ACI NSW Agency for Clinical Innovation

Care of Adult Patients in Acute Care Facilities with a Tracheostomy

Clinical Practice Guideline

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Foreword

Adult patients with a Tracheostomy tube require complex care involving clinicians across healthcare specialties; highlighting the need for good communication, coordination and team work.

Monitoring and analysis of New South Wales clinical incident data, undertaken by the Clinical Excellence Commission (CEC) identified important areas where Tracheostomy care could be improved. The Intensive Care Coordination and Monitoring Unit were tasked with developing an evidence based guideline to inform best practice. An expert multidisciplinary group was formed and this clinical guideline represents the teams work and collaboration.

This important piece of work represents collaboration between the Clinical Excellence Commission (CEC), Agency for Clinical Innovation (ACI) and Local Health Districts (LHDs), to improve the safety and quality of care delivered to adult patients with tracheostomies in acute care hospitals.

The ACI has the important ongoing remit of supporting the implementation of these guidelines in our acute hospitals.

On behalf of the ACI, I would like to thank the many clinicians and staff who have worked on the development and implementation processes for the Tracheostomy guideline.

Dr Nigel Lyons

Chief Executive, Agency for Clinical Innovation

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Executive Summary

This guideline has been developed to support local health districts and/or hospitals to develop local policies and practices that map to their specific patient population. The recommendations apply to adult patients with a temporary or permanent tracheostomy tube who are inpatients in acute care facilities. Most patients with a tracheostomy tube will have healthcare needs that cover several healthcare disciplines and while there is evidence to suggest non-Ears Nose Throat (ENT) patients have enhanced outcomes where a specific tracheostomy team is available, the guideline does not mandate such a team be created. As hospital case mix and resources vary, each hospital will need to examine local conditions to develop a model of care that ensures patients receive comprehensive multi-disciplinary care.

1. Establish model/s of care that ensure patients receive comprehensive multi-disciplinary care.
2. Ensure a safe environment by
    a. Developing local guidelines for practice
    b. Establishing emergency procedures and making them available within all in-patient areas (may include radiology, physiotherapy)
    c. Providing comprehensive education program for patients and carers
    d. Providing continuing education to ensure all staff are competent especially in regards to emergency interventions
    e. Ensuring patients are located in wards where appropriate numbers of competent nursing staff are available
3. Develop local documentation method/s to ensure patients with a tracheostomy tube have a documented plan of care (including discharge plan) specific to tracheostomy care that is initiated on insertion, reviewed on a daily basis and updated as required.
4. Where patients and/or carers come from culturally and linguistically diverse backgrounds (CALD) provide appropriate resources to facilitate their understanding.
5. Ensure a range of humidification systems are available to ensure patients inhale humidified air/gases and the tracheostomy tube does not block
6. Minimise the risk of healthcare associated infections (HAI) by ensuring that:
    a. staff are compliant with the 5-moments of hand hygiene when attending all tracheostomy care
    b. Inner tracheostomy cannulaes are not cleaned at hand basins
7. Undertake periodic evaluation of Incident Information Management System (IIMS) and rapid response team data to identify the causal factors associated with adverse events in patients with tracheostomy

Glossary: abbreviations & definitions

AAC	alternative and augmentative communication
AIN	Assistant in nursing
CPDP	Continuing professional development program
CPG	Clinical practice guideline
Cutaneotracheal tract	The tract created by the opening in the neck into the trachea which matures over time
EN	Enrolled nurse
HCP	Healthcare professional includes nurses, doctors and allied health
HME	Heat moisture exchanger
IIMMs	Incident Information Management System
ISBAR	The **ISBAR** acronym provides a simple but effective way of prioritising information when communicating about a patient and their situation. Introduction – Situation – Background – Assessment - Recommendation[1]
LOS	Length of stay
MDT	Multidisciplinary team: group of specialised clinicians that work together to care for a patient with a tracheostomy. Do not necessarily need to be part of a TRT
MEBDT	Modified Evan's Blue Dye Test
Primary Care Team	Refers to the medical team responsible for management of a patient's primary condition. In ICU this would be the intensive care team
RN	Registered nurse
TRT	Tracheostomy referral team
TT	Tracheostomy tube
VFSS	Videofluoroscopic swallowing study
WOB	Work of breathing

[1] For further information please refer to Between the Flags program – Detect Training. http://nswhealth.moodle.com.au/DOH/DETECT/content/00_worry/when_to_worry_06.htm

Introduction

Adult patients with a tracheostomy tube are a vulnerable patient group because of changes to their airway. Additionally, their care may be highly complex involving a number of clinicians across different healthcare specialties; highlighting the need for good communication, coordination, team functioning and documentation. In 2009, the Clinical Excellence Commission released a report that found that patients with a tracheostomy were experiencing significant adverse events as a result of deficits in their care. Specifically, these deficits were related to the competencies of clinical staff and lack of appropriate action especially after hours. The guideline has been developed using a multi-stage process to ensure that:

- the recommendations reflect best available evidence and current accepted standards of clinical practice
- the scope of practice of all healthcare professionals (HCP) involved in the care of the patient has been considered
- broad consultation with all HCP
- recommendations are flexible and applicable across all acute care settings

Purpose of the guideline

The recommendations in this guideline have been developed to guide local health districts (LHDs) and/or hospitals develop local policies and practices that map to their specific patient population. The recommendations apply to adult patients with a temporary or permanent tracheostomy tube who are inpatients in acute care facilities. The guideline DOES NOT address issues related to:

- reasons for insertion of a tracheostomy tube or surgical approach
- timing of insertion
- conditions or circumstances related to possible surgical intervention to facilitate removal of the tracheostomy tube or discharge from hospital
- care of patients with tracheal stomas only

When reviewing this document clinicians and managers

- must keep in mind that the recommendations reflect best evidence and practice as of the release date and that newer evidence and/or policies or guidelines may also have been published which could influence recommendations AND
- should read the accompanying narrative to each of the sections as the narrative provides the important context and evidence for the recommendations

The guideline has been organized in the following sections.

A. System of Care
B. Patient Preparation
C. Maintaining a patent airway
D. Prevention of infection
E. Swallowing
F. Facilitating communication
G. Weaning to decannulation
H. Complications and emergencies
I. Nutrition
J. Education
K. Transfer of care
L. Appendices
M. References

Literature review

An integrative literature review was undertaken to address the subsections of the CPG as previously discussed. A systematic literature review was not possible because of a lack of experimental research. These reviews were undertaken in groups of two or more. Data was extracted from papers using a standard tool and each paper was evaluated for quality using the National Health and Medical Research Council (NHMRC) grading grid. The strength of practice recommendations were also graded according to NHMRC.

Table 1 NHMRC designations of levels of evidence

Level	Intervention
I	A systematic review of level II studies
II	A randomised controlled trial
III-1	A pseudorandomised controlled trial
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group
IV	Case series with either post-test or pre-test/post-test outcomes
GPG	Guidelines from international organisation

Table 2 Body of evidence matrix

Component	A	B	C	D
	Excellent	Good	Satisfactory	Poor
Evidence base	one or more level I studies with low risk of bias or several level II studies with a low risk of bias	one or two level II studies with a low risk of bias or a SR/several level III studies with a low risk of bias	one or two level III studies with a low risk of bias, or level I or II studies with a moderate risk of bias	level IV studies, or level I to III studies/SRs with a high risk of bias
Consistency	all studies consistent	most studies consistent and inconsistency may be explained	some inconsistency reflecting genuine uncertainty around clinical question	evidence is inconsistent
Clinical impact	very large	substantial	moderate	slight or restricted
Generalisability	population/s studied in body of evidence are the same as the target population for the guideline	population/s studied in the body of evidence are similar to the target population for the guideline	population/s studied in body of evidence differ to target population for guideline but it is clinically sensible to apply this evidence to target population	population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalise to target population
Applicability	directly applicable to Australian healthcare context	applicable to Australian healthcare context with few caveats	probably applicable to Australian healthcare context with some caveats	not applicable to Australian healthcare context

SR = systematic review; several = more than two studies

Table 3 Grade of recommendation (NHMRC)

Grade of Recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Consensus Opinion	Where no evidence could be applied Consensus opinion developed by: • formulation of recommendation through discussion • assignment of agreement by individual participants (Likert 1-9) • consensus set at median of 7

Background

Tracheotomy/tracheostomy refers to an artificial opening into the trachea, which may be temporary or permanent. For the purposes of this guideline, the term tracheostomy will be used. This CPG has been developed to assist hospitals and LHDs to develop clinical practices for patients with a tube inserted into the stoma. There are a number of indications for a tracheostomy tube including:

- Maintenance of airway patency for patients with mechanical obstruction of the upper airways (e.g. bilateral vocal fold palsy)
- Prophylactic insertion during head and neck/ENT surgery where airway is likely to be temporarily compromised by post-surgery oedema
- As a weaning step from the ventilator in patients with respiratory failure
- To protect the airway from secretions entering the lungs in patients with a compromised swallow and/or impaired airway protection
- To allow access to bronchial secretions (respiratory toileting) when a patient is unable to cough effectively

While bypassing the upper airway using a tracheostomy tube may be necessary, for these patients, there are significant alterations to normal physiology that require consideration and may need to be compensated for. These may include:

- Bypassing normal gas humidification processes
- Normal mucociliary clearance is altered by
  - Presence of tube obstructing upward movement of mucus
  - Dry inspired air changes ciliated epithelium to squamous epithelium
- Disruption of normal communication and eating
- Pooling of oropharyngeal secretions above the cuff leading to microaspiration and increased risk of nosocomial pneumonia.

For patients, the experience of having a tracheostomy tube is difficult with many complex physical sensations and emotions to deal with [1-2]. Patients are comforted when they are assured that the clinicians caring for them are competent. Additionally communication and information needs are particularly important because this is a new experience accompanied by a fear of the unknown. Patients experience significant uncertainty, worry and long term anxiety over the frequency of tube changes, length of wound healing and the dread of being reliant on a small plastic tube to breathe [3]. The diversity of emotions experienced suggests that patient preparation and information given should be tailor-made to match individual needs [1].

Most patients with a tracheostomy tube will have healthcare needs that cover several healthcare disciplines and the complexity of this care means ideally an experienced clinician or a tracheostomy team will be required to coordinate this care (Table 4 Clinician scope of practice type). Because hospital case mix varies, each hospital will need to examine local conditions to make appropriate decisions to ensure that patients receive person-centred time sensitive-care in a safe environment.

Section A: System of Care

Recommendations in this section refer to organisational level practices to ensure an optimal environment for patients with a tracheostomy tube. NB the recommendations for practice WERE NOT developed for patients with stomas only. Elements include:

- Environment of care
- Plan of care and communication
- Patient assessment
- Essential equipment
- Transport and transfer
- Scope of practice

Many patients with tracheostomy tubes have complex care needs with a resulting long length of stay (LOS) and high cost diagnostic related group (DRG) [4]. There are two groups of patients with tracheostomies in acute care settings. The first group is mostly homogenous and comprises patients who have a tracheostomy tube inserted electively by an ENT surgeon with the aim of treatment for a specific ENT problem. These patients are admitted to a limited number of tertiary hospitals and generally cared for in a specialist ward setting by clinicians with significant expertise in the care of tracheostomies. The second group is heterogeneous with a broad spread of diagnoses where a tracheostomy is inserted to either aid weaning from the ventilator or to protect their airway or both. This second group of patients are cared for in multiple ward settings with variable tracheostomy expertise available. Furthermore these patients may have other significant clinical problems that require ongoing management by multiple healthcare care specialties and clinicians. It should be noted however that these are general statements only that may not reflect the case mix in all settings. Currently there are a number of different models of care present in NSW facilities including:

- A multi-disciplinary tracheostomy review team (TRT) [5]
- Specialist clinician input within a multi disciplinary team (MDT)
- A case management approach where a specific clinician coordinates all care
- An expert nurse service where a nurse specialist coordinates care and/or provides advice.

Whatever the approach the needs of tracheostomy patients, even short term, include:

- Management of their primary and chronic medical condition/s
- Expert tracheostomy nursing care
- Allied health consultation and intervention including but not limited to: physiotherapy, speech pathology, social worker and dietetics.

Table 4 outlines the scope of practice for each of the healthcare disciplines. This list is not exhaustive and many roles may overlap depending on institution.

Table 4 Clinician scope of practice type

Recommendations	Grade of Recommendation
ENT Surgeon	Medical management of patient

Recommendations	Grade of Recommendation
ICU Specialist	Medical management of patient in intensive care
ENT Specialty Nurse[#]	Coordination of care • Planning of admission through to discharge • Pre-operative assessment - Product suitability and ensure it is in operating theatre for surgery • Referral to MDT • See all elective head and neck patients Consultation Education – direct and seminars • Facility - nursing staff and medical staff • Patients and carers • Nursing homes Clinical Interventions • Change tracheostomy tube (TT), site naso-gastric tubes, size laryngo stomas • Wound assessment (as related to tracheostomy) • Cuff deflation
ICU Liaison[#]	Provides review service for ex-ICU patients which can include • Coordination of tracheostomy care • Education of clinical staff
Respiratory Specialty Nurses[#]	Provide regular tracheostomy care in conjunction with nursing staff caring for tracheostomy patient including • Suctioning, cleaning inner tubes, tracheostomy stoma care, checking cuff pressures • Assessing and monitoring respiratory status • Maintaining airway patency • Monitoring hydration and integrity of secretions • Involved in selection of tracheostomy tubes • Consultation and education to ward staff • Troubleshoot problems as they occur • Management of tracheostomy emergencies • Changing tracheostomy tubes of both hospital and community patients • Involved in weaning and decannulation of tracheostomy • Providing education to Carers, families, patient and parents that facilitates patient independence and promotes discharge planning • Liaising between hospital and community/nursing home
Registered Nurse/	Provides clinical care to patient (subject to competency) including • Suctioning, cleaning inner tubes, tracheostomy stoma care, checking cuff pressures • Assessing and monitoring respiratory status • Maintaining airway patency • Monitoring hydration and integrity of secretions • Identification and intervention where emergencies occur
Endorsed enrolled nurse	Provides clinical care to patient (subject to competency) under the supervision and as directed by registered nurse and specialist nurses
Dietician	• Nutrition assessment and monitoring • Development and implementation of an individualized nutrition care

Recommendations	Grade of Recommendation
	plan (incorporating oral, enteral or parenteral) • Education
Case Manager	Responsible for the coordination of patient care of multiple services
Speech Pathologist	• Assessment and treatment of swallowing dysfunction (secretions and food/fluids) • Assessment of communication ability (verbal and/or augmentative) • Providing an effective communication system to patient. This may include speaking valve trial, finger occlusion training and/or leak speech • Communication (verbal) and training in voice output devices, communication boards and strategies to optimise intelligibility of mouthed words (augmentative). • Cuff deflation trials in conjunction with team • Advice on weaning and readiness for decannulation in conjunction with team • May provide advice on tube selection to promote verbal communication or weaning • Consultation and education to ward staff, patient, family as required
Physiotherapist	May include • Tracheobronchial hygiene including cuff deflation • Mobility • Cuff deflation trials • Physical decannulation or tube changes • Humidification recommendations • Respiratory muscle strengthening -+ retraining • Nursing staff education
Social Worker	A patient unable to communicate has considerable concerns and needs support and assistance of a social worker
Occupational Therapist	Patients may require re-training to enable them to become more independent, especially regarding activities of daily living (ADL). In addition, home modifications may also be necessary to facilitate discharge planning
[#]In regional settings, the task of coordinating the care of tracheostomised patients is most often undertaken by the intensive care team, predominantly the CNC or CNE where available.	

A TRT has been established by a number of Australian institutions in order to coordinate the care of patients who are discharged from ICU with a tracheostomy. A TRT includes a number of clinicians who are able to provide expert clinical care including assessment and intervention for the patient. The literature review revealed an emerging evidence base suggesting that such teams are able to reduce time to decannulation; adverse events; and hospital LOS [6]. Additionally, there is an enhancement in the use of communication strategies. Importantly there is an improvement in outcomes for patients with spinal injuries [7] and severe head injuries [8] with significant cost savings. Teams are able to:

- review patients on a regular basis and coordinate care of the many healthcare professionals caring for the patient
- provide ‘just in time’ and structured education enabling clinical staff to become more confident and provide better care

- provide a consultation service especially around: appropriate appliances and decannulation; respiratory and physical care; communication and swallow; and diet.

The recommendations outlined in the following pages emphasise the need for acute care facilities to create a safe clinical environment for patients with tracheostomy tubes insitu. It is organised into the following sections:

- Environment of care
- Plan of care and communication
- Patient assessment
- Essential equipment
- Patient transport between clinical areas.

