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# Standards for the care of adult patients with a temporary tracheostomy

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**STANDARDS AND GUIDELINES**

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Ratified by ICS Council: July 2008  
Review date July 2011

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# 1. Introduction

Tracheostomy is a common procedure in intensive care. As with all procedures, the benefits are associated with risk, both during and after insertion. The most common problems, in both general wards and critical care, are related to obstruction or displacement. Recent developments have increased the significance of these issues for the NHS: longer-term respiratory support for a range of conditions, the increased use of tracheostomy, and the drive to de-escalate intensity of care as soon as possible.

Historically, the indications for temporary tracheostomy in the intensive care environment have centred upon treatment for upper airway obstruction, the avoidance of the laryngeal complications of prolonged tracheal intubation and the continued need to protect and maintain the airway in patients with severe neurological injury. More recently temporary tracheostomy has become regarded as beneficial for the general critical care population. This has coincided with the development of percutaneous techniques that enable a temporary tracheostomy to be inserted by the critical care physician as a bedside procedure. The result is that temporary tracheostomy has become a more commonplace, and frequently early, intervention in critical care units.

At the same time, pressure on intensive care beds and a desire to use resources effectively has encouraged earlier discharge to intermediate and ward care. The very effectiveness of tracheostomy in accelerating weaning from mechanical ventilation and discharge from level 3 care often results in patients with temporary tracheostomies being cared for in multiple locations throughout an organisation. This creates a risk that they are cared for separately from the clinical services that are best placed to identify and treat the potentially life threatening complications associated with a temporary tracheostomy. It is therefore very important that there is clear documentation and communication, together with explicit responsibility and training for the healthcare staff involved.

The main focus of this document is on the care of adult patients with temporary tracheostomies. This is the largest group of patients, but the standards should be applicable to patients in other situations. The authors acknowledge that there is limited evidence for many of the recommendations. To make the document useful, it has often been simplest to use trade and manufacturer names. This is for convenience, and the ICS is neither endorsing nor deprecating any particular product. The document is not intended to be a manual. For the sake of brevity, standard procedures (for example with regard to infection control) have been assumed. It has been produced in conjunction with the NPSA and staff may find it useful to also refer to the NPSA website for sample policies and integrated care pathways. This is particularly the case for specific nursing procedures.

## 2. Insertion

A tracheostomy may be fashioned surgically or percutaneously (PCT), and as an emergency or elective procedure, for a range of indications. This document is primarily concerned with planned temporary tracheostomy in the critically ill, rather than emergency procedures for airway obstruction.

There is no conclusive evidence to justify recommending a surgical or percutaneous technique over the other [1, 2, 3]. The choice will be affected by available expertise, and individual patient characteristics. Surgical techniques are in the realm of the specialist surgeon and will not be further described. At present, intensivists using a percutaneous technique perform the majority of tracheostomies undertaken in the critically ill in the UK. Precise techniques are beyond the scope of a standards document and are covered in other publications but there are some important principles that should be covered, including:

- indications for the procedure, including indications for a surgical rather than percutaneous approach
- contra-indications and cautions
- issues surrounding consent (particularly since many patients will lack capacity)
- equipment and monitoring
- staffing issues, particularly relating to training and competence
- documentation, follow-up and audit

### 1. Indications for temporary tracheostomy

The only indication for an emergency tracheostomy is an obvious imperative to bypass an obstructed airway. The majority of tracheostomies on the ICU will be planned, and result from the perceived need for a (relatively) long term artificial airway. The timing of a 'planned' tracheostomy versus continued trans-laryngeal intubation is currently a matter for clinical judgement, and although the ICS is currently sponsoring a randomised trial [4] to assess the benefits of early or delayed tracheostomy, it is inevitable that individual patient factors will continue to influence timing to some degree. The recognised indications for tracheostomy in the critically ill are listed in the box below.

#### Indications for tracheostomy

- **to maintain airway;** e.g. reduced level of consciousness, upper-airway obstruction, intubation difficulties
- **to protect airway;** e.g. bulbar palsy
- **for bronchial toilet;** e.g. excessive secretions/inadequate cough
- **for weaning from IPPV;** e.g. patient comfort, reduction of sedation

### 2. Cautions and contraindications

In the absence of airway obstruction, the only absolute contraindication to either an open or percutaneous tracheostomy is severe local sepsis or an uncontrollable coagulopathy. More commonly, the clinician will be required to decide between the convenience of employing a percutaneous technique at the bedside and the potential benefits of conducting the procedure in the operating theatre (either surgically, or with the option to convert to an open surgical procedure should difficulties with a percutaneous approach be encountered), recognising the hazards associated with transfer to the operating theatre, and the declining general surgical experience in formal tracheostomies.

#### Cautions and relative contraindications to percutaneous tracheostomy

- **difficult anatomy:** e.g. morbid obesity, lack of neck mobility, proven or potential cervical spine injury, known difficult intubation, tracheal pathology, thyroid pathology, aberrant vessels, friable tissues, COPD with hyper-expansion or bullae
- **moderate coagulopathy**
- **proximity to site of recent surgery or trauma:** e.g. carotid endarterectomy, anterior cervical fixation, sternotomy, oesophageal drainage, burn
- **potential aggravated morbidity:** e.g. patients unable to tolerate cardiovascular or respiratory changes, such as those with unstable intra-cranial pressure (ICP) after brain injury
- **severe gas exchange problems:** e.g.  $FiO_2 > 0.6$  and  $PEEP > 10$  cm  $H_2O$
- **age:** children under 12 years of age

### 3. Provision of Information & Consent / Assent

Very few critically ill patients have the capacity to give informed consent during the acute phase of their illness, but attempts should be made to seek their understanding and approval where this is possible. The role of the next of kin in healthcare decision-making is being formalised under the new Mental Capacity Act (England and Wales) and the Adults with Incapacity Act (Scotland). Current directives from the GMC and Department of Health specify their involvement using Consent Form 4; '*Form for Adults who are Unable to Consent to Investigation or Treatment*'. This process requires provision of information on the nature of the procedure, proposed benefits, potential hazards and alternatives, ideally written and visual in the first instance, and an example of this is provided in Appendix 1.

### 4. Equipment and monitoring

#### a. tracheostomy equipment

There are a number of commercially available tracheostomy kits and tubes, which are constantly evolving, but those presently available all follow a similar principle. There is no evidence to justify recommending a particular product but tubes with an inner cannula are preferable. Clinicians who

find that a particular technique or product carries an increased risk of any particular complication, should notify the relevant authority. This should include the MHRA (Medical and Healthcare products Regulatory Agency, which incorporates the previous Medical Devices Agency, and regulates the manufacturers of medical devices), the NPSA. Reports to MRHA can be made on-line at [www.mrha.gov.uk](http://www.mrha.gov.uk). The choice of tracheostomy tube is discussed in the following section, but an important consideration in this section is whether the choice of kit inappropriately restricts the choice of tracheostomy tube to one which is not necessarily fit for longer term purpose. A key feature in minimising the trauma associated with tube insertion is close and even contact between tube and obturator, and a smooth tapered end to the tube, such that a wide rim does not create an impediment to entry within the trachea. There is increasing realisation that in many patients, particularly those with marked obesity, conventional length tracheostomy tubes are too short. The need for a longer adjustable flange tube should be assessed on an individual patient basis.

### **b. airway rescue**

Regardless of which percutaneous technique is chosen, clinicians must be prepared for the possibility of losing the airway during insertion and difficulties in re-securing it. Intensive care units must have a comprehensive 'difficult airway' trolley equivalent to that found in operating theatres, the completeness and availability of which is confirmed prior to performing a percutaneous tracheostomy. The contents of the trolley should include a range of tracheal tubes, laryngoscopes, bougies, airway exchange catheters, laryngeal mask airways and cricothyroid needles for emergency oxygen insufflation.

**All Critical Care Areas should have a Difficult Airway trolley**

### **c. monitoring**

Routine intensive care monitoring of ECG and oxygen saturation can be assumed for these patients. Invasive blood pressure monitoring should be in place, given the potential for abrupt changes in blood pressure with either administration of anaesthetic agents or the stimulation of the procedure. Capnography should be considered mandatory given the potential for accidental extubation, and subsequent need for re-intubation, assessment of the adequacy of ventilation with obstruction of the airway by a bronchoscope or as a leak develops, as well as for confirmation of correct placement. The limits of capnography in monitoring arterial PaCO<sub>2</sub> should be appreciated (particularly in the presence of air leaks, tube obstruction and lung disease) and an arterial line is also indicated for ABG analysis.

### **d. ultrasound**

Ultrasound is of value to identify blood vessels (the first marker of an anterior jugular vein in the line of the proposed stoma may be uncontrollable bleeding), the size of the thyroid and the tracheal rings. Unfortunately, ultrasound cannot be used to visualise within the trachea so it is somewhat limited for the actual cannulation procedure itself, particularly since this requires two hands, and the probe furthermore tends to obstruct the small operating field.

### e. endoscopy

Although there is no evidence that the routine use of endoscopy during the procedure is essential, it offers a number of potential benefits:

- confirmation of tracheal cannulation in the midline, between the tracheal rings, without cartilage fracture or posterior wall trauma
- confirmation from above that the tracheostomy tube is correctly sited with the cuff fully inside the trachea
- confirmation from within the tracheostomy tube that this is sitting within the tracheal lumen, orientated parallel to the tracheal walls and that there is no active bleeding into the trachea (any blood should be suctioned out)
- light enhancement to aid the identification of a deep-seated trachea,

The problems associated with endoscopy include:

- impairment of ventilation,
- increased risk of tube displacement during endoscopic manipulation
- expensive damage by the seeker needle

The preferable system for endoscopy is a large screen such that all present can see the procedure. The choice of flexible or rigid bronchoscope is open to the individual unit, but a rigid scope which can be fashioned to the curve of the tracheal tube is clearly resistant to puncture, and if designed for vision rather than suction, will have a significantly smaller cross-sectional area with less impediment to ventilation.

**Bronchoscopy should be available and its routine use may well be beneficial.**

## 5. The Environment

The basic requirements for a procedure with the known potential for complications include:

1. adequate space and lighting
2. sufficiently clean to support an aseptic approach
3. a bed capable of tipping and suitable for resuscitation
4. monitoring facilities
5. support staff, familiar with the requirements of the procedure and resuscitation
6. anaesthetic/emergency drugs and full resuscitation equipment including chest drains
7. access to x-ray equipment

## 6. Anaesthesia

Tracheostomy is a surgical procedure that requires adequate anaesthesia. Although it can be performed under local anaesthesia comfort for the patient and operating conditions are generally superior under general anaesthesia with paralysis and assisted ventilation. Levels of sedation and analgesia utilised to tolerate tracheal intubation and assisted ventilation in the average patient on ICU do not equate with general anaesthesia. The same care should be taken with prevention of



awareness as occurs in the operating theatre with adequate doses of intravenous or inhalational agents.

