Emergency Medicine Society of South Africa

PRACTICE GUIDELINE
EM015

RAPID SEQUENCE INTUBATION

This Practice Guideline sets out algorithms for Intubation in the emergency environment. **The evidence review supporting this Practice Guideline is presented at Practice Guideline EM015B**. It should be read in conjunction with Practice Guideline EM010 (Verification of Endotracheal Tube placement) and EM013 (Procedural Sedation).

Excluding the cover page, this Practice Guideline is **22** pages.

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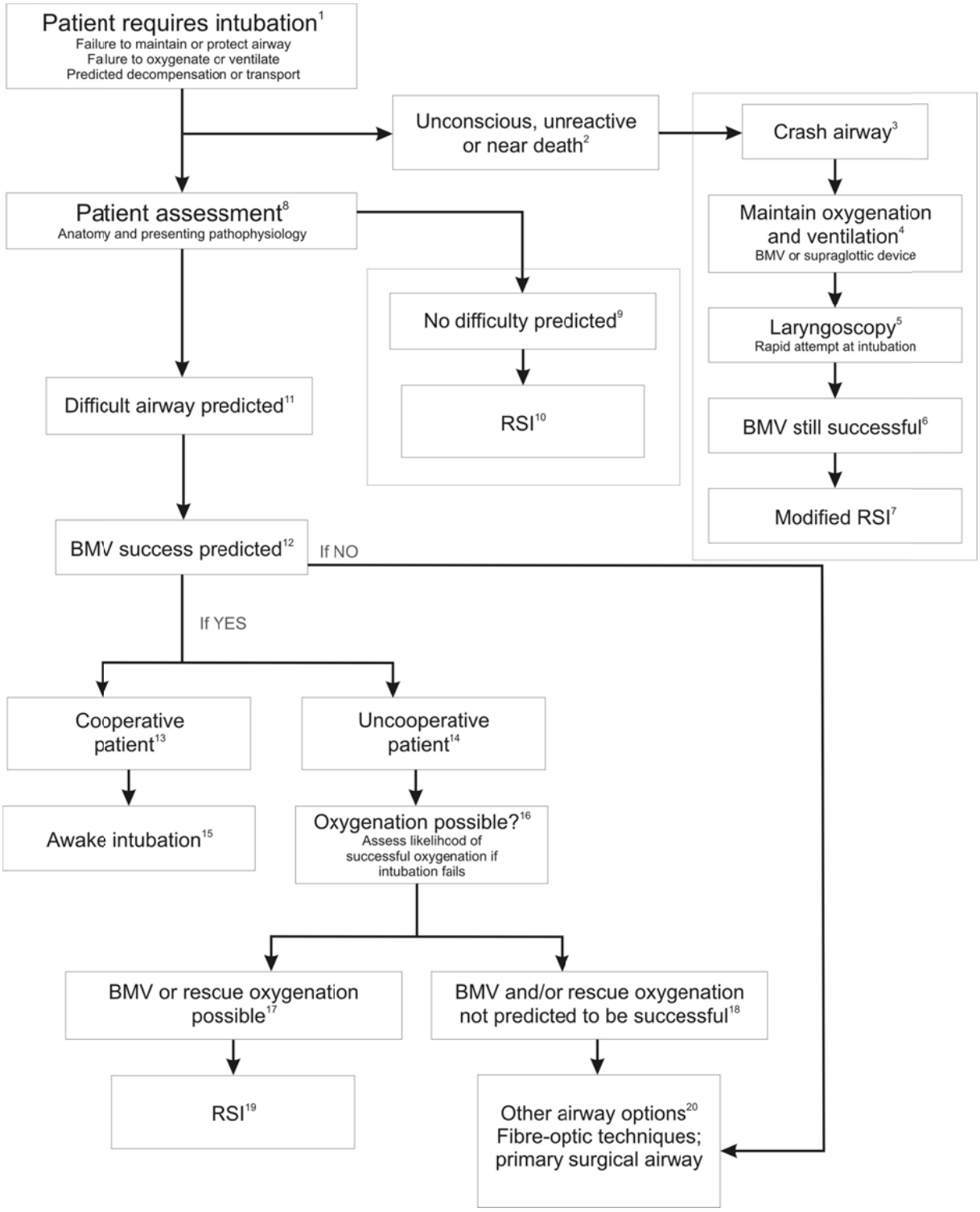
(This Guideline was written and produced by Dr Mike Wells, who acknowledges extensive input from Dr Lara Goldstein, Mr Martin Botha, Dr Walter Kloeck and Dr Heike Geduld)

