Kōrerorero tahi | Consultation

Te Kaunihera Manapou is seeking information on intensive care paramedicine specialist practice endorsement

In 2023, Te Kaunihera Manapou | Paramedic Council (Te Kaunihera) sought feedback on whether paramedic titles and descriptors should be standardised to protect the public. This would ensure that paramedics would only be allowed to use specialist titles if they are qualified, competent, and fit to practise in a specialist role.

Feedback on Te Kaunihera's initial proposal was sought via a public consultation, which was open for six weeks from Ākuhata | August to Hepetema | September 2023. All responses to this consultation, including an analysis, have been available on Te Kaunihera's website since Tīhema | December 2023. Of the 147 respondents (including individuals and organisations), 93.75% agreed that titles and descriptors should be standardised via specialist paramedic practice endorsement. Click here for the latest update on Te Kaunihera's progress.

No decisions have yet been made by Te Kaunihera regarding intensive care paramedics (ICPs). Further information is now being sought to help guide us in understanding ICP practice.

All paramedics, and those currently practising as ICPs, will have an opportunity to provide feedback prior to decisions being made. The kōrero | discussion around ICP practice is ongoing and will be managed separately to Extended Care Paramedic (ECP) and Critical Care Paramedic (CCP) endorsement.

Ngā mihi nui

Jacquelyn Manley
Tumu Whakarae/Kairēhita | Chief Executive/Registrar

He waka eke noa | A canoe we are all in with no exception

Kaunihera Manapou
Paramedic Council

Contents

Background

Te Kaunihera is a responsible authority established under the Health Practitioners Competence Assurance Act 2003 (HPCA Act). Te Kaunihera's primary purpose is to protect the health and safety of the public by ensuring paramedics are competent and fit to practise[1].

One of the key drivers behind the regulation of paramedics was to protect the public by having a single consistent system for setting minimum requirements for paramedic practice, and to monitor the ongoing practice and competence of paramedics.

Registration and the practising certificate regime provide assurance to the public and any employers of paramedics that a person is competent and fit to practise as a paramedic. The standards set by Te Kaunihera are used by Te Kaunihera, the public of Aotearoa New Zealand, and other bodies (such as the Health and Disability Commissioner) to measure the practice and conduct of paramedics.

Te Kaunihera's statutory functions also include describing the paramedic profession through scopes of practice[2]. There is currently one paramedic scope of practice. All paramedics are registered in this scope of practice. However, Te Kaunihera has broad powers to describe paramedic services "in any way [it] thinks fit",[3] which includes describing specialist paramedic practice.

As the HPCA Act protects titles[4], only those individuals who are registered with Te Kaunihera can use the title paramedic.

Te Kaunihera is aware that additional descriptors are sometimes added to the paramedic title to further describe the role that paramedics perform. However, health consumers, colleagues, and others providing health or paramedic services are likely to view the use of specialist titles or descriptors as indicating that the paramedic has an increased level of qualifications, skills, competence, or experience in a particular area of paramedic practice.

In some cases, the additional descriptors or titles could over-represent a paramedic's qualifications or skills.

To protect the public and to ensure consistency across the profession, Te Kaunihera considers it is necessary and appropriate to determine whether a paramedic is suitably qualified, skilled, and competent to safely represent their paramedic practice with additional descriptors to their paramedic title.

[1] HPCA Act, s 3.
[2] HPCA Act, s 11. This is a mandatory statutory requirement for Te Kaunihera.
[3] HPCA Act, s 11(2).
[4] HPCA Act, s 7(1).

With this in mind, Te Kaunihera has been undertaking mahi | work involving a careful and consultative process. The outcome of this process was that Te Kaunihera agreed to move forward with specialist practice endorsement for ECPs and CCPs. An update on this, dated Āperira | April 2024, is available here.

During the consultation process, pātai | questions were raised about ICP practice. There was concern raised that this title would not be given specialist practice endorsement by Te Kaunihera.

Following receipt of consultation feedback, Te Kaunihera has agreed to seek further information. As a result, no decisions have yet been made regarding ICPs. The kōrero | discussion around ICP practice is ongoing and will be managed separately to ECP and CCP endorsement.

Information has been received regarding ICPs within Emergency Ambulance Service providers. Further information is now being sought to help guide the understanding of ICP practice outside of Emergency Ambulance Service[5] providers.

Why didn't Te Kaunihera initially propose specialist practice endorsement for ICPs?

Te Kaunihera did not initially propose specialist practice endorsement for ICPs because Te Kaunihera was advised that ICP education is no longer available. To be assured that a paramedic is qualified to be endorsed to use the ICP title, a prescribed qualification for endorsement is necessary. Further, Te Kaunihera had also been advised that traditional ICP practice has moved on to what is now commonly seen as being CCP practice. As such, many ICPs have now upskilled to become either a CCP or an ECP.

As a result, in its 2023 consultation, Te Kaunihera proposed that it would not recognise ICP practice with specialist practice endorsement. However, it is noted that it would allow ICPs currently practising in Aotearoa who hold an ICP authority to practise (ATP) to continue to use this title. Te Kaunihera also noted that those currently practising with the ICP title will be expected to maintain relevant continuing professional development (CPD). Te Kaunihera acknowledged that the number of ICPs currently practising in Aotearoa New Zealand is likely to be small.

[5] the five Emergency Ambulance Services that hold contracts with the Ambulance Team (previously NASO).

Meeting with education providers and Emergency Ambulance Service (EAS) Medical Directors

In Tīhema | December 2023, Te Kaunihera met with education providers and the EAS Medical Directors[6].

The EAS Medical Directors contribute to the Clinical Practice Guidelines Working Group to develop and continue to update the National Clinical Practice Guidelines (CPGs). Kōrero | discussion with this rōpū | group prompted pātai | questions regarding ICP practice.

In particular, as part of this kōrero | discussion it was noted that endotracheal intubation without rapid sequence induction (RSI)[7] is a procedure performed by ICPs, but not other paramedics. Pātai | questions were raised as to whether this procedure remains acceptable practice or whether contemporary practice had since changed[8]. As a result of those pātai |questions about ICP practice, Te Kaunihera asked for advice on whether:

- there is current ICP education in Aotearoa New Zealand.
- endotracheal intubation without rapid sequence induction (RSI) is consistent with acceptable contemporary practice
- there was any evidence or research to support whether endotracheal intubation without RSI remains acceptable practice

Response provided by the Clinical Practice Guidelines Working Group

The Clinical Practice Guidelines Working Group is responsible for writing and updating the CPGs. While these guidelines are primarily used by the EAS, they provide a useful starting point for identifying the procedures and interventions that a paramedic can undertake. With this in mind, Te Kaunihera endorses the CPGs and acknowledges that they may be referred to when considering paramedic practice alongside Te Kaunihera's own standards and statements.

The Clinical Practice Guidelines Working Group has provided the following response to the pātai | questions raised by Te Kaunihera:

> *Consensus clinical opinion of the Medical/Clinical Directors for the Emergency Ambulance Service (EAS) sector, and the consensus clinical opinion of the Clinical Practice Guidelines working group for the EAS sector.*

[6] this hui included EAS Medical Director representation and Medical Director representation from an independent ambulance provider. Attendance at this hui was to provide a wide range of views not to represent individual organisation.
[7] Otherwise known as drug facilitated intubation or prehospital emergency anaesthesia
[8] it was noted this no longer remains acceptable practice but may still occur in the event of an out of hospital cardiac arrest.

Consensus clinical opinion

We believe that the evidence supports drug facilitated intubation (rapid sequence intubation) having a better first-pass success rate compared to non-drug facilitated intubation, but the effects on morbidity and mortality remain unclear.

We do not believe that Intensive Care Paramedics should be involved in providing clinical services within an emergency ambulance service that has an adequate number of Critical Care Paramedics. The presence of both Intensive Care Paramedics and Critical Care Paramedics to support other crews introduces a significant level of complexity in dispatch. Therefore, we advocate for the transition of the Intensive Care Paramedic workforce to a Critical Care Paramedic workforce, within the EAS sector.

We note that all current EAS providers have committed to discontinuing the issuance of new Authority to Practise at the level of Intensive Care Paramedic, and we fully support this decision.

We recommend to The Paramedic Council that, in alignment with the move towards specialist endorsement of the paramedic scope of practice, existing Intensive Care Paramedics should be endorsed. We estimate that in mid-2024 this will affect approximately 40 Intensive Care Paramedics within the EAS sector. However, once enacted we recommend closing the pathway to new endorsements at the Intensive Care Paramedic level.

Response provided by education provider Te Wānanga Aronui o Tāmaki Makau Rau | Aukland University of Technology (AUT)

AUT provided two pieces of evidence in response to Te Kaunihera's pātai | questions, which have been attached to this document as *Appendix 3*:

1. **BMC Emergency Medicine**
   This research article is a retrospective descriptive analysis of non-physician-performed pre-hospital endotracheal intubation practices and performance in South Africa.

2. **ANZ Journal of Surgery**
   Neurosurgery – a tale of two cities: pre-hospital intubation with or without paralysing agents for traumatic brain injury.

Further, when asked if Te Wānanga Aronui O Tāmaki Makau Rau | Auckland University of Technology (AUT) intend to continue to provide ICP education, Te Kaunihera was advised as follows:

> *… as the tertiary provider of an international and nationally recognised programme of study, we have an obligation to ensure that we are meeting required standards of practice and educational best practice as required by the industry. To align with our Australasian, UK and Canadian colleagues the Critical Care Paramedicine model of care is where we believe NZ tertiary education should be focused.* [Given this, it is] *foreseen that AUT will discontinue to offer the ICP pathway.*
>
> *However, students will always be able to take individual papers that may be used by some organisations to award a variation of qualification i.e. ICP.*

AUT also noted that its purpose is to provide educational pathways that meet industry need.

