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# Clinical Consensus Statement: Tracheostomy Care

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## Abstract

**Objective.** This clinical consensus statement (CCS) aims to improve care for pediatric and adult patients with a tracheostomy tube. Approaches to tracheostomy care are currently inconsistent among clinicians and between different institutions. The goal is to reduce variations in practice when managing patients with a tracheostomy to minimize complications.

**Methods.** A formal literature search was conducted to identify evidence gaps and refine the scope of this consensus statement. The modified Delphi method was used to refine expert opinion and facilitate a consensus position. Panel members were asked to complete 2 scale-based surveys addressing different aspects of pediatric and adult tracheostomy care. Each survey was followed by a conference call during which results were presented and statements discussed.

**Results.** The panel achieved consensus on 77 statements; another 39 were dropped because of lack of consensus. Consensus was reached on statements that address initial tracheostomy tube change, management of emergencies and complications, prerequisites for decannulation, management of tube cuffs and communication devices, and specific patient and caregiver education needs.

**Conclusion.** The consensus panel agreed on statements that address the continuum of care, from initial tube management to complications in children and adults with a tracheostomy. The panel also highlighted areas where consensus could not be reached and where more research is needed. This consensus statement should be used by physicians, nurses, and other stakeholders caring for patients with a tracheostomy.

## Keywords

tracheostomy, tracheotomy, pediatric airway management, adult airway management

## Background

Tracheostomy is one of the oldest and most commonly performed surgical procedures among critically ill patients.<sup>1-5</sup> Tracheostomy creates an artificial opening, or stoma, in the trachea to establish an airway through the neck.<sup>6</sup> The stoma is usually maintained by inserting a tracheostomy tube through the opening.<sup>7,8</sup>

Tracheostomy is increasingly performed on adults in intensive care units (ICUs) for upper airway obstruction, prolonged endotracheal intubation, and for those

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requiring bronchial hygiene.<sup>9</sup> In adults, the traditional surgical tracheostomy has been accompanied by the emergence of percutaneous dilatational techniques (PDTs). Adult tracheostomy can be performed in the operating room or at the bedside in an ICU. In children, other than on rare emergencies, tracheostomy is performed in the operating room with the child intubated under general anesthesia. In children, tracheostomy is most frequently performed in the first year of life because of the increased survival of premature infants requiring prolonged ventilation.<sup>10</sup>

There is debate about whether the correct terminology for the procedure is *tracheotomy* or *tracheostomy*. Both words are derived from the Greek language. *Tracheotomy* is the operation of “opening the trachea,” whereas *tracheostomy* has an ending derived from the word *stoma* and, strictly speaking, implies a permanent opening in the neck created by suturing skin flaps onto the tracheal walls.<sup>11</sup> The terms are used interchangeably in published reports and were discussed by the panel during the first conference call. A near-unanimous decision, with disagreement from the laryngologist on the panel, was made to use the term *tracheostomy* throughout the consensus process. It was understood among the panel that *tracheotomy* is the correct name for the surgical procedure discussed in this document.

There is evidence that a multidisciplinary approach and use of a tracheostomy care protocol for patients with a tracheostomy lead to decreased morbidity and mortality with a reduced average time to decannulation.<sup>12-15</sup> Equally, good management of a patient with a tracheostomy, both in the hospital and the outpatient environment, has a significant positive impact on quality of life.<sup>16</sup> This often involves education of the patient and family, intensive care, knowledge of the tube characteristics (ie, size, settings, and function), supervision of the tube change, and frequent troubleshooting. Variations in care and management of patients with a tracheostomy exist between hospitals, in inpatient and outpatient facilities, and in emergency rooms.<sup>17,18</sup> Efforts should be made among clinicians to reduce variations in practice when managing patients with a tracheostomy, thus minimizing complications, prolonged hospitalizations, and even death.

A review of the literature on the care and management of tracheostomy shows a paucity of both well-controlled studies and high-quality evidence. The majority of publications are book chapters, expert opinions, and small observational studies. There are essentially no controlled studies or peer-reviewed papers to guide care or practice in this field. As evidence-based research is lacking, the current literature does not support the development of a clinical practice guideline but favors a consensus of expert opinions.

A consensus panel was therefore convened by the American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNSF) to create a clinical consensus statement (CCS). This document reflects information synthesized, using a modified Delphi method—a rigorous process that minimizes bias and facilitates a consensual

position. An organized group of multidisciplinary experts were selected to review the literature, synthesize information, and clarify specific areas of controversy or ambiguity regarding the care and management of patients with a tracheostomy. Despite significant differences between pediatric and adult tracheostomy care, the panel concluded there are sufficient similarities to justify a single document for both groups of patients. The findings of this consensus group are stated as opinions or suggestions, not as recommendations. Clinicians should always act and decide in a way they believe will best serve their patients’ interests and needs, regardless of consensus opinions. They must also operate within their scope of practice and according to their training.