1. INTUBATION ALGORITHM

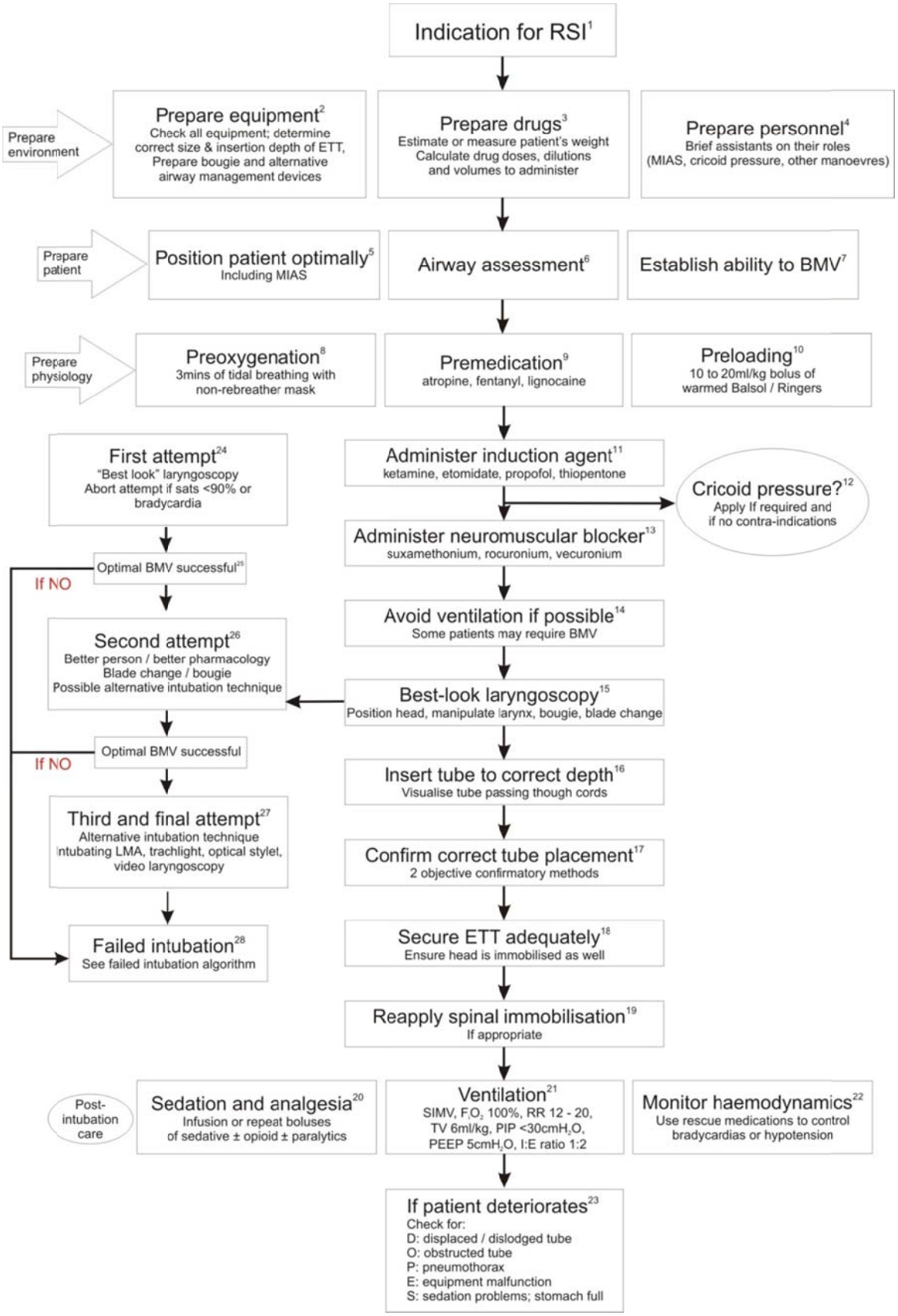


Key

1. Once the indication for intubation has been established then the most appropriate method of performing the intubation needs to be determined.
2. Patients who are deeply unconscious (GCS of 3/15) or moribund may require a definitive airway as a matter of urgency and the "Crash airway" pathway should be followed. Patients in cardiac arrest should NOT routinely be intubated as this worsens outcomes.
3. A crash airway is characterised by an intubation that is performed without the need for drugs to assist the intubation because of the condition of the patient.
4. Preoxygenation by bag-mask ventilation or ventilation through a supraglottic device must precede attempts at laryngoscopy. This should be for at least 3 minutes, if the circumstances permit this.
5. Best-look laryngoscopy principles should be followed and a rapid attempt made to insert the endotracheal tube.
6. If a single attempt at laryngoscopy is unsuccessful and bag-mask ventilation is still possible then a modified rapid sequence intubation should be attempted. If bag-mask ventilation is not possible then a supraglottic device may be positioned or a cricothyroidotomy performed, depending on the clinical circumstances.
7. A modified RSI in these circumstances entails the use of muscle relaxants only without the use of induction agents.
8. In all other patient scenarios the decision about which method of intubation to use begins with an assessment of the patient's clinical condition and a directed assessment of their airway anatomy to predict which patients might be difficult to intubate.
9. If no difficulty in intubation is anticipated based on an assessment of the airway anatomy then an RSI should be performed. The need for manual inline immobilisation of the cervical spine, although a predictor of a "high-risk" airway, should not influence this decision.