Why are we contacting you?

To help guide our whakairo | thoughts, Te Kaunihera is seeking feedback and further information on ICP practice in Aotearoa. Our particular focus is on:

- specialist practice endorsements
- intensive care paramedic descriptors
- continuing professional development
- endotracheal intubation without rapid sequence induction (RSI)
- fees

Further information on each of these areas is included below.

Specialist practice endorsements

The recommendation from the Clinical Practice Guidelines Working Group was that ICPs should have specialist practice endorsement, but that "once enacted we recommend closing the pathway to new endorsements at the Intensive Care Paramedic level". This would limit ICP specialist practice endorsement to those who are currently working in this area in Aotearoa and would align with AUT's intentions to discontinue the ICP education pathway.

Te Kaunihera would like to hear your thoughts on the options below.

1. **'Open' specialist practice endorsement – Intensive care paramedic:**
   For the purpose of this consultation, 'open' ICP endorsement means that all paramedics with additional qualifications and experience as an intensive care paramedic can apply to use the specialist practice paramedic title, intensive care paramedic (ICP). Like CCP and

ECP endorsement, an ICP endorsement would recognise their additional qualifications and experience as an ICP.

If Te Kaunihera adopted this approach, ICP endorsement would be available to all paramedics with the relevant ICP qualifications and experience. However, a current education pathway is required to make this option a possibility. A relevant ICP qualification is necessary to provide assurance that a paramedic has the relevant skills and knowledge to practise as an ICP. Both CCP and ECP endorsements require paramedics to complete qualifications relevant to the specialist practice area. Noting the matters set out above regarding ICP education pathways, Te Kaunihera is seeking feedback on what education pathway would be available to enable ICP endorsement to remain open to all paramedics going forward.

2. 'Closed' specialist practice endorsement - Intensive care paramedic:
This approach would allow currently registered paramedics with additional qualifications and experience practising as an ICP in Aotearoa to apply for a specialist paramedic practice endorsement (ICP). This would recognise their additional qualifications and experience as an ICP, but the timeframe to apply for a specialist practice (ICP) endorsement would be limited to enable only those currently working as an ICP in Aotearoa to seek endorsement.

Those paramedics who meet the requirements and who are granted an ICP endorsement can continue to use the ICP title after the application period ends, provided that they comply with any ongoing requirements relevant to their ICP endorsement. However, no new paramedics would be able to apply for an ICP endorsement after the specified date. This would also mean that overseas-qualified paramedics who are not currently working as an ICP in Aotearoa would not be able to apply for a specialist practice ICP endorsement. Paramedics seeking a specialist endorsement would be encouraged to focus on CCP and ECP practice endorsements.

This option does not need a current education pathway as it would only be available for a limited period for currently practising ICPs.

3. No Specialist practice endorsement – intensive care paramedic
As proposed in the initial consultation in 2023.

Grandparenting for ICP endorsement

Should Te Kaunihera decide to create a specialist practice endorsement for ICPs, it is proposed that there will be an *18-month* 'grandparenting' period.[9] Grandparenting, or recognition of prior qualifications and experience, would be available for a limited timeframe to allow those currently practising as an ICP in Aotearoa to apply for specialist practice endorsement. Applicants applying for registration during grandparenting would need to provide evidence of a current authority to practice (ATP) as an ICP, and other evidence to demonstrate their qualifications, skills, experience, and competence to work as an ICP.

Te Kaunihera may require some applicants who are grandparenting for ICP endorsement to successfully complete an ICP clinical assessment day (CAD) if it is considered necessary to confirm their competence to practise as an ICP.

After this limited time period, paramedics wanting to apply for an ICP specialist practice endorsement would need to hold a relevant ICP qualification approved by Te Kaunihera. This highlights the importance of an ICP education pathway.

In our pātai | questions, available either online via SurveyMonkey or in Appendix 1, we are seeking your feedback on whether, if introduced, there should be a time-limited grandparenting for ICP endorsement as recommended by the Clinical Practice Guidelines Working Group.

Intensive care paramedic descriptors

If a specialist practice endorsement is created for ICP, a distinct descriptor will need to be developed. As an example, following careful consideration, descriptors were developed to capture the mahi | work involved with the specialist practice endorsement for ECP and CCP:

> ***Extended care paramedic***
> *An extended care paramedic is a registered paramedic with an expanded scope of paramedic practice specialising in primary and preventive care in the community. An extended care paramedic has advanced knowledge and skills beyond that of a paramedic, with a focus on patients with low acuity and often high-complexity clinical conditions. This includes providing advanced medications and interventions, including (where necessary) invasive procedures below the gingival margin or the surface of the skin, mucous membranes or teeth. An extended care paramedic practises with an emphasis on positively impacting health disparities and helping patients/family/whānau navigate the healthcare system and may practise autonomously or collaboratively with other health professionals in various clinical settings.*

[9] A limited period of grandparenting would be available for both options of 'open' or 'closed' practice endorsement.

Critical care paramedic

A critical care paramedic is a registered paramedic with an expanded scope of paramedic practice specialising in the care of the critically ill or the critically injured. A critical care paramedic has advanced knowledge and skills beyond that of a paramedic, with a focus on patients with high acuity and often life-threatening clinical conditions. This includes providing advanced airway management and medications and interventions, including (where necessary) invasive procedures below the gingival margin or the surface of the skin, mucous membranes or teeth, including during interfacility transfer. A critical care paramedic may practise autonomously or collaboratively with other health professionals in various clinical settings.

In our pātai | questions, available either online via SurveyMonkey or in Appendix 1, we are seeking your input on what an ICP descriptor might look like and what it should include.

A key pātai | question is what makes ICP practice different from paramedic practice and different from CCP (or ECP) practice?

Continuing professional development

Continuing professional development (CPD) requirements support paramedics to maintain their competence to practise and continue to learn. Participation in ongoing professional development is mandatory and applies to all paramedics holding practising certificates.

As noted above, Te Kaunihera has agreed to move forward with specialist practice endorsement and will be endorsing ECP and CCP practice. This means that, paramedics who hold an endorsement with Te Kaunihera as an ECP or a CCP will need to complete 30 hours of CPD.

Feedback on Te Kaunihera's CPD framework was sought via a survey that was sent to all registered paramedics in Hūrae | July 2023. An analysis of the feedback that was received from this survey is available on Te Kaunihera's website.

Following careful consideration of the feedback, at its Pēpuere | February 2024 hui, Te Kaunihera has now made decisions regarding changes to the CPD framework for paramedics. To allow time for paramedics and employers to transition to the new framework, these changes come into effect from 1 Āperira | April 2025. Click here to view the CPD consultation response document.

CPD for ICPs

Decisions regarding CPD requirements for ICPs have yet to be made by Te Kaunihera. As such, ICPs will continue to complete the same CPD requirements as ECPs and CCPs until a decision has been made.

To help guide our whakairo | thoughts, what do you think the minimum requirement of CPD for ICPs should be? Historically, it has been 30 hours.

Going forward, should this be:

- 30 hours – the same as for those who hold specialist paramedic practice endorsements as ECPs and CCPs.
- 25 hours – the same as for paramedics who do not hold specialist paramedic practice endorsements.

Please respond to this in our pātai | questions, available either online via SurveyMonkey or in Appendix 1.

Endotracheal intubation without rapid sequence induction

Kōrero | discussion with education providers and the emergency ambulance sector Medical Directors raised pātai | questions around endotracheal intubation without rapid sequence induction (RSI). It was noted that this is a procedure performed by ICPs, and the kōrero | discussion involved whether this procedure remains acceptable practice or whether contemporary practice had since changed.

The view provided by the Medical Directors was that "*the evidence supports drug facilitated intubation (rapid sequence intubation) having a better first-pass success rate compared to non-drug facilitated intubation, but the effects on morbidity and mortality remain unclear*".

AUT agree with the viewpoint presented by the EAS Medical Directors.

Because of the significance of this procedure and its link to ICP practice, Te Kaunihera are seeking views on its role in current ICP practice.

In our pātai | questions, available either online via SurveyMonkey or in Appendix 1, we are seeking your feedback on endotracheal intubation without rapid sequence induction (RSI) and whether this remains acceptable practice.

Fees

Te Kaunihera notes that, should a specialist practice endorsement be created for ICPs, the endorsement fee would be the same as the other specialist practice endorsements (ECP and CCP).

We will be seeking feedback on the proposed fees for specialist practice endorsements via a separate fee consultation in due course.

Huitīma | Teams meeting

To enable transparency, an easy flow of communication, and to answer any pātai | questions you may have before making a submission, we are providing an opportunity to meet with Te Kaunihera to kōrero | discuss the request for feedback.

Te Kaunihera will be holding two Huitīma | Teams meeting on 12 and 14 Hune | June 2024

1. **Stakeholder Hui** – for all stakeholders
    - Rāapa | Wednesday, 12 Hune | June 2024
    - 1.30pm – 2.30pm (1 hour)
    - Click here to join.
    - Meeting ID: 473 629 740 820
    - Passcode: nMftzi

2. **Intensive Care Paramedic Hui** – specifically for intensive care paramedics
    - Rāmere | Friday, 14 Hune | June 2024
    - 12.00pm – 1.00pm (1 hour)
    - Click here to join.
    - Meeting ID: 420 363 087 596
    - Passcode: YnZYhg

To account for the limited timeframe for these Huitīma and to allow us to tailor the discussion, we ask that any pātai | questions you have are emailed at least two days in advance of the hui to registrar@paramediccouncil.org.nz. We will not include your name when we answer your pātai | questions via Huitīma unless you specifically ask us to do so.

