts by experienced intubators. It is possible this could reflect an emphasis placed on training in a supportive environment whilst also prioritising patient safety.

Adverse events (AE) from intubation were 17.5%. This is favourable when compared to similar studies which quote 32.8% (9) and 23.9% (6) but in absolute terms this still constitutes 10 complications from 57 patients. Self reporting does allow a degree of reporting bias, (15) however it is unclear whether lower AE rates were due to potential underreporting. This audit provides a baseline for ongoing comparison with the hope that this could further reduce towards zero.

Whilst it remains controversial as to whether checklists improve overall patient outcome they have been shown to reduce patient harm through improved standardization and communication. (16-18)

Throughout the period of the audit, our department developed and introduced an "airways checklist" with the aim of standardising practice. This may have prompted planning and prior airway assessment, both of which are key elements in ensuring optimum outcome. (3) A formal airway assessment was documented as being completed 50% of the time, with use of the airway checklist in 54% of patients. However, only 9.4% of patients were intubated in an emergent/arrest situation (where use of a checklist may be less feasible due to the emergent nature of the scenario). It is possible that increased checklist use may further reduce AEs.

Areas identified as requiring improvement

Studies have previously outlined the importance in first pass success rate for intubation in reducing adverse events (19-21) with AEs tripling to nearly 50% after two attempts. Of note, whilst the first pass success rate for intubation was lower in comparison to other studies (as outlined below) the adverse event rate was also lower.

Almost a quarter of all patients required more than one attempt for intubation, 78.8% of patients were intubated on the first attempt. This rates poorly compared to other studies which quote 87.4%, (9) 83%, (5) and 82%. (6) It is hypothesised that inexperience or inadequate skills maintenance contributed to this result. With a department average of only seven intubations per month, opportunities for trainees to gain adequate experience are lacking. Indeed, only one ED registrar (already experienced) performed seven of seven successful intubations. This is in comparison to 27 clinicians (of whom at least 23 were ED clinicians) performing only one or two intubations in the eight month period within the ED. Such low exposure to what is an advanced, high risk skill has substantial ramifications for acquisition of skills and their ongoing maintenance. Pathways for development and maintenance of the required skills are being explored through other environments including simulation, Anaesthesia Departmental liaison and formal courses.

On reviewing the laryngoscopic grades of view reported at each attempt, 81% of first attempts were reported to have an easy view (grade 1-2) on direct visualisation. Whilst on the second attempt, only one patient was noted to have a difficult view (grade 3). Of those who needed at least two attempts, 81.8% of intubators in the first attempt had done <100 intubations compared to 36.4% in the second attempt. Difficult laryngoscopy (grade 3-4) was reported in 16.6% of those using direct laryngoscopy and 18.8% of those using videolaryngoscopy. The expected incidence of a grade 3-4 view is less than 1.2%. (22) A number of possible explanations for this disparity are proposed: lack of familiarity with the laryngoscope and poor technique may contribute, particularly with regard to videolaryngoscopic use, incorrect application of Cormack-Lehane grade or unfamil-

iarity with its use, suboptimal patient positioning (only 10.4% of patients were ramped) or exaggeration of difficulty following a failed intubation attempt. Alternatively, the ED patient population may still provide inherently more difficult grades of airway than those undergoing elective anaesthesia simply by the acute nature of the presentation, potential for distorted anatomy and unstable physiology. (2,3)

Interestingly, more complications were reported with videolaryngoscopy (McGrath) 37.5% compared to direct laryngoscopy 12.5%. Of the 16 videolaryngoscopy uses for the first attempt, 12 patients were not predicted to have a difficult airway. It is not documented why the McGrath was chosen as first line in these 12 cases. It is possible however that an inexperienced operator considered it could make intubation easier or that its use was considered primarily as teaching aid.

Appropriate patient positioning is important and patients should be ramped if possible to aid preoxygenation and improved view. (9,23) However, only 10.4% of patients were ramped. Thirty-one point three percent had an occipital pad or pillow. Less than a quarter of patients required manual inline C spine immobilisation.