10. A standard rapid sequence intubation should be performed in patients in whom no difficulty is predicted.
11. A difficult intubation might be predicted as a result of anatomical abnormalities (e.g. missing teeth) or the clinical scenario (e.g. a gunshot wound to the face).
12. If bag mask ventilation is predicted to be unsuccessful (which might occur in about 0.1% of patients) then alternative strategies should be considered from the outset (e.g. primary surgical airway or fibre-optic laryngoscopy).
13. If the patient is cooperative (with or without mild to moderate sedation) then an awake intubation may be considered. Children are seldom amenable to awake intubation.
14. Most patients requiring intubation in the Emergency centre will not be able to cooperate with an awake intubation.
15. An awake intubation should be performed with the patient in the optimum position for their clinical condition: patients in respiratory distress should be in a sitting position; other patients may be positioned for optimal laryngoscopy.
16. Uncooperative patients that require intubation should be assessed to determine the likelihood of failure of bag mask ventilation.
17. If bag-mask ventilation is likely to be successful (which would account for the vast majority of patients) then RSI should be performed.

18. In the event that bag mask ventilation might be difficult or impossible then alternative airway management options need to be considered.
19. Standard rapid sequence intubation.
20. In the patient with a high-risk airway alternative strategies for intubation should be considered, of which an awake fibreoptic intubation is the gold standard. A primary surgical airway is also a valid consideration.

2. RAPID SEQUENCE INTUBATION ALGORITHM



EMSSA Practice Guidelines provide advice on recommended practice for emergency centres, emergency personnel and emergency care activities.

