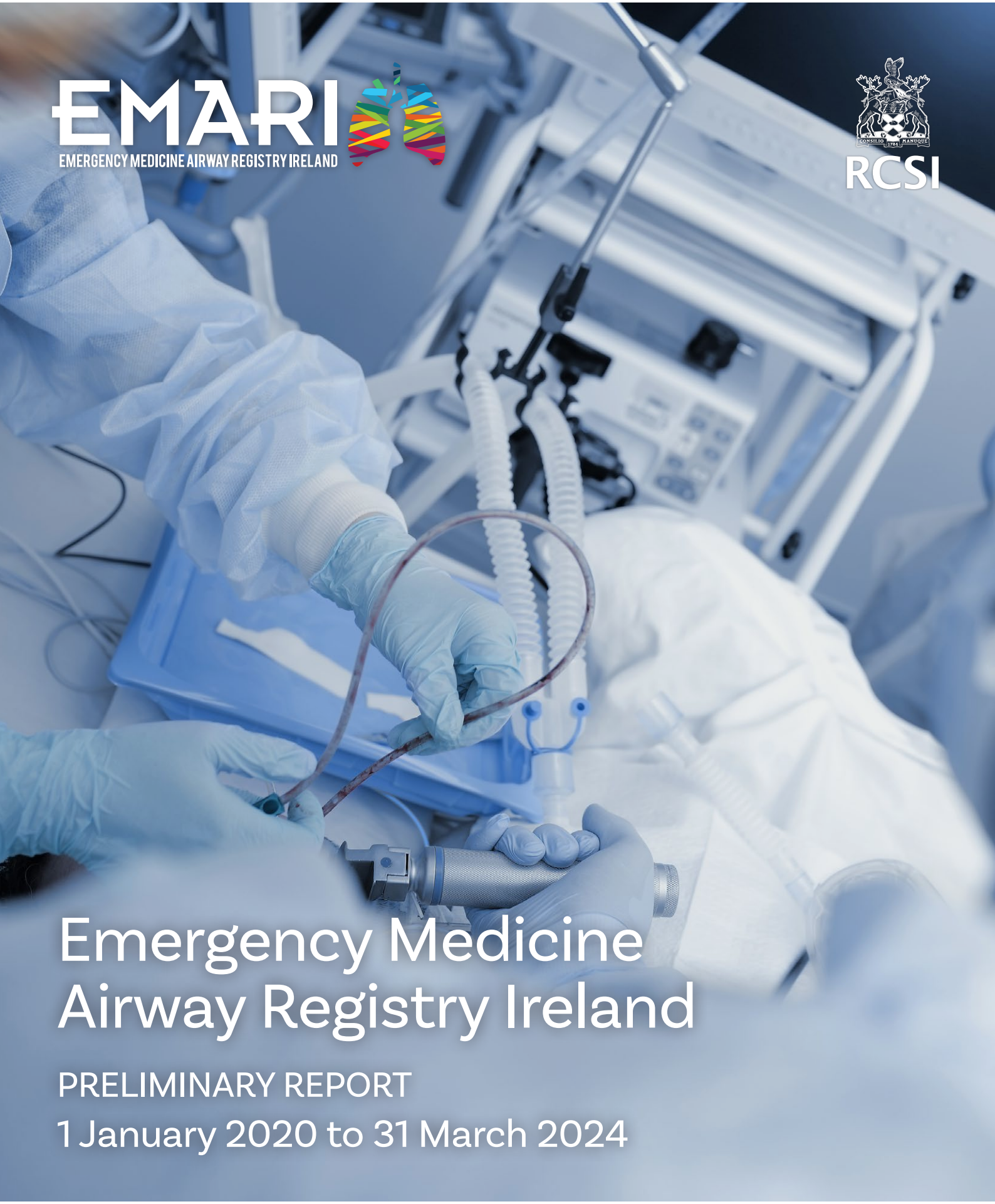
EMARI
EMERGENCY MEDICINE AIRWAY REGISTRY IRELAND

RCSI



Emergency Medicine Airway Registry Ireland

PRELIMINARY REPORT
1 January 2020 to 31 March 2024

APRIL 2025

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Ospidéil OL UL Hospitals Working together, caring for you
HSE
Clinical Design & Innovation
EMERGENCY MEDICINE

ACRONYM	DEFINITION
COVID-19	Coronavirus disease 2019
CPAP	Continuous positive airway pressure
DSI	Delayed sequence induction[1]
ED	Emergency department
EMAR-I	Emergency Medicine Airway Registry Ireland
EMAR-UK	Emergency Medicine Airway Registry United Kingdom
GDPR	General Data Protection Regulation
HSE	Health Service Executive
IAEM	Irish Association for Emergency Medicine
ICU	Intensive care unit
NAP4	Fourth National Audit Project
NOCA	National Office of Clinical Audit
QR	Quick response
RSI	Rapid sequence induction
SHO	Senior House Officer
SpR	Specialist Registrar[1]
UK	United Kingdom

1. Rapid/ Delayed Sequence Induction is the correct term although for context it is used interchangeably with Rapid/Delayed Sequence Intubation as per the Irish Association of Emergency Medicine Guidelines (Grossi et al, 2024).

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1 January 2020 to 31 March 2024

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Foreword

Inspiring a culture of continuous learning and improvement

In the complex and challenging landscape of emergency medicine, the airway remains a critical frontier where mastery and innovation intersect. In my career I have seen emergency medicine embrace and recognise that acute critical airway management is a core skill for our specialty in order to ensure the best outcomes for our patients. In the past, this space has been the domain of other critical care specialties as well, which reflected several factors, including adequate training, equipment, adequate supervision of trainees, and a belief that Emergency Medicine Physicians could be masters and experts in this domain. As we stand on the cusp of a new era, the establishment of the Emergency Medicine Airway Registry Ireland (EMAR-I) heralds a transformative approach to airway management. The Australian and New Zealand Emergency Department Airway Registry had the same impact on Australian and New Zealand practice. The lessons learned assisted with training, policy, guideline development and equipment requirements, and confirmed our ability as practitioners to perform these important skills in the unique environment of emergency departments safely and competently.

EMAR-I will not merely be a collection of data; it will be a living, breathing entity that will capture the intricate tapestry of airway practices across Ireland. It will embody the collective wisdom of Ireland's emergency medicine airway practice, drawing on experiences and insights to enhance patient outcomes, training and policy. By documenting and analysing your airway interventions, you will forge a pathway towards greater understanding, consistency and excellence in care.

I am positive that EMAR-I, like our registry, will inspire a culture of continuous learning and improvement. It will illuminate best practices and highlight the challenges faced in airway management. EMAR-I will foster collaboration, promote research and empower clinicians to make informed decisions about practice and training based on data from your nation.

As you embark on this journey, I invite all practitioners to engage with the EMAR-I, to contribute their unique experiences, and to be part of a collective movement towards safer and more effective airway management that is based on data. This is a pivotal moment in the landscape of emergency medicine in Ireland and, ultimately, patient care. I wish you the best and congratulate you and thank you for what you do.

John Vassiliadis

Bachelor of Medicine, Bachelor of Surgery (University of Sydney), Fellowship of the Australian College for Emergency Medicine, Master of Health Professionals Education (Monash University), Affiliate of the Australian Institute of Company Directors Royal Australian Navy; Chair Prevocational Training Council, Health Education and Training, New South Wales Government; Senior Staff Specialist, Emergency Medicine, Royal North Shore Hospital; Director of Prevocational Education and Training, Royal North Shore Hospital; Clinical Professor, Specialty of Emergency Medicine, Sydney Medical School; Honorary Professor, Macquarie University; Adjunct Clinical Professor, Monash Centre for Scholarship in Health Education, Monash University; Captain, Director of Navy Health Training, Royal Australian Navy.

Executive summary

Emergency airway management

This is the inaugural report of the Emergency Medicine Airway Registry Ireland (EMAR-I), which was established in 2019 and was implemented nationally just ahead of the coronavirus disease 2019 (COVID-19) pandemic. This is the first national airway registry for emergency departments (EDs) in Ireland. The registry provides comprehensive details on patient demographics, clinical management and outcomes of patients requiring emergency intubation. The data allow for the assessment of patient management and benchmarking of individual hospitals.

Advanced airway management is a high-risk procedure used in emergency situations and known to have increased rates of complications. Of the 218 cases recorded in the EMAR-I database across the 4-year period from 1 January 2020 to 31 March 2024, the overall first-pass success rate was 84.4%, which is comparable with international rates. The complication rate reported in the EMAR-I cohort was 25.2%; again, this is comparable with international rates. This report shows the ongoing commitment of staff to high-quality clinical patient care in the recorded patient group.

However, the number of recorded EMAR-I cases represents a fraction of the number of emergency intubations performed in the time period covered by this report, with legacy cases to be included in future yearly reports. Moreover, it represents a fraction of the cases that should have been recorded.

This report has practical recommendations for emergency airway management. It highlights an opportunity for optimally managing the governance and care of this patient cohort by implementing EMAR-I in all EDs across the health service and for participating EDs to identify Airway Clinical Leads and governance structures to support the local implementation of EMAR-I. At the patient bedside, the report recommends the use of an airway checklist for every airway intubation in the ED, a patient safety-focused tool that is immediately implementable.

At the end of 2024, the Health Service Executive National Centre for Clinical Audit commissioned and provided funding to the National Office of Clinical Audit (NOCA) to develop and implement EMAR-I. The EMAR-I team would specifically like to thank all those who have supported the project both nationally and internationally.

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1. Introduction

The Emergency Medicine Airway Registry Ireland (EMAR-I) is a national repository (a registry) for collecting the details of every intubation that is undertaken in all 29 emergency departments (EDs) in Ireland. The aim of EMAR-I is to assess the practice and safety of endotracheal intubation in all Irish EDs. EMAR-I has been gathering data since 2019.

The Irish Association for Emergency Medicine (IAEM) publishes national clinical guidelines for emergency medicine. These are based on best available evidence and reflect the safest way to perform a competency-based skill such as intubation. As a high-risk, low-frequency procedure, adherence to the intubation guidelines is essential for the safest patient outcomes. Until the EMAR-I database was established, no system of continuous national oversight was possible for this procedure.

