

# Airway Patency and Ventilation

## Key Teaching Objectives

Each candidate should receive practical instruction on the following:

1. Basic airway opening manoeuvres and clearance / Oxygen delivery / Oropharyngeal airway insertion / Nasopharyngeal airway insertion / Bag-mask ventilation – one & two person techniques. Emphasise the use of the 2 person techniques and HME-viral filters (with BVM, LMA, ETT) to minimize potential infective aerosol
2. LMA insertion in an infant
3. Orotracheal intubation of an infant and an older child
4. Allow time for questions.

**Note: This is a skill station and does not require a detailed discussion of the decision making.**

## Equipment Required

Mannequins – for intubation & nasal airways

3x infant

3x child

Antibacterial wipes x 2

Hudson Face Masks

Paediatric with and without reservoirs

Adult with and without reservoirs

LMAs:

LMA Supreme (or Ambu Auragain or  
Aura-i)

6x #1.0

6x #1.5

Endotracheal tubes:

2.5 - 9.0 mm uncuffed (in 0.5 increments) x 1

3.5 mm uncuffed x 2

7.5 cuffed x 2

Laryngoscope handles x 2:

Miller Straight Laryngoscope blades:

1x size 0, 1

Macintosh curved laryngoscope blades

1x size 1, 2,3

Paediatric Magills forceps x2

Paediatric yankauer suckers x 2

Y-suction catheters

14Fr x1

10Fr x1

Spare batteries for laryngoscopes

Stethoscopes x 2

HME/Viral filters by 4

Endotracheal tube stylet introducers:

1x 14Fr (adult)

1x 10Fr (paediatric)

Eschmann Tracheal tube introducer – “Bougie”

1x 14Fr adult

1x 10Fr paediatric

Infant - circular

Nasopharyngeal airways 6 x 2

Size range: 3.5mm – 6mm in 0.5mm  
increments

Oropharyngeal airways:

(000, 00, 0, 1, 2, 3, 4, 5, 6) x 2

Self-inflating bags with reservoir and oxygen  
tubing:

240 mL x 1

500 mL x 1

Face masks for bag ventilation

Round 4cm, 5cm, 6cm

Moulded paediatric & small adult

Syringe 10 mL

Tape to tie in endotracheal tube

Tongue depressors x 4

## Environment

There will be three instructors to 6 candidates, so that the hands-on aspect of each station is taught by one instructor to two candidates. The manikins and equipment should be arranged into three separate stations.

- An infant mannikin for the three teaching stations and two child mannikins to share

## Plan

### The sequence & timing:

- Set (by one instructor to the whole group) **(5 mins)**
- Airway opening, BVM & adjuncts, LMA insertion (infant) **(30 mins)**
  - Demo, real time run through (stage 1) and with explanation/questions (stage 2) (whole group)
  - Split into the 3 groups for hands-on (stage 3/4)
- Oro-tracheal intubation **(20 mins)**
  - Demo, real time run through (stage 1) and with explanation/questions (stage 2) (whole group)
  - Split into the 3 groups for hands-on (stage 3/4)
- Closure done within small groups **(5 minutes)**

## Set

"In this session we will revise and practice the three main approaches to airway opening and ventilation.

- Airway opening manoeuvres, oxygenation and bag valve mask ventilation (BVM)
- Laryngeal mask airway/iGel insertion
- Endotracheal intubation

The session will emphasise the primary aim of oxygenation with the use of airway opening and BVM ventilation techniques while considering the alternatives, calling for help early and limiting the duration and number of ETT/LMA attempts to minimize the chances of hypoxemia and airway obstruction.