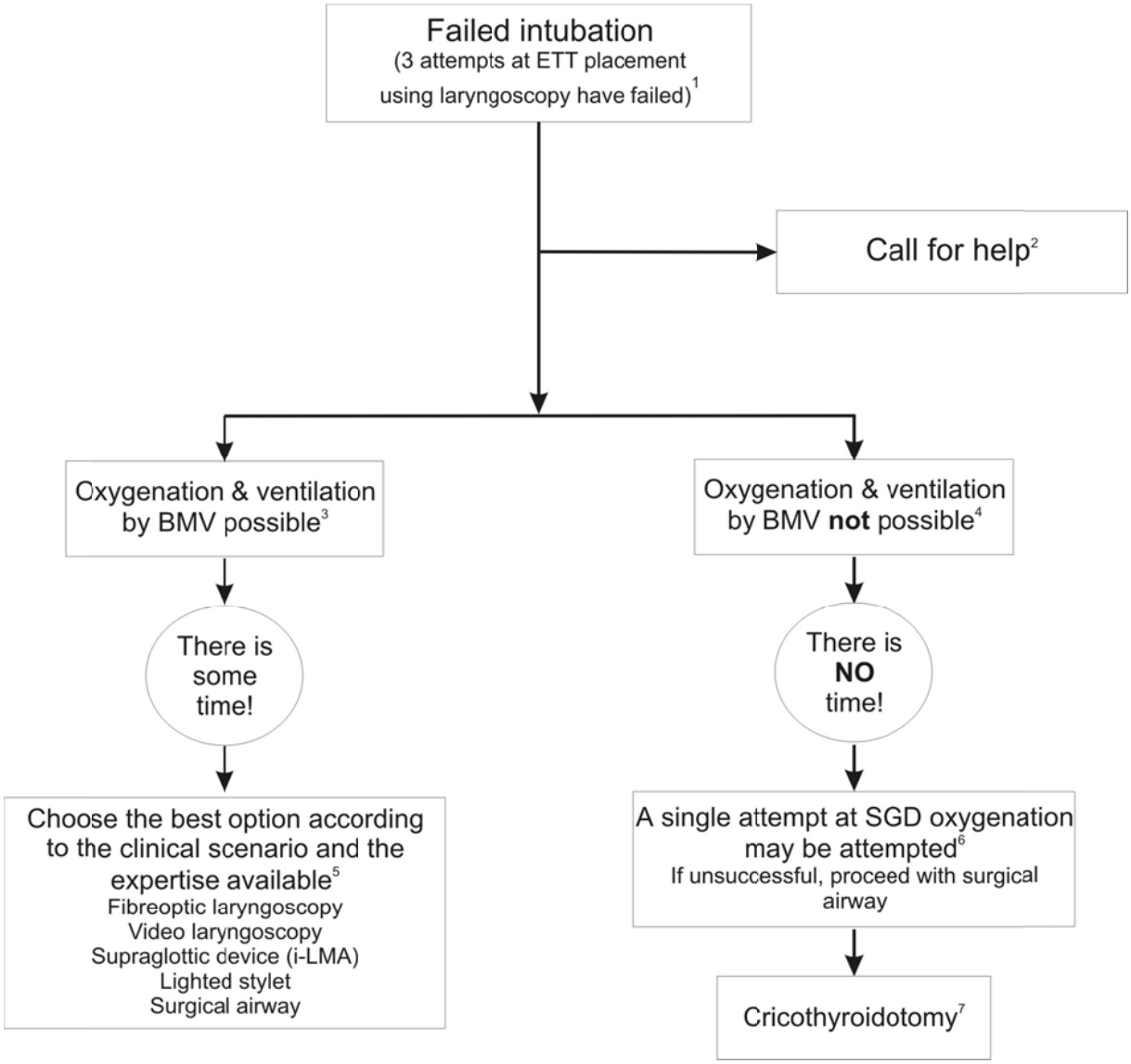
The information within these papers statements is advice only. EMSSA will not be held liable for clinical outcomes related to these Guidelines.

Key

1. Rapid sequence intubation is the gold standard and default method of intubation in the Emergency centre (see text).
2. Equipment should be checked and prepared prior to commencing with RSI (see checklist).
3. The dose of drugs should be calculated, prepared and double checked. Any modifying factors (such as body composition, haemodynamic status) should be taken into consideration.
4. Personnel should be briefed and clear on their responsibilities during the RSI.
5. The patient should be carefully positioned on the trolley for optimal laryngoscopy. If present, the cervical collar must be removed and manual inline axial stabilisation initiated.
6. An airway assessment should be conducted to determine patients with high risk airways and patients with potentially difficult intubation.
7. Part of the airway assessment should be the identification of patients that might be difficult or impossible to bag-mask ventilate.
8. Preoxygenation by vital capacity or, preferably, deep tidal breathing should be performed once everything is in readiness for the RSI.
9. Premedication agents should be administered at the commencement of preoxygenation – at least 3 minutes prior to the injection of the induction agent.
10. Unless specifically contraindicated (such as patients with acute heart failure with systemic fluid overload) all patients should receive a judicious fluid bolus prior to the initiation of RSI.
11. Once preoxygenation has been accomplished then the induction agent should be injected as a bolus. It may be necessary to titrate the induction agent under certain circumstances.
12. Cricoid pressure may used once the patient has become unconscious, if desired, but is not obligatory. It must be released if there is any difficulty with bag-mask ventilation or with laryngoscopy.
13. The muscle relaxant must be injected immediately after the induction agent with no delay.
14. Ideally positive pressure ventilations should be avoided after the administration of the drugs. Children, the elderly and patients with underlying lung pathology might require ventilations. The oxygen saturations should not be allowed to drop below 95% while waiting for the muscle relaxants to work.
15. Once the muscle relaxants have caused complete muscle relaxation laryngoscopy should be performed with the intention of creating the ideal conditions for first chance success.
16. The endotracheal tube (or bougie) should be visualised passing through the vocal cords to a depth that the cuff is just distal to the cords. The depth should be noted.
17. The correct placement of the tube should be confirmed by auscultation and an objective confirmatory device (ideally an exhaled carbon dioxide detector device or capnography). This is a crucial step of the RSI.
18. Once the correct placement and positioning of the tube has been confirmed the tube must be adequately secured to prevent displacement or dislodgement. This might include immobilising the head as well. This is particularly important in children.
19. If spinal immobilisation precautions are required, the cervical collar and head blocks should be reapplied at this stage.