When an airway intubation occurs with potent sedative and paralytic medications, it is usually referred to as a rapid sequence induction (RSI). There is a known higher rate of complications when these procedures are performed in the ED compared with other hospital locations. Importantly, this is independent of the specialty of the practitioner. EMAR-I collects data on all ED intubations, even if they are performed by non-emergency personnel. All grades of Emergency Medicine Physicians, Retrievalists, Intensivists and Anaesthetists who perform intubations in Irish EDs can upload data. In essence, it is the procedure that is primarily being audited.

Following the launch of EMAR-I in 2019, the onset of the coronavirus disease 2019 (COVID-19) pandemic resulted in changes in airway management and adjusted intubation practices in Irish hospitals, with fewer intubations occurring in EDs. As a result, the utilisation of the EMAR-I platform has not gone as expected. EDs have become busier and data tracking has moved down the list of priorities for many clinicians. However, a number of hospitals have been successfully tracking data but not uploading them due to the challenge and complexity of maintaining General Data Protection Regulation (GDPR) compliance.

The aim of the national EMAR-I project sponsored by the Health Service Executive (HSE) Emergency Medicine Programme and the IAEM, is to promote better use of the EMAR-I audit tool, with an the ability to have a more accurate national picture of all intubations carried out in the ED. At the end of 2024, the HSE National Centre for Clinical Audit (NCCA) commissioned and provided funding to the National Office of Clinical Audit (NOCA) to develop and implement EMAR-I.

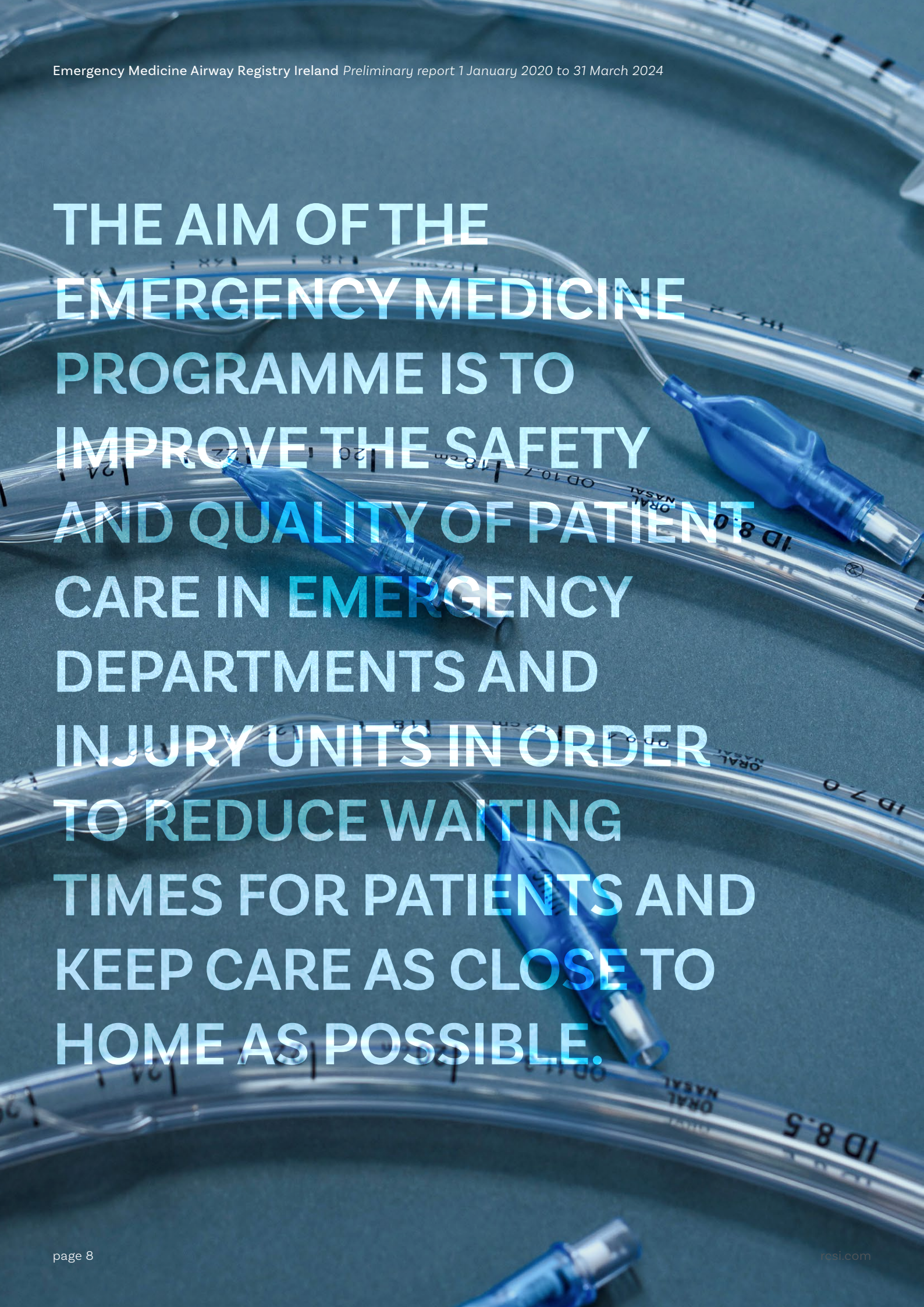
Purpose of this report

This preliminary report describes the quality of care provided to patients who have had an endotracheal intubation in EDs across Ireland. It describes the types of patients who require intubation, the doctors performing this procedure, the procedure itself, and any complications arising from or during the procedure. Throughout this report, the quality of care is evaluated against best-practice clinical standards in order to inform recommendations for improvement.

Who is this report aimed at?

This report presents the key findings of EMAR-Ion the process and outcomes of care for patients receiving advanced airway management in the ED resuscitation room. It is intended for use by a wide range of individuals and organisations, including:

- Healthcare professionals involved in endotracheal intubation in the ED;
- Healthcare managers and policy-makers;
- Patients using the healthcare service;
- Researchers.



THE AIM OF THE EMERGENCY MEDICINE PROGRAMME IS TO IMPROVE THE SAFETY AND QUALITY OF PATIENT CARE IN EMERGENCY DEPARTMENTS AND INJURY UNITS IN ORDER TO REDUCE WAITING TIMES FOR PATIENTS AND KEEP CARE AS CLOSE TO HOME AS POSSIBLE.

2. *Quality improvement in action:* Using EMAR-I to improve airway governance

A narrative on the experience of the Emergency Department, University Hospital Galway

Dr Jimmy Lee
Consultant in Emergency Medicine and Airway Lead,
Emergency Department, University Hospital Galway

What is the problem?

With the inclusion of a 6-month foundational training in anaesthesiology now well-established in emergency medicine training in Ireland, it is common to see Emergency Medicine Physicians intubating in the resuscitation room. The now more difficult question is: How do we maintain our skills as low-frequency intubators? It is an uncomfortable question, as some may conclude that without a large volume of patients, it would only be natural for us to de-skill to the point where we are no longer competent, relying on our previously acquired 'licence to tube' during our core training to proclaim our expertise. Though welcomed, the increasing number of junior doctors on our rosters has not been met with a proportional increase in critically ill patients requiring intubation, which has further exacerbated the problem of maintaining our airway currencies.

Governance comes into question: How are we maintaining our competency to intubate? Our ED only began uploading our data in mid-2024. Without data, things were left to anecdotes and hearsay. Comments like "Anaesthesia does all the airway management in Galway ED" or "the Emergency Medicine Physicians are intubating, but they're probably not as good as the Anaesthetists" were not unusual, nor probably unique to our ED.

What can be done?

EMAR-I was vital to show the reality of airway management in our resuscitation rooms, which in our governance strategy aims to answer the question "Are we intubating?" and, perhaps more importantly, "Are we good enough to be intubating?" As EMAR-I is a well-established, easy-to-use tool, we used it to record all our intubation data. This was only made possible with buy-in from multidisciplinary staff of all grades, from Consultants to Registrars to Clinical Nurse Managers and Staff Nurses. To date, every single intubation performed in our resuscitation room has been captured on EMAR-I. This has been vital to understanding our performance and adjusting our training. Our airway governance programme maintains training through a dedicated programme of regular Consultant-led airway training, with daily multidisciplinary airway drills with the resuscitation teams on duty on any given day. Registrars (and Consultants) are required to maintain their skill currencies through Consultant-supervised simulations at a rate of at least twice a month.

Positive first results

At the time of writing, our airway data suggests that we are intubating just under twice a week, with Emergency Medicine Physicians intubating more than 80% of the time. The majority of non-emergency medicine led intubations were for children. Importantly, the first-pass success rate of Emergency Medicine Physicians in University Hospital Galway ED is over 92.3%. The use of EMAR-I has been a vital tool for both the assessment and buy-in of our in-hospital colleagues for our emergency medicine airway programme and is a way to keep asking ourselves the honest but difficult question, "Are we intubating, and are we intubating well?"

Using our airway data, I can currently say yes – but there is still room for improvement.

3. EMAR-I methods

Data collection and sources for EMAR-I

Data on every intubation are collected by practitioners using an online portal. This is best done immediately after the intubation, when details can be accurately recalled. The portal is accessed directly online or via a smartphone quick response (QR) code, which opens a quick-pick drop-down questionnaire. The questionnaire can be completed within a couple of minutes.

The anonymised data that are collected include patient demographics and specific details about the procedure, including any complications. Once the form has been completed, the data are uploaded to the REDCap database and are immediately available to practitioners for interpretation. REDCap is an anonymised patient software application hosted at the University of Limerick. A nominated Airway Lead Consultant in each ED has access to the data, allowing them the ability to assess their individual department's performance.

The data for an individual practitioner, the specific ED, a region, or Ireland as a whole can be interpreted. This allows for audit, quality improvement, competency assessment planning, and benchmarking. Moreover, international benchmarking can take place when EMAR-I is compared with similar databases, such as the Emergency Medicine Airway Registry United Kingdom (EMAR-UK) and the Australian and New Zealand Emergency Department Airway Registry. Overall, the tool provides a system of oversight of the practice for this high-risk, low-frequency core skill that is performed in Irish EDs.

Data governance for this report

The data for developing this report were shared with NOCA under a data-processing agreement with the University of Limerick. Dr Jimmy Lee shared the clinician experience of using EMAR-I in Chapter 2, and Dr Irene Grossi shared the clinician experience of using EMAR-UK in Chapter 8.

Data validation and data analysis for this report

The data validation and analysis for this report were conducted using SPSS Version 29.0.1.0. A total of 218 intubation cases were recorded in the EMAR-I system between 1 January 2020 and 31 March 2024. This dataset represents only a small fraction of the total number of intubations performed in Irish EDs during this period. Fourteen EDs contributed data, with the number of cases per ED ranging from 1 to 115. Notably, a single ED accounted for more than 50% of all recorded intubation cases.

