Ministry of Health
Malaysia

NATIONAL TRACHEOSTOMY CARE GUIDELINE 2023

NATIONAL PERIOPERATIVE MORTALITY REVIEW COMMITTEE

National Tracheostomy Care Guideline 2023

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1. What is tracheostomy?

- A tracheostomy is a stoma-creation or surgical opening in the trachea for ventilation of the lungs (Figure 1).
- An incision is made through the anterior part of the neck into the trachea, which then becomes a temporary or permanent opening for ventilation.
- Enables air to enter the trachea directly, bypasses the upper segment of the respiratory tract, and reduces respiratory dead space by about 50%.
- Allows the removal of secretions from the lungs by suctioning through the stoma.

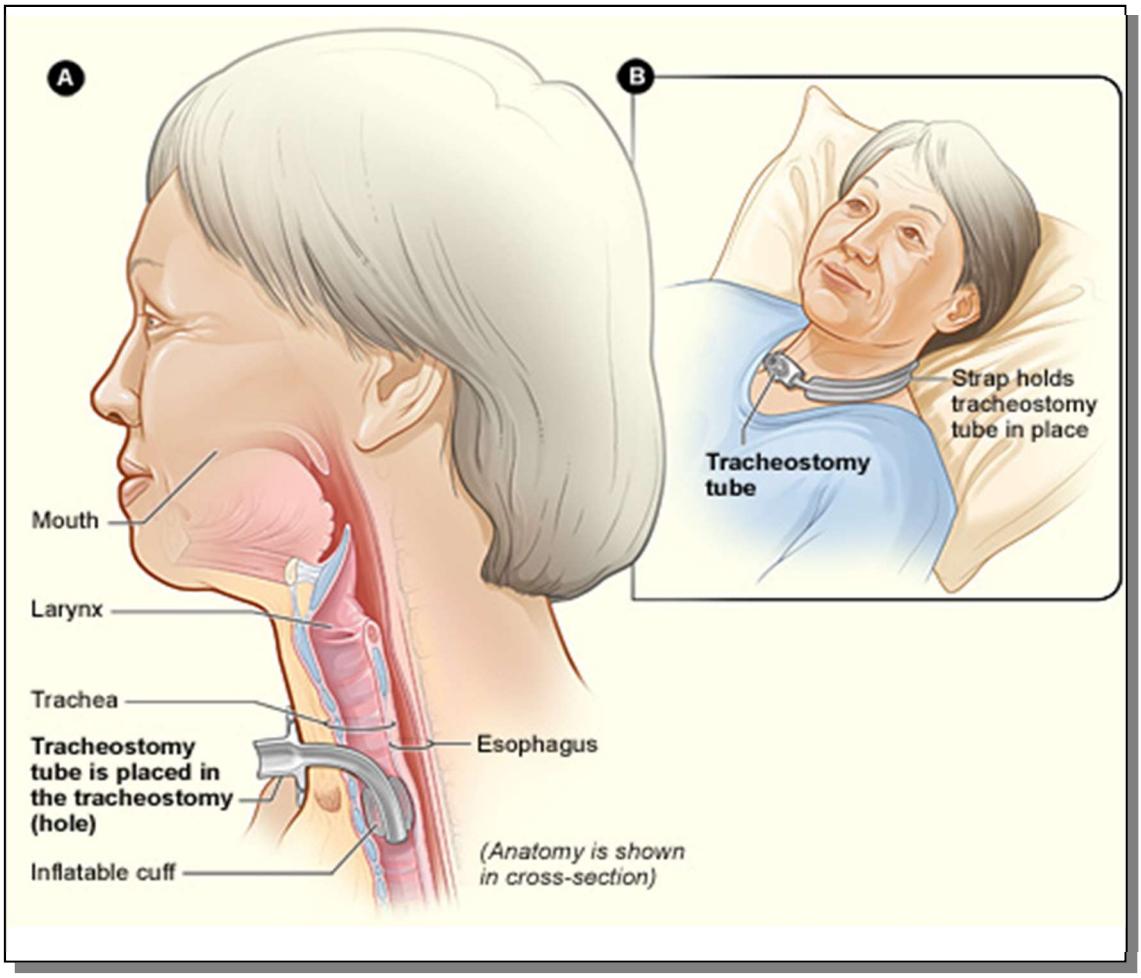

Figure 1: Tracheostomy is created to bypass the upper segment of respiratory tract.

2. What is a laryngectomy stoma?

- A laryngectomy is a surgery in which the larynx is removed. When laryngectomy is performed, a permanent opening (stoma) is created for the patient to breathe through.
- The new entrance of the airway is thus at the laryngectomy stoma, as there is no connection between the trachea and the rest of the upper airway (i.e., the nasal cavity and oral cavity).
- For practical purposes, a laryngectomy stoma requires vigilant care similar to tracheostomy care and thus requires special nursing attention.

3. Indications for Tracheostomy

a. To maintain the airway *(Emergency procedure)*
e.g. upper airway obstruction, reduced level of consciousness, intubation difficulties

b. Airway protection in patients with severe neurological injury *(Semi-emergency procedure)*
e.g. severe head injury, bulbar palsy, Guillain-Barre Syndrome

c. For bronchial toilet *(Semi-emergency procedure)*
e.g. excessive secretions, inadequate cough

d. Prolonged intubation *(Semi-emergency procedure)*
e.g. patient comfort, reduction of sedation, continuation of care

e. Adjunct to major head and neck surgery *(Elective procedure)*

4. Cautions and contraindications

In the absence of airway obstruction, the only absolute contraindication is either severe local sepsis or an uncontrollable coagulopathy.

Relative contraindications:

- difficult anatomy (pending further radiological studies or clearance from the primary team)
  e.g. morbid obesity, lack of neck mobility, proven or potential cervical spine injury, known difficult intubation, tracheal pathology, thyroid mass and aberrant vessels
- significant coagulopathy
- proximity to the site of recent surgery or trauma (tracheostomy to be done only after the anterior neck wound has healed):
  e.g. carotid endarterectomy, anterior cervical fixation, sternotomy, oesophageal drainage, and burns
- potential instability
  e.g. patients unable to tolerate cardiovascular or respiratory changes, such as those with unstable intracranial pressure (ICP) after brain injury

5. Pre-operative preparations

A. Consent

- Attempts should be made to get consent from the patient if they have the capacity to do so.
- For children, consent must be obtained from a parent or next-of-kin.
- Information include:
  - nature of the procedure
  - proposed benefits
  - potential hazards and alternatives
- Should emphasise that, like all surgical interventions, this procedure is not to be undertaken lightly and is not risk-free, nor is prolonged translaryngeal intubation.
- The patient and next-of-kin should be informed of the possibility of long-term tracheostomy care and cost even after discharge.

B. Blood parameters consensus:

- Intraoperative and postoperative complications include bleeding and poor wound healing. Preoperative optimisation is important to minimise complications.