Feedback and submissions

Te Kaunihera is committed to collaboration and engagement and welcomes responses to this consultation from all interested parties, including ICPs, the public, and employers.

Te Kaunihera has developed pātai | questions for respondents to provide feedback. Responses can be completed online via SurveyMonkey by clicking here, or you can email your submissions using Appendix 1 to registrar@paramediccouncil.org.nz.

This document will also be available on Te Kaunihera's website for feedback from any interested individual or organisations.

The consultation period will be open for six weeks and will close on **Rāhina | Monday 8th Hūrae | July 2024.** At the close of the consultation period, Te Kaunihera will carefully review all feedback using the information.

Appendix 1: Ngā pātai whakawhitinga kōrero | Consultation questions

Te Kaunihera has developed pātai | questions for respondents to provide feedback. Responses can be completed online via SurveyMonkey by clicking here or by using the form below.

In the interest of transparency, Te Kaunihera usually publishes stakeholder submissions on its website. We will not publish submissions we consider derogatory or inflammatory. Please let us know if you would like us to remove your name and/or the name of your organisation in any publicly available analysis of responses.

It will help us analyse responses if you identify which part of the sector you belong to (paramedic, employer, ākonga | student, education provider, member of the public etc).

Details of person making submission	
What is your name?	
Are you writing a response on behalf of an organisation or as an individual?	
Please let us know if you would like us to remove your name and/or the name of your organisation in any publicly available analysis of survey responses: ☐ Please remove my name ☐ Please remove the name of my organisation ☐ Please remove my name and the name of my organisation ☐ Te Kaunihera may publish this information	
If you are responding on behalf of an organisation	
Name of organisation	
Does your organisation employ intensive care paramedics (ICPs)?	☐ Yes ☐ No
If yes, how many ICPs?	
If you are an ICP, and are writing a response as an individual *The pātai below are designed help us understand who makes up our ICP population. Your answers to these pātai | questions will not be used to personally identify you, or your submission.*	

What is your gender?	☐ Female ☐ Male ☐ Gender diverse ☐ Prefer not to say
What is your age range?	☐ Under 25 ☐ 25–29 ☐ 30–34 ☐ 35–39 ☐ 40–44 ☐ 45–49 ☐ 50–54 ☐ 55–59 ☐ 60–64 ☐ 65–69 ☐ 70–74 ☐ 75 or older
If you are a registered paramedic *Your answers to these pātai | questions will not be used to individually identify you, or your submission.*	
If you are a registered paramedic with Te Kaunihera, what is your current practice level?	☐ Emergency medical technician (EMT) ☐ Paramedic ☐ Intensive care paramedic (ICP) ☐ Critical care paramedic (CCP) ☐ Extended care paramedic (ECP)
What best describes your mahi | work?	☐ Road ambulance service ☐ Air ambulance service ☐ Ambulance management ☐ Event services ☐ Hospital ☐ Kaupapa Māori health provider ☐ Military services ☐ Oil and/or gas industry ☐ Paramedic education ☐ Private ambulance service ☐ Telehealth ☐ Vaccination services ☐ Other, please describe: _____

What is your primary work environment?	☐ City/metropolitan ☐ Rural ☐ Offshore ☐ A mixture
What is your employment status?	☐ Full-time ☐ Part-time ☐ Casual ☐ Volunteer ☐ Not currently in employment ☐ Other, please describe: _____
Do you hold more than one authority to practise? If yes, please indicate.	☐ Emergency medical technician (EMT) ☐ Paramedic ☐ Intensive care paramedic (ICP) ☐ Critical care paramedic (CCP) ☐ Extended care paramedic (ECP)

Consultation pātai | questions

Pātai | Question: Endotracheal intubation without rapid sequence induction (RSI)

Does endotracheal intubation without rapid sequence induction (RSI) remain acceptable practice in Aotearoa New Zealand?

☐ Yes
☐ No

Please explain the reasons for your answer:

Pātai | Question: Endotracheal intubation without RSI – evidence

Do you have any evidence and/or research and/or expert opinion that you can provide Te Kaunihera on whether endotracheal intubation without rapid sequence induction (RSI) remains acceptable practice?

☐ Yes
☐ No

If you have any evidence and/or research and/or expert opinion on this, please provide this to us to support your response. This can be included as a link or emailed to registrar@paramediccouncil.org.nz alongside your submission.

Pātai | Question: ICPs using endotracheal intubation without rapid sequence induction (RSI)

Should ICPs be able to continue to use endotracheal intubation without RSI?

☐ Yes
☐ No

Please explain the reasons for your answer:

Pātai | Question: Differences

Other than RSI, what are the differences between paramedic and ICP practice?

Please clearly list and explain the differences:

Pātai | Question: Titles and descriptors for ICPs

To protect the public, do you agree that titles and descriptors should be developed and standardised for ICPs?

☐ Yes
☐ No

Please explain the reasons for your answer:

Pātai | Question: ICP descriptor

Noting how ECP and CCP have been described, how would you describe ICP practice as being a separate specialist practice endorsement?

Please provide an example descriptor:

Pātai | Question: Relevance of intensive care practice

From a public safety point of view, does ICP practice remain relevant in Aotearoa New Zealand?

☐ Yes
☐ No

Please explain the reasons for your answer:

Pātai | Question: Open or closed endorsements

If ICPs receive specialist practice endorsement, do you think this endorsement should:

- ☐ Be an **open** endorsement that would allow new paramedics with the relevant (agreed) qualifications to access specialist practice endorsement for ICPs.
- ☐ Be a **closed** endorsement and limited those currently working as an ICP at an agreed date, and no new paramedics would receive specialist practice endorsement for ICP.
- ☐ An endorsement for ICP practice is unnecessary and should not be created

Please explain the reasons for your answer:

Pātai | Question: Continuing professional development (CPD) hours for ICPs

Te Kaunihera must set the minimum requirement of CPD that ICPs should have to complete each year to maintain their competence to practise. What is an appropriate level?

- ☐ 30 hours – the same as for those who hold specialist paramedic practice endorsements as ECPs and CCPs.
- ☐ 25 hours – the same as for paramedics who do not hold specialist paramedic practice endorsements.

Please explain the reasons for your answer:

Pātai | Question: Availability of CPD

Is there enough relevant CPD available for ICPs to be able to maintain competence if ICPs were to receive specialist practice endorsement?

- ☐ Yes
- ☐ No

Please explain the reasons for your answer. If you have answered "Yes", please also include examples of ongoing training that is available.

Pātai | Question: Other feedback

Do you have any other feedback that would help Te Kaunihera to consider how to move forward with ICP specialist practice endorsement?

Completed consultation pātai | questions can be sent to registrar@paramediccouncil.org.nz and should be received prior to **Rāhina | Monday 8th Hūrae | July 2024.**

Appendix 2: National Clinical Practice Guidelines

National Clinical Practice Guidelines (CPGs) are existing guidelines that are updated regularly and are applicable to and accepted as the standard of clinical practice for paramedics.

These guidelines are created by the Clinical Practice Guidelines Working Group with input from a number of experts. Te Kaunihera endorses these CPGs and acknowledges that they may be referred to when considering paramedic practice alongside Te Kaunihera's own standards and statements.

Whilst it is acknowledged that the guidelines are primarily used by the Emergency Ambulance Service, they do provide a useful starting point for defining the procedures and interventions that a paramedic can undertake.

Appendix 3: Documents provided by education provider

Te Wānanga Aronui o Tāmaki Makau Rau | Aukland University of Technology (AUT) provided two pieces of evidence in response to Te Kaunihera's pātai | questions, which have been attached following this page.

1. **BMC Emergency Medicine**
   This research article is a retrospective descriptive analysis of non-physician-performed pre-hospital endotracheal intubation practices and performance in South Africa.

2. **ANZ Journal of Surgery**
   Neurosurgery – a tale of two cities: pre-hospital intubation with or without paralysing agents for traumatic brain injury.

BMC Emergency Medicine

RESEARCH ARTICLE Open Access

A retrospective descriptive analysis of non-physician-performed prehospital endotracheal intubation practices and performance in South Africa

Craig A. Wylie[1], Farzana Araie[2], Clint Hendrikse[1], Jan Burke[1], Ivan Joubert[2], Anneli Hardy[1] and Willem Stassen[1*]

Abstract

Introduction: Prehospital advanced airway management, including endotracheal intubation (ETI), is one of the most commonly performed advanced life support skills. In South Africa, prehospital ETI is performed by non-physician prehospital providers. This practice has recently come under scrutiny due to lower first pass (FPS) and overall success rates, a high incidence of adverse events (AEs), and limited evidence regarding the impact of ETI on mortality. The aim of this study was to describe non-physician ETI in a South African national sample in terms of patient demographics, indications for intubation, means of intubation and success rates. A secondary aim was to determine what factors were predictive of first pass success.

Methods: This study was a retrospective chart review of prehospital ETIs performed by non-physician prehospital providers, between 01 January 2017 and 31 December 2017. Two national private Emergency Medical Services (EMS) and one provincial public EMS were sampled. Data were analysed descriptively and summarised. Logistic regression was performed to evaluate factors that affect the likelihood of FPS.