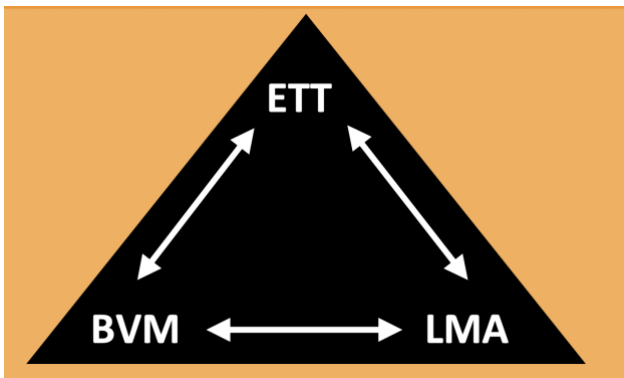


Image from QLD Paediatric Airway Management Algorithm  
<https://www.childrens.health.qld.gov.au/wp-content/uploads/PDF/qpec/Queensland-paediatric-airway-management-algorithm.pdf>

The practical application of these techniques in the context of the team approach and difficult airway management will be further covered in the day 2 safe airway management workshop.

## Dialogue

This station is taught using the 4 part technique as described previously in the Pocket Guide to Teaching for Medical Instructors. The following sequence/methods should be taught:

### **Teaching station 1:**

**Clinical context: On assessment the infant is unconscious with an obstructed airway and breathing spontaneously**

#### **Basic airway positioning and clearance**

##### **Head Tilt & Chin lift**

1. Place the hand nearest to the child's head onto the forehead
2. Apply pressure to gently tilt the head back to achieve the following degrees of tilt

##### **Infant**

Neutral

##### **Child**

Sniffing

3. Place the fingers of the other hand under the chin and lift gently upwards.
4. Positioning – briefly discuss positioning of infant /small child on flat surface, whereas older child (and adult) would have pillow under head. A small shoulder roll may be useful in infants to improve position. This may also be of use during intubation (see below)

##### **Jaw Thrust**

1. Place two or three fingers under the angle of the mandible bilaterally.
2. Lift the jaw upwards and mouth opens.

##### **Suctioning**

1. Extend the head and open the mouth
2. Use a tongue depressor, or laryngoscope blade to visualise the oro-pharynx
3. Maintaining direct vision of the tip of the device, insert a suction device into the oro-pharynx and suction the airway

##### **Oxygen Delivery**

1. High flow O<sub>2</sub> via face mask commenced early
2. Pre-oxygenation via BVM or T-piece circuit with 100% O<sub>2</sub> before insertion of LMA/iGel or intubation

##### **Oropharyngeal airway Insertion**

If the gag reflex is present, it is best to avoid the use of an oropharyngeal tube or other artificial airway, since they may cause choking, laryngospasm or vomiting

**Selecting size: Centre of the mouth to the angle of the jaw**

1. Select an appropriate size of oropharyngeal airway.
2. Open the mouth using the chin lift taking care not to move the neck if trauma has occurred.
3. Use a laryngoscope blade or a tongue depressor to aid insertion of the airway under direct vision in anatomical alignment - 'the right way up'.
4. Re-check airway patency and look for improvement.
4. If necessary, consider a different size from the original estimate.
5. Provide oxygen with a face mask and reservoir,
6. If assisted ventilation is required – use a self-inflating bag and mask

**Clinical context: On further assessment the infant is now apnoeic**

**Bag – mask ventilation**, ensure HME/viral filter (if available) between BVM and face mask

**Face mask selection & application**

1. Select the correct size face mask
  - a. the correct size mask extends from the furrow of the chin, to cover the bridge of the nose
  - b. It should not apply pressure to the eyes
  - c. The smallest size which achieves this will have the least dead space, and often the best seal



Image from:  
[http://www.neoresus.org.au/pages/LM1-7-Breathing.php#B\\_Positive](http://www.neoresus.org.au/pages/LM1-7-Breathing.php#B_Positive)