Environment of Care

Recommendations		Grade of Recommendation
1.	Care of patients with a tracheostomy requires a coordinated multi-disciplinary approach	Consensus
2.	Where established, Tracheostomy Review Team (TRT) members should include but are not limited to: • Medical specialist • Senior nursing specialist • Physiotherapist • Speech pathologist	Evidence B Recommendation C
3.	The TRT will work collaboratively with the primary care team to devise a management plan for the patient.	Consensus
4.	To ensure optimal patient outcomes hospitals without a TRT or relevant medical, nursing or allied health expertise should develop close links with the TRT or specialist clinicians at their LHD tertiary referral centre.	Consensus
5.	All hospitals must have specific policies and procedures to guide the clinical management of patients with tracheostomies. These documents must be available at point of care.	Consensus
6.	All LHDs are to provide continuing professional development programs that are appropriate to patient case mix, to ensure the competence of staff caring for patients with tracheostomies (see Section J).	Consensus
7.	All hospitals are to have documented action plans that identify how to deal with tracheostomy tube emergencies (see Section H). These action plans must include • action/s to be taken • key personnel at all times of the day • be specific for the clinical area	Consensus
8.	Patients with tracheostomy tubes are to be cared for in ward areas that are able to provide care appropriate to the patient's general clinical condition and • where adequate members of nursing staff have been assessed as being competent to care for these patients [9] • there is adequate equipment to facilitate monitoring • the patient is under close observation	Consensus
9.	All LHDs must monitor and evaluate the outcomes of patients with a tracheostomy. At a minimum this should include regular and systematic evaluation using incident monitoring systems (i.e. IIMS)	Consensus
10.	All LHDs should • evaluate current practice against this guideline • develop an implementation plan to address any gaps • monitor uptake of guideline	Consensus

Plan of Care and Communication

Recommendations		Grade of Recommendation
11.	All patients with a tracheostomy tube must have a documented plan of care (including discharge plan) specific to tracheostomy care that is developed on insertion, reviewed on a regular basis and updated as required [9]. Where available, the TRT assists the primary care team and the patient or designated proxy to develop this plan.	Consensus
12.	All changes to the plan should t be written and verbally communicated to the primary care team and nurse caring for the patient.	Consensus
13.	All HCP must maintain contemporaneous patient documentation.	Consensus
14.	Where patients and/or carers come from culturally and linguistically diverse backgrounds (CALD), healthcare interpreters should be involved to ensure patients and carers understand all aspects of tracheostomy care. Ideally, patient/carer information should be available in a range of languages that map to the LHD population	Consensus
15.	When transferring care between clinicians ideally a visual, verbal and written handover should occur including: • Patient history including reason for TT, airway anatomy, physiology, • Tracheostomy tube insertion date, type of tube, method of insertion, size and method of anchoring • Date of next tube change • Secretion management (amount, colour , consistency, ability to cough and suction requirements) • Humidification method • Oxygen requirements - current method, FiO_2 and SpO_2 target range • Nutrition • Communication method	Consensus

Patient Assessment

Recommendations		Grade of Recommendation
16.	All healthcare professionals directly involved in patient care must complete and document patient assessment at • intervals appropriate for the patient's general clinical condition; and • pertains to the HCP scope of practice (seeTable 4)	Consensus
17.	For nursing staff, this interval should be • Intensive care and high dependency: as clinical condition dictates • Ward areas: This interval is not to be greater than six hours	Consensus

Recommendations		Grade of Recommendation
18.	For nursing staff, this patient assessment should include: • Airway patency (includes evaluation of tracheostomy tube patency, effectiveness of stabilization method and cuff pressure) • Breathing (includes chest auscultation) • Level of consciousness and orientation	Consensus
19.	Patients should have a complete set of vital signs, including respiratory rate, blood pressure, heart rate, and temperature and oxygen saturation, at intervals appropriate for their general clinical condition. • Intensive care and high dependency: as clinical condition dictates • Ward areas: - Routine post operative observations and - Tracheostomy observation chart - Stable post op period and patients discharged from ICU: Observations a minimum of 4 hourly for first 48 - Thereafter as clinically indicated, however, this interval is not to be greater than eight hours [10] • When moved to a different clinical or diagnostic area.	Consensus
20.	Continuous pulse oximetry should be in place where clinically indicated. Typically this may include patients: • With a new or recently changed TT • Receiving continuous oxygen ≥ 4lpm • Experiencing an unstable respiratory status • Changes in TT management • Ventilatory support	Consensus

Essential Equipment

Recommendations		Grade of Recommendation
21.	To facilitate optimal clinical care and intervention under emergency circumstances, the following equipment should be available WITHIN the patient's bed space AND must be checked on a shift-by-shift basis to ensure availability: • suction equipment including size appropriate suction catheters and oral suction equipment • oxygen supply and attachments to apply oxygen to both tracheostomy and face • cuff manometer and 10 mL syringe (where a cuffed tracheostomy is in use) • personal protective equipment for standard precautions including: gloves, aprons/gowns, goggles and fluid-resistant mask, or full-face visor. The type of mask required may vary if patient under droplet or airborne precautions • humidification devices as appropriate • appropriate waste receptacles for general and clinical waste • bottle of sterile water to clean suction tubing after use (labelled with date and changed daily) • spare inner cannula (where dual lumen tracheostomy tubes are	Consensus

Recommendations		Grade of Recommendation
	in use) • tracheostomy emergency response plan specific to critical nature of patient airway Units may choose to keep some equipment on an emergency trolley, which is located within the immediate ward rather than in the patient's bed space: • two spare tracheostomy tubes (one the same size as tube insitu, and one a smaller size). Sites may consider a cuffed TT is required in case of emergency • tracheal dilators may also be considered	
22.	To facilitate optimal clinical care and intervention under emergency circumstances, the following equipment should be available within wards where patient with a tracheostomy are cared for AND checked each shift and after use to ensure availability: • Emergency trolley including resuscitation bag and airway equipment • Patient monitor • Tracheal dilators	Consensus

Patient Transportation between Clinical Areas

This group of recommendations concerns movement between clinical areas including transfer to new ward settings, theatre or diagnostic units.

Recommendations		Grade of Recommendation
23.	Before a patient is transported between different areas of the hospital, they must be clinically assessed by a senior clinician to ensure that it is clinically appropriate to move them AND any risks of acute deterioration can be addressed. This includes patients who are being transported within the hospital under the care of relatives.	Consensus
24.	When a patient with a tracheostomy is moved between different clinical areas, they must be supervised by clinical staff who: • have tracheostomy care within their scope of practice AND • are able to care for them as appropriate to the patient's clinical condition, interventions and vulnerability of airway.	Consensus
25.	When a patient with a tracheostomy is moved around the hospital by their relatives and not directly supervised by a clinician: • a risk assessment must be undertaken to ensure the patient will be safe • an emergency action plan is in place if the patient should experience an adverse event including loss of airway or acute respiratory deterioration	Consensus
26.	To facilitate optimal clinical care and intervention under emergency circumstances, the following equipment must be with the patient when	Consensus

Recommendations		Grade of Recommendation
	they are transported within the hospital: • Pulse oximetry and other monitoring as appropriate to clinical condition • Portable suction equipment including size appropriate suction catheters and oral suction equipment • Full oxygen cylinder with flow meter attached as well as oxygen tubing, masks and attachments as appropriate to apply oxygen to both tracheostomy and face • Resuscitation bag • Cuff manometer and 10 mL syringe (where a cuffed tracheostomy is in use) • Personal protective equipment for standard precautions including: gloves, aprons/gowns, goggles and fluid-resistant mask, or full-face visor. The type of mask required may vary if patient under droplet or airborne precautions • Heat moisture exchange • Two spare tracheostomy tubes (one the same size as tube insitu, and one a smaller size) • Spare inner cannulae (where dual lumen tracheostomy tubes are in use) • Tracheostomy emergency response plan specific to critical nature of patient airway • Fluids and medications as appropriate • Patient documentation as appropriate to reason for clinical transport This equipment must be checked immediately prior to transport to ensure availability	
27.	Where patients are transferred between clinical settings, a comprehensive handover MUST occur at the bedside and • be based on ISBAR principles (does the ISBAR principle need to be included as attachment or have a reference so it can be located)? • include information regarding why a tracheostomy tube is being used, especially with respect to vulnerability of airway • be communicated verbally and in written form	Consensus
28.	Upon transport or transfer to a different clinical setting and regardless of the length of time, a patient assessment MUST be completed to ensure that the patient's airway and general condition has not deteriorated	Consensus
29.	Where patients are moved to a diagnostic area, they must be directly supervised by nursing staff able to intervene if the tracheostomy tube or airway is compromised	Consensus

Section B: Patient Preparation

Research suggests that the experience of a tracheostomy is a complex mix of physical sensations and emotions [1, 3]. Although this can be considered a relatively routine procedure for clinicians, it can be very distressing to patients both during and after removal of the tracheostomy [1, 3]. For non emergency insertion there is some literature to support the need for patients to be well prepared for the likelihood of undergoing insertion of a tracheostomy and some have studied the patients' perspective of what it is like to experience a tracheostomy tube [1-3, 11]. Patients may experience disturbing physical and psychological effects highlighting the need for sufficient information adapted to individual [12]. In addition even elective patients may have individual information needs as seen in a study of patients with head and neck cancer [13]. This highlights the importance of customising care and education of patients who have or are expected to have a tracheostomy [3]. It is also important to evaluate the effectiveness and understanding of any information given to the patient.

Table 5 Patient concerns when they have a tracheostomy

• Necessity of communication • Retaining normality • Psycho social discomfort • Painful procedures • Fear of the unknown • Relationship with staff	• Loss of normal body function • Physical discomfort • Loss of control • Negotiating care • Sense of safety and security

Recommendations		Grade of Recommendation
1.	Patients with a tracheostomy must receive care based on a patient-centred MDT approach, allowing the patient and carers access to all members of the TRT. This will also assist in ensuring time appropriate continuum of care and builds a sense of security from the patient's perspective	Consensus
2.	Where possible, when an elective tracheostomy is planned, a preoperative assessment by TRT or specialist clinician should be undertaken to develop a plan of care that includes: • education of patient and carers/parents relating to all issues of tracheostomy care • identification of psychological/psychosocial support • identification of the most appropriate product(s) for the patient • provide a range of communication options to enable patient to choose preferred method	Consensus
3.	Where the tracheostomy is a result of an emergency, post insertion review should include: • education of patient and carers/parents relating to all issues of tracheostomy care • psychological/psychosocial support • evaluation of the most appropriate product(s) for the patient	Consensus

Recommendations		Grade of Recommendation
4.	Where possible, alternative communication methods should be explored pre-operatively with the patient and their carer. Where this is not possible, it should be addressed as soon as the patient is awake (within the limitations of concentration span/altered consciousness/effects of medication anatomical limitations, and clinical status). Once an appropriate communication method is identified it should be used consistently.	Consensus
5.	If the tracheostomised patient is currently in a non-tertiary facility without access to TRT or specialised clinicians, consider collaboration with tertiary institution for person-centred, time appropriate care.	Consensus
6.	Each hospital should establish referral processes to the MDT to ensure timely assessment and intervention.	Consensus

Education

Education plays a vital role in preparing the patient for a tracheostomy tube and may assist in lessening the psychological and physical distress that a tracheostomy may cause. Patients' fears and discomfort even after removal of the tube were found to be sufficiently powerful to suggest that they need further support to cope [12]. In one study, participants commented on the differences between people and the knowledge they need suggesting that some patients use friends and family for information provision [12]. Nurses and other health professionals are often in the position of interpreting the non-verbal communication of the voiceless patient, and this plays an integral role in decision-making in relation to treatment options and end of life choices [11]. This demonstrates the need for all health professionals to have an increased awareness of the importance of education of patients and staff in relation to all aspects of tracheostomy care.

Health professionals need to ensure that information is available to patients (and their care givers) but also that patients should have an opportunity to control the timing and type of information they receive [13]. Therefore, any information provided should be delivered in a way that the patient understands and should cover the following:

- Type of product
- Reason for the tracheostomy
- How it will be secured
- Treatment trajectory
- Altered physiology resulting in potential changes to communication and humidification
- Carer aspects – securing of tube, how often, why, how often to suction
- Psychological changes affecting self-image, aspects i.e. pain, fear of the unknown, communication, patients' perspective, identification of patients' primary support person/care giver
- Consent
- Medications that may affect cognition and memory (repetitive reinforcement may be required)
- Include patients in all discussions relating to their care

Section C: Maintaining a patent airway

Patients with tracheostomy tubes are at a greater level of risk than most hospital patients because of changes to their airway. This is especially important where patients do not have an intact airway above the tracheostomy. Another important consideration is that the management of a patient with short term tracheostomy may be significantly different to those with a permanent tracheostomy tube especially in relation to tube structure, suction and humidification. This emphasises the need for individualized care plans. Additionally these recommendations do not apply to patients with a stoma. Maintaining a patent airway has a number of sub-elements which will be addressed separately. These elements are

- Choice of tracheostomy tube – this pertains to principles that can be used to guide the most appropriate TT for an individual patient
- Maintenance of an optimal position of the tracheostomy tube (?TT) in the trachea – these practices pertain to tracheostomy stabilisation methods
- Cuff Management
- Humidification
- Suction of respiratory secretions
- Cleaning & changing of tracheostomy tube

Choice of Tracheostomy Tube

There is very little evidence in current literature pertaining specifically to choice of tube or product selection, particularly in the elective pre-operative context. The choice of tubes will be influenced by clinical condition, the type of tracheostomy performed (surgical vs. percutaneous), their expected duration of intubation and the individual patients needs. The tube may be made from thermosensitive or hard PVC. Cuffed tracheostomy tubes are used for patients requiring mechanical ventilation or at risk of aspiration; whereas uncuffed tubes are used for patients who are spontaneously breathing and can clear their own secretions. An uncuffed tube maintains airway patency and may enable voice production. Tubes are also available with or without fenestrations. Fenestrations allow additional airflow to the larynx to assist vocalisation [14]. It is important for clinicians to understand these differences when considering tube selection for their patients [15].

This section contains some considerations that clinicians have expressed may influence the selection of TT. It can be used as a prompt to promote critical enquiry and discussion amongst the MDT prior to the patient undergoing a tracheostomy. Where possible, it is helpful to educate the patient and carer about the product selected for them and how it works (see Section B: Patient Preparation).

Factors that may be considered when selecting the type of tracheostomy tube

- Anatomy of patient's airway, including size, any stenosis, obstruction:
  - Size of airway
  - Congenital airway
  - Tracheomalacia – flaccidity of the trachea

  - Tracheal stenosis - Narrowing of the trachea by stenotic granular tissue (scar tissue). This may occur at the tracheal orifice, cuff site, or at the position of tube tip.
  - Tracheal dilatation – a bulge in the trachea usually caused by long term ETT
  - Tracheal granulation – areas of over-granulation in or around the trachea
- Mechanical airway obstruction – above the level of the tracheostomy tube
- Swallow function in patients with, or at risk of, impaired swallowing function due to their clinical condition and/or co-morbidities
- Secretion management:
  - Sputum load – above and below the cuff
  - Patient's ability to manage secretions
  - Ability to cough
  - Suction – deep versus shallow suction
  - Humidification

Table 6 Potential complications of incorrect tracheostomy tube size

Complications caused by tube length	Complications caused by tube width
Too long • Trauma caused by tube tip or suction catheter catching on carina • Collapsed lung due to unilateral ventilation • Patient discomfort • Convulsive or excessive coughing due to irritation of the carina	**Too wide** • Tracheal ulceration • Tracheal erosion • Granulation tissue caused by shearing effect of TT against tracheal wall • Discomfort • Difficulty swallowing • Inability to achieve voice • Tracheostomy stoma site stenosis • Difficult tube changes • Subcutaneous emphysema caused by shearing and tearing of the trachea wall • Trachoesphageal fistula caused by the TT and/or cuff pressing against the posterior wall of the trachea
Too short • Tube displacement - loss of tracheostomy tract, respiratory arrest and/or death - causing ventilation into pre-tracheal space leading to surgical emphysema • Ulceration and/or erosion of the posterior tracheal wall, from poorly positioned/angled tube in trachea • Ineffective ventilation from a poorly positioned/angled tube within the trachea	**Too narrow** • Inadequate ventilation • Increased respiratory effort • Ventilator indicates leakage via nose and mouth • Ineffective clearance of secretions
Adapted from Russell and Matta (2004) Tracheostomy: a multiprofessional handbook [16]: **Table 5b-6**	

Maintenance of Tracheostomy Tube Position

Maintaining the optimal position of the tracheostomy tube within the trachea requires attention to:

- Patient condition including diagnosis, level of consciousness, cooperation and orientation
- Stabilisation - method of tying taping or suturing the tube so that it remains within the trachea
- Level of competency and experience of clinical staff

The optimal position for a TT within the trachea is important to ensure

- Adequate ventilation and gas exchange
- Prevention of complications such as injury to trachea

No research literature was found to underpin recommendations specific to tracheostomy stabilisation practices. These recommendations are therefore based on: 1) ICCMU stabilisation of ETT [17] and 2) clinical expertise of expert and Consensus groups.