Results: A total of 926 cases were included. The majority of cases were adults ($n = 781$, 84.3%) and male ($n = 553$, 57.6%). The most common pathologies requiring emergency treatment were head injury, including traumatic brain injury ($n = 328$, 35.4%), followed by cardiac arrest ($n = 204$, 22.0%). The mean time on scene was 46 minutes (SD = 28.3). The most cited indication for intubation was decreased level of consciousness ($n = 515$, 55.6%), followed by cardiac arrest ($n = 242$, 26.9%) and ineffective ventilation ($n = 96$, 10.4%). Rapid sequence intubation (RSI, $n = 344$, 37.2%) was the most common approach. The FPS rate was 75.3%, with an overall success rate of 95.7%. Intubation failed in 33 (3.6%) patients. The need for ventilation was inversely associated with FPS (OR = 0.42, 95% CI: 0.20–0.88, $p = 0.02$); while deep sedation (OR = 0.56, 95% CI: 0.36–0.88, $p = 0.13$) and no drugs (OR = 0.47, 95% CI: 0.25–0.90, $p = 0.02$) compared to RSI was less likely to result in FPS. Increased scene time (OR = 0.99, 95% CI: 0.985–0.997, $p < 0.01$) was inversely associated FPS.

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Conclusion: This is one of the first and largest studies evaluating prehospital ETI in Africa. In this sample of ground-based EMS non-physician ETI, we found success rates similar to those reported in the literature. More research is needed to determine AE rates and the impact of ETI on patient outcome. There is an urgent need to standardise prehospital ETI reporting in South Africa to facilitate future research.

Keywords: Prehospital emergency care, Airway management, Endotracheal intubation, South Africa

Introduction

Prehospital advanced airway management is one of the most commonly performed invasive interventions in the out-of-hospital setting [1–3]. Protecting the airway of a critically ill or injured patient and facilitating adequate ventilation and oxygenation is an essential part of prehospital emergency care [2]. The skill of endotracheal intubation (ETI) is normally reserved for only the highest qualified prehospital providers and, depending on the prehospital system and available resources, often only to anaesthetists or emergency physicians who practice in the prehospital phases of care [2]. Owing to conflicting results on the safety and impact on mortality of prehospital ETI performed by non-physicians, this practice has come under immense scrutiny in recent times [2].

Controversies surrounding non-physician performed ETI relate mostly to lower first pass (FPS) and overall success rates [4], or poorer outcome associated with prehospital ETI, especially in traumatic brain injury [5, 6]. A more recent systematic review and meta-analysis found that a marginal difference in the overall ETI rates between physicians (99%) and non-physicians (97%) and a 10% difference in first pass intubation success when comparing physicians (88%) versus non-physicians (78%). Fouche et al. also reported a higher rate of adverse events (AEs) among non-physicians, which may be explained by a lower FPS rate in this cohort [2]. Almost all cited studies originate from a higher income country (HIC) setting.

There are important differences in prehospital and emergency care systems in low-to middle-income countries (LMICs) that data originating from HICs do not take into consideration. Firstly, prehospital services in LMICs are predominantly non-physician based [7] because of a critical shortage of physicians [8]. Secondly, LMICs may have significantly prolonged prehospital times because of proximity to hospital [9]. Patients also experience many barriers to accessing emergency care [10], delaying presentation. Lastly, LMICs suffer from unique burdens of disease including injury, infectious disease (including human immunodeficiency virus and tuberculosis) and chronic non-communicable diseases [9]. All these factors may make the need for earlier critical interventions in the prehospital setting, including prehospital ETI [11].

South Africa has one of the most developed emergency medical services (EMS) systems on the African continent [7]. Here, prehospital advanced life support non-physicians have been performing prehospital ETI for well over a decade [11, 12]. Yet, there is still a paucity of literature to assess the safety and impact of non-physician performed ETI originating from LMICs, including South Africa. Where literature exists, it frequently originates from a single centre [6, 11], student paramedics [13] or from the aeromedical environment [14]. The aim of this study was to describe non-physician ETI in a South African national sample in terms of patient demographics, indications for intubation, means of intubation and success rates. A secondary aim was to determine what factors are predictive of first pass success.

Methods

We performed a retrospective chart review of prehospital ETIs performed by non-physician prehospital providers, between the periods of 01 January 2017 to 31 December 2017. Two national private EMS and one provincial public EMS were sampled. This manuscript has been prepared in accordance with the The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) extension of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist [15].

Setting

South Africa is an upper-middle income country with an estimated population of approximately 58 million people. There are two distinct healthcare systems, private healthcare and state healthcare. State healthcare is that provided by the South African government to citizens while private healthcare is only accessible to patients through funds to pay for the services, or those with healthcare insurance aid. Only 17% of South Africans currently belong to a healthcare insurance scheme [16]. In the context of EMS though, private EMS are mandated by the constitution to provide emergency care to all patients regardless of their ability to pay or insurance status. Private EMS are generally better-resourced and have faster response times than provincial EMS [17], but follow the same national guidelines and scopes of practice.

Together, the services included in this study receive approximately 150,000 incoming calls per month. The two private EMS provide national coverage in all

provinces, while the provincial EMS sampled in this study provide coverage only to the Western Cape province of South Africa. Approximately 10% of South Africa's population live in the Western Cape. These services provide care to rural and urban populations.

In South Africa prehospital emergency care is provided by non-physician prehospital care providers. Although many cadres of prehospital providers exist, only advanced life support (ALS) providers may perform endotracheal intubation. These providers, who most often respond on a single crewed rapid response vehicle, may either be qualified through a vocational training (1 year certificate course) or higher education training (three-year university diploma or four-year university honours degree). While this changed in 2020, during the study period, certificate and diplomat prehospital providers were able to intubate only via deep sedation (or no sedation) while degree holders were licensed to perform rapid sequence intubation (RSI). RSI is performed with a choice of ketamine or etomidate for induction and succinylcholine or rocuronium for neuromuscular blockade. Deep sedation-only ETI is performed with either midazolam alone or a combination of midazolam and morphine. No sedation ETI is generally indicated in instances of cardiac arrest or where a patient is deeply unconscious without a gag reflex. After 2020, endotracheal intubation of any form is reserved for degree paramedics only [18, 19].

Sample and sampling

Instances of ETI were identified in a variety of ways, depending on the type of the patient report form or archiving systems of each EMS. For the first national private EMS, hand-written, scanned patient report forms (PRFs) of all patients who were intubated by non-physician prehospital providers, between the periods of 01 January 2017 to 31 December 2017 were eligible for analysis. A standard checkbox on the patient report form indicates that intubation was performed, as well as the number of intubation attempts. Both of these are captured onto a central billing system before the form is scanned for archiving. This allowed for the easy identification of intubated patients.

Both the second national private and provincial public EMS utilise electronic patient report forms (ePRFs). For this reason, an extract of cases that fit our inclusion criteria were extracted. In these cases, the number of intubation attempts is not a field in the ePRF and thus has to be extracted from the narrative, typed clinical notes of the prehospital care provider.

Any patients who were intubated by a physician, those who underwent intubation for interfacility transfer, and those intubated on the aeromedical platforms were excluded from analysis. Patients who were intubated by crew members from another service who were attending to the same scene were also excluded.

Data extraction and definitions

After specific training in the research aims, objectives, data variables, and the contents of the PRFs, data were extracted according to a dedicated, standard data abstraction form by a data capturer with experience in clinical administration and the authors (FA, JB). Regular meetings between the data capturers and authors were held to ensure credibility of the extraction process. The data extraction form was based on the Utstein reporting guidelines for prehospital advanced airway management [20].

An intubation attempt was defined as the placement of a laryngoscope blade into the pharynx with the aim of exposing the glottis. An intubation success was defined as placement of the distal end of the endotracheal tube and cuff into the patient's trachea as confirmed by waveform capnography and/or chest auscultation. First Pass Success (FPS) refers to the situation where intubation was successful after a single attempt. If intubation was successful after more than one attempt, this was referred to as Overall Success. A failed intubation was defined as an inability to place an endotracheal tube.

For specific Utstein clinical variables, predicted airway difficulty, and aggravating factors, the PRFs were assessed and interpreted by one of the investigators with clinical experience in anaesthesia and/or prehospital care. If there was a case in which there was uncertainty or dispute, the investigators discussed that case in order to make a joint decision on the variable in question in order to resolve the uncertainty, by consensus.

Lastly, a 10% random sample was drawn for manual verification of accuracy of the data capture. Further manual verification of all discrepant and missing data was undertaken. Where necessary, disputes were resolved by a third investigator.

Data analysis

Regardless of the data source, data were extracted onto a Microsoft Excel (Microsoft Corporation, Redmond, Washington, United States) spreadsheet. All analyses were conducted using Stata 17.0 (StataCorp, Texas, United States). Continuous variables were summarised as mean and standard deviation; while nominal and ordinal variables were summarised as counts and percentages.

Logistic regression was performed to evaluate the effect of age, sex, reason for emergency treatment, indication for intubation, approach, risk factors, aggravating conditions and scene time on the likelihood of three outcomes: 1) First Pass Success; 2) Overall Success; and 3) Failed Intubation. The outcome was

predicted perfectly for two reason variables (infection (including sepsis) and psychiatry (e.g. agitation/psychosis)) and two indication variables (humanitarian and failure of airway device). These variables were thus omitted in the models. This resulted in nine cases being excluded from the FPS model, 83 cases excluded from the overall success model and 220 cases excluded from the failed intubation model.

Model fit was assessed based on the Hosmer-Lemeshow (HL) goodness of fit test and inspection of plots for influential observations. Results from the HL tests indicated reasonable fit for all models. Multicollinearity was assessed using the variance inflation factor (VIF). A VIF is derived for each predictor in the predictor set reflecting the variance by which the estimated coefficient is increased due to near-linear dependences among the predictors. VIFs exceeding 10 indicates that the associated regression coefficients are poorly estimated because of multicollinearity [21]. Cardiac arrest and cardiopulmonary resuscitation (CPR) as indications for intubation both had VIF values greater than 10. Cardiac arrest as an indication was excluded and CPR kept for subsequent models. The indicators for "whether or not aggravating conditions were assessed" and "no aggravating conditions indicated", also had VIF values larger than 10. Both indicators were kept in the models since it is likely that the distinction between "not assessed" and "no aggravating conditions" cannot be clearly delineated retrospectively.

