AmbulanceVictoria

Medical Advisory Committee

Agenda item 4.1.2

Meeting date	11th December 2019
Subject	Endotracheal Intubation CPG Review
Appendices	Appendix 1 - CPG A0302 – Endotracheal Intubation (current) Appendix 2 - CPG P0301 – Endotracheal Intubation (Paediatric) DRAFT Appendix 3 - CPG A0302 – Endotracheal Intubation (proposed Adult) Appendix 4 - Pharmacology – Ketamine (proposed) Appendix 5 - AAV Endotracheal Intubation (Adult) DRAFT Appendix 6 - QAS CPP Rapid Sequence Intubation Appendix 7 - ARV SOP 2.01 Preparation and Preoxygenation for RSI Appendix 8 - ARV SOP 2.02 PHARM Rapid Sequence Intubation
Authors	Bart Cresswell, MICA Representative Medical Advisory Committee Kate Whiting, MICA Paramedic Scott Bennetts, Manager Clinical Practice Guidelines
Presenter	Bart Cresswell, MICA Representative Medical Advisory Committee

1. Executive summary:

Ambulance Victoria (AV) clinical practice guidelines (CPGs) are scheduled for reviewed at least once every five years. CPG A0302 and P0301 'Endotracheal Intubation' were last reviewed in 2014. This paper presents the current evidence surrounding prehospital intubation and expert consensus in relation to advanced airway practice and the rationale for a new guideline supporting prehospital intubation by MICA paramedics. The proposed guideline changes include:

1. Changed clinical indications for prehospital intubation including:
    - Removal of 14 separate indications, based on suspected aetiology
    - Addition of 3 specific indications, related to assessment of the airway at risk
2. Addition of structured risk versus benefit analysis for each prehospital intubation, providing decision making assistance both to either support or withhold prehospital intubation
3. Removal of 'intubation facilitated by sedation' (IFS)
4. Simplified RSI sedation medications:
    - Removal of fentanyl for RSI sedation in post cardiac arrest patients (ROSC)
    - Addition of preferred ketamine for RSI sedation in all patients, unless contraindicated
    - Addition of fentanyl and midazolam for RSI sedation where ketamine is contraindicated
    - Removal of 5 sedation pathways, replaced by 2; a primary and alternate
5. Changed neuromuscular blocking agent for RSI:
    - Removal of Suxamethonium
    - Addition of rocuronium
6. Changed post intubation management:

- Preference for fentanyl/midazolam infusion (replaced morphine/midazolam preference)
- Addition of ketamine bolus sedation until infusion established
- Addition of rocuronium infusion for maintenance of paralysis

2. Background

Rapid Sequence Intubation (RSI) was first introduced to the MICA paramedic (MP) skillset as part of a prehospital led trial of traumatic brain injury (TBI) patients in the Victoria State Trauma system (2007-2010). Indicated patients were intubated using Fentanyl, Midazolam and Suxamethonium, with a demonstrated improvement in functional neurological outcome (1). At the time of the study, RSI in the prehospital setting was controversial, historically being the domain of anaesthetists and, more recently emergency department (ED) physicians. The rollout of road-based MP RSI was predicated on the high success achieved by MICA flight paramedics and continuation of the training rigor and governance supporting this practice over preceding years. The TBI RSI study by Bernard et al, demonstrated a high rate of intubation success and subsequently all road-based MP's were authorised by the Medical Advisory Committee (MAC) to intubate TBI patients using RSI. The independent practice of RSI by MP's is currently restricted with staged authority to practice requirements supported by an education program and simulation assessment. Every RSI state-wide is audited, reviewed were necessary and reported to board quality.

In the years following the trial the list of indications for prehospital RSI has grown significantly with the experience of MP and consistent high intubation success rates >98%. The indications have been rolled out based on conscious state (GCS<10) and the suspected clinical aetiology (2). Whilst altered conscious state, as determined by the Glasgow Coma Score (GCS), is consistent with evidence base, suspected clinical aetiology is a relatively one-dimensional viewpoint that fails to fully capture the hierarchy of the patient's needs. The current indications are also reflective of, what is, an evolution in practice and skillset in the form of a list, rather than specific clinical indicators for inclusion.

The clinical practice guideline (CPG) A0302 'Endotracheal Intubation' has not been updated since 2014. In this time, there has been significant evolution in MP airway management practice, principles, and procedural experience. The training of MP's has undergone significant change and is now completed as a component of a Masters of Specialist Paramedic Practice, part-time while working and lasting three semesters in duration. Advanced airway management is now a comprehensive component of MP education and this is consistent with tertiary training across Australia. Since 2014, changes to the AV guideline have been implemented in an ad-hoc fashion via clinical bulletin and clinical practice development (CPD) based on operational needs and changes in equipment such as video laryngoscopy. These changes require holistic integration into the CPG both for clarity, consistency and ease of reference.

MP led advanced airway management, including prehospital intubation, is now an essential skill in the Victorian health system, particularly in regional Victoria where access to clinician's trained in advanced airway management is limited. Given the evolving professional context in which paramedics work and the education level of currently practicing MPs, the guideline to support this skill should be evidenced-based, up-to-date and consistent with the industry standard.

The clinical practice guideline (CPG) P0301 'Endotracheal Intubation Paediatric' was last updated in 2014. It also requires review and update to ensure that it is consistent with current evidence base and furthermore that it reflects a standardised approach to intubation (e.g. adult version). The road-based MP practice of intubation in paediatric patients has a low incidence (less than 40 per year). While there is opportunity to move from intubation facilitated by sedation (IFS) to RSI for the age <12 patients, there are significant organisational hurdles to overcome in order to achieve this. Specifically the need for an increase in training and currency rigor with rollout of state-wide paediatric cricothyroidotomy. For this reason, this paper presents the updated indications and special notes reflected in the proposed adult guideline for the paediatric intubation CPG. At this time there are no recommended changes to the procedure itself which remains as an IFS technique.

Air Ambulance Victoria (AAV) practice of adult intubation is not currently aligned with the road-based MP guideline. This review affords an opportunity to align these two guidelines with the intent of improving patient safety via consistent operational procedure. While AAV MP's are permitted to intubate patients GCS<12

rather than <10 for road-based MPs, the indications for RSI would be better applied if consistently presented in all relevant AV guidelines. With the proposed road-based MP guideline, alignment with AAV is now not only feasible, but an important step towards universal principles of practice within the scope of airway management.

3. Guideline Review Methodology

In order to identify key areas of consideration in the review of CPG A0302 Endotracheal Intubation, feedback regarding the current CPG was requested from a key group of senior MP staff. This consultative group was used extensively in the configuration of the first draft of the new guideline and included MICA flight paramedics (MFP), clinical support officers (CSO) and MICA team managers (TM).

Other ambulance service guidelines were consulted in the review process including Queensland Ambulance Service (QAS), AAV, Adult Retrieval Service Victoria (ARV) and Australian Capital Territory Ambulance Service (ACT-AS).

