Standards for the care of adult patients with a temporary Tracheostomy; STANDARDS AND GUIDELINES

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1. Executive summary

Insertion techniques
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 senior bedside supervision.

The minimum staffing required is 2 trained medical practitioners plus a third member of staff to assist.

All Critical Care Areas should have their own Difficult Airway trolley.

Endoscopy should be readily available and its routine use is likely to improve the safety of insertion procedures and management of airway problems thereafter.

A recent NCEPOD study has confirmed a relatively low frequency of serious peri-procedural complications in ICU patients receiving a tracheostomy.

Tracheostomy wherever performed is a surgical procedure. As highlighted in the recent NCEPOD report; practices would be improved by national data collection of tracheostomy and other airway procedures, introduction of WHO style preoperative checklists and more consistent consent procedures.

Tracheostomy tube choice
Tracheostomy tubes should be chosen to suit the individual 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 that it may be misplaced.

Tracheostomy tubes with an inner cannula are inherently safer and are normally preferred. In situations where ventilation is difficult (high FiO_2 or high airway pressures) the risks of repeated circuit disconnection to facilitate inner cannula care must be balanced on a daily basis.

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 (‘manufacturer’s reference 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.

Obese patients, or those with abnormal anatomy, or a low tracheostomy stoma may require a longer adjustable flange tube or a tube with a fixed extended distal or proximal portion.

Routine care
In order to avoid complications, the main priorities are humidification, ensuring the cleanliness and patency of the inner tube, secure fixation of the tube and attention to cuff pressure.

The same care should be taken when moving, handling and nursing a patient with a tracheostomy as with any other invasive airway device.

In non-ventilated patients the inner cannula should be regularly removed, cleaned or changed at a maximum interval of 4 hourly in a patient with a productive chest, and at least 8 hourly in all cases, being cognisant of the patient's need for sleep and rest.

In mechanically ventilated patients, an inner cannula is desirable as a safety measure but routine cleaning or changing needs consideration against the risks of de-recruitment and infection. In this group replacement inner cannula, should be immediately available at the bedside and replaced if ventilator parameters suggest narrowing of the cannula with secretions.

The entire tube should be changed at least every 30 days or as per manufacturer's recommendations.

Cuff pressure should not exceed 25 cm H_2O.

If an air leak occurs with the cuff pressure at the maximum recommended, the tracheostomy may have become displaced or may require changing or resizing.

Failure to deflate the cuff when a 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, competent to do so.

Patients should be monitored at levels appropriate to their condition, and the predicted ease or difficulty of replacement. Technologies to confirm correct placement should be immediately available (capnography and endoscopy).

It is essential that if the new tube cannot be inserted or is misplaced, there is an agreed procedure for managing the situation. A 'Plan B' should be discussed and agreed, with appropriate equipment and drugs available as necessary.

Emergencies

Detailed guidance is available nationally form the National Tracheostomy Safety Project (NTSP, www.tracheostomy.org.uk).

Respiratory difficulty should lead to an urgent assessment of the airway, and to consider whether the tube has become displaced (inside or outside the trachea), 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. Creating designated 'safe' locations within an organisation and cohorting tracheostomy patients together may improve the quality and safety of care.

In an emergency situation attending staff need to be aware that 'bag and mask' ventilation may not be possible via the upper airway if a cuffed tracheostomy tube remains in situ within the trachea, or the patient has had a laryngectomy.

Changing an inner cannula will often relieve the obstruction.
If the tube is obstructed or angulated within the trachea then simple procedures such as deflating the cuff may relieve obstruction and buy time.

If the tracheostomy tube is partially displaced, it may be safer to remove it, rather than to reinsert it if experienced senior staff are not present.

Bleeding problems are usually minor, arising from vessels within the stoma, but the risk of severe bleeding from erosion of major paratracheal vessels (including concealed bleeding) must always be considered. Blood clot in the airway can cause partial or complete airway obstruction.

Weaning and decannulation
Tracheostomy tubes should be removed as soon as they are no longer required. The person or team responsible for tracheostomy management must be clearly defined, 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, before any longer term occlusive test of the tracheostomy is undertaken. Prior to decannulation, an assessment of the upper airway should be undertaken. This may be clinical or require fibreoptic inspection, and may require multi-disciplinary expertise in complex cases.

Discharge and follow up
Discharge to a ward requires careful planning and suitable trained staff to look after patients. Similar issues apply to the patient discharged home with a tracheostomy. All patients should be followed up to assess long-term complications following an ICU tracheostomy. Responsibility for this may rest with Head and Neck surgical teams for surgical patients. Robust local arrangements must be developed to ensure adequate follow up of non-surgical patients, including those transferred to other centres. This

is a good potential project for a national audit, as currently the true frequency of such problems is not known.

The NCEPOD report and others highlight the importance of truly multidisciplinary tracheostomy management with key team members including Critical Care, Head & Neck Surgery, Nursing, Respiratory Medicine, Speech and Language Therapy, Physiotherapy, Dietetics and other allied health professionals. These teams must work closely with the patient and their families/carers to ensure high quality, safe, timely and co-ordinated care. Critical Care staff should be encouraged and supported in contributing to these teams, with allocated time, both inside and outside the ICU.

2. Introduction

This is the second revised ICS standards document on tracheostomy care. The first was prompted by an appreciation of a national need to improve the care of tracheostomies in both ICU and on general wards. Such concerns were raised in part by referrals to MHRA, NPSA, Coroners and other bodies. The NAP4 audit, NCEPOD study 2014, and other reports highlight continuing issues: namely obstruction, dislodgement, bleeding, hypoxaemia and cardiac arrest. The release of this document has been timed to coincide with launch of the NCEPOD report in June 2014.

Since the original ICS Standards, there have been a number of detailed national guidelines, which are referred to in this document. We have tried here to provide a reasonably concise overview, referring to more detail available elsewhere. Key initiatives include the National Tracheostomy Safety Project (NTSP) and Global Tracheostomy Collaborative.

Tracheostomy is a common procedure in intensive care units (ICUs), with an estimated 15,000 insertion procedures in the UK annually (extrapolated from North West regional data). The NCEPOD study estimates that the figure is around 12,000 overall for adult procedures performed in both critical care (approx. 70%) and theatres (30%), in England, Wales and Northern Ireland. It is also likely, but not documented, that there is an increasing number of patients being admitted/readmitted to ICUs with a tracheostomy already present. NCEPOD highlights that such information on airway management techniques is not currently available on UK national ICU databases.

As with all procedures, the benefits are associated with risk, both during and after insertion. The most common problems, in both general and critical care wards, are related to obstruction or displacement. Recent developments have increased the significance of these issues for the NHS. These include: 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. This highlights a number of issues including: Which designated areas in individual hospitals should care for patients with tracheostomies and what training and standards are required?

Historically, the indications for a temporary tracheostomy in ICUs centred upon treatment for upper airway obstruction, the avoidance of the laryngeal complications of prolonged tracheal intubation, and to provide some protection to the airway in patients with severe neurological injury. Today, temporary tracheostomy is increasingly used earlier in the management of the general critical care population. Two factors have probably contributed to this change: 1. the belief that it reduces sedation requirements and promotes earlier weaning and mobilisation; 2. the development of percutaneous dilational techniques (PDT), which enable a temporary tracheostomy to be safely and quickly inserted by critical care physicians as a bedside procedure. However studies related to early versus late tracheostomy (e.g. The UK Tracman study) have failed to show benefit from early procedures, in terms of a reduction in mortality or hospital length of stay.

At the same time, pressure on ICU beds and a desire to use resources effectively has encouraged earlier discharge to intermediate level and ward based care. This means that patients with temporary tracheostomies are discharged from Level 3 care and looked after in multiple locations throughout an organisation. This creates a risk that they are cared for separately from the clinical services, which is best placed to identify and treat the potentially life-threatening complications associated with a temporary tracheostomy. It is very important that there is clear documentation and communication, together with explicit responsibility and training for all the healthcare staff involved. As a result of such concerns national guidance has evolved (NTSP).

The main focus of this document is on the care of adult patients with a temporary tracheostomy, generally initially inserted percutaneously in critical care areas. This is numerically the largest group of patients with tracheostomy, but the standards should be applicable to patients in other situations e.g. patients admitted either electively or as an emergency with a tracheostomy in situ, and the laryngectomy patient. The authors acknowledge that there is a limited evidence base for many of the recommendations. 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. Readers will find it useful to also refer to the NTSP Manual 2013, the Global Tracheostomy Collaborative and St Georges tracheostomy guidelines, for sample policies and integrated care pathways. This is particularly the case for specific nursing procedures.

The success of PDT procedures, and centralisation of relevant surgical services, in particular ENT, means that in many hospitals tracheostomy insertion, removal, troubleshooting and complication management, by default, becomes the responsibility of intensive care medical staff and associated outreach services. These roles need to be recognised, funded and formalised if adequate support to wards is to be provided. Acute hospitals are usually supported around the clock by Critical Care and Anaesthesia, who are also responsible for performing the majority of tracheostomies. It is therefore partly our responsibility as a profession to ensure the highest standards of routine and emergency care, even when patients have left the ICU. The multidisciplinary nature of tracheostomy care is a familiar working environment for our speciality. We should ensure that our own medical, nursing and allied health staff, and those working on wards, are able to safely manage this vulnerable patient group.

3. Insertion

A tracheostomy may be fashioned by an open surgical or percutaneous dilatational technique (PDT), either as an emergency, emergent or elective procedures, 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 surgical or PDT over each other. The choice will be affected by available expertise, local practices, and individual patient characteristics. Surgical techniques are in the realm of the specialist surgeon and will not be further described. At present, intensivists using PDT perform the majority of tracheostomies undertaken in the critically ill adult patient 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 that for a surgical rather than PDT.
Contra-indications and cautions
Issues surrounding consent (most ICU patients will lack capacity)
Equipment and monitoring
Staffing issues, particularly relating to training and competence
Documentation, follow-up and audit

WHO style checklist.

Following the success of WHO style checklists in theatres, NCEPOD recommended adoption of similar approaches in relation to tracheostomy procedures in critical care units. This approach has merit and a sample form is provided in their document.

1. Indications for a temporary tracheostomy

The traditional indication for an emergency tracheostomy was an imperative to bypass an obstructed airway. In contrast the majority of tracheostomies on an 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 to date there is no strong evidence to guide such timing. The Tracman study of early versus late tracheostomy demonstrated neither a mortality advantage, nor a reduction of length of stay in ICU or Hospital, but there was a reduction in days of sedation with early tracheostomy. Timing of tracheostomy therefore relates to individual practitioners experience, local facilities and expertise and individual patient factors and casemix.

The NCEPOD audit noted that 18% of patients underwent decannulation in under 7 days in the critical care unit, and 85 of 141 patients who had an early decannulation did not undergo a trial of extubation before tracheostomy insertion. This might suggest that some patients could avoid a tracheostomy procedure by a trial of extubation or a longer period of translaryngeal intubation.

Commonly recognised indications for tracheostomy in the critically ill are listed in the box below. These typically follow a few days translaryngeal intubation whilst the

patient's condition is stabilised and their potential for early recovery and extubation is assessed. Tracheostomy provides a medium to longer term solution to airway care.