NAP4 (3) has shown that obese patients are twice as likely to develop serious airway complications during general anaesthesia compared to non obese patients. Only 14% of intubated patients in this study were obese (>100kg). The rate of obesity in New Zealand is currently 31%. (24) This unexpectedly low number is not representative of the typical ED patient population and could perhaps have contributed to the lower number of AEs reported in this study.

The use of cricoid pressure was associated with higher number of complications (16.2% versus 60%). This result correlates with multiple studies where it is shown to be not useful and potentially be harmful. (25,26) NAP4 (3) showed regurgitation/aspiration to be the major airway complication but with no evidence of harm. Use of cricoid pressure remains controversial. (3,25-28) Its use is not recommended in our airway checklist.

Etomidate was the most frequently used agent for sedation and anaesthesia (54% of patients) because 48.2% of patients had indications for intubation that could be complicated by hypotension and increased intracranial pressure. (29,30)

Two sepsis patients were both intubated with etomidate. Whilst researchers have raised concerns with etomidate use in sepsis and its effect on adrenal suppression (31) a multicenter randomized trial of critically ill patients requiring urgent intubation compared etomidate and ketamine and found no significant difference in organ failure score, 28-day mortality, or intubating conditions between the two groups. (32) A metanalysis has since confirmed single dose etomidate does not increase mortality in patients with sepsis. (33)

Only a small number of patients received an anaesthetic in combination with an analgesia. Thirty-four percent of intubations using propofol or etomidate had concurrent use of opioid analgesia.

Limitations

The study comprised very small numbers carried out in a single institution. It required voluntary completion of a hand-written form within a working ED. In order to obtain full capture of data investigators had to retrospectively complete some forms, review clinical notes and contact team leaders directly. This was time consuming and some forms were still incomplete or partially illegible. The study was conducted over a continuous eight-month period rather 12 months due in part, to a delay in introducing the airway checklist within WHED. This timeframe for data collection may have missed some seasonal variation.

Recommendations

Overall, a higher proportion of intubations were performed by WHED clinicians than previous studies. (6,7) but with seven intubations per month on average it is unlikely that a trainee or emergency physician in full time practice will see enough cases requiring RSI to use the procedures alone to maintain skills and other training opportunities should be sought. Suggestions include the expansion of training focusing on team work and communication, use of a checklist as a teaching aid, facilitating familiarity with equipment especially videolaryngoscopy. Creating increased awareness of the importance of analgesia. In addition, the use of didactic teaching, high fidelity simulation and involvement of our anaesthetic colleagues in order to achieve this. (34) Better documentation is highly recommended. The use of a version of the study data collection form could form part of standard documentation of intubation procedures within WHED. The feasibility of creating a mandatory record for intubation as a ‘procedure’ on WHED electronic database should be explored to improve quality processes. Finally, ideally 100% compliance with the use of the airway checklist should be encouraged and re-auditing should occur.

Conclusion

This audit provides a baseline of local data from which to drive further quality improvement processes. In particular, it has identified that there are limited opportunities for training and skills maintenance in a high-risk procedure. Adverse incidents are common and so resources should be utilized in addressing areas of training, processes and ongoing audit.

Acknowledgments

With thanks to Dr. Toby Fogg and Dr. Andrew Brainard for the initial concept and use of the Australian and New Zealand Emergency Department Airway Registry data collection form.With thanks to Dr. Maria Poynter and Dalice Sim (Otago University) for statistical support.

Table 1. Baseline descriptive data of the events

Variables	Frequency	Percentage
Age (years) (n=57)		
- 0-17	5	8.8
- 18-65	40	70.2
- >65	12	21.1
Gender (n=57)		
- Female	28	49.1
Weight (kg) (n=36)		
- <100 kg	31	86.1
- >100 kg	5	13.9
Speciality of intubator (n=52)		
- Anaesthetics	6	11.5
- ED	43	82.7
- ICU	3	5.8
Intubator experience (n=48)		
- <10 intubations	11	22.9
- 10-100 intubations	19	39.6
- >100 intubations	18	37.5
Time of induction (n=39)		
- Day (>8 a.m. - <5 p.m.)	18	46.2
- Evening (>5 p.m. - <10 p.m.)	9	23.1
- Night (>10 p.m. - <8 a.m.)	12	30.8
Frequency of attempts		
- 2 attempts	11	19.3
- 3 attempts	2	3.5
Disposition (n=53)		
- Died in ED	1	1.9
- Extubated in ED	1	1.9
- ICU	43	81.1
- Operating theatre	8	15.1

Legend: ED=emergency department; ICU=intensive care unit.