## Methods

### Initial Literature Search

An information specialist with the Cochrane ENT Disorders Group conducted 2 literature searches using a validated filter strategy to prioritize evidence gaps for the scope of this consensus statement. The initial literature search identified clinical practice guidelines, systematic reviews, and meta-analyses related to tracheostomy care in pediatric and adult patients through April 2011. A second literature search identified randomized controlled trials, observational studies, and case series published through August 2011. The following databases were used: National Guidelines Clearinghouse (NGC), Canadian Medical Association (CMA) InfoBase, United Kingdom National Health Service (NHS) Evidence ENT and Audiology, United Kingdom National Library of Guidelines, United Kingdom National Institute for Health and Clinical Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN), New Zealand Guidelines Group, Australian National Health and Medical Research Council, TRIP database, PubMed, Guidelines International Network (G-I-N), Cochrane Library (Cochrane Database of Systematic Reviews, The Database of Abstracts of Reviews of Effects, Health Technology Assessment database, United Kingdom NHS Economic Evaluation Database), EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Allied and Complementary Medicine Database (AMED), BIOSIS Previews, CAB Abstracts, ISI Web of Science, Agency for Healthcare Research and Quality (AHRQ), CENTRAL, and Health Services Technology Assessment Texts (HSTAT). Publications were identified using the following PICOS criteria:

- Population: Children or adults with tracheotomy or tracheostomy
- Intervention: Postoperative care, home care, emergency care
- Comparison: Any techniques
- Outcome: Any
- Setting: Inpatient, outpatient, or home

Final results of both literature searches were distributed to panel members, including electronic full-text versions, if available, of each article. These publications were supplemented, as

needed, with targeted searches to address specific needs identified in writing the consensus statement through February 2011. Experts were asked to review articles identified during the literature searches for evidence gaps and areas of ambiguity in tracheostomy care to assist with development of the qualitative survey.

### Expert Panel

Patients with a tracheostomy are seen in many clinical settings by a variety of health care professionals. This CCS was developed by a multidisciplinary panel of 9 experts as several studies have indicated a team approach to tracheostomy care results in improved patient outcomes.<sup>12</sup> Members of the panel represent pediatric and adult otolaryngology, laryngology, head and neck oncologic surgery, advanced nursing practice, respiratory therapy, and emergency medicine. An AAO-HNSF staff member sent invitations electronically to select medical specialty societies requesting they identify a representative with an interest and expertise in airway management to serve on the panel. Members of the panel did not represent the society from which they were elected but rather were asked to base their decisions on their own experience and expertise. Although it would be beneficial to have equal representation of academic and nonacademic institutions, it was not feasible to request this of other medical specialty societies. An initial conference call was held to facilitate introductions, review the purpose and scope of the CCS, and identify evidence gaps in the literature.

### Qualitative Survey

A qualitative survey was developed by the chair and staff liaison to further refine evidence gaps identified on the first conference call. Panel members were asked to provide a written response to each question on the survey. The survey included

42 questions addressing the following categories: tube type, suctioning, humidification, patient and caregiver education, home care, emergency care, decannulation, tube care (including use of cuffs and sutures), and overall clinical airway management.

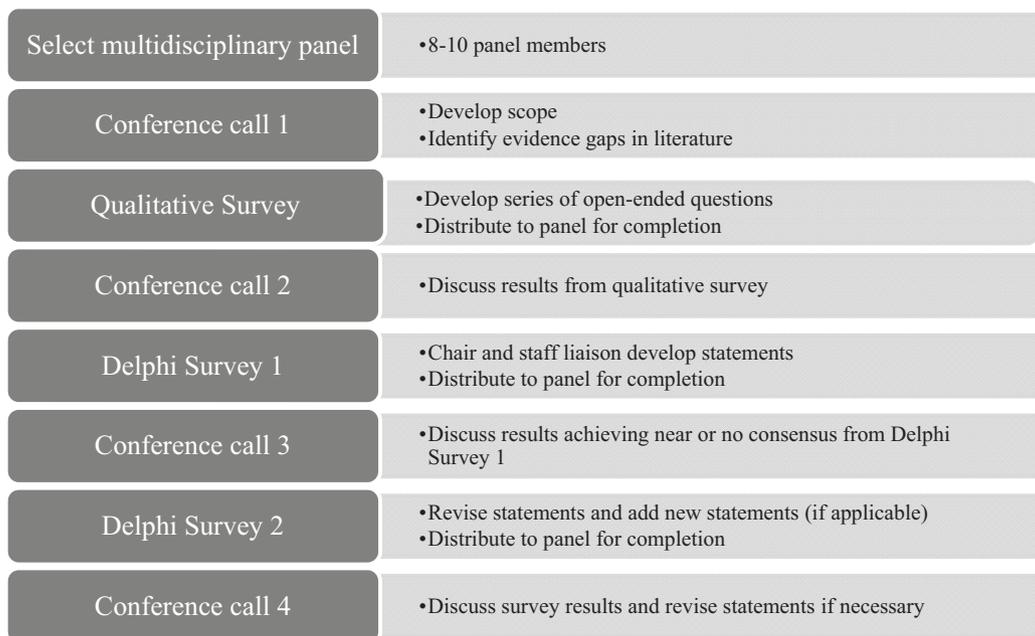
### Modified Delphi Method

This consensus statement was developed using a modified Delphi method, a systematic approach to achieving consensus among a panel of topic experts. Initially designed by the RAND Corporation to better utilize group information in the 1950s, this methodology has been modified to accommodate advances in technology and is used widely to address evidence gaps in medicine and improve patient care without face-to-face interaction.<sup>19,20</sup> **Figure 1** provides an overview of the consensus process used to create this CCS.