A literature review was conducted, specifically relating to the use of sedation medication in the setting of RSI. An OVID MEDLINE database search was used to identify relevant papers.

Prior to presentation at Clinical Practice Guideline Development Committee (CPDC), consultation with Professor Steve Bernard (AV Medical Directorate) and Dr John Moloney (AV Medical Advisor, anaesthetist) approved a provisional draft. The draft was then presented to CPDC and further changes were made to the content and layout.

An all day workshop was then held with a representative sample of both experienced and in-experienced MP clinicians from both rural and metropolitan regions. This workshop included discussion, feedback and testing of the new CPG based on historical cases. The primary intention of the workshop was to ensure appropriate capture by the revised clinical indications. Feedback was collated and a final draft was presented to CPDC for endorsement.

4. Discussion

The development of this guideline had several key priorities. They were;

1. Consistency with other states and services/industry standard
2. Best practice based on current evidence, and
3. Simplification

The following discussion will highlight the major changes and provide subsequent rationale for the following:

- The introduction of conceptually different indications that aim to simplify both the procedure and improve the sensitivity and specificity of prehospital intubation
- Removal of intubation facilitated by sedation (IFS)
- New emphasis on risk-versus-benefit that may preclude prehospital ETT, despite clearly present indications
- Simplified medications for RSI, with Ketamine being the primary choice and fentanyl/midazolam as an alternate option
- Changes to medications for post intubation sedation, introduces??? ketamine and preference for fentanyl/midazolam infusion
- Consistency between RSI neuromuscular blocking (NMB) medication and post intubation NMB medication, including rocuronium for RSI and for infusion post ETT

Indications for prehospital intubation

The purpose of rapid sequence intubation (RSI) is to quickly and definitively secure the at-risk airway. In the AV CPG there are currently 14 indications listed. These are predicated on a GCS < 10 and include:

1. Absent airway reflexes

2. Cardiac arrest
3. Respiratory arrest
4. Diabetic ketoacidosis (DKA) with a blood sugar reading (BSL) 'HI'
5. Respiratory failure
6. Hypoxic brain injury e.g. ROSC, post hanging/drowning
7. Non-traumatic brain injury e.g. stroke
8. Traumatic brain injury (TBI)
9. Overdose with difficult extrication, transport time >30mins and/or oxygen saturations <90%
10. Tricyclic antidepressant (TCA) overdose
11. Status epilepticus
12. Severe hyperthermia
13. Suspected airway burns
14. Severe pain

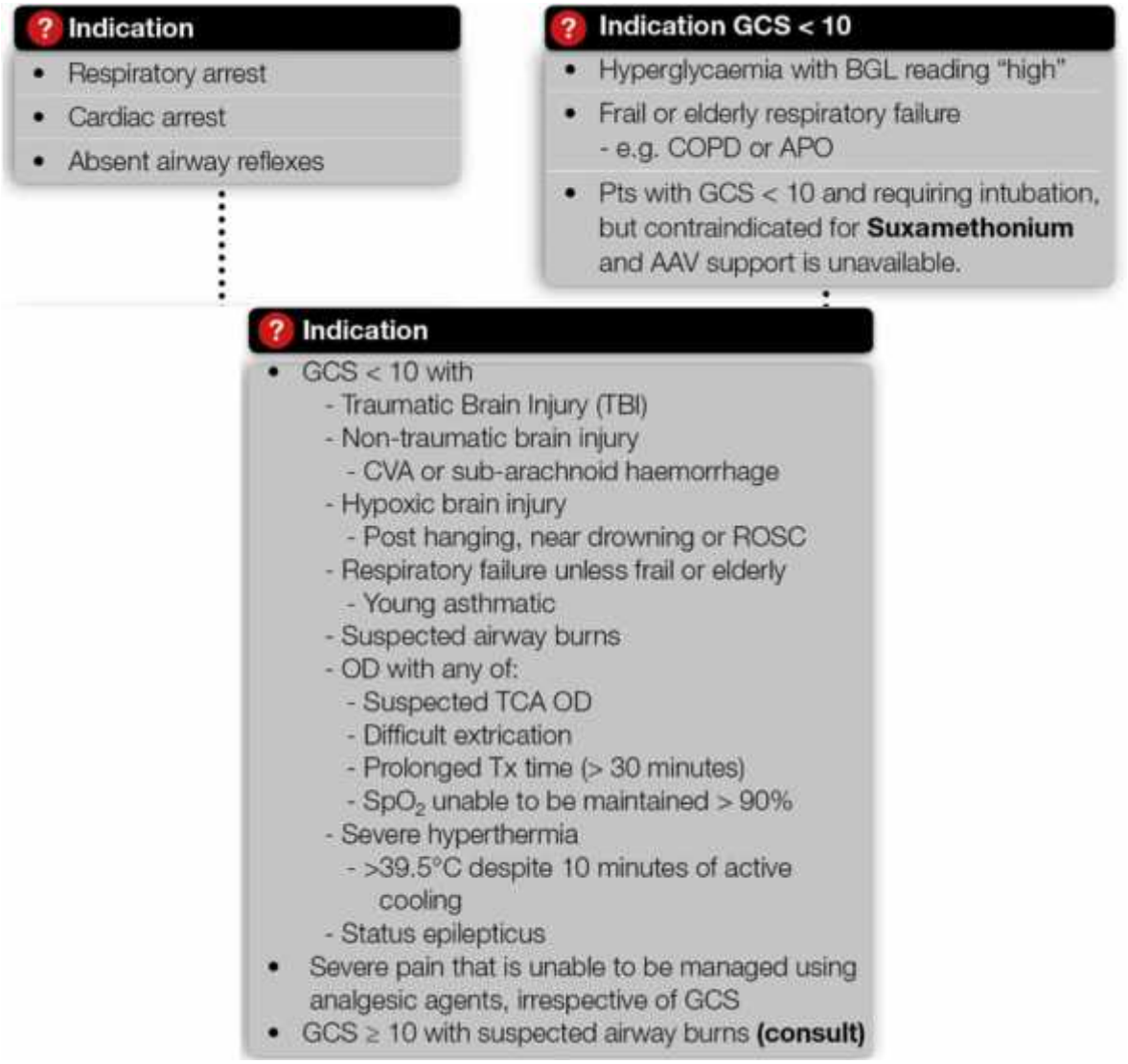


Figure 1. Current indications

In contrast to this extensive list, current best practice describes only 3 clinical indications for intubation, all of which are based on assessment of airway and clinical judgement. Walls et al recommend answering the following three questions in order to determine the necessity of emergency intubation (3):

1. Is there a failure of airway maintenance or protection?
2. Is there a failure of ventilation or oxygenation?
3. What is the anticipated clinical course for the patient?