Table 2. Team leader seniority according to time of day

Time of induction	Team leader registrar		Team leader consultant	
	Frequency	Percentage	Frequency	Percentage
Day (>8 a.m. - <5 p.m.)	6	31.6	13	68.4
Evening (>5 p.m. - <10 p.m.)	4	44.4	5	55.6
Night (>10 p.m. - <8 a.m.)	6	60.0	4	40.0

Table 3. Indications for intubation

Reasons for intubation	Frequency (n=53)	Percentage
Airway obstruction	1	1.9
Altered mental status - not overdose	2	3.8
Burn/inhalation	1	1.9
Cardiac arrest	5	9.4
Cardiac failure	1	1.9
Head injury - airway not patent	2	3.8
Head injury - reduced GCS	10	18.9
ICH/stroke	6	11.3
Neck/facial trauma	1	1.9
Overdose/ingestion	10	18.9
Respiratory failure	4	7.5
Seizure	6	11.3
Sepsis	2	3.8
Shock	2	3.8

Legend: GCS=Glasgow coma scale; ICH=intra cranial haemorrhage.

Table 4. Prior to intubation procedures

Variables	Frequency	Percentage
Pre-assessment (n=44)		
- Formal airway assessment made	22	50.0
- Laryngoscopy predicted to be difficult	12	27.3
Pre-oxygenation (n=50)		
- BVM	28	56
- BVM+PEEP	5	10
- CPAP/BiPAP	1	2
- NRBM	16	32
Apnoeic oxygenation (n=50)		
- Nil	17	34.0
- Nasal prongs	20	40.0
- BVM	13	26.0
- CPAP/BiPAP	0	-
- LMA	0	-
Patient positioning (n=48)		
- Bed tilted	1	2.1
- Flat	27	56.3
- Pillow or occipital pad	15	31.3
- Ramped or head up	5	10.4
Pre-RSI checklist used (n=44)	24	54.5

Legend: BMV=bag mask ventilation; PEEP=positive end-expiratory pressure; CPAP=continuous positive airway pressure; BiPAP=bilevel positive airway pressure; NRBM=non-rebreather mask; LMA=laryngeal mask airway; RSI=rapid sequence induction.

Table 5. Medications used for intubation

Medication used	Frequency	Percentage
Nil	2	3.8
Ketamine	4	7.5
Propofol	14	26.4
Etomidate	29	54.7
Thiopentone	0	0.0
Fentanyl	18	34.0
Suxamethonium	26	49.1
Rocuronium	29	54.7
Missing data	4	7.5
Propofol and fentanyl	9	17.0
Propofol and etomidate	2	3.8
Etomidate and fentanyl	9	17.0
Ketamine and fentanyl	1	1.9
Suxamethonium and rocuronium	9	17.0