Cases that were outlying from the other observations in terms of standardised Pearson residuals, leverage values and difference of Chi-square values were excluded from follow-up runs of the models, to evaluate estimates without these observations. Standard errors on the coefficients for the Failed Intubation model improved markedly with the exclusion of one particular case.

Results

A total of 1339 patients received non-physician performed ETI during the study period. The number of intubation attempts were not recorded in 413 (30.8%) patients, and these were therefore excluded from the study as it fell outside our inclusion criteria. Figure 1 outlines the sampling process and exclusion. This yielded a final sample size of 926 cases with 793 (85.6%) cases having complete data and 133 (14.4%) cases with at least one missing data point. These cases were therefore excluded from the regression models.

Table 1 describes the demographics of all available cases. The majority of cases were adults ($n = 781$, 84.3%) and male ($n = 553$, 57.6%). The most common reasons requiring emergency treatment were head injury, including traumatic brain injury (TBI, $n = 328$, 35.4%), followed by cardiac arrest ($n = 204$, 22.0%), and blunt trauma ($n = 126$, 13.6%). The mean time on scene was 46 minutes (SD = 28.3).

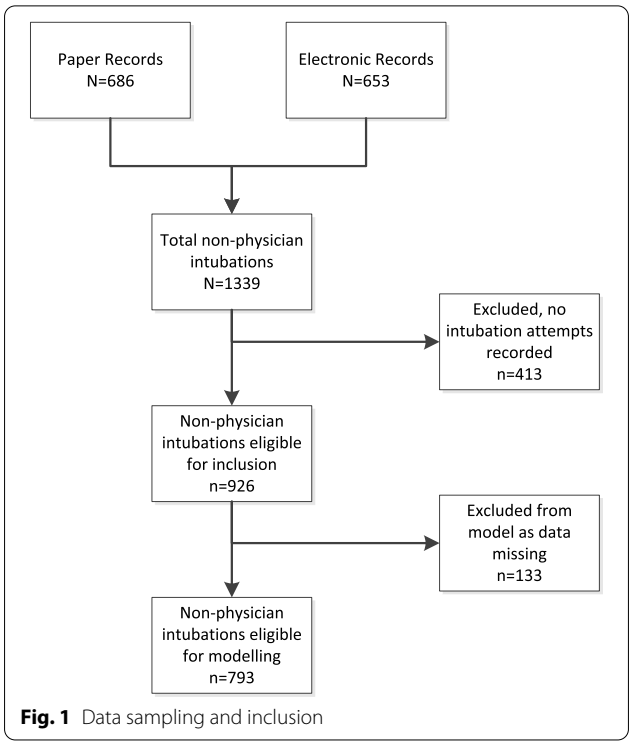

Fig. 1 Data sampling and inclusion

In Table 2, we present the reasons for intubation as well as the approach taken for intubation. The most cited indication for intubation was decreased level of consciousness ($n = 515$, 55.6%), followed by cardiac arrest ($n = 242$, 26.9%) and ineffective ventilation ($n = 96$, 10.4%). RSI ($n = 344$, 37.2%) was the most common mode of intubation, followed by deep sedation ($n = 256$, 27.7%) and CPR ($n = 236$, 25.5%).

Table 3 presents the risk factors for difficult intubation and aggravating conditions for airway management. In the 584 cases where risk factors were assessed, only 68 (11.6%) cases stated that no risk factors were present. Of other cases, $n = 363$ (62.2%) had reduced neck mobility (including manual in-line neck stabilisation), 205 (35.1%) had fluid in the airways, while 72 (12.3%) cases had significant facial or airway trauma reported.

In instances where there was a documented assessment of the aggravating conditions for airway management ($n = 732$), 479 (65.4%) cases had no aggravating conditions. Darkness ($n = 96$,13.1%) and intubation in a stationary ambulance ($n = 57$, 7.79%) were the most common aggravating conditions. In 45 (6.2%) cases the patient was entrapped during intubation while there were hostile conditions on scene in 42 (5.8%) cases.

Table 1 Patient demographics and ETI success

	FPS *n* = 697 (%)	Overall success *n* = 886 (%)	TOTAL *n* = 926 (%)
Age, n (SD)			
Child	54 (7.8)	77 (8.7)	79 (8.5)
Adult	597 (85.7)	743 (83.9)	781 (84.3)
Unknown	46 (6.6)	66 (7.5)	66 (7.1)
Sex (practitioner assigned)			
Male	391 (56.1)	518 (58.6)	533 (57.6)
Female	288 (41.3)	346 (39.1)	371 (40.1)
Unknown	18 (2.6)	22 (2.5)	22 (2.4)
Predominant reason for emergency treatment			
Trauma			
Head injury, incl. TBI	243 (34.9)	325 (36.7)	328 (35.4)
Blunt	95 (13.6)	115 (13.0)	126 (13.6)
Penetrating	24 (3.4)	24 (2.7)	25 (2.7)
Other	21 (3.0)	23 (2.6)	23 (2.5)
Medical			
Cardiac arrest	153 (22.0)	195 (22.0)	204 (22.0)
Intoxication	46 (6.6)	56 (6.3)	62 (6.7)
Respiratory distress or difficulties	44 (6.3)	55 (6.2)	58 (6.3)
Other	10 (1.4)	13 (1.5)	13 (1.4)
Neurology			
Stroke	36 (5.2)	49 (5.5)	54 (5.8)
Other	24 (3.4)	30 (3.4)	30 (3.2)

FPS First pass success, *TBI* Traumatic brain injury

Table 2 Indications for and approach to ETI and ETI success

	FPS *n* = 697 (%)	Overall success *n* = 886 (%)	TOTAL *n* = 926 (%)
Indication for ETI (multiple/patient)			
Decreased LOC	382 (54.8)	497 (56.1)	515 (55.6)
Cardiac Arrest	192 (27.6)	240 (27.1)	249 (26.9)
Ineffective ventilation	62 (8.9)	85 (9.6)	96 (10.4)
Existing airway obstruction	33 (4.7)	42 (4.7)	49 (5.3)
Combative or uncooperative	42 (6.0)	47 (5.3)	48 (5.2)
Impending airway obstruction	39 (5.6)	41 (4.6)	45 (4.9)
Hypoxemia	7 (1.0)	10 (1.1)	11 (1.2)
Humanitarian (e.g. pain relief)	7 (1.0)	7 (0.8)	7 (0.8)
Failure of A/W device	1 (0.1)	1 (0.1)	1 (0.1)
Approach			
RSI	271 (38.9)	337 (38.0)	344 (37.2)
Deep Sedation	179 (25.7)	238 (26.9)	256 (27.7)
Cardiac Arrest	181 (26.0)	226 (25.5)	236 (25.5)
No Medication	65 (9.3)	84 (9.5)	89 (9.6)

FPS First pass success, *ETI* Endotracheal intubation, *LOC* Level of consciousness, *A/W* Airway, *RSI* Rapid sequence intubation

First pass success (FPS) was achieved in 697 patients, yielding an FPS rate of 75.3%. Intubation failed in 33 (3.6%) patients, yielding an overall all success rate of 95.7% ($n = 886$).

First pass success

In a multiple logistic regression model ($R^2 = 0.07$; HL $p = 0.96$), adjusting for all variables in Table S1, an indication of ventilation was inversely associated with first pass

Table 3 Risk factors and aggravating conditions and ETI success

	FPS $n = 697$ (%)	Overall success $n = 886$ (%)	TOTAL $n = 926$ (%)
Patient risk factors for difficult intubation[a]			
Reduced neck mobility (incl. MILNS)	266 (38.2)	355 (40.17)	363 (39.2)
Risk factors not assessed	269 (38.6)	324 (36.6)	342 (36.9)
Fluid in airways	145 (20.8)	200 (22.6)	205 (22.1)
Significant facial or airway trauma	56 (8.0)	70 (7.9)	72 (7.8)
No risk factors for difficult intubation	55 (7.9)	63 (7.1)	68 (7.3)
Severe obesity or thick/short neck	11 (1.6)	18 (2.0)	20 (2.2)
Other	11 (1.6)	15 (1.7)	16 (1.7)
Limited mouth opening	5 (0.7)	11 (1.2)	12 (1.3)
Pre-existing airway device ineffective	6 (0.9)	7 (0.8)	9 (1.0)
Prior difficult intubation	5 (0.7)	7 (0.8)	8 (0.9)
Short TMD	2 (0.3)	3 (0.3)	3 (0.3)
Aggravating conditions for airway management[b]			
Not assessed	144 (20.7)	174 (19.6)	194 (21.0)
Darkness	68 (9.8)	95 (10.7)	96 (10.4)
In stationary ambulance	42 (6.0)	50 (5.6)	57 (6.2)
Patient entrapped	35 (5.0)	43 (4.9)	45 (4.9)
Hostile environment	35 (5.0)	40 (4.5)	42 (4.5)
In moving ambulance	23 (3.3)	28 (3.2)	29 (3.1)
Not 360-degree access	12 (1.7)	13 (1.5)	15 (1.6)
Bright light/sunlight	9 (1.3)	12 (1.4)	12 (1.3)
Suboptimal provider positioning	4 (0.6)	5 (0.6)	6 (0.7)

FPS First pass success, *MILNS* Manual in-line neck stabilisation, *TMD* Thyromental distance

[a] Individual cases may have > 1 risk factor

[b] Some cases had no aggravating condition

success (OR = 0.42, 95% CI: 0.20–0.88, $p = 0.02$); deep sedation (OR = 0.56, 95% CI: 0.36–0.88, $p = 0.13$) and no drugs (OR = 0.47, 95% CI: 0.25–0.90, p = 0.02) compared to RSI was less likely to result in a first pass success; and increased on scene time (OR = 0.99, 95% CI: 0.985–0.997, $p < 0.01$) was inversely associated with first pass success.