**Face mask with chin lift manoeuvre**

1. Place the thumb over upper margin of the mask (over the bridge of the nose), and the index finger around the lower margin of the mask, in a "C" grip.
2. The middle, ring and little fingers are then applied to the bony prominences of the mandible, and then **lift the chin up into the mask**.
3. In this position the thumb and index finger oppose the other fingers and maintain a mask seal, simultaneous with chin lift to maintain the airway
4. Note common errors
  - a. avoid compressing the airway due to pressure on the soft tissues under the oral floor, from fingers creeping medially off the mandible
  - b. avoid excessive pressure of the mask down on the chin, which will move the jaw posteriorly, flex the neck and obstruct the airway.
5. The position of the thumb and index fingers may need to be adjusted to achieve an adequate seal on all sides



"C" Grip on face mask

Image from: F.E. Wood, , *et al* Improved techniques reduce face mask leak during simulated neonatal resuscitation: study 2; Arch Dis Child Fetal Neonatal Ed, 93 (2008), pp. F230-F234



OR



6. Squeeze the bag observing the resulting chest movement. "EASY SQUEEZE".
7. Avoid excessive volumes or very rapid inflations as these will tend to inflate the stomach and increase the risk of regurgitation
8. Ventilate at 12-20 breaths/minute depending on the age of the child.
9. **It should be emphasised that bag and mask ventilation is the foundation skill for the goal of oxygenation and ventilation**
10. **If oxygenation / ventilation is difficult – bag ventilation techniques should be combined with an oro-pharyngeal +/- naso-pharyngeal airway**

11. If adequate oxygenation still cannot be achieved – progress to two-person technique

### Nasopharyngeal airway insertion

Mention benefits (e.g. trismus during a seizure, or obtunded with gag), risks (e.g. haemorrhage), and contraindications such as a base of skull fracture.

#### Lateral edge of the nostrils to the tragus of the ear

1. Select an appropriate size (length and diameter).
2. Lubricate the airway with a water-soluble lubricant.
3. Insert the tip into the nostril and direct it posteriorly along the floor of the nose (rather than upwards).
4. Gently pass the airway past the turbinates with a slight rotating motion. As the tip advances into the pharynx, there should be a palpable 'give'.
5. Continue until the flange rests on the nostril.
6. If there is difficulty inserting the airway, consider using the other nostril or a smaller size from the original estimate.
7. Recommence 2 person BVM

### Two person bag mask ventilation with jaw thrust

1. Place the appropriately sized mask in its correct position. Use the fingers to apply jaw thrust and the thumbs and thenar eminences to ensure a seal (vice grip, see diagram).
2. With optimal jaw thrust the lower incisors will move anteriorly relative to the upper incisors.
3. Ventilate at 12-20 breaths/minute depending on the age of the child.



## **LMA/iGel insertion is a simple, reliable alternative to face mask BVM ventilation**

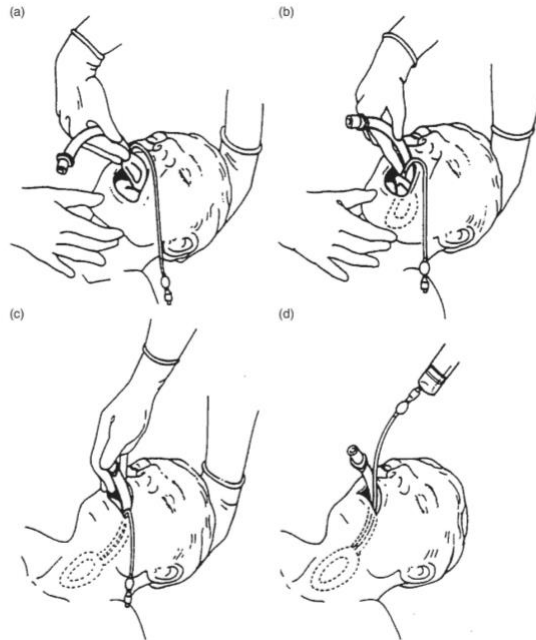
### **Clinical context: Unsuccessful BVM ventilation in an unconscious patient**

#### **Technique for LMA insertion**

Let the candidates know that there are a variety of effective ways used by experienced airway managers. We are teaching only one technique which is slightly different to that described in the 6<sup>th</sup> Ed APLS manual.