Common Indications for tracheostomy

- **To maintain the airway;** e.g. reduced level of consciousness, upper-airway obstruction, intubation difficulties
- **To provide some protection to the 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 PDT is severe local sepsis or an uncontrollable coagulopathy. Surgical tracheostomies often require a transfer to theatre, which may present logistical challenges and potential delays. However, an open surgical procedure may be judged to be the best option in the following circumstances, depending on local expertise:

Cautions and relative contraindications to PDT

- **Difficult anatomy**: e.g. morbid obesity, lack of neck mobility, proven or potential cervical spine injury, known difficult intubation, tracheal pathology, thyroid pathology, and aberrant vessels.
- **Significant coagulopathy**
- **Proximity to site of recent surgery or trauma**: e.g. carotid endarterectomy, anterior cervical fixation, sternotomy, oesophageal drainage, and burns.
- **Potential instability:** e.g. patients unable to tolerate cardiovascular or respiratory changes, such as those with unstable 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

Note; many of the above are also relative contraindications for an open procedure, and are certainly a reason to further assess overall risk benefits.

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 if this is possible. Nevertheless it is the responsibility of medical staff to act in the best interests of patients lacking capacity, rather than pass the responsibility for consent to the next of kin. The role of the next of kin in healthcare decision-making is increasingly formalised under the 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 with visual aids in the first instance, and an example of this is provided in the Appendix. It should be emphasised that like all surgical interventions, this procedure is not undertaken lightly and is not risk-free, however nor is prolonged translaryngeal intubation. Inconsistencies and lack of documentation in consent processes were highlighted in the NCEPOD report.

4. Equipment and monitoring

a. tracheostomy equipment

There are a number of commercially available PDT kits and tubes, which periodically evolve, but those presently available follow similar principles. There is no evidence to justify recommending a particular product but consideration should be given as to the choice of tube as well as insertion kit. Ideally the two devices should be manufactured to match each other to minimise trauma on insertion. 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 regulates the manufacturers of medical devices), and the NPSA (www.mrha.gov.uk). The choice of tracheostomy tube is discussed in a later section. Of interest NICE recently considered the translaryngeal tracheostomy device but did not come to definite conclusions nor compared performance against other devices.

There is increasing realisation that in many patients, particularly those with marked obesity or anatomical distortion, conventional length tracheostomy tubes are too short and this was highlighted in NAP4 and NCEPOD reports. The need for a longer adjustable flange tube, or tubes with fixed extensions of the distal or proximal portion, should be assessed on an individual patient basis, and changes may be needed mid or end of procedure if the stoma is found to be deeper than anticipated, and the tip of the tube does not lie in a safe or satisfactory position. Preparation for this possibility should be made before starting the procedure. Tube tip position should be assessed by endoscopy during placement and documented.

b. airway rescue

Regardless of which PDT technique is chosen, clinicians must be prepared for the possibility of losing the airway during insertion and difficulties in re-securing it. A comprehensive dedicated ‘difficult airway’ trolley equivalent to that found in operating theatres, the completeness and availability of which is confirmed prior to starting, must be available on the ICU. The contents of the trolley should include a range of tracheal tubes, laryngoscopes, bougies, airway exchange catheters, laryngeal mask airways, paediatric facemasks, and cricothyroid needles/cannulae for emergency oxygen insufflation. NCEPOD reported that nearly 10% ICUs didn’t have a Difficult Airway trolley and over 20% didn’t have access to immediate endoscopy. NICE have recently reviewed the disposable Ambuscope and it is likely that such devices will become increasingly used in this context in the future.

All Critical Care Areas should have their own, appropriately stocked and checked Difficult Airway trolley to deal with airway and tracheostomy emergencies.

c. monitoring

Routine intensive care monitoring of ECG and SpO_2 is assumed for these patients. Invasive blood pressure monitoring should be used, given the potential for abrupt changes in blood pressure with either administration of anaesthetic agents or the stimulation of the procedure. Capnography is mandatory during airway

manipulations, tracheostomy insertion and subsequent invasive ventilation in critical care areas. An arterial line is also required for rapid serial ABG analysis.

d. ultrasound
Ultrasound is of value to identify tracheal rings, blood vessels and the thyroid. Ultrasound cannot easily visualise structures within the air filled trachea, nor the tracheal cannulation procedure itself, and the probe 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 anterior 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 and distal tube within the long axis of the trachea
- Confirmation from within the tracheostomy tube that this is within the tracheal lumen, orientated parallel to the tracheal walls, an appropriate distance from the carina, and that there is no active bleeding into the trachea. This should be documented post procedure as recommended by NCEPOD.
- Light enhancement to aid the identification of a deep-seated trachea,

The potential problems associated with endoscopy include:

- Impairment of ventilation,
- Increased risk of tube displacement during endoscopic manipulation
- Expensive damage to endoscope by a seeker or introducer 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, resistant to puncture, and if designed for vision rather than suction, will have a significantly smaller cross-sectional area with less impairment to ventilation. There are now disposable scopes which may be more convenient, available and cost effective solutions, particularly for more occasional use (see above).

Suitable Endoscopes should be available and their routine use is likely to improve the safety of insertion procedures. Predictable difficulty due to aberrant anatomy or a previous tracheostomy would require justification for not using an endoscope, as would any difficulty in accessing the trachea or complications such as haemorrhage during repeated attempts at insertion.

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

- adequate space and lighting
- sufficiently clean to support an aseptic approach
- a bed capable of tipping and suitable for resuscitation

- monitoring facilities
- support staff, familiar with the requirements of the procedure and resuscitation
- anaesthetic/emergency drugs and full resuscitation equipment including chest drains
- access to x-ray equipment

6. Anaesthesia

Tracheostomy is a surgical procedure that requires adequate anaesthesia. Although it can be performed under local anaesthesia alone, patient comfort and operating conditions are generally superior under general anaesthesia, with use of neuromuscular blocking agents and assisted ventilation. Levels of sedation and analgesia utilised to tolerate a tracheal tube and assisted ventilation in the average patient on ICU do not equate to 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, plus injection of local anaesthesia at the site of incision. The use of depth of anaesthesia monitors may be helpful.

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. Suitable alternative plans for re-intubation and oxygenation should be formulated in advance with appropriate equipment and expertise immediately available.

The precise technique for withdrawing the endotracheal tube sufficient to allow access to the trachea is a matter for the individual practitioner. It should be appreciated that difficulty in accessing the trachea may be attributable to the physical presence of the endotracheal tube in the upper trachea. Video-laryngoscopes may make airway manipulations easier and potentially safer, especially when withdrawing an ETT from a patient who is placed in an unfavourable head position for conventional direct laryngoscopy.

Consideration should also be given to post-procedural analgesia.

7. Staffing

Two trained 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 the procedure, equipment and environment and able to support clinicians in the management of any complications that might develop.

PDT, anaesthesia and related airway care should only be performed by those competent in these procedures, or under direct supervision by a competent doctor. Individual hospitals should have groups of competent practitioners, who can provide a training programme.

Two trained medical practitioners plus a third member of staff to assist is the minimum staffing.

Expertise in PDT 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.

Key elements for training for PDT are detailed 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. Percutaneous Tracheostomy Technique.

A brief summary of technique for PDT is given in appendix. It is not intended as a comprehensive manual, but defines some elements.

4. 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. Although compatibility with the insertion kit is an important consideration, it cannot override the need to choose the correct tracheostomy tube for a patient, even if this makes a PDT more difficult, or impossible, requiring conversion to a surgical technique.

There is a wide range of tubes available, with differing characteristics, and even for an individual patient, what is required of a tracheostomy tube may vary with time and changing clinical circumstances. Clinicians should make an informed choice of which tubes to stock and 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 below.

Respiratory function: Most temporary tracheostomies will be inserted whilst a patient is on an ICU and still requiring some positive pressure ventilation. Typically this will require the use of a non fenestrated cuffed tracheostomy tube. However 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, or those with local neck swelling or oedema, may require a tube with an extended proximal length, whilst patients with fixed flexion abnormalities may not easily accommodate tubes with a fixed angulation (NAP5 and N CEPOD).

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 protection and weaning problems: Many patients can be weaned to decannulation without any need to change from the cuffed tracheostomy tube initially inserted. In problematic cases, 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, which may reduce the risks of VAP. The introduction of a speaking valve may also aid swallowing and secretion control, and assist in ‘re-training’ the larynx after periods of disuse.

Obstructed / absent upper airway: Patients with an obstructed 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.

Bed head information signs or other similar easily accessible documentation such as an Integrated Care Plan or Passport (containing critical and emergency details) have recently been proposed and adopted by an increasing number of centres worldwide. Their use is to be encouraged in the ICU and they can follow the patient if discharged with a tracheostomy in situ (See NTSP for samples). This and other documentation could be seen as part of the so called "patient passport" where vital information travels around with the patient, as suggested in NCEPOD report.

The manufactured 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. length of the tube proximal and distal to angulation), shape and angulation
- Compatibility with percutaneous insertion kit
- Presence and nature of tube cuff
- Presence of inner cannula (dual cannula tracheostomy)
- Subglottic suction devices
- Fixed versus adjustable flange
- Presence of fenestration
- Specialist features, e.g. low contour on deflation tight to shaft cuffs, voice enhancement tubes etc

It is essential that 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, tracheostomy documentation and a bedhead sign. An emergency pack containing a tube of the same size must be available at the bed side

Choosing the correct size and shape of tracheostomy tube.

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

Diameter
When selecting the size of tube, 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) 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). Trauma on insertion is also an important consideration.

Length and shape

There may be a clinical need to insert non-standard length tubes, e.g. with abnormal anatomy, obesity, trauma, fistulae, infection, oedema or burns. Stomal depth can be estimated with finger, forceps, depth markers in insertion kits or endoscopy.

Extended length adjustable flange tubes are available from a number of manufactures including those for PDT and with removable inner cannula. Some manufacturers offer a short delivery time bespoke service should none of their stock items be suitable.

Inner cannula/tube/lumen (dual cannula tracheostomies)
Many tracheostomy tubes are now manufactured with an inner cannula. The design of some makes their use optional, whilst for others it is mandatory, as it is this inner cannulae, which has the standard 15mm attachment to connect to a breathing circuit. Whilst some inner cannulae are disposable and designed for single use, others can be cleaned and re-used.

The principal advantage of an inner cannula is to provide immediate relief of life-threatening airway obstruction in the event of blockage of a tracheostomy tube with blood clot or encrusted secretions. Traditionally, this has been seen to be particularly advantageous for patients discharged to a ward environment, it is now recognised that tube obstruction can occur even while the patient is in a critical care facility. In such circumstances removal of an obstructed inner cannula may be preferable to removal and repeat tracheal intubation. Clinicians need to aware of the risk of blockage despite the use of an inner cannula and consider additional actions to unblock the tube (see emergency algorithms).

The principal disadvantage is that the inner cannula may significantly reduce the effective inner diameter of the tracheostomy tube and thereby increase the work of breathing and impair weaning. Failure to properly lock the inner tube in place or movement of the ventilator tubing can unlock the inner cannula in some devices resulting in disconnection of the breathing circuit, in circumstances where it is connected to this rather than the outer cannula.