Overall success

In a multiple logistic regression model ($R^2 = 0.24$; HL $p = 0.46$) adjusting for all variables in Table S1, deep sedation (OR = 0.17, 95% CI: 0.06–0.52, $p < 0.01$) and no drugs (OR = 0.24, 95% CI: 0.06–0.97, $p = 0.04$) compared to RSI was less likely to result in overall success.

Failed intubation

In a multiple logistic regression model ($R^2 = 0.29$; HL $p = 0.76$), adjusting for all variables in Table S1, deep sedation (OR = 8.87, 95% CI: 2.30–34.26, $p < 0.01$) and no drugs (OR = 9.71, 95% CI: 1.95–48.43, $p < 0.01$) compared to RSI was more likely to result in failed intubation. Increased on scene time was not associated with failed intubation (OR = 1.01, 95% CI: 0.999, 1.03, $p = 0.079$).

Discussion

This study describes ETI in South Africa in terms of patient demographics, indications for intubation, means of intubation and success rates. To our knowledge, this is the largest study of paramedic-performed ETI from the African continent and other low-resource settings. We found that most patients who underwent ETI during this period were adults, males, trauma victims, or had a decreased level of consciousness following trauma. Non-physician ETI appeared to have high overall success rates, despite the presence of risk factors for difficult intubation. The most common approach to ETI was RSI.

South Africa, like many other LMICs, has a tremendously high trauma burden [22, 23]. It is therefore not surprising that the predominant reason for emergency care was following injury. Injury, and particularly TBI, is one of the most important contributors to morbidity and mortality in LMICs, especially in the younger, economically active population [24]. Out-of-hospital cardiac arrest was also a common presentation and this is likely reflective of an increasing burden of cardiovascular disease in Sub-Saharan Africa, including South Africa [25]. ETI in the setting of cardiac arrest is only recommended

under optimal conditions and in settings with demonstrable high success rates, but has further been de-emphasised with chest compressions as the priority [26]. The utility of ETI in the South African context, where out-of-hospital cardiac arrest survival rates are very low [17, 27], is yet to be determined.

Across the world, non-physician ETI FPS rates range from 47 to 98% [28–30]. Further, a recent systematic review that was limited to ETI with an RSI approach only, found non-physician FPS of 78% (95% CI [65–89%]) [2]. The FPS rates reported in this study (75%) compares favourably to that reported in the international literature, despite comprising ETI approaches other than RSI. The use of neuromuscular blocking agents have been found to decrease the risk of difficult intubation [31], and yield a higher FPS rate [32]. This was also demonstrated in our study where RSI was shown to improve the odds of FPS over other approaches. Consequently, these other approaches could have had a lowering effect on the reported FPS. A third of cases had to be excluded because the number of intubation attempts was not recorded. It is not possible to know whether this was more likely to be noted when one or multiple intubation attempts were made. It is therefore conceivable that this could have influenced the reported FPS rate. Similarly, the overall success rates (95.7%) in this sample also compared favourably to that reported elsewhere (97% (95% CI [95 to 99%]) in RSI only [2]. When comparing these rates with non-physician ETI using multiple approaches, the overall success rate is slightly higher in our study than reported in a recent meta-analysis (91.7 (95% CI 61.6–100)) [3].

Owing to heterogeneity in prehospital emergency medical services across the world in terms of provider profile and skill level, and resourcing, comparisons of FPS is not always appropriate, and this should be taken into consideration when interpreting the results.

Perhaps then, it might be more appropriate to compare our FPS rates in this study with other studies originating from South Africa. A recent retrospective descriptive analysis of ETIs in Helicopter Emergency Medical Services (HEMS) reported a FPS rate of 79%, and an overall success rate of 98% [14]. This study included all approaches to ETI, and again compares favourably to the success rates reported herein for ground-based EMS. In another study, prehospital emergency care students achieved FPS and overall success rates of 85.2 and 92.4% when using an RSI approach only [13]. This is a higher FPS rate than reported in our study, but this could again be explained by the utility of neuromuscular blocking agents. Lastly, when comparing prehospital with emergency department success rates in South Africa, a recent study reported an FPS of 81.8%, which is considerably higher than reported herein. However, a sub-analysis of this sample reveals an FPS rate of 73.3% in cases where direct laryngoscopy was attempted, versus video laryngoscopy [33]. Video laryngoscopy was not available in the ground-based EMS involved in this study and thus, the latter FPS is a more appropriate comparison. Another consideration when comparing the FPS rates of this study with our results is the low proportion of trauma patients (20.9%). Manual in-line neck stabilisation, common practice during ETI in trauma victims, has been shown to significantly increase difficulty and failure of ETI [34].

Following multiple regression analysis, three factors remained associated with FPS: RSI approach, ventilation as an indication for intubation, and on scene time. RSI was associated with overall success, and inversely related to failed intubation. The impact of an RSI approach on intubation difficulty and success rates has already been discussed.

On scene time was inversely associated with FPS, while increasing on scene time was associated with overall failure. It is a logical conclusion that the requirement for multiple intubation attempts may prolong scene time, while successfully securing the airway on first attempt will limit the time spent on scene for stabilisation. This was demonstrated in a South African HEMS-based study where the number of clinical interventions were correlated with scene time, and every 1 additional intervention increased scene time by approximately 4 min [1]. Importantly though, interventions (with ETI being one of the most prevalent) did not result in a significantly more stable patient. The effect of prolonged scene time on mortality is yet to be determined in the South African context, especially with such a high burden of injury.

Ineffective ventilation as indication for ETI was inversely associated with FPS. This might be explained by the predictable instability associated with acidosis and hypoxaemia that accompany hypoventilation [35]. This may preclude prolonged attempts at securing the airway and result in earlier termination of an intubation attempt to avoid adverse events.

While success rates are a useful measure of airway management, they can be misleading as surrogates for safe ETI. Instead, there is a drive towards reporting of peri-intubation adverse events, rather than simply relying on success rates. In this retrospective study, it was difficult to validly extract AEs from the PRFs as the exact time of intubation was not recorded in most instances. Poor reporting was also the reason why a third of eligible cases where the number of intubation attempts were not recorded, had to be excluded. We therefore suggest that PRFs and/or reporting documents for all ETI instances be adjusted to allow for meaningful analysis as part of quality improvement and research practices. Using

standardised airway forms has been found to reduce the rate of missing information and significantly increase the quality of data reported during prehospital ETI [36]. Calls for standardisation and robust clinical governance for prehospital intubation in South Africa, have been made previously [12] but there seem to be barriers to their implementation [37].

During the data collection period of this study, all advanced life support prehospital providers were licensed to intubate patients. In 2020, the Health Professions Council of South Africa (HPCSA) made the decision to remove ETI from the scope of practice of all prehospital providers and subsequently prehospital intubation can only be performed by degreed providers using the RSI approach. Currently, there are only 900 degreed providers registered with the HPCSA [38], yet it is unclear how many are actually still in full-time clinical practice in South Africa - a major concern as South Africa has had some considerable challenges in retention of prehospital providers [39, 40].

Emergency intubation in the prehospital environment is a complex intervention with severe complications if it is poorly planned or performed, so optimising all factors involved prior to intubation makes sense. This would include allowing only well-trained, competent individuals with adequate skills and experience to undertake ETI [41, 42]. While it can be seen as a commendable decision to reserve intubation for the highest qualified prehospital providers, this might translate into lack of access to a potentially life-saving intervention early in the course of emergency care. This may be undesirable, especially in TBI where early control of oxygenation and ventilation may prevent secondary brain injury [43] - TBI comprised over two-thirds of the patients in this study. The potential impact and unintended consequences of removing access to ETI in these patients warrants urgent examination. Some solutions to this may be to develop retention strategies for degreed paramedics and incentivise them to remain in practice, especially in rural or underserved communities. Another option may be regionalised scopes of practice for all ALS that are tailored to anticipated prehospital times and local injury and illness epidemiology.

Non-degreed paramedics are now licensed to insert supraglottic airway (SGA) devices as a primary means of securing the airway, while degreed paramedics often use SGAs as a rescue device in case of failed intubation. In other settings, SGAs have been shown to be safe and effective means for securing the airway and achieving oxygenation and ventilation in the prehospital setting [44]. This is especially true in cardiac arrest [45], a major indication for ETI in this study. However, their role in trauma is less clear with limited data [44]. There are currently no studies on the use of SGA as primary airway device from the South African setting and this should be considered in future however, its use as primary device shows some promise.

It is essential to acknowledge the paucity of robust data on the effect of prehospital ETI on morbidity and mortality [46], especially in trauma [6, 42, 47]. Where data exists, it is mostly from high income settings, or cannot allow for meaningful comparison or meta-analysis owing to health system variation, selective reporting, or risk of bias. There is an urgent need to perform additional research that evaluates the peri-intubation safety and outcome following prehospital ETI. In our view, the only way that this could happen robustly is through the implementation of mandatory standard reporting databases.