20. Drugs for post-RSI sedation / analgesia / neuromuscular blockade should be prepared before commencing RSI. They should be started immediately after the endotracheal tube has been secured.
21. Ventilator settings must conform to lung-protective ventilation strategy guidelines even in patients with no existing acute lung injury.
22. Vigilant monitoring of the patient's vital signs is important during and for 15 minutes after the RSI. Rescue medications should be used to manage hypotension and bradycardias.
23. A systematic approach to a deterioration of an intubated patient is essential. The DOPES mnemonic is universally known and used for this purpose.
24. The first attempt at laryngoscopy should follow the "best look" principle i.e. everything should be optimised to maximise the chance of first time success. An "attempt" can be considered to be the time that the mask is removed from the patient's face to the time that the oxygen saturations fall to 90%. An "attempt" is not necessarily defined by a particular length of time or the number of times the laryngoscope is actually inserted into the airway.
25. If the first attempt is unsuccessful then the patient should be preoxygenated again with positive pressure bag-mask ventilations. If bag-mask ventilation (using an optimal two person technique) is unsuccessful the failed intubation protocol should be followed.
26. During the preoxygenation prior to the second attempt, information gained during the initial laryngoscopy should be used to plan the subsequent approach e.g. the use of a different blade or a bougie.
27. The third attempt should generally not simply be another attempt at standard laryngoscopy (unless there is a compelling reason or unless there is an attempt by a more skilful laryngoscopist).
28. If the endotracheal tube cannot be passed after three attempts, no further attempts must be made. The failed intubation protocol should be followed.

3. FAILED INTUBATION PROTOCOL



Key

1. Failed intubation may be defined as a failure of traditional laryngoscopic techniques to secure a definitive airway.
2. Help should be sought from more experienced colleagues whether Emergency Physicians, anaesthetists or surgeons
3. If oxygenation through optimal bag-mask ventilation is possible (two-person technique) then there is some time to attempt alternative intubation techniques.
4. A failed airway results from a failure of oxygenation with bag-mask ventilation and failed intubation. This is a time-critical emergency.
5. If the expertise and equipment for alternative intubation techniques are available then these can be considered; a surgical airway (cricothyroidotomy or tracheostomy) may still be the best option.
6. If bag-mask ventilation is impossible a supraglottic device may be used while preparations are made for a surgical airway. If ventilation through the device is successful then other options may be considered (see block 5).
7. Open or over-the-wire cricothyroidotomy must be able to be rapidly performed in the patient with a failed airway.

4. CHECKLISTS

DRUGS				
	Dose	**Preparation**		
Premedication				
Atropine	0.01mg/kg	0.5 or 1 mg/mℓ		□
Fentanyl	1 to 3µg/kg	50 µg/mℓ		□
Lignocaine	1.5mg/kg	20 mg/mℓ		□
Induction				
Propofol	1 to 3 mg/kg	10 mg/mℓ		□
Etomidate	0.2 to 0.3mg/kg	2 mg/mℓ		□
Ketamine	2 to 3mg/kg	10 or 50 or 100 mg/mℓ		□
Thiopentone	3 to 5mg/kg	25 mg/mℓ		□
(Midazolam)	0.1 to 0.3mg/kg	1 or 5 mg/mℓ		□
Paralytic				
Suxamethonium	1.5 to 3mg/kg	50 mg/mℓ		□
Rocuronium	1mg/kg	10 mg/mℓ		□
Rescue				
Atropine	0.01mg/kg	0.5 or 1 mg/mℓ	Min 0.1mg Max 1mg	□
Phenylephrine	50 to 100 **µg**	10 mg/mℓ	Dilute 10mg in 200mℓ NS = 50 µg/mℓ	□
Ephedrine	5 to 10 mg	50 mg/mℓ	Dilute with 9mℓ NS = 5 mg/mℓ	□
Post-intubation				
Sedation?				
Midazolam	1-2 mg	1 or 5 mg/mℓ	q10min titrated to effect	□
Analgesia?				
Morphine	1-2 mg	15mg/mℓ	q10min titrated to effect	□
Paralysis?				
Vecuronium	0.1mg/kg	2 or 4 mg/mℓ		□
Pancuronium	0.05 - 0.1 mg/kg	2 mg/mℓ		□