1. **Only demonstrated on the baby manikin,** with the size 1 LMA (0-5 kg) which works well with our infant manikins. (Guideline weights and cuff volumes are printed on the LMAs)
2. Preoxygenate the patient with 100% oxygen via BVM before inserting the LMA
3. Select a size 1 LMA. Half inflate the cuff, about 2 mls.
4. Lubricate the posterior surface of LMA cuff (before the session begins ensure the manikin tongue is well lubricated)
5. Extend the head, open the mouth fully, and insert the tip of the mask along the hard palate with the open side facing, but not touching the tongue - **Fig 21.8 a in the 6<sup>th</sup> edition APLS manual** (jaw thrust by an assistant can move the tongue forward to prevent it obstructing the passage of the LMA or alternatively a laryngoscope or spatula can be used to control the tongue while passing the LMA. **With the hypermobile tongue of the manikins we are using, the laryngoscope, spatula technique works best in many mannikins**)
6. Insert the mask further along the posterior pharyngeal wall by pushing on the tube. Sometimes some twisting manipulation is required to pass the mask around the base of the tongue and epiglottis. Eventually resistance is felt as the tip of the LMA lies at the upper end of the oesophagus – **Fig 21.8 c**
7. Inflate cuff. Attach BVM/filter. Test ventilate checking for chest expansion and that the abdomen is not distending. (If minimal or no chest expansion with adequate pressure, attempt repositioning by gradual partial LMA withdrawal and retesting. If still unsatisfactory, remove and reinsert. If leak is too great, adjust cuff pressure and retest. If still too great remove and insert next size up)
8. Secure the LMA with adhesive tape.
9. If LMA insertion is not achieved in 30 seconds, discontinue the attempt and re-establish BVM ventilation. Help should be called for early and attempts limited to three including an attempt by an “expert”.





**Figure 21.8 (a–d)** Insertion of a laryngeal mask airway

It is sometimes easier to insert an LMA rotated 90° or 180° from its final position. The mask is then quickly rotated into its natural position as it passes into position.

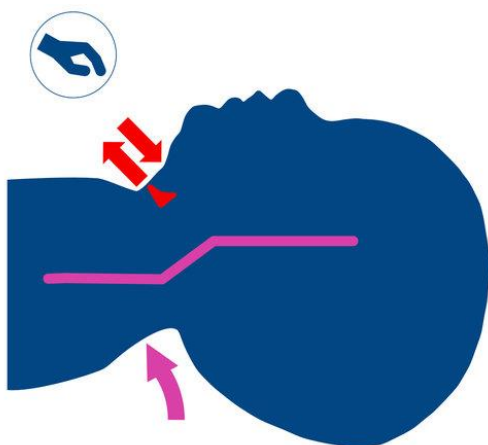
## **Teaching station 2:**

### **Technique of orotracheal intubation**

This is about the technical skill of planned intubation in the apnoeic child following rapid sequence induction. Pre-oxygenation, optimisation and the prime goal of oxygenation are emphasised.

### **Infant or small child using a straight-blade or curved laryngoscope**

1. Ensure that adequate ventilation and oxygenation by face mask are in progress. The patient should be monitored by ECG, pulse oximetry and capnography.
2. Prepare and check equipment including selection of an appropriately sized tube, including the size above and below the best estimate (see chapter 5).
3. Optimal position is neck flexion with head extension ("flextension") which may be best achieved with a shoulder roll in infants with a large occiput