Stabilisation of the Tube

Recommendations		Grade of Recommendation
1.	To minimise damage to the tracheal wall by the distal end of the tracheostomy tube, the tube has to be maintained in a central position, avoiding angling and contact between tracheal mucosa and tube. Traction as well as unnecessary movement of the tube should be avoided [18].	Consensus
2.	Two clinicians must always be present to change the method of securing the tracheostomy tube. One clinician changes the tapes while the other holds the tracheostomy in position [19].	Consensus
3.	Of the two clinicians changing the tracheostomy tube securement, at least one clinician must be experienced in tracheostomy care [19].	Consensus
4.	Due to the risks of TT dislodgment, the tracheostomy tube tapes MUST not be changed for 24 hrs after insertion or as specified by the team.	Consensus
5.	The method of stabilisation should be consistent within units to promote staff proficiency in safe and effective tracheostomy care [19].	Consensus
6.	The most appropriate method of stabilisation should be used based on the: • patients diagnosis • patient's level of consciousness, orientation, understanding, memory and cooperation • age of tracheostomy stoma or maturity of cutaneotracheal tract • skin condition and • level of difficulty in achieving an airway if the tracheostomy tube was to become dislodged	Consensus

Recommendations		Grade of Recommendation
7.	Careful consideration should be given to the method chosen for securing the tracheostomy tube. A combination of techniques may be required by some patients. • Sutures may be appropriate where there is - Oedema formation secondary to interruption of venous and lymph drainage - Increased intra-cranial hypertension as venous flow from the head may be impaired by ties around the patient's neck - Complete loss of the airway if the tracheostomy was to be displaced - Patients who have undergone micro vascular reconstruction (flap) to the head/neck area • Cotton tapes secured with a double knot are appropriate for newly formed tracheostomy stomas (<one week old) as these are less likely to become loose • Manufactured tapes using Velcro should only be used for TT > 7 days old and patients unlikely to self-extubate [19] • Shoulder epaulettes (created using elastoplasts and white tape) may be of use where there are concerns regarding the skin or blood flow of the neck vessels [19]	Consensus
8.	Tracheostomy tapes should be changed at least once daily (except within the first 24 hrs) and under the following circumstances [19]: • Soiled or wet • Excess movement (> 1cm in any direction) of the tracheostomy tube • Restriction of blood flow • Where tapes are too tight (unable to insert one digit between tapes and skin)	Consensus
9.	Where sutures are used, these should be reviewed daily. Sutures used to close surgical incisions should be removed by Day 7-10	Consensus
10.	Assessment of the neck should be completed and documented at least daily with abnormalities reported to the treating team. Assessment includes • Visual inspection of all skin • Evaluation of tracheostomy stoma healing	Consensus
11.	Where closed suction devices are being used, the suction tubing should be removed (non-ventilated patients only) or supported so that there is no lateral drag on the tracheostomy tube.	Consensus
12.	If the patient is on a ventilator, the tubing should be supported by a ventilator arm that maintains the tracheostomy tube in a central position with no lateral drag	Consensus
13.	Where an adjustable flange tracheostomy tube is used, the position of the flange relative to the tube must be • marked permanently • inspected at least each shift and • documented to identify tube migration	Consensus
Prevention of dislodgement or displacement when the patient is moved including		

Recommendations		Grade of Recommendation
	• Position changes in a bed, theatre table or chair • From bed to chair and the reverse • Standing from a chair • Walking	
14.	Under the circumstances listed above, an experienced clinician must complete a risk assessment and decide if a designated tube holder is required. However a designated clinician must hold the TT when: • When the patient is on mechanical ventilation • Newly inserted TT (< 7days) • Where reinsertion of the tube OR oral intubation is difficult if the tube were to become dislodged	Consensus

Examples of tracheostomy tube stabilisation

Figure 1 Velcro re-usable tracheostomy tapes

Figure 2 Shoulder Epaulettes

Cuff Management

A cuffed tracheostomy tube is required to create a closed respiratory system to facilitate mechanical ventilation; and reduce gross entrance of gastric or oropharyngeal secretions into the lungs. In general most studies focused on ETT cuffs therefore the evidence base regarding tracheostomy cuffs is:

- limited regarding the ideal or consequences of intracuff pressures
- satisfactory regarding measurement of intra-cuff pressure

The significant of complications and long term sequelae of high pressure-low volume cuffs lead to the development of the high volume-low pressure (HV-LP) cuff in the 1970s. The premise of HV-LP cuff is that the cuff drapes a large proportion of the trachea creating a larger surface area and achieving an effective seal at a lower pressure, preventing tracheal necrosis. The objective is to create a seal in the trachea where the pressure applied to the tracheal wall by the cuff (intracuff pressure) is less than tracheal capillary perfusion pressure (43cmH_2O) [20] mucosal closing pressure. However if the tracheal tube is too small, the cuff will not drape the tracheal wall across a large area and the volume required to create a seal will create a high intracuff pressure, applying a higher pressure to the tracheal mucosa and potentially impairing circulation. In 1984 Seegobin and Hasselt [21] conducted endoscopic studies on intubated, anaesthetised patients and demonstrated that where intracuff pressures were greater than 30cmH_20 (22mmHg) circulation to the mucosa and submucosa of the tracheal rings was progressively compromised until complete attenuation at 50cmH_20 (37mmHg). Furthermore, they showed that even at maximal pressures of 100cmH_20, air and secretions remained trapped within folds of the cuff. Despite significant changes to ETT and tracheostomy tube technology since the 1980s; there has been little research to identify what are safe intracuff pressures.

Within the studies identified there was considerable variability in what was considered a safe or appropriate intracuff pressure. In terms of the lower end of intracuff pressure, a pressure of less than 20cmH_2O has been previously identified as an independent predictor for ventilator associated pneumonia (VAP) [22]. However, a single randomised control trial (RCT) [23] did not demonstrate that ensuring intracuff pressure remained above this pressure most of the time reduced VAP. In terms of an upper limit for intracuff pressure, there is a progressive impairment of tracheal circulation when intracuff pressures exceed 30cm H_2O [22mmHg] [21]. Although it is unclear regarding the impact on tracheal mucosal closing pressure when age or generalised circulation insufficiency are considered. Within the ICU another important factor to consider is the linear relationship between intracuff pressure and peak inspiratory pressure (PIP) [24], that is, the higher the PIP, the higher the intracuff pressure required to create a closed respiratory system. Therefore the upper limit of intracuff pressures should be 30cm H_2O (adults).

Intra-cuff pressures do not remain constant, with studies [23, 25] showing a loss of pressure over time. A cuff leak may be evidenced by

- audible respiratory or vocal sounds by the patient;
- loss of tidal volume or low minute volumes [for ventilated patients]; and
- coughing by patients.

An inability to achieve an appropriate cuff pressure or a persistent cuff leak may be the result of:

- Too small a TT with the cuff requiring large volumes of air to achieve a seal
- Malposition of the TT
- High intra-thoracic pressure
- Break in the pilot tube to cuff circuit.

Studies (mostly Level III and IV) identified considerable variability in cuff management practices in terms of how to measure intracuff pressures and what to measure the cuff pressure with [20, 25-30]. Study findings indicate that indirect [minimal occlusive volume, standard cuff -predetermined volume or fingertip palpation] measurement does not achieve optimal intracuff pressures when compared to direct [using a specific cuff manometer]. This finding is consistent across different professional groups and different levels of experience with tracheostomy tubes. Prior to the development of HV-LP cuffs it was common practice to periodically deflate the cuff as a preventive practice for tracheal necrosis. No research evidence was found to support this rationale. Additionally deflating the cuff will allow any secretions sitting above the cuff to drain into the lungs potentially increasing the risks of nosocomial infection.

Table 7 Complications of incorrect intracuff pressures

Over inflated cuff	• Tracheal mucosal ischaemia causing ulceration and erosion • Tracheo-oesophageal fistula, caused by cuff pressing on the posterior tracheal wall • Tracheo innominate fistulae, necrosis of the tracheal mucosa and artery wall; this can lead to a potentially fatal bleed • Laryngotracheal stenosis • Difficulty in swallowing as oesophagus is impacted
Under inflated cuff	• Insufficient seal for ventilation • Aspiration of oro-pharyngeal secretions and gastric contents
Russell and Matta (2004) Tracheostomy: a multiprofessional handbook Table 7 [16] (p108)	

Recommendations

Recommendations		Grade of Recommendation
15.	When using a cuffed tracheostomy tube, the intracuff pressure should be high enough to achieve a closed respiratory system and be between 20-30cmH_2O to • Maintain a closed respiratory system to facilitate mechanical ventilation and • Prevent tracheal mucosal necrosis and minimize microaspiration	Evidence - C Recommendation C
16.	Intracuff pressure should be measured directly using a cuff manometer, optimised and documented • At least once every 8 hours and when clinically indicated • Immediately post intubation • Immediately on receiving patient from another clinical area • After significant patient movement • Where there are any concerns about air leak from the respiratory system such as when the patient vocalizes or a ventilator alarms	Evidence - B Recommendation B
17.	Where there is a persistent cuff leak, the nurse must notify the TRT or ENT team to review.	Consensus
18.	Preferably patients should have their own cuff manometer. However, where a cuff manometer is used among multiple patients, it MUST be cleaned between patients using the usual disinfection practices and according to manufacturer's instructions.	Consensus
19.	Infectious patients MUST have their own cuff manometer.	Consensus
20.	Cuff deflation is to be managed by experienced clinicians and may include members of the ENT team or TRT (e.g. speech pathologist, specialist nurses, physiotherapists or medical professional).	Consensus
21.	Where patients are transported by air, tracheostomy cuffs will require specific care to prevent over-distension and high intra-cuff pressures.	Consensus

Figure 3 Examples of cuff manometers

Humidification

When a tracheostomy is inserted, the normal humidifying function of the upper airway is bypassed. Therefore it is essential that artificial humidification is applied to maintain effective respiratory function and prevent secondary complications. It should be noted that most literature refers to endotracheal tubes; the evidence base for tracheostomy tubes is limited.

A Cochrane review of the current literature strongly recommends the use of either active (heated humidifier) or passive [heat moisture exchange (HME), saline nebulisers, sprays] humidification in all patients with a tracheostomy tube [31]. Over time the need for and type of humidification will change and, for these reasons, needs to be reviewed regularly especially in relation to the patient's clinical presentation. Important aspects include:

- the patient's general physical condition especially the ability to clear secretions from lower airways
- clinical stability and concurrent diagnoses
- the volume and nature of respiratory secretions
- oxygen requirements
- mobility

The literature to 2011 suggests:

- Both active and passive humidifications have been shown to minimise the prevalence of artificial airway occlusion, mortality and pneumonia.
- Heated humidification and HME have been shown to be more effective in maintaining inspired air temperature and absolute tracheal humidity than cold humidification options [32].
- No significant difference of HME and heated humidification on mucus properties and cilial transport over 72 hours in mechanically ventilated patients [33].
- Heated humidification and HME have not been found to negatively impact respiratory function i.e. atelectasis, pneumothorax, changes in tidal volume, minute ventilation or tracheal aspirations [31].
- HME reduces total respiratory heat loss and evaporative heat exchange without increasing WOB in tracheostomised patients. Thus passive humidification is effective [34].

Because the evidence base surrounding humidification focuses mainly on patients with endotracheal tubes, clinicians must be especially careful regarding these clinical decisions. This is especially true for mechanically ventilated patients because they are not only reliant on the tracheostomy tube for an airway but also on a machine. Additionally different brands of HME provide different levels of humidification. For these reasons a HME should be used with caution.

Recommendations

Recommendations		Grade of Recommendation
22.	Inspired gases must be humidified to maintain effective mucociliary function and gas exchange and prevent complications.	Consensus
23.	Patient's systemic hydration must be assessed and maintained to reduce the viscosity of sputum and prevent complications.	Consensus
24.	The choice of humidification method should be made on an individual patient basis, be assessed at least daily and documented.	Consensus
25.	HMEs are suitable for patients with all of the following: • Stable respiratory function • Volume of secretions is moderate or less • Double lumen tracheostomy tube • FiO_2 < 40%	Consensus
26.	Active humidification is required for adult patients with: • Hypothermia • FiO_2 ≥ 0.4% • Thermal injury to airway • Single lumen, adjustable flange or foam tracheostomy tubes • Large volume or purulent secretions • Irritable airways • Airway bleeding • Where a speaking valve is in the ventilator circuit • As clinically indicated	Consensus
27.	Where active humidification is used, the temperature of inspired gases must be 37° to ensure 100% relative humidity [31].	Evidence - B Recommendation B
28.	HME should be checked every 1-2 hours for patency	Consensus
29.	HME should be changed • when soiled • per manufacturer's guidelines • at least daily where patients are receiving ventilator support	Consensus
30.	Water-bath humidifiers must not be left to run dry due to the risk of airway burn	Consensus
31.	Active humidification circuits should be changed at least weekly or if soiled.	Consensus
32.	Only sterile water-for-irrigation can be used in water-bath humidifiers.	Consensus
33.	Humidification circuit must be lower than the level of the TT at all times to prevent aspiration of condensation from the tube (rain out).	Consensus
34.	Ongoing humidification should be considered post decannulation to maintain airway integrity	Consensus

Recommendations		Grade of Recommendation
35.	Humidification equipment utilised (HME or active circuits) should be used as per manufacturer's instructions to prevent complications such as rain out (for the later device) that may impact ventilation and respiratory function.	Consensus

Figure 4 Active Humidification

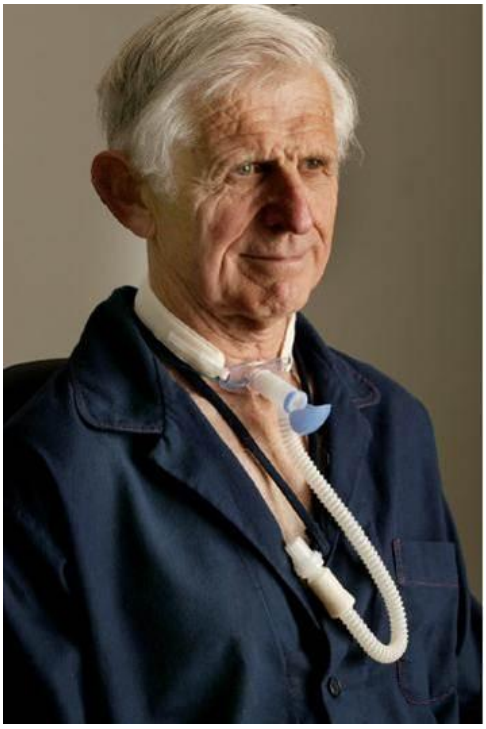

Figure 5 Passive Humidification

Both pictures sourced from Fisher & Paykel Australia

Suction of Respiratory Secretions

Suctioning is a necessary procedure for patients with a tracheostomy tube to maintain the patency and integrity of the airway. Due to the potential for adverse effects, suctioning should only be performed when clinically indicated, and not on a routine basis [35-37]. A thorough assessment should be carried out before making the decision to suction, since the evidence demonstrates that patients with the largest amount of tracheobronchial secretions exhibit the most clinical signs on assessment, while those with no secretions showed fewer clinical signs [36]. This implies that different diagnostic groups and individual patients will have different suctioning requirements. Clinical indications for suctioning are listed in table 8

Patient preparation

Recommendation		Grade of Recommendation
36.	To reduce patient anxiety and to promote patient understanding of and compliance with suctioning, where possible, patients must be given clear information regarding the suction procedure including: • Need for suction • Consequences of not suctioning when it is required • Effects of suctioning Furthermore this information should be repeated because some patients may not recall previous instructions.	Consensus [39]

While the evidence for closed suction and ventilated associated pneumonia is equivocal in adult ventilated patients, a closed suction system (CSS) minimises aerosolisation of respiratory secretions, is safer for clinicians and is a technically simpler procedure [37]. Care should be taken; however, as the closed suction system adds weight to the tracheostomy tube and potential for dislodgment. Additionally if a CSS is in use, it should be attached at all times and not attached for individual suction procedures. To do otherwise would expose the patient to significant infection risk.

Strict adherence to infection control policies is necessary to protect patients and staff but a strictly sterile suctioning technique may not be necessary for all patients [38]. There is still no high level evidence supporting a maximum, safe and effective suction level in adults. The suction pressure should be high enough to be effective in removing secretions, but not so high that it causes mucosal damage or lung volume loss [36-37]. Choosing the correct size catheter, adhering to shallow suctioning technique and keeping each suctioning event as short as possible will minimise damage to the mucosa.

Suctioning carries risks, and careful monitoring of the patient during and after the suctioning event is important.