## 7. Staffing

Two trained medical operators are required, one to administer anaesthesia and related airway care and a second to perform the procedure itself. They must be supported by a third member of staff, who will frequently be a nurse, who is familiar with both the procedure and environment and able to support clinicians in the management of any complications that might develop.

The practitioner responsible for anaesthesia also has to manipulate and control the airway. Direct laryngoscopy should be performed prior to starting the procedure in order to assess the ease of translaryngeal re-intubation. If a difficult intubation is anticipated, due to pre-existing abnormalities or glottic oedema, which is very common in the ventilated patient, then active consideration should be given to how the patient could be re-intubated should the translaryngeal tube become displaced.

Percutaneous tracheostomy should only be performed by those competent in the procedure, or a doctor under direct supervision by a competent doctor. Every hospital should have a list of competent practitioners, and a training programme if appropriate.

**Two trained medical practitioners plus a third member of staff to assist is the minimum staffing. Hospitals should maintain a list of practitioners competent in the procedure.**

Expertise in this most interventional of anaesthetic/intensivist skills goes beyond the simple insertion of the tracheostomy tube and embraces anticipation, avoidance and competent management of complications. It is inevitable that such expertise can only be acquired with experience, but this principle should never be considered an excuse for exposing patients to potential harm from the relative novice. Any practitioner should be aware of all the potential complications and have a strategy to address these including knowing when to abort the procedure and seek assistance. The key elements for training for percutaneous tracheostomy are detailed in the box below.

- maximise use of simulation and cadaveric animal models
- demonstrate the procedure for the benefit of trainees
- systematically question the theoretical knowledge of trainees before allowing actual intervention,
- ensure appropriate patient selection and supervise the trainee
- consider beforehand the criteria for taking over the procedure, including the number of unsuccessful passes with a needle
- formally assess the performance and debrief the trainee
- clarify the point at which the trainee may carry out these procedures without direct supervision.

## 8. Tracheostomy Technique.

**A brief summary of technique for percutaneous tracheostomy is given here. It is not intended as a comprehensive manual, but defines standards.**

1. Tracheostomy 'Cockpit Check' including 'Right patient, right kit', consent, withholding of anticoagulation, stopping of NG feed.
  
2. Anaesthetic sequence;
  - a. Preoxygenate, induce anaesthesia, and paralyse the patient.
  - b. Ventilate with adequate PEEP and FiO<sub>2</sub> 1.0.
  - c. Optimise the position of the patient for access - extend the head by repositioning the pillow (or 'sandbag') under the shoulders.
  - d. Check the airway using direct laryngoscopy, aspirate any secretions within the pharynx and down the tracheal tube, and assess difficulty of re-intubation.
  - e. Pull back the tracheal tube under direct vision and re-secure so that the cuff lies within the larynx and the tip is at the level of the cricoid cartilage - or alternatively, consider the use of an LMA.
  - f. Assess position of a tracheal tube and anatomy of the trachea using an appropriate endoscope
  
3. Operator Sequence;
  - a. The Operator should wear sterile gown, gloves and surgical mask. Eye protection from aerosolised blood and respiratory secretions is recommended for both anaesthetist and operator.
  - b. Disinfect the skin, using 2% chlorhexidine or iodine preparations, for an area of at least 10 cm around the proposed incision site and apply surgical drapes. Ensure however that the anaesthetist can visualise and has access to the upper airway.
  - c. Ensure all essential equipment is available, functional, and laid out ready for use
  - d. The incision site should be chosen according to the shape of the patient's neck, rather than rigidly adhering to a quoted optimal level of T2-3. Most authorities recommend avoiding the cricoid and first ring due to risks of stenosis. Low stomas however increase the risk of erosion of great vessels in the thoracic inlet, are technically more difficult as the trachea becomes deeper and make tube changes more problematic. Furthermore, if the tube becomes wedged against the sternal notch on resumption of a neutral neck position, this causes difficulty and discomfort for the patient on swallowing. In practice therefore, decisions need to be individualised with documentation of the reason why a particular approach has been adopted.
  - e. Local anaesthetic with adrenaline 1 in 200,000 should be injected into the pre-tracheal tissues, but not in such a volume that the anatomy is distorted.

- f. The choice of skin incision or cannulation of the trachea as the first procedure is a matter of operator choice.
- g. The issue of blunt dissection with forceps is again a matter of operator choice. It may reduce the force required to cannulate the trachea and allows positioning of the needle tip between the tracheal rings prior to cannulation.
- h. Whatever technique of cannulation is chosen, the objective should be to achieve midline cannulation, between rather than through the tracheal rings. It should not be associated with such uncontrolled force that posterior wall trauma is generated.
- i. Needle entry into the trachea can be confirmed by aspiration of air or pulmonary secretions. If for any reason bronchoscopy has not been used, confirmation can be gained from attaching the capnograph lead and/or observing bubbles being generated on the hub of the needle during positive pressure ventilation if water/saline drops are placed there. **Regardless of method, verification of intra-tracheal placement is mandatory** to ensure that the tube is not inserted in an extra-tracheal position.
- j. Subsequent dilatation should apply progressive, controlled pressure between rather than through the tracheal rings. The exposed cartilage of fractured rings is a potent stimulation to the production of granulation tissue, with greater likelihood of subsequent stenosis. Bronchoscopic supervision can be very useful in avoiding this, and perforation of the posterior wall.
- k. The correct size of tracheostomy tube is usually determined by clinical examination prior to embarking on the procedure but occasionally the trachea will be far deeper than originally predicted. It is important to consider at this stage whether or not tube length needs to be revised.
- l. Even if dilatation has been correctly performed, it is possible to displace the tracheostomy tube particularly through excessive force. **It is vital therefore to confirm correct placement before IPPV leads to surgical emphysema or a pneumothorax, either by direct vision with a bronchoscopic or immediate use of capnography.** The limitations of chest auscultation, and pulse oximetry in a pre-oxygenated patient should be appreciated.
- m. Bronchoscopic assessment from above at this stage may also identify too short a tube if the cuff is seen to be impinging on the anterior tracheal wall. A longer-stemmed tube should be inserted instead.
- n. Bronchoscopy from above and through the new tracheostomy tube can also confirm the presence or absence of bleeding. Bronchoscopy can also assess the larynx for potential problems during weaning and decannulation.
- o. The wings of the tracheostomy can be sutured or taped or both.
- p. Chest X-rays are not routinely required if tube placement has been confirmed endoscopically and the procedure has been uneventful. There is little likelihood of either displacement or pneumothorax without obvious clinical signs.
- q. Following the procedure, ventilatory measurements and settings should be reassessed.
- r. The dose of analgesic and anaesthetic agents should be modified as appropriate.

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- s. Documentation of the process should be completed. This is an invasive procedure with recognised immediate and late complications. As a minimum, documentation should record the staff involved, the technique employed, the size and type of tube inserted, and difficulties or immediate complications and post-procedure instructions.

### 3. Tracheostomy tube types and choice

Ease of percutaneous insertion has become a major influence on the design of tracheostomy tubes and there is a trend for tracheostomy tubes to be incorporated into the percutaneous insertion kit. There is a risk that this may lead to the placement of inappropriate tubes in some patients. Although compatibility with the insertion kit is an important consideration, other factors must be taken into account when selecting the correct tracheostomy tube for a patient, even if this makes a percutaneous insertion more difficult, or impossible.

There is wide range of tubes available, with differing characteristics and clinicians need to recognise that, even for an individual patient, what is required of a tracheostomy tube may vary with time and changing clinical circumstances. Clinical staff must therefore make an informed choice of which to tubes to stock, and which to use for a particular patient.

**Tracheostomy tubes should be chosen taking account of patient and tube characteristics and not just the ease of insertion.**

The clinical factors to be considered when selecting a tracheostomy tube for a patient are listed in Table 3.1.

<b>Factor</b>	<b>Notes</b>
Respiratory function	Most temporary tracheostomies will be inserted whilst a patient is in an intensive care unit and still requiring some degree of positive pressure ventilation. As a standard, this will require the use of a cuffed tracheostomy tube (although it is recognised that long term mechanical ventilation can be delivered through an uncuffed tube).
Abnormal airway anatomy	Upper airway endoscopy following percutaneous insertion suggests that a standard tracheostomy tube may be anatomically unsuitable in as many as a third of adult patients. Obese patients may require a tube with an extended proximal length, whilst patients with fixed flexion abnormalities may not easily accommodate tubes with a fixed angulation.
Airway pathology	Localised airway pathology such as tracheomalacia, granuloma formation etc may on occasion necessitate the use of a tracheostomy tube that has a longer distal length than standard.
Compromised airway	Many patients can be weaned to decannulation without any need

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protection and weaning problems	to change from the cuffed tracheostomy tube that was initially inserted. In problematic cases however, it may be useful to consider options such as downsizing, to an uncuffed or fenestrated tube, or a tube with the option for sub-glottic aspiration of airway secretions. The introduction of a speaking valve may also aid swallowing and secretion control.
Obstructed / absent upper airway	Patients with an obstructed or absent upper airway are at particular risk should a tracheostomy become obstructed or misplaced. This has implications for both the choice of tracheostomy tube as well as the method by which the stoma is fashioned.
Clinical environment	Obstruction of a cuffed tracheostomy tube is a potentially life-threatening emergency. Wherever possible a dual cannula tube (i.e. a tube with an inner cannula) should be used, particularly for patients in HDU or ward environments who may not have immediate access to clinicians with emergency airway skills. Ward staff can change inner tubes easily and quickly to relieve obstruction with secretions.

The characteristics of the tube to be considered when selecting a tracheostomy tube for temporary use include:

- construction
- dimensions
  - internal and outer diameter (ID and OD respectively)
  - proximal and distal length (i.e. the length of the tube proximal and distal to its angulation)
  - shape and angulation
- compatibility with percutaneous insertion kit
- presence and nature of tube cuff
- presence of inner cannula (dual cannula tracheostomy)
- fixed versus adjustable flange
- presence of fenestration
- specialist features, e.g. low contour on deflation tight to shaft cuffs, subglottic secretion control systems, voice enhancement tubes etc

**It is essential that the staff caring for a patient with a tracheostomy know the type of tube in place at any time, and this should be clearly documented in the patient's notes.**

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## Construction

### Material

Tracheostomy tubes can be constructed of either metal or plastic, and thereby vary considerably in rigidity, durability and kink resistance. This may be clinically relevant.

Metal tracheostomy tubes are constructed of either silver or stainless steel, but are seldom used in the critical care environment, and will not be discussed further.

