Topic Overview: Rapid Emergency Intubation (REI) in the ED
Module Airway 3
Date of last update: 27th October 2012

Objectives

1. To discuss the role of rapid emergency intubation (REI) in the emergency department
2. Practice skill of intubation
3. Prepare and plan to perform a REI
4. Use an emergency algorithm in the event intubation is difficult
5. Trouble shoot problems post REI, such as desaturation.
6. Develop skills with video laryngoscopy

1. What is a Rapid Emergency Intubation?

This is a method of rapid intubation. In the ED it is used in patients considered at risk of aspiration because they are sedated or unconscious and not fasted (ie the majority of patients requiring intubation). It is an adaptation of a method used more commonly in anaesthesia termed Rapid Sequence Induction (RSI).

The RSI involves a set of three key steps incorporated into the larger number of steps involved in the intubation (see sections 2 and 3):

1. **Preoxygenation** which delays desaturation during the interval required for the muscle relaxant to work (step 2) when hand ventilation is avoided because of its associated risk of gastric insufflations and aspiration
2. Administration of a **rapidly acting muscle relaxant** enabling intubation within 60 seconds (classically achieved with 1.5 mg/kg of suxamethonium)
3. Application of **cricoid pressure** (Sellick's manoeuvre) to prevent passive regurgitation of stomach contents

How is a REI different to RSI? Firstly RSI is commonly performed in the ED. However the use of cricoid pressure is somewhat controversial with some people feeling that it may create difficulties with visualisation, which creates its own risks for people who do not intubate frequently. This paper will discuss RSI to allow for both approaches.

2. Basic approach to endotracheal intubation

This section will explain the basic approach. This will be incorporated into a RSI in section 3.

2.1: Principle

Endotracheal intubation is the placement of an endotracheal tube (ETT) into the trachea. The term when commonly used assumes that the ETT will be placed under direct vision through the laryngeal inlet by performing a technique called laryngoscopy. The soft tissues of the oral, pharyngeal and laryngeal cavities present along three axes. The objective of tracheal intubation is to align these three axes into one axis that can project between the intubator's eyes and the vocal cords (Figure 1).

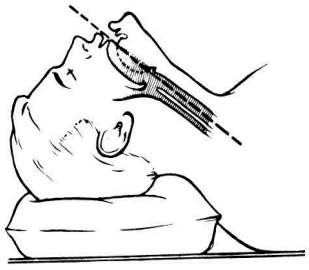


Figure 1: Three axes aligned

Intubation carries risks and should only be undertaken after adequate training and clinical experience, especially if drugs are required to facilitate intubation. Less experienced people should limit intubation to situations where drugs are not required, such as in resuscitation during cardiac arrest or under the direct supervision of senior staff.

2.2: Equipment

The equipment required is listed in Box 1

Box 1: Equipment for basic intubation

Intubation equipment

- ETT – estimated size plus size above and below
- [Adult females 7.5 / males 8.0-8.5]
- Introducer [do not project past end, fashion a hockey at end]
- Bougie [lubricate the distal 10% only]
- Yanker Sucker [used in REI turned on and placed under the pillow]
- Laryngoscope [bulb tightened and light working] or Videolaryngoscope
- Spare laryngoscope
- ETT tie or tape cut
- Bed with head-down gear [used in RSI in case of regurgitation]
- End Tidal CO2 monitoring (all REI)
- Difficult airway equipment –
    - Supraglottic devices and surgical airway equipment

Oxygenation (ventilation) equipment

- Oro-pharyngeal airway [size 2-3 females / size 3-4 males]
- Naso pharyngeal airway [size 6 females / size 7 males]
- Face mask [size 4 females / size 5 males]
- Bag Valve Mask with self-inflating bag
- O2 source [wall or cylinder]
- Self inflating resuscitation bag and mask
- Nasal Prongs with O2 source able to deliver high flow 15L/min

2.3: Technique

A handy acronym to guide practice is presented in Box 2

Box 2: The "SIMPLE" acronym

The Technique is "SIMPLE"

Head in **S**niffing position

Insert blade in right side of mouth

Move tongue up and to the left (looking for the epiglottis as the first landmark – don't insert the blade very far at this stage)

Position blade tip in the aryepiglottic fold (failure to extend it will lead to a poor view)