- Ideally, acceptable blood parameters required before proceeding to surgery:
  - Haemoglobin ≥10g/dl
    - in chronic anaemia ≥8g/dl
  - Platelet ≥50 x 10^3/mL
  - Urea ≤25mg/dL
  - INR ≤1.5
  - APTT 25-35 sec
  - PT 11-14 sec
  - Aspirin to be withheld for 5-7 days or clopidogrel to be withheld for 3-5 days is encouraged. However, studies showed that the continuation of antiplatelet in an open tracheostomy carries a low risk of post-operative bleeding. Thus, in patients with a high risk of thrombosis, discontinuation of DAPT is not advisable.
  - Warfarin to be converted to heparin first
  - if patient is on S/C Heparin last dose to be withheld 12 hours before surgery and to restart 6 hours after surgery
  - Clexane and Fondaparinux to be withheld the morning of surgery
  - Direct thrombin inhibitors (Dabigatran) must be according to creatinine clearance (CrCl)
    - CrCl ≥50mL/min to be withheld 1-2 days
    - CrCl<50mL/min to be withheld 3-5 days prior to surgery
  - Direct factor Xa inhibitor (Rivaroxaban) to be withheld ≥24hours prior to surgery
  - for heparin free dialysis prior to surgery
  - for other novel antiplatelets, the decision to withhold it needs to be tailored according to the exact individual drugs.
  - to make sure patient has blood products available in case of bleeding, following local hospital Maximum Blood Ordering Schedule (MBOS)

- The parameters listed are for reference only; the risk for each case should be judged individually on a case-by-case basis, with discussion among the surgeon, anaesthetist team and primary treating team.

6. Special operative consideration

a. Patient with marked obesity or anatomical distortion (e.g. thick short neck):
   i. should consider need for longer adjustable flange tracheostomy tube
   ii. risk should be assessed on individual patient basis
   iii. changes may be needed at mid or end of procedure if the stoma is found to be deeper than anticipated
   iv. tube tip position should be assessed by endoscopy after placement and documented

b. In ventilated patient, cuffed tracheostomy tube is required
   i. the cuff should be of a "high volume/ low pressure" design, and should effectively seal the trachea at a pressure of no more than 20-25 cm H_2O in order to minimise the risk of tracheal mucosal ischaemia and subsequent tracheal stenosis
   ii. size of the tracheostomy tube usually corresponds with the ETT tube. Tracheostomy tubes of one size smaller and one size larger should be available at the time of the surgery

c. For children, the size of the tracheostomy tube is based on the age of the patient as shown in Table 1 or based on formula:

[age (in years)/4] + 4

Age	Tracheostomy Tube Size
0 - 1 month	3.0
1 - 6 months	3.5
6 - 18 months	4.0
18 months - 3 yrs	4.5
3 - 6 yrs	5.0
6 - 9 yrs	5.5
9 - 12 yrs	6.0
12 - 14 yrs	6.5

Table 1: Age-appropriate tracheostomy tube sizes.

*Tube sizes vary with different manufacturers having different outer diameters. The figures stated refer to Shiley tubes.

7. Types of Tracheostomy Tube

- Cuffed tracheostomy tube

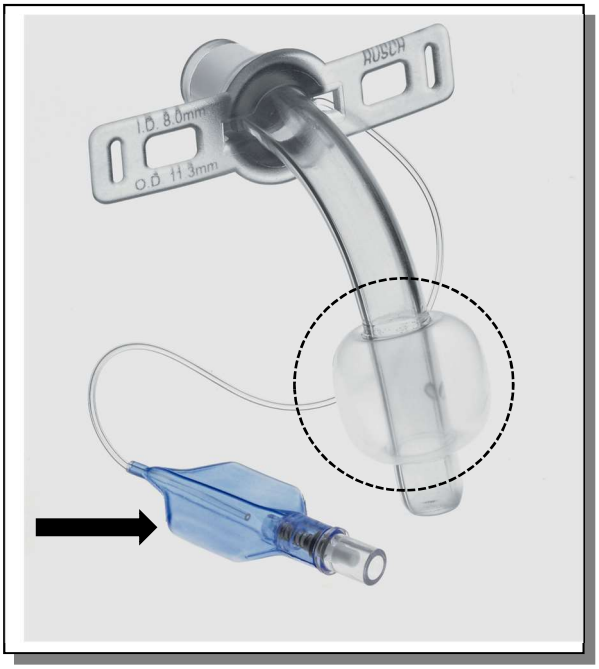

Figure 2: Cuffed tracheostomy tube

Note the balloon cuff (dotted circle) with attached pilot balloon (arrow).

- Uncuffed tracheostomy tube

Figure 3: Uncuffed tracheostomy tube

Note the absence of balloon cuff and pilot balloon.

- Double-cannula (double-lumen) tracheostomy tube

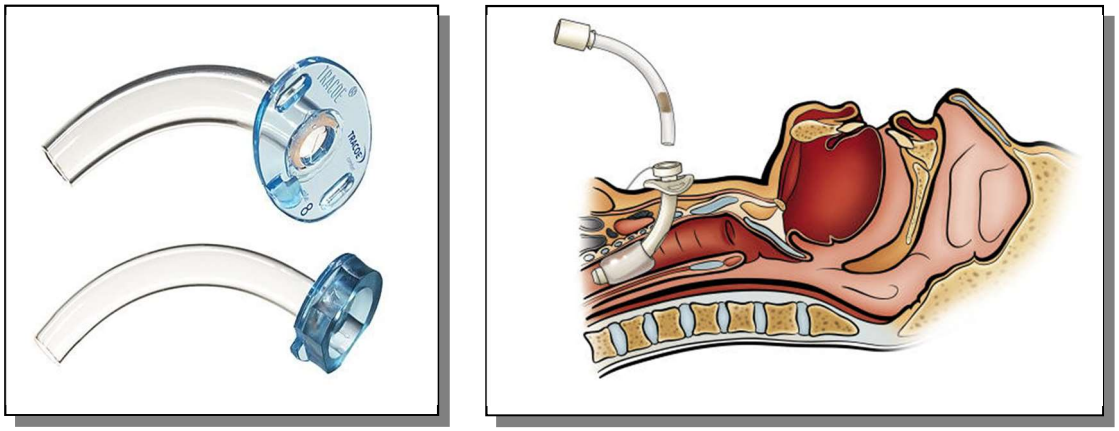

Figure 4: Double-cannula (double-lumen) tracheostomy tube

Note that the inner tubing can be removed for cleaning purpose without removing the outer tubing, allowing easier tracheostomy care.