Table 6. Characteristics of intubation attempts

	Attempt 1		Attempt 2		Attempt 3	
Intubating parameters	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Intubator speciality	n=52		n=11		n=2	
- Anaesthetics	6	11.5	0	-	0	-
- ED	43	82.7	11	100	2	-
- ICU	3	5.8	0	-	0	-
Intubator seniority	n=52		n=11		n=2	
- Consultant	4	7.7	6	54.5	1	-
- Registrar	48	92.3	5	45.5	1	-
Intubator experience	n=48		n=11		n=2	
- <10	11	22.9	1	9.1	1	-
- 10-100	19	39.6	3	27.3	0	-
- >100	18	37.5	7	63.6	1	-
Laryngoscope type	n=48		n=11		n=2	
- Manual	32	66.7	10	90.9	1	-
- Video	16	33.3	1	9.1	1	-
Grade direct vision	n=32		n=8		n=1	
- 1	19	59.4	3	37.5	0	-
- 2	7	21.9	4	50	0	-
- 3	3	9.4	1	12.5	1	-
- 4	3	9.4	0	0	0	-
Grade video	n=12		n=1		n=1	
- 1	7	58.3	0	-	0	-
- 2	3	25	0	-	0	-
- 3	1	8.3	1	-	1	-
- 4	1	8.3	0	-	0	-
Adjuncts	n=45		n=11		n=2	
- Bougie	18	40	4	36.4	1	-
- Stylet	14	31.1	5	45.5	1	-
- Neither	13	28.9	2	18.2	0	-
Maneuvers	n=42		n=11		n=2	
- ELM	7	16.7	1	9.1	1	-
- Cricoid	5	11.9	2	18.2	1	-
- MILS	11	26.2	3	27.3	0	-