Limitations

This retrospective study is not without limitations. Data were extracted from self-reported clinical notes that are not intended for research and therefore had to be extracted based on the clinical impression of the extractors. Certain data such as airway difficulty and aggravating factors relating to airway assessment are based on the subjective judgement of the practitioner performing the assessment and can therefore only be considered as estimates of potential airway difficulty. Only instances of prehospital ETI were included in this study and other methods of basic or advanced airway management was not studied. External validity is certainly affected by the inclusion of private services and only one, provincial public emergency medical service. Other smaller, local private EMS were also excluded. External validity is also influenced by the relatively well-developed prehospital system in South Africa, as compared to other LMICs. This limits the immediate generalisability to other countries in Africa however, the results here may be of interest in settings where the EMS system is just developing. Another important limitation is that no patients that did not have ETI were included to allow for comparisons of outcome and scene time delays associated with ETI.

Conclusion

In this sample of ground-based EMS non-physician ETI, we found success rates similar to that reported in international literature on non-physician ETI. Success rates also compared favourably to South African facility-based rates, when intubation is performed by physicians. RSI, on scene time and ineffective ventilation as an indication for intubation were the most important variables associated with FPS. More research is needed to determine AE rates and the impact of prehospital ETI on patient outcome. There is an urgent need to standardise airway management reporting in South Africa.

Abbreviations
A/W: Airway; AEs: Adverse events; ALS: Advanced Life Support; CPR: Cardiopulmonary Resuscitation; EMS: Emergency Medical Services; ePRF: Electronic Patient Report Form; ETI: Endotracheal Intubation; FPS: First Pass Success; HEMS: Helicopter Emergency Medical Services; HIC: High Income Country; HL: Hosmer-Lemeshow goodness of fit test; HPCSA: Health Professions Council of South Africa; LMIC: Low- to Middle-income Country; LOC: Level of Consciousness; MILNS: Manual In-line Neck Stabilisation; PRF: Patient Report Form; RSI: Rapid Sequence Intubation; SGA: Supraglottic Airway; TBI: Traumatic Brain Injury; TMD: Thyromental Distance; VIF: Variance Inflation Factor.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12873-022-00688-4.

Additional file 1.

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Authors' contributions
CW conceptualised and designed the study, analysed and interpreted data, and drafted and approved the final manuscript. FA, JB conceptualised and designed the study, collected and analysed data, and approved the final manuscript. IJ, CH contributed to study design and data interpretation, and approved the final manuscript. AH analysed and interpreted data, and approved the final manuscript. WS conceptualised and designed the study, analysed and interpreted data, and drafted and approved the final manuscript.

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Availability of data and materials
The datasets used and analysed during the current study are available form the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval was obtained from the Human Research Ethics Committee of the University of Cape Town (HREC ref.: 698/2018 and 706/2018), with waiver of informed consent as the study was retrospective. Administrative permissions to access clinical patient data was obtained from the provincial public EMS and both private services.

Consent for publication
No consent for publication was gained or required as the study does not contain any individual person's data.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

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A tale of two cities: prehospital intubation with or without paralysing agents for traumatic brain injury

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Abstract

Background: The role of prehospital endotracheal intubation (PETI) for traumatic brain injury is unclear. In Victoria, paramedics use rapid sequence induction (RSI) drugs to facilitate PETI, while in New South Wales (NSW) they do not have access to paralysing agents. We hypothesized that RSI would both increase PETI rates and improve mortality.

Methods: Retrospective comparison of adult primary admissions (Glasgow Coma Scale <9 and abbreviated injury scale head and neck >2) to either Victorian or NSW trauma centre, which were compared with univariate and logistic regression analysis to estimate odds ratio for mortality and intensive care unit (ICU) length of stay.

Results: One hundred and ninety-two Victorian and 91 NSW patients did not differ in: demographics (males: 77% versus 79%; $P = 0.7$ and age: 34 (18–88) versus 33 (18–85); $P = 0.7$), Glasgow Coma Scale (3 (3–8) versus 5 (3–8); $P = 0.07$), and injury severity score (38 (26–75) versus 35 (18–75); $P = 0.09$), prehospital hypotension (15.4% versus 11.7%; $P = 0.5$) and desaturation (14.6% versus 17.5%; $P = 0.5$). Victorians had higher abbreviated injury scale head and neck (5 (4–5) versus 5 (3–6); $P = 0.04$) and more often successful PETI (85% versus 22%; $P < 0.05$). On logistic regression analysis, mortality did not differ among groups (31.7% versus 26.3%; $P = 0.34$; OR = 0.84; 95% CI: 0.38–1.86; $P = 0.67$). Among survivors, Victorians had longer stay in ICU (364 (231–486) versus 144 (60–336) h), a difference that persisted on gamma regression (effect = 1.58; 95% CI: 1.30–1.92; $P < 0.05$).

Conclusion: Paramedics using RSI to obtain PETI in patients with traumatic brain injury had a higher success rate. This increase in successful PETI rate was not associated with an improvement in either mortality rate or ICU length of stay.

Introduction

The role of prehospital endotracheal intubation (PETI) performed by paramedics in patients with severe traumatic brain injury (STBI) is controversial.[1–11] Theoretically, PETI prevents secondary brain injury from hypoxia and therefore improves outcomes. Practically, when investigated by retrospective and prospective studies, PETI (facilitated by rapid sequence induction (RSI) protocols or performed without paralysing agents, the so-called 'cold intubation') was not consistently associated to a survival advantage.[12–28] This lack of evidence to support PETI is reflected in the varying prehospital protocols, even within the same nation.[1–13] In Australia, for example, only paramedics in the state of Victoria are trained and allowed to use RSI protocols to facilitate PETI.[12] The remaining Australian states and territories rely on 'cold intubation' techniques and other non-invasive airways protection strategies to maintain adequate oxygenation and ventilation in patients with STBI.[13]

In this study we compare the outcome of STBI patients treated in two different prehospital trauma systems: a Victorian (paramedics with access to RSI protocol) and a New South Wales (NSW) ambulance service (paramedics without access to RSI protocol). We hypothesized that RSI would increase the PETI rate and thus reduce in-hospital mortality rates at the receiving level 1 trauma centres.

Methods

The study protocol was approved by the Hunter New England Human Research Ethics Committee. This is a retrospective cohort study including all adult trauma patients admitted from January 2009 to December 2011 to a level 1 trauma centre of New South Wales (NSW group) and a level 1 trauma centre of Victoria (Victorian group). Prospectively maintained institutional trauma registries were queried for patients with first recorded prehospital Glasgow Coma Scale (GCS) of less than nine and abbreviated injury scale head and neck (AIS H/N) higher or equal to three. Patients with penetrating STBI, those retrieved from other hospitals, and those below 18 years of age were excluded. The trauma registry, hospital and prehospital patient records were investigated to obtain the following data points: demographics, mechanism of injury, injury severity score (ISS), AIS H/N, worse prehospital vital signs (systolic blood pressure, oxygen saturation) and first recorded field GCS, prehospital airway management, vital signs on arrival to emergency department (ED), length of stay in intensive care unit (ICU), and outcome (alive at discharge versus deceased in hospital).

Patient characteristics were compared between sites using chi-squared/Fisher's exact tests for categorical variables and *t*-tests/Kruskal-Wallis for continuous variables. The between site mortality odds ratio (OR) was adjusted with logistic regression models using variables found to have $P < 0.2$ (ISS, prehospital GCS, AIS H/N and successful PETI). ISS was categorized in groups and fit as a continuous variable. The fit of the model was assessed using the Hosmer and Lemeshow statistic and outlier detection was conducted using plots of DFBETAs and Cook's Distance. Akaike information criterion and log-likelihood test statistic were used to guide variable selection.

Post hoc analysis was conducted in patients with field GCS below six (GCS: 3–5) and those with field GCS above five (GCS: 6–8) using the same statistical methodology.

Length of stay in ICU for surviving patients was compared between sites using gamma regression with a log link function adjusting for ISS and GCS. ISS was again categorized into groups and fit as a continuous variable. Akaike information criterion and log-likelihood test statistic were used to guide variable selection and ISS categorization. Coefficients in gamma regression were exponentiated and interpreted as multiplicative effects. These are presented with 95% profile-likelihood confidence intervals (CIs) and *P*-values. All statistical analyses were performed using SAS v9.4 (SAS Institute, Cary, NC, USA).

Results

A total of 337 patients with prehospital GCS below nine and AIS H/N above two were identified (49 retrieved and five penetrating STBI patients were excluded). Demographics, clinical characteristic and outcomes of the 192 Victorian patients and 91 NSW patients are presented and compared with univariate analysis in Table 1. The two groups were similar in terms of demographics and injury severity. Victorian paramedics obtained PETI in 85.4% of their patients while NSW paramedics were successful in 22.2% of cases ($P < 0.05$). On arrival to ED the prevalence of hypotension and desaturation did not statistically differ among the two groups. Mortality did not differ between cohorts on univariate analysis. On logistic regression analysis the mortality OR was 0.84 with a 95% CI containing one (0.38, 1.86) and thus was not statistically significant ($P = 0.67$). Mortality was independent both of PETI success rate and ISS, but affected by AIS H/N and prehospital GCS (Table 2).

Table 1 Univariate analysis of demographics, clinical characteristics and outcomes of patients with prehospital GCS below nine and AIS H/N higher or equal to three stratified by location of trauma centre

	Victoria	NSW	*P*-value
Patients	192	91	
Male, *n* (%)	148 (77)	72 (79)	0.7
Age, median (IQR)	34 (18–88)	33 (18–85)	0.75
ISS, median (IQR)	38 (26–75)	35 (18–75)	0.09
AIS H/N, median (IQR)	5 (4–5)	5 (4–5)	0.04
Prehospital systolic below 90 mmHg, *n* (%)	27 (15.4)	10 (11.7)	0.53
Prehospital SaO_2 below 90, *n* (%)	28 (14.6)	16 (17.5)	0.59
Prehospital GCS, median (IQR)	3 (3–8)	5 (3–8)	0.07
Successful PETI, *n* (%)	164 (85.4)	20 (22.2)	<0.05
ED systolic below 90, *n* (%)	20 (11.7)	8 (9.0)	0.83
ED SaO_2 below 90, *n* (%)	21 (11.2)	7 (8.2)	0.52
Hours in ICU, median (IQR)	275 (24–1046)	120 (24–960)	<0.05
Hours in ICU for survivors, median (IQR)	364 (231–486)	144 (60–336)	<0.05
Mortality, *n* (%)	61 (31.7)	24 (26.3)	0.34

AIS H/N, abbreviated injury score head and neck; ED, first recorded in emergency department; ICU, intensive care unit; IQR, interquartile range; ISS, injury severity score; PETI, prehospital endotracheal intubation; Prehospital GCS, prehospital first recorded Glasgow Coma Scale.