Table 8 Clinical indicators of need for suction

System	Clinical Indicator
Respiratory	Visible • Visible or audible secretions such as sputum, blood or gurgling • Acute respiratory distress • Increased work of breathing Auscultation • Coarse or added breath sounds • Prolonged expiratory breath sounds Vital signs – clinically significant changes • Desaturation below baseline • Increased/decreased respiratory rate Ventilator • Decreased tidal volume during pressure modes • Rising peak inspiratory pressure during volume modes • Saw tooth pattern on flow-volume loop or expiratory flow time waveform
Musculoskeletal	Inability to generate an effective cough
Cardiovascular	Vital signs – clinically significant changes • Heart rate • Hypertension
Other	Anxious or restless patient Patient requests suction Diaphoresis
Based on Restrepo [35]	

Indications for suctioning

Recommendations		Grade of Recommendation
37.	Due to the potential for adverse effects and significant patient discomfort, suctioning a tracheostomy tube should be performed on the basis of clinical need and not be carried out on a routine basis.	Evidence - B Recommendation B
38.	For ventilated patients, assessment of the patient to identify the need to suction a tracheostomy tube should be continuous with chest auscultation performed every two hours or more frequently as indicated by clinical signs (see table 8)	Consensus
39.	For non-ventilated patients, assessment of the patient to identify the need to suction should be based on observation and clinical assessment.	Consensus

Type of suction catheter

Recommendations		Grade of Recommendation
40.	The size of the suction catheter should occlude no more than 50% of the internal diameter of the artificial airway to avoid greater negative pressure in the airway [35, 39].	Evidence - C Recommendation C
41.	Closed suction catheter systems should be used as the system of choice for patients with high FiO_2 or PEEP or at risk of lung derecruitment) [39].	Evidence - B Recommendation C
42.	Closed suction catheter systems should be cleaned as per manufacturer's guidelines to maintain patency and minimise colonisation.	Consensus
43.	Closed suction systems should be changed as per manufacturer's guidelines.	Consensus

Process of suction

Recommendations		Grade of Recommendation
44.	Individualised pre-oxygenation should be used where the patient • has significant lung pathology with high oxygen/PEEP requirements; or • may experience a clinically significant reduction in oxygen saturation when suctioned [35].	Evidence - B Recommendation B
45.	For ventilated patients, use the ventilator capacity to deliver the additional oxygen.	Evidence - C Recommendation B
46.	Due to risk of adverse events, use of hyperventilation or hyperinflation is only indicated for a small group of patients and should only be used by experienced clinicians under limited circumstances.	Evidence - C Recommendation B
47.	As the presence of a suction catheter within a tracheal tube has adverse effects on adequate ventilation, a single suction procedure event should take less than 15 seconds and negative pressure should only be applied as the catheter is withdrawn from the suction catheter and for a maximum of 10 seconds [35, 39].	Evidence - C Recommendation C
48.	During a suction procedure, trauma to and stimulation of the carina should be minimised, therefore the suction catheter should only be inserted down a TT until it just emerges out of the lumen of the tube.	Consensus
49.	Due to the risk of trauma and derecruitment, suctioning the tracheobronchial tree distal to the end of the tracheostomy tube is	Consensus

Recommendations		Grade of Recommendation
	indicated under limited circumstances.	
50.	Hand hygiene must be completed immediately prior to and following any suctioning procedure.	Consensus
51.	Suction procedures using an open technique must be completed using an aseptic technique, including sterile gloves [40].	Consensus
52.	Where closed suction systems are used, non-sterile gloves must be worn when handling this apparatus and the tracheostomy tube because these may be colonized by organisms and potentially contaminated by body fluids.	Consensus
53.	HCP completing suction procedures must wear personal protective equipment where there is a risk of aerolised secretions.	Consensus
54.	Hospital infection control policies must be followed when suctioning.	PD2007_036
55.	The response to tracheal suction can be cumulative therefore during an individual suction procedure catheter passes should be limited to maximum of three unless clinically indicated; additionally patients should be given time to stabilise and recover between suction passes.	Consensus
56.	During a suction procedure, the patient must be assessed for clinical stability and tolerance.	Consensus
57.	The effectiveness of the suction procedure should be evaluated using clinical indicators.	Consensus
58.	Documentation regarding suction procedures and outcomes must be documented including: • Patient assessment – indications for suction • Outcomes of suction procedure including patient tolerance, sputum quality/quantity and frequency of need.	Consensus
59.	Suction pressure should be set at 100-150mmHg for adults [35, 39].	Evidence - C Recommendation C
60.	To prevent the occurrence of adverse events, bolus instillation of normal saline should not be used routinely during suctioning [35, 39].	Evidence - B Recommendation B
61.	Where a fenestrated tracheostomy tube is insitu, a non-fenestrated inner cannula must be inserted prior to suction	Consensus
62.	The upper airway should be suctioned periodically to remove oral secretions and to minimise stasis of pooled secretions about the tracheostomy cuff with subsequent potential for aspiration to lower	Evidence - C Recommendation

Recommendations		Grade of Recommendation
	airways.	C
63.	Clinicians should consider the use of tracheostomy tubes with subglottic suction capabilities as part of a coordinated program to prevent nosocomial pneumonia.	Evidence - A Recommendation A

Time constraints did not allow for a systematic review around the specific question of whether, for adult patients, tracheostomies with a subglottic suction port are effective in preventing nosocomial pneumonia. The pathogenesis of nosocomial pneumonia in ventilated patients is complex. However, it is widely accepted that aspiration of contaminated oropharyngeal secretions or leakage around the cuff is a major source of bacterial entry into the lungs [41]. As current cuff technology does not prevent channels forming in the cuff, clinicians need to use strategies to remove these potentially infected secretions. A meta-analysis on mechanically ventilated patients [42] found that where patients were expected to be ventilated more than 72hrs, use of subglottic suction reduced length of mechanical ventilation by 2 days (95% CI: 1.7 to 2.3 days); length of stay in the intensive care unit by 3 days (95% CI: 2.1 to 3.9 days); and, delayed the onset of pneumonia by 6.8 days (95% CI: 5.5 to 8.1 days).

Care of the Inner Cannulae

Dual lumen TT offer a safety mechanism where the risk of TT blockage is considered significant, despite this, they are not always used. For instance, because in ICU active humidification is generally used and weaning the patient from ventilatory support is important, the inner cannulae may not be used because of the increase in the work of breathing imposed by the smaller lumen. However, in many institutions, inner cannulaes are used outside the ICU to ensure a patent airway where humidification cannot be optimised. There is no research data available to underpin the following recommendations; therefore they are based on good infection control practice and clinical expertise. The cleaning recommendations reflect the advice of NSW HAI expert committee.

Recommendations		Grade of Recommendation
64.	The inner cannula must be checked for patency, cleaned and replaced 2-4hourly. More frequent checks will depend on the volume and viscosity of secretions.	Consensus
65.	The inner cannula should be cleaned and dried according to manufacturer's guidelines and stored in a clean dry container.	Consensus
66.	Under most circumstances the inner cannula can be cleaned with sterile water with a tracheostomy cleaning brush or a pipe cleaner (with the end turned over). Where secretions are tenacious, alternative solutions can be used; however, the tube should not be soaked for more than 15 minutes.	Consensus
67.	This procedure is a clean procedure which requires hand hygiene before	Consensus

Recommendations		Grade of Recommendation
	and after donning appropriate PPE e.g.; gloves, apron, full-face visor.	
68.	It is inappropriate to clean or rinse the inner cannula at hand basins used for hand washing because of the risk of contaminating the basin with organisms or contamination of the inner cannula.	Consensus
69.	When placing a clean inner cannula into a TT tube it should be rinsed with sterile water immediately prior to insertion.	Consensus

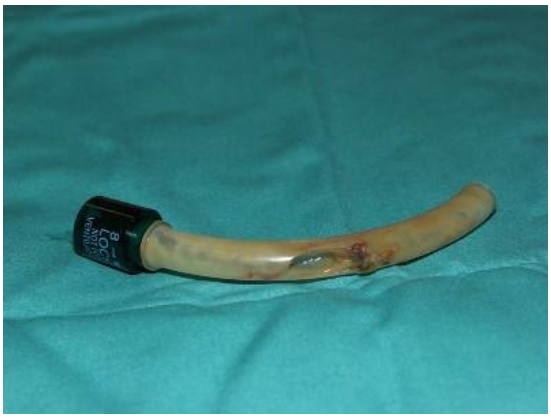

Figure 6 Blocked inner cannulae

http://www.nhsggc.org.uk/content/mediaassets/images/wee%20blocked%202P1165094.jpg

Changing a tracheostomy tube

Recommendations for the frequency of changing tracheostomy tubes are inconsistent and there is a lack of consensus regarding this issue in the current literature. Yaremchuk [43], however, reported fewer complications associated with granulation tissue after implementation of a policy in which tracheostomy tubes were changed every 2 weeks. Tracheostomy tubes should not be changed within 72 hours of insertion. Despite this, it may be necessary to change a tracheostomy tube if the tracheostomy tube is non-functional, the cuff has ruptured or the patient requires a specific tube to meet their respiratory needs (such as an extendable length TT). Ideally the most appropriate product should be selected pre-tracheostomy to reduce the associated risks of having to change products in the first week.

If the TTis changed prior to the cutaneotracheal tract and tracheostomy stoma being well formed, it is advisable that the physician or surgeon that performed the insertion is present for the change of the tracheostomy, particularly for the initial tracheostomy tube change. It is essential that when initial tube changes occur that an individual skilled in endotracheal intubation be present in the event that the tube cannot be replaced and the patient then requires endotracheal intubation. If the initial sized tube cannot be placed, placement of a smaller tube should be attempted.

Recommendations		Grade of Recommendation
70.	Ideally the TT should not be changed for the first week.	Consensus
71.	Elective early tracheostomy tube changed within 72 hours of the formation of the tracheal stoma may be hazardous and should be avoided, particularly in patients with a history of difficult intubations.	Consensus
72.	The decision to change a tracheostomy must be made by the MDT experienced in tracheostomy care in conjunction with the primary care team.	Consensus
73.	Where the TT change is required within the first seven days, or when there is a risk of difficult recannulation, a senior medical officer with advanced airway skills MUST be present.	Consensus
74.	Tracheostomy tube changes are only to be performed by or under the direct supervision of a medical officer, clinical nurse consultant, physiotherapist or nurse with advanced accreditation in this skill.	Consensus
75.	A TT change should be at least a two person procedure, one of whom has proven experience in tracheostomy tube changes.	Consensus
76.	Where the TT change is a planned procedure, the patient should be assessed to identify the risk of aspiration of gastric contents. This may require fasting for 4-6 hours prior to change of TT, or aspiration of the NG tube.	Consensus
77.	The procedure is undertaken in a safe environment with • Two clinicians present; with at least one of these being assessed as competent at the procedure • Monitoring of the patient including pulse, respiratory rate and work of breathing, continuous SpO_2 monitoring • Emergency equipment available at the bedside (Essential Equipment)	Consensus
78.	If difficulties are anticipated prior to the tracheostomy tube change, a tube changer may be used during the procedure [15].	Consensus
79.	Appropriate tube changers include suction catheters (with y-connection removed), which is passed through the current TT whilst in situ (i.e. prior to removal). Care must be taken to ensure that tube changer is completely removed post change.	Consensus
80.	The old /current TT is withdrawn while keeping the tube changer in position in the patient's trachea, and the new sterile tracheostomy tube is then passed over the tube changer into the trachea.	Consensus
81.	Alternatively, the tracheostomy tube changer can be passed through the new sterile lubricated TT and gently slid into position, at which point the tracheostomy tube changer can be removed and the inner cannula inserted.	Consensus

Recommendations		Grade of Recommendation
82.	The tube should be securely held in place until it is safely secured by sutures or neck ties.	Consensus
83.	It should be noted that an obturator will not be used when using a tracheostomy tube changer.	Consensus
84.	The procedure must be documented in the patient notes, tracheostomy management and observation chart and should include: • Size and type of tracheostomy tube • Any complications/problems arising during procedure (abnormal bleeding, trauma or difficult insertion) • The condition of the tracheostomy stoma and the surrounding skin (i.e. over-granulation, wound breakdown) • When the next tube change is required	Consensus
85.	Any complications must be reported to the medical officer and clearly documented in the patient notes.	Consensus
86.	Patients should be monitored post tube change as clinically indicated (Table 11).	Consensus

Section D: Prevention of infection

Patients with tracheostomies are at an increased risk of nosocomial infections because of:

- Foreign body in the neck providing a portal for infection
- Impaired mucociliary clearance
- Interrupted natural humidification and filtration
- Greater risk for dysphagia and therefore aspiration of contaminated oropharyngeal secretions because of de-conditioning, neurological compromise and sedation
- Prolonged length of stay
- Interaction with large numbers of HCP

Clinicians MUST refer to NSW Health policies related to general hygiene principles.

- Infection control policy - http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_036.html
- Infection Control Policy: Prevention & Management of Multi-Resistant Organisms (MRO) http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_084.html
- Hand hygiene Policy http://www0.health.nsw.gov.au/policies/pd/2010/pdf/PD2010_058.pdf
- Australian Guidelines for the Prevention and Control of Infection in Health Care http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cd33_complete.pdf

General

Recommendations		Grade of Recommendation
1.	Because the TT, as well as any attachments, will become colonized by organisms, clinicians should wear gloves when touching these items, AND follow usual hand hygiene practices.	Consensus
2.	Patients and care givers must receive direct instructions on hand hygiene and other infection control principles	Policy PD2010_058 Hand Hygiene Policy; PD2007_036 Infection Control Policy
3.	Clinicians MUST wear PPE, including facial protection, when there is a risk of respiratory secretions escaping from the TT including but not limited to: • during suction • changing HME or closed humidification • cleaning of the inner cannulae • changing the TT	PD2007_036 Infection Control Policy

Oral Hygiene

A systematic literature review was not undertaken however recommendations are based on the 2007 oral care clinical guideline for the critically ill adult [44]. Clinicians should refer to more research guidelines and research as it becomes available

Recommendations		Grade of Recommendation
4.	A comprehensive oral hygiene program will: • reduce the incidence of nosocomial pneumonia (GRADE: B) • improve oral health • improve patient comfort and appetite [45]	Pneumonia – Grade B Consensus
5.	A comprehensive oral hygiene program includes: • Daily assessment of the oral cavity using an oral assessment tool to evaluate oral health and plan appropriate oral care • Cleaning and moistening of all structures within the oral cavity • Evaluation of the patient's ability to complete their own oral care • Escalation of care for patients with poor oral health including dentistry assessment if required	Consensus
Patients in intensive care and/or not eating an oral diet		
6.	The oral cavity should be cleaned at least twice daily to: reduce colonisation with nosocomial organisms; and promote oral health and immunity. This cleaning should include: • Checking the cuff pressure (if applicable) ensuring the pressure is 20-30cmH_2O to prevent microaspiration • Brushing of the teeth, gums, tongue and hard palate with a soft-toothbrush to remove and prevent plaque development (GRADE: B). Toothpaste is not necessary, however, if one is to be used a small amount of low-foaming or anti-bacterial toothpaste is appropriate. Excess use of toothpaste will dry the mouth • Rinsing or irrigation with small amount of clean water to remove toothpaste and debris (GRADE: Consensus) • Deep oropharyngeal suctioning to remove secretions (GRADE: Consensus) • Use of antiseptic agent, such as chlorhexidine 0.12% rinse or 2% gel, may reduce colonisation with nosocomial organisms and reduce the incidence of VAP (GRADE B)	Consensus
7.	To maintain a moist oral cavity the mouth should be rinsed or moistened at regular intervals. Clean or sterile water can be applied using swabs or a dental syringe. However, for patients with poor oral health, regular sodium bicarbonate or chlorhexidine based mouth rinse may be necessary. Excess fluid should be aspirated using a sucker.	Consensus
8.	For patients with reduced saliva flow (xerostomia), a regular salivary replacement may be necessary	Consensus
Patients eating on oral diet		
9.	The oral cavity should be cleaned following each meal to: reduce colonisation with nosocomial organisms; and promote oral health and immunity. Patients should be offered assistance and provided with	Consensus

Recommendations		Grade of Recommendation
	necessary equipment. This cleaning should include: • Brushing of the teeth, gums, tongue and hard palate with a soft-toothbrush to remove and prevent plaque development (GRADE: B). Toothpaste is not necessary; however, if one is to be used, a small amount of low-foaming or anti-bacterial toothpaste is appropriate. Excess use of toothpaste will dry the mouth. • Dentures must be cleaned • Rinsing or irrigation with small amount of clean water to remove toothpaste and debris (GRADE: Consensus) • Use of antiseptic agent, such as chlorhexidine 0.12% rinse or 2% gel, may reduce colonisation with nosocomial organisms and reduce the incidence of VAP (GRADE B) • This regime will need to be modified for patients who have or are at a high risk for bleeding gums. Regular rinsing with anti-septic and use of swabs may be necessary. • Where the patient is unable to complete this care, the nursing staff must complete it for them	
10.	To maintain a moist oral cavity, the patient's level of hydration should be monitored. Regular fluid intake should be encouraged after swallowing has been assessed as safe. Patients may require assessment of swallowing by a speech pathologist if they exhibit swallowing difficulties or if they are considered to be at high risk of having dysphagia.	Consensus
Patients with significant abnormalities		
11.	Patients with the following abnormalities require assessment by a medical practitioner to develop a plan of care. These abnormalities include: • Coating of the tongue or pharynx • Loose, decaying or broken teeth • Blisters on any part of the mucus membranes	Consensus
12.	Patients with the following abnormalities should have a dental assessment to develop a more comprehensive plan of care. These abnormalities include: • One or more inflamed or infected tooth • Generalised inflammation of the oral cavity • Swelling or haematomas in the oral cavity • Drainage of purulent secretions from a tooth	Consensus

Stoma Care

Strictly speaking only patients with a laryngectomy have a permanent (end) stoma. However, for the purposes of this guideline, 'stoma' is used to describe the surgical opening in the patient's neck which connects to the trachea. The tract formed is known as the 'cutaneotracheal tract.'

No research literature was found to inform the development of recommendations. A data extraction tool was used to identify how available guidelines or literature reviews had described common practices. These recommendations are based on this information and the clinical expertise of clinicians.

Recommendations		Grade of Recommendation

13.	Tracheostomy stoma care includes:
	• The stoma and surrounding skin
	• Clinical assessment for
	  ○ External evaluation of cutaneotracheal tract
	  ○ signs of inflammation, infection or granuloma formation
	Assessment and cleaning of the tracheostomy stoma and surrounding skin are undertaken each nursing shift.
		Consensus

14.	Decisions regarding stoma care should be guided by • the age of the patient and stoma • underlying patient conditions • assessment of stoma and skin	Consensus
15.	Where possible, avoid changing the dressing for the first 24 hours after the TT is inserted to reduce the risk of bleeding. However, if there are heavy exudates or bleeding, consider a more absorbent dressing type.	Consensus
16.	Regular cleaning & pressure area care of the tracheostomy stoma & surrounding skin will result in reduced complications from the tracheostomy tube, flanges & iso connector	Consensus
17.	The tracheostomy stoma should be cleaned with Normal Saline at least daily and PRN using gauze, not cotton wool. Ensure stoma & surrounding skin is thoroughly dried after cleaning, using gauze or cotton tips.	Consensus
18.	Clean technique is advocated for tracheostomy stoma care, as the skin is contaminated with organisms. Care should be taken to prevent the introduction of infection as tracheal stomas are a potential avenue for infection.	Consensus
19.	A tracheostomy dressing is not essential, however, should be applied if secretions are excessive as secretions may act as a medium for bacterial growth. All tracheostomy dressings must be pre-cut by manufacturers.	Consensus
20.	Tracheostomy dressing should be replaced daily & PRN.	Consensus

Table 9 Wound assessment

Tracheostomy stoma site • Bleeding • Increase in size • Appearance of stomal edges • Appearance of peri-stoma tissue (e.g. maceration, cellulitis) • Nature & quantity of exudates • Presence of granuloma tissue	Surgical incision • Bleeding • Infection or wound breakdown General • Offensive odour • Pain during dressing change • Allergic reaction to products
Adapted from Scase, C (2004) Wound Care in Russell & Matta EDS Tracheostomy: a multiprofessional handbook, Cambridge University Press, Chapter 10, 173-186	

Figure 7 Inflamed stoma

Section E: Swallowing

It has been reported that patients who have undergone prolonged mechanical ventilation or have a tracheostomy insitu may have a greater incidence of swallowing dysfunction. The aetiology of this dysfunction is thought to be secondary to anchoring of the larynx, a reduction in the anterior and superior movement of the hyolaryngeal structures and a loss of expired air via the upper airway, resulting in reduced pharyngeal sensation and increased aspiration risk. Reports of physiological change are largely based on anecdotal evidence, or from research studies with poor design and small patient numbers.