- Fenestrated tracheostomy tube

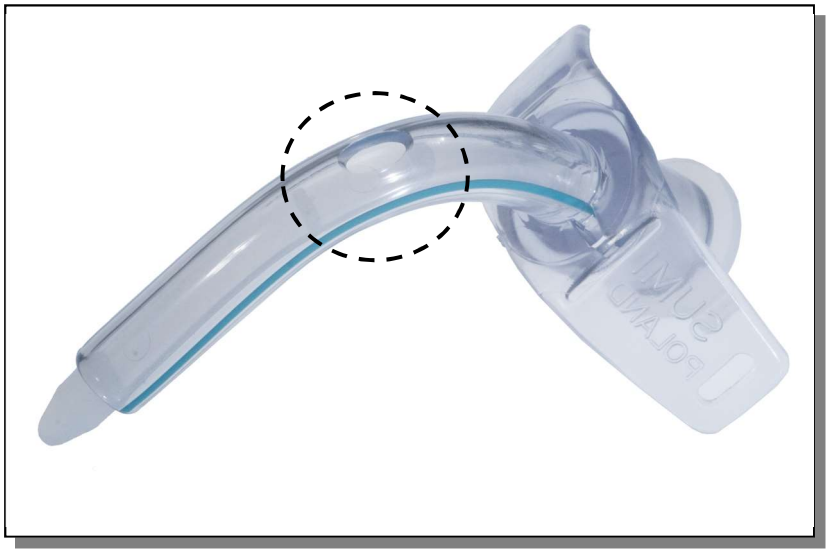

Figure 5: Fenestrated tracheostomy tube

Note that the fenestration on the tubing (dotted circle), to allow respiration via patient's own upper airway.

- Tracheostomy tube with adjustable flange

Figure 6: Tracheostomy tube with adjustable flange

Note that the flange position of the tube can be adjusted according to need for patient.

8. Parts of a Cuffed Tracheostomy Tube

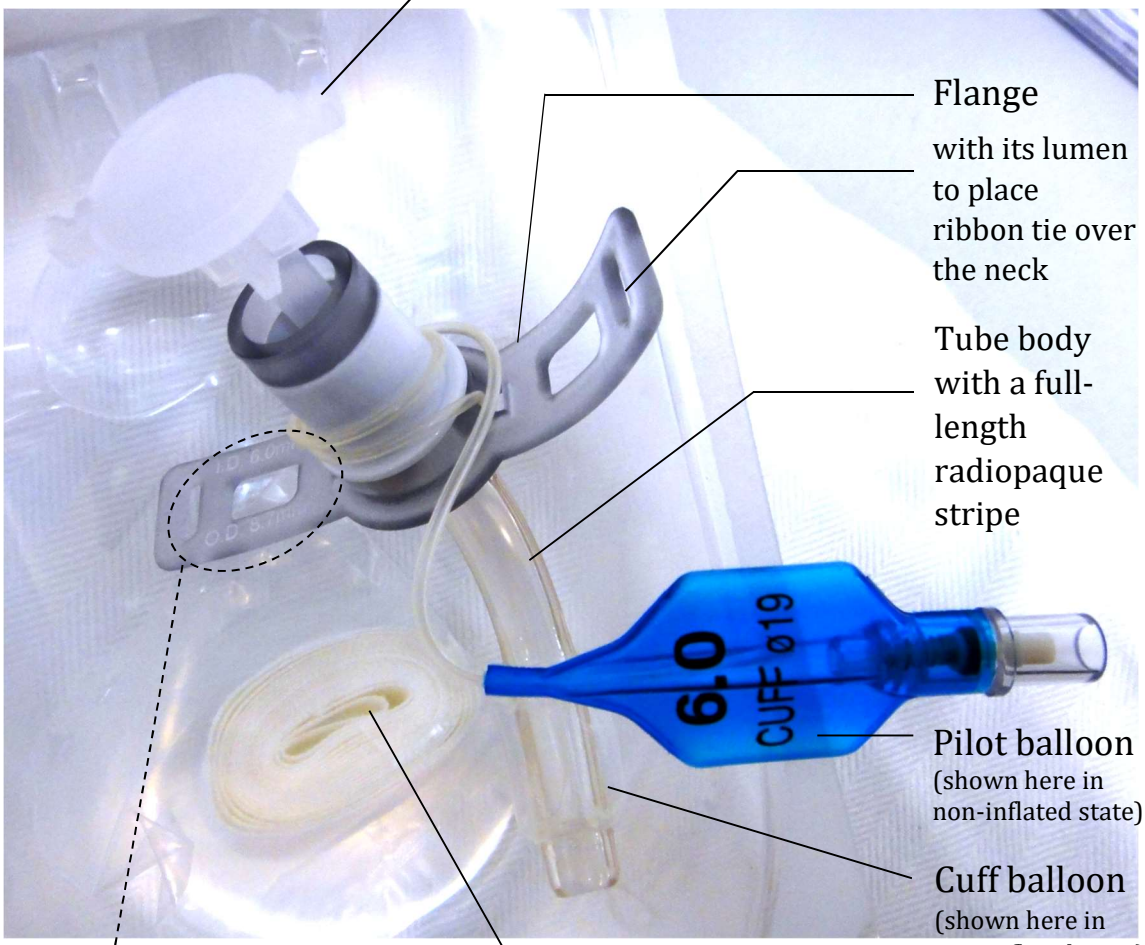

Figure 7: A cuffed tracheostomy tube.

9. Post-tracheostomy tube check

- Check that the tape tension is appropriate (not too tight as to cause pressure ulcers and not too loose as to make the tube not secured properly, especially considering the weight of ventilation circuit tubing).
- Observe any neck swelling (surgical emphysema).
- Check for air entry through the tube. Place your finger above the tube opening and feel for a passage of air.
- Inspect the chest for bilateral chest movement.
- Auscultate the chest for equal air entry (to look for any pneumothorax or to adjust tube position).
- Chest X-ray post-tracheostomy when clinically indicated.
- Haemorrhage: may be primary, reactionary or secondary; a massive haemorrhage may be fatal.

**Special consideration in children:

- Make sure lateral stay sutures clearly marked right and left, kept in situ and intact for at least one (1) week. The stay sutures are not to be removed before day-7 post tracheostomy (Figure 8).
- For patients with maturation sutures, leave the sutures in situ.
- Document the tracheostomy tube size and type, with the pre-measured depth for suctioning charted on the patient's bedside charts.
- Two spare tracheostomy tubes (same size and one size smaller) are to be prepared at the bedside, with instruments for tracheostomy tube change available.

Figure 8: The stay sutures marked on the right and left sides.

10. Methods to ensure patency of a tracheostomy tube

- Feel the gush of air from the tracheostomy tube.
- Place a mirror or cold metal spatula opposite the opening of the tracheostomy tube and observe for vapour or mist formation.
- Place a wisp of cotton opposite the tracheal opening and observe the movement of the cotton wisp.

** Ward staff is advised to check the patency of the tracheostomy tube at least twice a day, always check oxygen saturation and evaluate air entry during the evaluation of tracheostomy tube patency.