Laryngoscope **is** **E**levated to ceiling using a two-step manoeuvre as seen in fencing – forward and up

1. **Place head in sniffing position.** The correct position for the head is "sniffing the morning air", with the neck slightly flexed on the thorax (C7/T1) and the head extended on the neck (C1). A pillow or folded towel is placed under the head and neck assuming cervical spine injury is not suspected. See Fig 3. This allows a straight line of vision from the mouth to the vocal cords. (Figure 1).
2. **Insert blade.** The laryngoscope is always held in the left hand. It is introduced into the right hand side of the mouth.
3. **Move tongue up and to the left.** The tip of the blade is advanced, gently moving the tongue to the left and elevating it as you advance until a fold of skin/cartilage is visualised at twelve o' clock. This is the epiglottis and it sits over the glottis (the opening of the larynx) during swallowing. The epiglottis appears early and a common mistake is to advance the blade too quickly and too far before looking for this landmark.
4. **Position the laryngoscope tip at the base of the epiglottis.** The tip of the blade is advanced in front of the epiglottis, toward its base, known as the vallecula. It is gently nudged in until it will not advance any further. This last step is critical. If the tip of the blade is not as far in as it will go, then the epiglottis will be tipped down to conceal the laryngeal inlet, rather than elevated to reveal it, during the next step (See Figure 2).

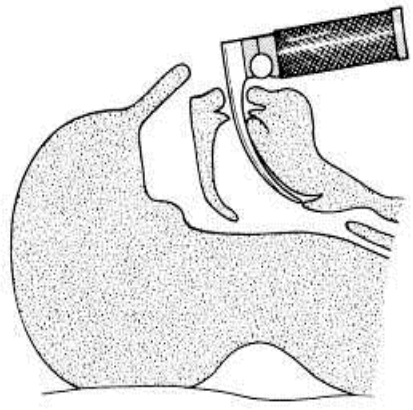


Figure 2: Positioning the Laryngescope Blade

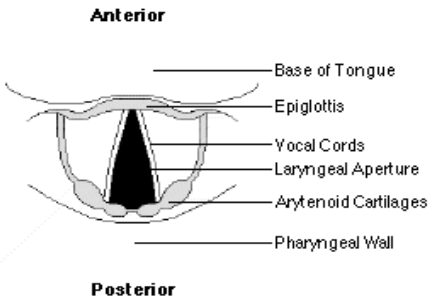


Figure 3: Anatomy of the Larynx

5. **Lift and elevate the laryngoscope.** Now elevate the entire laryngoscope upwards toward the ceiling, being mindful not to angle it forward. You should feel this manoeuvre in your biceps muscles, not your forearm muscles. This flips the epiglottis upwards and exposes the glottis below, typified by two white vocal cords forming a triangle on each side (See Figure 3).

6. The tip of the endotracheal tube is advanced through the vocal cords and once the cuff has passed through, one stops advancing. If an introducer is used, you should ask your assistant to remove it now, while you maintain a firm grip on the ETT. The laryngoscope is removed.

7. Inflate the pilot cuff with air. If an RSI technique is used you should inflate with a bolus of 5 ml as soon as the laryngoscope is removed. After the ETT position is confirmed, go back and adjust the volume in the ETT pilot cuff. Withdraw 2 ml with lung inflation until a small leak is just heard, then quickly reinflate 1 ml. Alternatively, measure the cuff pressure with an ETT cuff pressure gauge, if you are particularly concerned about regurgitation. Excessive volume in the pilot cuff can lead to high pressures exerted on the tracheal mucosa, which may cause necrosis and tracheal stricture. This is less of a problem with modern ETTs that have low-pressure cuffs, but still possible.
8. The tube length is best assessed by visualising the passage of the ETT through the cords and then passing the cuff just beyond the cords. Also check the ETT markings at the teeth or nares. In the ***adult male*** the length of the orotracheal tube ranges from 20 - 24 cm and its nasotracheal counterpart is 29 cm. The ***adult female*** requires an orotracheal tube length of 18 - 22 cm and a nasotracheal tube length of
27 cm.

9. Hold onto the ETT until its position is confirmed, and it is secured. The tube may be secured by tying with fabric tape or taping it securely, ensuring that it cannot slide up and down the trachea.