Repeated ventilator disconnection to change and clean an inner tube may result in de-recruitment, especially in patients receiving high levels of PEEP and/or inspiratory pressures, and increase the risk of VAP/infection. The risks and benefits of using inner cannulae in this situation should be considered on a daily basis. A useful pragmatic guide is that patients requiring greater than FiO_2 >50% may be better without an inner tube.

Fenestrated tracheostomy tubes

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

Cuffed tracheostomy tubes
In the ICU setting, most patients will require a cuffed tracheostomy tube initially, to facilitate mechanical ventilation and provide some protection of the lower respiratory tract. The cuff should be of a “high volume / low pressure” design, and should

effectively seal the trachea at a pressure of no more than 20 – 25 cm H_2O in order to minimise the risk of tracheal mucosal ischaemia and subsequent tracheal stenosis. There is now evidence to suggest that the current high volume/low pressure design is unable to guarantee isolation of the lower respiratory tract.

The cuff pressure should be monitored regularly, at minimum once per (8 hour) shift. Appropriate cuff inflation and pressure monitoring devices must be available at each bedside to avoid cross contamination. Some units have moved to automated devices which continuously monitor and adjust pressures. 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
- cuff lying partially in the stoma

Most patients can wean to decannulation by simply deflating the existing cuff, or alternatively by changing to a smaller or uncuffed tube.

Summary of recommendations

1. Clinicians need to be aware of the wide variability in the construction, design and functionality of tracheostomy tubes which are currently available, and recognise that anatomical variation limits the universal applicability of a single type.

2. Most adult critical care patients who require a temporary tracheostomy will initially need a non-fenestrated semi-soft tube with an air-filled cuff. As a standard, many centres now utilise a dual cannula tube (i.e. a tube with an inner cannula) from the outset, including adjustable flange tubes which are available for PDT with inner cannulae.

3. Patients with single cannula adjustable flange tracheostomies should not be discharged from a critical care environment without an inner cannula in place, as there are other tubes on the market to meet this requirement. Similarly all patients, once off assisted ventilation, should have an inner cannula in place.

4. When considering changing an existing tracheostomy to that of another type or manufacturer, clinicians should compare the relative lengths and external diameters of tubes, particularly if the proposed new tube 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, self-sealing foam cuffs, tight to-shaft cuffs or a sub-glottic suction channel may be useful in specific circumstances.

5. Routine care of the established tracheostomy

Patients immediately post tracheostomy placement are usually already on a critical care area, or return to a specialist ward environment used to dealing with tracheostomies. Routine care of an established tracheostomy was in the past considered a basic ward skill, but unfamiliarity with tracheostomies and their routine care means that this can no longer be considered true. The NCEPOD audit found that 70% of hospitals had wards who admitted <2 tracheostomy patients per month.

Wards receiving tracheostomy patients must have the appropriate skills to care for them, and this will require additional training and assessment of competence.

There are several principles behind safe and effective routine care of the established tracheostomy, which can minimise the potential for critical incidents to develop. Care provided by staff, who are familiar and experienced in tracheostomy care, troubleshooting and emergency management will be of a higher standard than those unfamiliar with tracheostomies. For example some hospitals insist that over 80% of permanent nursing staff having achieved the basic care competency before a ward can be deemed trachy competent. NCEPOD commented on the need for mandatory recorded training for all staff managing trachy patients – basic care for nusrses and emergency care for doctors or senior staff. Critical care staff have important roles in such training. There are national / international courses available through the Advanced Life Support Group ALSG.

Several approaches have been described which attempt to improve care including:

- Cohorting patients into safe locations within hospitals. These are wards that are staffed, trained and equipped and supported in providing routine tracheostomy care.
- Multi-disciplinary tracheostomy outreach teams. NCEPOD outlined some limitations of these teams in particular in relation to 24/7 care.
- Multi-disciplinary tracheostomy ward rounds for all relevant patients to include medical staff, ward nursing staff, outreach staff, physiotherapists, specialist nurses, SALT, dietetics and others. This needs to be co-ordinated so different specialists visit simultaneously not all at different time points.

The latter two approaches are not adequate replacement for appropriate skills from bedside staff. These and other initiatives are part of the Global Tracheostomy Collaborative launching in Europe in 2014.

Regular review, comprehensive documentation and good communication are key to avoidance of problems and effective treatment. Consideration should be given to a form such as in appendix to ensure that staff are aware of all relevant information. An example tracheostomy care chart which has boxes for suctioning and cleaning and replacement of inner tubes etc. is shown in appendix.

4.1 Essential Equipment

The following sections cover the equipment requirements for safe care, wherever the patients are managed. Certain equipment is required in all situations, See appendix**.**

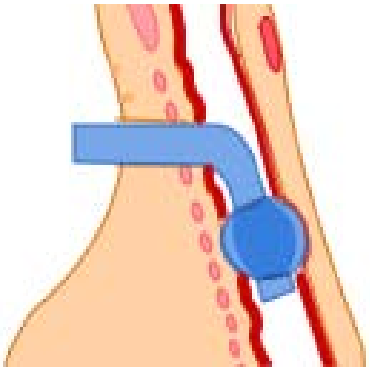
Fibreoptic scopes and their availability
Waveform capnography and a fibreoptic endoscope are essential for managing patients with tracheostomy obstruction. In critical care and specialist areas, these should be immediately available. For other ward areas, availability should be within minutes (e.g. on a cardiac arrest trolley). All staff caring for tracheostomy patients and those who respond to emergencies should know how to access and operate these devices around the clock. See algorithms later.

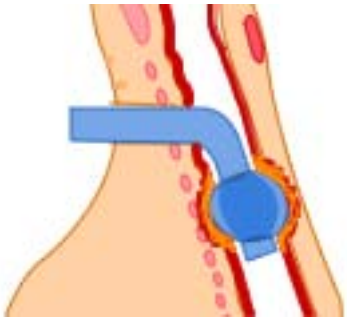
4.2 Cuff management
The tracheostomy cuff provides a seal to enable positive pressure ventilation and also provides some protection against aspiration of secretions. Modern tracheostomy tubes have low-pressure cuffs which extend over a greater surface area, however over-inflation should still be avoided. The pressure in the cuff should be just adequate to prevent air leakage and seal the airway against aspiration.

The capillary pressure in the tracheal mucosa is around 20 cm H_2O and consistent cuff pressure above this limit will risk ischaemic damage to the tracheal mucosa. This situation may be made worse by critical illness and hypotension, plus local infection, which will reduce the capillary perfusion pressure. Direct mucosal damage can also occur by poor tracheal suctioning techniques, ill-fitting tubes, or excessive movement of the tube within the trachea. In severe cases this leads to tracheal stenosis, tracheomalacia and great vessel erosion, or granuloma and stenosis above or below the tracheostomy stoma.

The pressure within the cuff should be checked regularly with a hand held pressure manometer and should be maintained ideally below 20 – 25cm H_2O. It is considered good practice to document cuff pressure and inflating volume at least every nursing shift or 2-3 times daily (although such recommendations are not evidence based), and following any tracheostomy-related intervention or patient repositioning.
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, for assessment of swallowing to allow speech, and when a speaking valve or decannulation cap is secured to the tube. Apply subglottic suction and/or airway toilet prior to cuff deflation to reduce the aspiration from collected sub glottic secretions.

- **Cuff pressure should not exceed 25 cm H_2O.**
  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.





Legend to images: overinflated cuff pressing onto tracheal mucosa and causing pressure necrosis.

4.3 Humidification

Inadequate humidification of respiratory gases may lead to life-threatening blockage of the tracheostomy with tenacious sputum, keratinisation and ulceration of the tracheal mucosa, sputum retention, atelectasis, impaired gas exchange and secondary infection. Humidification should be complimented by physiotherapy, patient mobilisation, adequate hydration, appropriate suctioning, prompt treatment of infection and mucolytics in certain circumstances.

The level of humidification required by patients will change depending on their clinical state, level of respiratory support required and their degree of hydration. If the current degree of humidification is inadequate, then the patient should be 'stepped up' to the next level. Patients with tracheostomies and laryngectomies are very vulnerable to complications due to inadequate humidification and its importance cannot be overemphasised. This becomes even more important if the patient is unwell, dehydrated and has purulent secretions.

The humidification ladder:

HME (Buchanon bib, Swedish nose)
- Self ventilating patients (no oxygen)

Cold water bath
- Self ventilating patient (on oxygen)

HME for breathing circuit
- Ventilated patient with minimal secretions (replace every 24 hrs)
- Monitor effectiveness (less likely to be effective if required for more than 5 days)

Heated water bath (active humidification)
- Ventilated patient with thick secretions
- Self-ventilating patient (on oxygen) with thick secretions

Add saline nebulisers or mucolytics and ensure adequate hydration if secretions are still difficult to clear.

Humidification is essential for ALL hospitalised patients with tracheostomies (and laryngectomies).

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 available elsewhere (NTSP).

Any difficulty in passing the suction catheter should lead to consideration that the inner cannula may be partially blocked and therefore require changing. If there is no inner cannula the tube may be partially blocked, badly orientated or misplaced and requires immediate attention. This may include visualisation using an endoscope and changing the tracheostomy tube.

4.5 Dressings, wound care and tube securement.

The tube should be secured carefully, ensuring that the chosen method minimises the risks of pressure sores. All tracheostomies are at risk of displacement, of greatest significance in the first few days following insertion, as it takes around 4 days for an open surgical stoma and 7-10 days for a percutaneous stoma to become established. The tube should normally be secured with a commercial tracheostomy holder rather than thin tape; this protects the patient from pressure on the back of the neck and corner of the mouth and is easily adjusted. Sutures may be used to secure the tube in place (e.g. in the agitated patient), but are not mandatory and are usually removed once the stoma is established. Sutures will make urgent removal of a partially displaced or blocked tube more difficult. Stitch cutters should be immediately available.

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 with 0.9% saline at least once in every 24 hours using an aseptic non-touch technique. A commercially available thin pre-cut dressing should be used rather than gauze. Red, excoriated or exuding stomas should have microbiology swabs sent for culture and may require additional cleansing products.

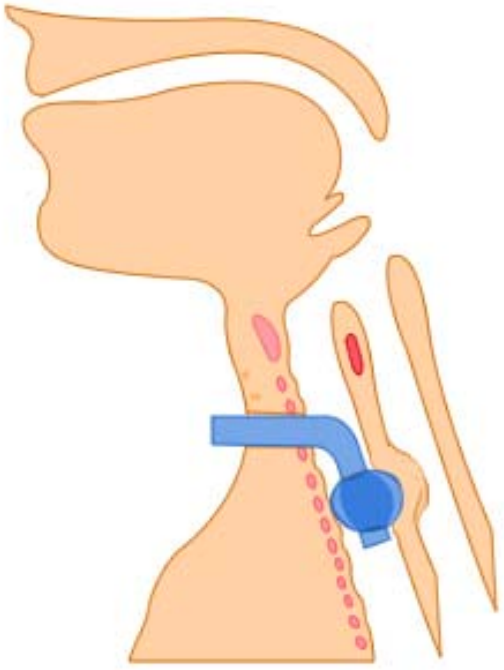
Tracheostomy stomas should be considered as an open surgical site. The presence of an artificial airway device, movement and respiratory secretions make the stoma at risk of wound infection. Colonisation with respiratory flora is inevitable and occasional cases will develop more serious local site infection, which can progress to spreading cellulitis or mediastinitis. This is more common with open surgical procedures, thought to be due to the greater surgical exposure and dissection. Systemic antibiotics and occasional surgical debridement are required.