EQUIPMENT	
Resuscitation equipment	□
Monitors	
3-lead ECG	□
Non-invasive blood pressure	□
Pulse oximetry	□
Airway Equipment	
Bag-valve device + oxygen reservoir + PEEP valve	□
Facemask x 2	□
Laryngoscope handle + spare batteries	□
Laryngoscope blade x 2	□
Magills forceps	□
Suction + tubing + hard and soft tip catheters in appropriate sizes	□
Introducer stylet	□
Bougie + lubricant	□
$ETCO_2$ Detector	□
Stethoscope	□
Airway Disposables	
Oropharyngeal and/or nasopharyngeal airway	□
Atraumatic rigid suction	□
Endotracheal tubes x 2	□
Oesophageal detector device (if no $ETCO_2$ detector available)	□
Heat Moisture Exchange Filter	□
10 mℓ syringe	□
Trachy tape	□
Rescue Airway	
Laryngeal mask airway/laryngeal tube airway	□
Surgical Airway	
Cricothyroidotomy set	□
Percutaneous tracheostomy set	□

5. DRUGS

PRE-TREATMENT AGENTS

DRUG	DOSE	PAEDIATRIC CONSIDERATIONS	PEARLS & PITFALLS
ATROPINE ***0.5/1 mg/mℓ***	0.01 mg/kg	Min dose 0.1 mg/kg	Max dose 1mg/dose**; r**educe dose to 0.5mg/kg in Ischaemic Heart Disease Exclude hypoxia as the cause for the bradycardia
FENTANYL **Sublimaze®** ***50 µg/mℓ***	1-3 µg/kg		
LIGNOCAINE **Remicaine®** ***20mg/mℓ***	1.5 mg/kg		No proven effect on intracranial pressure

INDUCTION AGENTS

DRUG	DOSE	PAEDIATRIC CONSIDERATIONS	PEARLS & PITFALLS
ETOMIDATE **Hypnomidate®** ***2mg/mℓ***	0.2-0.3 mg/kg	Under 10 years, no dose established. Over 10 years, as for adults.	Least effect on haemodynamics Adrenal suppression (debatable significance) **Precautions** Category C in pregnancy Increased CNS depressant effect with alcohol **Contraindications** Porphyria Relative: Septic shock **Side Effects** Commonly causes myoclonus Nausea / Vomiting Lowers seizure threshold No release of histamine No analgesic properties
KETAMINE ***10/50/100 mg/mℓ***	1-2 mg/kg	Atropine should NOT be given routinely as it has been shown to be associated with a higher incidence of respiratory complications.	Useful for bronchospastic conditions Increased secretions do not require routine pre-treatment with atropine BP may drop in patients that are maximally sympathetically stimulated Head injury NOT a contraindication to use **Precautions** Seizure or CNS disorders History of airway instability, tracheal surgery or stenosis **Contraindications** Cardiovascular disease or hypertension Active pulmonary infection or disease Age 3 months of less **Side Effects** Nystagmus Hypersalivation (potential) Laryngospasm (potential) Emesis (potential) ↑ HR, ↑BP

PROPOFOL **Diprivan®** **10mg/ml**	1-3 mg/kg		Fluid bolus pre-injection due to peripheral vasodilation Myocardial depressant **Precautions** Smaller doses in elderly/debilitated patients **Contraindications** Patients with soybean and egg hypersensitivity **Side Effects** Hypotension
THIOPENTONE ***25mg/mℓ***	3-5 mg/kg		Decreases cerebral oxygen consumption and intracranial pressure Precipitates when mixed with acidic solutions e.g. neuro-muscular blockers **Contraindications** Severe asthma (due to histamine release) Porphyria **Side Effects** Hypotension **Precautions** Elderly/debilitated
MIDAZOLAM **Dormicum®** ***1/5mg/mℓ***	RSI 0.2-0.3mg/kg Post-intubation 1-2 mg q10min titrated to effect	0.05 mg/kg q10min titrated to effect	*Not a true induction agent* **Side Effects** Hypotension