3. 7 P's of Rapid Emergency Intubation (REI)

This section explains the procedure of REI Before you decide to intubate a patient you must perform an assessment of the risks of intubation looking for predictors of airway difficulty (See Submodule A1) to guide the clinical judgement that intubation is indicated, that REI is the appropriate technique and that the staff involved have adequate training and experience.

P1. Preparation (patient / equipment / staff / drugs)

- Prepare the Patient: If awake, explain the procedure and obtain consent as appropriate to the patient's cognitive ability at the time. Position with neck flexed and atlanto-occipital joint extended (sniffing position), ramping if obese, with ear in line with the sternal notch. Don't forget to protect the C-spine in high risk trauma.
- Equipment: Use a checklist or memory aid to ensure you have the appropriate equipment at hand. The STOP IC BARS acronym is a useful tool (See Box 3). Some EDs are now using videolaryngoscopes as first line intubation devices while others reserve their use as a secondary measure when an unfavourable view is seen on first attempt at laryngoscopy.

Box 3: Pre-intubation Checklist

Box 3: THE STOP IC BARS

S---Suction. Under pillow right hand side.

T---Tubes - Check the ETT cuff and pilot line. Most people will use a lubricated stylet and shape the ETT to straighten the tube proximally and create a 30 degree upward bend just before the cuff.

O---Oxygen. Check manual resuscitator. Apply nasal prong oxygen.

P---Pharmacology. Drugs drawn and labelled.

I---IV access. 2 lines. 1 attached to pump set.

C---Connect to monitors – ECG, BP, Sats monitoring. End Tidal CO2.

B---Blades and bougie

A---Alternative devices. E.g. Videolaryngoscope

R---Rescue techniques. Laryngeal mask airway (LMA)

S---Surgical technique. Which and where.

Staff - to hand equipment / give drugs / watch monitor / perform cricoid pressure / record events

Drugs - All must be drawn up and labelled with calculated dose for patient's weight

- Staff: REI requires a tightly coordinated team of two to three people (See next section).
- Drugs: You should learn about drugs elsewhere. In summary drugs are administered that achieve the following:
    - (1)render the patient unaware
    - (2) blunt CVS reflexes that could dangerously elevate BP, this is especially important in head injury and
    - (3) provide muscle relaxation.

  A commonly given combination is a hypnotic agent (Thiopentone, Propofol or Midazolam) and Opiod (e.g. Fentanyl or Alfentanil) and muscle relaxants (Suxamethonium or Rocuronium, the latter only

given by highly experienced clinicians when Sugammadex is immediately available). These should be flushed in with at least 20 ml of saline. Thiopentone, Propofol and Midazolam in particular cause BP to fall and should be used cautiously. Further their response time will be delayed in patients with reduced cardiac output so they need to be titrated slowly to avoid overdosage. Ketamine is also used as a hypnotic induction agent in REI especially when the patient is at high risk for hypotension, including in hypotensive trauma cases.

P2 - Planning

- As explained above REI requires a tightly coordinated team as errors and delays can lead to desaturation and aspiration. It is important to plan and brief the entire team. There are four levels of plans starting with Plan A (the primary plan) with Plans B C and D being back up and emergency plans. These are explained in section 4. At a minimum you should your brief should include clarify Plan A (everyone's roles, timing and cues, drugs expected to give, equipment required, sequence of steps) and the back-up plans B and C should there be any difficulty.
- Roles:
    - The **team leader** is often the member of staff who administers the drugs, they are well placed to provide situational awareness for the team and co-ordinate the entire team in the context of the clinical condition of the patient. They should have a clear view of the monitoring, ensure that the entire team is briefed in their roles for the intubation and post intubation care and be able to respond in leading the team in the case of clinical deterioration during the procedure. The team leader should articulate plans A,B,C and D to the entire team.
    - The **intubator** should focus on management of the airway. He or she must check the airway assistant knows the plan, knows how to apply cricoid pressure (it is useful to have the assistant locate the cricoids before commencing) and understands the cues to apply and take away cricoid pressure
    - The **airway assistant** ensures with equipment is readily available and assists the intubator with their equipment. The airway assistant generally stands to the right of the patient with cricoid applied with the right hand and holding the ETT in the left hand. If cricoid pressure is to be provided a separate staff member may need to be assigned and briefed for this role.
    - A person should be available for **manual inline stabilisation** as required (see A4 Trauma module)
    - A staff member should be assigned as a **runner**, with clear knowledge of the environment and location of extra equipment that may be required. This staff member is ideally placed to be the scribe for the procedure.
    - The person administering drugs (if different from the team-leader) awaits directions from the team leader and is on stand-by in case additional manoeuvres are required such as pulling back the lip or External Laryngeal Manipulation (ELM (See below))