Legend: ED=emergency department; ICU=intensive care unit; ELM=external laryngeal manipulation; MILS=manual in-line stabilisation.

Table 7. Intubator experience specifically in those patients requiring multiple attempts

	Attempt 1		Attempt 2		Attempt 3	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Intubator experience	n=11		n=11		n=2	
- <10	5	45.4	1	9.1	1	-
- 10-100	4	36.4	3	27.3	0	-
- >100	2	18.2	7	63.6	1	-

Table 8. List of complications in order of frequency

Complications	Frequency
Nil	47
Desaturation	4
Hypotension	2
Second dose neuro muscular blocking agent needed	2
Oesophageal intubation	2
Equipment failure	1
Bradycardia	1
Main stem bronchi intubation	1
Vomiting with aspiration	1♦
Other	1
Dental injury	0
Airway trauma	0
Laryngospasm	0
Medication error	0
Cardiac arrest	0
2 complications	1♣
3 complications	0
4 complications	1♥

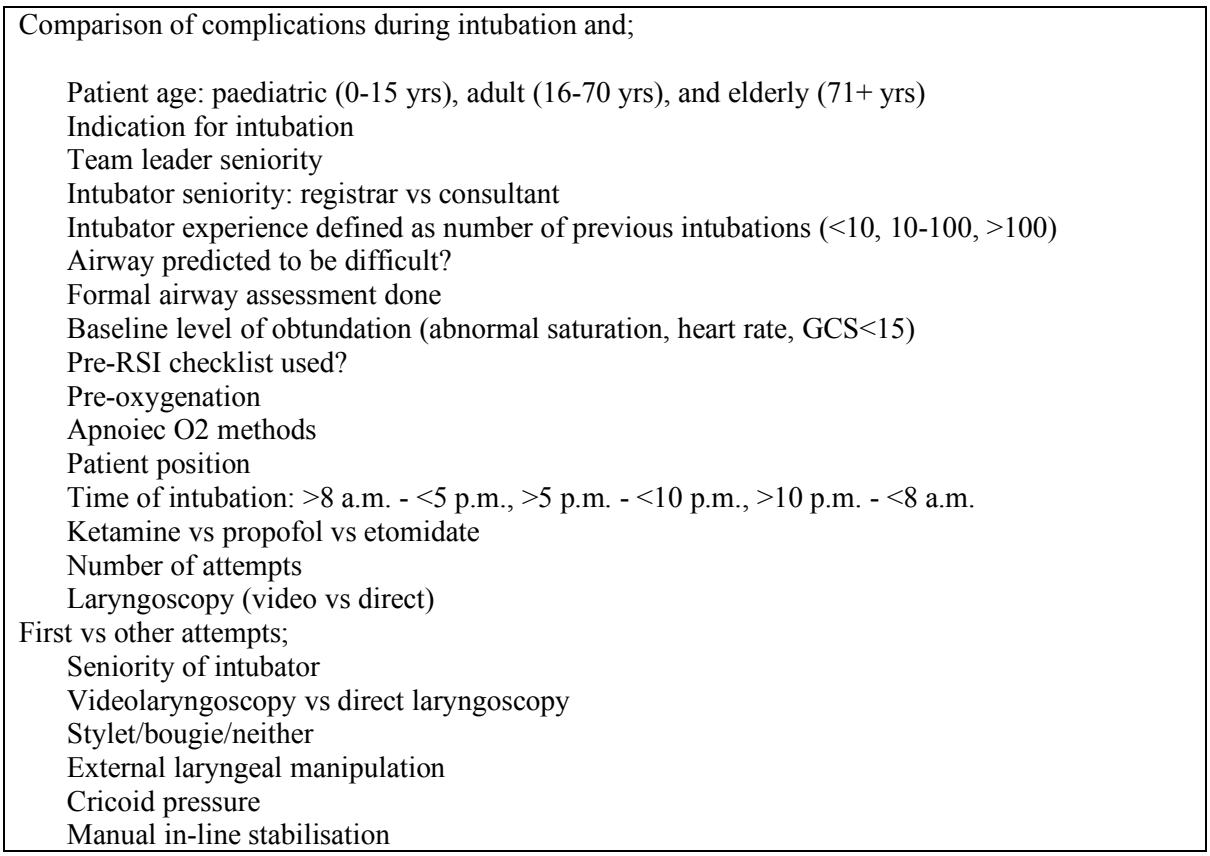
Legend: ♦=required 3 intubation attempts due to vomitus in airway obstructing view; ♣=desaturation and hypotension; ♥=equipment failure, desaturation, 2nd dose neuromuscular blocking agent, “other” blood expelled from ETT.