**LARYNGEAL MANIPULATION/EASE CRICOID  
FLEXTENSION**

4. Hold the laryngoscope in the left hand and insert it into the mouth along the right side, displacing the tongue to the left. The blade is brought into the midline and either rests in the vallecula or picks up the epiglottis. The handle is then pulled forward and upward to reveal the glottis. It is easy to obscure the view by inserting the blade too far past the larynx and down into the oesophagus. In these circumstances the blade is cautiously and slowly withdrawn in the midline until the vocal cords often come into view with the blade retracting the epiglottis.
5. Insert the endotracheal tube from the right hand side of the mouth into the trachea, concentrating on how far the tip is being placed below the vocal cords. The tip should lie at least 2 cm below the vocal cords, depending on age. If the tube has a "vocal cord level" marker, place this at the vocal cords.
6. Following intubation, placement of the tube should be confirmed by:
  - a. observing bilateral and symmetrical movement of the chest,
  - b. auscultation of the chest and abdomen,
  - c. monitoring carbon dioxide by either colour-change capnometry or end-tidal capnography. This is the definitive test for tracheal tube placement. [Note that exhaled CO<sub>2</sub> may be low or absent in cardiac arrest.]
7. If ETT insertion is not achieved in 30 seconds, discontinue the attempt and re-establish BVM ventilation. Help should be called for early and attempts limited to three including an attempt by an "expert".
8. Once the tube is inserted and fixed firmly into place arrangements should be made to obtain a chest x-ray to confirm correct tube length. The end of the tube on x-ray should be below the level of the vocal cords, but above the carina.

### **Older child using a curved-blade laryngoscope**

1. Ensure that adequate ventilation and oxygenation by face mask are in progress and patient monitoring established.
2. Prepare and check equipment. (before inducing RSI if used under these circumstances), including selection of an appropriately sized tube, but prepare a range of sizes, including the size above and below the best estimate (see chapter 5).
3. Ensure manual immobilisation of the neck by an assistant if cervical spine injury is possible.

4. Hold the laryngoscope in the left hand and insert it into the mouth along the right side, displacing the tongue to the left. The blade is brought into the midline to visualize the tip of the epiglottis
5. Place the tip of the laryngoscope anterior to the epiglottis in the vallecula. The handle and blade are then pulled forward to visualize the vocal chords as demonstrated in the illustration.
6. Gently but firmly lift the handle towards the ceiling on the far side of the room being careful not to lever on the teeth.



7. Insert the endotracheal tube into the trachea, concentrating on how far the tip is being placed below the vocal cords. The tip should lie at least 2 cm below the vocal cords, depending on age. If the tube has a "vocal cord level" marker, place this at the vocal cords. Be aware that flexion or extension of the neck may cause migration downwards or upwards, respectively.
8. Inflate the cuff if present, to provide an adequate seal.  
Following intubation, placement of the tube should be confirmed by:
  - a. observing bilateral and symmetrical movement of the chest,
  - b. auscultation of the chest and abdomen,
  - c. monitoring carbon dioxide by either colour-change capnometry or end-tidal capnography. This is the definitive test for tracheal tube placement. [Note that exhaled CO<sub>2</sub> may be low or absent in cardiac arrest.]
9. If ETT insertion is not achieved in 30 seconds, discontinue the attempt and re-establish BVM ventilation. Help should be called for early and attempts limited to three including an attempt by an "expert".
10. Fix tube firmly in place. Once the tube is in place obtain a chest x-ray to confirm correct placement.

## **Closure**

It is vital to allow time for questions. Important concerns may be addressed at this time. The session can be closed by emphasising the importance of oxygenation, airway manoeuvres, BVM ventilation and calling for help early in managing the critically ill child. While considering LMA/iGel insertion and intubation as alternative airway approaches. There may be issues raised regarding the implications of Covid 19. Laminated guidelines will be available. There will not be time for an extensive discussion.

## **Challenges**

Because there is a great deal to cover on this station, it is very easy to run out of time. Time management is essential to ensure all candidates practice the skills

Candidates with significant paediatric airway experience can enhance the learning experience for all candidates, however it cannot be assumed that they have nothing to learn from the station. To support the diversity of learners it is important to emphasise APLS safe airway management principles and that each candidate receives the opportunity for hands-on practice.

## **Assessment Techniques**

The candidate's performance is assessed during the session to ensure they are competent at airway opening manoeuvres, OPA insertion and BVM ventilation. This is recorded. If this competency is not achieved in the session another opportunity will be provided during the course.