4.7 Swallowing

Patients with tracheostomies often experience problems with swallowing. A tracheostomy tube, which is sited very low and abuts the sternal notch may prevent the vertical movement of the larynx that is intrinsic to 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, so 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 decision 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, then the patient may eat and drink, noting that a soft diet may be more easily managed. Should the patient fail to swallow effectively, then assessment by a speech and language professional is recommended. Guidance for initiating oral intake, along with risk factors for likely problematic patients, is shown in the boxes below.

The potential value of SALT input in both routine and more complex cases was noted in the NCEPOD report. However less than a third of patients with a new tracheostomy on ICU were assessed by SALT, and there were delays or lack of assessment in significant numbers of more complex patients. SALT assessment may also detect occult laryngeal pathology and swallowing problems, which were not apparent clinically, especially when Fibreoptic Endoscopic Evaluation of Swallowing (FEES) is used.



Legend to image. Backwards pressure of tube cuff may compress the oesophagus to produce swallowing difficulty.

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, place a suction catheter just to the end of the tracheostomy tube and deflate cuff while suctioning. This is a two person technique that prevents secretions suddenly falling into the lower airways when the cuff is deflated.
- Start with sips of water, fluids and then soft diet providing the

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 for swallowing assessment. The more complex patient longer term may benefit from more formal endoscopic or radiological assessment of swallowing.
- More detailed guidance is available from the Royal College of Speech & Language Therapists Tracheostomy Competency Framework 2014 (www.rcslt.org)

Risk factors for swallowing problems in patients with a tracheostomy

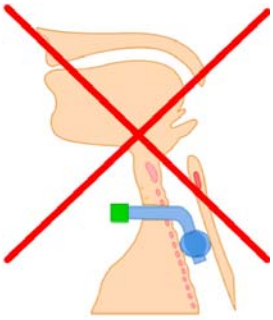
- Neurological injury e.g. bulbar palsy
- Disuse atrophy
- Head & neck surgery
- Evidence of aspiration of enteral feed or oral secretions on tracheal suctioning
- Increased secretion load, or persistent wet / weak voice, when cuff is deflated
- Coughing and / or desaturation following oral intake
- Patient anxiety or distress during oral intake
- High FiO_2

4.8. Communication

Patients with a cuffed tracheostomy will be unable to speak and this can cause great distress to the patient, even if warned beforehand. This can cause fear because of inability to attract attention or anxiety due to inability to communicate (even with the cuff down). Communication aids such as pen / paper or picture cards are vital to prevent the patient feeling frightened and isolated. In addition ensure the patient has a nurse call bell at all times.

Speaking valves

These are one-way valves that fit over the end of the tracheostomy tube. They allow the patient to breathe in through the tracheostomy, but not out. The airflow has to go up through the larynx and out of the mouth. This can allow the patient to talk, but can be tiring for the patient due to increased resistance to airflow. Because air cannot flow out through the tracheostomy, these valves can be extremely dangerous. Speaking valves should ideally only be used with an un-cuffed and fenestrated tube (plus fenestrated inner cannula if in place). Short term use with other tubes may be appropriate to avoid a tube change but only after demonstration of adequate airflow, with the cuff down, and patient tolerance before applying a valve or cap. If a speaking valve is used with a standard tube with the cuff deflated, this is potentially hazardous and should only be used by staff with the experience and the necessary infrastructure to recognize and immediately manage any resulting complications.



A speaking valve in situ with a cuffed tube. The cuff must *always* be deflated otherwise the patient cannot exhale and will asphyxiate, suffer barotrauma or lose cardiac output as intra-thoracic pressure rises.

Speaking valves may have a role in 'training' the larynx after prolonged disuse and can improve swallowing, secretion management and psychological state by allowing communication. These valves can be incorporated into ventilator circuits (e.g. for those receiving pressure support ventilation) although a ventilator that will tolerate a leak from the upper airway is required.

6. Changing tracheostomy tubes

Changing a tracheostomy tube is potentially hazardous, but so is failure not 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.

Basic principles for changing a tracheostomy tube

Tracheostomy tubes without an inner cannula generally should be changed around every 7-14 days. This is to prevent obstruction of the lumen with secretions. Subsequent frequency may decrease once the patient is free of pulmonary secretions and has a well formed clean stoma. Timing is a matter of clinical judgement but general recommendations are that tracheostomies should be changed every 30 days to prevent infection, maintain a healthy stoma, and prevent degradation of the composition material. Individual manufacturers have recommendations for maximum use of their devices.

A European Economic Community Directive (1993) states that tracheostomy tubes with an inner cannula can remain in place for a maximum of thirty days. This assumes the inner cannula is changed or cleaned according the manufacturers instructions at least daily. In patients with very productive chests the inner cannula may need reviewing every couple of hours.

The first routine tracheostomy tube change:

- Should not be performed within 4 days following a surgical tracheostomy and 7-10 days after a percutaneous tracheostomy to allow the stoma to become established.
- The decision to change the tube is usually a multi-disciplinary one, considering weaning, swallowing, ventilation, speaking and the on going need for a cuff.
- Must be carried out by a person competent to do so and with advanced airway expertise and equipment immediately available.
- Techniques involving exchange over a gum elastic bougie or airway exchange catheter may be safer for the first change.
- Technique used and ease should be recorded, along with recommendations for future exchanges.

Subsequent changes can be made by relevant staff, who are competent to do so, e.g. specialist tracheostomy nurses or therapists. 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 an emergency.

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.

Although problems can occur in any patient, they are particularly likely in the obese, those with a deep trachea, and other anatomical difficulties. In all circumstances the patient should be pre-oxygenated and monitored appropriately, which should include pulse oximetry and the availability of capnography or bronchoscopy to confirm placement. Whilst the same principles apply to subsequent changes, the first change is usually the most difficult and technically challenging. Significant numbers of patients in NCEPOD report experienced unplanned early tube changes at less than 7 days.

Prior to tube exchange, consideration should be given to equipment, personnel, procedure and the environment required should problems arise when inserting the new tube.

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

6. Common Complications and emergency Management

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All staff working in clinical locations where tracheostomy patients are managed must be competent to assess and initiate management in the event of an airway emergency occurring. These complications may occur at any time or location. They may be life threatening, and even when not, may be challenging for patients and staff. The NCEPOD tracheostomy audit highlighted low overall insertion complications but significant numbers of later complications during aftercare.

Complications associated with a tracheostomy

Complications can be divided into those associated with insertion of the tracheostomy (surgical or percutaneous), those which arise following the procedure (usually blocked or displaced tracheostomy tubes) or later complications. These can be serious and sometimes fatal. These complications may coexist and are usually grouped as follows:

1. Immediate Complications (peri-procedural period)

- Haemorrhage (this is usually minor, but can be severe if thyroid or major para-tracheal blood vessels are damaged).
- Primary misplacement of tube - within tissues around trachea or to main bronchus, or secondary displacement e.g. after severe coughing on emergence.
- Pneumothorax.
- Tube occlusion.
- Surgical emphysema.
- Loss of the upper airway.

2. Delayed Complications (post-operative period < 7 days)

- Tube blockage with secretions or blood. May be sudden or gradual.
- Partial or complete tube displacement.
- Infection of the stoma site.
- Infection of the bronchial tree (pneumonia).
- Ulceration, and/or necrosis of trachea.
- Mucosal ulceration by tube migration (due to loose tapes or patient intervention).
- Risk of occlusion of the tracheostomy tube in obese or fatigued patients who have difficulty extending their neck.
- Tracheo-oesophageal fistula formation.
- Haemorrhage (local tissue trauma or erosion through blood vessels).

3. Late Complications (late post-operative period >7 days)

- Granulomata of the trachea may cause respiratory difficulty when the tracheostomy tube is removed.
- Tracheal dilation, stenosis, persistent sinus or collapse (tracheomalacia).

- Scar formation-requiring revision.
- Blocked tubes may occur at any time, especially if secretions become thick, the secretions are not managed appropriately (suction) and humidification is not used.
- Haemorrhage.

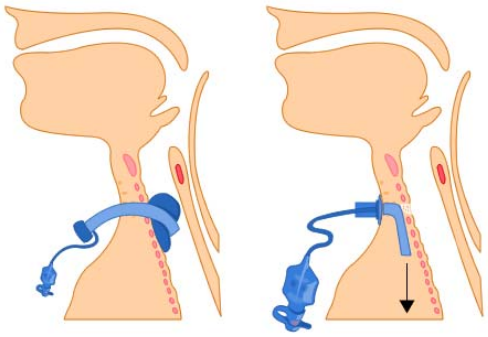
Blocked Tracheostomy

Inserting a tracheostomy tube bypasses the natural warming and humidification mechanisms of the upper airway. Patients may have reduced ability to cough or clear secretions, which may be increased or purulent if infected, or thickened if the patient is dehydrated. The risks of blocked tracheostomy tubes can be minimised by careful humidification, tracheal suction and inner tube care. Prevention is better than cure.

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

Displaced Tracheostomy Tube

The tracheostomy tube can become partially or completely displaced. The tube may migrate out of the stoma or into the soft tissue of the neck. The tube may become displaced by coughing, the weight of the tube and breathing circuits, or by patient interference. Partial tube displacement is more dangerous as it is not always obvious that there is a problem with the tube. In order to keep tracheostomy tubes in position, tubes must be carefully selected and inserted, secured carefully and monitored. Waveform capnography is mandatory for any acutely ventilator dependent tracheostomy patient.



Legend to figure

a. Tracheostomy tube migrating outwards with cuff distortion.
b. Tracheostomy tube in pre-tracheal tissues

Haemorrhage

It is common for some bleeding to occur after a tracheostomy has been performed. This usually settles within a few days. Bleeding can occasionally be significant or even catastrophic resulting in death. Bleeding can be from the trachea, stoma or surrounding tissues and can be due to direct trauma of the tissues, puncture, infection or injury to adjacent blood vessels or the tube or cuff eroding into surrounding tissues or vessels over time. Bleeding can also come from the lungs themselves and become evident through tracheal suction. These problems are compounded in the presence of a coagulopathy.

If airway obstruction occurs due to blood clot in the airway (identify if possible with an endoscope) 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 fibreoptic scope suction channel. Suction may need to be applied directly to the tracheal tube and/or the tube removed with suction applied. Do not make repeated attempts at suctioning with conventional catheters, as delay in removing a blocked tracheostomy tube may cause hypoxia, which may lead to significant morbidity or may even be fatal. At this stage, the tracheostomy tube must be removed. The stoma can be suctioned directly once the tube is removed. Direct endobronchial intubation, (under fibreoptic guidance) with an uncut endotracheal tube and with suction then applied directly to the endotracheal tube may be needed to try to remove obstructing clots. It may be necessary to repeat this procedure and it may be necessary to apply suction in this manner to both main bronchi.