The important question to be answered is, whether the presence of the tracheostomy tube itself increases the risk of swallowing dysfunction. In the only systematic review available, the author does not find a direct causal relationship between the presence of a tracheostomy and swallowing dysfunction [46]. Importantly, and not surprisingly, researchers have shown that if the underlying aetiology requiring the patient to have a tracheostomy is known to have a negative effect on swallowing (neurological disease, head and neck cancer and chronic respiratory disease), patients will present with higher rates of dysphagia. Additionally, in older individuals, the higher incidence of aspiration in the context of a tracheostomy may be attributable to the critical illness that necessitated the tracheostomy tube. A review article [47] found that patients with a tracheostomy often have underlying medical conditions that could predispose them to swallowing dysfunction. In this review they state:

- the aspiration attributed to the presence of a tracheostomy is more likely to be a result of critical illness e.g., trauma and the contributing factors of age, altered mental status and the medications to treat the critically ill patient; and,
- older individuals with a tracheostomy are more likely to be at risk of oropharyngeal dysphagia due to their co-morbidities and the normal effect of aging on the swallow.

In summary, some physiological parameters may be affected in individuals with a tracheostomy; however, it is the underlying clinical condition / co-morbidities of the patient, which are most likely to be the primary cause of dysphagia. Evaluation of the various co-morbidities that increase the risk of dysphagia is beyond the scope of this review.

When to conduct a swallowing assessment

Recommendations		Grade of Recommendation
1.	Consideration should be given to the patient's underlying clinical status as this will be a major factor that will impact on swallowing function.	Consensus
2.	The presence of a tracheostomy tube should therefore not preclude an assessment of swallowing.	Evidence - C Recommendation B
3.	Patients should undergo a swallowing assessment by a speech pathologist if any swallowing dysfunction is observed or if requested by the treating team.	Consensus

Swallowing Assessment Procedures

Historically blue food dye assessments, for example the Modified Evan's Blue Dye Test (MEBDT), have been used to detect the presence of aspiration at the bedside in patients with tracheostomy. The validity of blue dye tests has been examined over a number of studies and the majority of these have shown high rates of false negatives, while a smaller number have also shown false positives. These results suggest that blue dye tests are non-valid assessments to detect the presence or absence of aspiration. The literature also highlights variation in blue dye protocols as a potential factor affecting the accuracy of results [48].

A videofluoroscopic swallowing study (VFSS) is the gold standard for assessing swallowing function in adults, allowing for assessment of physiological swallowing parameters and unequivocal evidence of silent aspiration. This assessment is used to objectively trial intervention strategies to improve swallowing. There is only one adult study where the use of VFSS was employed to objectively measure swallowing function in patients with a tracheostomy.

The fibreoptic endoscopic evaluation of swallow (FEES) does appear to be a far more sensitive assessment than a clinical examination alone and is useful in the ICU setting or where a VFSS is unable to be performed. Further, the FEES assessment also provides the ability to observe how well the patient is able to tolerate saliva.

Speaking valves/capping

There are mixed results with regard to the benefit of using a speaking valve and/or occluding the tracheostomy to improve swallow function. Patients who are able to tolerate capping or tube occlusion appear to have the lowest secretion load; however, this is unlikely to be due to the capping itself. Rather, these patients are likely to have improved respiratory parameters, facilitating improved secretion tolerance and the ability to be able to tolerate tracheostomy capping. Capping/occluding the tube has been shown in some limited studies to decrease laryngeal penetration. Again, the ability to tolerate capping and/or tube occlusion is likely to be individual for each patient and more related to their co-morbidities and clinical status. Suturing the stoma post removal of the tracheostomy was found to be effective in improving swallow function in the head and neck cancer (HNC) population. The research results are mixed regarding the effects of digital tube assessment [49]

Likewise, their review of the benefit of speaking valves highlights that research has been on small patients numbers, only using the Passy-Muir valve (there are a number of other tubes available including the Shiley Phonate, the Montgomery and the Rusch valve) and has shown equivocal benefit. It is therefore imperative that the benefit of using a phonation valve on swallowing is assessed on individual patients taking into account their current clinical status, their age and their co-morbidities.

There are also mixed results in regards to swallowing differences with a cuff inflated vs. deflated. Some researchers have shown subtle increases in aspiration risk with the cuff inflated. However, these studies contain small sample sizes and are often biased as they contain only patients with dysphagia. In the review article [49], they illustrate the design flaws in the studies investigating the influence of cuff deflation on swallowing with significant

methodological flaws to the research design (e.g., failure to assess the swallow in both the cuff up/down situation). With a cuff inflated, it is not possible to perform a comprehensive assessment of swallowing as the airway protective mechanisms (vocal fold function, cough) are unable to be determined.

Swallow assessment

Recommendations		Grade of Recommendation
4.	A VFSS should be considered, where feasible, to objectively assess swallowing function when sufficient information is not gained from the clinical examination. A VFSS should also be used if silent aspiration is suspected or to trial the effectiveness of therapeutic manoeuvres.	Consensus
5.	Where objective assessment of swallowing is required, a FEES may be considered as alternative objective assessment to a VFSS. A FEES has been demonstrated to have greater sensitivity than clinical assessment alone to detect aspiration and is particularly useful in critical care environments. FEES may allow earlier commencement of oral intake.	Recommendation C
6.	Use of blue food dye assessments to detect the presence or absence of aspiration is not recommended due to poor test validity.	Recommendation B
7.	Swallowing assessment by a speech pathologist is required in adult patients to determine whether changes to tracheostomy tubes (cuff up/down, tube occlusion, use of speaking valve) change patient's swallowing status. Cuff deflation should be assessed/conducted with an understanding of the potential risks of aspiration. Further management and planning for cuff deflation should be managed within a team approach considering appropriate parameters/contingency plans that allow for changes to the patient's clinical condition.	Consensus
8.	An objective assessment using VFSS or FEES may be required if a clinical assessment is not sufficient to determine whether cuff up/down, tube occlusion, use of speaking valve, can improve swallow function in adult patients	Recommendation C
9.	Although there is no evidence to suggest that a particular group/cohort of patients is safer to be fed in with the cuff up, it may be considered in some circumstances. A clinical assessment of swallowing requires the cuff to be deflated for the period of assessment. If the cuff cannot be deflated for an assessment, it is recommended that the patient have an objective swallowing assessment prior to commencing any oral intake.	Consensus

Section F: Facilitating communication

Clinicians should not underestimate the impact that loss of normal voice following tracheostomy may have on patients and their families [50]. The most commonly distressing symptom reported by ventilated patients is communication difficulty, which may lead to anxiety, panic, anger, frustration, sleeplessness and distress [2]. Developing alternative means of communication is a vital part of care and, where possible, clinicians must seek to prepare patients and their families [2, 50].

The ability to perform a communication assessment and the success of the chosen communication system is dependent on the patients' clinical condition (e.g. respiratory function, level of alertness, cognitive status), ENT anatomy, physical dexterity, co-morbidities and environmental factors (e.g. staffing limitations and skills). Further, patient preferences and the patient's language and cultural background may influence the communication system that is chosen.

A combination of communication methods or systems is recommended where possible. For example a picture communication chart may be used in addition to a speaking valve to allow for patient choice and to provide an alternative if it is required.

This section is divided into three distinct areas:

- Achieving speech in *ventilated* patients
- Achieving speech in *non ventilated* patients
- Alternative communication methods when speech is not possible.

Achieving speech in *ventilated* patients

Carroll [51] reported that an inability to speak whilst ventilated is a frustrating experience as voice is fundamental to identity and non verbal methods can be misinterpreted by medical professionals. Non verbal methods of communication are also time consuming, less natural and more difficult to understand. Given this, verbal communication (speech) should be facilitated where possible.

Ventilator patients with tracheostomy can often achieve speech using cuff deflation, termed "leak speech". Initially, patients may not be able to tolerate the 'circulatory leak' that results from cuff deflation and still be able to sustain adequate respiration. The quality of leak speech is dependent on a number of factors including patency of the upper airway and ventilation mode/settings. During leak speech patients typically only speak on the inspiratory cycle of the ventilator resulting in varying loudness, large periods of pausing and effortful speech. While some patients may have intelligible speech using this method, others do not. Where leak speech is not intelligible, it may be improved using a one-way valve or by modifying ventilator settings.

Speaking valve (one-way valve) use within the ventilator circuit

A one-way valve (like the Passy Muir Aqua™) re-directs the entire expiratory airflow up and around the tracheostomy tube through the larynx. Before placement of a one-way valve, the tracheostomy cuff must be deflated and adequate airway patency needs to be established,

otherwise the patient will be unable to effectively exhale. A one-way valve will allow speech across both the inspiration and expiratory cycles of the ventilator. Use of a speaking valve in line with the ventilator circuit introduces an element of risk. If the valve is placed on a tube with an inflated cuff, the patient will be unable to exhale and is at risk of barotraumas, respiratory arrest and death.

Modification of ventilation settings

Increasing Positive End Expiratory Pressure (PEEP) has been shown to improve speech in chronically ventilated tracheostomy patients [52-54] and in an acutely ventilated tracheostomy patient [55]. When the cuff is deflated, the majority of expired air will return through the tracheostomy – i.e. pathway of least resistance. Increasing PEEP allows increased airflow to bypass the tracheostomy, satisfying the normal expiration pressure. In effect this method produces more airflow through the vocal folds. In some patients, with an increase of PEEP between 5cm to 15cm H_20, impedance is sufficient so that there is no expiratory return of air to the ventilator and all the airflow is directed to the vocal folds. In this situation, the increase in PEEP is essentially acting like a one-way valve without the risk of placing a valve on a cuffed tube. The resulting speech has been judged to be similar in quality to using a one-way valve [54]. Increases in respiratory rate may be observed when increasing PEEP to achieve speech, however, this is not observed with the use of one way valves.

PEEP is not the only parameter that can be altered to promote speech. Researchers [54] have found in chronically ventilated patients, by lengthening the inspiratory cycle of ventilation there is a corresponding increase to the duration of airflow through the vocal folds, allowing a longer period of phonation. Increasing PEEP and inspiratory cycle at the same time was found to produce additional benefits to speech quality. These findings have not been replicated.

Increasing PEEP to improve speech has risks to the patient including hypotension and increased respiratory rate. The research to date is limited as modifications to the ventilator to produce speech have not been assessed for greater than 30 minutes and, aside from one acute case study application, has only been investigated in chronically ventilated patients.

Achieving speech in ventilated patients who *can tolerate cuff deflation*

Recommendations		Grade of Recommendation
1.	Communication assessment should be considered by all members of multidisciplinary team with engagement of the patient and caregivers.	Consensus
2.	Communication assessment should occur as soon as clinically indicated.	Consensus
3.	Speech should be used where possible. However, when it is not possible, alternative communication strategies should be trialled. (Please refer to last part of this section.)	Consensus

Recommendations		Grade of Recommendation
4.	Medical clearance must be obtained prior to cuff deflation to achieve leak speech, before there is modification of a patient's ventilation settings and before a one-way valve is placed (such as a Passy Muir valve) in the ventilator circuit. Cuff deflation should be assessed/conducted with an understanding of the potential risks of aspiration	Consensus
5.	Individual assessment of speech methods (leak speech, modification of a patient's ventilation settings or use of a one-way valve) and ongoing monitoring must be guided by each patient's clinical condition. Recommendations and management plan for the chosen speech method must be documented in the medical notes.	Consensus
6.	One-way valves should be considered in both acute and chronically ventilated patients to promote speech. They should only be used in patients **who are judged medically stable by the managing medical team** and in accordance with the manufacturer's guidelines	Acute patients C Chronic patients D
7.	In the acute care setting, prior to an increase in PEEP to promote speech, medical clearance needs to be obtained and there should be multidisciplinary consideration of current ventilation settings, the potential negative effect on weaning, and the potential psychosocial benefits to the patient. In the chronic setting, increases in PEEP and/or increasing inspiration time (using ventilation modifications) should be considered as a way to achieve speech as an alternative to one-way valve use. There are inherent respiratory risks in using PEEP/ventilator modification to achieve speech and these need to be considered in a team approach, with medical team approval and within the manufacturer's guidelines.	Consensus Increasing PEEP alone Grade B, Increasing inspiration time Grade D Consensus achieved

Achieving speech without cuff deflation in ventilated patients

A patient must be able to tolerate cuff deflation to use leak speech, speaking valves or to allow ventilator modification to be used. In patients who are unable to tolerate cuff deflation, or where it is contraindicated for another reason, there are a variety of tracheostomy tubes available to achieve speech. These include use of "talking tracheostomy tubes" (e.g. Portex Blue Line Trach-talk™), use of a subglottic suction tube aid to facilitate speech, or the use of specialised "speaking inner cannulae" tubes (e.g. Blom™ tracheostomy tube).

Tracheostomy tube with speaking inner cannula

Kunduk et al [56] (2010) observed that the Blom™ tracheostomy tube with speaking inner cannula enabled "speech without cuff deflation or modification to ventilator settings without adverse change to cardio-respiratory measures." The study, however, included only ten patients, did not have any defined outcome measures, and did not compare the phonation achieved with that of other speaking valves.

Speaking/talking tracheostomy tubes

Speaking tracheostomy tubes work by directing a small flow of pressurized air, above the level of the tracheostomy cuff, to allow phonation without cuff deflation. The data regarding the effectiveness of speaking tracheostomy tubes [57-58] is limited and it falls outside the dates of the current literature review. In clinical practice, the speech achieved by these patients is often poor and as dry air is directed through the vocal folds, there have been reports of discomfort secondary to drying of the vocal tract. Given this, the use of speaking tracheostomies should be limited initially to short periods, and the tolerance and comfort of each patient monitored closely. Additionally, these tubes tend to become ineffective for speech due to accumulated oral/pharyngeal secretions. At present these tubes are not readily available in Australia.

Using subglottic suction aid tracheostomy tubes to achieve speech

There is no evidence available to support using air through a subglottic suction aid tracheostomy to facilitate speech. As the design of this tube is similar to existing speaking/talking tracheostomy tubes, these tubes may be able to be used in the same way in certain patients to facilitate speech.

Achieving speech in ventilated patients *who cannot tolerate cuff deflation*

Recommendations		Grade of Recommendation
8.	Specialised tracheostomy tubes with speaking inner cannulae, may be considered in patients who are ventilator dependent and unable to tolerate cuff deflation to achieve speech with agreement of patient's primary clinical team.	Recommendation D
9.	Subglottic suction aid tracheostomy with air redirection may be considered in patients who are ventilator dependent and unable to tolerate cuff deflation to achieve verbal speech.	Recommendation D

Achieving speech in *non ventilated* patients

A number of methods to promote phonation/speech for non-ventilated patients who have a tracheostomy exist. When using these methods, humidification and filtering systems should be considered.

Cuff deflation (around tube speech) with no occlusion of the tube

Cuff deflation allows air to pass around the tracheostomy tube to the vocal folds to achieve speech. This method of speech may not be effective if there is any upper airway obstruction, if the tracheostomy tube is too large, or if there is any vocal fold pathology. For adequate speech, the patient requires respiratory forces to move the vocal folds. Unfortunately, the majority of exhaled air will be directed out of the tracheostomy tube (given it is the point of lowest resistance) and so the resulting speech is often breathy and low in volume. If speech is not achieved on full cuff deflation, further assessment or a change in management (e.g., downsizing the tracheostomy) is needed.

Intermittent finger occlusion (with full cuff deflation)

Intermittent finger occlusion, predominately on expiration, increases airflow to the vocal folds but may increase airway contaminants. Prior to using this method, patient and carer education regarding hand hygiene is recommended. Using this method, there is no humidification of the inhaled air or airway filtering. In addition, patients and carers must be taught of the importance of cleaning their hands before and after touching the tracheostomy.

Intermittent finger occlusion (with full cuff deflation) and HME voice valve

Humidification and airway filtering can be added to intermittent finger occlusion by using a HME speaking valve, such as the TrachPhone™. These devices are essentially HMEs that can be depressed intermittently to occlude the tracheostomy.