Panel members were asked to complete 2 surveys using a 9-point Likert scale to measure agreement (see **Table 1**). An outlier was defined as any rating at least 2 Likert points away from the mean. Each survey was followed by a conference call, during which results were presented and statements discussed. Statements were categorized as follows:

- **Consensus:** statements achieving a mean score of 7.00 or higher and have no more than 1 outlier
- **Near consensus:** statements achieving a mean score of 6.50 or higher and have no more than 2 outliers
- **No consensus:** statements that did not meet the criteria of consensus or near consensus.

Statements achieving consensus were presented to the panel but were not discussed during the call. Statements with a mean score of less than 7.00 were discussed to



**Figure 1.** Consensus process using a modified Delphi method.

**Table 1.** Likert Scale Used to Measure Level of Agreement among Respondents for Both Delphi Surveys

Strongly Disagree	Disagree		Neutral		Agree		Strongly Agree	
1	2	3	4	5	6	7	8	9

determine whether they should be refined and added to the following Delphi survey or omitted completely. Panel members were asked to provide their name on each survey to ensure all responses were received and facilitate discussion when there was disagreement or ambiguity. Comment boxes were added to the second Delphi survey to assist with recall and allowed members the opportunity to provide an immediate rationale that enhanced postsurvey discussions but did not affect actual survey responses.

## Results

### Systematic Review

The search yielded 53 guidelines and 99 systematic reviews or meta-analyses. After removing duplicates, articles not obviously related to tracheostomy, those not indicating or explicitly stating a systematic review methodology, and non-English-language articles, 18 remained.

A second literature search identified 3964 randomized controlled trials (RCTs) and observational studies published through August 2011. After removing duplicates and non-English-language articles and animal model studies, as well as limiting the search to those published after January 2001, 1792 articles remained. The chair of the panel sifted through the remaining articles for relevancy and methodology before distributing 73 full-text articles to the panel.

### Delphi Surveys

The first Delphi survey included 110 statements developed from results of the qualitative survey. After panel discussion, 41 statements were revised to comprise the second Delphi survey. Responses from each survey were collected and analyzed by the chair and staff liaison. Following the second survey, a total of 77 statements achieved consensus and 36 were dropped.

### Statistical Analysis

Responses from each survey were collected and analyzed by the chair and staff liaison. A 100% response rate was achieved for all 3 surveys administered to the group. Descriptive statistics were calculated for each statement to include the mean, median, mode, interquartile range (IQR), and complete range of responses. Statements that attained consensus were grouped by topic area. Statements achieving near consensus were discussed during conference calls, and a proportion were added to the subsequent survey to achieve consensus. Low-scoring statements were dropped

because of lack of consensus unless panel members felt strongly that the statement should be modified and added to the following survey. These are included in Appendixes A and B.

### Key Statements

Panel members were asked to choose 10 statements they believed would most influence tracheostomy care and were essential to improving care among patients with a tracheostomy tube. Responses were collated, and the highest ranked statements were used to create **Table 2**.

Of the 77 statements that achieved consensus, 13 were considered the most important for day-to-day tracheostomy care in adults and children and are presented in **Table 2**.

The panel strongly agreed that tracheostomy education including a communication assessment should begin prior to an elective tracheostomy. The panel agreed an experienced physician should ideally be present for the first tube change, although there was recognition that in some facilities, this may not be feasible and thus performed by an experienced advanced practice provider (APP) with immediate physician backup available.<sup>21</sup> All supplies to replace a tracheostomy tube should be at the bedside or within reach, including a replacement tracheostomy tube of the same size and one of a smaller size, flexible suction tubing and suction apparatus, scissors, gloves, replacement ties, water-based lubricant, an oral endotracheal tube, and emergency supplies such as an Ambu bag (a bag valve mask or BVM).<sup>21,22</sup> The panel also strongly agreed that in the absence of aspiration, tracheostomy tube cuffs should be deflated when a patient no longer requires mechanical ventilation. This will decrease cuff pressure on the trachea and avoid complications. A discussion should take place with the family concerning care needs and preparation for decannulation, especially for children.

The panel reached consensus about several aspects of the discharge planning process and that it should include pre-procedure, hospital stay, and discharge instruction elements. The panel strongly agreed all patients and their caregivers should receive a checklist of emergency supplies and be evaluated prior to discharge to assess competency of tracheostomy care procedures, including what to do in an emergency. In an emergency, the panel strongly agreed that a dislodged, mature tracheostomy should be replaced with the same size or a size smaller tracheostomy tube. If those were not available or could not be inserted, then an appropriately sized endotracheal tube should be placed through the wound into the trachea. The panel strongly agreed that, regardless of timing, a patient in whom a tube could not be replaced, resulting in hypoxia or concern for eventual loss of airway, should undergo orotracheal intubation or immediate surgical revision tracheostomy. The other 64 statements are summarized below and are listed first by those that apply to all tracheostomy patients, followed by statements for pediatric patients and finally those that apply only to adults.