P3 - Pre-oxygenation

- All patients should be pre-oxygenated. The aim is to achieve nitrogen washout in the lungs so there is an oxygen reservoir available during the apnoea induced by paralysis for RSI. Saturations of 100% do not equate to adequate pre-oxygenation. Ideally need three minutes for spontaneous breathing on high flow, reservoir mask O2. Cooperative patients can achieve adequate pre-oxygenation by five vital capacity breaths (breathing all the way in and all the way out) using 100% O2
- In an unconscious or compromised patient the decision to manually pre-oxygenate via bag mask ventilation must be weighed against the risk of gastric insufflation and subsequent increased risk of aspiration.
- It is becoming common practice to add nasal prongs to provide apnoeic oxygenation, these should be set to greater than 15L.

P4 - Positioning +/- cricoid pressure

The first stage of positioning is performed in the preparation stage (P1). Ideally the patient should be positioned with the ear to the sternal notch (the sniffing position). Obese patients should be ramped to achieve this. The

second stage involves cricoids pressure applied as the patient loses consciousness. Cricoid pressure (Sellick manoeuvre) is applied by pushing the cricoid cartilage posteriorly with a pincer grip. Subsequently the posterior cricoid ring compresses the oesophagus and hopefully prevents aspiration. It is uncomfortable for the patient, so should be applied as the patient becomes sedated with the induction agent. In practice the patient is instructed to keep his or eyes open so the airway proceduralist recognises when they lose consciousness. As the patient's eyes begin to close they instruct the assistant to apply pressure. Cricoid pressure if applied heavily from the right of the patient can push the larynx to the left, distorting the view. If the larynx cannot be viewed fist instruct the assistant to move the larynx side to side and if this fails to reveal a view, lesson the cricoids by half before removing it. Bimanual upwards backwards pressure on the larynx (BURP) or external laryngeal manipulation (ELM) is also commonly required and involves externally manipulating the larynx higher in the neck over the thyroid cartilage to improve the position and bring the vocal cords into view.

P5 - Paralysis with induction

Firstly the patient is made unconscious with an appropriate dose of an appropriate induction agent. See P1. Suxamethonium (or high dose Rocuronium in the hands of very experienced clinicians) are the most commonly used drugs for paralysis as they have rapid onset. Muscle relaxant drugs are contra-indicated in upper airway obstruction. In these settings, alternative techniques of intubation such as topicalizaton of the airway with local anaesthetics followed by awake oral intubation, awake tracheostomy, awake fibreoptic intubation or gaseous induction need to be considered.

P6 - Procedure

Under direct vision, perform laryngoscopy and place the endotracheal tube (ETT) between vocal cords and into trachea (See Section 2).

In REI we recommend that an intubating adjunct such as a malleable introducer or bougie is routinely used.

- The introducer should be inserted into the ETT with a small amount of lubrication at the tip and the tip moulded to the shape of a hockey stick. Never allow the tip of the introducer to extend past the end of the ETT as it can lacerate the trachea, which is a life threatening complication.
- If a bougie is used then select the largest diameter that will fit through the ETT. Slightly lubricate the distal end (don't lubricate the top half). Shape the bougie into a hockey stick shape and insert under direct vision. Additional steps may be required to railroad the ETT over the bougie. These include: 90 degrees anticlockwise rotation; forward subluxation of the jaw by another assistant and relaxation of cricoids pressure.

P7 – (a) Post ETT position confirmation (b) care and (c) documentation

P7 (a) Post ETT position confirmation

A malpositioned endotracheal tube, if unrecognized can lead to death. Confirming the correct placement of the endotracheal tube is an essential competency for anyone performing endotracheal intubation. The gold standard for confirmation of correct positioning of the ETT is the continued presence of CO2 evidenced by a normal sustained square wave capnograph trace, capnography is the minimum standard of care in Australasia. As no approach is 100% reliable clinical signs should be looked for. A post intubation CXR will show the depth of the tube in the trachea, it does not confirm tracheal placement. A systematic approach and acronym is shown in Box 4.