Temporary tracheostomies are constructed of polyurethane, polyvinyl chloride or silicone. Products made of polyurethane are more rigid than those constructed of silicone, whilst those of polyvinyl chloride construction are of an intermediate stiffness (although some become softer at body temperature).

### Shape

Many tubes have an inherent curvature or angulation; others are completely flexible and only assume a correct anatomical alignment through appropriate stabilisation at the stoma and the level of the cuff. Some flexible tubes are reinforced with a spiral wire in order to avoid kinking and airway obstruction. Whilst the design of some tracheostomy tubes has been modified to facilitate percutaneous introduction, others are only appropriate for insertion once a formal track has been formed (either surgically or through the prior placement of an alternative tube). Various aspects of the construction of some commonly used tracheostomy tubes are described in appendix 2.

### Dimensions

In most circumstances a tracheostomy tube is both described and selected on the basis of its size, or more specifically its diameter. This is simple in theory but may easily be confusing in practice.

**The European Standard** for the basic requirements and method of size designation of tracheostomy tubes are those defined by the International Standards Organisation in EN ISO 5366-1:2004. This standard requires that tracheostomy tubes are sized according to their functional internal diameter (ID) at the narrowest point, quoting the ID of the outer cannula for the case of single cannula tubes and the ID of the inner cannula for double cannula tubes, but only if this is required for connection to a ventilator or other breathing circuit. This has the potential to cause confusion: for example, the Portex® Blue Line Ultra® tracheostomy tube is provided with an inner cannula that sits flush within the outer tube and which is not necessary for connection to a ventilator circuit, it is primarily described according to the ID of the outer tube, even though the inner tube reduces the functional internal diameter by 1.5mm for tubes of 7mm ID upwards (Table 3.2). The standard also requires that machine end of the neck plate of the tube displays the size of the

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tracheostomy tube (i.e. the ID), the tubes outside diameter (in mm) and the name or trademark of the manufacturer.

**Most tracheostomy tubes are sized by internal diameter in millimetres, but this may not take account of inner cannula in all cases.**

Equivalent Jackson size (approx.)	ID without inner cannula (mm)	ID with inner cannula (mm)	OD (mm)	length (mm)
5	6.0	5.0	9.2	64.5
6	7.0	5.5	10.5	70.0
7	7.5	6.0	11.3	73.0
8	8.0	6.5	11.9	75.5
-	8.5	7.0	12.6	78.0
-	9.0	7.5	13.3	81.0
10	10.0	8.5	14.0	87.5

The dual cannula products from Shiley® are still primarily described according to the **Chevalier Jackson** sizing system originally developed for metal tubes (Table 3.3), although the appropriate information is available on the neckplate of the tube. Note also that, for a given ID, there can be considerable variation between manufacturers in the both the external diameter and length of their tracheostomy tube, an issue that may be of some clinical significance should (as commonly occurs) a transition from one tube to another be made.

**Tracheostomy tubes with the same internal diameter ('size') may have quite different external diameters and length.**

Jackson size	ID without inner cannula (mm)	ID with inner cannula (mm)	OD (mm)	length (mm) <sup>*</sup>
4	6.7	5.0	9.4	62 – 65
6	8.1	6.4	10.8	74 – 76
8	9.1	7.6	12.2	79 – 81
10	10.7	8.9	13.8	79 – 81

<sup>\*</sup> varying according to the precise model selected





### Choosing the correct size

#### Diameter

When selecting the size of tube for a patient, there is an unavoidable compromise to be made between a desire to maximise the functional internal diameter (and thereby reduce airway resistance and the work of breathing during weaning) and a need to limit the OD to approximately three-quarters of the internal diameter of the trachea (in order to facilitate airflow through the upper airway when the cuff is deflated). Furthermore, selection of a tube that is too small may result in the need to over-inflate the cuff, thereby increasing the risk of mucosal pressure necrosis, which in turn increases the risk of complications such as tracheal stenosis and tracheo-oesophageal fistula. A need to exceed the quoted nominal cuff volume is often an early indicator that too small a tube has been selected. As a general rule, most adult females can accommodate a tube with an OD of 10mm, whilst a tube with an OD of 11mm is suitable for most adult males.

**Need for excessive cuff volume or pressure suggests that the tube size may be too small or it may be misplaced.**

#### Length and shape

Although a temporary tracheostomy is most commonly selected on the basis of its diameter, there may be situations where the length, angulation or curvature of a tube is of relevance. Thus, whilst many tracheostomy tubes are smoothly curved, others are clearly angulated, thereby allowing a distinction to be made between the proximal (or horizontal) length of a tube (i.e. the distance between the neckplate and the mid-point of the angulation) and the distal length (i.e. the distance from the mid-point of the angulation and the tip). It should be appreciated that these respective lengths are quite short in standard tubes and may be too short even in the patient with apparently normal anatomy.

There may be occasions where the proximal length of a standard tube is inadequate (e.g. in the obese, or when cellulitis around a tracheostomy site increases the depth of the anterior cervical tissues after insertion), and leads to the tube tip then abutting against the posterior tracheal wall. This can result in

- obstruction of the tube, and consequent difficulties with ventilation and weaning
- injury to the posterior tracheal wall, thereby increasing the risk of tracheo-oesophageal fistula formation
- suboptimal positioning of the tube cuff, with the associated risk of aspiration, inadequate ventilation and high cuff pressures

There may also be occasions where the proximal length is too long, with the result that the knuckle of the tube abuts against the posterior tracheal wall, whilst the tip is pivoted towards the anterior tracheal wall (the latter increasing the risk of granuloma formation and the development of a tracheal – innominate arterial fistula). Less commonly, there may be a need to review the distal length of a temporary tracheostomy. For instance, there may be occasions where there is a need for additional

distal length in order to bypass fistulae or obstructing lesions such as tracheomalacia, tracheal stenosis or excessive granuloma formation.

Clinically significant anatomical and pathological variances such as these can be circumvented by using either extended length tracheostomy tubes with an adjustable flange or pre-formed extended tubes which are offered with a range of extended proximal or distal lengths. Extended length adjustable flange tubes, examples of which are given in Appendix 2 are suitable for short term situations but are often difficult to introduce percutaneously and are not currently supplied with an inner cannula.

Whilst adjustable flange devices are considered suitable for short terms problems, patients who are likely to need airway access for a considerable length of time may be better served with pre-formed non standard products such as the Shiley® Tracheosoft XLT range or the Portex® Blue Line® Extra Horizontal and Vertical length products (appendix 2). Some manufacturers offer a bespoke service should none of their stock items be suitable.

### **Inner cannula (dual cannula tracheostomies)**

Many tracheostomies are now manufactured with an inner cannula. The design of some makes the use of this optional (e.g. Portex® Blue Line Ultra®), whilst for others it is mandatory, as it is the inner cannulae that has a standard 15mm attachment to connect to the breathing circuit of a mechanical ventilator (e.g. Shiley®, Kapitex Tracoetwist®). Whilst some inner cannulae are disposable and designed for single use, others can be cleaned and re-used.

The principal (and very major) advantage of an inner cannula is that it allows the immediate relief of life-threatening airway obstruction in the event of blockage of a tracheostomy tube with blood clot or encrusted secretions. Whilst traditionally, this has been seen to be particularly advantageous for patients once they have been discharged to a ward environment, it is now recognised that tube obstruction can occur even while the patient is in a critical care facility, and that in such circumstances removal of an obstructed inner cannula may be preferable to removal and repeat tracheal intubation.

The principal disadvantage of dual cannula tubes is that the inner cannula may significantly reduce the effective inner diameter of the tracheostomy tube (Table 3.4), and thereby increase the work of breathing and impair weaning. Failure to properly lock the inner tube in place may also result in disconnection of the breathing circuit in circumstances where it is connected to this rather than the outer cannula.

**Tracheostomy tubes with an inner cannula are inherently safer and are normally preferred**

**Table 3.4. Comparison of ID and OD of tracheostomy tubes with and without inner cannulae**

Portex® Blue Line®			Portex® Blue Line Ultra®			Shiley® Dual Cannula Tube			Kapitex® Tracoetwist®		
ID with (mm)	<b>ID without (mm)</b>	OD (mm)	ID with (mm)	<b>ID without (mm)</b>	OD (mm)	ID with (mm)	ID without (mm)	OD (mm)	ID with (mm)	ID without (mm)	OD (mm)
									<b>4.0</b>	5.8	7.2
									<b>5.0</b>	7.0	8.6
n/a	<b>6.0</b>	8.3	5.0	<b>6.0</b>	9.2	5.0	6.7	9.4	<b>6.0</b>	8.1	9.2
5.0	<b>7.0</b>	9.7	5.5	<b>7.0</b>	10.5				<b>7.0</b>	8.9	10.4
			6.0	<b>7.5</b>	11.3						
6.0	<b>8.0</b>	11.0	6.5	<b>8.0</b>	11.9	6.4	8.1	10.8	<b>8.0</b>	10.1	11.4
			7.0	<b>8.5</b>	12.6						
7.0	<b>9.0</b>	12.4	7.5	<b>9.0</b>	13.3	7.6	9.1	12.2	<b>9.0</b>	10.8	12.5
n/a	<b>10.0</b>	13.8	8.5	<b>10.0</b>	14.0	8.9	10.7	13.8	<b>10.0</b>	11.9	13.8

Bold type indicates the dimension used to describe the tube commercially. Data for the Shiley® dual cannula tube refers to Jackson sizes 4, 6, 8 and 10 respectively.

### Fenestrated tracheostomy tubes

Many tracheostomy tubes come with the option of a fenestration in the posterior wall of the intra-tracheal component of shaft above the cuff. Manufacturers do not recommend the use of such tubes at the time of percutaneous tracheostomy, and generally they should not be used whilst a patient still requires mechanical ventilation because of significant risk of surgical emphysema (even when a non-fenestrated inner cannula is in place) [5,6,7]. Although a correctly sited fenestrated tube may aid both phonation and weaning (by facilitating the flow of air both through as well as around the tracheostomy tube), in practice the fenestrations are frequently poorly positioned within the trachea, and when abutting against the posterior tracheal wall may increase airway resistance and as well as promote the development of granulation tissue in the tracheal mucosa. The design of the fenestrations varies between manufacturers, with some clinicians favouring tubes with multiple smaller openings to a single large one, although both patterns are at risk of blockage by encrusted secretions. If a fenestrated tube is used, it is vital that the position and on-going potency of the fenestration(s) are checked regularly if the patient is to benefit from this option. In practice down sizing or switching to an uncuffed tracheostomy tube is enough to improve flow of air through the upper airway in most patients.