Fenestrated tracheostomies, downsizing or use of cuffless tubes

Tracheostomy tubes with a fenestration allow air to pass through the centre of the tube on expiration through the vocal folds. A fenestrated tube is indicated if there is insufficient space around the tracheostomy tube (following cuff deflation or with a cuffless tracheostomy tube) to allow adequate airflow to produce voice. In clinical practice, fenestrated tubes can be associated with granulation tissue. If the fenestration rests against the tracheal mucosa, there will be no benefit to phonation. Caution needs to be used when suctioning a tracheostomy tube which is fenestrated; a non-fenestrated inner cannula needs to be inserted prior to suctioning to prevent tracheal damage.

Speaking valve (one-way valve)

If patients are able to achieve phonation using finger occlusion with no decrease in oxygen saturations, they may be a candidate for a one-way speech valve. Evidence for using speaking valves in non-ventilator patients is scarce and dated. Despite the lack of research evidence, they are frequently used in clinical practice with good results. As with their use within a ventilator circuit, there are risks of barotrauma, respiratory arrest and death if the valve is placed on tube with a non-deflated cuff as the patient cannot exhale. The required degree of humidification, if any humidification is provided via a speaking valve, is also unclear.

Suction aid tracheostomy/speaking tracheostomy tube

Patients who have a cuffed tracheostomy due to aspiration risk (i.e. unable to swallow secretions/vocal fold palsy) may have an above cuff suction tracheostomy inserted to aid clearance of secretions. A trial of redirecting air via the suction port to achieve speech may be considered in some patients.

Achieving speech in tracheostomised *non-ventilated patients*

Recommendations		Grade of Recommendation
10.	Cuff deflation in a non-ventilated patient should be assessed/conducted with an understanding of the potential risks of aspiration. Further management and planning for cuff deflation for speech should be managed within a team approach considering appropriate parameters/contingency plans that allow for changes to the patient's	Consensus

Recommendations		Grade of Recommendation
	clinical condition.	
11.	If intermittent finger occlusion is recommended, education on the importance on hand hygiene is needed to patient, carer or staff. A HME speaking valve may be considered as a way to reduce infection risk.	Consensus
12.	Using a fenestrated tracheostomy (or inner-cannula), downsizing a tracheostomy tube, or inserting a cuffless tracheostomy tube may be considered as methods to facilitate/improve speech with less respiratory effort.	Consensus
13.	A one-way valve should be considered in an acute and chronic non ventilated population to promote phonation. Manufacturers' guidelines need to be adhered to. There are risks of barotraumas, respiratory arrest and death if the valve is placed on an inflated cuff. Additional external humidification may be considered in patients with a one way speaking valve insitu.	Recommendation D

Alternative communication methods when speech is not possible

For patients with a tracheostomy who are unable to achieve speech through the methods described, there are a number of communication options available. These include:

- mouthing
- gesture
- indicating yes/no by head movement or an alternative motor activity (e.g., eye blinking)
- electronic speech output devices
- picture and letter boards (that patients point to or use eye gaze)
- writing/drawing
- use of an electro larynx

There is, however, limited evidence for the efficacy of these alternative communication options in the tracheostomised population. The evidence that does exist is of a qualitative descriptive nature making it difficult to rate it in terms of the NHMRC designations of evidence.

Despite this, evidence review identified a number of important clinical findings:

- Pre-operative assessment is recommended for patients who are to receive elective surgery when it is known they will be unable to speak temporarily. This assessment should include a language assessment and training on alternative communication devices [59]
- Patients who are unable to speak should be encouraged to use multiple methods to communicate (including gestures, voice output devices, nodding) [60]
- Some head and neck cancer patients may prefer to write as their method of communication rather than use a voice output device [60]
- Voice output devices encourage the initiation of communication [60-61]
- Voice output devices use resulted in more emotion being expressed with family members when compared to other non-verbal communication methods [61]
- Both nurses and speech pathologists have a role in establishing a functional communication system for patients who are unable to speak [2, 62].
- Access to communication boards may decrease patient frustration [63].
- Nurses working in critical care may benefit from training in augmentative and alternative communication methods to improve communication with patients [2].

Artificial larynges (electrolarynx) are sometimes trialled with patients in the ICU setting. No research surrounding the effectiveness of their use in this population was found. Clinically, these devices are difficult to use particularly in those patients who are unable to hold or position the device independently. To use these devices effectively, significant training is required and the resulting speech can be hard to understand for those not familiar with these devices.

Alternative communication *where/when speech is not possible*

Recommendations		Grade of Recommendation
14.	Pre-operative communication assessment is recommended for all patients when speech is likely to be temporarily lost/impaired to improve psychological and communication success post surgery. Assessment should include the choice of appropriate augmentative communication system(s).	Consensus
15.	All conscious patients without speech should have access to alternative communication systems (e.g. pen/paper, whiteboard, communication board) at all times to supplement mouthing and gesture.	Consensus
16.	Where simple alternative communication methods are not effective, the patient is experiencing significant distress with their communication or no speech is expected for an extended period, patients should be referred for a communication assessment by a Speech Pathologist or similar person with skills in alternative and augmentative communication (AAC) devices.	Consensus
17.	Where an effective communication system has been established, consistent use should be encouraged.	Consensus
18.	A variety of communication methods should be available during communication assessment to ensure individual patient needs are met including voice output devices, picture boards, and electrolarynges.	Consensus
19.	Consultation by specialised communication services should be considered when an effective communication system has not been able to be established, for patients, and in particular, for long-term patients without speech.	Consensus
20.	The effectiveness of communication methods needs to be evaluated on an ongoing basis, in accordance with patient's preferences and clinical status.	Consensus

Section G: Weaning to Decannulation

For the purposes of this document, weaning has been defined as a systematic approach for the safe removal of the TT, whereas decannulation is defines as the direct removal of the TT. This section will not discuss weaning a patient with a TT from the ventilator as there are many factors that influence this decision. Exploration of these factors is beyond this document.

The requirements for a TT vary between patients and this may impact the rate of weaning to final decannulation. Patients who demonstrate a rapid and straightforward wean may be decannulated if they meet a set of criteria below:

- The patient does not require or no longer requires a cuff to protect their airway from oral secretions.
- The airway has been assessed as patent. This may be identified via direct visualisation (nasoendoscope) or clinical assessment by direct occlusion (for example digital occlusion or capping).
- The patient no longer requires ventilatory support.
- The patient is able to protect their own airway i.e. effective cough.

Patients who do not meet these criteria may need a more systematic and gradual approach to weaning the TT.

The process of weaning and decannulating patients from a TT can be a complex process depending on the patient's prolonged dependence on TT due to poor secretion management and maintenance of airway patency. This may also include patients who may still require intermittent periods of respiratory support.

The evidence base for weaning of a TT was found to be limited. There were no systematic reviews or RCTs, six level III studies, five level IV studies, two bench-top studies and five narrative reviews. For patients with prolonged dependence on a TT, the literature to date recommends the need for a multidisciplinary and systematic approach [64-65]. Researchers tend to outline centre-specific practices for weaning with the exception of three studies that specifically compared different approaches to weaning and the outcome on decannulation [66-68]. These studies [66-67] are dated without replication and are Level III-IV, respectively, with significant methodological limitations affecting the conclusion of the study. Thompson – Ward et al [66] was a multidisciplinary retrospective study comparing cuff deflation trials with routine downsize TT and capping versus 24-48 hours cuff deflation and patency assessment. They demonstrated an average of less than 3% incidence of recannulation with either protocol. In contrast, Minh Le et al [67] compared the use of tracheostomy capping to the use of the one-way speaking valve with neither method superior to the success of decannulation.

While there is little evidence to guide the process of weaning, clinicians involved should have suitable background knowledge and problem-solving skills for them to be systematic, safe and competent in achieving a successful decannulation. Thompson-Ward et al [66] describe that the "process of weaning varies from institution to institution". Weaning may be achieved with a number of different pathways including direct removal of the TT, routine downsizing,

changing to a cuffless TT, use of fenestrated TT, spigotting/capping/corking or use of a speaking valve. The clinicians' choice to use one or all of the stages should be individualised to the patient, the patient's location and team involved and, if necessary, in consultation with a tertiary tracheostomy team.

In general, the weaning process can begin once the patient's condition is stable and the medical team approve the commencement of a cuff deflation trial. Because a number of complications can occur during the weaning process, it should only occur in clinical areas able to provide ongoing assessment and close monitoring) of the patient, and when the experienced clinicians/TRT are available to provide timely clinical advice should problems occur

Table 10 Clinical criteria of patient readiness for decannulation

• Has the upper airway obstruction been resolved? • Is the patient weaned mechanical ventilation? • Are airway secretions controlled? • Does the patient have an effective cough? • Is aspiration non-existent or minimal and well controlled by the patient?
Based on Heffner [69]

Complete cuff deflation

This involves deflation of the tracheostomy cuff to restore the passage of air to the upper airways. This process assists in determining the ability of patients to manage their own oral secretions, protect their own airway and assist clinicians to determine upper airway patency.

The length of cuff deflation trials should be established in consultation with the MDT without signs of respiratory distress or aspiration. Initially, cuff deflation trials may be brief (5-10 minutes) but can be extended as tolerated. Clinical practice strongly supports 24-48 hours of successful cuff deflation in conjunction with adequate airway patency as a good indicator for successful decannulation. If a patient is unable to tolerate cuff deflation for extended periods, the cuff should be re-inflated and the reasons for failure should be established.

Cuff deflation is a minimal requirement for decannulation and/or progression to another weaning stage.

Criteria for cuff deflation

- coping with oral secretions, no drooling anteriorly
- no signs of deteriorating chest
- medically stable

Weaning pathway options

Changing the tracheostomy tube

Anatomy and size of the patient's trachea and the size of the TT may influence the volume of airflow around the TT to the patient's upper airway during cuff deflation. Changing the TT to a smaller diameter size, changing to a cuffless tube and/or changing to a fenestrated TT

may allow greater airflow to the upper airways and may improve airway patency, increase cough ability and facilitate ability to phonate.

Prior to undertaking any TT changes, medical consultation should be sought to ensure the tube choice is suitable.

Airway Patency

An important stage in the weaning process is to establish airway patency. This may be initially *assessed by successful digital occlusion which may lead to a trial of speaking valve or capping*. This should be performed in a supportive environment with close monitoring of clinical parameters (Table 11). If the patient is unable to tolerate digital occlusion, further assessment by ENT may be recommended. Generally for safety considerations, it is recommended that a cap or speaking valve is utilised where the patient has a fenestrated or downsized TT to ensure adequate airflow.

Table 11 Clinical signs of decompensation during weaning process

System	Clinical Indicator
Respiratory	Audible • Absence of audible airflow from mouth/and or TT • Stridor (early sign) • Sudden increase in airflow from TT when any occlusion is removed including speaking valve, digital occlusion or cap Visible • Copious secretions such as sputum, blood or gurgling • Acute respiratory distress - Increased work of breathing - Accessory muscle use - Increased/decreased respiratory rate Auscultation – indicating inability of patient to clear respiratory secretions • Coarse or added breath sounds • Prolonged expiratory breath sounds Vital signs – clinically significant changes – MUST be documented on observation chart to reflect individual patient • Desaturation • Increased/decreased respiratory rate
Musculoskeletal	Inability to generate an effective cough
Cardiovascular	Vital signs – clinically significant changes • Increased heart rate • Altered level of consciousness
Other	• Anxious or restless patient • Clammy or diaphoretic skin • Pale or cyanosed skin (late)

Weaning

Recommendations		Grade of Recommendation
1.	The decision to commence weaning and proceed to decannulation is a collaborative decision involving the treating medical team and TRT. This must be documented in patient notes prior to beginning the weaning process.	Consensus
2.	Together, the treating medical team and TRT, where available, in conjunction with patient and caregivers/significant others must establish a systematic weaning/decannulation plan that is based on the patient's overall clinical presentation and status.	Multidisciplinary approach
3.	The weaning/decannulation plan should be documented. Following this, it should be reviewed at least daily and updated as required.	Consensus
4.	In the presence of a cuffed TT, a successful cuff deflation is a minimal requirement for decannulation.	Consensus
5.	An absent swallow in isolation is not a contraindication for an initial cuff deflation trial. Where there is no swallow present, it is recommended that a Speech Pathologist is consulted.	Consensus
6.	Although gross neurological function contributes to successful extubation, reduced consciousness or a low GCS does not preclude a patient from the weaning process.	Consensus
7.	During the weaning process and post decannulation, patients must have **individualised** monitoring plan developed and discussed with the clinicians responsible to identify clinical tolerance, acute emergency or gradual deterioration (see table 12). This plan should be based on current diagnosis and condition as well as co-morbidities. Patients with long standing illness such as impaired respiratory function are at significant risk of failure.	Consensus
8.	Where airway patency is insufficient a medical/ENT assessment of the upper airway is recommended.	Consensus
9.	Before placing a cap or speaking valve, the cuff needs to be completely deflated and airway patency established.	Consensus
10.	Emergency equipment must be available and checked prior to changes in TT management related to weaning/decannulation.	Consensus
11.	A medical officer with advanced airway management skills MUST be present when the TT is changed for the first time or is removed.	Consensus
12.	In head and neck patients, the decision to decannulate is made by, or in consultation with, the ENT team.	Consensus
13.	In general, the decision to decannulate is based on clinical criteria indicating the patient's readiness including: • Clinically stable	Evidence – C Recommendation

Recommendations		Grade of Recommendation
	• Resolution of need for TT • Able to manage own oral secretions or a secretion management plan (e.g. alternate suction route, pharmacological agents, positional management) • No signs of deteriorating lung function • Strong effective cough • Minimal oxygen requirements • Airway patency	C
14.	In patients who do not meet typical decannulation criteria, weaning and decannulation should still be considered with multi-disciplinary input in a risk-benefit approach including quality of life factors.	Long term spinal D Other patients – Consensus
15.	The patient should be nil by mouth (NBM) for a minimum of four hours prior to TT removal OR if a NG tube is present, this should be aspirated to empty the stomach.	Consensus
16.	Sutures securing the TT must be removed before decannulation	Consensus
17.	Where possible in the ward setting, decannulation should occur when specialist clinicians are available to provide expert assistance if required. In general terms, this would mean decannulating the patient in the morning and during the week. If no tracheostomy review service is available on weekends, careful consideration should be given if deciding to decannulate patients on Fridays.	Consensus
18.	Hospital infection control policy must be adhered to during the weaning/decannulation process.	Consensus
19.	An airtight dressing must be applied to the stoma after the tracheostomy tube is removed. This dressing should be changed • at least DAILY • if odorous or contaminated by secretions • if no longer airtight	Consensus

Table 12 Minimum standards for monitoring during weaning and decannulation

These parameters are **MINIMUM** requirements and patients MUST be assessed individually	
Constant presence of clinician	30 minutes after any changes including • Capping or insertion of speaking valve • Cuff deflation • Removal of TT
Assessment	The nurse responsible for the care of the patient must make a visual assessment that the patient is tolerating the change at least hourly
Vital signs	Pulse oximetry • Continuous for 4hrs • Hourly for 20 hours • Review at 24 hours Respiratory rate • Hourly for 4hrs • As required by clinical condition Pulse • Hourly for 4hrs • As required by clinical condition Blood pressure • As required by clinical condition

Table 13 Dressing suggestions for stoma post tube removal

Cover stoma with 3 packets of large steristrips, small piece of sleek over steristrips (to produce airtight surface). Cover edges with micropore; attach ECG dot over old stoma. Encourage patient to use ECG dot to locate centre of old stoma when coughing and talking. To increase integrity of dressing.	SESIAHS tracheostomy guideline
Single sterile gauze folded in quarter, then a small tegaderm and small ECG.	SESIAHS tracheostomy guideline
Dry sterile 4 X 4 dressing.	AACN procedure manual for Critical Care [70]
Gauze [folded in four] covered by two transparent semi-permeable dressings such as tegaderm or opsite.	St Georges Trust [14]

Section H: Complications and emergencies

Complications and emergencies in patients with a TT can occur at any time along the patient continuum. A British health service report reviewing adverse events associated with airway devices found that patients with tracheostomies suffered more harm when they experienced an adverse event than patients with an endotracheal tube [71]. In Australian ICUs, tracheostomies are inserted using either a surgical or percutaneous technique (PDT) depending on the patient and availability of skilled operators. A 2005 review [72] shows different complication rates for the two techniques. These recommendations are based on local and international guidelines as well as the clinical expertise of the expert group and Consensus participants.

Where a TT is less than 72 hours old then there is a high risk of collapse of the tract, therefore the TT should not be removed unless absolutely necessary, that is, if the patient is NOT ventilating at all and letting the cuff down does not allow for a minimal amount of ventilation.

Emergency definitions

Tube displacement

Occurs when the TT is no longer in the correct anatomical position to ensure adequate ventilation. The displacement can be partial or complete and can occur at any time. Partial dislodgment can be particularly difficult as it may go undetected and can completely block the patient's airway. Due to these factors, the outcomes for partial dislodgement are worse than from complete dislodgment [71]. Patients are particularly vulnerable when:

- they are moved, especially if there are any attachments (such as suction, oxygen or ventilation tubing) attached
- in the first 3-7 days before the cutaneotracheal tract has not matured
- they have impaired cognition or level of consciousness and are therefore unable to fully understand the consequences of manipulation of the tube
- there is no airway above the tracheostomy tube

It is important where tubes are dislodged or removed, they are not simply pushed back into place as this increases the risk of placing the tube in between the skin and trachea. Additionally forceful ventilation increases the risk of surgical emphysema.