Current AV intubation practice relies primarily on the 14 indications with additional detail provided in the special notes section of the CPG. This CPG long and overly complex for a high risk, low exposure procedure. Alignment with standard indications begins the simplification outlined further in the following discussion paper. It will reduce the cognitive load on MICA paramedics implementing the skill and assist with improved crew resource management practices. This is likely to lead to improved patient safety and better outcomes. The refinement of criteria and clinical assessment required for their application also assists with the need to support decision making where timely transport to definitive care should be prioritised over advanced airway management. In the case of acute hypovolemic trauma, stroke patients requiring urgent clot retrieval and acute hypovolemic injury such as ruptured ectopic pregnancy, guidelines should empower MICA paramedics to adopt a less ideal airway intervention, where there is need to prioritise rapid patient transport. This is not possible when the indication for intubation is provided as a clinical condition such as stroke or overdose. Shifting the decision towards appraisal of airway, breathing and clinical course as a risk stratification acknowledges the entire patient journey, not just their pre-hospital management.

The proposed guideline change to indications removes the 14 and adds only 3, which correlate directly to the aforementioned questions. Rather than basing the decision on suspected or provisional diagnosis, the revised indications require a clinical airway assessment in order to identifying the ‘airway at risk’. The airway at risk might be evidenced by patient snoring/obstruction, the need for airway adjuncts, pooled secretions in the oropharynx requiring suction or an inability to swallow in patients with low conscious state (3). Once identified, the implementation of an RSI procedure requires justification within the current clinical setting, detailed in subsequent discussion on risk versus benefit analysis. The airway assessment requires understanding of the role of intubation and immediate rationalisation for prehospital invasive airway management (3).

The proposed indications are aimed at improving the sensitivity and specificity of MICA paramedic led endotracheal intubation. The change and focus on a detailed airway assessment to identify the airway at risk is a conceptual change, however all the current indications are captured, albeit by the much simplified answer to three questions.

The proposed guideline details the indications as follows:

Airway not patent

A patient’s inability to maintain their own airway, such that ongoing airway support and/or clearance is required considers the indicators for aspiration risk (3). Patients who repeatedly require suctioning or who tolerate an oropharyngeal airway, nasopharyngeal airway, or SGA are unable to protect themselves from aspiration and therefore require intubation (3). It is not uncommon for patients to be transported short distances with OP airway in situ and, where precautions exist, this may still be the most appropriate course of action. As per the risk benefit analysis, described in detail below, once airway patency issues are identified, the clinician still needs to ask themselves if *prehospital* intubation is required in the clinical context.

Respiratory failure

By definition, respiratory failure is the inadequacy of oxygenation or ventilation (3). When this inadequacy cannot be reversed by non-invasive ventilation and medications, or where ongoing assisted manual ventilation is required, patients require emergency intubation (3). Examples include unconscious asthma refractory to medication, some polypharmacy overdoses with respiratory depression and near/post drowning (3). Patients who are currently indicated for RSI using the existing guideline will be more appropriately captured by this guideline via these refined criteria. Furthermore the change aligns AV practice with accepted indications and terminology regarding respiratory failure and its definitions.

Clinical Course

There are multiple cases where intubation is recommended in order to appropriately treat the patient or prevent further deterioration (3). This is based on the trajectory or expected clinical course for the patient. Examples include refractory hyperthermia, tricyclic antidepressant (TCA) overdose, TBI and airway burns (3). In these settings and others, intubation is indicated despite the patient not needing

ongoing airway support or clearance, or indeed assistance with ventilation (3). The specific examples listed in the guideline represent no change from current practice authorised by medical advisory committee.

Peri-arrest with TBI

Currently, TBI patients are contraindicated for intubation without prior administration of sedation and paralysis (2). There are several recent cases where poly-trauma patients with suspected TBI have undergone RSI on scene with significant scene delay >45 minutes, when hospital attendance and surgery are urgently required. These delays may have contributed to poor patient outcomes but more likely, they have not permitted opportunity for survival. Patients who are deemed to be at imminent risk of cardiac arrest post trauma – often referred to as the 'crash airway' – even where TBI is present, are approved for 'cold intubation' under the proposed guideline (3). These patients have significant morbidity and require rapid airway control to ensure adequate ventilation and oxygenation but, more importantly, transport without delay to a major trauma service. The risks associated with intubation without paralysis in the GCS3, peri-arrest multi-trauma TBI patient are considered less than the greater benefits to be gained from achieving a more timely transport to definitive care.

4.2 Revised Precautions and Risk versus Benefit analysis

The current AV CPG for intubation has a list of 7 precautions. These are:

1. Time to intubation at hospital vs time to intubate at the scene
2. Poor baseline neurological functioning and major comorbidities
3. Advanced care plan/Refusal of treatment/NFR
4. Severe hypothermia
5. Anticipated difficult intubation
6. Anticipated difficult BVM
7. In general if transport time less than 10mins, IFS/RSI should not be undertaken

As per the current indications for intubation and the need for their update, the current precautions have also been revised in the proposed guideline. The existing precautions, while reasonable, are difficult to remember, non-specific and do not clearly assist with decision making. It is clear that the precautions are not being used as intended: that is to justify a MICA paramedic decision to **withhold** prehospital intubation where it is indicated. This represents a significant problem with current practice and places patients at risk. The intention of the revised precautions are simplification, clear translation into clinical context/practice and to function as a decision making tool for prioritisation of patient safety.

The new proposed precautions are:

1. Baseline neurological function, significant comorbidities or advanced care directive may preclude intubation
2. Anticipated difficult BVM or intubation (e.g. situation, anatomical, resourcing)
3. RSI may be harmful in hypovolemic shock, multitrauma and metabolic acidosis
4. Scene delay for RSI may be harmful where there is need for rapid in-hospital management
5. Severe hypothermia < 30°C

The addition of a structured risk versus benefit analysis, designed to be superimposed over any relevant precautions is the final component to the decision making process. This has been designed as a 'stop point' in the clinical management for shared decision making and requires a real time, big picture consideration of the following question;

"Is prehospital intubation the most appropriate airway management for this patient?"

In the setting of hypovolemic shock (AAA, ruptured ectopic pregnancy, polytrauma) the patient risk versus benefit is heavily weighted towards rapid transport and in-hospital intubation, where distance to hospital is not excessive, despite the compromise in any provision of airway care. Whilst there is good understanding

of the need to minimise time to surgery in this patient group, the current guideline does not adequately empower MP decisions to withhold prehospital intubation if it is otherwise clinically indicated. This is particularly the case when polytrauma includes TBI.