Table 9. Complications compared with variables listed

Complications compared with	p value
Age group	0.358
Intubation reason	0.42
Team leader seniority	0.483
Intubator speciality	0.285
Intubator seniority	0.163
Intubator experience	0.287
Formal assessment made	0.721
Predicted difficult airway	0.433
Pre-RSI checklist use	0.147
Pre-oxygenation - Nil - Nasal prongs - BVM	 1 1 0.928
Patient position	0.685
Time of intubation	0.171
Inductions medication used	0.153
Number of attempts	0.042
Video vs direct	0.064
View grades direct	0.117
View grades video	0.788
Adjuncts used	0.257
ELM	0.314
Cricoid	0.057
MILS	0.403

Legend: BVM=bag valve mask; ELM=external laryngeal manipulation; MILS=manual in-line stabilisation.

Figure 1. Comparison of complications during intubation



Legend: GCS=Glasgow coma scale; RSI=rapid sequence induction.

References

1. Brown AF. Advanced airway management in the Emergency Department: Finally moving on from provence to providence. Emerg Med Australas 2007;19:185-7.
2. Cook T, Behringer EC, Benger J. Airway management outside the operating room: hazardous and incompletely studied. Curr Opin Anaesthesiol 2012;25:461-9.
3. Cook TM, Woodall N, Frerk C, Fourth National Audit Project. Major complications of airway management in the UK: results of the Fourth National Audit Project of The Royal College of Anaesthetists and The Difficult Airway Society. Part 1: anaesthesia. Br J Anaesth 2011;106:617-31.
4. Levitan RM, Rosenblatt B, Meiner EM, Reilly PM, Hollander JE. Alternating day emergency medicine and anaesthesia resident responsibility for management of the trauma airway: a study of laryngoscopy performance and intubation success. Ann Emerg Med 2004;43:48-53.
5. Sagarin MJ, Barton ED, Chng YM, Walls RM, National Emergency Airway Registry Investigators. Airway Management by US and Canadian emergency medicine residents: a multicentre analysis of more than 6000 endotracheal intubation attempts. Ann Emerg Med 2005;46: 328-36.
6. Stevenson AG, Graham CA, Hall R, Korsah P, McGuffie AC. Tracheal intubation in the emergency department: the Scottish district hospital perspective. Emerg Med J 2007;24:394-7.
7. Fogg T, Annesley N, Hitos K, Vassiliadis J. Prospective observational study of the practice of endotracheal intubation in the Emergency Department of a tertiary hospital in Sydney, Australia. Emerg Med Australas 2012;24:617-24.
8. Fogg T, Alkhouri H, Vassiliadis J. The Royal North Shore Hospital Emergency Department airway registry: Closing the audit loop. Emerg Med Australas 2016;28:27-33.
9. Collins JS, Lemmens HJ, Brodsky JB, Brock-Utne JG, Levitan RM. Laryngoscopy and morbid obesity: a comparison of the "sniff" and "ramped" positions. Obes Surg 2004;14:1171-5.
10. Australasian College for Emergency Medicine, Australian and New Zealand College of Anaesthetists, College of Intensive Care Medicine of Australia and New Zealand. Guidelines for Transport of Critically Ill Patients [Internet]. 1992 Feb [updated 2015 Aug; cited 2016 Mar 7]. Available from: https://acem.org.au/getmedia/0daba691-5e60-4a88-b6a8-24f2af3e5ebf/P03_Transport-of-Critically-Ill-Patients_Aug_(2015).aspx
11. Semler MW, Janz DR, Lentz RJ, Matthews DT, Norman BC, Assad TR, et al. Randomized Trial of Apneic Oxygenation during Endotracheal Intubation of the Critically ill. Am J Respir Crit Care Med 2016;193:273-80.
12. Ramachandran SK, Cosnowski A, Shanks A, Turner CR. Apneic oxygenation during prolonged laryngoscopy in obese patients: a randomized, controlled trial of nasal oxygen administration. J Clin Anesth 2010;22:164-8.
13. Taha SK, Siddik-Sayyid SM, El-Khatib MF, Dagher CM, Hakki MA, Baraka AS. Nasopharyngeal oxygen insufflation following pre oxygenation using the four deep breath technique. Anaesthesia 2006;61:427-30.
14. Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. Ann Emerg Med 2012;59:165-75.
15. Kerrey BT,Rinderknecht AS, Geis GL, Nigrovic LE, Mittiga MR. Rapid sequence intubation for pediatric emergency patients: higher frequency of failed attempts and adverse effects found by video review. Ann Emerg Med 2012;60:251-9.
16. Kirkpatrick DH, Burkman RT. Does standardization of care through clinical guidelines improve outcomes and reduce medical liability? Obstet Gynecol 2010;116:1022-6.
17. Russ S, Rout S, Sevdalis N, Moorthy K, Darzi A, Vincent C. Do safety checklists improve teamwork and communication in the operating room? A systematic review. Ann Surg 2013; 258:856-71.
18. Urbach DR, Govindarajan A, Saskin R, Wilton AS, Baxter NN. Introduction of Surgical Safety Checklists in Ontario, Canada. N Engl J Med 2014;370:1029-38.
19. Hasegawa K, Shigemitsu K, Hagiwara Y, Chiba T, Watase H, Brown CA 3rd, et al. Association between repeated intubation attempts and adverse events in emergency departments: an analysis of a multi centre prospective observational study. Ann Emerg Med 2012;60:749-54.
20. Sakles JC, Chiu S, Mosier J, Walker C, Stolz U. The importance of first pass success when performing orotracheal intubation in the emergency department. Acad Emerg Med 2013;20:71-8.
21. Kerslake D, Oglesby AJ, Di Rollo N, James E, McKeown DW, Ray DC, et al. Tracheal intu-