Missing data were handled by including them in the tables and graphs, where appropriate. Any missing values are clearly indicated, and the analysis accounts for the gaps in the data so as to ensure transparency and accuracy in the findings.

Evidence synthesis and recommendation formation for this report

A writing group – comprising emergency medicine clinicians with NOCA audit methodologists and data analysts – was established in order to plan and write this report. Following data analysis, the Data Analyst provided the writing group with figures and analytical commentary while the clinicians provided clinical commentary, and meetings were held to review, edit and interpret the results.

The writing group agreed on the key findings and developed the recommendations by consensus. Once the recommendations were agreed, the owners of each recommendation were identified in order to aid in the implementation of each recommendation.

4. Data quality statement

Scope

This data quality statement assesses the EMAR-I dataset used for this report, focusing on the data quality dimension of "Accuracy and Reliability" (Health Information and Quality Authority,2018). Specifically, it examines the completeness and accuracy of the data release. Due to limitations, the data quality dimension of coverage could not be assessed, as there is no mechanism currently available to measure this.

Purpose

The purpose of this statement is to assist users in evaluating whether the data are fit for their specific purposes.

Data source

The data for this report were extracted from the EMAR-I system.

Time frame of data release

The data included in this report were recorded between 1 January 2020 and 31 March 2024.

Type of data

The data provided are finalised and represent the final state of the dataset at the time of reporting.

Completeness

The dataset demonstrates over 90% completeness for the variables reported in this release. Instances of missing data have been clearly labelled and noted as 'missing' within the report. Missing values were included in the tables and graphs where appropriate, and the analysis accounts for these gaps so as to ensure transparency and accuracy in the findings.

Accuracy

The data were subject to standard validation processes within the EMAR-I system in order to ensure the accuracy of recorded entries.

Limitations

While the data provide valuable insights, there are several limitations:

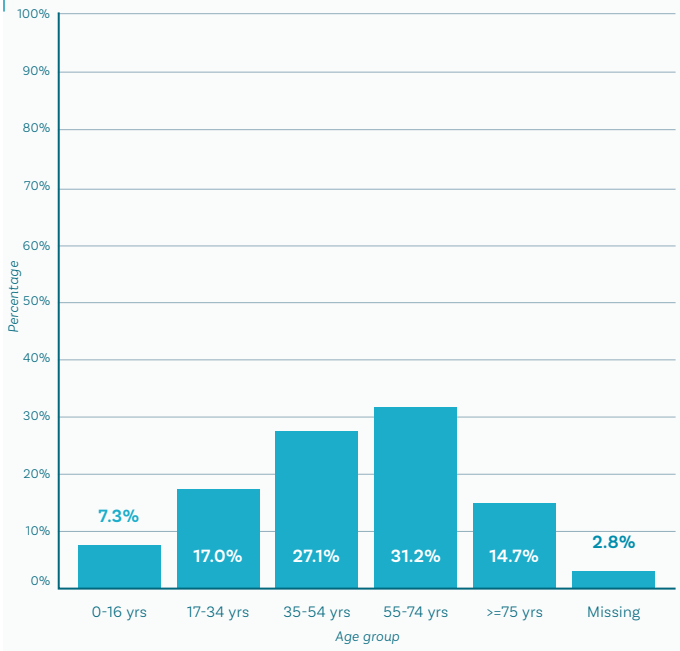
- The dataset represents only a small fraction of total intubations performed in Irish EDs during the reporting period.
- Data were submitted from 14 EDs, but 1 ED contributed more than 50% of all recorded cases, which may skew the findings and reduce their generalisability.
- The wide variation in the number of cases per ED, ranging from 1 to 115, limits the ability to draw broad conclusions about intubation practices across all Irish EDs.

Conclusion

This data quality statement highlights the strengths and limitations of the EMAR-I dataset, providing users with the necessary context to make informed decisions about its applicability. While the data offer valuable insights into intubation practices in Irish EDs, caution must be exercised when interpreting the findings due to the limited sample size and uneven distribution of data.

5. Pre-intubation

Figure 5.1 Percentage of intubations, by age group *(n=218)*

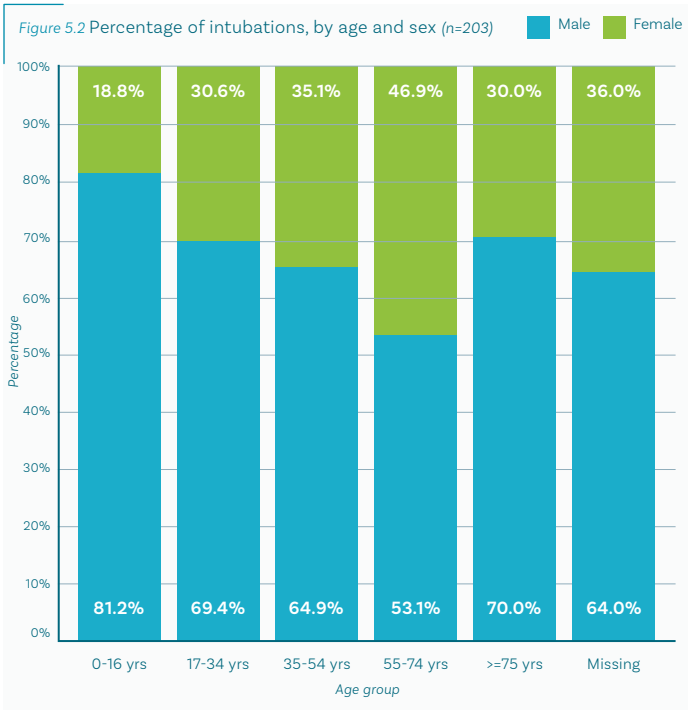


Patient demographics

A total of 218 cases were recorded in the EMAR-I database during the 4-year period covered by this report, more than half of which took place in patients aged between 35 and 74 years *(Figure 5.1)*. The low incidence of intubations in those aged 75 years and over likely reflects the increased level of frailty in this population combined with the use of advance directives that dictate the ceilings of care provided to these patients *(Figure 5.1)*. Across all age groups, more males than females were intubated, and this was especially evident in younger age groups, as illustrated in Figure 5.2.

Similarly, the low rate of intubations occurring in patients aged under 16 years is likely due to multiple factors, most significantly that this age group has a reduced prevalence of chronic conditions, and those that do have such conditions are at a much earlier stage of the disease. This, combined with newer therapies for respiratory illnesses such as high-flow nasal oxygen and continuous positive airway pressure (CPAP) for bronchiolitis, means that intubation in the paediatric population is a much rarer occurrence than in adults *(Dafydd et al., 2021)*.

Figure 5.2 Percentage of intubations, by age and sex *(n=203)*



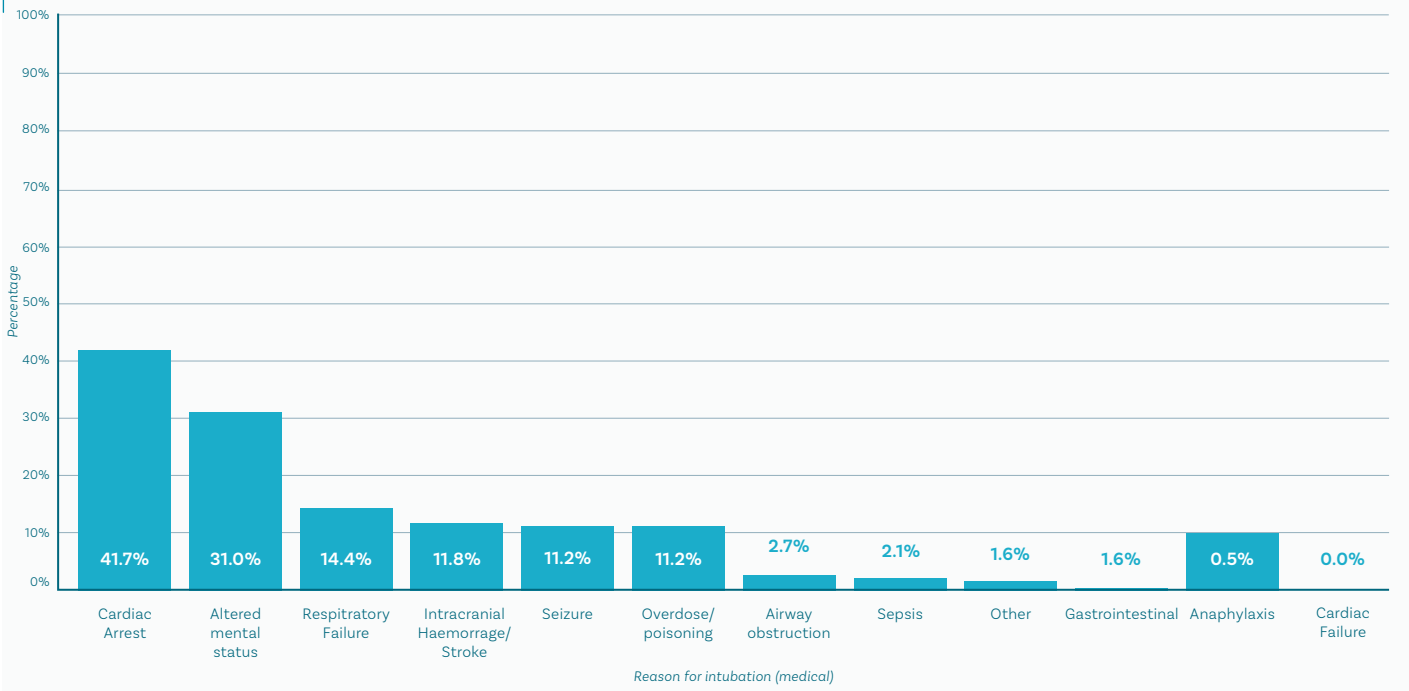
Indication for intubation

Indications for intubation have been divided into two main categories in EMAR-I – medical and trauma – each with multiple choices for the pathologies leading to intubation. These choices are not mutually exclusive, as the most critically ill patients often have multiple concomitant issues requiring intervention.

Current data show that medical indications for intubation are much more common than traumatic ones, but this may reflect the need for pre-hospital interventions for major trauma in addition to the frequency of medical presentations to EDs in Ireland.