11. Suctioning methods for tracheostomy tube

- Hyper-oxygenate the patient before suctioning (except for COAD patients).
- Insert the suction catheter into the tracheostomy tube without applying any suction pressure.
- The length of the suction catheter inserted is limited to 0.5cm longer than the length of the tracheostomy tube only; do not insert the suction catheter too deep beyond the tracheostomy tube into the trachea as it would cause irritation and subsequent granulation tissue formation (Figure 9 and Appendix 2).
- If the patient has excessive secretions, do chest percussion before suctioning.
- If excessive crusting or secretion is thick, instil a few drops of sterile normal saline or nebulized saline into the tracheostomy tube to soften the secretions prior to suctioning.
- Do not perform continuous suction for more than 20 seconds at any one time; prolonged suctioning can cause hypoxia.
- For a double-lumen tracheostomy tube, the manufacturer recommends a change every 29 days; however, due to socio-economic considerations, the change can be delayed up to 90 days depending on the condition of the tube.
- Tracheostomy tubes, if they need to be cleaned, should only be soaked with normal saline or mild soapy water and rinsed thoroughly before usage.

Figure 9: Measuring the correct suction tubing length which should not extend >5mm past the tip of the tracheostomy tube.

12. Management of a blocked tracheostomy tube

- In patients under mechanical ventilation or with spontaneous breathing, to commence 100% oxygen and pass a suction catheter into the tracheostomy tube and do suctioning.
- If excessive lung secretion is the cause of the block, perform tracheostomy tube suctioning alternating with hyperoxygenation.
- If there are thick secretions, a few drops of sterile normal saline (0.9% NaCl) can be instilled or nebulised and allowed to flow along the inner wall of the tracheostomy tube; this may be used to help clear up thick secretions.
- If suctioning is not helpful due to very thick secretions, change to another tracheostomy tube immediately, the same size or one size smaller, as the tube may already be partially-blocked.
- Where available, flexible bronchoscopy can be performed through the tracheostomy tube to aid in assessment.
- If all the above steps fail, consider reintubating the patient immediately.

13. Management of dislodged tracheostomy tube

- Always look for red flags of a dislodged tracheostomy tube:
  i) abnormal position of the tube
  ii) the flange is lifted away from the neck (Figure 10)
  iii) a suction catheter cannot go in adequately
  iv) no or reduced air entry on auscultation
  v) no or low tidal volume on the ventilator
  vi) audible voice in non-ventilated patients

- For a partially dislodged tube, attempt to re-position the tube and check for tube patency; auscultate the lung for air entry and the presence of good tidal volume.
- If the above method fails or the tube is totally dislodged, change to another tube immediately, of the same size or one size smaller.
- If all the above steps fail, consider reintubating the patient immediately.

Figure 10: Flange is lifted away from the neck in a partially dislodged tube.

14. Tracheostomy care for ventilated patients

- Maintain the patient using a cuffed tracheostomy tube while the patient is mechanically ventilated (except for paediatric patients).
- Regular, gentle suctioning.
- Change the keyhole dressing whenever it is soiled.
- Monitor cuff pressure (using a pressure gauge, if available) regularly to avoid over- or under-inflating the cuff.
- Remove any securing (except stay sutures in paediatric patients) and wound sutures on day 5-7 post-operatively.
- Where available, flexible bronchoscopy through the tracheostomy tube can be performed from time to time to ensure the patency of the airway distal to the tracheostomy tube tip.
- Once the patient no longer requires mechanical ventilation, deflate the balloon cuff as soon as possible and then change to a non-cuffed tracheostomy tube.
- Utilise a humidifier for wall oxygen to avoid drying and crust formation.

15. Tracheostomy care for non-ventilated patients

- Deflate the tracheostomy tube cuff 24-hours post-operatively.
- Change to a non-cuffed tracheostomy tube 3-5 days post-operatively.
- Regular, gentle suctioning.
- Change the keyhole dressing whenever it is soiled.
- Remove any securing and wound sutures on day 5-7 post-operatively.
- Utilise a humidifier for wall oxygen to avoid drying and crust formation.
- Feeding can be initiated 6 hours post-operatively, provided there is no risk of aspiration.

16. Tracheostomy care at home

- It is important to educate the patient and his or her caretaker about basic stoma care before the patient is discharged home.
- Keep the skin around the stoma clean and dry; this will help with healing and prevent infection.
- A home suction machine is preferable for regular stoma suctioning (if the patient is discharged with single lumen tracheostomy tube).
- Stoma care should be done every morning, in the evening, and as needed.
- Tracheostomy care supplies to be kept at a handy location: normal saline, a paper cup, cotton bud swabs, mirror, clean tweezers or forceps, a flashlight, a pair of scissors, and a secure tie (Figure 11).

Figure 11: Tracheostomy care supplies should be kept in a handy location at the patient's home.

- Dip a cotton swab in normal saline poured into the cup, then clean the stoma.
- Tweezers may be used to clean hard-to-reach or hard-to-remove crusts.
- Inspect the stoma daily for any redness, swelling, or discharge. The patient is advised to seek medical attention if any of these signs are noticed.

- Single lumen tracheostomy tube changes should be done once every 2 weeks with a clean spare tube; change more frequently if there are copious, thick secretions.
- Another alternative is to use a double-lumen tracheostomy tube; the patient just needs to regularly clean the inner tube without taking out the outer tube.
- Instruct the patient to go to the nearest medical facility immediately if there are any signs of airway difficulty or undue difficulty re-inserting the tracheostomy tube.

** Special consideration in children:

- Before the patient is discharged, parents or caretakers must be trained in the use of the equipment, tracheostomy care, early detection of complications, and appropriate measures for handling airway emergencies.

17. When to change a tracheostomy tube?

- First tracheostomy tube change, preferably after 3 days post-operatively (when the tract is well-formed).
- Start regular changing of the tracheostomy tube. One (1) week post-operatively, followed by every fortnight (2 weeks) for non-ventilated patients for single lumen tubes.
- Change more frequently (weekly or twice per week), if copious and thick secretions.
- For double-lumen tubes, the manufacturer recommends a change every 29 days; however, it can be delayed by up to 90 days for socio-economic considerations.
- Change the tube immediately when blocked.

18. Preparations to change tracheostomy tube:

- **Instruments** required:
  - suction instruments
  - tracheal dilator
  - a clean tracheostomy tube of the same size and 1 size smaller
  - string to tie the tracheostomy tube
  - scissors
  - gloves
  - gauze for keyhole dressing
  - water-based lubricant gel
  - apron
  - special dressing for skin protection (optional)

- **Illumination** required:
  - headlight, or
  - bedside lamp, or
  - torch light

- **Assistant** must be present at all time.

- All wards should have an emergency tracheostomy nursing box readily available, comprising the above-mentioned items.