**Fenestrated tracheostomy tubes should be used with caution in mechanically ventilated patients, and only with patients who are weaning from ventilation.**

## Cuffed tracheostomy tubes

In the ICU setting, most patients will require an air-filled cuffed tracheostomy tube initially, both to facilitate effective mechanical ventilation and also to protect the lower respiratory tract against aspiration. 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 cmH<sub>2</sub>O in order to minimise the risk of tracheal mucosal ischaemia and subsequent tracheal stenosis. Although many manufacturers offer tracheostomy tubes with suitable cuffs, there is considerable variation between them in the length of the cuff and its precise shape when inflated. Furthermore, there is now considerable evidence to suggest that the current high volume / low pressure design is unable to guarantee isolation of the lower respiratory tract.

The intra-cuff pressure should be monitored regularly (see section 4).

Causes of excessive cuff pressures include:

- the use of a tube that is too small (an indication for which would be a need to inflate with more than the nominal cuff volume in order to achieve an effective seal)
- poor tube positioning in the trachea
- tracheal dilatation
- over inflation of the cuff

One proposed solution to the problem of cuff-related tracheal mucosal ischaemia is the use of a foam rather than air-filled cuff (Bivona® Adult Fome-Cuf® tracheostomy tube). The cuff is constructed of air-filled polyurethane foam within a silicone envelope that is deflated prior to insertion and then allowed to expand once sited by opening the pilot port to atmosphere. Correct sizing and placement is crucial to their use, which tends to be limited to patients with existing tube-related tracheal injury. The prevention of phonation is a further significant drawback to the device.

Most patients can wean to decannulation by simply deflating the existing cuff (even though the residual profile of the deflated cuff can still significantly restrict airflow around the tube), or alternatively by changing to a smaller or uncuffed tube. In circumstances where a patient still requires periods of airway protection, but is unable to satisfactorily breathe past a deflated cuff, it may be advantageous to switch to a so-called “tight to shaft” tube in which the deflated cuff makes no distinguishable contribution to the external profile of the tracheostomy tube.

## Percutaneous tracheostomy tubes / kits

Several manufacturers have modified aspects of the construction of their standard tracheostomy tubes such as cuff and distal tube profiles in order that they are more easily introduced as part of a percutaneous dilatational technique (e.g. Portex® Per-Fit and Shiley® PERC). Such changes frequently go unnoticed when the tube comes as a component of a percutaneous tracheostomy kit

and may have unpredictable functional consequences. Clinicians are advised to carefully evaluate situations where such product consolidation occurs.

### Specialist functionality

Some specialist tracheostomy tubes incorporate a facility for aspiration of sub-glottic secretions (e.g. Portex® Blue Line Ultra® “Suctionaid” tracheostomy tube, Tracoetwist® 306). Initially advocated in the prevention of ventilator-associated pneumonia, they may also benefit patients with poor bulbar function who are unable to effectively clear secretions that accumulate above the tracheostomy tube, although they carry a high risk of significant laryngeal injury if suction is applied continuously. When considering changing to one of these devices clinicians are also advised that in order to accommodate the additional suction channel these tubes may have a wider OD than the standard device that it is replacing.

Other options include features that enhance phonation such as the Portex® “Vocalaid” cuffed Blue Line® tracheostomy, in which an external air source is used to deliver gas via a separate pilot channel to the sub-glottic area, or the introduction one-way speaking valves such as the Passy-Muir® valve, the latter also improving swallowing and secretion control.

Descriptions of some of the currently available tubes can be found in appendix 2.

### Summary recommendations

1. Critical care clinicians need to be aware of the wide variability in the construction, design and functionality of the tracheostomy tubes that are currently available, and recognise that the anatomical variation of their patients limits the universal applicability of a single tube type.
2. Most adult patients who require a temporary tracheostomy as part of their critical illness will initially need a non-fenestrated semi-soft tube with an air-filled cuff. As a standard, a dual cannula tube (i.e. a tube with an inner cannula) should be used from the outset unless there is a requirement to insert an extended adjustable flange tracheostomy (which currently do not have inner tubes available).
3. Patients with single cannula adjustable flange tracheostomies should not be discharged from a level 3 critical care environment without review of their on-going need for a device that puts them at particular risk of the consequences of tube obstruction. A change to a pre-formed extended tracheostomy with an inner cannula should be considered as soon as the patient is actively weaning from mechanical ventilation and certainly before discharge from critical care.
4. When considering changing an existing tracheostomy to that of another type or manufacturer, clinicians should compare the relative lengths and external diameters of the two tubes, particularly if the proposed new tracheostomy has a wider OD (because the existing stoma may not accommodate it), shorter length (in case cuff related granulation tissue obstructs the tube) or different curvature / angulation.

5. Specialist features such as fenestrations, foam or tight to shaft cuffs or a sub-glottic suction facility may be useful in specific circumstances, although are not recommended as a routine.

# 4. Routine care of the established tracheostomy

Patients immediately post tracheostomy placement usually return either to a critical care area or a specialist ward environment used to dealing with tracheostomies. Routine care of an established tracheostomy is a basic ward skill, but unfamiliarity with tracheostomies and the simple rules governing their routine care often leads to anxiety for both patient and carer. Good routine care is not difficult and will avoid almost all emergencies, but patients with tracheostomies should only be cared for in areas where staff are competent in such care. Regular review and good communication are the keys to both avoidance of problems, and effective treatment. Consideration should be given to a form such as in appendix 3 to ensure that staff are always aware of all relevant information.

## 4.1 Essential Equipment

The following equipment should be immediately available at all times for a patient with a tracheostomy, both by the bedside as well as during transfers:

- Operational suction unit, which should be checked at least daily, with suction tubing attached and Yankeur sucker
- Appropriately sized suction catheters
- Non-powdered latex free gloves, aprons and eye protection
- Spare tracheostomy tubes of the same type as inserted: one the same size and one a size smaller
- Tracheal dilators
- Rebreathing bag and tubing
- Catheter mount or connection Tracheostomy disconnection wedge
- Tracheostomy tube holder and dressing
- 10ml syringe (if tube cuffed)
- Artery forceps
- Resuscitation equipment

One approach is to ensure that all these are in a 'tracheostomy box' that goes with the patient from critical care to the ward.

## 4.2 Cuff management

The tracheostomy cuff provides a seal to enable positive pressure ventilation and also provides some protection against aspiration of secretions. Over-inflation of the cuff may cause ischaemia of the tracheal mucosa and thereby lead to tracheal stenosis, tracheomalacia and arterial erosion. The pressure within the cuff should be checked regularly with a hand held pressure manometer and should be maintained ideally below 20 – 25cm H<sub>2</sub>O. It is good practice to document cuff pressure and inflating volume on a daily basis and following any tracheostomy-related intervention.

- **Cuff pressure should not exceed 25 cm H<sub>2</sub>O.**



- **If an air leak occurs with the cuff pressure at the maximum recommended, the tracheostomy may have become displaced or may require changing: medical or other professionals who are competent in tracheostomy management should review the patient.**

See section 3 for further information on types and choice of tube. Finger tip pressure on the external pilot balloon is not an accurate method of measuring cuff pressure.

The cuff should be deflated to remove the tube, to allow the patient to eat or drink and when a speaking valve or decannulation cap is secured to the tube.

- **Failure to deflate the cuff when the speaking valve or decannulation cap is secured to the tube will result in a total occlusion of the patient's airway.**

### 4.3 Humidification

Inadequate humidification may lead to life-threatening blockage of the tracheostomy with tenacious sputum, keratinisation and ulceration of the tracheal mucosa, sputum retention, atelectasis and impaired gas exchange. The provision of adequate humidification of inspired gases is therefore essential, and can be achieved in patients with minimal or low oxygen requirements using a heat-moisture exchanger (HME) or cold water venturi humidifier system connected to a T-piece or tracheostomy mask. HMEs may also suffice in patients who remain mechanically ventilated and offer the additional advantage of bacterial filtration. Patients with more tenacious sputum, or who require high flow oxygen therapy will require additional saline nebulisers and may require heated water humidification.

**Humidification is essential for patients with temporary tracheostomies.**

### 4.4 Suctioning

Tracheal suction is an essential component of secretion control and maintenance of tube patency. However, it may be both painful and distressing for the patient, and can also be complicated by hypoxaemia, bradycardia (particularly in patients with autonomic dysfunction such as spinal injuries), tracheal mucosal damage, bleeding, and introduction of infection. As a result, the suction requirements of an individual patient should be re-assessed each shift, and where possible patients should be encouraged to expectorate their own secretions. Basic guidelines for effective, safe suctioning are shown in the box below.

#### **Guidelines for tracheal suction**

- Suctioning should be performed using aseptic techniques, with the patient upright and in a neutral head alignment
- Always suction with the inner tube *in situ*, and change to a non-fenestrated inner tube
- The suction catheter should have a diameter no greater than half internal diameter of the

tracheostomy tube

**Suction catheter size (Fg) = 2 x (Size of tracheostomy tube – 2)**

**For example, 8.0mm ID tube: 2 x (8 – 2) = 12 Fg**

- The lowest possible vacuum pressure should be used -  $\leq$  100-120mmHg (13-16kPa) to minimise atelectasis.
- Patients with high oxygen requirements may require pre-oxygenation
- Insert the suction catheter approximately 10-15cm (or less, depending on the length of the tracheostomy tube) into the tube before applying suction and slowly withdrawing the catheter.
- Suction should be applied for a maximum of 10 seconds.
- Installation of saline to 'aid' suctioning is not recommended

**Any difficulty in passing the suction catheter should lead to consideration that the tube may be partially blocked, badly orientated or misplaced and requires immediate attention.**

### 4.5 Inner cannulae

Wherever possible, tracheostomy tubes with an inner cannula should be used for all patients, even for those who are still within in a critical care area (see chapter 3). The inner cannula must be removed, inspected and when necessary cleaned at regular intervals, the frequency of inspection being determined by the volume and tenacity of a patient's secretions. Disposable inner cannulae should be discarded if soiled and replaced with a new one. Basic guidelines for changing the inner cannula of a tracheostomy tube are listed in the box below:

#### **Guidelines for changing inner cannula**

- Position patient with neck slightly extended
- Preoxygenate and suction as necessary
- Using a sterile technique, remove or change inner cannula. If non disposable clean cannula with sterile saline 0.9% or water and dry thoroughly
- Clear persistent secretions on cannula in line with manufacturer's instructions, rinsing the inner cannula thoroughly with normal saline or water before re-insertion. Do not leave inner cannula to soak.