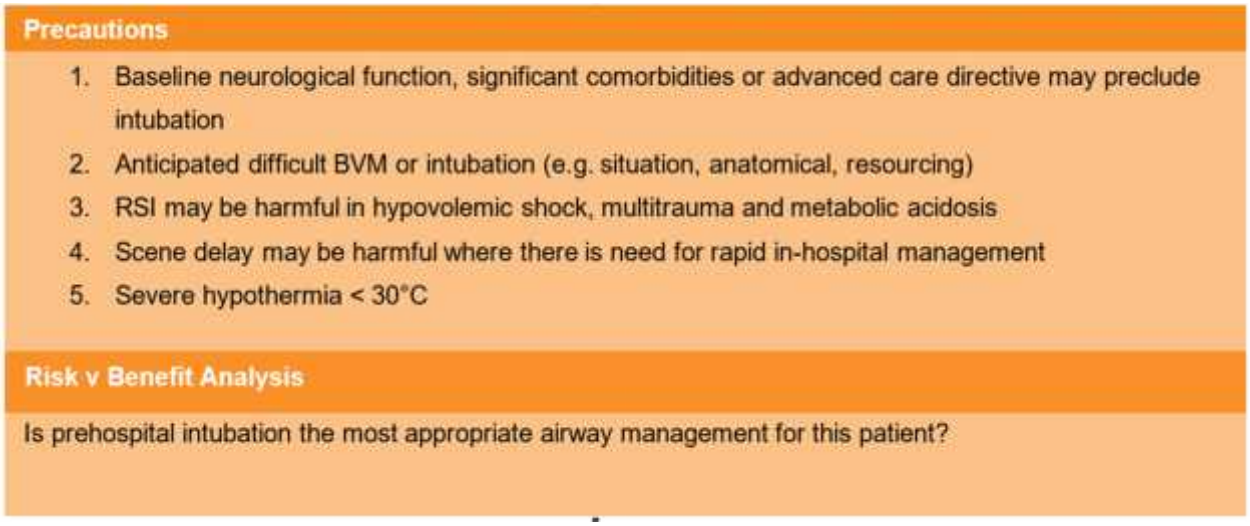


Figure 2. Proposed precautions

The consideration of risk versus benefit is also relevant where patients require perfusion optimisation prior to RSI and in the setting of anticipated intubation or bag-valve-mask BVM ventilation difficulty (3). There is a real need for the intubation guideline to evolve in such a way that emphasises the need to consider risk versus benefit for each patient **after** they have been determined to meet the inclusion criteria. The proposed guideline has been designed to emphasize the need for a holistic and patient-specific risk benefit analysis whenever prehospital RSI is indicated.

Removal of intubation facilitated by sedation

IFS describes intubation using sedation alone, without administration of an neuromuscular blocking agent (NMBA) to paralyse skeletal muscles and prevent oropharyngeal reflexes (3, 4). Withholding NMBA maintains respiratory effort – although typically somewhat inhibited secondary to high dose sedation – and will allow for skeletal muscle movement and gag if the patient is not adequately sedated (3-5). Each of these factors increases difficulty of successful intubation (3, 5). Prior to the availability of RSI, MP's were only authorised to intubate patients using a sedation-only technique. As the list of indications for RSI grew, the indications for IFS decreased to the point where the guideline captures fewer patient and is now rarely utilised. Throughout this time, the inferiority of the IFS method has become more apparent, particularly related to grade of view. Currently within AV, IFS is reserved for adult patients who are hyperglycaemic with suspected DKA; frail or elderly respiratory failure patients; or patients where administration of Suxamethonium is contraindicated (2). Only frail or elderly respiratory failure patients can receive a delayed dose of Suxamethonium if the sedation dose is inadequate to allow intubation (2). Despite repeated and targeted education, there remains some confusion around the indication for delayed administration of a NMBA, and this has result in at least one inappropriate administration of Suxamethonium in the setting of a known contraindication.

IFS cases are uncommon (approx. 40 cases per year), and have a significantly lower success rate than that of RSI, at 90% to 98% respectively (Limited Occurrence Screening AV data). This pattern is mirrored in-hospital, where avoidance of NMBA resulted in significantly higher rates of difficult tracheal intubation, characterised by multiple parameters including number of attempts, time required for intubation, type and number of alternative techniques used other than direct laryngoscopy, and grade of view as defined by Cormack and Lehane (5). The decision to remove IFS from practice is based on the low frequency of such cases, the lower success rate given the suboptimal conditions it produces, and the higher complication rate.

It is also supported by the proposal to replace Suxamethonium with rocuronium, permitting prehospital RSI of DKA patients. (see later section 'Rocuronium' page 9)

Simplified RSI sedation

There are 5 possible pharmacology combinations to facilitate intubation in the current CPG, each unique to the suspected clinical aetiology (2). These are detailed in table 1.

Sedation	NMBA
1.Fentanyl & Midazolam (half or full dose)	Suxamethonium
2.Fentanyl	Suxamethonium
3.Ketamine	Suxamethonium
4.Midazolam & Ketamine	Suxamethonium
5.Fentanyl & Midazolam (repeat dose if required)	None (IFS)

Table 1. Sedation regimes for Adult Intubation

Within these 5 pathways, there are further stipulations and dose adjustments surrounding blood pressure and frailty status. The advantage of the proposed change includeds both a removed dose adjustment stipulation and no requirement for diagnostic conjecture in order to establish an induction pathway.