**Table 2.** Key Statements Achieving Consensus

No.	Statement	Mean	Median	Mode	IQR	Range
1	The purpose of this consensus statement is to improve care among pediatric and adult patients with a tracheostomy.	8.56	9	9	1	8-9
2	Patient and caregiver education should be provided prior to performing an elective tracheostomy.	8.22	9	9	2	7-9
3	A communication assessment should begin prior to the procedure when nonemergent tracheostomy is planned.	7.67	7	7	2	7-9
4	All supplies to replace a tracheostomy tube should be at bedside or within reach.	8.78	9	9	0	7-9
5	An initial tracheostomy tube change should normally be performed by an experienced physician with the assistance of nursing staff, a respiratory therapist, medical assistant, or assistance of another physician.	8.22	8	9	1.5	7-9
6	In the absence of aspiration, tracheostomy tube cuffs should be deflated when a patient no longer requires mechanical ventilation.	8.22	9	9	2	7-9
7	In children, prior to decannulation, a discussion with family regarding care needs and preparation for decannulation should take place.	8.67	9	9	1	8-9
8	Utilization of a defined tracheostomy care protocol for patient and caregiver education prior to discharge will improve patient outcomes and decrease complications related to their tracheostomy tube.	8.11	8	9	2	7-9
9	Patients and their caregivers should receive a checklist of emergency supplies prior to discharge that should remain with the patient at all times.	8.89	9	9	0	8-9
10	All patients and their caregivers should be evaluated prior to discharge to assess competency of tracheostomy care procedures.	8.89	9	9	0	8-9
11	Patients and their caregivers should be informed of what to do in an emergency situation prior to discharge.	8.89	9	9	0	8-9
12	In an emergency, a dislodged, mature tracheostomy should be replaced with the same size or a size smaller tube or an endotracheal tube through the trach wound.	8.44	9	9	2.5	7-9
13	In an emergency, patients with a dislodged tracheostomy that cannot be reinserted should be intubated (when able to intubate orally) if the patient is failing to oxygenate, ventilate, or there is fear the airway will be lost without intubation.	8.11	9	9	2.5	5-9

Abbreviation: IQR, interquartile range.

### General Tracheostomy Care for Pediatric and Adult Patients

*Tracheostomy tube selection, care, and maintenance (refer to statements 1-18 in Table 3).* The panel agreed that plastic tracheostomy tubes should be used for initial tube placement and humidification used routinely during the immediate postoperative period.<sup>21,22</sup> With regard to determining the appropriate diameter tracheostomy tube, the panel felt that a number of factors should be considered, including lung mechanics, upper airway resistance and airway clearance, ventilation and communication/speech needs, and indications for the procedure.<sup>23</sup> The tracheostomy tube size, shape, and diameter should be determined based on the need for the tube to fit the airway without undue pressure on the tracheal wall but also to satisfy the functional needs of the patient, including speech and airway clearance

requirements. The tube should be replaced if the cuff is broken and not functioning properly or there is blockage of the tube. There was agreement that this should be done using a clean technique. The panel felt that a sterile technique was not necessary and would not lead to a reduction in infections. A clean technique was in keeping with the current standard of care. In a clinical setting, tracheostomy change should be supervised by experienced medical or nursing staff. The panel is aware that caregivers and parents are often experienced at changing tubes in the home environment. However, as patients are often in a clinical environment because of tracheostomy-related problems, it is safer if tube changes are supervised by experienced clinicians until the patient is discharged. Humidification should be used if a patient requires ventilation or has a history of thick secretions.<sup>21</sup> The stoma and tracheostomy tube should be suctioned when there is evidence of visual or audible