bation in an urban emergency department in Scotland: a prospective, observational study of 3738 intubations. Resuscitation 2015;89:20-4.
22. Yentis S.M, Lee DJ. Evaluation of an improved scoring system for the grading of direct laryngoscopy. Anaesthesia 1998;53:1041-4.
23. Lane S, Saunders D, Schofield A, Padmanabhan R, Hildreth A, Laws D. A prospective, randomised controlled trial comparing the efficacy of pre-oxygenation in the 20 degrees head-up vs supine position. Anaesthesia 2005;60:1064-7.
24. Ministry of Health New Zealand Government. Annual Update of Key Results 2014/15: New Zealand Health Survey. Obesity and stats [Internet]. 2016 [cited 2016 Jun 2]. Available from http://www.health.govt.nz/nz-health-statistics/health-statistics-and-data-sets/obesity-data-and-stats
25. Levitan RM, Kinkle WC, Levin WJ, Everett WW. Laryngeal view during laryngoscopy: A randomised trial comparing cricoid pressure, backward-upward-rightward pressure, and bimanual laryngoscopy. Ann Emerg Med 2006; 47:548-55.
26. Ellis DY, Harris T, Zideman D. Cricoid pressure in emergency department rapid sequence tracheal intubations: a risk-benefit analysis. Ann Emerg Med 2007;50:653-65.
27. Cook TM. The cricoid debate - balancing risks and benefits. Anaesthesia 2016;71:721-2.
28. Cranshaw J, Nolan J. Airway management after major trauma. Continuing Education in Anaesthesia, Critical Care & Pain 2006;6:124-7.
29. Oglesby AJ. Should etomidate be the induction agent of choice for rapid sequence intubation in the emergency department? Emerg Med J 2004;21:655-9.
30. Zed PJ, Abu-Laban RB, Harrison DW. Intubating conditions and hemodynamic effects of etomidate for rapid sequence intubation in the emergency department: an observational cohort study. Acad Emerg Med 2006;13:378-83.
31. Jackson WL Jr. Should we use etomidate as an induction agent for endotracheal intubation in patients with septic shock?: a critical appraisal. Chest 2005;127:1031-8.
32. Jabre P, Combes X, Lapostolle F, Dhaouadi M, Ricard-Hibon A, Vivien B, et al. Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomised controlled trial. Lancet 2009;374:293-300.
33. Gu WJ, Wang F, Tang L, Liu JC. Single-dose etomidate does not increase mortality in patients with sepsis: a systematic review and meta-analysis of randomized controlled trials and observational studies. Chest 2015;147:335-46.
34. Graham CA. Advanced airway management in the emergency department: what are the training and skills maintenance needs for UK emergency physicians? Emerg Med J 2004;21: 14-9.

Appendix 1

The Sharp End. New Zealand Emergency Medicine Network-Australian New Zealand Emergency Department Airway Registry (NZEMN-ANZEDAR) [Internet]. 2016 [cited 2016 May 26]. Available from: http://www.thesharpend.org/airway-registry/

Appendix 2
Data collection form

AUSTRALIA & NEW ZEALAND ED AIRWAY REGISTRY

Name / Medical Record Number	Date:
Place Patient Sticker Here	Estimated Patient Weight:
Age / Gender	Team Leader: — Specialty / Seniority / Role (ED / Reg / Working in ED – or Anaes / reg / Working in ED)

Indication For Intubation – tick ONE only

Trauma:		Medical:			
Head injury – reduced LOC	☐	Respiratory failure	☐	Altered mental status – not overdose	☐
Head injury – airway not patent	☐	Airway obstruction	☐	Overdose / ingestion	☐
Neck / facial trauma	☐	Anaphylaxis	☐	Cardiac arrest	☐
Burn / inhalation	☐	Cardiac failure	☐	**Other** (please state):	
Drowning	☐	Sepsis	☐		
Chest trauma	☐	GI bleed	☐		
Shock	☐	Seizure	☐		
Traumatic cardiac arrest	☐	ICH/stroke	☐		

Was laryngoscopy predicted to be difficult?	Y / N	Was a formal assessment made?	Y / N
Why difficult?: eg "LEON" criteria (See over)			

Observations	At time of **Decision** to Intubate	GCS	RR	SBP	HR	$Sa0_2$
	First set **AFTER INTUBATION**			SBP	HR	$Sa0_2$

Preoxy* (Final device used)	NRBM ☐	BVM ☐	BVM+PEEP ☐	CPAP/BiPAP ☐	LMA ☐
Apnoeic O_2† (Tick all that apply)	NIL ☐	NP ☐	BVM ☐	CPAP/BiPAP ☐	LMA ☐

Patient Position		
	Flat ☐	Bed tilted- head up ☐
	Pillow or occipital pad ☐	Ramped- head up ☐

Was a Pre-RSI Checklist Used?	Y / N
Time Of Induction (24 Hrs)	:
Time Of Intubation (24 Hrs)	:

Medication For Induction			
NIL	☐		Other (state)
Ketamine		dose (mg)	
Thiopentone		dose (mg)	
Propofol		dose (mg)	
Etomidate		dose (mcg)	
Suxamethonium		dose (mg)	
Rocuronium		dose (mg)	

Attempt (#)	Primary Airway Operator (Name)	Specialty / Seniority / Role (ED / Reg / Working in ED or Anaes / Reg / Working in ED)	No. Previous Intubations (Please circle)	Laryngoscope M=Mac V=Video (state) O=Other (state)	Cormack & Lehane Grade (1-2-3-4)		B=bougie S=stylet N=neither	External Laryngeal Manipulation (Y/N)	Cricoid (Y/N)	Manual In-line Stabilisation (Y/N)
					Direct Vision	Video				
1			<10 10-100 >100							
2			<10 10-100 >100							
3			<10 10-100 >100							
4			<10 10-100 >100							
5			<10 10-100 >100							

*NRBM = Non Re-Breather Mask, BVM = Bag Valve Mask, BVM+PEEP = PEEP Valve attached to BVM, CPAP/BiPAP = NIV for preoxygenation
†NP = Nasal Prongs, BVM = *Active Ventilation* using BVM after induction until laryngoscopy, CPAP/BiPAP = NIV after induction until laryngoscopy

PLEASE TURN OVER

Version 190814 (MMH)

ETT Placement Confirmation					
Waveform capnography	☐	Colour change capnometry	☐	Clinical confirmation alone	☐

Intubation Manoeuvres			
NIL	☐	Cricoid pressure removed	☐
Guedel / NPA inserted post induction	☐	LMA inserted post induction	☐
BVM ventilation after failed attempt	☐	Patient position changed	☐
		Surgical airway	☐

Intubation Complications			
NIL	☐	Oesophageal intubation	☐
Equipment Failure – state what in comments	☐	Mainstem bronchial intubation	☐
Desaturation – Sa02 < 90%	☐	Vomit – no aspiration	☐
Bradycardia –HR < 60bpm	☐	Vomit – with aspiration	☐
Hypotension – requiring IV fluid/pressors	☐	Laryngospasm	☐
Dental trauma due to intubation	☐	Medication error	☐
Airway trauma by intubator	☐	Cardiac arrest	☐
Second dose of paralytic agent	☐	Other (State in Comments)	☐

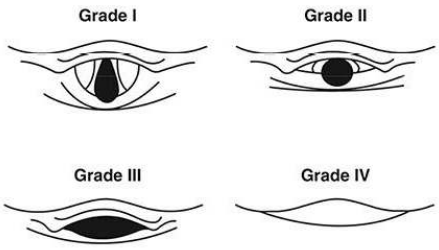
Disposition					
ICU ☐	Theatre/Angio/ Cath Lab ☐	**Transferred** to another hospital ☐	Required subsequent **re-intubation** in ED. Please complete another airway form ☐	**Extubated** in ED ☐	**Died** in ED ☐

"**Crash**" Airway ☐	"**Emergent**" Airway ☐	"**Semi-Elective**" Airway ☐

How difficult was it to control this patient's airway? (mark with an "X")

Easiest ever ⟷ Most difficult ever

Comments

"LEON" Evaluation	Cormack and Lehane Grading
Look Externally: **Facial Trauma** **Large Incisors** **Beard or Moustache** **Large Tongue** **Evaluate 3-3-2 Rule:** **Inter incisor distance ≥ 3 fingers** **Hyoid-mental distance ≥ 3 fingers** **Thyroid–hyoid distance ≥ 2 fingers** **Obstruction (eg haematoma, epiglottitis, large tonsils)** **Neck mobility limited?**	

THANK YOU: **Return to ED Intubation Registry BOX in ED**

Admin use only:

Data reviewed ☐	Data complete ☐	More data required ☐	Form updated ☐	Record complete ☐	Sequence No.

Developed by Toby Fogg, John Vassiliadis, Alex Tzannes, John Mackenzie and Matt Murray (and Andrew Brainard)

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