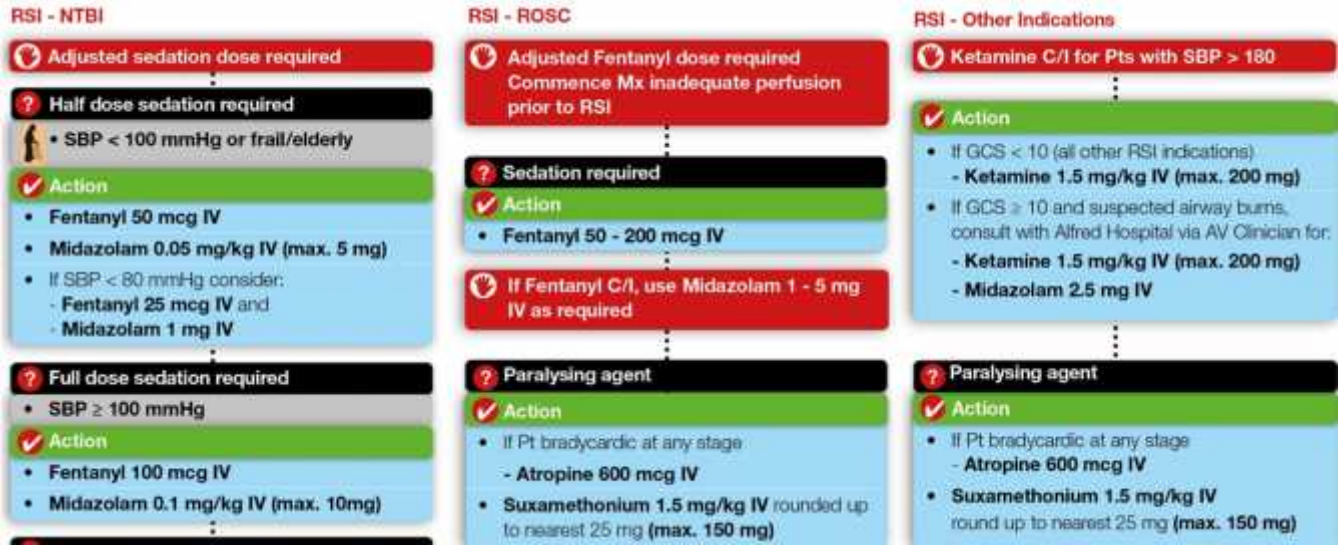


Figure 3. RSI medications

Ketamine is the most haemodynamically stable of available sedative agents, making it the ideal choice in most emergency settings (3, 4, 6). Additionally, it rapidly provides dissociative and analgesic effects, as well as sedation (3, 4, 6). Ketamine is currently used in all settings but stroke (NTBI) and post arrest (ROSC). The proposed guideline change calls for ketamine sedation in nearly all patients requiring prehospital intubation. In the event ketamine is contraindicated – most commonly if the patient is severely hypertensive – fentanyl/midazolam should be used as alternative sedation. It is anticipated that by reducing the range of sedation choices that the safety profile of RSI will improve by the reduction of medication errors and in circumstances of unclear diagnosis.

Ketamine in ROSC

The current guideline calls for 50-200mcg of IV fentanyl for RSI of the return of spontaneous circulation (ROSC) patient, due to the potential direct negative inotropic effects of ketamine and the effect of this in the post arrest patient. These negative inotropic effects, however, are likely to be overshadowed by its sympathomimetic effects and achieve an overall increase in heart rate, cardiac output, and blood pressure (4, 6). These patients are usually receiving concurrent adrenaline infusion post ROSC and the negative inotropy secondary to ketamine would be minimal in this context. Using Ketamine in likely to be beneficially in the haemodynamically unstable post-arrest patient (6). In rare cases, catecholamine depletion after long term sympathetic stimulation – for example, in the post-arrest septic patient - may lead to hypotension after

ketamine administration (3, 4). Replacement of catecholamine's (and fluid) intra-arrest is likely the cause of ROSC in this cohort, rendering the risk of cardiovascular collapse negligible. Additionally, ketamine induced myocardial depression in the catecholamine depleted patient is thought to only occur in doses of greater than 1.5mg/kg (3, 4).

Ketamine in non-traumatic brain injury (NTBI)

Ketamine should be avoided in patients with severe hypertension, due to its sympathomimetic effects and its likelihood to further increase blood pressure. For this reason, an alternative option of fentanyl/midazolam has been included in this event. The contraindications have been revised in the proposed ketamine pharmacology sheet to exclude **only** the NTBI patient with severe hypertension BP>180mmHg. However it is proposed that in circumstances where the BP is >160mmHg and NTBI suspected, Fentanyl and Midazolam should be used in preference to ketamine.

Ketamine and hypertension

The proposed CPG and ketamine pharmacology sheet permit the use of ketamine in the setting of severe hypertension BP >180mmHg, however consideration of precautions is required. The intent of this change is to specifically capture hypertensive patients with a severe pain aetiology. Severe pain, such as in burns is likely to result in an extreme sympathetic response which may include significant hypertension. Due to the strong dissociative and analgesic effects of ketamine, it is still considered to be the ideal agent in this patient group and in the absence of any ketamine precautions, may be administered to achieve RSI sedation. The new guideline encourages the MP to address possible contributors to hypertension such as pain, prior to selecting the sedation based on blood pressure.

Delayed Sequence Intubation

This intubation method is recommended in circumstances where a patient is not tolerating pre-oxygenation, commonly due to agitation or combativeness associated with head injuries or hypoxia e.g. critical asthma (7, 8). Delayed sequence intubation (DSI) involves the administration of a sedation agent prior to pre-oxygenation, followed by several minutes of positive pressure ventilation to allow complete denitrogenation (3, 7). Ketamine is considered the ideal agent to facilitate oxygenation prior to administration of paralytic, as it rarely affects airway tone or respiratory drive, but will trigger a dissociative state to allow non-invasive ventilation (7-9). A version of DSI has been available to road-based MPs for some time, albeit with a significantly reduced initial sedative dose (currently 20-40mg ketamine) (2). This initial dose alteration has led to confusion with subsequent RSI dose requirements.

Formalisation of the DSI process – that is, full dose sedation, followed by three minutes of pre-oxygenation followed by administration of NMBA – as per the proposed guideline aims to standardise the approach and reduce confusion. It also has the advantage of specifically outlining the clinical context for its use. As per the special notes, this approach is for oxygen optimization and not normalisation, which may not be possible in the clinical setting. The duration of IV ketamine allows significant time for the entire RSI procedure and also for the post-intubation long-term sedation onset (2). DSI has been proven to increase pre-intubation oxygen saturations, thereby prolonging the safe apnoea time (9, 10). It is therefore recommended as an alternative when patient agitation precludes the traditional RSI procedure (7-10). DSI is currently permitted in the MICA flight paramedic scope of practice in the same format as proposed in this guideline.

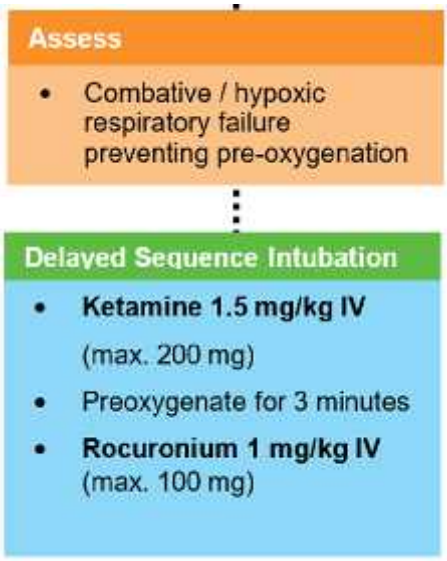


Figure 4. Delayed sequence pathway

Rocuronium

A significant component of the proposed update is the change in induction paralytic from Suxamethonium to rocuronium. The current guideline prescribes 1.5mg/kg of Suxamethonium, followed by fifteen minutely bolus administration of rocuronium for maintenance of paralysis (2). Debate remains around the ideal paralytic agent to facilitate RSI, however, there has been a recent shift in industry standard towards rocuronium (11-13). In 2015, a Cochrane review determined there was no statistical difference in intubating conditions between Suxamethonium and rocuronium at doses of 0.9-1.2mg/kg (14). Additionally, a recent study with a focus on emergency airway management (as opposed to operating theatres) reports no association between paralytic and first-pass intubation success, glottic view or incidence of adverse events (13). Given the comparable intubating conditions the two medications provide, multiple other factors must be considered to make a recommendation (13, 15).