The most common indication for medical intubation recorded in Figure 5.3, is cardiac arrest. Altered mental status accounted for 31% of intubations for medical reasons – this includes not only patients with lower scores on the Glasgow Coma Scale, but also agitated patients requiring rapid tranquilisation or patients who are also agitated from hypoxia to tolerate non-invasive ventilation for respiratory conditions. The absence of cardiac failure in indications for intubation is likely due to a combination of the efficacy of less invasive management options (nitrates, diuretics, CPAP) and the fact that patients with pulmonary oedema secondary to cardiac failure would likely be categorised under respiratory failure when their data are being recorded.

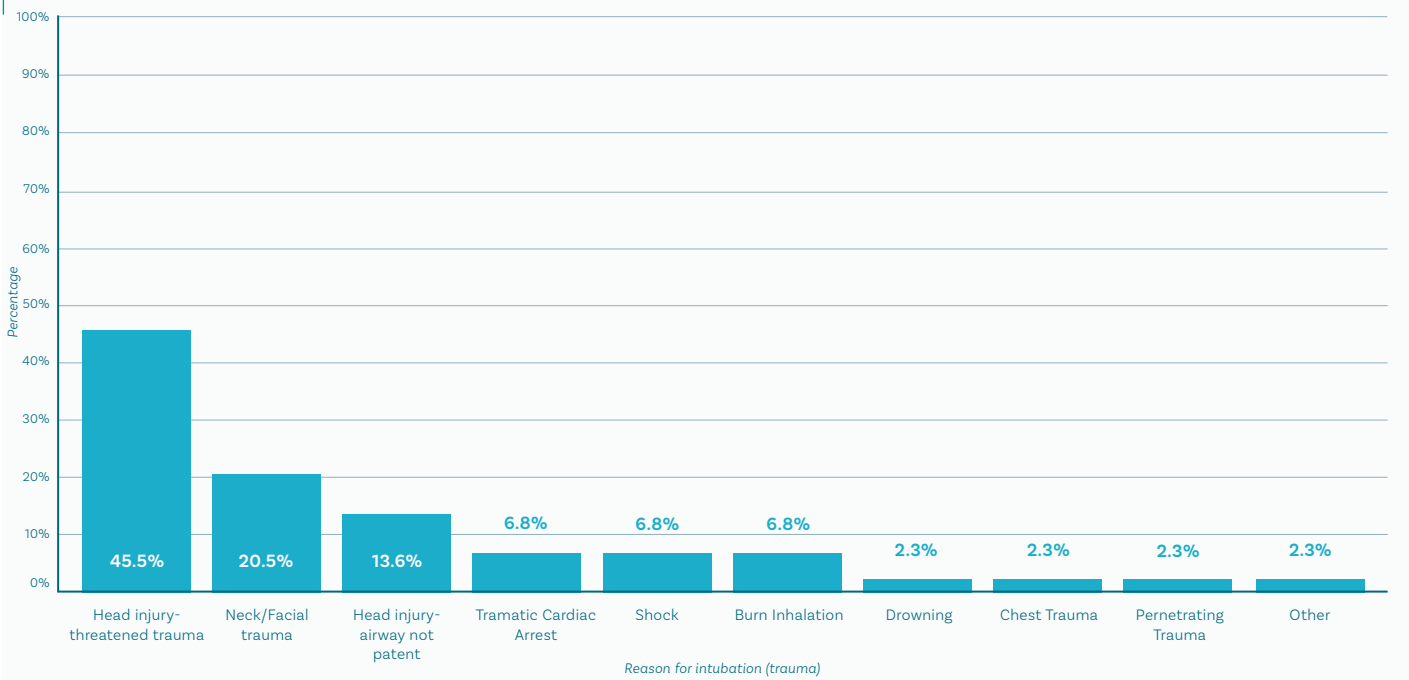
Figure 5.3 Medical indications for intubation *(n=187)*[2]



Head injuries are the most common indications for intubating in trauma cases *(Figure 5.4)*. This reflects the distribution of incidence of injuries in trauma cases, as shown in the Major Trauma Audit National Reports for 2019–2020 and 2021 *(National Office of Clinical Audit, 2023; 2022)*. Additionally, patients with significant head injuries benefit from early intubation and neuroprotective ventilation.

2. Percentages may add up to more than 100%, as a patient may have had more than one reason for intubation. Percentages are based on the number of patients, not the number of reasons.

Figure 5.4 Trauma indications for intubation *(n=44)*[3]

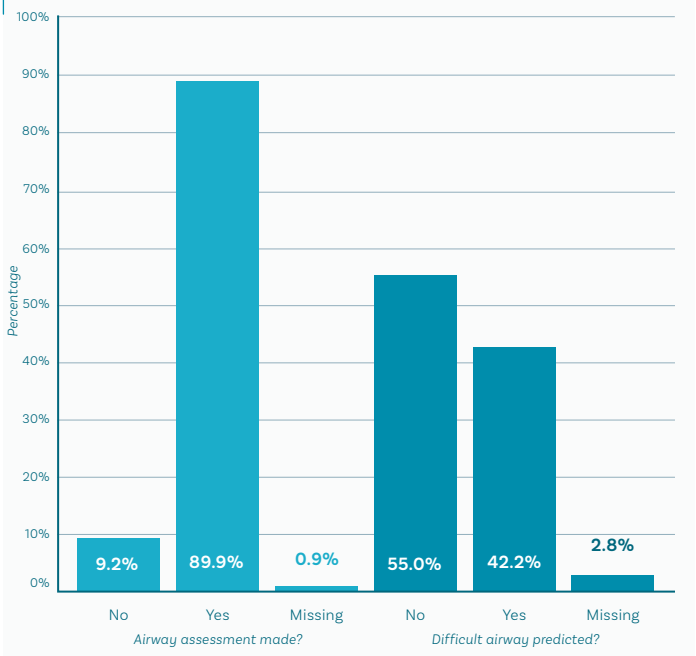


Preparation

Airway assessment can be challenging in critically ill patients, particularly in obtunded (patients with a reduced score on the Glasgow Coma Scale) or uncooperative patients, where urgency may preclude a complete assessment. Despite this, the data show that an airway assessment was performed prior to intubation in 89.9% of cases, with a difficult airway predicted in 42.2% of instances *(Figure 5.5)*, indicating concerns about difficulty performing intubation or face-mask ventilation on the patient.

3. Percentages may add up to more than 100%, as a patient may have had more than one reason for intubation. Percentages are based on the number of patients, not the number of reasons.

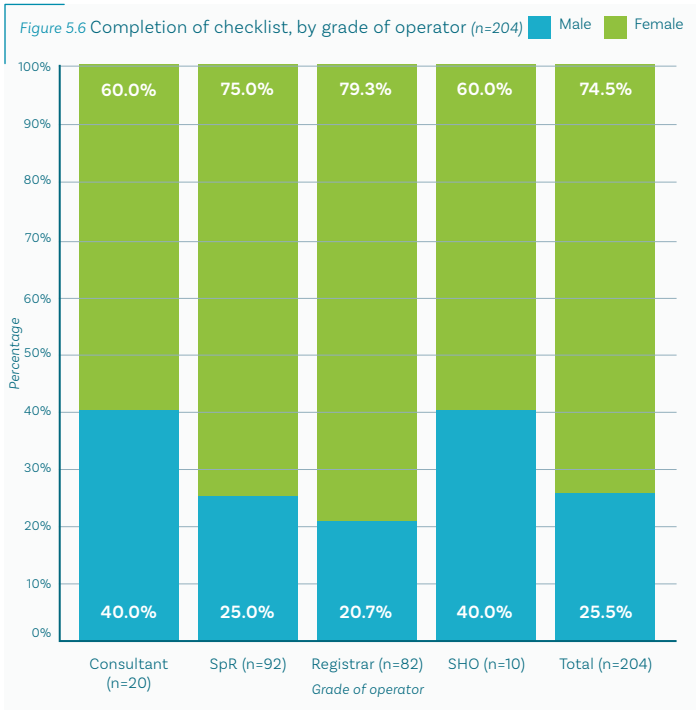
Figure 5.5 Airway assessment and resultant predictions *(n=218)*



Checklists have been shown to enable cognitive offloading, aid decision-making, and improve overall performance in stressful situations *(Higgs et al., 2018)*. As such, their use has been recommended in emergency intubations internationally.

Most intubations performed (74.5%) showed prior completion of a checklist, with Specialist Registrars (SpRs) and Registrars having higher rates of completion (75.0% and 79.3%, respectively) than Consultants and Senior House Officers (SHOs) (both 60.0%), illustrated in Figure 5.6. These figures reflect the relatively recent introduction of checklists into national guidelines and training in Ireland *(Grossi et al., 2024)*.

Figure 5.6 Completion of checklist, by grade of operator *(n=204)*



6. Intubation

Who carried out intubation?