**Table 3.** Statements Achieving Consensus in Pediatric and Adult Patients

No.	Statement	Mean	Median	Mode	IQR	Range
1	Plastic tracheostomy tubes should usually be used among pediatric and adult patients for initial tube placement.	8.00	8	7, 9	2	7-9
2	A patient's initial tracheostomy tube should normally be replaced within 10 to 14 days if it is a PDT.	7.89	8	7	2	7-9
3	When determining the appropriate diameter tracheostomy tube, lung mechanics, upper airway resistance, and airway clearance should be considered.	8.33	9	9	1.5	7-9
4	When determining the appropriate diameter tracheostomy tube, indications for the procedure, trachea size, and shape should be considered.	8.22	8	9	1.5	7-9
5	When determining the appropriate diameter tracheostomy tube, clearance for ventilation and communication/speech needs should be considered.	8.33	9	9	1.5	7-9
6	Tracheostomy tube ties should be used unless the patient recently underwent local or free flap reconstructive surgery or other major neck surgery.	8.22	8	9	1.5	7-9
7	A patient should not be discharged from the hospital with a tracheostomy tube sutured in place.	7.67	8	7, 9	2	5-9
8	Humidification should be used during the immediate postoperative period and as necessary thereafter.	8.11	9	9	2	7-9
9	Humidification should be used if a patient requires mechanical ventilation.	8.22	9	9	2	7-9
10	Humidification should be used for patients with a history of thick secretions.	8.22	9	9	2	7-9
11	In a clinical setting, after the initial tube change, replacement of a tracheostomy tube should be supervised by experienced medical or nursing staff.	8.22	8	9	1.5	7-9
12	During hospitalization and at home, the inner cannula should be cleaned regularly.	8.44	9	9	1.5	7-9
13	While at home, the tracheostomy tube should normally be replaced using a clean technique.	8.11	8	9	2	7-9
14	The stoma and tracheostomy tube should be suctioned when there is evidence of visual or audible secretions in the airway.	8.11	8	8	1.5	7-9
15	The stoma and tracheostomy tube should be suctioned if airway obstruction is suspected.	8.33	9	9	2	7-9
16	The stoma and tracheostomy tube should be suctioned before and after the tracheostomy tube is changed.	8.22	9	9	2	7-9
17	If there is a blockage in the tracheostomy tube, the tube should be replaced.	8.44	9	9	1.5	7-9
18	If the tracheostomy tube is malfunctioning, the tube should be replaced.	8.56	9	9	1	7-9
19	Tracheostomy tube cuff pressure should be checked routinely and adjusted as necessary.	8.00	8	7, 9	2	7-9
20	Bivona Aire-cufs should be inflated with air only.	8.56	9	9	1	7-9
21	Bivona TTS (tight-to-shaft) tracheostomy tube cuffs should be inflated only with sterile water as saline will sediment in tubing and air will diffuse through the cuff.	7.67	9	9	2	3-9
22	Shiley tracheostomy tube cuffs should be inflated with air only.	8.22	9	9	2	7-9
23	A patient should not use a swallowing or speaking valve while the tracheostomy tube cuff is inflated.	7.89	8	7	2	7-9
24	If a tracheostomy cuff is broken and not functioning properly, replace it with a tube and functional cuff that can be readily inflated if necessary.	7.78	8	8	1	7-9
25	Prior to cuff deflation, the tracheostomy tube and stoma should always be suctioned.	8.33	9	9	1.5	7-9
26	Acute tracheostomy tube occlusion is most likely caused by a mucous plug, obstructing granuloma, or insertion of the tube into a false tract.	8.00	8	7, 9	2	7-9
27	Clinicians should assess patients with severe bleeding for innominate fistula.	8.22	9	9	2	7-9
28	Bronchoscopy is indicated among patients with suspected laryngotracheal stenosis or tracheoesophageal fistula.	7.67	7	7	2	7-9

(continued)

**Table 3.** (continued)

No.	Statement	Mean	Median	Mode	IQR	Range
29	In an emergency, a dislodged, fresh tracheostomy (within 7 days of tube insertion) should be replaced with the same size or a size smaller tube and the patient observed for a period of time.	8.00	8	7, 9	2	7-9
30	In an emergency, a dislodged, fresh tracheostomy (within 7 days of tube insertion) should be replaced and the service responsible for inserting the original tube usually be contacted.	7.78	8	7, 9	2	6-9
31	A patient may be turned in bed once tube security has been assessed to avoid accidental decannulation.	8.11	8	9	2	7-9
32	A treatment plan should be developed based upon a communication assessment to include possible recommendation of speech or swallowing valve and referral to a speech language pathologist.	8.00	8	7, 8, 9	2	7-9
33	A swallowing or communication valve may be recommended to patients who are stable to facilitate better speech and swallowing capacity.	7.78	7	7	2	7-9
34	Patients and their caregivers should be informed of the type, size, and length of the tracheostomy tube prior to discharge.	8.56	9	9	1	7-9
35	Patients and their caregivers should be informed as to when and how to suction the tracheostomy tube prior to discharge.	8.78	9	9	0.5	8-9
36	Patients and their caregivers should be informed as to when and how to clean the area around the tube as well as the tube itself prior to discharge.	8.78	9	9	0.5	8-9
37	Patients and their caregivers should be informed as to when and how to change tracheostomy tube ties prior to discharge.	8.78	9	9	0.5	8-9
38	Patients and their caregivers should be made aware of signs of respiratory distress prior to discharge.	8.89	9	9	0	8-9
39	Patients and their caregivers should be instructed on how to use all home equipment associated with their tracheostomy tube prior to discharge.	8.67	9	9	0.5	7-9
40	Patients and their caregivers should be made aware of signs of infection and skin breakdown prior to discharge.	8.22	9	9	1.5	7-9
41	Patients and their caregivers should receive contact information from their health care provider and any other pertinent health care personnel, including the equipment supply company, prior to discharge.	8.78	9	9	1.5	8-9
42	If a patient and/or their caregivers are incapable of properly caring for the tracheostomy, home nursing care should be considered.	8.33	9	9	1.5	7-9
43	A home care instruction manual for tracheostomy should be given to patients and their caregivers prior to discharge.	8.44	9	9	1.5	7-9

Abbreviations: IQR, interquartile range; PDT, percutaneous dilatational technique.

secretions in the airway,<sup>21</sup> suspected airway obstruction, and when the tube is changed or cuff deflated. During hospitalization and at home, the inner cannula should be cleaned regularly.