PARALYTIC AGENTS

DRUG	DOSE	PAEDIATRIC CONSIDERATIONS	PEARLS & PITFALLS
SUCCINYLCHOLINE Suxamethonium® ***50mg/mℓ***	1.5-2 mg/kg	Neonate 3 mg/kg	If repeat dosing, pre-treat with atropine Dose based on actual body weight in obese patients Majority of adverse reactions are not dose dependent therefore a larger dose assures rapid onset and good muscle relaxation Can be used in severe burns, crush injuries, spinal cord injuries of less than 24 hours duration Effects prolonged in patients with pseudocholinesterase deficiency e.g. Organophosphate toxicity **Precautions** Hyperkalaemia - succinylcholine results in a transient rise (0.5-1 mEq/ℓ) of potassium **Contraindications** Denervated muscle Genetic muscular disorders
ROCURONIUM Esmoron® ***10mg/mℓ***	1 mg/kg		Paralysis lasts 45-80 min RSI dosage may lead to prolonged paralysis ± 3 hrs Minimal cardiac effects **Precautions** Difficult airway
VECURONIUM Norcuron® ***2/4mg/mℓ***	RSI 0.3 mg/kg Post-intubation 0.1 mg/kg		**Contraindications** Incompatible with thiopental
PANCURONIUM Pavulon® ***2mg/mℓ***	Post-intubation 0.05-0.1 mg/kg		Duration 60-90 min **Contraindications** Incompatible with thiopental **Side Effects** Tachycardia

RESCUE AGENTS

DRUG	DOSE	PAEDIATRIC CONSIDERATIONS	PEARLS & PITFALLS
EPHEDRINE ***50mg/mℓ***	5-10 mg	Not for kids	Not a per kg dose Dilute with 9ml NS to produce 5mg/ml Causes an increase in BP & HR Tachyphylaxis may occur due to noradrenaline stores depletion **Contraindications** Concurrent MAO inhibitor therapy
PHENYLEPHRINE ***10mg/mℓ***	50-100 µg	Not for kids	Not a per kg dose Dilute 10mg in 200ml NS = 50 µg/ml Peripheral vasoconstrictor May cause a reflex tachycardia **Contraindications** Hyperthyroidism Heart block Bradycardia Concurrent MAO inhibitor therapy
ATROPINE ***0.5/1 mg/mℓ***	0.01 mg/kg	Minimum dose 0.1 mg/kg	Max dose 1mg/kg/dose Reduce max dose to 0.5mg in Ischaemic Heart Disease Exclude hypoxia as the cause for the bradycardia

ANALGESIA

DRUG	DOSE	PAEDIATRIC CONSIDERATIONS	PEARLS & PITFALLS
MORPHINE ***15mg/mℓ***	Post-intubation 1-2 mg q10min titrated to effect	Max per dose 0.1 mg/kg Reduced dose or dose frequency in infants 0.05-0.1 mg/kg	Histamine release Hypotension

6. SPECIAL SITUATIONS

A. Pre-hospital RSI

RSI can be a safe, appropriate and effective technique when performed in the prehospital environment by either doctors or appropriately trained and credentialed advanced life support paramedical personnel. The following special considerations apply to prehospital RSI

- Endotracheal intubation has the risk to worsen patient outcomes (in both adults and children) when performed in the prehospital environment. There are no guidelines validated in South Africa with respect to this practise. The Emergency Medicine Society of South Africa makes the following recommendations with respect to prehospital intubation:
    - If transport time to a fully equipped and staffed ED is less than 30 minutes then prehospital intubation should be performed only for an actual or impending airway obstruction or if the patient requires mechanical ventilation. It should not be performed solely for airway protection in the case of a reduced level of consciousness. Organisations that employ paramedics should have a written policy and quality assurance program to endure appropriate patient selection for prehospital intubation.
- If a patient requires prehospital intubation, RSI is the recommended method of intubation (within the framework of this practice guideline) and advanced life support paramedics should be trained and equipped to safely perform RSI.
    - Training in RSI should include a theoretical component, a simulation component (manikin based) as well as a practical component with supervised intubations in a controlled environment.
    - The end-point of training should be proficiency in performing RSI as demonstrated to the satisfaction of an appointed examiner.
- Prehospital RSI programs should ensure that RSI can safely be performed by ensuring that the following essential elements are addressed
    - Equipment – a full range of equipment should be available to perform RSI. This must include *inter alia* a variety of types of laryngoscope handles and blades, a bougie, rescue airway devices, surgical airway kits and some form of capnometry or capnography device.
    - Drugs – a range of induction agents, sedatives and neuromuscular blocking agents must be available.