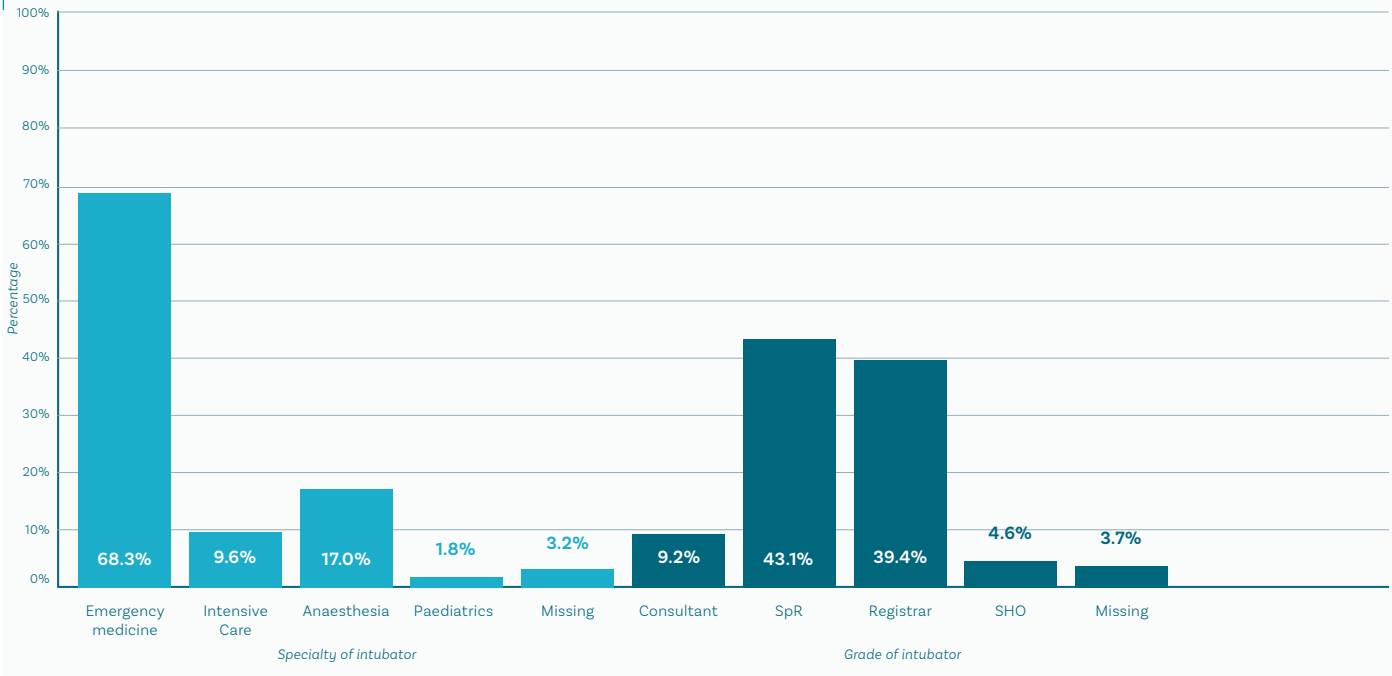
Intubation is a high-risk procedure with potentially fatal complications. It has been shown that increased rates of complications with delays in tracheal intubation are associated with multiple attempts at laryngoscopy, regardless of setting *(Sakles et al., 2019; Frerk et al., 2015)*.

Emergency Medicine Physicians performed the greatest proportion of intubations in EDs, presented in *Figure 6.1*. This aligns with international data *(Alkhouri et al., 2017)*.

SpRs and Registrars represent the overwhelming majority of the intubators, while Consultants are performing less than 10% of emergency intubations *(Figure 6.1)* – this is in contrast to the practice in Australia and New Zealand, which showed Consultants performing intubations in approximately 19% of cases *(Alkhouri et al., 2017)*.

This last point is likely related to the lower number of Emergency Medicine Consultants in Ireland (3.4 per 100,000 population) compared with other jurisdictions (4.18, 5.18 and 10.5 per 100,000 population in England, Scotland and Australia, respectively) *(HSE National Doctors Training & Planning, 2024; Patiño et al., 2022)*.

Figure 6.1 Specialty and grade of intubators *(n=218)*



Induction

RSI and endotracheal intubation are core skills of Emergency Medicine Physicians. In brief, RSI and intubation is the practice of pre-oxygenating a patient, giving anaesthetic and paralytic agents immediately before the attempt at intubation. It has been the standard approach in critically ill patients for decades, as it is believed to reduce the risk of complications such as aspiration.

Delayed sequence induction (DSI), by contrast, is a relatively new approach that is currently being used for highly agitated patients whom physicians are unable to pre-oxygenate. In this scenario, the patient is given dissociative doses of ketamine in order to allow pre-oxygenation prior to the administration of paralytic agents. This has been shown to reduce the incidence of desaturation at the time of intubation *(Bandyopadhyay et al., 2023)*.

The EMAR-I data show that RSI is the most common method of intubation, at 53.2%, while intubation without any agents occurred in 45.0% of cases, presented in *Figure 6.2*. This may reflect the high proportion of intubations performed during cardiac arrests (approximately 40% of total intubations). DSI was performed in only 1.8% of cases *(Figure 6.2)*, reflecting its status as a newer approach to be used in specific circumstances.

Of the induction agents used, fentanyl and propofol were the most commonly used agents, followed by ketamine, which was used in 28.6% of inductions, highlighted in *Figure 6.3*. Until 2010s, the use of ketamine was limited due to fears of potentially raising intracranial pressure, particularly in patients with head injuries. These concerns have been refuted, and ketamine is seeing more frequent use, particularly in trauma cases, due to its haemodynamic stability and wide therapeutic window *(Ferguson et al., 2019)*.

Figure 6.2 Type of intubation *(n=218)*

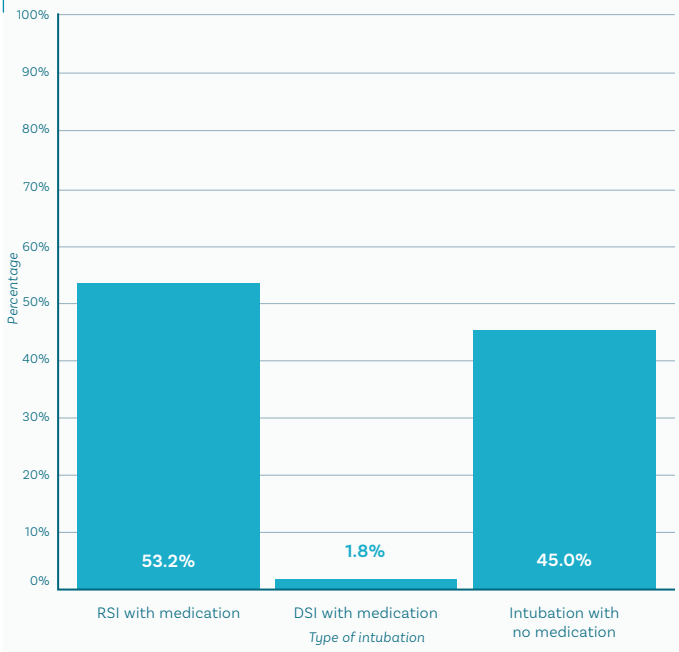


Figure 6.3 Induction agents used *(n=140)*[4]

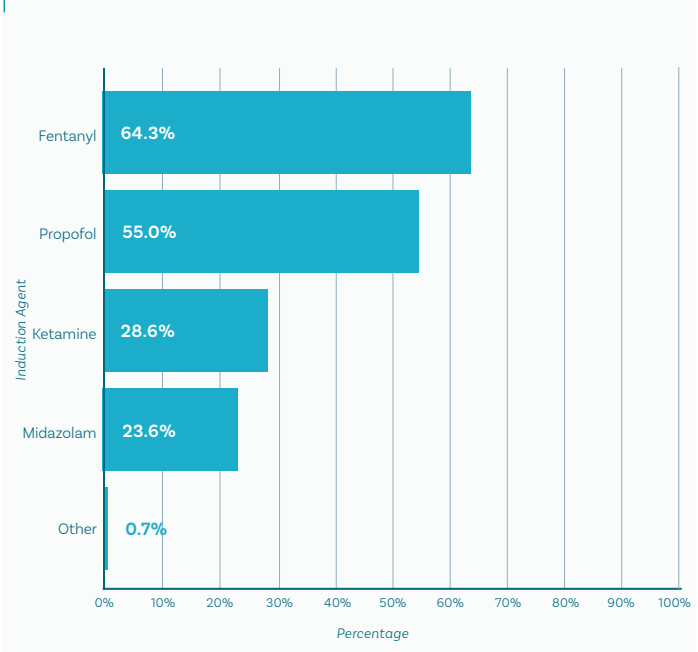
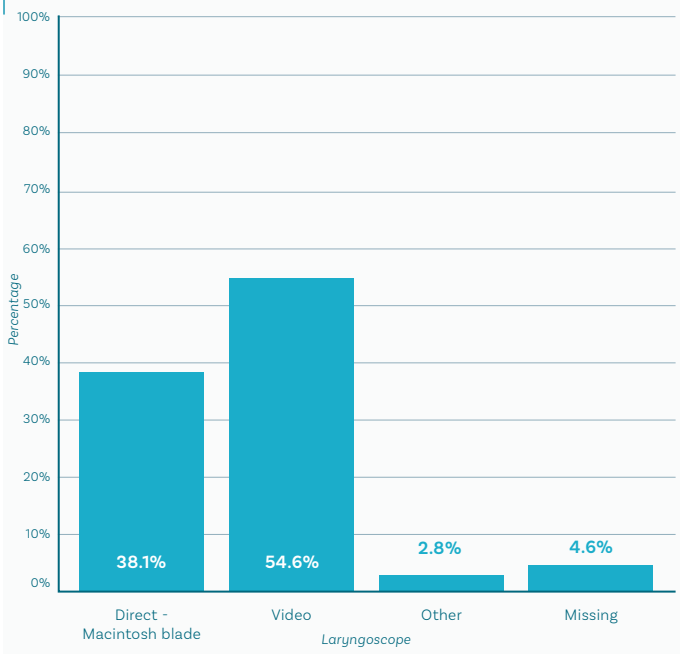


Figure 6.4 Laryngoscope used for first intubation attempt *(n=218)*



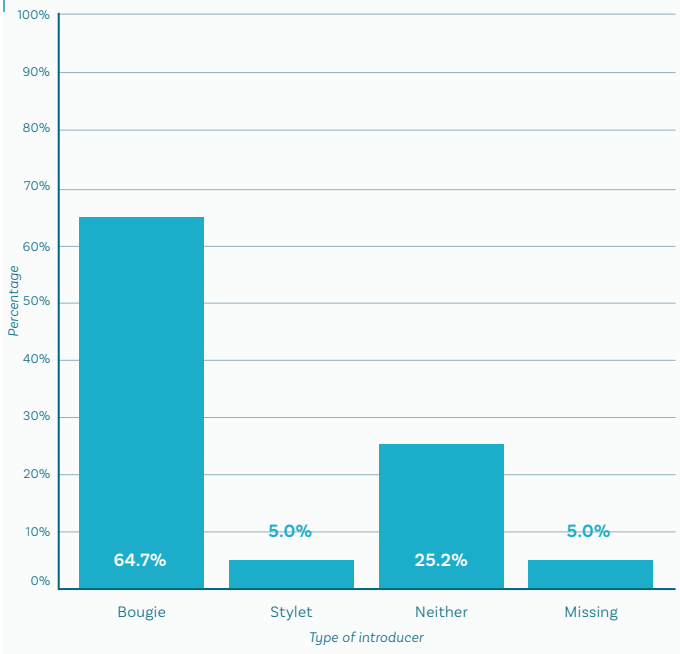
Equipment

Use of video laryngoscopes has increased since 2014 as the primary method of intubating critically ill patients. While there has been much debate about their efficacy compared with standard direct laryngoscopes, the latest evidence shows that their use leads to higher rates of first-pass success without increased risk of complications *(Prekker et al., 2023)*.