A tracheo-arterial fistula can occur if the tube erodes into the brachiocephalic artery. This is a rare complication but is associated with lower placement of the tube in the trachea. There may be a warning or 'sentinel' bleed. Any haemorrhage should prompt a fibreoptic inspection of the trachea. If an arterial bleed is suspected, this examination should occur immediately with an experienced surgeon and resuscitation measures available. Arterial haemorrhage can become rapidly fatal. Hyperinflation of the tracheostomy tube cuff or an endotracheal tube cuff, or digital pressure in the stoma may help to tamponade the bleeding point, prior to definitive surgical management.

Tracheostomy Red Flags

Tracheostomy 'Red Flags' are used as a warning signal that a problem has, or is about to occur and need to be acted upon. Prompt assessment by someone competent to do so is required and a fibreoptic inspection of the position of the tracheostomy tube to confirm correct placement within the trachea may be indicated. All staff caring for patients with a tracheostomy should be familiar with these warning signs. As with all assessments of the acutely unwell patient, an ABCDE assessment includes ensuring that the airway is patent, including assessment of the tracheostomy tube if present. The airway problems are identified and managed, or the assessment is continued having confirmed airway device patency.

Red flags include:

1. Airway
    a. A suction catheter not passing easily into the trachea
    b. A changing, inadequate or absent capnograph trace
    c. The patient with a cuffed tracheostomy tube suddenly being able to talk or noises or bubbles coming from the upper airways (implying gas escaping proximally and the cuff no longer 'sealing' the trachea)
    d. Frequent requirement for (excessive) inflation of the cuff to prevent air leak

e. Pain at the tracheostomy site
f. Visibly displaced tracheostomy tube. If this is an adjustable flange tube, check to see where (at what length?) it was last positioned
g. Bleeding from the tube or stoma

2. Breathing
    a. Increasing ventilator support or increasing oxygen requirements
    b. Respiratory distress
    c. Surgical (subcutaneous) emphysema (gas in the soft tissues)
    d. The patient complaining that they cannot breathe or have difficulties in breathing
    e. Suspicion of aspiration (feed aspirated on tracheal toilet – suggests that the cuff is not functioning adequately)

3. Circulation or any other general clinical deterioration
    a. An airway emergency may lead to cardiovascular collapse.
    b. Anxiety, restlessness, agitation and confusion may also be due to an airway problem.

Other complications following tracheostomy

Local Infection

The stoma is an open surgical wound and routine wound care is covered above. Colonisation with respiratory flora is inevitable and occasional cases will develop more serious local site infection, which can progress to spreading cellulitis or mediatinitis. This is more common with open surgical procedures due to the greater surgical exposure and dissection. Systemic antibiotics and occasional surgical debridement are required.

Tracheal Damage/Mucosal Ischaemia

The capillary pressure in the tracheal mucosa is around 20cm H_2O and consistent cuff pressure above this limit will risk ischaemic damage to the tracheal mucosa. This situation may be made worse by critical illness and hypotension, plus local infection, which will reduce the capillary perfusion pressure. Direct mucosal damage can also occur by poor tracheal suctioning techniques, ill-fitting tubes, or excessive movement of the tube within the trachea. Modern tracheostomy tubes have low-pressure cuffs, which extend over a greater surface area, however over-inflation should still be avoided. The pressure in the cuff should be just adequate to prevent air leakage and seal the airway against aspiration. Such problems may be manifest by the development of granuloma and stenosis above or below the tracheostomy stoma.

Emergency airway management of the patient with a tracheostomy or laryngectomy.

The management of tracheostomy (and laryngectomy) related emergencies is summarised in Multidisciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies. *Anaesthesia* 2012; 67:1025-41. This guidance was developed by the UK National Tracheostomy Safety Project (Full guidance at NTSP, www.tracheostomy.org.uk) and included representation from key stakeholders.

The algorithms are coupled with bed-head signs, allowing essential information to be clearly displayed and immediately available to responders in an emergency, including key details regarding the nature and date of the tracheostomy, method of forming the stoma and the function of any 'stay sutures.' Separate, colour-coded algorithms and bed-head signs are available for patients with a potentially patent upper airway and those with a laryngectomy.

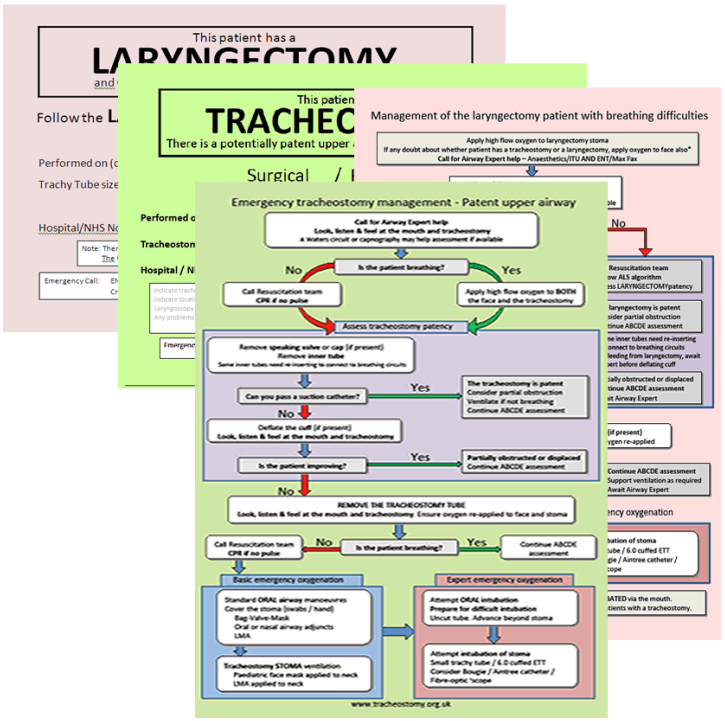
Two key principles are followed: oxygenation of the patient takes priority (not necessarily securing the airway immediately and definitively, unless required for oxygenation) and the best assistance should be sought early. The generic algorithms cover the majority of common and easily reversible clinical situations that arise whilst accepting that a number of special circumstances do exist. Even in complicated scenarios, key airway management principles should be followed.

Competencies and training required are divided between those of the primary and secondary responder. The primary responder (typically a nurse, junior doctor or allied health professional) needs to be guided to detect airway problems, to assess tracheostomy and airway patency and to provide basic emergency oxygenation. The secondary responder (typically an anaesthetist, intensivist, head and neck surgeon or specialist practitioner) will have skills in conventional airway management and will also be guided to use skills in managing the tracheostomy or stoma. These skills would typically include oro-nasal intubation techniques (including difficult intubations), ability to use a fibreoptic endoscope to assess or replace tracheostomy tubes and the ability to perform and manage an emergency surgical airway or tracheostomy. Algorithms are thus divided into sections to reflect the differing skills of the responders.

The algorithms are applicable for any urgent or emergency situation that develops in a patient with a tracheostomy or laryngectomy.

Interactive algorithms with video links to each of the key steps are available from the website www.tracheostomy.org.uk, in SmartPhone applications (NTSP) and explained in the associated e-learning resources. The website also includes details of in-house training for staff, links to training courses and the freely available NTSP Manual 2013. Sample algorithms and bedhead signs see below; Reproduced from McGrath BA, Bates L, Atkinson D, Moore JA. Multidisciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies. Anaesthesia.

2012 Jun 26. doi: 10.1111/j.1365-2044.2012.07217, with permission from the Association of Anaesthetists of Great Britain & Ireland/Blackwell Publishing Ltd."



This patient has a

LARYNGECTOMY

and CANNOT be intubated or oxygenated via the mouth

Follow the LARYNGECTOMY algorithm of breathing difficulties

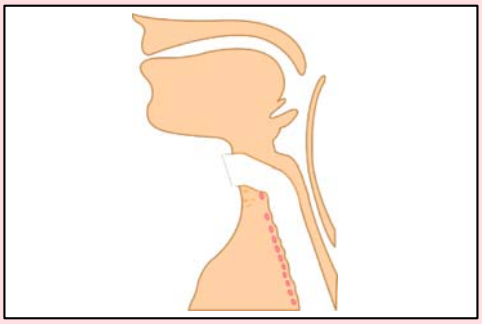
Performed on (date) .....

Tracheostomy tube size (if present) .....

Hospital / NHS number .....

Notes:

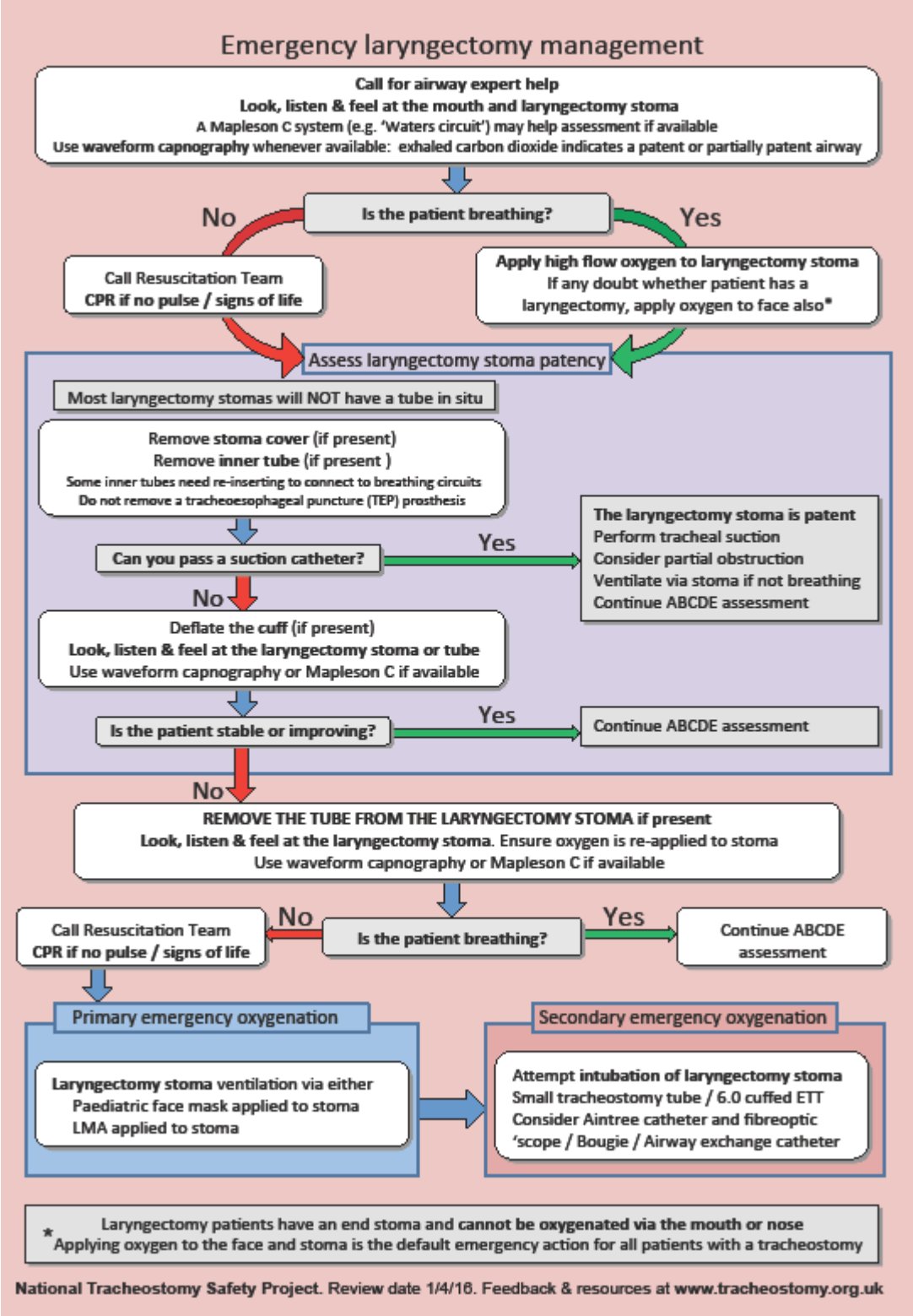
There may not be a tube in the stoma.
The trachea (wind pipe) ends at the neck stoma



Emergency Call: **Anaesthesia** **ICU** **ENT** **MaxFax** **Emergency Team**

www.tracheostomy.org.uk

Laryngectomy patients, who will largely be seen in specialised ENT centres, may be seen in more general units in the context of other problems e.g. resuscitation or IPPV for a pneumonia.