### 4.6 Dressings

Secretions that collect above the cuff ooze out of the stoma site producing a moist environment leading to excoriation and infection. The site should be assessed and stoma cleaned at least once in every 24 hours using a clean technique. Routinely a thin pre cut dressing e.g. metaline is ideal, but for exuding stomas alleevyn is more absorbent. Where the skin around the stoma is excoriated, a thin layer of duoderm may prevent further deterioration. The tracheostomy tube should normally be secured effectively with a commercial tracheostomy holder rather than thin tape; this protects the

patient from pressure on the back of the neck and is easily adjusted. Red, excoriated or exuding stomas should have microbiology swabs sent for culture.

## 4.7 Swallowing

Patients with tracheostomies may experience problems with swallowing. Whilst oral intake may be permitted with an inflated or partially deflated cuff for psychological well being and to help establish enteral feeding early, the presence of an inflated cuff compresses the oesophagus, and makes swallowing difficult for some patients, increasing the risk of aspiration. The risk is greatest in those patients with associated neurological or mechanical causes of dysphagia, or those with significant on-going respiratory failure. The decisions to allow feeding with an inflated cuff should be made on an individual patient basis after a swallowing assessment, and the patient should be regularly reviewed for evidence of aspiration. Sips of sterile water are initially given and if tolerated without coughing, desaturation, fatigue or signs of aspiration on tracheal suctioning thickened fluids may be introduced followed by a soft diet. Guidance for initiating oral intake, along with risk factors for likely problematic patients, is shown in the boxes below.

### **Guidelines for the initiation of oral intake in patients with a tracheostomy**

- Confirm that patient can tolerate cuff deflation (see above for exceptions)
- Sit patient up with head slightly flexed and deflate cuff
- Start with sips of water, moving on to thickened fluids and then soft diet providing patient shows no signs of respiratory distress (coughing, desaturation, increased tracheal secretions, increased respiratory rate etc)
- In problematic cases consider referral to Speech and Language therapy

### **Risk factors for swallowing problems in patients with a tracheostomy**

- Neurological injury e.g. bulbar palsy
- Disuse atrophy
- Head & neck surgery
- Evidence of aspiration of enteral feed or oral secretions on tracheal suctioning
- Increased secretion load, or persistent wet / weak voice, when cuff is deflated
- Coughing and / or desaturation following oral intake
- Patient anxiety or distress during oral intake



## 5. Changing tracheostomy tubes

Changing a tracheostomy tube is potentially hazardous, but so is failure to do so. Unfortunately, recommendations for the frequency of changing tracheostomy tubes are inconsistent and unsupported by evidence. Basic principles guiding replacement of a tracheostomy tube are listed in the box below. A more detailed example is given in appendix 4.

### Basic principles for changing a tracheostomy tube

- Tracheostomy tubes without an inner cannula should be changed every 7-14 days, the frequency then decreasing once the patient is free of pulmonary secretions and has a well formed clean stoma
- A European Economic Community Directive (1993) states that tracheostomy tubes with an inner cannula can remain in place for a maximum of thirty days.
- The first tracheostomy tube change:
  - Should not be performed within 72 hours following a surgical tracheostomy and not before 3 – 5 (and ideally 7 – 10) days after a percutaneous tracheostomy to allow the stoma to become established.
  - The decision to change the tube must be made in conjunction with a medical practitioner competent in the care of tracheostomies.
  - Must be carried out by either:
    - a medical practitioner with appropriate, advanced airway skills, or
    - Another suitably skilled practitioner.
- Subsequent changes can be made by experienced personnel trained in tracheostomy tube changes (e.g. specialist tracheostomy nurse)
- In practice, the frequency with which the tube needs to be changed will be affected by the individual patient's condition and the type of tube used. Elective changes are inherently safer than those done in a crisis.

**Tracheostomy tubes should only be changed by staff who are competent to do so. Most will be doctors, but there are specialist non-medical practitioners who have the necessary skills. Doctors who have not had relevant training will not have competency in this area, and should not undertake the procedure unsupervised.**

### The first tube change

Changes within the first 72 hours should be avoided unless absolutely essential and should only be performed in an environment in which trans-laryngeal intubation can immediately be established.

## TRACHEOSTOMY CARE

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Although the risk of stomal closure lessens somewhat thereafter, the first change remains hazardous, particularly following a percutaneous procedure, and exchange over a bougie or an airway exchange catheter that allows the continued insufflation of oxygen such as the Frova catheter or Cook™ airway exchange catheter should be considered.

Whilst problems can occur in any patient, they are particularly likely in the obese, those with a deep trachea, other anatomical difficulties.

### **Second and subsequent changes**

A standard procedure for subsequent changes of a tracheostomy tube is described in appendix 4. It is reasonable to expect that two skilled practitioners should be present when changing the tube, particularly when a previous change has been difficult. Resuscitation equipment must be readily available, as should a smaller tube.

If a patient has a smooth long term stoma and has regular tracheostomy changes, it is reasonable to introduce the new tube using the tracheostomy introducer rather than an airway exchange device. The practitioner must however be aware of the risk of paratracheal tube placement with any blind technique and be able to recognise the clinical features of failure to re-cannulate the trachea.

**It is essential that if the new tube cannot be inserted or is misplaced, there is an agreed procedure for handling the situation.**

## 6. Emergencies, Common Complications and their Management

The main life threatening complications associated with a tracheostomy are blockage, dislodgement and bleeding.

### **Blockage and displacement**

A blocked or displaced tracheostomy tube generally presents with respiratory difficulty. The nature of the problem will often be obvious, but if not, it is important to adopt a systematic approach and be aware that acutely ill patients may have other cardio-respiratory reasons for difficulty in breathing.

**Every hospital must have a procedure for managing patients whose tracheostomy is blocked or displaced. Staff must be aware of this and receive appropriate training to manage the problem.**

Tracheostomy tubes may become dislodged or displaced for a number of reasons. This can be a stressful event for both patients and staff, and prevention is better than cure. It is important to ensure that the tracheostomy tube holder is adjusted regularly so that the tube is fixed in a secure, comfortable position all times. Tracheostomy tubes may become dislodged when a ventilated patient is turned, or moved from their bed to a trolley. Restless or agitated patients may pull at their tracheostomy tubes, or ventilator tubing attached to the tracheostomy.

A partly dislodged tracheostomy tube is just as dangerous, if not more dangerous, as a completely removed tracheostomy tube.

Airway: is the airway (at least partially) patent?

- If the tube is displaced, the patient may be breathing through their nose or mouth. The patient may be safe in the short term, requiring urgent but not emergency action. Only experienced staff should try to replace the tube under such circumstances. If in doubt it will usually be safer to remove a partly dislodged tube, although a suction catheter or airway exchange catheter may be first advanced through it to allow oxygen administration. The airway should be maintained by other methods until experienced help arrives.
- If tube is partially occluded, the patient may still be able to breathe through it, but with difficulty. If the tube has an inner cannula, this should be removed and changed. If the tube does not have an inner cannula, but a suction catheter can be passed down the tracheostomy tube, then it must be at least partially patent. It may be possible to change the tube over a catheter or other airway exchange device.

**Staff treating patients with a tracheostomy in an emergency situation need to be aware that 'bag and mask' ventilation via the mouth is not possible with a cuffed tracheostomy tube *in situ*.**

Individual hospitals are advised to develop their own specific guidelines with bleep numbers, taking account of available staff and recognising this may happen day or night.

Chest X rays do not give useful information about the position of the tube in this situation. Fiberoptic bronchoscopy may be useful if it is immediately available, but this should not delay treatment.

### Displaced tracheostomy tube

**This guidance is appropriate for patients capable of spontaneous respiration. In a patient who is fully ventilated, critically ventilator dependent or paralysed, prompt replacement or removal and replacement by a tracheal tube will be required. Such a situation is only likely to arise in a level 3 area, but can also occur in a cardio-respiratory arrest elsewhere. Remember tube displacement as a possible cause of cardio-respiratory arrest.**

1. **DON'T PANIC!**
2. Call for help – senior medical and nursing staff, other AHPs with tracheostomy care skills (e.g. physiotherapist). If in doubt, call for anaesthetic assistance
3. Reassure patient.
4. Assess patency of airway (A) and patient's breathing (B). Is air passing through the tracheostomy tube or stoma? Is the patient breathing via mouth or nose? Check oxygen saturation with a pulse oximeter.
5. If airway is not patent, it must be cleared immediately.
  - **ONLY SENIOR STAFF WITH APPROPRIATE EXPERIENCE OF TRACHEOSTOMY MANAGEMENT SHOULD ATTEMPT TO RE-INSERT A DISLODGED OR DISPLACED TRACHEOSTOMY.**
  - **ANY SUCH ATTEMPT SHOULD BE QUICKLY ABANDONED IF UNSUCCESSFUL.**
  - **MULTIPLE ATTEMPTS SHOULD NOT BE MADE.**
  - **IF IN ANY DOUBT, REMOVE TRACHEOSTOMY TUBE AND ALLOW BREATHING THROUGH THE STOMA OR THE MOUTH/NOSE.**
  - **APPLY OXYGEN MASK OVER ONE OR BOTH SITES OF AIR ENTRY.**

Appropriately experienced staff may attempt to re-insert a tracheostomy tube in a patient with a well-formed track from skin to the tracheal stoma. Typically, this would be more than 72 hours following surgical tracheostomy or more than 7 days after percutaneous



tracheostomy. It is advisable to attempt any such re-insertion using a gum elastic bougie or, if time permits, a fibre-optic bronchoscope.

6. Re-establish the airway in the usual fashion – tilt the head back to extend the head on the neck, perform a jaw thrust. If necessary insert an oral airway (Guedel). Note that if ‘bag and mask’ ventilation is attempted, air will escape through the stoma. In this situation, get a colleague to occlude the stoma by applying pressure over it with gauze swabs or a pad.
7. Tracheal intubation may be needed – this should only be performed by a doctor competent in tracheal intubation. This is not the time to “have a go”. It may be necessary to push the tracheal tube distal to the stoma. (Use an ‘uncut’ tube.)
8. If the patient is breathing adequately at this point, there may be no need to artificially assist ventilation. Check the oxygen saturation with a pulse oximeter and administer oxygen as required via a facemask or resuscitation bag with an oxygen reservoir.
9. If artificial ventilation is needed, use a resuscitation bag and mask in the standard fashion. Maintain occlusion of the stoma as above to prevent an air leak. If the patient has been intubated, the person controlling the airway (usually an anaesthetist or intensivist) will ventilate with the resuscitation bag. Measurement of oxygen saturation with a pulse oximeter will confirm adequacy of oxygenation.
10. At this point the patient is safe, with a patent airway and adequate respiration. Do not panic or rush. Take time to think about what the patient needs at this time.
11. A decision must now be reached about re-insertion of the tracheostomy tube. This decision should only be made an experienced anaesthetist, intensivist, or ENT surgeon. The decision will be depend on the ability of the patient to maintain a patent airway without the tracheostomy tube, and to maintain oxygenation, cough and clear respiratory tract secretions without artificial assistance. If there is any doubt, the correct decision is to re-insert the tracheostomy tube.
12. Re-insertion of the tracheostomy tube can now take place in a controlled manner. It may be possible to do this in the ward, providing the stoma has a well-established track (at least 7 days old). Relevant equipment should be available at the bedside in the patient’s tracheostomy box or from the cardiac arrest trolley (e.g. tracheal dilator forceps). If in doubt arrange to move the patient to a critical care area, ENT ward, or operating theatre. Another option for an experienced practitioner is to pass a tracheal tube via the tracheostomy stoma, which may be easier to advance than a tracheotomy tube.