Box 4: Confirming the position of the ETT

ETT Position C_2H_2ECKS ETT

Compliance in bag
Chest wall moves symmetrically
Hear breath sounds in axillae (R&L)
Hear NO breath sounds over epigastrium
Examine ETT: Exhaled mist seen in ETT at the lips, and marking at the teeth
Cuff leak eliminated with 5 ml of air
Kapnograph has square CO2 waveform (or litmus test)
Saturation maintained > 95%

Three patterns can be looked for when confirming the position of the ETT (See Box 5).

👍 **Trachea** - The correct position for the endotracheal tube is the mid trachea where it enables ventilation of both lungs. If all the signs in C2H2ECK are present the ETT is likely to be in the trachea and O2 Saturation will be persistently high (95-100%).

👎**Main bronchus -** If the tube is pushed too far down the trachea it will enter one of the main bronchi, here the chest will rise asymmetrically, and unequal breath sounds will be heard on auscultation. In healthy patients this causes borderline low levels of oxygenation (90-95%).

👎👎👎**Oesophagus -** If the tube is placed in the oesophagus, none of the C_2H_2ECKS ETT criteria will be fulfilled convincingly. The O2 saturation will eventually fall below 90% and will then rapidly fall to an unrecordable level but this may take several minutes in a healthy patient so an early high SaO2 should not be solely relied upon. Persistent ventilation via a tube placed in the oesophagus can cause death or permanent brain injury to a patient so it is essential that you identify this and remove the tube immediately.

Box 5: Recognising a mal-positioned ETT: 3 patterns of placement

👍 ☺ TRACHEA	👎[1] MAIN BRONCHUS	👎👎👎OESOPGAGUS:
▪ Expired end tidal CO_2 capnograph shows a square wave for 5 or more breaths (this is the most reliable method ▪ The ETT was witnessed to go through the cords. ▪ The ETT leak is readily obliterated with 4 - 5 ml air ▪ Chest wall excursion is easily achieved with BMV ▪ Bilateral breath sounds are auscultated in the axillae ▪ Mist forms in the ETT ▪ The SaO2 remains above 95 %	▪ Chest wall excursion is reduced on the left ▪ Breath sounds are reduced on the left ▪ The SaO2 remains 90 – 94 % **ACT** ▪ Withdraw the ETT while auscultating ▪ Use US to confirm placement	▪ Chest wall excursion is absent in both axilla ▪ The SaO2 falls below 90% (Can take several minutes in pre-oxygenated healthy people) ▪ A persistent burping sound escapes around cuff despite filling with air ▪ The stomach expands with ventilation ▪ Other signs of tracheal placement are absent **ACT** Remove the ETT

P7 (b) Ongoing Care**:** Once the ETT is in place the care process needs to continue – treating the Condition, Cause, Complications and Co-morbidities. Ongoing sedation should be provided and analgesia given for tube tolerance and to assist in allowing adequate assisted ventilation. An acronym for post intubation care that is often used in the Intensive Care unit could be used in the Emergency Department – FAST HUG (See Box 6)

Box 6: FAST HUG checklist for post intubation care

F - luids
A - nalgesia
S - edation
T - hromboembolic prophylaxis
H - ead Up
U - lcer Prophylaxis
G - lycaemic Control

P7 (c) Post procedure documentation– document who was involved (medical and nursing), drugs used, Cormack-Lehane view seen during laryngoscopy, 'Percentage of Glottic Opening (POGO)', difficulties found, and airway manoeuvres used to optimise view (e.g. BURP, Bougie etc, 2 handed mask ventilation). This is important as it will influence extubation and provide information for future intubation attempts.

4. Emergency algorithms for difficult intubation

Before commencing a REI the team needs to know not only the primary plan (Plan A) but a backup plan (Plan B) in the event the intubation is difficult but it is still possible to easily ventilate the patient with Bag mask ventilation (BMV). It is essential that BMV is confirmed and if it is difficult then the situation should be re-framed and the focus on supraglottic rescue (Plan C). Supraglottic rescue involves a series of steps including BMV with adjuncts, use of a LMA and intubation attempt. BMV is covered in Submodule A1 and LMA is covered in Submodule A2. If these fail the focus should shift to infraglottic rescue (Plan D) (See Figures 4 and 5). Note that while this Submodule focuses on intubation the entry point for these emergency algorithms can be BMV.