Tracheostomy tube ties should be used to prevent accidental decannulation. A patient may be turned in bed after making sure the tracheostomy tube is secure. The panel recognized that ties may not be suitable and the tracheostomy sutured, for example, in a patient who recently underwent local or free flap surgery, to avoid neck pressure from the ties. A patient should not be discharged from the hospital with a tracheostomy tube sutured in place. Sutures are usually removed at the first tube change, which should occur prior to discharge.

**Tracheostomy tube cuffs** (refer to statements 19-25 in **Table 3**). The panel agreed that a patient should not use a speaking valve while a cuff is inflated as this will not allow for

airflow through the glottis.<sup>21</sup> The cuffs should be checked routinely, adjusted to the appropriate pressure, and the tube replaced if the cuff is not holding air.<sup>21</sup> The cuff should be deflated when the patient no longer requires mechanical ventilation and is not aspirating. As per manufacturer recommendation, Bivona Aire-Cuf (Smiths Medical North America, Dublin, Ohio) and Shiley cuffs (Covidien, Mansfield, Massachusetts) should be inflated with air only, and Bivona tight-to-shaft (TTS) cuffs should be inflated with water only. There was no agreement about the use of air or saline in cuffs or specific circumstances when the cuff would always be used or inflated.

**Complications** (refer to statements 26-31 in **Table 3**). The panel reached consensus that early complications include acute tracheostomy tube occlusion (most likely a mucous plug), obstructing granuloma, or insertion of the tube into a false tract.<sup>24,25</sup> Other early complications can include hemorrhage,

wound infection, and subcutaneous emphysema.<sup>24</sup> There was also consensus that a patient with severe bleeding should undergo bronchoscopy for suspected laryngotracheal stenosis or tracheoesophageal fistula.

One of the most common tracheostomy tube complications is accidental tube dislodgement. The panel felt that management decisions should be triaged based on whether the tracheostomy was “fresh” or “mature.” Dislodged, fresh tracheostomies (within 7 days of insertion) should be replaced with the same size or a size smaller tube. Successful recannulation should be followed by a period of observation, either in the emergency department or hospital, and the service responsible for placing the tube should be notified.

*Patient/caregiver education (refer to statements 32-43 in Table 3).* The panel reached consensus with agreement or strong agreement on a number of important areas, including education needs prior to performing a tracheostomy, during the hospital stay, and at discharge. There was uniform agreement among all panelists that patient and caregiver education should be provided before surgery if possible.<sup>26</sup> A communication assessment should also be completed to determine if the patient would benefit from a speech or swallowing valve or referral to a speech language pathologist. In the hospital and prior to discharge, the patient and caregiver should be assessed for competency of tracheostomy care procedures, and a defined tracheostomy care protocol is strongly suggested that includes care of the tube, suctioning, and a checklist of emergency supplies that should remain with the patient at all times. The need for home nursing should be evaluated prior to discharge. Also, a home care instruction manual for tracheostomy should be given to patients and their caregivers prior to discharge. A summary of the suggested educational components is included in **Tables 4 and 5**.

*Pediatric tracheostomy care (refer to statements in Table 6).* In fresh pediatric tracheostomy, waiting until days 5 to 7 was felt necessary to establish a mature tract.<sup>27</sup> The panel agreed specific criteria should be met prior to attempting decannulation in children with a tracheostomy. First, no ventilation support should be required for a period of 3 months prior to decannulation. There was discussion that the period of time with no ventilation may range from 2 to 4 months depending on, for example, if it was during the winter or summer months. This should be documented during colds and upper respiratory infections with the tracheostomy still in place. Second, there should be no aspiration events that would preclude decannulation.<sup>28-30</sup> This would include signs and symptoms of ongoing aspiration, including multiple episodes of aspiration, pneumonia, or signs of pooling of secretions such that a tracheostomy would still be needed for suctioning to maintain pulmonary toilet. A flexible laryngoscopy should document a patent airway with at least one mobile vocal cord. At the time of bronchoscopy, the suprastomal granulation should be excised prior to decannulation by an experienced otolaryngologist. A child 2 years or older should have his or her tracheostomy tube capped all day and the cap removed at

**Table 4.** Home Care Educational Components for Clinicians

#### Teaching component

- Signs of respiratory distress
- Signs of infection and skin breakdown
- Checklist of emergency supplies
- Contacts
  - Health care provider
  - Pertinent health care personnel
  - Equipment supply company

#### Hands-on component

- When and how to suction the tracheostomy tube
- When and how to clean the tube and the surrounding area
- When and how to change tracheostomy tube
- Use of home equipment

night for several weeks. If the child tolerates a cap, options prior to decannulation include, but are not limited to, a capped sleep study, a capped exercise test, or a nighttime capping trial while hospitalized and being observed. In younger or in small children, the small size of the trachea in relation to the tracheostomy tube may preclude capping, and the decannulation protocol should be individualized.