### BLOCKED TRACHEOSTOMY TUBE

A tracheostomy tube may become blocked with thick tracheal secretions, blood or foreign bodies. The patient may present with increasing respiratory distress over a few hours, or with a much more rapid deterioration. In either case, a blocked tracheostomy tube is an emergency situation in which the patient's life is at risk if it is not rapidly resolved.

Prevention is better than cure:

- Patients with tracheostomies must always receive adequate humidification of their inspired gas to lessen the risk of tube blockage.
- The risk of tube blockage is reduced by the use of a tracheostomy tube with an inner cannula. Such tubes should have their inner cannula cleaned regularly to prevent the build-up of secretions. The precise frequency will depend on individual risk assessment.
- Certain specialist tracheostomy tubes (e.g. adjustable length or custom-made long tubes) may not have an inner cannula. Extra vigilance is needed in these patients to minimise the risk of tube blockage.

If a blocked tracheostomy tube is suspected, rapid diagnosis will enable prompt treatment.

YOU NEED TO KNOW IF THE TRACHEOSTOMY TUBE HAS AN INNER CANNULA

1. Patient with tracheostomy tube develops respiratory embarrassment or distress.
2. **DON'T PANIC!**
3. Call for help: senior medical and nursing staff, other AHPs with tracheostomy care skills (e.g. physiotherapist).
4. Reassure patient.
5. Assess patency of airway (A) and patient's breathing (B). Is air passing through the tracheostomy tube or stoma? Is the patient breathing via the mouth or nose? Check the oxygen saturation with a pulse oximeter.
6. If the airway is not patent, this must be dealt with first.
7. If the patient is awake, breathing spontaneously and co-operative, encourage the patient to give a vigorous cough – this may be sufficient to relieve the obstruction by shifting a plug of thick secretions.
8. If the tracheostomy tube has an inner cannula, remove it.
9. Attempt tracheal suction with a suction catheter – this alone may be sufficient to remove a thick plug of secretions.
10. If the obstruction is not relieved, then deflate the tracheostomy tube cuff. Administer oxygen via a facemask if the patient is breathing spontaneously. If the patient is not breathing spontaneously, it will be necessary to ventilate the patient with a resuscitation bag and mask – an oral airway (Guedel) may be necessary. Monitor the oxygen saturation with a pulse oximeter.
11. If it is not possible to achieve adequate oxygenation, then remove the tracheostomy tube and suction and proceed as per dislodged tracheostomy tube protocol. Consider passing Yankeur or other large bore suction catheters directly into the trachea via stoma to remove

thick secretions or blood clot. Suction applied directly via the tracheostomy tube or translaryngeal tube may also be required to remove big clots, or large mucus plugs (as in neonates for meconium aspiration).

12. If the patient is now adequately oxygenated, then it is now safe to consider changing the tracheostomy tube. This is not necessary if removal of the inner cannula has relieved the obstruction.

### BLEEDING FROM A TRACHEOSTOMY

Bleeding is the most common complication of tracheostomy. Bleeding may occur early (within 48 hours of formation of the tracheostomy) or late (several days afterwards). It may be minor (settles with simple conservative management) or major (requiring transfusion of blood and/or blood products) and surgical exploration may be needed to identify and deal with the source of bleeding.

The management of bleeding from a tracheostomy therefore depends upon the context in which the bleeding occurs.

#### Early minor bleeding

Oozing from the stoma site is the most common type of bleeding seen following formation of a tracheostomy. Most commonly, this is the result of the effects of the vasoconstrictor used to infiltrate the incision site wearing off. Blood staining of the dressings may be noted, or there may be blood staining of tracheal secretions. Large volumes of fresh blood represent significant bleeding, which may require surgical exploration.

1. **DON'T PANIC!**
2. Call for help– senior medical and nursing staff, other AHPs with tracheostomy care skills (e.g. physiotherapist).
3. Reassure patient.
4. Whilst maintaining control of the tracheostomy tube, remove the tracheostomy tube holder and dressing.
5. Clean stoma site with sterile saline.
6. Inspect stoma site, looking for any obvious bleeding point.
7. Apply manual pressure to any obvious bleeding point – this may be sufficient to stop minor oozing. Suturing locally may also be effective.
8. If still bleeding, infiltrate any obvious bleeding point with dilute adrenaline (1:80,000 to 1:200,000). If no obvious bleeding point, infiltrate the stoma margins with dilute adrenaline.
9. If still oozing, apply Kaltostat packing to stoma to promote local clot formation. The Kaltostat may also be soaked in dilute adrenaline.
10. Check full blood count and a coagulation screen. Correct any abnormalities in the standard fashion.
11. If bleeding is not stopped by these measures, refer to ENT or other appropriate surgeon for surgical exploration.

Then seek surgical haemostasis in theatres with appropriate senior surgeon. Junior surgeons should not explore such wounds alone as major vessel bleeding and a compromised airway will require senior ENT, cardiothoracic or vascular expertise.

## Major early bleeding

Proceed as minor bleeding guideline. Note that large volumes of blood in the trachea may cause respiratory embarrassment – the patient may need further respiratory support in a critical care area. Beware of the risk of the tracheostomy tube becoming occluded by blood clot. If this occurs, proceed as per blocked tracheostomy tube guideline. If airway obstruction occurs due to blood clot in the airway (look with a laryngoscope) then direct suction on the tracheal tube with suction tubing may be required to remove it. Large clots will not pass through a suction catheter or a fiberoptic bronchoscope suction channel.

1. In most situations of significant bleeding, secure the airway by translaryngeal intubation with the cuff below the stoma so the airway is protected from blood entering the trachea from the stoma. Then temporary haemostasis of the stoma can be achieved by digital pressure, packing the wound with gauze or deep tension sutures.
2. Early referral to an appropriate SENIOR surgeon (e.g. ENT, cardiothoracic, vascular expertise) for urgent surgical exploration is necessary.
3. Ensure that cross-matched blood is made available.
4. Check full blood count and a coagulation screen. Correct any abnormalities in the standard fashion.

### Late bleeding

Late bleeding may occur because of erosion of blood vessels in and around the stoma site. This is more likely if there has been infection of the stoma site. Such bleeding may settle with conservative management, as described in the early bleed guideline. More worryingly, however, is the prospect of such bleeding being the result of erosion of a major artery in the root of the neck where there has been pressure from the tracheostomy tube itself or the cuff tube (another reason why it is important to ensure that the tracheostomy tube cuff pressure is monitored to avoid over-inflation). Most commonly, this erosion occurs into the right brachio-cephalic artery (also known as the innominate artery), resulting in a tracheo-innominate artery fistula. This situation may be heralded in the preceding hours by a small, apparently insignificant, sentinel bleed. Bleeding from such a fistula will be massive. THIS IS A LIFE-THREATENING EMERGENCY and so decisions need to be rapidly made. It is well recognised that fatalities occur in this situation, and that this may be the mode of death for some patients with head and neck cancers. The appropriate management may, therefore, be palliation. Such a decision should, ideally, have been made in advance and in discussion with the patient and family, clearly documented in the patient's medical notes and communicated to the nursing staff (who will undoubtedly have to deal with this situation). If active treatment is still the plan, proceed as below:

1. **DON'T PANIC**
2. Call for help– senior medical and nursing staff, other AHPs with tracheostomy care skills (e.g. physiotherapist).
3. Reassure the patient.
4. Proceed as described in the major early bleeding guideline.
5. Bleeding may be temporarily reduced or stopped by applying finger pressure to the root of the neck in the sternal notch, or by inflating the tracheostomy tube cuff (if present) with a 50ml syringe of air. This inflation should be done slowly and steadily to inflate the balloon to a maximum volume without bursting it. Depending on the type and size of the tracheostomy tube this may be anywhere between 10 and 35 ml.
6. Urgent referral for surgical exploration must now be made, if not already done so. In addition to an ENT or maxillofacial surgeon, it may be necessary to get help from a vascular surgeon. Sometimes, the damage can only be repaired utilising cardio-pulmonary bypass, and so a cardiothoracic surgeon may also be needed to help. The operating theatres must be informed that this is an NCEPOD Category One emergency, as any delay will increase the risk of death significantly.

## 7. Decannulation and longer term follow up

### 7.1 Weaning & Decannulation

Decannulation should be undertaken as soon as it is feasible to minimize the risk of complication. However, de-cannulation is itself associated with potential hazards such as airway obstruction, aspiration, ventilatory failure, sputum retention and difficulty in oral re-intubation. The decision and process should therefore demonstrate a balancing of risk and benefit and should be performed:

- using objective criteria
- by competent staff
- in an appropriate environment
- with appropriate monitoring
- with a range of drugs and equipment to address any predictable hazard

There should be clear guidance to staff to observe for complications, clear criteria for review and point of contact to obtain urgent review by tracheostomy team, anaesthetic, intensive care or surgical staff.

**A tracheostomy should be removed as soon as it is no longer required.**

Care of patients with tracheostomies will be multidisciplinary, but it must be clear who is responsible, particularly when patients are not under the direct care of the critical care team. Every Trust should have an explicit policy on this.

**It must be clear which person or team is responsible for management of the tracheostomy, especially if it is not the specialty with primary responsibility for the patient's care.**

Reviewing the 'need' for a tracheostomy and planning weaning should be part of the daily assessment. Some patients may tolerate rapid airway decannulation, especially if their ventilation period has been short or if they do not suffer significant lung or airway pathology. Others, particularly those with underlying cardiopulmonary disease, muscle weakness, neurological deficits, upper airway oedema or problems managing airway secretions, will take much longer to wean and it is important that the process is both planned and sequential.

Prior to removal of a tracheostomy, the patient will be breathing spontaneously and the following points should be considered:

- The pathological process necessitating the insertion of a tracheostomy has resolved.
- The patient is able to cough and swallow effectively and protect their airway
- Ventilatory reserve is adequate (decannulation increases anatomical dead space and may increase the work of breathing).

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- Reversible bronchopulmonary infection or pathology has been treated and is resolving.
- Pulmonary secretions are not excessive.
- Nutritional status is adequate.
- Patient is comfortable with the cuff deflated.
- The airway is patent above the level of the stoma.