The data show that just over one-half of first attempts at intubations were performed using video laryngoscopes, compared with direct laryngoscopy using the standard Macintosh blade *(Figure 6.4)*.

Introducers such as bougies or stylets are designed to assist with passing the endotracheal tube beyond the vocal cords by increasing control of the path of the tube at the time of intubation before being subsequently removed. Bougies were used in 64.7% of intubations, while stylets were used in only 5.0%, presented in Figure 6.5. This reflects the practice in the United Kingdom (UK) and Australian systems *(Alkhouri et al., 2017)*. Approximately one-quarter of intubations performed used no introducer *(Figure 6.5)*.

Figure 6.5 Use of introducer, by type *(n=218)*



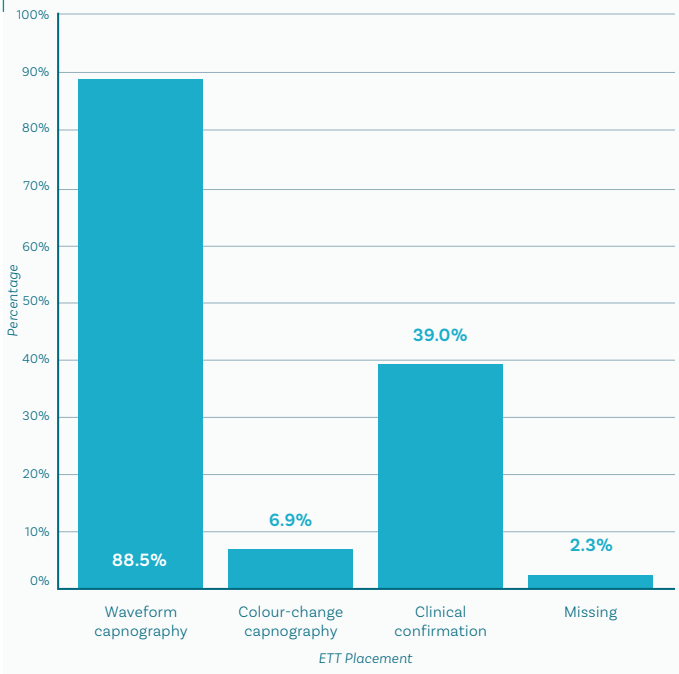
4. Percentages may add up to more than 100%, as more than one agent may have been used.

5. Percentages sum to more than 100%, as more than one placement method may have been used.

Continuous waveform capnography is the gold standard to confirm tracheal intubation – the absence of a waveform trace should be considered an oesophageal intubation *(Higgs et al., 2018)*.

The use of colour-change capnography is no longer recommended, as it does not give real-time information and will fail to alert clinicians to a displaced tube following intubation. Almost 90% (88.5%) of intubations were confirmed using waveform capnography, while 6.9% used colour-change capnography *(Figure 6.6)*.

Figure 6.6 Confirmation of endotracheal tube placement *(n=218)*[5]



Success rates

As stated at the beginning of this chapter, the number of attempts at intubation has been shown to correlate to the risk of adverse events, with one study showing that a second attempt more than tripled the incidence of these events *(Sakles et al., 2019)*.

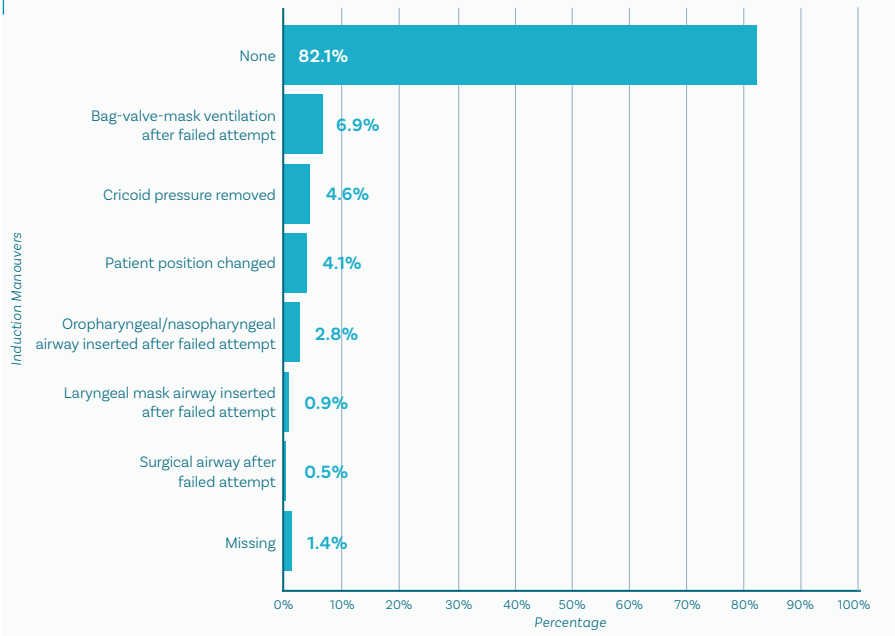
The overall first-pass success rate was 84.4% (n=184), while 97.2% (n=212) were successfully intubated within two attempts, both of which are comparable with international rates *(Alkhouri et al., 2017)*.

7. Intubation manoeuvres and complications

Intubation manoeuvres

The primary goal after a failed intubation attempt is to restore adequate oxygenation. According to the data outlined in Figure 7.1, 82.1% of failed first intubation attempts did not require additional rescue intubation manoeuvres. This is consistent with first-pass success rates in the EMAR-I cohort with adequate ventilation and oxygenation post-intubation.

Figure 7.1 Intubation manoeuvres *(n=218)*[6]



Among the patients requiring rescue manoeuvres (17.9%) following a failed attempt at intubation, bag-valve-mask (BVM) ventilation (6.9%) and adjustments to patient positioning (4.1%) were the most used manoeuvres, with a small percentage requiring insertion of oropharyngeal or nasopharyngeal airways (2.8%) and laryngeal mask airways (0.9%). Only one patient required emergency front-of-neck access, indicating that less invasive interventions were sufficient in most cases.

6. Percentages do not add up to 100%, as patients could have more than one manoeuvre.

Complications

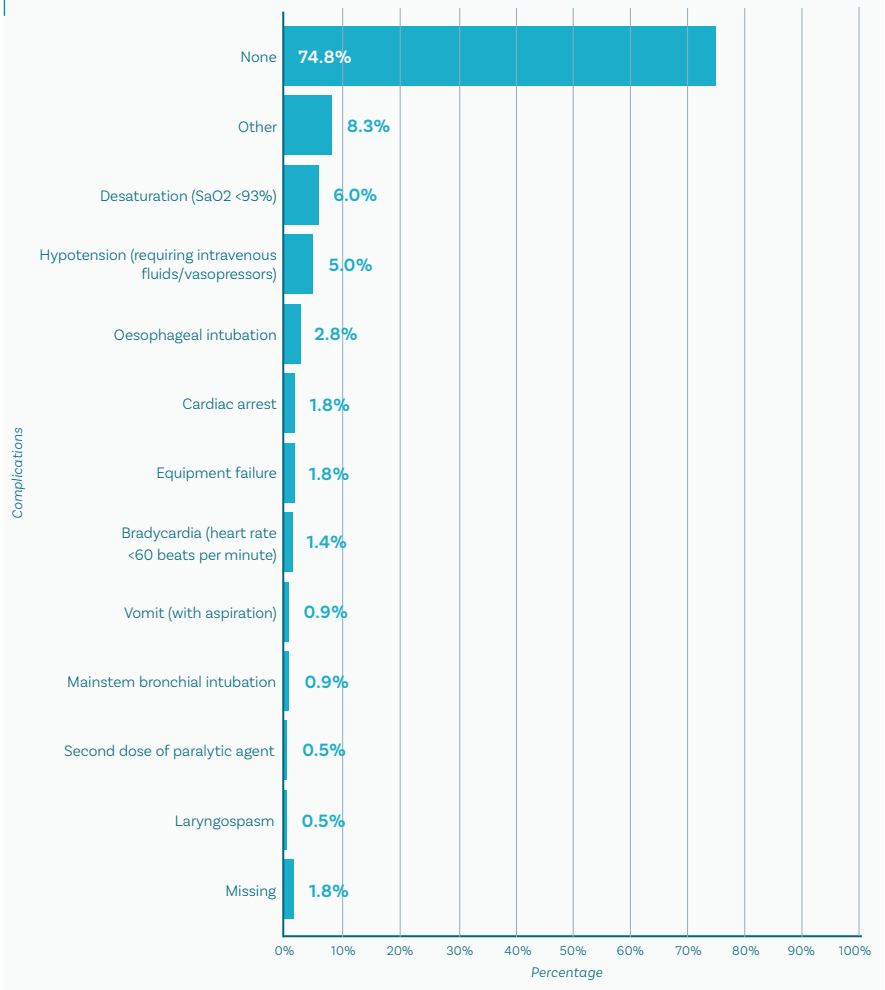
The complication rate reported in the EMAR-I cohort was 25.2%. This is in line with international airway registries, with reported complication rates as high as 26%. Desaturation (defined as a drop in arterial oxygen saturation to below 93%) was the most commonly reported complication, occurring in 6% of cases. Severe hypotension – requiring intravenous fluids and/or vasopressors – was the second most common complication, observed in 5% of cases.

Oesophageal intubation was observed in 2.8% of cases, while peri-intubation cardiac arrest and equipment failure were each reported in 1.8% of cases. Bradycardia (heart rate below 60 beats per minute) and laryngospasm were each reported in 1.4% and 0.5% of cases respectively.

Mainstem bronchial intubation and aspiration of gastric contents each occurred in 0.9% of cases, while administration of a second dose of a paralytic agent was required in 0.5% of intubations. Figure 7.2 shows a detailed breakdown of complications.

Unspecified complications occurred in 8.3% of intubation events, while data were missing in 1.8% cases. These suggest areas for improved documentation and analysis in order to promote continuous improvement in clinical practice and patient outcomes. The overall incidence and types of major adverse peri-intubation events in critically ill patients reported here do not differ significantly from those observed in UK practice; EMAR-UK data show that cardiovascular instability is the most common complication reported, followed by desaturation.

Figure 7.2 Percentage of complications recorded *(n=218)*[7,8]



7. 163 patients had no complications, 51 patients had a total of 65 complications, and 4 patients had no data recorded.
8. Percentages do not add up to 100%, as patients could have more than one complication recorded.