The GCS 3–5 cohort consisted of 136 and 58 patients from Victorian and NSW groups, respectively. The two groups were similar in terms of demographics (male: 78% versus 81%; $P = 0.8$ and median age: 34 (interquartile range (IQR): 10–23) versus 32.5 (IQR: 23–50); $P = 0.6$), ISS (41 (IQR: 30–48) versus 38 (IQR: 29–500; $P = 0.8$) and AIS H/N (5 (IQR: 4–5) versus 5 (IQR: 4–5); $P = 0.5$). The groups differed in first recorded scene GCS (3 (IQR: 3–4) versus 3 (IQR: 3–5); $P < 0.05$) and the rate of successful PETI (83.8% versus 32.7%; $P < 0.05$). Mortality did not differ among groups on univariate analysis (39.3% versus 41.3%; $P = 0.8$) and the lack of difference persisted in the logistic regression model (Table S1).

There were 59 and 33 patients in the field GCS 6–8 cohort in Victorian and NSW groups, respectively. The groups had similar

Table 2 Corrected mortality odds ratio for Victorian and NSW cohorts of patients with prehospital GCS below nine and AIS H/N higher or equal to three

Parameter	Odds ratio	95% confidence interval	*P*-value
Victoria versus NSW	0.84	0.38–1.86	0.6744
Prehospital GCS	0.57	0.44–0.7	<0.0001
Successful PETI	1.36	0.61–3.07	0.4520
ISS	1.21	0.87–1.7	0.2640
AIS H/N	3.70	2.07–7.19	<0.0001

AIS H/N, abbreviated injury scale head and neck; ISS, injury severity score; PETI, prehospital endotracheal intubation; Prehospital GCS, prehospital first recorded Glasgow Coma Scale.

demographics (male: 74.5% versus 75.7%; $P = 1$ and median age: 34 (IQR: 22–54) versus 33 (IQR: 22–55); $P = 0.9$), and ISS (36 (IQR: 29–43) versus 34 (IQR: 25–38); $P = 0.25$), but differed in AIS H/N (5 (IQR: 4–5) versus 4 (IQR: 3–5); $P = 0.02$), first recorded field GCS (7 (IQR: 6–8) versus 6 (IQR: 6–8); $P < 0.05$) and rate of successful PETI (84.7% versus 3.1%; $P < 0.05$). Mortality differed among groups significantly both on univariate analysis (15% versus 3%; $P < 0.05$) and on logistic regression analysis (Table S2).

When compared to NSW, the Victorian cohort showed a longer ICU stay even when just the survivors were considered. On gamma regression adjusting for ISS and GCS ICU length of stay was significantly different between sites with the average length of stay in the Victorian group estimated to be 1.58 times that of the NSW group (Table S3).

Discussion

In the field, the priority for paramedics attending STBI patients is to establish and maintain a secure airway.[1–13] While the success rate in obtaining PETI varies according to paramedics training, it is dramatically increased by the availability of prehospital RSI protocols. Observational studies on patients with STBI have consistently demonstrated that paramedics performing RSI facilitated PETI are successful in up to 97% of attempts,[14–19] while paramedics performing 'cold intubation' rarely succeed more than 25% of the time.[20–25] This has important implications, as prevention of secondary brain injury from hypoxia and hypercapnia is of paramount importance in STBI patients.[29] These deleterious insults might be exacerbated when PETI is attempted, but not obtained. With or without RSI assistance the role of PETI remains controversial. Several retrospective and prospective observational studies have tried to understand the impact of PETI in STBI patients, but the results have been conflicting. The only randomized control study comparing RSI-assisted PETI versus bag-mask ventilation failed to demonstrate a survival advantage (though long-term functional outcome was somehow improved by the intervention).[28] A recent study has compared RSI-assisted PETI versus prehospital 'cold intubation' in patients with blunt STBI.[27] This is a retrospective cohort-matched study comparing patients treated on scene by either European ambulance physicians (with access to RSI) or US paramedics (without access to RSI): physicians had longer prehospital times though a higher successful PETI rate. Interestingly no difference in length of stay or in mortality was observed. The comparison of two trauma systems that differ in practices, resources and prehospital systems (relying either on a physician or a paramedic) introduces several biases. These differences appear critical enough to cause the loss of the cause–effect of the indexed intervention (RSI-assisted PETI).

Our study has taken advantage of the critical differences between ambulance service protocols of two different Australian states. We have compared the in-hospital mortality of patients with STBI who were managed by either Victoria paramedics, who routinely use RSI protocols to obtain PETI, or by NSW paramedics, who have no access to paralysing agents. The two cohorts were statistically very similar in terms of demographics, severity of injury and vital signs and therefore comparable, but because some *P*-values were considered small, logistic regression analysis was also obtained to adjust for these suspicious variables. It appears that Victoria paramedics were highly successful in performing PETI (85%), while the NSW paramedics were successful only in a minority of cases (22%). Despite this substantial difference in the prehospital management, the primary outcome measures (mortality) did not statistically differ between the two groups, even after logistic regression analysis.

This lack of improved outcome when such an invasive and efficient intervention is applied poses doubts on the indication to perform PETI. Potentially, the blanket delivery of RSI-assisted PETI to all patients with a GCS below nine causes harm to some (most likely those with higher GCS who can maintain adequate airway and ventilation).[23,24] This and other previous studies seems to suggest that PETI (with or without RSI) should be offered only to patients with a GCS at least below six.[23,25] Based on the *post hoc* analysis our study seems to confirm that PETI does not influence mortality in patients with a GCS lower than six, but was linked to an increased mortality for those patients with initial GCS above five.

Interestingly, the incidence of both prehospital and ED-arrival hypoxia was similar among the groups. An explanation for this unexpected finding (lack of effect), might be a form of patients auto selection. Possibly, STBI patients who would allow PETI without RSI will be able to maintain oxygenation even without definitive airway management. One more factor to consider, which may explain the similarity among groups, is the increased risk of hypoxia during the intervention itself.[9,30] It is also highly likely that few hypoxic events were unrecorded during critical PETI. The shorter duration of ICU stay for the NSW patients (even among the survivors) is also intriguing. It may well reflect different in-hospital protocols and ICU beds availability, but could also suggest reduced incidence of complications when intubation is performed in more ideal circumstances such as ED.

Our study has several limitations. First, it has a retrospective design which may introduce unforeseen bias despite accurate data collection from the prospectively maintained trauma database and the patient's in-hospital and prehospital notes. Second, GCS like all vital signs varies over time and analysis of variance was not performed. We have selected patients based on the first GCS recorded in the field (therefore, ahead of any sedative drugs administration or PETI attempts). Third, patients who died in the prehospital settings were not captured (this may bias the results as potentially some of the sickest patients in the NSW group could have died from hypoxia on the field when PETI could not be obtained). On the other hand, about 5% of patients with a prehospital GCS below nine are in haemorrhagic shock[25] and PETI may increase bleeding rates and is associated with prehospital death from haemorrhagic shock.[9,31] This is particularly true considering the relatively long prehospital times typical of a geographically large and sparsely populated country such as Australia. Unfortunately, prehospital times were not collected. Motor score has shown to be a better triage tool,[32] but we have not analysed it in isolation. Last, we have used mortality as the primary outcome and did not have any access to short- or long-term functional outcomes. This understates the cognitive role of the brain. Others have shown in similar studies how PETI could positively affect long-term functional outcome.[28]

The strength of this study is in its simplicity and pragmatism. We have compared two Australian trauma systems with comparable prehospital and in-hospital resources, which differ only for the intervention of interest (namely, the use of RSI drugs by paramedics to obtain PETI). In this quasi-experimental study we have excluded patients retrieved from other hospitals and those who did not have a proven STBI as cause of low prehospital GCS. As a result, the two groups were extremely similar in demographics and injury severity. When a statistical difference was queried ($P < 0.2$), logistic regression analysis was conducted. With the above limitations in mind, this study demonstrates that the use of RSI in the field did not result in a difference in outcome and might potentially be detrimental in those patients with a GCS higher than five. To our knowledge, this is the first study to compare the effect of diverse prehospital RSI protocols in STBI patients in two otherwise comparable trauma systems.

Conclusion

Paramedics with access to RSI protocols show a higher success rate of PETI when compared to paramedics who can only practice 'cold intubation' for patients with STBI. This improvement did not lead to a reduced mortality rate or to a shorter ICU stay. Further studies are necessary to identify the population which would really benefit from PETI.

Conflicts of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Corrected mortality odds ratio for Victorian and NSW cohorts of patients with first prehospital GCS below or equal to five and AIS H/N higher or equal to three.

Table S2. Corrected mortality odds ratio for Victorian and NSW cohorts of patients with prehospital GCS between six (included) and eight (included) and AIS H/N higher or equal to three.

Table S3. Corrected comparison of the length of ICU stay among patients with prehospital GCS below nine and AIS H/N higher or equal to three from the Victorian and NSW cohorts, who were discharged alive.