Emergency laryngectomy management
Call for airway expert help
Look, listen & feel at the mouth and laryngectomy stoma
A Mapleson C system (e.g. 'Waters circuit') may help assessment if available
Use waveform capnography whenever available: exhaled carbon dioxide indicates a patent or partially patent airway
Is the patient breathing?
No
Yes
Call Resuscitation Team
CPR if no pulse / signs of life
Apply high flow oxygen to laryngectomy stoma
If any doubt whether patient has a laryngectomy, apply oxygen to face also*
Assess laryngectomy stoma patency
Most laryngectomy stomas will NOT have a tube in situ
Remove stoma cover (if present)
Remove inner tube (if present)
Some inner tubes need re-inserting to connect to breathing circuits
Do not remove a tracheoesophageal puncture (TEP) prosthesis
Can you pass a suction catheter?
Yes
The laryngectomy stoma is patent
Perform tracheal suction
Consider partial obstruction
Ventilate via stoma if not breathing
Continue ABCDE assessment
No
Deflate the cuff (if present)
Look, listen & feel at the laryngectomy stoma or tube
Use waveform capnography or Mapleson C if available
Is the patient stable or improving?
Yes
Continue ABCDE assessment
No
REMOVE THE TUBE FROM THE LARYNGECTOMY STOMA if present
Look, listen & feel at the laryngectomy stoma. Ensure oxygen is re-applied to stoma
Use waveform capnography or Mapleson C if available
Call Resuscitation Team
CPR if no pulse / signs of life
No
Is the patient breathing?
Yes
Continue ABCDE assessment
Primary emergency oxygenation
Laryngectomy stoma ventilation via either
Paediatric face mask applied to stoma
LMA applied to stoma
Secondary emergency oxygenation
Attempt intubation of laryngectomy stoma
Small tracheostomy tube / 6.0 cuffed ETT
Consider Aintree catheter and fibreoptic
'scope / Bougie / Airway exchange catheter
* Laryngectomy patients have an end stoma and cannot be oxygenated via the mouth or nose
Applying oxygen to the face and stoma is the default emergency action for all patients with a tracheostomy
National Tracheostomy Safety Project. Review date 1/4/16. Feedback & resources at www.tracheostomy.org.uk

This patient has a

TRACHEOSTOMY

There is a potentially patent upper airway (Intubation may be difficult)

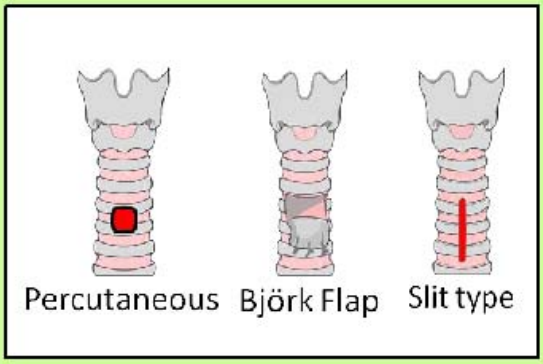
Surgical / Percutaneous

Performed on (date) .....

Tracheostomy tube size (if present) .....

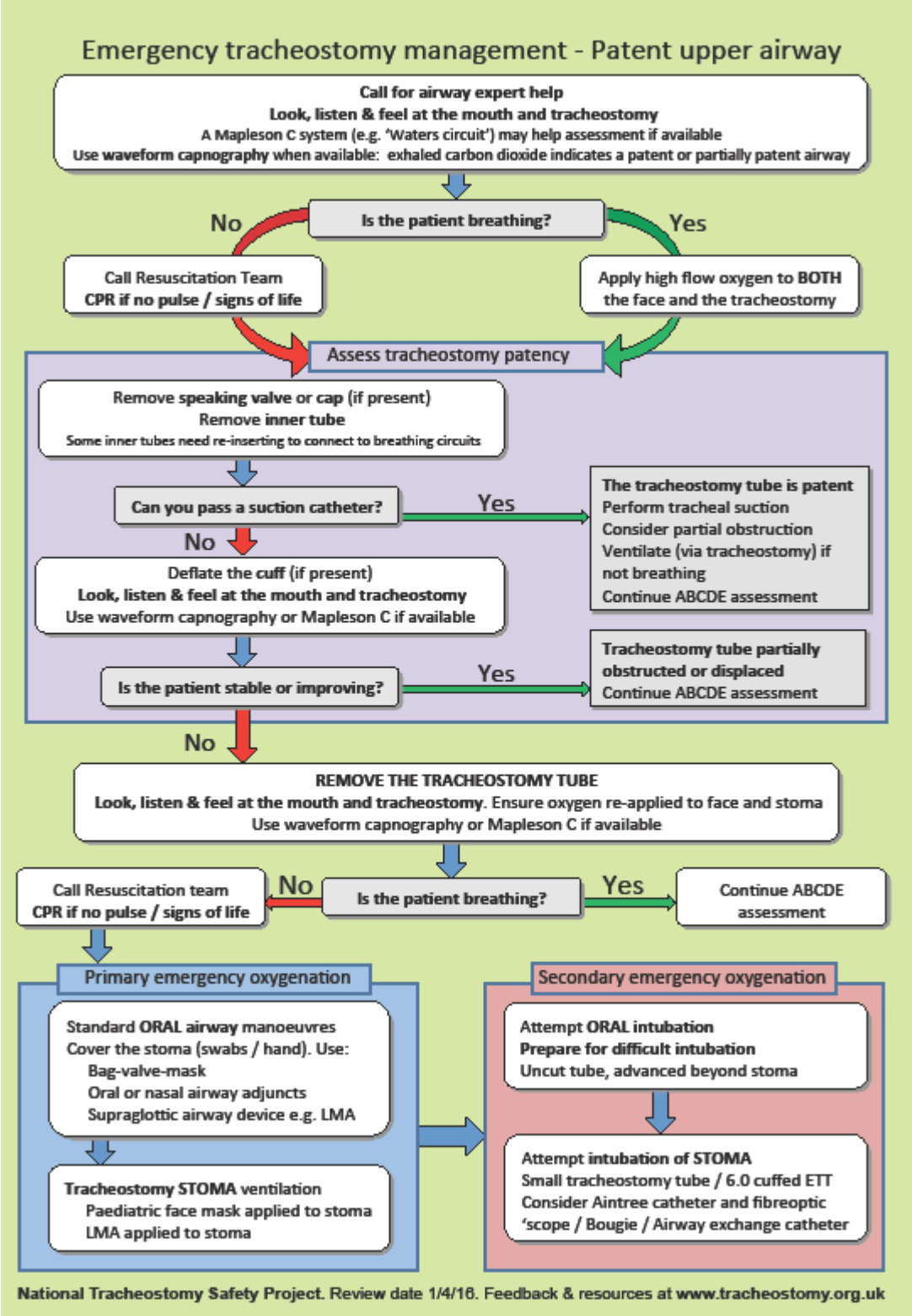
Hospital / NHS number .....

Notes: Indicate tracheostomy type by circling the relevant figure.
Indicate location and function of any sutures.
Laryngoscopy grade and notes on upper airway management.
Any problems with this tracheostomy.



Emergency Call: Anaesthesia ICU ENT MaxFax Emergency Team

www.tracheostomy.org.uk


Emergency tracheostomy management - Patent upper airway
Call for airway expert help
Look, listen & feel at the mouth and tracheostomy
A Mapleson C system (e.g. 'Waters circuit') may help assessment if available
Use waveform capnography when available: exhaled carbon dioxide indicates a patent or partially patent airway
Is the patient breathing?
No
Yes
Call Resuscitation Team
CPR if no pulse / signs of life
Apply high flow oxygen to BOTH the face and the tracheostomy
Assess tracheostomy patency
Remove speaking valve or cap (if present)
Remove inner tube
Some inner tubes need re-inserting to connect to breathing circuits
Can you pass a suction catheter?
Yes
The tracheostomy tube is patent
Perform tracheal suction
Consider partial obstruction
Ventilate (via tracheostomy) if not breathing
Continue ABCDE assessment
No
Deflate the cuff (if present)
Look, listen & feel at the mouth and tracheostomy
Use waveform capnography or Mapleson C if available
Is the patient stable or improving?
Yes
Tracheostomy tube partially obstructed or displaced
Continue ABCDE assessment
No
REMOVE THE TRACHEOSTOMY TUBE
Look, listen & feel at the mouth and tracheostomy. Ensure oxygen re-applied to face and stoma
Use waveform capnography or Mapleson C if available
Call Resuscitation team
CPR if no pulse / signs of life
No
Is the patient breathing?
Yes
Continue ABCDE assessment
Primary emergency oxygenation
Standard ORAL airway manoeuvres
Cover the stoma (swabs / hand). Use:
Bag-valve-mask
Oral or nasal airway adjuncts
Supraglottic airway device e.g. LMA
Tracheostomy STOMA ventilation
Paediatric face mask applied to stoma
LMA applied to stoma
Secondary emergency oxygenation
Attempt ORAL intubation
Prepare for difficult intubation
Uncut tube, advanced beyond stoma
Attempt intubation of STOMA
Small tracheostomy tube / 6.0 cuffed ETT
Consider Aintree catheter and fibreoptic 'scope / Bougie / Airway exchange catheter
National Tracheostomy Safety Project. Review date 1/4/16. Feedback & resources at www.tracheostomy.org.uk

Special considerations

Tracheostomy emergencies in ICU patients usually involve displacement of a tube that is likely to have been placed percutaneously. Percutaneous stomas do not usually become established tracts for 7-10 days after initial insertion. This may make early re-insertion of a displaced tube difficult or impossible. Patients are also often oxygen and/or ventilator dependant, and the deranged physiology of critical illness mandates that airway management is prompt and decisive. There is extensive consideration of tube related problems in NCEPOD report.

Bedside details of the nature and date of tracheostomy should guide the responders. Conventional upper airway management is likely to be safer and easier when managing a recently formed, percutaneous, displaced tracheostomy tube. For patients with a known, difficult upper airway (including the absent upper airway of the laryngectomy patient) emergency management plans should be made in advance, communicated and recorded where they are readily accessible.