These checks are intended to prevent decannulation being followed by a need for re-insertion, and to allow a patient to be assessed objectively. It is common to progress through several stages during weaning and it is important to appreciate the changes, and risks, associated with each. With cuff deflation, there is an expectation that there will be some respiration through the upper airway, past the tracheostomy. When a speaking valve or occlusion cap is also used, this becomes essential. Whilst it is harder to breathe with a tracheostomy in place after it has been removed, persistent respiratory difficulty when using any of these techniques should raise questions about possible upper airway obstruction.

**Cuff deflation:** Weaning often includes increasing the periods of time with the cuff deflated. The inflated cuff provides some protection from aspiration and means that the patient becomes unaccustomed to managing their own oral secretions and swallowing. Before cuff deflation, warn the patient about the possibility of an alteration in tracheal airflow sensation and that they may cough.

The cuff should be deflated slowly and completely. The tracheostomy tube should be occluded briefly with a clean, gloved finger to check for airflow around the tube. If the patient continuously coughs with the cuff deflated and this does not resolve with suction and reassurance, re-inflate the cuff.

**Speaking Valves:** A one way speaking valve attached to the tracheostomy, allows air in through the valve on inspiration, but closes on expiration, thus diverting the air past the vocal cords and out through the nose and mouth. **It should only be used with an uncuffed tube, a cuffed tube with the cuff deflated or a fenestrated tracheostomy tube with the cuff deflated.** If the patient finds it hard to breathe, or they are unable to vocalise (which they should be able to do) or they begin to sound wheezy or stridulous, then the speaking valve must be removed immediately and the cause of the problem sought.

It is not uncommon for a patient to experience breathlessness when starting to use a speaking valve. They need reassurance and if this does not settle the speaking valve must be immediately removed. If difficulties persist:

- Check that the tracheostomy is fenestrated and that the inner lumen is clean with patent fenestrations.
- Consider changing the tracheostomy to ensure that the fenestrations of outer lumen are clear.



- Consider downsizing the tracheostomy or changing it for an uncuffed one to increase space around tracheostomy in the trachea.

If problems continue it may indicate an upper airway problem: consider referral to Speech and Language Therapist and/or ENT for panendoscopy.

**Occlusion or decannulation Cap:** with this in place, the tracheostomy is effectively blocked off. This is the hardest stage of weaning for the patient, as airways resistance will be higher than when the tracheostomy is subsequently removed. The patient should usually have a fenestrated tracheostomy with a fenestrated inner tube in situ, and the cuff deflated all the time that the decannulation cap is in place.

Predictors of decannulation:

- The patient can tolerate four hours or more breathing around a tracheostomy of at least size 7.0mm occluded with a decannulation cap. This suggests that they will tolerate decannulation without suffering from airway obstruction [8].
- The patient can tolerate four continuous hours with a decannulation cap and is able to expectorate pulmonary secretion effectively. Removal of the tracheostomy is indicated.

It is important to be aware that the decannulation cap completely occludes the tracheostomy. The work of breathing in this situation can be difficult and may not be tolerated by some patients. Failure to tolerate a decannulation cap is not necessarily an indication to leave the tracheostomy in-situ. Look at the overall condition of the patient. If they have good motor power, full head control, are conscious and alert, success is much more likely than if they have a weak cough and are obtunded.

## Decannulation

The procedure is usually straightforward, but adequate assessment and preparation as outlined above is required to maximise success.

The optimal time for decannulation is usually the early morning when the patient has rested overnight and their condition can be observed during the daytime.

After decannulation the stoma should be covered with a semi-permeable dressing. The patient should be instructed to apply gentle pressure with their fingers over the site when coughing. There is no need to apply a more rigid dressing to occlude the site.

In the event of a failed decannulation, the following equipment must be available to provide oxygenation, ventilation and a patent secure airway:

1. airway devices
  - a. a range of tracheal and tracheostomy tubes
  - b. laryngoscopes, bougies, airway exchange catheters, and aides to intubation
  - c. laryngeal masks

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- d. ready access to a fibre-optic bronchoscope
2. a means of oxygen insufflation if the airway becomes obstructed
  - a. e.g. a suction catheter or airway exchange catheter which can be advanced through the stoma and connected to an oxygen supply
3. a means of ventilatory support e.g. self-inflating bag or Mapleson C circuit
4. a means of reopening the stoma: tracheal dilator forceps
5. access to a tracheostomy kit
6. effective suction equipment
7. monitoring which should include; ECG, pulse oximeter, automated BP recordings, with ready access to a capnograph if it is necessary to reintubate the patient
8. anaesthetic drugs, vasopressor agents, atropine
9. access to resuscitation equipment such as defibrillator

An example of a form to document care variables on a daily basis is included in the appendix.

### Post Decannulation Observations

The patient should be observed for signs of respiratory distress including:

- Dyspnoea
- Laboured or noisy respiration, stridor
- Increased respiratory rate and heart rate
- Excess use of accessory muscles
- Diaphragmatic respiration
- Agitation
- Oxygen desaturation

### Long Term Follow Up

It is recommended that all patients who have had a tracheostomy be reviewed prior to hospital discharge for evidence of wound infection, excess scar tissue/distortion, a persistent stoma, or evolving stenosis. Tracheal stenosis, either from the pressure of the cuff, or more commonly at the stoma site [9, 3], is often not recognised and should be considered in all patients with symptoms, such as stridor or breathlessness on exertion. Such symptoms may be gradual in onset and may only be present on exercise and be minimized by the patient who is often expecting to feel unwell post discharge from ICU. Patients may rarely require tracheal surgery such as stenting or even tracheal resection and should be referred to ENT for a panendoscopy.

**All patients who have undergone tracheostomy should be followed up.**

## 8. Summary

### Insertion:

This guideline does not cover emergency tracheostomies.

- A planned tracheostomy should be performed by medical practitioners who have been trained, and are competent in the procedure, or are under direct supervision. Two trained medical practitioners plus a third member of staff to assist is the minimum staffing. Hospitals should maintain a list of practitioners competent in the procedure.
- All Critical Care Areas should have a Difficult Airway trolley.
- Bronchoscopy should be available and its routine use is beneficial.

### Tracheostomy tube choice:

- Tracheostomy tubes should be chosen to suit the patient. The requirements of a patient may change over time. The need for excessive cuff volume or pressure suggests that the tube size may be too small or it may be misplaced.
- Tracheostomy tubes with an inner cannula are inherently safer and are normally preferred.
- Most tracheostomy tubes are sized by internal diameter in millimetres, but this may not take account of the inner cannula in all cases. Tracheostomy tubes with the same internal diameter ('size') may have quite different external diameters and length.
- Fenestrated tracheostomy tubes should be used with caution in mechanically ventilated patients and only in patients who are weaning from ventilation.
- It is essential that the staff caring for a patient with a tracheostomy know the type of tube that is in place. This should be clearly documented in the patient's notes.

### Routine care:

In order to avoid complications, the main priorities are humidification; secure fixation of the tube and attention to cuff pressure. Inner tubes should be changed 4 hourly, the entire tube should be changed at least every 30 days. The type of tube should be clearly documented.

- Cuff pressure should not exceed 25 cm H<sub>2</sub>O.
- If an air leak occurs with the cuff pressure at the maximum recommended, the tracheostomy may have become displaced or may require changing: medical or other health care professionals competent in tracheostomy management should review the patient.
- The cuff should be deflated to remove the tube, to allow the patient to eat or drink and when a speaking valve or decannulation cap is attached to the tube. Failure to deflate the cuff when the speaking valve or decannulation cap is attached to the tube will result in a total occlusion of the patient's airway.
- Humidification is essential for patients with temporary tracheostomies.
- Any difficulty in passing the suction catheter should lead to consideration that the tube may be partially blocked, badly orientated or misplaced and requires immediate attention.

### Changing tracheostomy tubes.

- Tracheostomy tubes should only be changed by staff who are competent to do so. Most will be doctors, but there are specialist non-medical practitioners who have the necessary skills.
- Doctors who have not had relevant training will not have competency in this area, and should not undertake the procedure unsupervised.
- It is essential that if the new tube cannot be inserted or is misplaced, there is an agreed procedure for managing the situation.

### Emergencies:

Respiratory difficulty should lead to an urgent assessment of the airway, and to consider whether the tube has become displaced or blocked.

- Every ward looking after patients with a tracheostomy must have a clear procedure for such emergencies. Staff must be aware of this, and be trained appropriately.
- In an emergency situation staff attending need to be aware that 'bag and mask' ventilation is not possible with a cuffed tracheostomy tube *in situ*.
- Changing inner cannula will usually relieve the obstruction. If tracheostomy is partially displaced, it may be safer to remove it than to reinsert it if senior staff are not present.
- Bleeding is usually minor, but the risk of severe bleeding must always be considered.

### Weaning and decannulation.

Tracheostomies should be removed as soon as they are no longer required. The person or team responsible for tracheostomy management must be clear, particularly if it is not the specialty with primary responsibility for the rest of the patient's care.

It is important to ensure that the cuff is deflated and that the patient can breathe through their upper airway. All patients should be followed up for long term complications.

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### Further reading

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### Appendices

#### Appendix 1

#### Information for patients and their relatives

Many patients on the Intensive Care Unit (ICU) need a ventilator (breathing machine) to help with their breathing. The ventilator has to be connected to the patient by a tube in the trachea (windpipe). This is usually done using a plastic tube in the mouth which passes through the larynx (voice box) to reach the trachea. It is safe to leave the tube in place for several days, although most patients find the presence of a tube in the throat to be very uncomfortable, and require sedative medication to make the tube acceptable.

The prolonged presence of a tube in the throat makes it difficult to keep the mouth clean, and can also lead to physical damage to the mouth, larynx and trachea. A tracheostomy can be useful by avoiding some of these problems. We are recommending a tracheostomy as we believe that you/your relative will need help from the ventilator for some time to come.

#### What is a Tracheostomy?

A tracheostomy is a hole in the front of the neck into the trachea (windpipe). A tube can then be inserted through this hole into the trachea in order to allow the patient to be connected to a ventilator and to allow access for suction.

#### Why do I/my relative need a tracheostomy?

There are a number of reasons why a tracheostomy may be beneficial

- A tracheostomy tube is far more comfortable than a tube in the mouth. Most patients with a tracheostomy require little or no sedation. This means that they can be more awake, more comfortable and may allow them to breathe for themselves at an earlier stage. This can actually reduce the time attached to a ventilator.
- A tube in the mouth can cause physical damage to the structures through which it passes, including the larynx (voice box), leading to problems later on with speaking.
- There are specific reasons why some patients may particularly benefit from a tracheostomy. These are usually because of the particular illness which has caused the need for ventilation. The doctors in ICU will discuss any specific reasons with you.