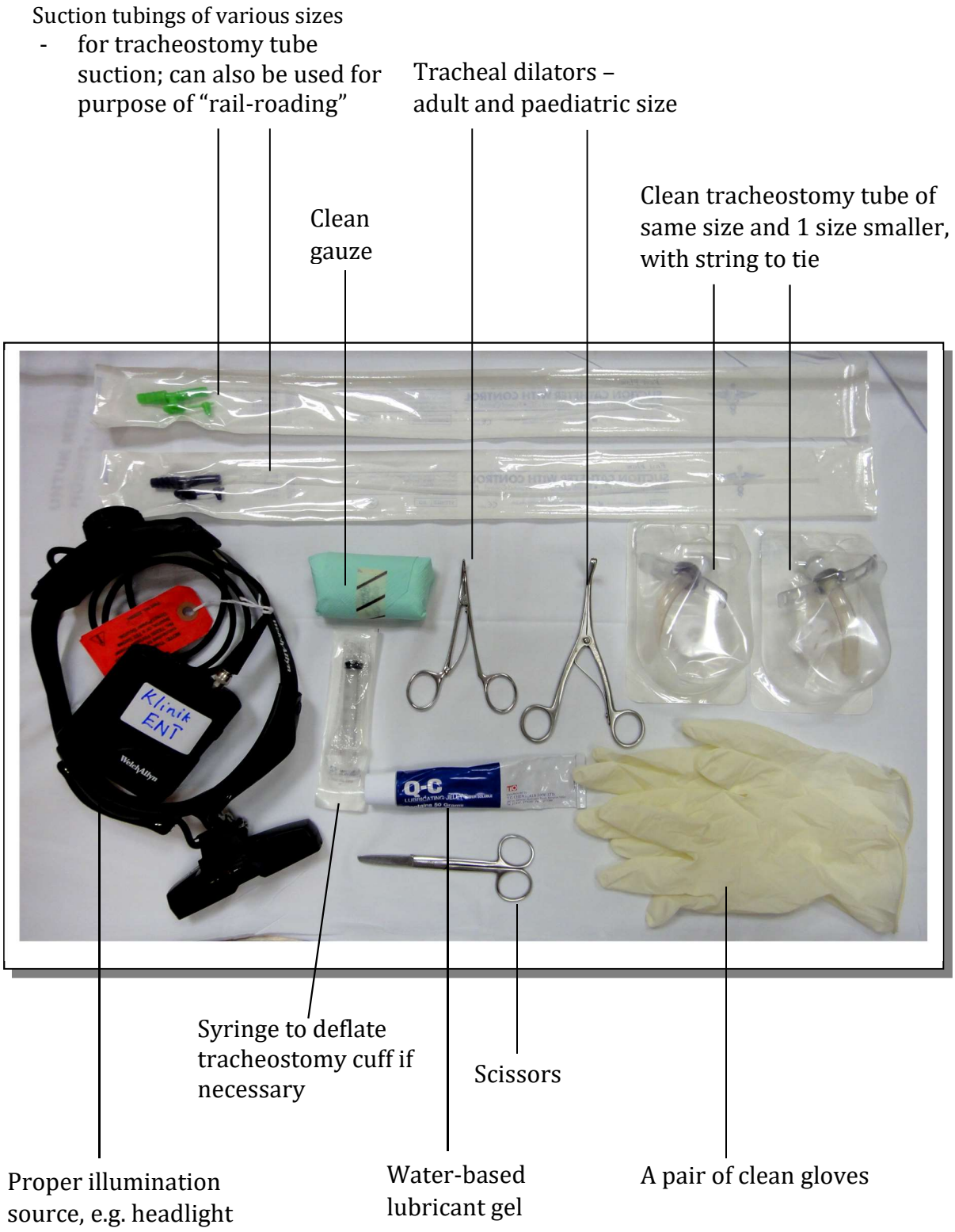

Figure 12: Instruments to be prepared for tracheostomy tube change.

19. How to change a tracheostomy tube?

- Prepare the apparatus needed; similar sized and one-size-smaller tracheostomy tubes, a suction machine with a catheter, a tracheal dilator, gel and a dressing set.
- Wear a headlight; if not available, an assistant can help with a good bedside lamp or torchlight.
- Protect oneself with an apron and mask.
- The preferred position is supine with the neck hyperextended (with a rolled-up towel inserted beneath the shoulders).
- Hyper-oxygenate the patient if the patient is on a mechanical ventilator.
- Do tracheal suction for any secretions.
- Deflate the tracheostomy tube cuff fully.
- Untie and remove the existing tracheostomy tube.
- Insert the new tracheostomy tube with the help of a tracheal dilator if the tract is not well-formed.
- Railroad changing of the tracheostomy tube is advisable in difficult tracts, especially for the first tracheostomy tube change.
- Hold the new tube firmly, check the patency and promptly secure the tracheostomy tube with a ribbon tie.
- For paediatric patients, additional steps include:
    - pull apart the lateral stay sutures (if present)
    - gentle suctioning

20. Weaning off the tracheostomy tube:

- Weaning off the tracheostomy tube can be considered when it is no longer needed, based on the following criteria:
    - airway patency is regained
    - the lung condition has been optimised
    - the patient has good cough reflex (no longer needs tracheostomy tube for bronchial toilet)
    - Comorbidities affecting the need for tracheostomy, including cardiac, pulmonary, and neurological conditions, have been optimised
    - there are no additional GA procedures planned in the near future

**Special consideration in children:
Formal airway assessment (e.g. direct laryngoscopy and bronchoscopy) is indicated in most paediatric patients prior to decannulation.

- Weaning procedure for patients deemed fit:
    i. spigotting of the downsized tube should be done during office hours on the first day
    ii. the second day, the downsized tube is spigotted for 24 hours
    iii. the optimal time for decannulation is usually in the morning
    iv. the patient should be instructed to apply gentle pressure with their fingers over the site when the tracheostomy tube has been removed
    v. after decannulation, the patient should be closely monitored in the ward following decannulation for 24 hours with oxygen saturation monitoring
    vi. the stoma should be covered with a semi-permeable dressing
    vii. stomas are not sutured and are allowed to contract and heal unaided

21. Tracheostomy in Tuberculosis (TB) & other infectious diseases.

- Ideally, all health care workers (HCW) handling TB patient should wear at least N95 disposable mask/respirator or 3 ply face mask (if N95 not available).

- Do not use valved or positive-pressure respirators because they do not protect the sterile field.

- Postpone non-urgent surgical procedures on TB patients until the patient is determined to be non-infectious.

- Procedures should be scheduled for patients with suspected or confirmed TB disease when a minimum number of HCWs and other patients are present in the surgical suite and at the end of the day to maximise the time available for the removal of airborne contamination.

- Air-cleaning systems can be placed in the room or in surrounding areas to minimise contamination of the surroundings after the procedure.

- Post-operative recovery of a patient with suspected or confirmed TB disease should be in an airborne infection isolation (AII) room in any location where the patient is recovering.

- If an AII or comparable room is not available for surgery or postoperative recovery, air-cleaning technologies can be used. However, the infection control committee should be involved in the selection and placement of these supplemental controls.

* In other infectious diseases, such as the Human Immunodeficiency Virus (HIV), all HCW handling the patient should follow "Blood and Body Fluid Precautions". (i.e. wearing gloves, a surgical mask, protective eyewear, or face shields and gowns).