Patient outcomes

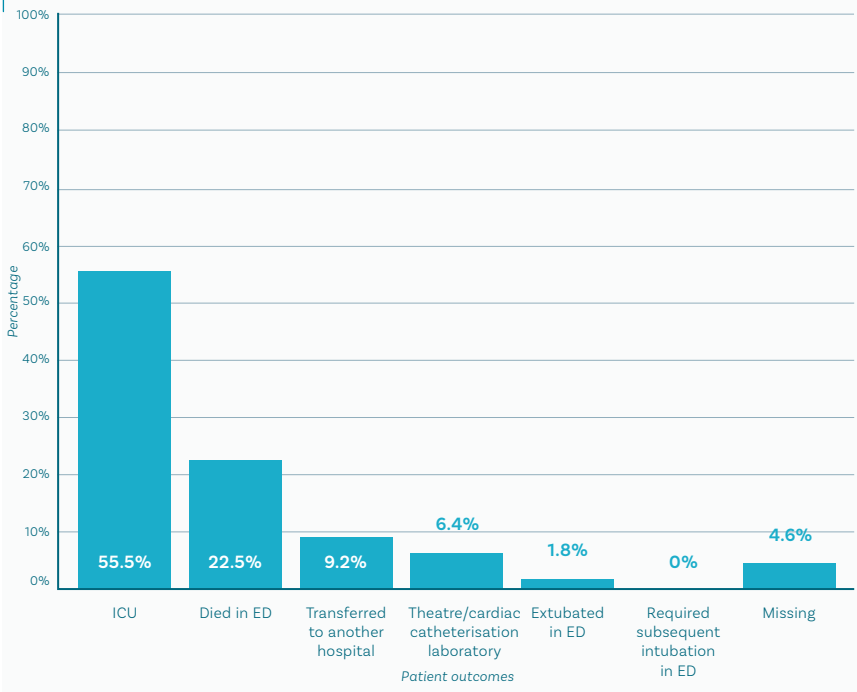
The data in Figure 7.3 provide a clear overview of the various outcomes for patients in the ED. The majority of patients (121 out of 218) were admitted to the intensive care unit (ICU), representing 55.5% of cases.

This high percentage indicates a significant need for intensive care among emergency patients, suggesting that many cases are severe and require critical care. A notable 22.5% of patients (n=49) died in the ED.

This is a significant proportion and highlights the critical nature of the conditions being treated. It may also point to potential areas for improvement in emergency care or early intervention strategies. Twenty patients (9.2%) were transferred to other hospitals. This could be due to the need for specialised care or resources not being available at the initial admitting hospital. Fourteen patients (6.4%) were taken to the theatre or catheterisation laboratory, indicating that a smaller but still significant fraction required surgical or interventional procedures. Only four patients (1.8%) were extubated in the ED, suggesting that extubation is relatively rare in this setting, possibly due to the severity of cases or the need for continued respiratory support. Interestingly, no patients required subsequent intubation in the ED. There were 10 cases (4.6%) with missing data.

Overall, the data reflect a high demand for critical care and significant mortality within the ED. These insights can be valuable for healthcare providers and policy-makers to improve emergency care services and patient outcomes.

Figure 7.3 Patient outcomes *(n=218)*



8. *Quality improvement in action:* Scaling up EMAR-UK

Dr Irene Grossi
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Why I started an emergency medicine airway registry at Bristol Royal Infirmary

During my emergency medicine training in Ireland, I had the privilege of working alongside Professor Fergal Cummins. In 2017, I was fortunate to contribute to the inception of EMAR-I, where Professor Cummins envisioned creating an emergency medicine airway registry that extended beyond national boundaries, aiming for a pan-European emergency medicine airway registry. His forward-thinking approach not only underscored the importance of data in improving patient outcomes, but also served as an incredible source of personal motivation during the most challenging times while scaling up EMAR-UK.

In 2020, I moved to the UK and began working as an SpR at Bristol Royal Infirmary. Once settled, it became evident that there were no established audits or quality improvement projects specifically focused on emergency airway management in my new ED. Recognising this need, I took the opportunity to develop EMAR-UK. The support and encouragement from the leadership team in the ED at Bristol Royal Infirmary were pivotal; they shared my vision for enhancing airway management standards and recognised the potential impact a dedicated registry could have.

Building system understanding

In order to ensure the successful implementation of EMAR-UK, I needed to deepen my understanding of the wider National Health Service and the specific context of Bristol Royal Infirmary. In collaboration with the Department of Anaesthesia and Intensive Care at Bristol Royal Infirmary and Royal United Hospitals Bath, we developed an electronic audit tool (based on the one created for EMAR-I) that was accessible through QR codes, which formed the foundation of EMAR-UK. We conducted a 6-month pilot study in order to evaluate its integration into day-to-day practice.

The pilot study highlighted several key areas for improvement, revealing gaps in medical and nursing staff airway training, inconsistencies in the availability and use of airway equipment, and poor documentation. It was evident that protocols and oversight structures were necessary in order to ensure compliance with best practices and facilitate ongoing quality assurance. This understanding of the complexities involved allowed us to tailor EMAR-UK effectively to meet the unique needs of our environment.

Interventions to improve

Despite the initial small sample size, the pilot study brought about significant improvements, including:

- Promoting EMAR-UK and the audit collection tool through the 'Message of the Week' and recommending video laryngoscopes and bougie for all first attempts;
- Implementing the recording of every intubation in order to create a video database for dedicated airway teaching sessions;
- Standardising the ED airway trolley to align with those in operating theatres and ICUs, enhancing support for Anaesthetists and Intensivists during intubations;
- Developing standard operating procedures and best-practice guidelines for emergency airway management in the resuscitation room in order to reduce errors and complications;
- Initiating multidisciplinary airway simulation sessions for emergency medicine, anaesthesia, and intensive care team members to practise their skills in a controlled environment and enhance collaboration and teamwork;
- Involving nurses and trainees from the multidisciplinary team in running quality improvement projects, leading to abstract and poster presentations at national and international conferences, which provided more junior team members with opportunities to enhance their research experience and portfolio.

At the end of the pilot study, we were able to demonstrate the feasibility and effectiveness of EMAR-UK at the pilot's conclusion, leading to its national launch in 2021.

What has this meant to our department?

With EMAR-UK, we can now monitor our performance locally and gain a better understanding of the challenges involved in this pivotal procedure. This has allowed us to develop and improve our practice through quality improvement initiatives, audits and tailored training programmes, with the ultimate goal of improving patient safety and outcomes.

EMAR-UK has also strengthened our relationships and collaboration with colleagues in anaesthesia and intensive care. Several anaesthesia trainees played a crucial role in developing EMAR-UK. After completing their rotations at Bristol Royal Infirmary, they helped initiate the registry in other hospitals.

However, the journey has not come without its challenges. As EMAR-UK expands rapidly, the day-to-day management has become onerous. Additionally, the frequent turnover of doctors has, at times, hindered continuity.

EMAR-UK represents a significant advancement in Bristol Royal Infirmary's approach to emergency airway management. It clearly enhances standards of emergency airway care, improving outcomes for our most critically ill and injured patients, the very core of modern emergency medicine.

9. Recommendations

Recommendation 1: Implement EMAR-I in all EDs across the health service

Rationale	Advanced airway management is a high-risk procedure, known to have increased rates of complications, especially in challenging environments such as the resuscitation room. There remains an expectation that doctors will perform this relatively high-risk procedure safely. To support clinical practice, the IAEM developed a clinical guideline and audit tool *(Grossi et al., 2024)*. EMAR-I was established in 2019. The data in this report come from 14 hospitals; 218 cases were recorded in the EMAR-I database across the 4-year period from 1 January 2020 to 31 March 2024, indicating a low participation rate. This report presents key quality indicators such as a first-pass success rate of 84.4% and a complication rate of 25.2%, identifying potential for improvement. However, these findings must be interpreted with caution due to poor data coverage.
Evidence for the effectiveness of this recommendation	A scoping review, published in 2023, identified 22 airway registries globally that monitor intubation in the ED. The authors concluded that airway registries provide an assurance mechanism and identify opportunities for improvement and research, optimising emergency airway practices *(Meulendyks et al., 2023)*.
Who will benefit from this recommendation?	• Critically ill patients requiring a definitive airway – EMAR-I promotes definitive airway management, which is predictable, reproducible, generalisable and safe for acutely ill or injured patients, and has the potential to identify opportunities for improvement at the ED, health service provider, and national level. • Doctors carrying out intubations in the ED – EMAR-I can support effective and safe clinical practice by providing a framework for learning and improvement through reflection on personal and local practice findings.
Implementation lead(s)	NOCA has been commissioned by the HSE NCCA to implement EMAR-I.
Actions that should be taken	• Implement EMAR-I in EDs – first adult, then paediatric EDs – across the public health service. • Establish national governance structures and support the development of local governance structures. • Review and enhance the existing audit tool and delivery approach.
Planned timeline for implementation	Commence in 2025.
Resource dependency	In terms of personnel resources, the following are recommended: • NOCA – Project Coordinator, Data Analyst, Clinical Lead; • Participating EDs – Airway Lead, airway governance committee; • Clinician in ED – time to support dataset entry, learning and improvement.

Recommendation 2: Participating EDs should identify Airway Clinical Leads and governance structures to support local implementation of EMAR-I

Rationale	Both quality improvements in the action case studies in this report *(Chapters 2 and 8)* provide insight into what works. This includes clinical leadership, and a governance structure supporting that supports audit and feedback, learning and improvement to a multispecialty and multidisciplinary teams.
Evidence for the effectiveness of this recommendation	• The Difficult Airway Society in the UK recognises that guideline adoption itself is not enough to avoid serious complications of airway management during intubation. Situational and human factors impair decision-making and performance. The Difficult Airway Society highlights clinical leadership, teamwork training and simulation as key aspects of airway management in healthcare organisations *(Frerk et al., 2015)*. • The HSE EMP has applied a clinical leadership and governance model for the implementation of point-of-care, ED-led ultrasound. This has led to innovation as well as training opportunities to develop and enhance the competence of qualified and training doctors in the ED.
Who will benefit from this recommendation?	• Doctors carrying out intubations in the ED – EMAR-I can support effective and safe clinical practice by providing a framework for learning and improvement through reflection on personal and local practice findings. • Both EDs and their healthcare provider organisations can be assured of the quality of airway intubation in their EDs and hospital environments.
Implementation lead(s)	Consultant Emergency Medicine Department Lead.
Actions that should be taken	• Identify local Airway Clinical Leads. • Establish local governance committees to include doctors and nurses involved in airway intubation in the ED. Where an ED clinical governance committee is already in place, airway management should become a standing agenda item.
Planned timeline for implementation	Commence in 2025.
Resource dependency	In terms of personnel resources, the following is recommended for participating EDs – Airway Lead, airway governance committee.