#### Is it safe? Are there any risks?

Generally speaking, a tracheostomy is safe, but, like any procedure, there are some risks and complications. A tracheostomy is only performed when the potential benefits outweigh the potential risks.

The risks of having a tracheostomy may be associated with the procedure itself, the fact that an opening is made into the trachea (windpipe) and to the presence of a tube in the trachea. Most of the complications are minor and of no great significance. However, very occasionally, a severe complication may arise which may necessitate intervention.

The major risks associated with the procedure are: -

- Bleeding. The front of the neck contains several blood vessels, which may bleed during the formation of a tracheostomy. These can usually be dealt with very simply but occasionally require a surgical operation in the operating theatre.
- Pneumothorax. This is when air is in the chest but outside the lung, causing the lung to collapse. It can occur because of damage to the pleura (the lining surrounding the lung) or the trachea (windpipe) itself. It usually requires a drain to be placed in the chest.
- Infection. The tracheostomy can become contaminated with bacteria, either from the patient's own skin or from the secretions coughed up by the patient. Serious infection is rare.

## How is a Tracheostomy done?

A tracheostomy may be performed 'percutaneously' or 'surgically'. Whichever method is used, you will be given a general anaesthetic.

The percutaneous (meaning "through the skin") techniques involve making a small cut in the skin on the front of the neck and inserting a needle through this into the trachea. A guide-wire is then passed through this needle, and the hole around it is stretched until the tracheostomy tube can be inserted into the trachea. This is normally done in the Intensive Care Unit

The open surgical technique involves making a larger incision into the neck and cutting down into the trachea, allowing a tracheostomy tube to be inserted into the trachea. This is normally done in the Operating Theatre.

Most tracheostomies are now performed using a percutaneous technique, but the technique is not suitable for all patients. Your doctor will be happy to explain in more detail which technique is best for you (your relative).

## What happens afterwards?

Most tracheostomies in ICU are temporary and removed when no longer required. This may be before or after the patient leaves ICU. The tracheostomy is usually removed sometime after the patient is off the ventilator, but is sometimes left in longer especially if the patient is sleepy, or has difficulty in getting rid of chest secretions.

Sometimes a valve can be attached to the tracheostomy that allows the patient to speak. This is not possible for all patients; it depends on the condition of the individual.

After the tracheostomy tube is removed, a dressing is applied to the hole and secured with tape. The hole will usually close fairly quickly, and within a week to ten days after removal, the hole will have sealed off, leaving only a small scar.

## Are there any long-term problems?

Patients who have had a tracheostomy are potentially at risk from developing scarring of the inside of the trachea (windpipe), which can lead to narrowing of the trachea. This is called tracheal stenosis and can also occur with the tracheal tube. Investigations have shown that this can occur as many as 40% of patients who have had a tracheostomy, but usually cause the patient no problem. Very rarely, patients with tracheal stenosis develop noisy breathing as the air passes through the narrowed part of the trachea. In the event of this happening, the patient's General Practitioner is advised to refer them to an Ear, Nose and Throat surgeon for investigation and treatment.

Appendix 2

Tracheostomy Tubes

Table. Physical characteristics of some tracheostomy tubes					
Tube	material	stiffness	curvature or angulation	angle (°)	notes
Mallinckrodt armoured adjustable flange		soft		100	Spiral wire reinforced wall
Shiley		semi-rigid	curved	90	
Shiley® Tracheosoft XLT			angulated	90	
Mallinckrodt PERC					Designed for use with the Cook® percutaneous tracheostomy kit
Portex® Blue Line®	PVC	medium	curved	90 ?105	thermo labile PVC allows tube to soften in vivo. Portex® Blue Line®, Blue Line Ultra® and PERC® are compatible with a customised percutaneous tracheostomy kit.
Portex® Blue Line Ultra®	PVC	medium	curved	90?105	
Portex® adjustable flange	PVC	medium	angulated	110	
Portex® Per-Fit®	PVC	medium	curved		
Portex ® Blue Line Ultra® Suctionaid	PVC	medium	curved	105	
Bivona® Aire-Cuf® adjustable flange	Silicone	Soft	n/a	n/a	wire reinforced for kink-resistance
Bivona® Aire-Cuf® adjustable flange	Silicone	Medium	curved	90	
Kapitex® Tracoetwist®	Polyurethane	semi-rigid		90	
Kapitex® Tracoevario®	?	Soft			option for spiral wire reinforcement available

Table. Extended length adjustable flange tracheostomy tubes				
	ID (mm)	OD (mm)	length (mm)	
Portex® Adjustable Flange	6.0	8.2		Semi-rigid preformed tube with total length of 100 mm. Distinct angulation limiting maximum proximal length to 40mm. Constructed using thermosensitive polyvinylchloride that softens at body temperature. No inner cannula. Not specifically designed for compatibility with percutaneous introducer kits.
	7.0	9.6	91	
	8.0	10.9	104	
	9.0	12.3	119	
	10.0	13.7		
Bivona ® Mid-range Aire-Cuf®	6.0	8.7	110	Flexible spiral wire-reinforced silicone shaft. No angulation and seamless variability in position of flange and the resulting proximal and distal lengths. No inner cannula. Not specifically designed for compatibility with percutaneous introducer kits.
	7.0	10.0	120	
	8.0	11.0	130	
	9.0	12.3	140	



Rusch® Ultr Tracheofix®	7.0	10.8	82	Siliconised PVC construction with kink resistant spiral steel wire reinforcement. Pre-formed angulation with distal length ranging from 45 to 62mm. Long low pressure high volume cuff. No inner cannula. Not specifically designed for compatibility with percutaneous introducer kits.
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<b>Table. Extra-length preformed Portex® Blue Line® tracheostomy tubes</b>				
Extra Horizontal Length				
ID (mm)	OD (mm)	Horizontal Length (mm)	Total length (mm)	Currently only available in North America. Thermosensitive siliconised PVC construction. No inner cannula.
7.0	9.7	18	84	
8.0	11.0	22	95	
9.0	12.4	28	106	
Extra Vertical Length with Double Cuff				
ID (mm)	OD (mm)	Vertical Length (mm)	Total length (mm)	Thermosensitive siliconised PVC construction. No inner cannula. Constructed with two independently inflatable cuffs.
7.0	9.7	41	83	
8.0	11.0	45	93	
9.0	12.4	48	103	
10.0	13.8	52	113	

<b>Table. Shiley® TracheoSoft® XLT Extended Length tracheostomy tubes</b>					
Proximal extension					
ID (mm)	OD (mm)	Total length (mm)	Proximal length (mm)	Radial length (mm)	Distal length (mm)
5.0	9.6	90	20	37	33
6.0	11.0	95	23	38	34
7.0	12.3	100	27	39	34
8.0	13.3	105	30	40	35
Distal extension					
5.0	9.6	90	5.0	37	48
6.0	11.0	95	8.0	38	48
7.0	12.3	100	12.0	39	49
8.0	13.3	105	15.0	40	50
Provided with disposable inner cannula with integral 15mm twist lock connector. Available with or without high volume / low pressure cuff.					

**Appendix 3**

**TRACHEOSTOMY CARE**

Patient addressograph

**WARD BASED APPRAISAL OF NEED**

**DATE OF TRACHEOSTOMY:**

**TUBE TYPE:**

**SIZE:**

**FENESTRATED: Y/N**

(Y = YES, N = NO, √ = satisfactory, CFC = cause for concern)

DATE:							
PREVIOUS TUBE CHANGE ?Problems-Y/N							
GCS							
CPAP DEPENDENT Y/N							
O <sub>2</sub> DEPENDENT % FiO <sub>2</sub>							
BREATHING RATE/PATTERN							
Speaking Valve Y/N how long?							
Occlusion Cap Y/N how long?							
AIRWAY VOICE Strong/Weak?							
SWALLOW assessment?							
COUGH strong/weak/into mouth?							
SECRETIONS ?sticky/infected							
SUCTION No./24 HRS							
EXCESS DEMAND?e.g. Anaemic/pyrexial/ LV Function							
? Abdominal Distension							
FAILED Decannulation?							
WEANABLE ?Cuff Deflated							
Formal SALT assessment?							
DOCTOR /PHYSIOTHERAPIST:							

**Appendix 4****Changing a tracheostomy tube****Procedure for changing a tracheostomy tube**

1. Equipment – see “Basic equipment”, Chapter 4
2. Explain the procedure to the patient – verbal consent should be obtained if appropriate.
3. Ensure the patient has been nil by mouth for a minimum of 4 hours and aspirate the nasogastric tube present.
4. Position the patient - semi-recumbent position.
5. Pre-oxygenate the patient if they are oxygen dependent. Monitor oxygen saturations in all patients.
6. Check the cuff of the new tracheostomy tube for leaks. Check that the introducing obturator is easy to remove.
7. Lubricate the new tracheostomy tube.
8. Remove the old tracheostomy dressing and clean around the stoma site.
9. Clear the oro-pharynx of secretions and deflate the tube cuff using the synchronised cuff deflation and suction technique.
10. If you are inserting the new tracheostomy tube using an introducer obturator, remove the old tube in an ‘out then down’ movement on expiration. Insert the new tube into the stoma with the introducer in the tracheostomy tube lumen, ensuring that the first movement is 90° to the cervical axis, then gently rotate down to allow passage into the trachea. Remove the obturator immediately.
11. If using an airway exchange device, after the patient has stopped coughing pass it through the tracheostomy to just beyond the tip of the tracheostomy tube. Remove the tube leaving the exchange catheter in place, and railroad the new tracheostomy over it during expiration.
12. Remove the bougie, inflate the cuff and administer oxygen.
13. Where appropriate, insert the inner cannula and check the cuff pressure.
14. Confirm normal chest movement, air entry and oxygen saturation. Auscultate the lung fields and palpate for surgical emphysema if the change has been difficult.
15. Clean the stoma site as necessary, change the dressing and secure the

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tracheostomy tube with a tube holder.

16. Record tube change in the medical notes, document time, date, size, type of tube and any complications

- **If tube insertion fails or patient becomes compromised and cyanosed**
  - **Ensure appropriately experienced personnel are in attendance.**
  - **Use tracheal dilator and attempt to reinsert same tube**
  - **If this fails, attempt to insert smaller size tube**

**If this fails administer oxygen via the stoma or cover the stoma site, open the patient's airway and administer oxygen via a facemask and consider orotracheal intubation if respiratory difficulty – see blocked/dislodged tube algorithm**

We would welcome comments on this document and suggestions for other standards in intensive care.

Please send any comments to: [admin@ics.ac.uk](mailto:admin@ics.ac.uk)