A key consideration in support of Suxamethonium is the shorter half-life, allowing for a return to non-paralysed state in the event of a failed airway (3, 14). However, whilst there may be some return of respiratory rate and effort and possibly an ability to ventilate using positive pressure, after larges dose of induction sedation patients do not return to their pre-induction state with the offset of NMBA. Furthermore, in the setting of difficult intubation patients are likely to have a greater need for advanced and ongoing airway support of airway patency and aspiration risk. This is especially true with the proposed indication changes and the increased specificity.

The prolonged mechanism of action of rocuronium is likely to alleviate some time pressure for initial and subsequent laryngoscopy while also allowing for more time between attempts to re-oxygenate. Furthermore, should intubation be unsuccessful, the continuation of the difficult airway guideline is more feasible in a patient who remains paralysed, further supported by the availability of video laryngoscopy (3). Based on current AV data, unsuccessful first attempt RSI of patients equates to <2% of all intubations. When necessary, longer term paralysis will allow MPs to correct hypoxia via the difficult airway guideline (including supraglottic airway) and, where necessary, perform the high-acuity, low-frequency skill that is cricothyroidotomy, without the complicating factors of patient movement encountered when Suxamethonium wears off.

Rocuronium has a longer safe apnoea time than Suxamethonium, thought to be due to the increased oxygen consumption caused by fasciculations (16). As well as increasing oxygen consumption, fasciculations cause a potassium efflux, raising serum potassium. This is especially detrimental where hyperkalaemia is already present. Whilst ECG changes indicative of hyperkalaemia currently preclude administration of Suxamethonium, the absence of these signs do not indicate normokalaemia. In fact, a recent study showed that more than half of hyperkalaemic patients do not have the expected ECG changes, proving their unreliability as a diagnostic tool (17). The exacerbation of hyperkalaemia through Suxamethonium administration poses a clear risk to prehospital intubations, where serum potassium testing is not available. This and many other contraindications are easily avoided by using rocuronium. Fasciculations also pose a risk to patients with environmental or drug induced hyperthermia/serotonin syndrome.

With regard to other contraindications, using rocuronium avoids the need to consider (currently 9) significant contraindications to Suxamethonium (2). Whilst it is difficult to capture the true effect of these contraindications and their exclusion of patients requiring prehospital intubation, it remains true that the need to consider these increases cognitive load. Rocuronium has only one contraindication being hypersensitivity (2, 13). It is worth noting that the Cochrane review recommended that in situations where the rocuronium reversal agent was not readily available, Suxamethonium be used preferentially due to the reduced offset time. It is also worth noting that a more recent study by April et al recommended that, given the extensive list contraindications of Suxamethonium, rocuronium should be used as a default first-line paralytic agent (13, 14). Rocuronium is currently used for post intubation paralysis and by using it for RSI, the procedure is greatly simplified and includes a time saving as there is need to prepare only one agent. Finally, the longer half-life of rocuronium increased the safety profile for patients who are successfully intubation. Particularly in primary neurological patients, whose protection again gag and intracranial pressure elevation is essential to their management but beyond this to all prehospital intubations where the environment is uncontrolled and endotracheal security is paramount.

Taking into account the above risks and benefits of each medication, and in order to simplify the dose calculation and minimise the risk of human factor errors, a dose of 1mg/kg of rocuronium is recommended in the proposed guideline, with a 50mg/hr rocuronium infusion prescribed for maintenance.

4.3 Post intubation management

Following successful tracheal placement, sedation is maintained with a combination of midazolam and either fentanyl or morphine (2). After administration of a loading dose, sedation is titrated to effect and the patient is closely monitored for side effects or signs of under-sedation (2). Where targeted ventilation therapy is clinically required, or if the patient is to be mechanically ventilated during transport, long-term paralysis is also administered (2). The proposed post intubation management guideline involves only small changes; a preference for a fentanyl/midazolam infusion over a morphine/midazolam infusion, a change in the maximum sedation to dose to 15ml/hr (150mcg/15mg fentanyl/midazolam or 15mg each drug morphine/midazolam), the option of bolus Ketamine to maintain sedation and introduction of a rocuronium infusion.

Fentanyl/midazolam infusion

The preference for fentanyl/midazolam is indicated by its priority listing in the flowchart, and will be communicated in subsequent education. Intubation and ventilation involves a change from negative to positive pressure ventilation, which decreases blood pressure (3). Most sedative agents, including both midazolam and morphine, have negative effects on blood pressure (2, 4). These medications may work synergistically to cause significant hypotension in some patients. Fentanyl is more haemodynamically stable, therefore, it should be used preferentially to morphine (4). The exception to this is in the setting of serotonin toxicity. As fentanyl is known to contribute to serotonin toxicity, morphine/midazolam should be used for maintenance of sedation in this cohort (18).

Sedation dose increase and ketamine

In the current guideline, the maximum sedation infusion is listed as 10ml/hr (10mg morphine/10mg midazolam or 100mcg fentanyl/10mg midazolam). Increasing sedation beyond this requires clinical consultation with the receiving hospital (2). This is a reasonably frequent occurrence, particularly in patients with a mid-range pre-induction GCS or status epilepticus and creates an additional challenge when managing an intubated, ventilated patient in the back of an ambulance. Further, it results in delays to adequate sedation. Allowing an increased maximum to 15ml/hr will reduce the need for consult and allow for improved patient care, particularly in higher GCS intubation.

In addition, while the clear statement of sedation as the preference for managing seizure patients is retained, there are accompanying strategies that empower MPs to achieve this that were absent from the

previous guideline. This includes, but not limited to, the potential need for cardiovascular support in the heavily sedated patient.

Rocuronium infusion

Until recently, pancuronium was used as long-term paralysis after confirmation of tracheal intubation (2). Due to national supply and access issues, fifteen-minutely administration of rocuronium has replaced forty-five-minutely administration of pancuronium. This significantly shorter duration of action increases human factor errors of drug administration, and further complicates extrication – where access to the patient is sometimes limited and ETT security paramount. The increased availability of infusion pumps allows for inclusion of a long-term paralysis infusion, rather than bolus doses. The education plan surrounding rocuronium induction will suggest preparation of 200mg rocuronium in a 20ml syringe, to be used for both induction and maintenance. After induction with a maximum 100mg, the remaining rocuronium will permit two hours of paralysis via infusion. The benefits of steady state infusion over bolus doses are well known, and are especially prominent where a patient's hypermetabolic state may unknowingly shorten the duration of action of a medication (19).

5. Paediatric Intubation

Paediatric intubation by road-based MPs has an incidence of <40 cases per year state-wide. AAV MFPs are permitted to RSI paediatric patients (age <12) but undergo extensive training and re-accreditation on a yearly basis. Furthermore, MFPs are currently the only MICA paramedics in AV with the skills and training for needle cricothyroidotomy. It would be at substantial cost to upskill road-based MPs in this skill and unfeasible to provide the same credentialing opportunity. With the low exposure, perceived small benefit and significant associated resource and financial cost it is recommended that nil change be made to the IFS procedure for <12 year old paediatrics.