Blocked tracheostomy

Patients may have a single lumen or double lumen TT. Where a double lumen is in use, a blockage can be easily resolved by changing the inner cannula. However, where a single lumen is in use, this is not possible. A blocked or partially blocked tube is associated with significant harm to patients [71] and is commonly the result of a combination of factors including

- inadequate humidification and/or systemic hydration for the patient needs leading to thick tenacious sputum
- lack of cleaning of inner cannula

Figure 8 Blocked single lumen tracheostomy tube

http://www.flickr.com/photos/elixir/5801512915/

Table 14 Complications of tracheostomy

Stage	Potential complications	
Intra-operative	Haemorrhage	Air embolism
	Airway fire	Apnoea
	Injury to trachea and larynx	Cardiac arrest
	Injury to paratracheal structures	
Early post-operative	Subcutaneous emphysema	Wound infection
	Pneumothorax/pneumomediastinum	Tracheal necrosis
	Tube displacement	Secondary haemorrhage
	Tube blockage	Swallowing problems
Late post-operative	Haemorrhage	Tracheocutaneous fistula
	Granuloma formation	Laryngotracheal stenosis
	Tracheo-oesophageal fistula	Tracheostomy scar
	Difficult decannulation	
Adapted from [16]		

Table 15 Signs of respiratory distress associated with tracheostomy emergencies

	Signs	Cause/indicative of
Behaviour	Anxiety/agitation Posturing	Signs of difficulty in breathing and hypoxia
Vital signs	Increased pulse/respiratory rate	Increase RR & P are signs of clinical deterioration. A RR > 30 is a significant clinical indicator of critical illness
	Desaturation	This will depend on the patient's usual oxygen saturation
Increased work of breathing	Difficult, laboured or noisy breathing	Indicative of increased work of breathing including partial obstruction to the TT
	Use of accessory muscles	All indicate a lack of or limited air movement out of the respiratory tract which may be due to obstruction Partial obstruction – noisy breathing with limited air movement Complete airway obstruction Patients often develop a see-saw pattern of breathing in which inspiration is concurrent with outward movement of the abdomen and inward movement of the chest wall and vice-versa
	No or limited expired air from the TT	
	Reduced chest movement or reduced air entry upon auscultation	
	Stridor is caused by an obstruction above or at the level of the larynx	
	Inability to insert suction catheter past end of TT	May be indicative of partial or complete obstruction or dislodgment of TT. A fenestrated inner cannulae may also be insitu
	Clammy/diaphoretic skin	Associated with an increase in work of breathing from an occluded airway and stimulation of the sympathetic nervous system causing vasoconstriction
	Pallor or cyanosis	A late sign of airway obstruction
Ventilated patient	Rising airway pressures and decreasing tidal volumes	Indicative of developing obstruction in airways.
Adapted from [73]		

Emergency Recommendations

Recommendations		Grade of Recommendation
1.	All hospitals are to have documented action plans that identify how tracheostomy emergencies are to be managed. These action plans must include • action/s to be taken especially those of clinicians who are caring for the patient and are not part of emergency teams • key personnel at all times of the day • emergencies include but are not limited to - displaced or dislodged tracheostomy - blocking or blocked tracheostomy - airway haemorrhage - cuff leak or rupture • and be available at point of care	Consensus
2.	Elective early TT change, defined as within 72 hours of the formation of the tracheal stoma, may be hazardous and should be avoided, particularly in patients with a history of difficult intubation.	Consensus
3.	Emergency management must be included in education programs to ensure that clinicians who care for patients with tracheostomies are able to provide care in the event of an emergency.	Consensus
4.	Hospitals should include tracheostomy emergency scenarios within education on difficult airway drill.	Consensus
5.	All wards where patients are cared for with a tracheostomy must have emergency airway equipment available in the event of an emergency.	Consensus
6.	The appropriate level of emergency call should be activated if any of the signs and symptoms of respiratory distress (see Table 15) are present and are unable to be resolved quickly.	Consensus
7.	A competent clinician must stay with patient so that interventions can be commenced.	Consensus
8.	A blocked or displaced TT should only be replaced by an experienced clinician.	Consensus
9.	When a patient experiences a complication, this must be documented in the patient notes and the patient's primary care team and tracheostomy review team, where in place, notified.	Consensus
10.	Once a complication or emergency has resolved, the TT plan should be reviewed in relation to factors which may have contributed to the emergency. This may include but is NOT limited to the following: • type of TT • whether the TT stabilisation method is appropriate • the patient's current level of supervision and visibility on ward • use of chemical or physical restraints where appropriate • humidification method and hydration status	Consensus

Section I: Nutrition

Literature surrounding the provision of nutrition for hospitalised patients exists across a broad range of clinical conditions. A search of the English language literature using the electronic databases of Medline, PubMed, CINAHL and EMBASE from 1980- March 2011 using the search terms tracheostomy, nutrition and critical care/illness (or their database appropriate term/medical subject heading), inclusive of all database suggested subheadings within these categories, did not yield any results specific to the nutritional requirements of an individual with a tracheostomy. This was expected as patients with a tracheostomy are a heterogeneous group for nutrition and it is the clinical condition of each patient that dictates individual nutrition needs rather than the presence or absence of a tracheostomy. The literature search did identify two research papers relating to the patient's perspective on nutrition or eating during critical illness which, to the authors' knowledge, have not been included in previous clinical practice guidelines relating to nutrition in that setting.

It was not possible to complete a systematic review of all literature regarding the nutrition needs and interventions for acute care inpatients within the scope for the development of this guideline. Due to this limitation Consensus statements for the nutrition care of patients with a tracheostomy have been developed by the guideline expert group incorporating principles of nutrition for an individual in an acute care setting. These are inclusive of: screening for malnutrition; commencement of nutrition; nutrition requirements; consideration of timing for clinical interventions and long term enteral tube feeding. The literature supporting these principles of care is predominantly sourced from published clinical practice guidelines and systematic reviews. Where differences in recommendation exist between guidelines or reviews on the same topic, the authors have chosen levelled evidence over expert opinion. Where no guideline or review existed, individual studies have been referenced.

A summary of the literature base is discussed in the following narrative. Guideline or review publications which are cited quote the original authors' grading of the evidence as a thorough reassessment of the evidence could not be completed in time for publication. The individual studies referenced have been graded by the authors of this section of the guideline using the NHMRC classification. Future reviews of this section will endeavour to undertake a more rigorous approach to methodology. It is strongly encouraged that the CPG's, systematic reviews, review articles and the original studies which form the evidence base are accessed by each facility or service to determine the ability to generalise and apply the recommendations to their population.

Nutrition Screening

Nutrition for individuals across the continuum of care has been extensively searched and summarised into a practice guideline by Watterson et al [74]. Screening of individuals for risk of malnutrition is recommended for those in the community setting (Level IV evidence) and the acute care setting (Level II evidence). Within the acute care setting, it is encouraged that screening occurs 'routinely', however, the frequency required is yet to be determined in the literature. Therefore patients:

- attending a pre-admission appointment to plan elective tracheostomy insertion should be screened for malnutrition risk with subsequent nutrition assessment and care planning as appropriate;
- with an established tracheostomy who is admitted to the acute care setting should be screened via the same procedure as all acute care patients;
- with a tracheostomy inserted during the course of the acute care episode should receive ongoing routine screening for malnutrition throughout their admission

Commencement of nutrition

The most substantial literature base surrounding the timing for initiation of nutrition exists within the critically ill population. Three major guidelines/systematic reviews recommend that critically ill patients with a functioning gastrointestinal tract who are not expected to be on oral diet within 3 days should commence enteral tube feeding with 24-48 hours of admission (Level II evidence) [75-77]. Where enteral tube feeding is contraindicated or not tolerated, it is recommended that critically ill patients who are not expected to be on oral diet within 3 days should commence parenteral nutrition within 24-48 hours of admission (Level III evidence) [78]. As a result, patients who have a tracheostomy and are critically ill should be provided nutrition as per the above recommendations and all other patients with a tracheostomy should be provided with nutrition as soon as their clinical condition allows.

Patient perspective on eating while critically ill

Two articles relating to the patient perspective on eating in the intensive care setting were obtained via literature search. Although these studies have been rated as NHRMC Level IV, they provide valuable insight into the patient experience as a consideration for care. Issues such as hunger, thirst, dry mouth, weight loss, nausea and loss of appetite have been rated as moderate to severe symptom burdens causing physical and psychological distress in long term mechanically ventilated patients with a tracheostomy [79]. Consideration should also be given to the importance of eating for social and psychological wellbeing. In particular, eating can provide a positive milestone in recovery, empower the patient to make choices relating to their oral intake/nutrition, and ultimately take control over an aspect of their care [80].

Nutrition requirements

Ideally nutrition requirements of an individual are measured via indirect calorimetry and where this is not possible a predictive equation or formula should be utilised [75, 78, 81]. Within the critically ill population, it is recommended that enteral and parenteral nutrition are prescribed using these methods, with an emphasis on avoidance of both under- and over-feeding (Level II evidence) [76, 78]. A review by Ferrie and Ward [81] incorporates nutrition requirements for patient groups other than critical care. The provision of nutrition for patients with a tracheostomy does not differ from the above recommendations.

Nutrition monitoring

Monitoring of nutrition status and outcomes, such as improved nutrient intake, body weight and other anthropometry, nutrition knowledge and biochemistry, should be individualised to suit the clinical condition and nutrition care plan. A comprehensive list of outcomes as well as suggested frequency is provided within Watterson et al [74]. Specific to tracheostomy,

monitoring of the nutrition status of the long-term ventilator patient should occur at least weekly (Expert Opinion) [82].

Impact of clinical interventions on nutrition

It is acknowledged that many clinical interventions are required for the hospitalised patient. Literature identified on this topic focuses on mechanically ventilated intensive care patients and it identifies that a component of a patient's failure to achieve adequate energy intakes (<80% of estimated energy requirement) can be attributed to procedures, which includes those for airway management e.g. tracheostomy insertion and tube change. The resulting recommendation is that these procedures should be planned in order to minimise disruption to the delivery of nutrition (Level IV evidence) [83].

Long term tube feeding

Issues surrounding placement of a long term feeding tubes can be complex. One Consensus guideline specific to percutaneous endoscopic gastrostomy (PEG) recommends that PEG feeding should be considered if the patient's nutritional intake is likely to be compromised for >2-3 weeks (Expert Opinion) [84]. Literature regarding timing of placement for specific clinical conditions, as well as considerations relating to quality of life and patient wishes, is also detailed. It is the recommendation of the authors for this guideline that similar consideration is given to a patient with a tracheostomy.

Recommendations

Recommendations		Grade of Recommendation
1.	Pre-admission assessment for a patient being planned for an elective tracheostomy should include a nutrition risk screen to determine the patient's current nutritional status and mode of feeding in order to develop a plan for nutrition delivery post-tracheostomy insertion. This assessment should include the patient and, where possible, the patients carer or family.	Consensus
2.	All patients with a tracheostomy should be screened for risk of malnutrition on admission and routinely thereafter.	Consensus
3.	Nutrition in the form of oral intake, enteral tube feeding, or parenteral nutrition should be provided to a patient with a tracheostomy as soon as it is clinically appropriate.	Consensus
4.	Nutrition requirements for a patient with a tracheostomy should ideally be measured using indirect calorimetry to ensure adequate nutrition is provided. In the absence of indirect calorimetry, nutrition requirements should be determined via an appropriate predictive equation with nutrition support provided accordingly.	Consensus
5.	Hydration requirements for a patient with a tracheostomy should be assessed based on the clinical condition of the patient and their	Consensus

Recommendations		Grade of Recommendation
	associated co-morbidities.	
6.	Monitoring of the nutritional status and progress of a patient with a tracheostomy should occur regularly whilst in the acute care setting.	Consensus
7.	Clinical interventions, such as tracheostomy tube change or physiotherapy, should be planned to minimise disruption to nutrition delivery.	ICU – evidence C Wards – Consensus
8.	Patients with a tracheostomy who are expected to require prolonged enteral tube feeding, either for the sole provision of nutrition or as a supplement to oral intake, should be considered for the insertion of a gastrostomy for feeding. This should take into account the patient's clinical status, prognosis, quality of life and the patient's wishes.	Consensus

Section J: Education

Enhancement of theoretical skills through continued education is essential to improve the quality of care provided by the clinician. Clinicians require specialised knowledge and advanced skills when caring for patients with tracheostomies. There was no convincing evidence located in the literature that could guide what content should be included in professional development programs for tracheostomy care, or evaluated the best method of delivery be it simulation, self directed learning packages or online learning. All healthcare professionals in the multidisciplinary team must have some benchmark to the level of knowledge and skills that they will require for their scope of practice when involved with a patient with a tracheostomy. Infection control practices, airway safety management and an understanding of airway anatomy and physiology are important themes in directing clinicians to what should be included in competency assessment. Components of the guideline include knowledge of anatomy and physiology, infection control, humidification and airway safety.

There is a significant lack of evidence in the literature regarding evaluation of the best methods of providing education regarding tracheostomy care. Pelaes de Carvalho et al [85] used a pre and post knowledge test for an education program that consisted of theoretical educational sessions. They concluded that continued education helped stimulate the development of theoretical knowledge to improve performance in tracheostomy procedures with patients. This was a single centre study that used the same questions but mixed in the pre and post test. All education regarding tracheostomy management should involve evaluation of learning and assessment of competency. This should also incorporate a consistent transparent level of assessment by designated clinicians who have expert knowledge and skill in tracheostomy management.

Patient-Carer Education

Educational programs incorporating activities for all learning styles and utilisation of all available tools have proved to be effective in preparing care givers of patients with a tracheostomy [86]. Assessment of skills through the use of pre and post knowledge and skill assessment will enable the care giver to feel confident about providing care to the client in the community [87]. Graf et al [88] reported in their study that families required a median 14 days to complete a tracheostomy education program before discharge home. This study was for a paediatric population and did not provide clear evidence to support any benchmark in the guideline, but did provide an example of how long it may take for carers to be assessed competent at home. Evidence to support timeframes for education or evaluation of the best method of delivery of education is lacking in the literature and the recommendations put forward come from existing programs. The skills and knowledge required for safe care at home should be comparable with the competency development for direct care that is provided in the acute setting.

Recommendation		Grade of Recommendation
1.	A caregiver for the patient with a tracheostomy is identified early in the patient's hospital admission and their education program should commence as soon as possible to facilitate discharge. Adult patients will be responsible for their own care, however, an individual's dexterity and cognitive abilities need to be taken into consideration.	Consensus

Patient/caregiver competencies:

The caregiver is able to:

- Explain reasons for and purposes of the tracheostomy
- Describe the type and size of the current tracheostomy tube
- Describe and demonstrate TT stabilisation
- Demonstrate safe and effective suctioning of the tracheostomy tube including
  - Size of suction catheter/apparatus
  - Insertion depth of catheter
  - Length of suction procedure
  - Use of suction equipment
  - Assessment of outcomes of procedure
  - Normal and abnormal sputum, especially tenacity and infection
- Demonstrate safe and effective care of the tracheostomy stoma and the skin of the neck including
  - Cleaning of stoma
  - Application of dressing products, if applicable
  - Listing signs of infection and poor skin integrity
- Provide effective humidification of inspired gases including
  - Explanation of the purposes of humidification
  - Demonstration of attachment of humidification devices including passive humidification attachment
  - When, why and how to use nebulised saline
- Identifies and justifies essential equipment to be with person at all times
- Demonstrates safe and effective care of all equipment including
  - Correct use, cleaning and maintenance
  - Identification of contact person for malfunctioning equipment
- Demonstrates safe and effective care where home ventilation will be used, including
  - Correctly assembling ventilator equipment and circuit components
  - Correctly switching ventilator on and off
  - Correctly attaching/removing ventilator to/from tracheostomy
  - Demonstrate competence with inflating/deflating cuff and changing inner cannula (e.g. Between fenestrated and non-fenestrated) as needed to correctly attach/remove ventilator, as prescribed by home ventilation specialist
  - Demonstrate awareness of ventilator alarms and how to respond to them
  - Demonstrate awareness of possible problems requiring immediate intervention that may arise during ventilation via tracheostomy, and appropriate knowledge of how to respond to these problems
  - Knowledge of how and when to clean equipment, change disposable items and perform basic machine maintenance such as changing filters

NB. This competency only applies to patients on home ventilation.