22. Tracheostomy in COVID-19 patient

- The indication and appropriateness of tracheostomy need to be reconfirmed. Wherever possible, the procedure should be delayed until COVID-19 status is confirmed or seronegative conversion is achieved, unless deemed required.
- The procedure is best done in a negative pressure room in an ICU or operating theatre, where feasible. An adequate PPE isolation facility is pertinent to meeting the requirements for airborne, droplet, and contact precautions. The use of a Powered Air-Purifying Respirator (PAPR) device is highly recommended in the tracheostomy of COVID-19 positive and PUI patients to ensure HCW safety.
- Preparation of the "Tracheostomy Grab Bag," comprising a tracheostomy changing set including:
    - tracheal dilators
    - headlight
    - sterile gloves
    - cuffed, non-fenestrated tracheostomy tubes of appropriate sizes
    - Heat and Moisture Exchange Filter (HMEF)
- The Grab Bag is to be made readily available and stored in a designated zone and made known to all members of the team during the post-operative period. The grab bag should be checked and restocked regularly.
- A minimum PPE requirement includes (whenever Powered Air-Purifying Respirator (PAPR) device is not readily available):
    - double-layered disposable gloves which are changed for each patient
    - gowns: double gowning, fluid barrier protection
    - masks: FFP3 or N95
    - full-face visors or goggles for eye protection
    - disposable surgical cap
    - shoe covers
- Long term non-fenestrated cuffed double lumen silicone tube is recommended.
- Step by steps procedure when performing tracheostomy in COVID-19 patients (Appendix 5) and the postoperative care (Appendix 6).

23. Percutaneous Tracheostomy in the General Intensive Care Unit (GICU)

Percutaneous tracheostomy is performed as an elective bedside procedure in the ICU. It is commonly performed by a trained anaesthetist, intensive care trainee, or intensivist to facilitate weaning from mechanical ventilation. Surgical tracheostomy is usually performed by the ENT team in the Operating Theatre (OT) and is reserved for patients with contraindications to the percutaneous approach. Percutaneous tracheostomy is not for emergency airway access.

Technique

The most common technique used is the Seldinger-based technique using a single graded dilator on a guidewire. An additional approach to guiding tracheostomy placement may include using a flexible bronchoscope or ultrasound guidance.

Indications

a. Airway protection
   i. Poor GCS
   ii. Secretion management

b. Weaning from mechanical ventilation
   i. Prolonged dependence on artificial ventilation whether actual or anticipated

Contraindications

a. Absolute
   - Abnormal or distorted anatomy
   - Bleeding disorder or coagulopathy with potential active bleeding during or post-procedure
   - Children age < 15
   - Site infection
   - Previous tracheostomy
   - No consent

b. Relative
   - Difficult landmark/airway (short neck, obesity, overlying vessels)
   - Unstable cervical spine injury
   - Thrombocytopenia (Platelet count < 50,000)
   - High ventilator settings (Fio2>0.6, PEEP >10cmH20)

Consent

Informed consent must be obtained and documented prior to the procedure.

Complications and management

a. Bleeding
   - Most common complication, especially in patients with bleeding tendencies. Rarely life-threatening. Constitute up to 8% of complications following percutaneous tracheostomy.
   - Any exploration of a newly performed tracheostomy (<72h) must be carried out in the Operating Theatre (OT) after consultation with the anaesthesiologist or intensivist.
   - Management:
     - Ensure a platelet count > 50,000; transfuse platelets if necessary.
     - Maintain an INR of 1.5 and an aPPT of 50s.
     - Enforce site dressing.
     - Exploration by the ENT team in Operation Theatre (OT) if bleeding persists

b. Airway injury
   - Most serious complications include posterior tracheal wall tear, pneumothorax, or subcutaneous emphysema. Fractures to the tracheal ring or cricoid cartilage have also been reported. If undetected early, it may lead to tension pneumothorax and hypoxemia or hypoxia.
   - Trachea-oesophageal fistula (TOF) and aspiration pneumonia are possible long-term sequelae.

- Management:
  - Bronchoscopic guidance for needle and guidewire insertion into the tracheal lumen in actual or potentially difficult cases.
  - CXR post-procedure to confirm tracheal tube placement or to rule out an air leak i.e. pneumothorax, subcutaneous emphysema.
  - Orotracheal reintubation is recommended if placement of a tracheal tube is in doubt.
  - Urgent referral to the thoracic team if a tracheal wall injury is suspected.

c. Loss of airway
  - Include accidental decannulation of the tracheal tube or obstruction of the airway by either a blood clot, sputum plug, or herniated tracheostomy tube cuff. May result in failure to ventilate or oxygenate.
  - A newly inserted tracheostomy tube (<72h) has not formed a tract to allow direct re-cannulation. Therefore, orotracheal intubation is the safest option to re-establish airway patency. If orotracheal intubation fails, a supraglottic airway device is recommended to temporarily secure the airway until a definitive device is established in the Operating Theatre (OT).

Operator or supervisor

- The operator should be a qualified intensivist or anaesthetist. A percutaneous tracheostomy performed by an ICU trainee requires supervision by the intensivist.

- An additional doctor familiar with airway management is responsible for maintaining a patent airway at all times during the procedure. He or she is also responsible for sedation and monitoring of the patient and is capable of handling the airway in the event of an airway emergency. The intensivist or senior anaesthetist should be available to provide immediate assistance during the entire stage of the procedure.

Equipment

- This must include equipment for emergency management of the airway and devices for difficult airways.

- A functioning flexible bronchoscope and video laryngoscope must be readily available.

- Monitoring devices include:
  - Pulse oximetry.
  - Blood Pressure.
  - Pulse rate and ECG.

- Capnography to confirm ventilation and the correct placement of the tracheostomy tube.

Post-procedure care

- Immediate care after the procedure includes close monitoring for complications.

- A chest X-ray should be taken to confirm placement and rule out complications such as pneumothorax, lung collapse, or aspiration pneumonia.

- The nursing staff must be trained to care for the patient, particularly during mobilisation and sponging to prevent dislodgement.

- Collaboration with the ENT team for post-tracheostomy care and follow-up when the patient is discharged from the ICU is encouraged, depending on the local hospital setting.