Bedside emergency equipment
See appendix.

Troubleshooting & emergencies outside the ICU

Critical care staff are increasingly called to assist with tracheostomy problems outside the ICU. This reflects increasing numbers of critical care patients with tracheostomies, and the reducing resident cover from head and neck specialities. Each hospital will have to develop its own solutions, but if an institution is expected to admit and manage elective or emergency admissions with a tracheostomy or laryngectomy, then competent care needs to be provided around the clock. This is likely to involve competent medical, nursing and allied health staff, who are associated with the critical care unit.

Improvements in care have been described by institutions adopting a hospital-wide multidisciplinary tracheostomy team. Other approaches have seen designated wards established to concentrate patients, staff, equipment and experience. Critical care has an increasing role, increasing expertise and also a degree of responsibility in ensuring that safe care is delivered for patients managed both within the ICU and following discharge.

7.1 Weaning & Decannulation

A tracheostomy may be only a short term requirement for patients and should be removed as soon as it is no longer needed. Judging the timing of removal of the tube (decannulation) can be difficult, and the patient may need to spend several days or even weeks progressing towards this step. The best way to reduce complications is often to remove the tube as soon as it is safe to do so.

The term 'weaning' can mean; i)a reduction in support from mechanical ventilation (or CPAP/assisted spontaneous breathing modes), ii) a generic term for the period of time as the patient progresses towards decannulation, iii) a reduction in the size of the tracheostomy tubes. The latter term is referred to as 'down-sizing' in this document.

Prior to the removal of a temporary tracheostomy tube, there must be multidisciplinary team agreement that the indication for the tracheostomy has now been resolved sufficiently. This same team should remain the main point of contact for at least 48 hours post-decannulation. If patient location prevents this being a viable option, care should be formally handed over to someone able to provide adequate advice and interventions.

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

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 decannulation, especially if their ventilation period has been short or if they do not suffer significant lung or airway pathology or neuromuscular problems. 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.

A checklist to use prior to commencing weaning should ascertain:

- Is the upper airway patent? (may require endoscopic assessment)
- Can the patient maintain and protect their airway spontaneously?
- Are they free from ventilatory support?*
- Are they haemodynamically stable?
- Are they absent of fever or active infection?
- Is the patient consistently alert?
- Do they have a strong consistent cough (able to cough out of tube or into mouth)?
- Do they have control of saliva with or without a competent swallow?
- Are there any planned procedures requiring anaesthesia within next 7-10 days?
- Is this patient causing concern to any healthcare practitioner?
- Can we safely support the weaning process in the patient's current clinical environment?

*Under specialist supervision, it is possible to decannulate some patients who will need on-going non-invasive respiratory support via a face or nasal mask.

There are many variations on decannulation protocols described in the literature and in use in the UK. Many draw on local experience and expertise and work well locally. Most protocols move through increasing periods of cuff deflation, with some patients requiring the use of fenestrated tubes, speaking valves, occlusive tube caps or smaller 'down-sized' tubes prior to a decision to decannulate. A small diameter tracheostomy tube (4-6mm) can be left in situ to aid with airway toilet and preserve the stoma and tract in case re-insertion is required. Detailed discussion of weaning protocols is provided in the NTSP manual. Patients require careful monitoring during the weaning process.

The value of endoscopy prior to decannulation in routine cases in critical care is uncertain. It was performed in less than 2% of all cases in the NCEPOD audit. However if bedside observations suggest a problem with upper airway patency then endoscopy should be used to ascertain the nature of the problem. It can simultaneously be used to assess swallowing. A fine bore nasal flexible endoscope as used by ENT or SALT are ideal for such assessments in awake patients.

Decannulation

The procedure is usually straightforward, but adequate assessment and preparation as outlined above is required to maximise success. There should be a person present who is able to cannulate should decannuation quickly prove unsuccessful. 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. It is also advisable to ensure a sufficient interval after food or fluid intake. 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 or attempt to make the dressing air tight. Stomas are not sutured and are allowed to contract and heal unaided.

In the event of a failed decannulation, expertise, drugs and equipment to manage the airway and reinsert a tracheostomy tube must be immediately available. The patient should be closely monitored following decannulation, usually for 24 hours.

Altered Body Image

This is important as it can have a major psychological impact. If possible the patient should have careful pre-operative explanation. If not they should receive explanation and support later, noting that scarring is usually minimal. One of the most frustrating aspects for patients, especially those waking from an induced coma, is that they are unable to speak when the tracheostomy tube cuff is inflated. As soon as possible, the patient should be reassured that speech will return. Most stomas will heal well provided that the general condition and nutritional status of the patient is good, and the stoma is kept dry and infection free. The diameter of the stoma may be expected to shrink by around 50% in the first 12 hours following removal of the tube. Stomas

may close externally in as little as 3 to 4 days. On average the stoma will close and heal well within 4-6 weeks.

The above assumes that the patient will be decannulated, but a proportion will remain tracheostomy and ventilator dependent in the longer term.

7.2 Discharge to the ward with a tracheostomy

Patients should only be discharged to a ward where adequate tracheostomy management is available. NCEPOD commented on the significant numbers of patients being discharged with a tracheostomy out of hours which is against current ICS recommended practices, and the need for adequate staff skills. Emergency equipment should be available to the patient at all times see appendix. Staff caring for patients should be familiar and practiced in the care of the stoma and tube. This would usually require the completion of an additional competency document following appropriate education; this may be delivered as part of a specialist course (e.g. Advanced Life Support Group, http://www.alsg.org/uk/Tracheostomy).

On discharge from critical care a dual cannula tube should be in situ, ideally this would be uncuffed, but only where the patients condition enables it. There should be a clear plan of care for weaning, communication, swallow and tube changes documented and actioned. Ideally a multi-professional team should visit the patient on a regular basis to review and progress the patients care. Initially the patient should be followed up by critical care for at least 48hrs; this may be part of the Outreach team or follow up role.

7.3 Discharge home with a tracheostomy

Before a patient can be discharged from hospital with a tracheostomy it is important to identify who will be responsible for the day to day care and ongoing management of the tracheostomy tube and stoma. Patients will fall into four main groups:

- Those who can self-care or have family able to actively participate in their care
- Patients who require regular and often daily community support by the district nursing team to provide the necessary care for their tracheostomy
- Patients who require a nursing home placement in a home with the skills and knowledge to care for a patient with a tracheostomy.
- Patients who require round the clock care in their home environment by practitioners with advanced tracheostomy and respiratory care skills. Anecdotal experience from staff and adverse events suggest that there is no consistent national provision for such trained staff. This needs addressing nationally as the number of such patients is likely to increase over time.

The following should be provided as an absolute minimum before discharge:

- Competency assessed training and education in stoma and tube care for the patient and/or carers.
- Provision for supply of the required equipment and consumables, the equipment and supply arrangements must be in place prior to discharge

- What the patient or carer should do in an emergency, including laminated sheets of the NTPS algorithms. The local ambulance service should be notified prior to discharge of a neck breather living in their local community to set up a silent call emergency referral.
- Who is responsible for ongoing tube changes and weaning (where appropriate) from the tube. A date should be arranged for review in a suitable outpatient clinic before discharge.
- There may be lowered body image perceptions in patients with longer term tubes, suggesting that psychological surveillance and support may help patients with long terms tubes
- Guidance for carers and competency assessments can be found in the NTSP publications (www.tracheostomy.org.uk)

7.4 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, is often not recognised and should be considered in all patients with symptoms, such as stridor or breathlessness on exertion, since this usually only arises after significant reduction in cross-sectional area. Such symptoms may be gradual in onset and may only be present on exercise and be minimized by the patient who is poorly mobile and 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 endoscopy. Similar problems may also occur higher in the larynx from prolonged translaryngeal intubation.

In most hospitals such follow up is haphazard and this is an area for improvement in clinical practice and further research and audit. It is suggested that all patients who have had a tracheostomy are followed up at least once either by a Head & Neck surgeon or by critical care follow up clinic, and that clinicians have a low threshold for suspecting and investigating airway obstruction. This represents a suitable project for national audit as long term results are still not well known.

All patients who have undergone tracheostomy should be followed up. Their GP must be informed that the patient had a tracheostomy and be provided with a contact if they have concerns about longer term problems. It is accepted that to date, knowledge about the long term outcomes is limited.

8. Key References

On the right trach? A review of the care received by patients who underwent a tracheostomy 2014. http://www.ncepod.org.uk/index.htm

UK National Tracheostomy Safety Project. http://www.tracheostomy.org.uk/
Algorithm Summary in: Multidisciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies. Anaesthesia 2012; 67:1025-41.

The Global tracheostomy collaborative. http://globaltrach.org/

4th National Audit Project (NAP4): Major complications of airway management in the United Kingdom Report and Findings – March 2011
http://www.rcoa.ac.uk/nap4

Tracheostomy guidelines. St Georges Healthcare NHS Trust.
https://www.stgeorges.nhs.uk/gps-and-clinicians/clinical-resources/tracheostomy-guidelines/

NHS quality improvement Scotland. Best Practice Statement ~ March 2007
Caring for the patient with a tracheostomy.
http://www.healthcareimprovementscotland.org/previous_resources/best_practice_statement/tracheostomy care.aspx

Further reading

Ambu aScope2 for use in unexpected difficult airways.
http://guidance.nice.org.uk/MT/158

Translaryngeal tracheostomy. NICE guidance.
http://www.nice.org.uk/nicemedia/live/13614/64966/64966.pdf

Silvester W. Percutaneous versus surgical tracheostomy: A randomised controlled study
with long term follow up. Critical Care Medicine 2006; 34; 2145-2152.

Speech and Language Therapy in Adult Critical Care-Position paper 2006.
http://www.rcslt.org/members/publications/publications2/provision_for_critical_care_

Young D, Harrison DA, Cuthbertson BH, Rowan K; TracMan Collaborators.
Effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation: the TracMan randomized trial. JAMA. 2013 ;309: 2121-9.

Foster A. More than nothing: The lived experience of tracheostomy while acutely ill. Intensive and Critical Care Nursing. 2010; 26: 33-43.

B A McGrath, A N Thomas. Patient safety incidents associated with airway devices in critical care: a review of reports to the UK National Patient Safety Agency. Anaesthesia. 2009 ;64:358-65.

B A McGrath, A N Thomas. Patient safety incidents associated with tracheostomies occurring in hospital wards: a review of reports to the UK National Patient Safety Agency. Postgrad Med J 2010; 86: 522-525

Sherlock Z, Wilson J, Exley C. Tracheostomy n the acute setting: patient experience and information needs. Journal of Critical Care 2009; 24: 501-7

Hales PA1, Drinnan MJ, Wilson JA. The added value of fibreoptic endoscopic evaluation of swallowing in tracheostomy weaning. Clin Otolaryngol. 2008; 33: 319-24.

Eibling DE, Roberson DW. Managing tracheotomy risk: time to look beyond hospital discharge. Laryngoscope. 2012 ; 122: 23-4.

Cree N & Bonner S. Tracheostomy Management Ch. In Bonner S, Carpenter M & Garcia E. Care of the Critically Ill Medical Patient, Elsevier, Glasgow 2007.

Paw HGW, Bodenham AR. Percutaneous tracheostomy. A practical Handbook. Greenwich Medical Media, London 2004.