- Monitoring – appropriate monitoring equipment and protocols should be available and in place.
- Oversight – provisions should be made to provide oversight of the performance of prehospital RSI at three levels
    - Medical or senior paramedical oversight should be available 24 hours a day to provide telephonic advice on the indications and performance of prehospital RSI
    - All records of patients subjected to prehospital RSI should be critically reviewed by senior staff members and discussed at monthly meetings
    - Statistics of prehospital RSI performance, complications and outcomes should be kept and reviewed from time to time

B. The trauma patient

RSI is a safe, appropriate and effective technique in trauma patients with the following special considerations

- Adequate protection of a potentially injured cervical spine must be maintained during all airway manoeuvres (manual inline axial stabilisation). In the case of a failed intubation / failed airway it is acceptable to abandon cervical spinal immobilisation in order to secure an airway as a life-saving intervention.
- An increased level of care should be exercised when administering muscle relaxants to patients with penetrating trauma to the neck. While not absolutely contraindicated, the doctor should be aware that muscle relaxation may result in the complete loss of the airway and a surgical airway may be required.
- Suxamethonium should be avoided in trauma patients with, or at risk of hyperkalaemia (major burns >24hours from injury, crush injuries).

C. The obese patient

There are several important special considerations when contemplating RSI in an obese patient

- Meticulous care should be exercised to ensure correct patient positioning before laryngoscopy. Pillows or a wedge should be placed behind the patient's back, head and neck in a ramp until the external acoustic meatus is at the same horizontal level as the manubrium. This will provide the best chance of successful intubation.
- Difficult bag-mask ventilation should be anticipated because of potential difficulty in obtaining an adequate seal with the mask. Both bag-mask ventilation and ventilation through a supraglottic device might be difficult because of the high airway pressures needed to inflate the lungs against the resistance of an abnormal chest wall.
- Some drugs used for RSI or post-RSI management require dose modification when used in the obese patient. The suggested dosing guidelines are shown in the table.

Paralytic agents		
Succinylcholine[69,70]	TBW	NA
Vecuronium[71,72]	IBW	IBW
Atracurium[72,73]	TBW	TBW
Rocuronium[74,75]	TBW	TBW
Sedatives/anesthetics		
Benzodiazepine[55,76,78]	TBW	IBW
Propofol[79,82]‡	DW† = IBW + (0.4 × TBW)	6mg/kg/hr
Thiopental[83]	TBW	IBW
Phenobarbital[84]	TBW	IBW
Ketamine[85]	IBW	IBW
Etomidate[86]‡	TBW	
Methohexital[87]	TBW	IBW
Analgesics		
Morphine[88,89]	IBW	IBW
Remifentanil[90]	IBW	IBW
Fentanyl	TBW	0.8 × IBW
Sufentanil[91]	TBW	0.8 × IBW

Table from: Brunette DD. Resuscitation of the morbidly obese patient. Am J Emerg Med 2004; 22:40-47

- In setting the ventilator for the obese patient, tidal volumes should be selected according to ideal body weight rather than total body weight. Higher airway pressures than normal should be anticipated because of the effect of the mass of the chest wall and abdomen.

D. The neonate

RSI is a safe, appropriate and effective technique in neonatal patients and has been shown to be superior to other intubation techniques. The following special considerations apply

- A higher dose suxamethonium should be used in neonates (3mg/kg).
- Uncuffed tubes are generally still preferred to cuffed tubes in neonates.
- Rescue supraglottic devices are available for neonates and laryngeal mask airways have been shown to be effective in this age-group.
- The neonate should be carefully positioned before attempting laryngoscopy with a pad under the shoulders or torso to accommodate for the large occiput.
- Manual ventilation through an endotracheal tube should be provided with due care for the high risk of volutrauma / barotraumas and resulting pneumothorax. Mechanical ventilation should be provided by a ventilator appropriate for neonates.

E. The haemodynamically unstable patient

RSI can, and often must, be safely performed in haemodynamically unstable patients. The following special considerations are important in these patients

- Lower doses of induction agents (usually half the normal dose) should be administered to these patients to limit the fall in cardiac output caused by these drugs. Even ketamine causes adverse haemodynamic effects in hypotensive patients.
- Before commencing with RSI, treatment should be initiated in anticipation of a fall in cardiac output as a consequence of the cardiovascular effects of the induction agent, the effects of muscle relaxants, and the initiation of positive pressure ventilation. This treatment might include
    - Preloading with a bolus of warm intravenous fluids
    - The preparation and initiation of an infusion of an inotropic agent (adrenaline would be most appropriate)
    - The preparation of a vasopressor agent for infusion (e.g. phenylephrine)
- Vigilant monitoring of vital signs during and after RSI will enable rapid detection and treatment of any deterioration of haemodynamic status. If the patient's condition permits it, invasive haemodynamic monitoring should be initiated prior to RSI.