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Appendix 1

Bedside quick reference algorithms for tracheostomy nursing care
(*to be filled up and placed on the bed head of all inpatients with tracheostomy)*

THIS PATIENT IS ON TRACHEOSTOMY

Name:

Patient ID:

Indication of tracheostomy:

Tracheostomy tube size:

Type of tracheostomy tube: Cuffed / Non-cuffed

Status of airway above the tracheostomy site: Patent / Non-patent

Appendix 2

Suggested depth of suctioning according to size of tracheostomy tube (*Portex*)

Tube size (mm)	Depth of suctioning (cm)
2.5	6.5
3.0	6.5
3.5	7.0
4.0	7.5
4.5	8.0
5.0	8.5
5.5	8.5
6.0	9.0
6.5	9.5

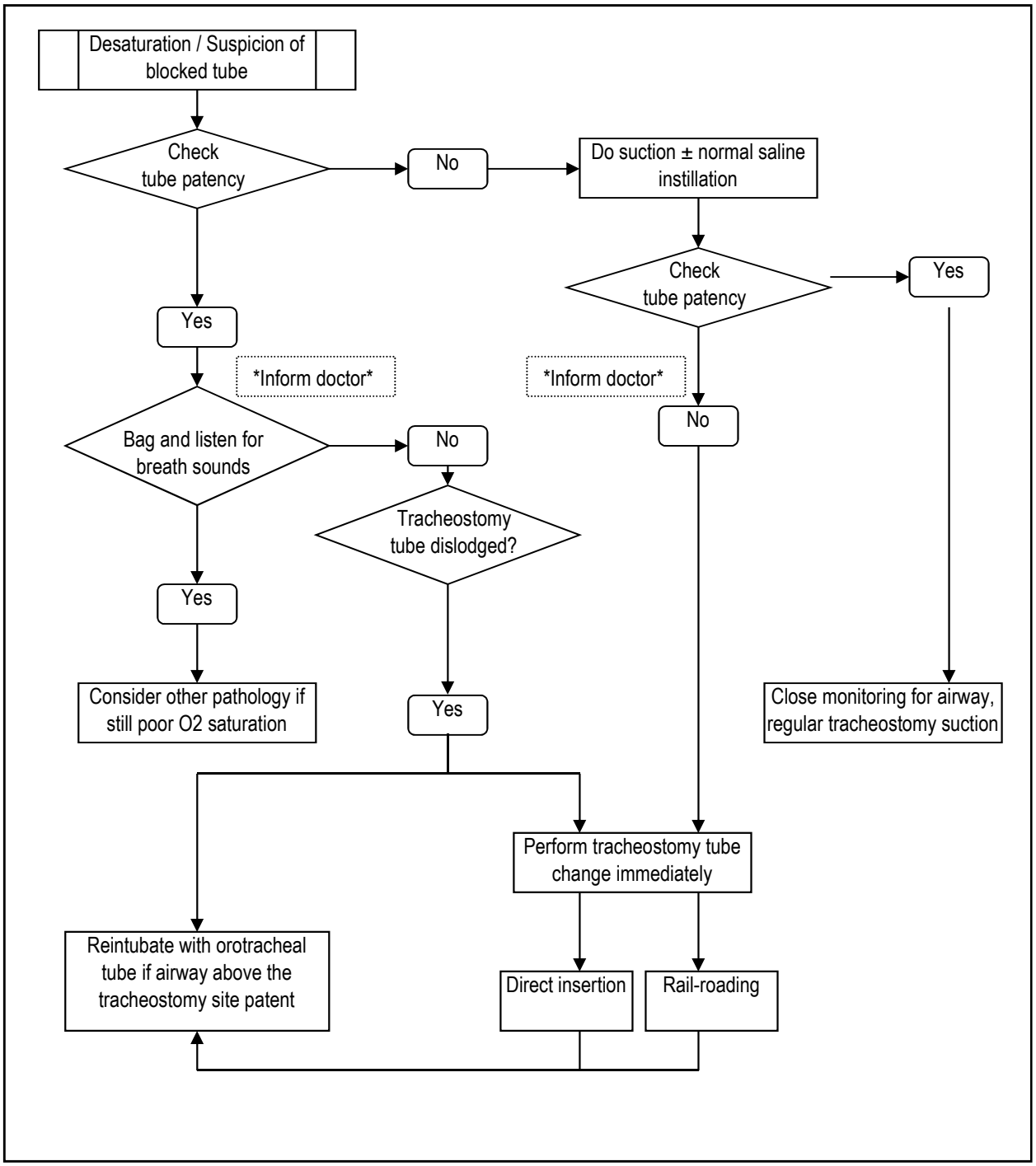
Appendix 3

Tracheostomy standby set *(please tick in the boxes after checklist review)*

Item	Availability (√ / X)
Spare tracheostomy tube same size	
Spare tracheostomy tube 1 size smaller	
Lubricant – water-based	
Round-ended scissors + tape	
Suction catheter (small size or smaller than the known internal diameter of tube needed for suctioning)	
Clean glove	
Clean gauze	
Tracheal dilator available in ward emergency trolley	

Appendix 4

Tracheostomy care flow chart



Appendix 5:

STEP BY STEP RECOMMENDATIONS WHEN PERFORMING TRACHEOSTOMY IN COVID-19 POSITIVE or PUI PATIENTS

Equipment

- Prepare PPE for operating and anaesthetic team.
- Defog the personal eyeglasses and goggles/face shields.
- The surgeon and assistant don a full PPE and perform "buddy check"
- Don additional protective gear or Enhanced PPE (e.g PAPR)
- Prepare equipments and layout of tracheostomy trays.
- A 10ml syringe and a mount-catheter are attached to the tracheostomy balloon readily for inflation and preloading the HME onto the inner tube.
- A closed in-line suction must be used for endotracheal tube (ETT) and tracheostomy tube

Operative Steps

- A standard open tracheostomy procedure approach through a horizontal neck incision is undertaken.
- A tie suture or LigaClip is preferred for hemostasis to diathermy to prevent production of vapor containing viral particles (4, 5).
- Inform anaesthetist before opening the trachea, to allow preparation of optimum preoxygenation with PEEP.
- When the oxygenation is adequate, the surgeon is informed and ventilation is ceased upon opening the trachea.
- The ETT is then clamped and level of cuff advanced inferiorly beyond the proposed tracheal window.
- The cuff is then hyperinflated to ensure no leakage/aerosolization from lower airway present.
- Upon incision of trachea, the anaesthetist will immediately turn off flows and allow time for a passive expiration with an open adjustable pressure-limiting (APL) valve.
- Tracheal window created, rather than slit incision.
- Patient is required to be in total paralysis throughout the procedure to reduce the risk of coughing and aerosolization intraoperatively.
- Deflate ETT cuff and drawback proximal to the tracheal window under direct vision
- Ensure window is of sufficient size to allow easy insertion of tracheostomy tube without injury to cuff and confirm the placement by presence of end-tidal CO2 (ETCO2).
- Suction should be performed immediately following tracheostomy tube insertion to ensure the ventilation is not impeded by secretion.
- All suction is advisably through the elbow port of mount catheter to minimize aerosolization.

Circuit Connection and Secure

- Immediate inflation of tracheostomy tube cuff and prompt attachment of circuit and resume ventilation.
- Confirm position with ETCO2, thus avoiding contamination of stethoscope by auscultation.
- Withdraw clamped ETT carefully.
- Secure tube with sutures, tracheostomy tapes and apply appropriate dressing.
- Meticulous doffing of the PPE as per the guidelines.