However, for consistency it is recommended that the indications for paediatric intubation align with the proposed adult guideline. A draft of these changes has been circulated to relevant key stakeholders from the Royal Children's Hospital including Dr Claire Wilkin, Dr Elliot Long and Dr Stefan Sebato with responses pending. Given the slight change, it is anticipated that a finalised CPG will be circulated for out of session's approval by MAC.

6. Air Ambulance Victoria

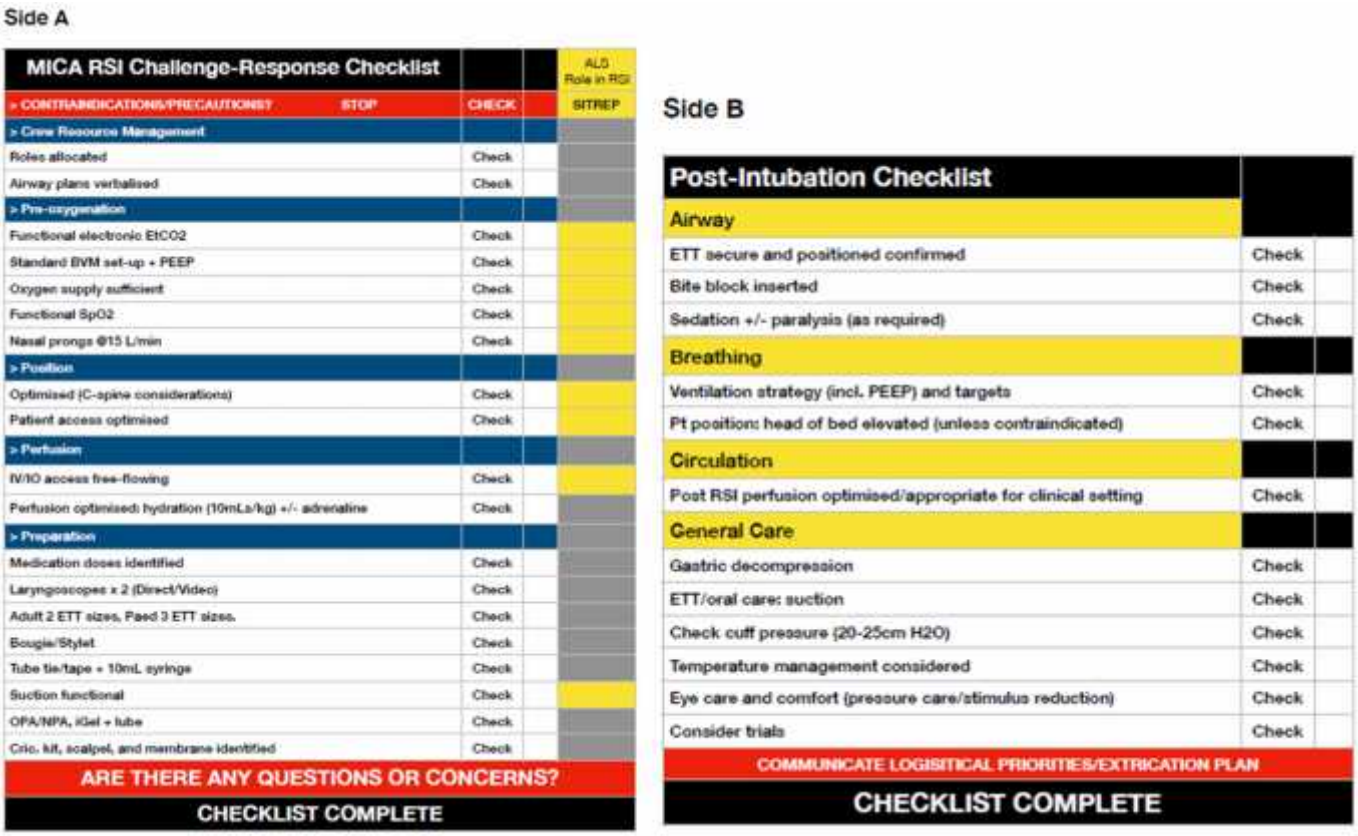
The introduction of RSI began with AAV, and has thus sent the MFP scope of practice on a parallel path to road practice. With the proposed changes to the road-based guideline there is an opportunity to bring alignment, creating safer and more universally understood scope of practice.. All the AAV indications are accurately captured within the proposed road-based indications. This has an important adage for patient safety as all MICA paramedics are equipped with a similar knowledge and understanding around the procedure and familiarity medications used.

MAC have previously authorised the use of rocuronium for RSI for AAV, DSI with the only other notable difference between this and the road-based guideline is the option of Propofol for RSI (medications) and intubating laryngeal mask airway (difficult airway guideline). AAV are authorised for intubation of patients who are GCS <12. There is no proposed change to this indication.

The proposed AAV guidelines for adult and paediatric intubation have revised and specific special notes, including updated mechanical ventilation strategies and blood gas analysis, supporting evolution of the MFP skillset. It is attached for reference and noting but it is anticipated that a finalised CPG will be circulated for out of session's approval by MAC.

7. RSI Checklist

The RSI checklist was developed approximately 2 years ago and implemented into MICA practice as part of a CPD program specifically aimed at airway management. The checklist is now integrated into practice and formally recorded in the case notes for all prehospital intubations. The checklist has been revised in the context of the proposed guideline change. A key function of the new design relates to the checklist's function as a communication tool/crew resource management.



Side A

MICA RSI Challenge-Response Checklist			ALS Role in RSI
> CONTRAINDICATIONS/PRECAUTIONS?	STOP	CHECK	SITREP
> Crew Resource Management			
Roles allocated		Check	
Airway plans verbalised		Check	
> Pre-oxygenation			
Functional electronic EtCO2		Check	
Standard BVM set-up + PEEP		Check	
Oxygen supply sufficient		Check	
Functional SpO2		Check	
Nasal prongs @15 L/min		Check	
> Position			
Optimised (C-spine considerations)		Check	
Patient access optimised		Check	
> Perfusion			
IV/IO access free-flowing		Check	
Perfusion optimised: hydration (10mL/kg) +/- adrenaline		Check	
> Preparation			
Medication doses identified		Check	
Laryngoscopes x 2 (Direct/Video)		Check	
Adult 2 ETT sizes, Paed 3 ETT sizes.		Check	
Bougie/Stylet		Check	
Tube tie/tape + 10mL syringe		Check	
Suction functional		Check	
OPA/NPA, iGel + lube		Check	
Cric. kit, scalpel, and membrane identified		Check	
ARE THERE ANY QUESTIONS OR CONCERNS?			
CHECKLIST COMPLETE			