*Adult tracheostomy care (refer to statements in Table 7).* The number of days needed before the first tube change was different between surgical and percutaneous tracheostomies. Panel members felt that in adults with favorable anatomy, an early tube change (day 3) can be justified at times to facilitate early teaching and discharge of the patient from the hospital, recognizing the first tube change more commonly occurs on day 5. Alternatively, a tracheostomy initially inserted percutaneously should not be removed initially until day 10 to establish a mature tract.<sup>21,26</sup> Metal or plastic tubes can be used in adults for a long-term tracheostomy (defined as 1 year or longer). The panel agreed on the majority of statements about decannulation in adults, and this is the basis of **Figure 2**, which summarizes the prerequisites, process, and criteria for successful decannulation.

## Discussion

The purpose of this CCS is to obtain and summarize expert opinions on the current management of tracheostomy in adults and children. In doing so, we planned to find areas of consensus and uncover areas of ambiguity that require further research. The panel recognized that some aspects of tracheostomy care are common to all patients and others may be specific to either adults or children. The panel reviewed the current literature but recognized the majority of evidence is of low quality and limited to retrospective reviews, small uncontrolled case series, and expert opinions. These studies, however, compared tracheostomy techniques or timing and did not address tracheostomy care and management, which were the goals of this CCS. A large number of

**Table 5.** Patient and Family Education Hands-on Verification Record

Patient and Family Education Record									
Tracheostomy Home Care Instructions									
Date	Preoperative Preparation and Teaching	Hand Hygiene	Humidification	Suctioning	Cleaning Inner Cannula	Skin Care	Changing Ties/Straps	Changing Tracheostomy Tube	Cleaning Supplies and Equipment

*Learning Evaluation Behavior Key*

- 1 = Demonstrated
- 2 = Return demonstration with assistance
- 3 = Independent return demonstration

*Learning Evaluation Behavior Key*

- 1 = Concept introduced
- 2 = Developing understanding of concept
- 3 = Verbalizes complete understanding of concept

Date	Airway/Stoma Care	Communication	Physical and Sensory Changes	Nutrition	Tube Details/Management	Precautions/Emergency Care	Tube Displacement	Signs of Respiratory Distress	Signs of Infection and Skin Breakdown
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**Table 6.** Pediatric Tracheostomy Care Statements Achieving Consensus

No.	Statement	Mean	Median	Mode	IQR	Range
1	A child's (<18 years) initial tracheostomy tube should typically be replaced within 5 to 7 days if inserted surgically.	7.56	7	7	2	5-9
2	In children, prior to decannulation, a bronchoscopy should be performed within a few months to ensure a patent airway with no occluding suprastomal granuloma.	7.89	7	7	2	7-9
3	In children, prior to decannulation, a flexible laryngoscopy should reveal at least one mobile vocal fold or a patent glottis.	8.22	9	9	2	7-9
4	In children, there should be no documented aspiration events that would preclude decannulation.	8.11	8	9	2	7-9
5	In children, prior to decannulation, no ventilator assistance should be needed where a tracheostomy would be required.	8.56	9	9	1	7-9
6	For children, prior to decannulation, the tracheostomy tube should be capped all day and the cap removed at night for several weeks to determine whether the cap can remain on even when the child has an URI.	7.89	8	8	1.5	7-9
7	Prior to decannulation, children with a tracheostomy should undergo a daytime capping trial (if they are older than 2 years and if it the tracheostomy does not occupy so much of the trachea so as to preclude capping). If they pass such a capping trial, options prior to decannulation include a capped sleep study, a capped exercise test, or a nighttime capping trial while hospitalized and being observed.	8.44	9	9	1	7-9
8	In a child who is either too young or too small to undergo a successful capping trial, decannulation protocols need to be individualized for the particular patient.	8.67	9	9	1.5	7-9

Abbreviations: IQR, interquartile range; URI, urinary tract infection.