- Identifies, articulates and demonstrates the appropriate action [on an airway mannequin] for emergencies including
  - Dislodged tube
  - Blocked airway
  - Acute respiratory distress
- Demonstrates the following clinical skills on airway mannequin and patient
  - Changing of tracheostomy tube
  - Suctioning
  - Changing of tapes
  - Application of oxygen
- Describes and demonstrates effective infection prevention principles including
  - Hand hygiene
  - Cleaning and storage of reusable equipment
- Where to get further equipment consumables

Clinician education

Recommendations		Grade of Recommendation
2.	Clinicians caring for patients with a tracheostomy must be provided with a continuing professional development program that prepares them to provide safe and effective care of patients with a tracheostomy.	Consensus
3.	The program should be targeted towards the scope of the clinician's practice (see	Consensus

Table 16 Components of clinician continuing professional development program (CPDP)

Competency	Performance Criteria	MO	Nursing		Allied Health		
			RN	EEN	Physio therapist	Speech pathologist	Dietician
1 – Plans care in consultation with patient, family	Discusses comprehensive tracheostomy care plan with patient and family (where appropriate) prior to undertaking procedures	X	X	X	X	X	
	Communicates with patient in regards to • Cognitive abilities • Developmental stage • Language and cultural differences	X	X	X	X	X	X
	Explains actions	X	X	X	X	X	X
	Able to identify site specific policy and procedures related to care of patients with a tracheostomy	X	X	X	X	X	X
2 – Demonstrates knowledge of upper airway anatomy and physiology, and placement of tracheostomy	Describes • anatomy of the upper airway • differences between laryngectomy & tracheostomy • implications of tracheostomy in terms of changes in breathing, airway and swallowing	X	X	X	X	X	
	Describes uses of different tracheostomy tubes	X	X	X	X	X	
	Describes how the patient's primary disease and treatment relate to the critical nature of the patient's airway	X	X	X	X	X	X
3 – Demonstrates ability to clinically manage and provide general care	Describes, provides a rationale and performs the following components of tracheostomy care: • Patient assessment as it applies to HCP scope of practice	X	X	X	X	X	X

Competency	Performance Criteria	MO	Nursing		Allied Health		
			RN	EEN	Physio therapist	Speech pathologist	Dietician
3 – Demonstrates ability to clinically manage and provide general care (cont'd)	• Completes specific tracheostomy observation chart • Infection prevention including 5-moments of hand hygiene, disposal and storage of equipment • Site care	X X X	X X X	X X X	X X	X	X
	Maintenance of a patent airway including • Humidification • Tube stabilisation • Inner cannulae cleaning & change • Suctioning • Tube change • Cuff pressure	X	X	X	X		
	Checklists of bedside and transport equipment & documentation	X	X	X			
	Communication with patient and MDT[2]	X	X	X	X	X	X
	Nutrition as appropriate to patient population	X	X	X		X	X
	Mobility and other activities	X	X	X	X		
4 –Discusses ongoing clinical management of the patient	Establishes and maintains open communication channels with patient and family	X	X	X	X	X	X
	Maintains contemporaneous documentation	X	X	X	X	X	X
	Describes complications of and appropriate treatment/actions	X	X	X	X		
5 –Demonstrates knowledge and skills to	Identifies, describes, provides a rationale for and performs the appropriate action for • Difficult airway drills • Dislodged tube • Acute deterioration • Bleeding • Acute respiratory distress	X	X	X	X		

[2] MDT – all other clinicians

Section K: Transfer of care

This group of recommendations covers those processes which need to be in place so that the patient makes a smooth transition from an acute care facility to either a chronic care facility or home. Limited information could be found to develop best practice recommendations regarding transfer of care for patients with a tracheostomy. The challenge of managing tracheostomised patients in uncontrolled environments (such as the patient's home) could be one of the reasons for a lack of controlled studies available [89] (Lewarski 2005). There appears to be a lack of scientific evidence regarding the longer term management of tracheostomised adult patients. Paul [90] has identified that literature recognises the transition from hospital to the community is an important phase in preparation for the long-term care of tracheostomised patients.

Recommendation		Grade of Recommendation
1.	Patients must only be transferred to another facility or home where safe and effective care is available.	Consensus
2.	Identified point of contact for patient/caregiver/facility for ongoing support or review.	Consensus
3.	The patient/carer/parent should be deemed as competent and have knowledge relating to what to do in an emergency situation if the tracheostomy tube: • Became dislodged • Became blocked • If the patient was unable to breathe • How to maintain the patient airway if any of the above were to occur • If the ventilator is not working properly or is alarming • How to provide ventilator support via an ambu bag • How to change a tracheostomy tube in an emergency	Consensus
4.	Where appropriate, a community nurse visit can be arranged for additional ongoing support of the carer and patient. It is strongly recommended that, where possible, the community nurse/carer visits the hospital and observes and practices care if needed, particularly for suctioning and tracheostomy tube changes [89, 91].	Consensus
5.	A documented plan of care should exist, which identifies the plan for follow-up and review of the patient's progress after discharge. This may take the form of review by a doctor (GP or specialist consultant yearly) or review in a specialist clinic (such as tracheostomy tube change clinic) at intervals deemed appropriate by the team managing the tracheostomised patient.	Consensus
6.	Additional support services are accessed by the carer/patient/parent to provide product support and product funding where possible, via ENABLE NSW [92]	Consensus

Recommendation		Grade of Recommendation
7.	It is the responsibility of the discharging facility to ensure the facility they are sending the patient to can provide adequate care to meet the needs of the tracheostomised patient. Education and support should be offered by the discharging facility to the facility receiving the patient. The facility receiving the patient has a duty of care to ensure they can provide an appropriate and safe level of care and have the adequate equipment (and staff) to do so, in line with the recommendations in this Clinical Practice Guideline.	Consensus

Appendix A: Guideline development process

- October 2010 – Expert group convened by Kaye Rolls CNC ICCMU. Specialist tracheostomy clinicians were recruited using professional networks and email groups. Potential participants were screened for expertise and representation of healthcare professional groups
- October 2010 – April 2011
  - Identification of scope of guideline
  - Systematic literature reviews
  - Formulation of recommendations for practice
  - Round 1 Consensus undertaken
- April 2011 – Consensus development conference (CDC)
  - Paediatric and Adult groups met to refine guideline recommendations
- April – August 2011
  - Guideline now split into adult and paediatric documents. Paediatric document referred to CEC.
  - Only adult clinicians continue process
  - Guideline document refined to reflect CDC outcomes and any additional literature
  - Guideline sent for second Consensus round

- September – October 2011
  - Guideline sent back out to expert group to refine document in relation to second Consensus round
  - Review by Healthcare Associated Infection (HAI) Expert Group
- November – December 2011
  - Guideline distributed by Statewide Services Development Branch for consultation to Local Health Districts, Enable NSW, Critical Care Taskforce
- January – February 2012
  - Guideline revised with consideration to collated feed back
- February-October 2012
  - At Ministry
- November-February 2013
  - Guideline returned to ACI for reformatting and release

Appendix B: Members of the expert group

To gather members of the expert group an EOI was circulated through various professional and personal networks.

Specialty group	Member	Hospital	LHD
Chair - CNC	Kaye Rolls	ICCMU	
ENT CNC	Catherine Johnson	POW	SESLHD
CNC Intensive care	Kelvin Smith	JHH	HNELHD
CNC Head & neck/ENT	Gai Shylan	Calvary Mater	HNELHD
CNC Respiratory	Mary Dunford	St George	SESLHD
CNC Infection control	Rita Roy	Hornsby	NSLHD
Nurse Educator	Amanda O'Regan	Westmead	WSLHD
MO Intensive care	Ian Seppelt	Nepean	NBMLHD
MO Intensive care	Deepak Bhonagiri	Liverpool	SWSLHD
MO Head & neck or ENT	Tom Havas		
MO Head & neck or ENT	Ian Cole		
AH Physiotherapy	Melissa Holdsworth	RPA	SYDLHD
AH speech pathology	Klint Goers	RNSH	NSLHD
AH speech pathology	Julia Maclean	SGH	SESLHD
Consumer	Marianne Matea		
Dietician	Claire Dain	Westmead	WSLHD
Dietician	Gwen Hickey	RNSH	NSLHD

Appendix C: Author information

Section Name		Primary Author	Literature Review	Recommendation Development (D) Refinement ®
System of Care		K Rolls	K Rolls K Johnson	K Rolls (D) Expert Group (R)
Patient Preparation		C Johnson M Dunford K Nadew M Matea	C Johnson M Dunford K Nadew M Matea	C Johnson (D) M Dunford (D) K Nadew (D) M Matea (D)
Maintaining a patent airway	Choice of TT		M Dunford C Johnson	
	Maintenance of optimal position	K Rolls	K Rolls	K Rolls (D) Expert Group (R)
	Cuff management	K Rolls	K Rolls K Goers	K Rolls (D) Expert Group (R)
	Humidification	M Holdsworth	M Holdsworth M Dunford	M Holdsworth (D) M Dunford (D) K Rolls (D) Expert Group (R)
	Suction	M Holdsworth	M Holdsworth K Rolls M Dunford	M Holdsworth (D) M Dunford (D) K Rolls (D) Expert Group (R)
	Changing/cleaning		M Dunford C Johnson M Holdsworth	M Dunford C Johnson M Holdsworth
Prevention of infection	Oral hygiene	K Rolls	K Rolls K Johnson	K Rolls (D) K Nadew (D)
	Tracheostomy stoma care	G Shylan	G Shylan K Nadew	G Shylan (D)
Swallowing		K Goers J MacLean	K Goers J MacLean	K Goers (D) J MacLean (D)
Facilitating communication		K Goers	K Goers K Smith	J Mclean (R) Amy Freeman Sanderson (R) Matt Tinker (R) Trish Reynolds (R) K Goers (D)
Weaning to decannulation		M Holdsworth K Goers J Maclean	M Holdsworth K Goers	M Holdsworth (D) Kgoers (R) J Mclean (R)
Emergencies				
Nutrition		G Hickey M Matea C Dain	G Hickey M Matea C Dain	G Hickey (D) M Matea (R) C Dain (R)
Education		K Rolls		
Transfer of care		C Johnson	C Johnson M Dunford	C Johnson (D) M Dunford (R)
General coordination of CPG development		K Rolls		

Appendix D: Consensus results - Round 2

A second Consensus round was undertaken following the CDC because key clinicians had been unable to participate. The draft guideline and systematic review were distributed via email to 63 clinicians and 21 were returned despite being given two months to return their forms. Of the returns, 11 had attended the CDC. All recommendations received a high level of agreement that is 8 or 9 with a similar IQR. The ten returns from non-CDC participants were evaluated separately as the cumulative results may have been influenced by CDC attendees. This was not found to be the case with all recommendations also receiving a high level of agreement. In addition, the guideline was sent to the NSW HAI expert group for evaluation and changes were made based on their recommendations. The demographics of round 2 Consensus respondents are in Table 17. Unfortunately, no ENT medical officers returned their forms. The cumulative results can be found in the figures below. In addition, please note that recommendation numbers may not reflect the numbers in the final document as recommendations may have been added, deleted or reordered.

Table 17 Demographic of Round 2 Consensus

Health professional group		Clinical specialty		Role in tracheostomy care	
Nurse	15	ICU/critical care	12	Clinical care	4
Medical	2	ENT	2	Consultancy	4
Physiotherapist	2	Respiratory	2	Member of TRT	5
Speech Pathologist	2	Neurosurgical/medical/spinal	4	Key trache clinician	7
Dietician	0	Infection control/infectious diseases	1	Trache care coordinator	1
Total	21	Total	21	Total	21

Table 18 Part A Environment of Care – Consensus Round 2

Part A	Environment of care									
Recommendation no.	1	2	3	4	5	6	7	8	9	10
Median (IQR)	9 (9-9)	9 (8-9)	9 (8.5-9)	9 (8.75-9)	9 (8-9)	9 (9-9)	9 (8.75-9)	9 (9-9)	9 (9-9)	9 (9-9)

Plan of care and communication				
11	12	13	14	15
9 (8.75-9)	9 (8.75-9)	9 (9-9)	9 (8.75-9)	9 (9-9)

Part A	Patient assessment				
Recommendation no.	16	17	18	19	20
Median (IQR)	9 (9-9)	8 (6.25-9)	9 (9-9)	9 (8-9)	8.5 (7.25-9)

Essential equipment	
21	22
9 (9-9)	9 (9-9)

Patient transport between clinical areas					
23	24	25	26	27	28
9 (9-9)	9 (9-9)	9 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 19 Part B Patient Preparation – Consensus Round 2

Part B	Patient preparation					
Recommendation no.	1	2	3	4	5	6
Median (IQR)	9 (8-9)	9 (8-9)	9 (8-9)	9 (8-9)	9 (8.75-9)	9 (9-9)

Table 20 Part C Maintaining a patent airway – Consensus Round 2

Part C	Stabilisation of tracheostomy tube													
Recommendation no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Median (IQR)	9 (9-9)	9 (9-9)	9 (9 - 9)	9 (8.5 -9)	9 (8-9)	8.5 (8-9)	8 (7-9)	9 (8-9)	9 (8-9)	8.5 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Part C	Cuff management					
Recommendation no.	15	16	17	18	19	20
Median (IQR)	9 (9-9)	9 (9-9)	9 (7.75 -9)	9 (9-9)	9 (8.5 -9)	9 (7.5 -9)

Part C	Humidification													
Recommendation no.	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Median (IQR)	9 (9-9)	9 (8-9)	9 (8-9)	9 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (8.25 -9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (4-9)	9 (9-9)

Part C	Pt prep
Recommendation no.	31
Median (IQR)	9 (8-9)

Indications for suctioning		
32	33	34
9 (9-9)	9 (8-9)	9 (9-9)

Type of suction catheter			
35	36	37	38
9 (8-9)	9 (9-9)	9 (9-9)	9 (8-9)

Part C	Process of suction										
Recommendation no.	39	40	41	42	43	44	45	46	47	48	49
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (8.25-9)	9 (9-9)	9 (9-9)	9 (9-9)
Recommendation no.	50	51	52	53	54	55	56	57	58	59	60
Median (IQR)	9 (9-9)	9 (9-9)	9 (8.25-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (8.25-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Part C	Cleaning inner cannula					
Recommendation no.	61	62	63	64	65	66
Median (IQR)	9 (9-9)	9 (9-9)	9	9 (9-9)	9 (9-9)	9

Part C	Changing a tracheostomy tube															
Recommendation no.	67	68	69	70	71	72	73	74	76	76	77	78	79	80	81	82
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (8.75-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 21 Part D Infection Prevention- Consensus Round 2

Part D	General			Oral hygiene								
Recommendation no.	1	2	3	4	5	6	7	8	9	10	11	12
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Part D	Stoma care							
Recommendation no.	13	14	15	16	17	18	19	20
Median (IQR)	9 (9-9)	9 (8-9)	9 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 22 Part E Swallow - Consensus Round 2

Part E	Swallowing								
Recommendation no.	1	2	3	4	5	6	7	8	9
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	8 (8-9)	8 (7-9)	8 (8-9)	9 (8-9)	8 (8-9)	8.5 (8-9)

Table 23 Part F Communication - Consensus Round 2

Part F	Communication and ventilated patients														
Recommendation no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Median (IQR)	9 (9-9)	9 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)	8 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)	9 (8-9)	9 (9-9)

Part F	Non ventilated			
Recommendation no.	16	17	18	19
Median (IQR)	9 (9-9)	9 (8-9)	9 (9-9)	9 (8-9)

Alternative communication						
20	21	22	23	24	25	26
9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (8-9)	9 (9-9)

Table 24 Part G Weaning to decannulation - Consensus Round 2

Part G	Weaning to decannulation								
Recommendation no.	1	2	3	4	5	6	7	8	9
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	8 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)
Recommendation no.	10	11	12	13	14	15	16	17	18
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	8 (8-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 25 Part H Complications and Emergencies – Consensus round 2

Part H	Emergencies									
Recommendation no.	1	2	3	4	5	6	7	8	9	10
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 26 Part I Nutrition - Consensus round 2

Part I	Nutrition							
Recommendation no.	1	2	3	4	5	6	7	8
Median (IQR)	9 (9-9)	9 (8-9)	9 (9-9)	9 (7.75 -9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Table 27 Part J Education - Consensus round 2

Part J	Clinician		Patient carer
Recommendation no.	1	2	3
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)

Table 28 Part K Transfer of Care - Consensus round 2

Part K	Transfer of care						
Recommendation no.	1	2	3	4	5	6	7
Median (IQR)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)	9 (9-9)

Appendix E: Tracheostomy stoma care summary table

Reference	Study Type	Cleaning Frequency	Cleaning Solution	Trache Dressing	Frequency of Dressings	Sterile V Cleaning	Tracheostomy Stoma Assessment
1. Dennis-Rouse 2008 [93]	Narrative	Twice daily to reduce risk of infection from excess secretions	None recommended	Pre-cut gauze or foam if L/A secretions (to prevent skin maceration) 2cm x 2cm dressing if flange sutured to skin	Every shift - daily	N/A	Every dressing change & when cleaning stoma
2. Yaremchuk 2003 [43]	Observational study	4/24 - daily	H_2O_2 & Normal Saline H_2O_2 & H_2O 0.25%AA & 0.5% peroxide	None recommended	N/A	'tracheostomy is a sterile procedure until the trachea is opened'	Stoma assessment tools used to assess granulation, ulceration, infection & inflammation
3. Portex - Tracheostomy Handbook	Company handbook	Frequently – make sure to dry stoma	Normal Saline or ½ strength peroxide	None recommended Do not use sterile gauze pads as fibres may become loose & be aspirated	Change as soon as soiled	Clean – using cotton-tipped swabs	Regular observation as stoma site healing
4. Scotland – Best Practice Statement 2003 [50]	Narrative	Twice daily	Normal Saline	Not recommended - polyurethane if necessary	N/A	clean	Evaluation of stoma assessment must be documented in nursing notes
5. NHS Quality Improvement Scotland – 2007	Best Practice Statement	Assess each patient individually	Normal Saline + application of barrier film	Only if necessary - can help to absorb secretions Dressings can provide an ideal environment for bacterial	N/A	Clean technique as skin colonized with organisms	Assess as per individual patient needs Documentation

Reference	Study Type	Cleaning Frequency	Cleaning Solution	Trache Dressing	Frequency of Dressings	Sterile V Cleaning	Tracheostomy Stoma Assessment
				multiplication			
6. NHS Grampian Care of the Adult with a Tracheostomy – 2005 [94]	A Practical Guide	Daily + prn	Normal Saline (if required) & dry	Pre-cut keyhole dressing	N/A	Clean technique	Assess & document at least daily
7. Dartford & Gravesham NHS Trust Tracheostomy Care Bundle for Ward patients	procedure	Daily + prn	Normal Saline & dry	None specified	At least daily or when soiled	Sterile gloves	Assess & document at least daily

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