Effective strategies in Plan A may prevent deterioration. If the larynx cannot be viewed first instruct the assistant to move the larynx side to side and if this fails to reveal a view, lessen the cricoids pressure by half before removing it. Bimanual upwards backwards pressure on the larynx (BURP) or external laryngeal manipulation (ELM) is also commonly required and involves externally manipulating the larynx higher in the neck over the thyroid cartilage to improve the position and bring the vocal cords into view. These should be rehearsed.

Figure 4: Emergency Airway Plan

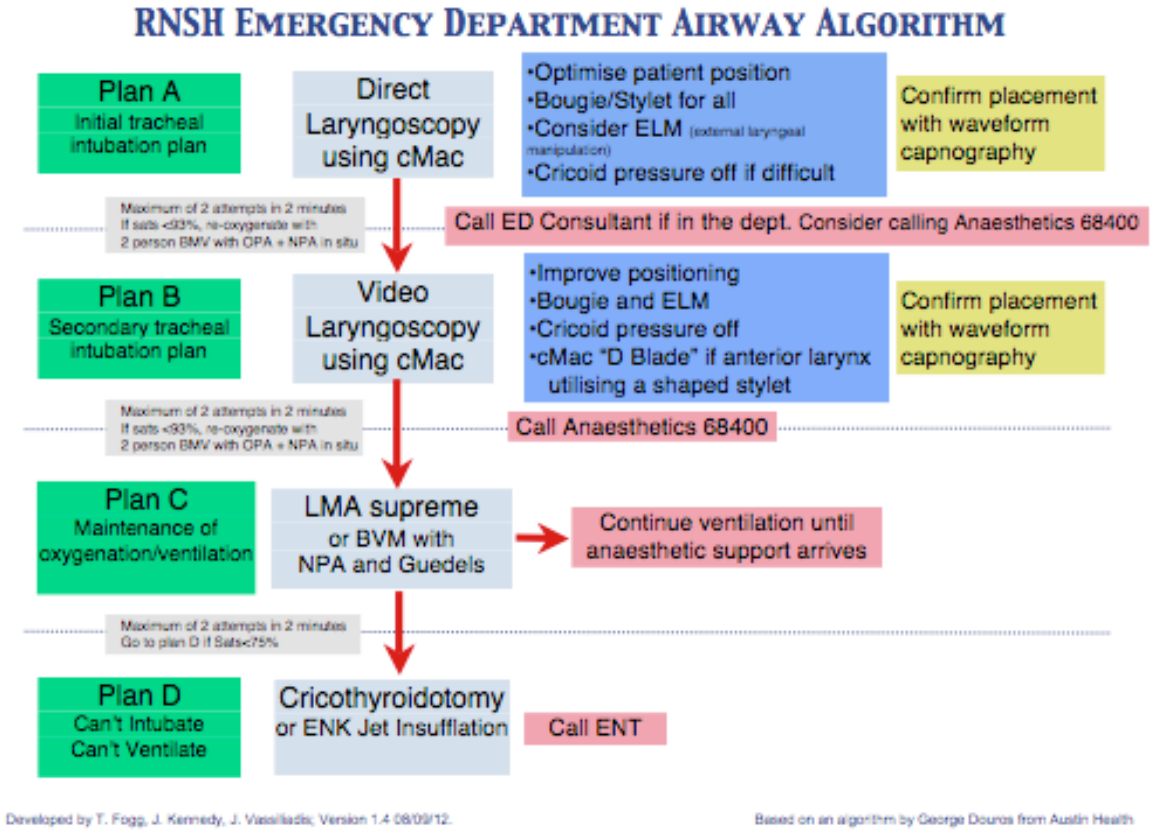
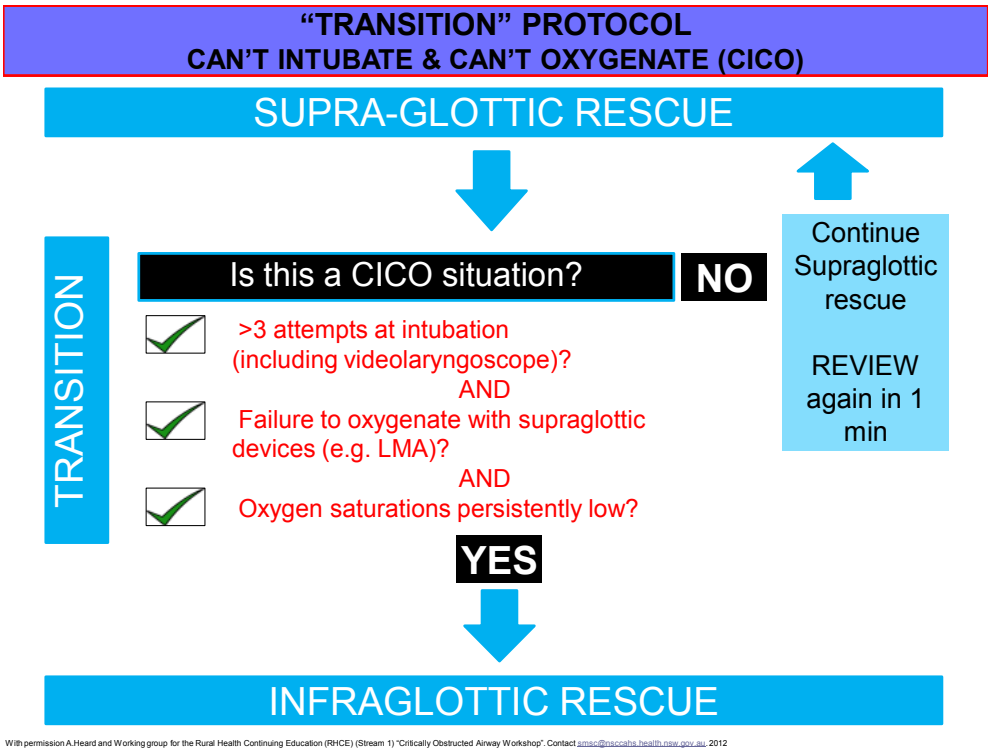