9. 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 initially performed 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 tolerate the tube.

The prolonged presence of a tube in the throat makes it difficult to keep the mouth clean, requires on going sedation, and can also lead to physical damage to the mouth, larynx and trachea. A tracheostomy can be useful by avoiding some of these problems.

What is a Tracheostomy?

A tracheostomy is an opening in the front of the neck into the trachea (windpipe). A tube can then be inserted directly 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 typically far more comfortable than a tube in the mouth or nose. 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 insertion procedure 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 surgical or other interventions. These include problems with the upper airways, bleeding, damage to the lungs, infection and scarring.

How is a Tracheostomy performed?

A tracheostomy may be performed ‘percutaneously’ or ‘surgically’. Whichever method is used, the patient will typically 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 to into the trachea under direct vision, 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.

What happens afterwards?

Most tracheostomies in ICU are temporary and are 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 clearing chest secretions.

If a patient requires help with their breathing from a ventilator, a cuff in the tracheostomy tube is usually inflated to ‘seal’ the airways. This means that airflow moves from the ventilator via the tracheostomy, directly to the lungs. This by-passes the upper airways and voice-box, meaning that speech is temporarily not possible. This can be very frustrating for patients, relatives and staff, although alternative means of communication can be used with varying success.

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 via the mouth. 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. Summary of insertion procedure steps

1. *Tracheostomy 'Cockpit Check'* including 'Right patient, right kit', consent, withholding of anticoagulation, stopping of NG feed. Consideration should be given to using a WHO type safer surgery type checklist.

2. *Anaesthetic sequence;*
a. Preoxygenate, induce and maintain anaesthesia, and paralyse the patient.
b. Ventilate with adequate PEEP and FiO_2 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 alcoholic 2% chlorhexidine or iodine preparations (only if the patient is allergic to CHX), for an area of at least 10 cm around the proposed incision site and apply surgical drapes. Ensure 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 increase the risk of erosion of great vessels in the thoracic inlet, are technically more difficult as the trachea becomes deeper and makes 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 pretracheal 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 in 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. Endoscopic supervision can be useful in avoiding tracheal ring damage 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 an endoscope or immediate use of capnography. The limitations of chest auscultation, and pulse oximetry in a pre-oxygenated patient should be appreciated.

m. Endoscopic 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. Endoscopy from above and through the new tracheostomy tube can also confirm the presence or absence of bleeding. Endoscopy can also assess the larynx for potential problems during weaning and decannulation.

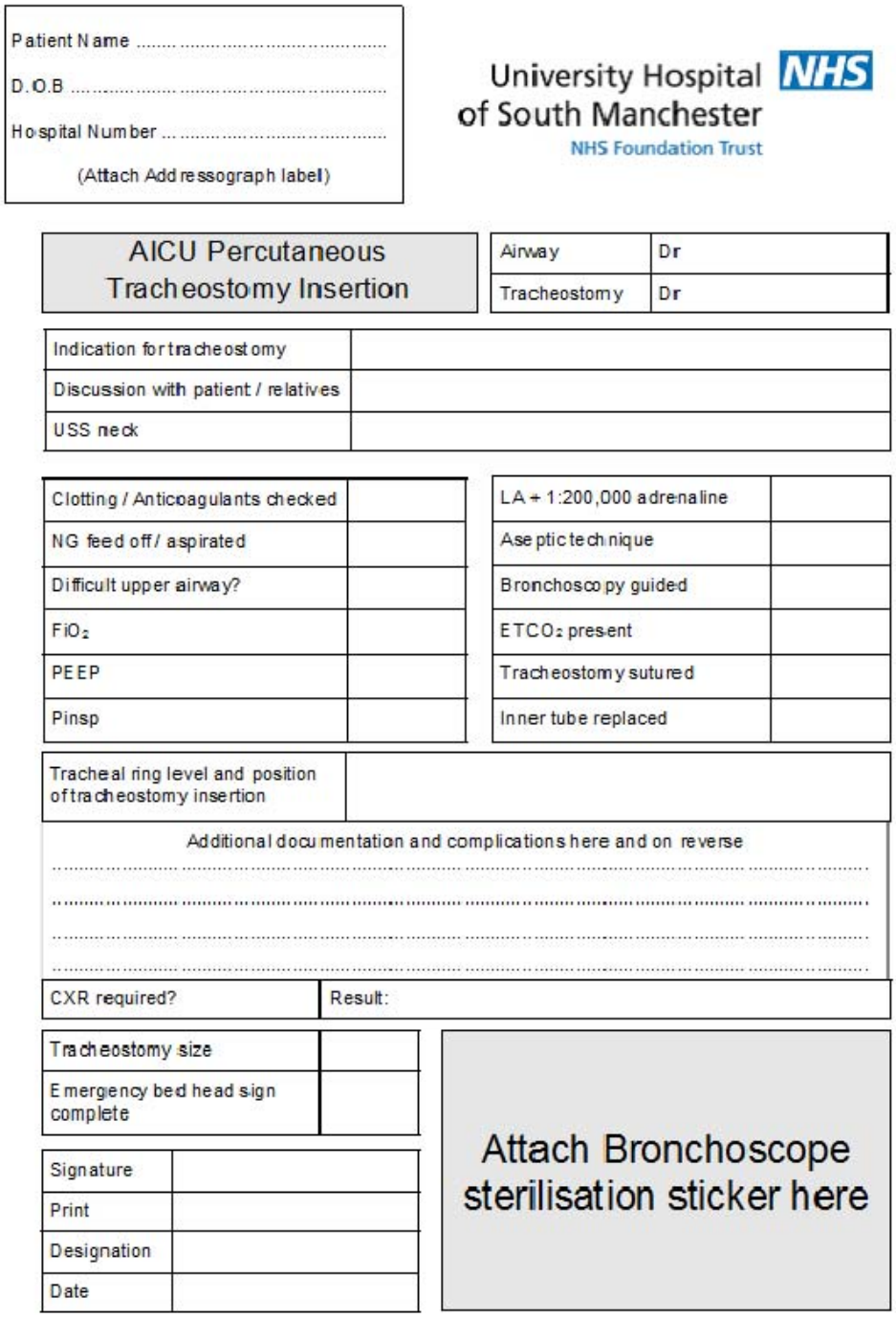
o. The wings of the tracheostomy should be held in pace with a proprietary tracheostomy holder, secured to ensure that the holder is neither too tight nor too loose, Chest X-rays are not routinely required if tube placement has been confirmed endoscopically and the procedure has been uneventful. There 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.

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.

Appendix 3; Sample tracheostomy insertion



Patient Name .....

D.O.B .....

Hospital Number .....

(Attach Addressograph label)

University Hospital of South Manchester NHS Foundation Trust

AICU Percutaneous Tracheostomy Insertion

Airway	Dr
Tracheostomy	Dr

Indication for tracheostomy	
Discussion with patient / relatives	
USS neck	

Clotting / Anticoagulants checked		LA + 1:200,000 adrenaline	
NG feed off / aspirated		Aseptic technique	
Difficult upper airway?		Bronchoscopy guided	
FiO_2		$ETCO_2$ present	
PEEP		Tracheostomy sutured	
Pinsp		Inner tube replaced	

Tracheal ring level and position of tracheostomy insertion	

Additional documentation and complications here and on reverse

.....

.....

.....

.....

CXR required?	Result:

Tracheostomy size	
Emergency bed head sign complete	

Signature	
Print	
Designation	
Date	

Attach Bronchoscope sterilisation sticker here

form.

Additional information could include; Manufacturers data (sticky labels) outlining tube and insertion kit reference

Appendix 4

Daily TRACHEOSTOMY CARE Form

PT. STICKER:

WARD BASED APPRAISAL OF NEED

DATE OF STOMA:
DATE OF LAST TUBE CHANGE:
TUBE TYPE: **?FENESTRATED:**

(Y for YES, N for NO)

DATE:							
GCS							
? CPAP DEPENDENT							
? O_2 DEPENDENT							
? %							
?ADEQUATE VENTILATION							
? RATE							
? EXPANSION							
? PATTERN							
AIRWAY							
? MAINTENANCE							
? PROTECTION							
? SWALLOW							
COUGH							
? PRESENT							
? EFFECTIVE							
SECRETIONS							
? TENACIOUS							
? INFECTED							
? SUCTION No./24 HRS							
? EXCESS DEMAND							
? ANAEMIA							
? PYREXIA							
? POOR LV FUNC.							
?IMPAIRMENT(DISTENSION)							
? FAILED WEAN							
? WEANABLE							
? CUFF DOWN							
? TRIAL OCCLUSION							

? TRIAL EXTUBATION							
DOCTOR:							

Appendix 5
Bedside equipment for all tracheostomy patients

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)
Resuscitation equipment
Tracheal hook (*to anchor anterior tracheal wall during tube changes recommended by ENT surgeons for open procedures but unfamiliar to many other staff).*

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

• Humidification equipment
• Clean pot for spare inner cannula
• Sterile water for cleaning the suction tube
• Scissors or stitch cutter if tracheostomy tube is sutured)
• Water soluble lubricating jelly
• Sterile dressing pack
• Nurse call bell: the patient may be unable to call for help verbally
• Communication aids: the patient may not be able to verbalise
• Bedside equipment checklist

Emergency equipment:

• Basic airway equipment
    - Oxygen masks, self-inflating bags, oral and nasal airways
• Advanced airway equipment
    - Laryngeal mask airways and laryngoscopes with appropriate tubes (intubation trolley or similar)

Anaesthetic drugs, vasopressor agents, atropine ECG, pulse oximeter, automated BP recordings

    -

• Capnography[1]
• A fibreoptic endoscope[2]
• Tracheal dilators[3]
• Bougies/airway exchange catheters

- A paediatric mask for those cases where mask ventilation is required over the stoma, for staff unable to pass a tube

a. e.g. a suction catheter or airway exchange catheter which can be advanced through the stoma and connected to an oxygen supply
a means of reopening the stoma and inserting tubes: tracheal dilator forceps and access to a PCT kit

Access to resuscitation equipment such as defibrillator

[1, 2] Waveform capnography and a fibreoptic endoscope (suitable for immediate use) should be available for all patients with a tracheostomy. In critical care and specialist areas, these should be immediately available. For other ward areas, availability should be within minutes (e.g. on a cardiac arrest trolley). Staff caring for tracheostomy patients and those who respond to emergencies should know how to access and operate these devices around the clock. In practice this would generally mean calling either anaesthetists or relevant surgical specialists. Single use scopes should make equipment provision easier.

[3] There is conflicting opinion on whether tracheal dilators are useful in an emergency. This should be agreed locally; influences include patients' characteristics, types of tracheostomy performed and clinicians' preference.

Appendix 6.

Procedures for changing a tracheostomy tube

Ensure that adequate consideration and preparation is made for a failure to re-insert a new tube. This includes ensuring the *availability* of equipment, airway expertise and anaesthetic medication. The immediacy of such support (bedside, on the unit, in the hospital) will be dictated by the clinical circumstances, location and personnel involved.

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/or aspirate the nasogastric tube if 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 tracheostomy tube with a tube holder. 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 in respiratory difficulty – see blocked/dislodged tube algorithm**