Side B

Post-Intubation Checklist		
Airway		
ETT secure and positioned confirmed	Check	
Bite block inserted	Check	
Sedation +/- paralysis (as required)	Check	
Breathing		
Ventilation strategy (incl. PEEP) and targets	Check	
Pt position: head of bed elevated (unless contraindicated)	Check	
Circulation		
Post RSI perfusion optimised/appropriate for clinical setting	Check	
General Care		
Gastric decompression	Check	
ETT/oral care: suction	Check	
Check cuff pressure (20-25cm H2O)	Check	
Temperature management considered	Check	
Eye care and comfort (pressure care/stimulus reduction)	Check	
Consider trials	Check	
COMMUNICATE LOGISITICAL PRIORITIES/EXTRICATION PLAN		
CHECKLIST COMPLETE		

Figure 5. Proposed checklist

8. Risk Analysis

The risk analysis for all changes are negligible, however specific to the introduction of rocuronium it is important to highlight that up to 2% of patients who are not successfully intubated will remain paralysed for 15-20 minutes. During this time, the difficult airway guideline remains effective and feasible, however this will result in an extended period of assisted ventilation via OP/NP/SGA. This is not a significant step beyond current scope of practice, whereby sedation for supraglottic airway maintenance occurs following consultation with receiving hospital.

There has been a significant focus on airway assessment over recent years, both formally during CPD education, the tertiary and vocational student MICA program and patient review. Informally this is supported via team directed discussion and paramedic educator training delivery. As such, currently practicing MICA paramedics should have sound understanding of the proposed changes and therefore the ability to appropriately assess the need for prehospital RSI.

6. Work Health and Safety / Industrial Issues

None identified.

7. Education

There are significant changes in the proposed guideline that will require detailed education. This will primarily be delivered at CPD, with reference and resource material provided for additional support. The schedule for the presentation of this material is achievable within the 2020 education plan should the proposed guideline be endorsed in December 2019.

Several medication sheets (indications) will also require updating, including fentanyl, midazolam, rocuronium, Suxamethonium (obsolete), atropine, normal saline. The pharmacy team have been included in this discussion via CPG committee and have a staged rollout of updated medication sheets designed around the rollout of this (and associated) proposed guidelines.

The clinical work instruction (CWI) will also require update prior to the delivery of CPD material and this work has not yet begun.

8. Monitoring and Evaluation

All medication assisted intubations are audited by the relevant MICA team manager and collated as a part of the limited occurrence screening (LOS) data set by the patient review team. The LOS is reported quarterly. The LOS is able to identify trends in the prehospital intubation data and reports on multiple data fields, including intubation success. Furthermore, LOS also includes all surgical airway insertion and this data is used to identify patient safety incidents related to difficult/unsuccessful intubation attempts.

5. Recommendation:

The Committee is asked to ENDORSE the proposed adult CPG A0302 ‘Endotracheal Intubation’, revised RSI checklist and revised pharmacology sheet for ketamine.

The CPG’s for Paediatric Intubation and AAV Intubation will be circulated for out of session’s approvals.

References:

1. Bernard S, Nguyen V, Cameron P, Masci K, Fitzgerald M, Cooper D, et al. Prehospital Rapid Sequence Intubation Improves Functional Outcome for Patients With Severe Traumatic Brain Injury: A Randomized Controlled Trial. Annals of Surgery. 2010;252(6):959-65.
2. Ambulance Victoria. Ambulance Victoria Clinical Practice Guidelines for Ambulance and MICA Paramedics: Ambulance Victoria; 2018.
3. Walls R, Murphy M. Manual of Emergency Airway Management. 4 ed. Philadelphia: Lipincott Williams & Wilkins; 2012.
4. Stollings J, Diedrich D, Oyen L. Rapid-Sequence Intubation: A Review of the Process and Considerations When Choosing Medications. Annals of Pharmacotherapy. 2013;48(1):62-76.
5. Lundstrom L, Duez C, Norskov A, Rosenstock C, Thomsen J, Moller A, et al. Effects of avoidance or use of neuromuscular blocking agents on outcomes in tracheal intubation: a Cochrane systematic review. British Journal of Anaesthesia. 2018;120(6):1381-93.
6. Caro D. Induction agents for rapid sequence intubation in adults outside the operating room. In: Grayzel J, editor. UpToDate2019.
7. Weingart S. Preoxygenation, reoxygentation and Delayed Sequence Intubation in the Emergency Department. The Journal of Emergency Medicine. 2011;40(6):661-7.
8. Pourmand A, Robinson C, Dorwart K, O'Connell F. Pre-oxygenation: Implications in emergency airway management. American Journal of Emergency Medicine. 2017;35(2017):1177-83.
9. Waack J, Shepherd M, Andrew E, Bernard S, Smith K. Delayed Sequence Intubation by Intensive Care Flight Paramedics in Victoria, Australia. Prehospital Emergency Medicine. 2018;2018:588-94.
10. Weingart S, Trueger N, Wong N, Scofi J, Singh N, Rudolph S. Delayed Sequence Intubation: a prospective observational study. Annals of Emergency Medicine. 2015;65(4):349-55.
11. Clinical Quality & Patient Safety Unit Q. Clinical Practice Procedures: Airway management/Rapid sequence induction. In: Queensland Ambulance Service, editor.: Queensland Ambulance Service; 2016.
12. Ambulance Victoria, Adult Retrieval Victoria. SOP 2.02 - PHARM Rapid Sequence Intubation: Ambulance Victoria; 2018.
13. April M, Arana A, Pallin D, Schauer S, Fantegrossi A, Fernandez J, et al. Emergency Department Intubation Success With Succinylcholine Versus Rocuronium: A National Emergency Airway Registry Study. Annals of Emergency Medicine. 2018;72(6):645-53.
14. Tran D, Newton E, Mount V, Lee J, Wells G, Perry J. Rocuronium versus succinylcholine for rapid sequence induction intubation. Cochrane Database of Systematic Reviews. 2015(10).
15. West J, Lott C, Donner L, Kanter M, Caputo N. Peri-intubation factors affecting emergency physician choice of paralytic agent for rapid sequence intubation of trauma patients. American Journal of Emergency Medicine. 2018;36:1151-4.
16. Taha S, El-Khatib M, Baraka A, Haidar Y, Abdallak F, Zbeidy R, et al. Effect of Suxamethonium vs rocuronium on onset of oxygen desaturation during apnoea following rapid sequence induction. Anaesthesia. 2010;65(4):358-61.
17. Varga C, Kalman Z, Szakail A, Drubits K, Koch M, Banheygi R, et al. ECG alterations suggestive of hyperkalemia in normokalemic versus hyperkalemic patients. BMC Emergency Medicine. 2019;19.
18. Koury K, Becky B, Gulur P. Incidence of serotonin syndrome in patients treated with fentanyl on serotonergic agents. Pain Physician 2015;18:E27-E30.
19. Rang H, Dale M, Ritter J, Flower R, Henderson G. Rang and Dale's Pharmacology. 7th ed. Sydney: Elsevier; 2012.