Recommendation 3: Use a checklist for all airway intubations in the ED

Rationale	A pre-intubation checklist was used across 74.5% of cases in this report, with SpRs and Registrars having higher rates of completion (75.0% and 79.3%, respectively) than Consultants and SHOs (both 60.0%). The use of airway checklists in 74.5% of cases presents an opportunity for improvement.
Evidence for the effectiveness of this recommendation	• The Fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) examined serious airway complications occurring during anaesthesia in ICUs and EDs *(Cook et al., 2011)*. One in four serious adverse airway events in a hospital are likely to occur in the ICU or ED. Poor identification of at-risk patients, poor or incomplete planning, and delayed recognition of events were identified as root causes of these complications. The NAP4 recommended the development and use of a checklist for all intubations of ED patients in order to identify the preparation of the patient, equipment, drugs and team, as well as back-up plans *(Cook et al., 2011)*. • Checklists have been shown to enable cognitive offloading, aid decision making, and improve overall performance in stressful situations, addressing the urgency as well as management of roles and responsibilities during intubation in critically ill patients *(Higgs et al., 2018)*. • In an Irish healthcare context, Grossi et al. (2024) recommend using a pre intubation checklist.
Who will benefit from this recommendation?	• Critically ill patients requiring a definitive airway – EMAR-I promotes definitive airway management, which is predictable, reproducible, generalisable and safe for acutely ill or injured patients, and has the potential to identify opportunities for improvement at the ED, health service provider, and national level. • Doctors carrying out intubations in the ED – EMAR-I can support effective and safe clinical practice by providing a framework to guide intubation in the ED, especially at times of crisis when information processing and decision-making can be extremely difficult.
Implementation lead(s)	Airway Clinical Lead.
Actions that should be taken	The Emergency Intubation Guideline (the checklist) is available on the IAEM website (IAEM, n.d.). This should be used by doctors involved in intubation in EDs.
Planned timeline for implementation	As soon as EMAR-I is introduced in EDs.
Resource dependency	No resources required.

Conclusion

This EMAR-I report provides a snapshot of airway management across multiple hospitals during the 4-year reporting period. This report analysed 218 patients who underwent airway management, providing insights into indications, intubators, medications, first-pass success rates patient outcomes and complications. Through these findings, EMAR-I highlights areas of both strong practice and areas for improvement.

Notably, most intubations are performed by Emergency Medicine Physicians, primarily at the Registrar level. This underscores the need to adequately train our non-consultant hospital doctor cohort in airway management in order to optimise patient outcomes. The airway assessment methods and medication choices for intubation align with current literature *(Umana et al., 2022; Alkhouri et al., 2017)*. This indicates not only clinicians' awareness of current practices, but also their comfort with using induction medications such as propofol, ketamine and midazolam.

The use of airway checklists, video laryngoscopy, and bougies exceeded 50%, representing an opportunity for improvement through focused teaching and simulation programmes. The availability of these aids and equipment within EDs is vital for enabling clinicians to practise according to current best evidence. The first-pass success rate in this EMAR-I report meets the benchmark set by Park et al. (2017), although there remains room for improvement. While the 25% complication rate aligns with the literature, it remains on the higher end. Evidence shows that dedicated airway programmes, including departmental and national airway audits, can improve first-pass success rates and reduce complications *(Groombridge et al., 2020; Sakles et al., 2019)*.

Like other national reports, this EMAR-I report can promote quality improvement in patient care delivery across Ireland and identify areas requiring enhanced training and service implementation. HSE NCCA commissioning of EMAR-I for development and implementation is truly welcomed. In order for EMAR-I to develop further, EDs nationwide must also support its continued implementation.

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APPENDIX: FREQUENCY TABLES FOR FIGURES

Figure 5.1 Percentage of intubations, by age group *(n=218)*

Age group	n	%
0–16 years	16	7.3%
17–34 years	37	17.0%
35–54 years	59	27.1%
55–74 years	68	31.2%
≥75 years	32	14.7%
Missing	6	2.8%
Total	**218**	**100%**

Figure 5.2 Percentage of intubations, by age and sex *(n=203)*

	Male		Female	
Age group	n	%	n	%
0–16 years	13	81.3%	3	18.8%
17–34 years	25	69.4%	11	30.6%
35–54 years	37	64.9%	20	35.1%
55–74 years	34	53.1%	30	46.9%
≥75 years	21	70.0%	9	30.0%
Total	**130**	**64.0%**	**73**	**36.0%**

Figure 5.3 Medical indications for intubation *(n=187)*

Medical reasons	n	%
Cardiac arrest	78	41.7%
Altered mental status	58	31.0%
Respiratory failure	27	14.4%
Intracranial haemorrhage /stroke	22	11.8%
Seizure	21	11.2%
Overdose/poisoning	21	11.2%
Airway obstruction	5	2.7%
Sepsis	4	2.1%
Other	3	1.6%
Gastrointestinal bleed	3	1.6%
Anaphylaxis	1	0.5%
Cardiac failure	0	0.0%

Percentages may add up to more than 100%, as a patient may have had more than one reason for intubation. Percentages are based on the number of patients, not the number of reasons.

Figure 5.4 Trauma indications for intubation *(n=44)*

Trauma reasons	n	%
Head injury – threatened airway	20	45.5%
Neck/facial trauma	9	20.5%
Head injury – airway not patent	6	13.6%
Traumatic cardiac arrest	3	6.8%
Shock	3	6.8%
Burn/inhalation	3	6.8%
Drowning	1	2.3%
Chest trauma	1	2.3%
Penetrating trauma	1	2.3%
Other	1	2.3%

Percentages may add up to more than 100%, as a patient may have had more than one reason for intubation. Percentages are based on the number of patients, not the number of reasons.

Figure 5.5 Airway assessment and resultant predictions *(n=218)*

Airway assessment made?	n	%
No	20	9.2%
Yes	196	89.9%
Missing	2	0.9%
Total	**218**	**100%**
Difficult airway predicted?	n	%
No	120	55.0%
Yes	92	42.2%
Missing	6	2.8%
Total	**218**	**100%**

Figure 5.6 Completion of checklist, by grade of operator *(n=204)*

	No		Yes		Totat	
Grade of operator	n	%	n	%	n	%
Consultant	8	40.0%	12	60.0%	20	100%
SpR	23	25.0%	69	75.0%	92	100%
Registrar	17	20.7%	65	79.3%	82	100%
SHO	4	40.0%	6	60.0%	10	100%
Total	**52**	**25.5%**	**152**	**74.5%**	**204**	**100%**

Figure 6.1 Specialty and grade of intubators *(n=218)*

Specialty	n	%
Emergency medicine	149	68.3%
Intensive care	21	9.6%
Anaesthesia	37	17.0%
Paediatrics	4	1.8%
Missing	7	3.2%
Total	**218**	**100%**
Grade	**n**	**%**
Consultant	20	9.2%
SpR	94	43.1%
Registrar	86	39.4%
SHO	10	4.6%
Missing	8	3.7%
Total	**218**	**100%**

Figure 6.2 Type of intubation *(n=218)*

Type	n	%
RSI with medication	116	53%
DSI with medication	4	2%
Intubation with no medication	98	45%
Total	**218**	**100%**

Figure 6.3 Induction agents used *(n=140)*

Induction agent	n	%
Fentanyl	90	64.3%
Propofol	77	55.0%
Ketamine (mg)	40	28.6%
Midazolam (mg)	33	23.6%
Other	1	0.7%

Percentages may add up to more than 100%, as more than one agent may have been used.

Figure 6.4 Laryngoscope used for first intubation attempt *(n=218)*

Laryngoscope	n	%
Direct - Macintosh blade	83	38.1%
Video	119	54.6%
Other	6	2.8%
Missing	10	4.6%
Total	**218**	**100%**

Figure 6.5 Use of introducer, by type *(n=218)*

Type of introducer	n	%
Bougie	141	64.7%
Stylet	11	5.0%
Neither	55	25.2%
Missing	11	5.0%
Total	**218**	**100%**

Figure 6.6 Confirmation of endotracheal tube placement *(n=218)*

Confirmation method	n	%
Waveform capnography	193	88.5%
Colour-change capnography	15	6.9%
Clinical confirmation	85	39.0%
Missing	5	2.3%

Percentages sum to more than 100%, as more than one placement method may have been used.

Figure 7.1 Intubation manoeuvres *(n=218)*

Intubation manoeuvres	n	%
None	179	82.1%
Bag-mask-valve ventilation after failed attempt	15	6.9%
Cricoid pressure removed	10	4.6%
Patient position changed	9	4.1%
Oropharyngeal/nasopharyngeal airway inserted after failed attempt	6	2.8%
Missing	3	1.4%
Laryngeal mask airway inserted after failed attempt	2	0.9%
Surgical airway after failed attempt	1	0.5%

Percentages do not add up to 100%, as more than one manoeuvre could be recorded

Figure 7.2 Percentage of complications recorded *(n=218)*

Complications	n	%
None	163	74.8%
Other	18	8.3%
Desaturation (SaO2 <93%) < 93%	13	6.0%
Hypotension - (requiring intravenous fluids/vasopressors)	11	5.0%
Oesophageal intubation	6	2.8%
Missing	4	1.8%
Equipment failure	4	1.8%
Cardiac arrest	4	1.8%
Bradycardia (heart rate <60 beats per minute) < 60 bpm	3	1.4%
Mainstem bronchial intubation	2	0.9%
Vomit - (with aspiration)	2	0.9%
Laryngospasm	1	0.5%
Second dose of paralytic agent	1	0.5%

Percentages do not add up to 100%, as patients could have more than one complication recorded.

Figure 7.3 Patient outcomes *(n=218)*

Outcome	n	%
ICU	211	55.5%
Died in ED	49	22.5%
Transferred to another hospital	20	9.2%
Theatre/cardiac catheterisation laboratory	14	6.4%
Extubated in ED	4	1.8%
Required subsequent intubation in ED	0	0.0%
Missing	10	4.6%
Total	**218**	**100.0%**

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