Appendix 6

POST OPERATIVE CARE

Nursing Care:

- Post operative tracheostomy nursing care is vital in COVID-19 patient to ensure tube patency and disease containment.
- Avoid the use of humidified oxygen.
- Heat and moisture exchanger filter (HMEF) with viral filter capacity is preferred.
- The suction circuit is to be in closed-line at all times and the cuff pressure is checked periodically.
- The cuff should not be deflated until further review.
- The operative area is kept dry.
- Dressing application is only undertaken if there are signs of infection or bleeding.

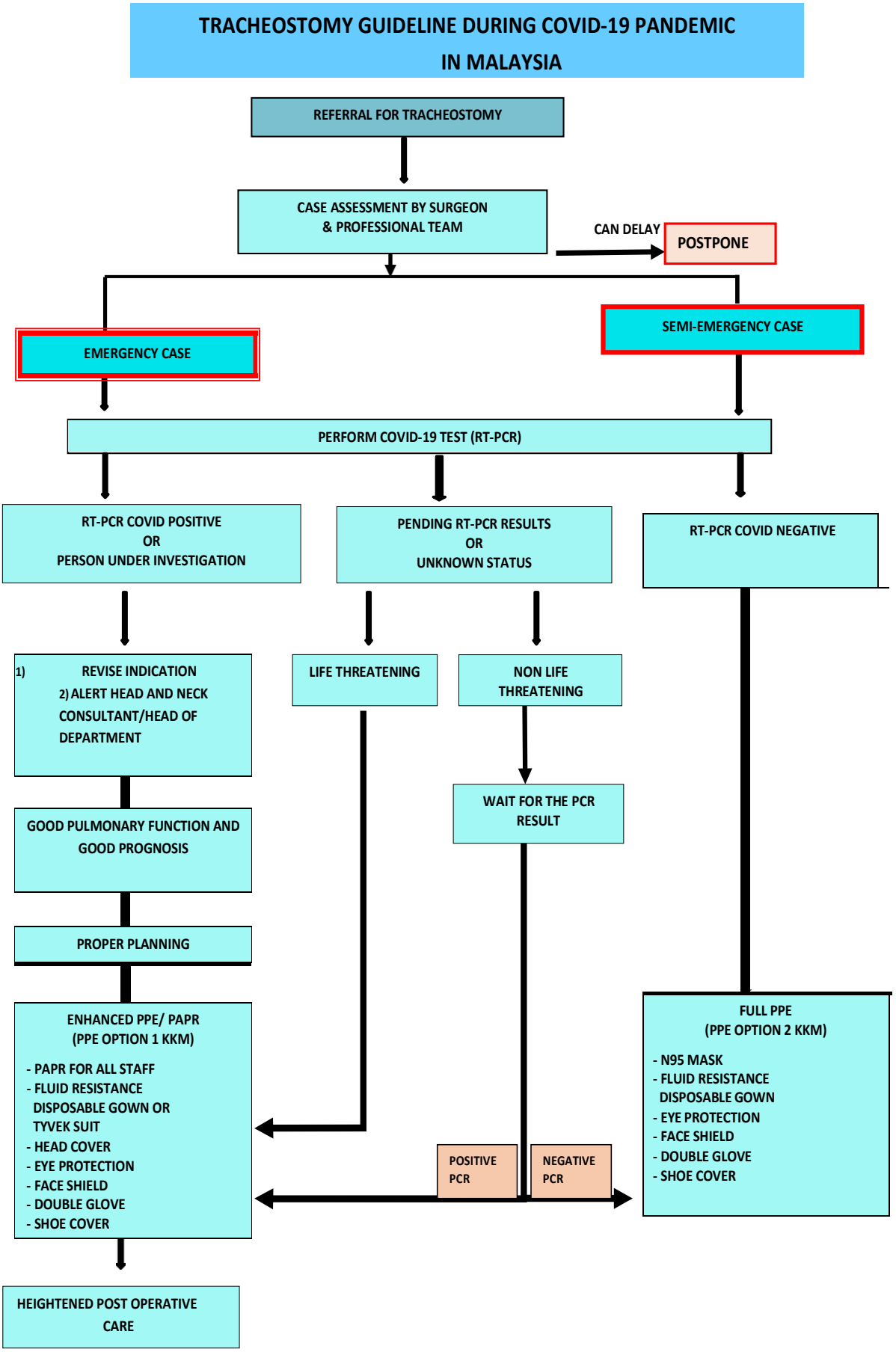
Tracheostomy Tube Change:

- The "Tracheostomy Grab Bag" is to be appropriately stocked and on standby at all times during tracheostomy change, or needed during emergency situations such as tube blockage and bleeding.
- The first tracheostomy tube change has to be delayed at 8-10 days and donning a full PPE. (6)
- The same sequence of pause in ventilation with flows off is to be adhered before deflating the cuff.
- This is followed by inserting a new tracheostomy tube with immediate re-inflation of cuff and reconnection of the closed-circuit.
- Subsequent tracheostomy tube change is planned at 30-day intervals.
- HMEF application on the tracheostomy tube is required to prevent aerosolization of the droplets.

Decannulation:

- The readiness for decannulation should be made according to a case to case basis.
- Decannulation is deferred until the patient is confirmed COVID-19 negative.
- Ideally, it is done in a dedicated COVID-19 ward with trained staffs.

Appendix 7


TRACHEOSTOMY GUIDELINE DURING COVID-19 PANDEMIC IN MALAYSIA
REFERRAL FOR TRACHEOSTOMY
CASE ASSESSMENT BY SURGEON & PROFESSIONAL TEAM
CAN DELAY
POSTPONE
EMERGENCY CASE
SEMI-EMERGENCY CASE
PERFORM COVID-19 TEST (RT-PCR)
RT-PCR COVID POSITIVE OR PERSON UNDER INVESTIGATION
PENDING RT-PCR RESULTS OR UNKNOWN STATUS
RT-PCR COVID NEGATIVE
1) REVISE INDICATION 2) ALERT HEAD AND NECK CONSULTANT/HEAD OF DEPARTMENT
LIFE THREATENING
NON LIFE THREATENING
GOOD PULMONARY FUNCTION AND GOOD PROGNOSIS
WAIT FOR THE PCR RESULT
PROPER PLANNING
ENHANCED PPE/ PAPR (PPE OPTION 1 KKM)
- PAPR FOR ALL STAFF
- FLUID RESISTANCE DISPOSABLE GOWN OR TYVEK SUIT
- HEAD COVER
- EYE PROTECTION
- FACE SHIELD
- DOUBLE GLOVE
- SHOE COVER
POSITIVE PCR
NEGATIVE PCR
FULL PPE (PPE OPTION 2 KKM)
- N95 MASK
- FLUID RESISTANCE DISPOSABLE GOWN
- EYE PROTECTION
- FACE SHIELD
- DOUBLE GLOVE
- SHOE COVER
HEIGHTENED POST OPERATIVE CARE

Ministry of Health
Malaysia