Figure 5: Criteria to support transition from Plan C (Supra-glottic Rescue) to Plan D (Infraglottic Resuce)



5. Troubleshooting desaturation post intubation

A systematic approach will help you solve the problem. One method for remembering what to do when an intubated patient desaturates is to disconnect the patient from the ventilator and hand bag and then check through the DOPES procedure (See Box 7. Another approach is to eliminate problems regionally: above the airway; in the airway; below the airway (See Box 8).

Box 7: DOPES checklist for troubleshooting desaturation in an intubated patient

D - Disconnection? Check connections all the way back to the oxygen source. Is the ETT in the trachea? Check position as earlier---if in doubt take it out and ventilate. If the ETT is in the trachea is it down a bronchus? Pull it back and ventilate.

O – Obstruction of ETT? Suction down the ETT.

P - Patient developed pneumothorax or severe hypotension? Examine the patient, treat the underlying cause.

E -Equipment (ventilator) problem? Disconnect from ventilator and hand bag whilst trouble shooting

S - Stacking of breath or bronchospasm? Disconnect, hand bag, feel for compliance, check the ventilator, suction, give bronchodilators

Box 8: A regional approach to troubleshooting problems with ventilation in intubated patients

STEP 1. EXCLUDE CAUSES ABOVE THE AIRWAY

1. Check O2 supply
2. Check connection of O2 tubing to ventilation device
3. Detach patient from the ventilator and manually bag with bag-mask device
4. Consider replacing existing bag and mask device with alternative bag-mask

STEP 2. EXCLUDE CAUSES IN THE AIRWAY

1. Check the position of the ETT at the lips
2. Inspect the ETT for external obstruction (eg. kinking)
3. Check the filter
4. Confirm the position of the ETT in the trachea (C_2H_2ECKS ETT)
5. Suction the ETT

STEP 3. EXCLUDE "PATIENT" CAUSES

1. Inadequate Minute Ventilation (Vm) – hypoventilation, bronchoconstriction
2. Alveolar gas exchange: endobronchial intubation, atelectasis, pulmonary venous
3. Congestion, aspiration
4. Space occupying lesion: eg. Pneumothorax
5. Circulation causes: hypotension, reduced venous return

6. References

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