**Table 7.** Adult Tracheostomy Care Statements Achieving Consensus

No.	Statement	Mean	Median	Mode	IQR	Range
1	An adult's (18 years or older) initial tracheostomy tube should typically be replaced within 3 to 7 days if inserted surgically.	7.56	7	7	2	5-9
2	Metal or plastic tubes can be used for long-term (>1 year) tracheostomies among adults who do not require ventilation.	8.22	9	9	2	7-9
3	In adults, prior to decannulation, initial indicators for tracheostomy should be reviewed and reasons for the tracheostomy should have improved or resolved to an appropriate degree.	8.11	9	9	2	7-9
4	In adults, prior to decannulation, the patient should be tolerating a decannulation cap on the tracheostomy tube without stridor, and a fiber-optic laryngoscopy should confirm airway patency to the level of the glottis/immediate subglottis.	8.33	9	9	2	7-9
5	In adults, prior to decannulation, there should be no evidence of gross aspiration based on the fiber-optic laryngoscopy exam or visualizing tolerance of secretions when the cuff is deflated.	8.78	8	9	2	5-9
6	In adults, prior to decannulation, the tracheostomy tube in place during a capping trial should be uncuffed and may need to be downsized if a large tracheostomy tube is present.	7.56	7	7	1.5	7-9
7	In adults, prior to decannulation, if there are concerns regarding airway patency, a bronchoscopy should be performed.	7.44	7	7	1	7-9
8	In adults, prior to decannulation, a physician should confirm that the patient's level of consciousness and laryngeal-pharyngeal function can protect the tracheobronchial tree from aspiration.	8.00	8	7, 9	2	7-9
9	In adults, prior to decannulation, the patient should have an effective cough while the tracheostomy tube is capped.	7.56	7	7	1.5	7-9
10	In adults, prior to decannulation, a physician should confirm there is no potential need for further procedures that would require general endotracheal anesthesia in the near future.	7.78	7	7	2	7-9
11	In adults, once the patient has tolerated a decannulation capping trial, the tracheostomy tube should be removed, the site cleaned, any remaining sutures removed, and the site covered with a dressing.	8.00	8	7, 9	2	7-9
12	In adults, after decannulation, patients should be instructed to apply pressure over the dressing with fingers when talking or coughing in order to decrease the air leak.	8.11	9	9	2	7-9
13	In adults, after decannulation, the gauze dressing should be changed daily and as needed if moist with secretions.	8.11	9	9	2	7-9

Abbreviation: IQR, interquartile range.

statements about tracheostomy care reached consensus, and a number of statements were dropped when consensus was not achieved. This document highlights the aspects of tracheostomy care that reached consensus.

Tracheostomy tube care and airway management are topics where widespread consensus exists regarding important factors such as determining the choice of an appropriate diameter tracheostomy tube, when the tube should be changed, who should change it, and what supplies should be at the bedside. It is important to emphasize proper perioperative care and maintenance of the tracheostomy tube as these are the first steps in preventing frequent tube-related complications.

Complications can be related to the procedure itself or the tracheostomy tube and can occur in the early or late postoperative period.<sup>24</sup> Many of these complications will be initially evaluated and managed by emergency physicians. Complications such as a mucous plug occur more easily in children with smaller tracheostomy tubes in place or among those children whose tracheostomy tube is a single, not double, lumen. If the tracheostomy tube becomes obstructed, prompt intervention is necessary to restore adequate ventilation. Failure to reestablish ventilation by suctioning through the tube requires immediate removal and replacement of the inner cannula or replacement of the entire tracheostomy tube. Another cause of tube occlusion is

### Answer the following to determine readiness of patient for decannulation of tracheostomy tube:

- Have the indications for the tracheostomy placement resolved or significantly improved?
- Is the patient tolerating a decannulation cap on an appropriately sized uncuffed tracheostomy tube without stridor?
- Does fiberoptic laryngoscopy confirm airway patency to the level of the glottis and immediate subglottis?
- Does the patient have an adequate level of consciousness and laryngopharyngeal function to protect the lower airway from aspiration?
- Does the patient have an effective cough while the tracheostomy tube is capped?
- Have all procedures that require general endotracheal anesthesia been completed?

### If yes to all, proceed with the following decannulation process:

- Remove the tracheostomy tube
- Clean the site
- Cover the site with a dry gauze dressing
- Instruct the patient to apply pressure over the dressing with fingers when talking or coughing
- Change dressing daily and as needed if moist with secretions until the site has healed
- Monitor for decannulation failure

**Figure 2.** Prerequisites for decannulation in adult patients.

Note: The decannulation protocol does not apply to pediatric patients.

the creation of a false tract that can occur with displacement of the tube and also during tracheostomy tube change, especially in the early postoperative period. This complication, known as accidental tube dislodgement, is minimized in a fresh tracheostomy when skin flaps are sutured to the trachea to form a permanent stoma or stay sutures are used.

Tracheostomy-associated emergencies can occur at any time after placement.

When tube displacement occurs, for any reason, an airway emergency can ensue and an alternative method of ventilation must be reestablished immediately through the use of bag-mask ventilation, orotracheal intubation, replacement of the tube through the existing tracheostomy tract, or surgical revision tracheostomy. Late complications of tracheostomy can occur in up to 65% of patients.<sup>31-33</sup> Fortunately, serious complications such as severe bleeding, tracheoesophageal fistula, and airway stenosis occur infrequently.<sup>25,34</sup> The most important aspect in diagnosing tracheoesophageal fistula and airway stenosis is for the clinician to have a high index of suspicion and have the patient undergo bronchoscopy, including distal airway assessment, to rule out other associated airway pathology. Once the diagnosis has been confirmed and a thorough airway inspection carried out, treatment can be implemented to optimize airway outcomes.

Utilization of a defined tracheostomy care protocol for patient and caregiver education prior to discharge was felt to be an important part of tracheostomy care. The goal is to improve patient outcomes and decrease complications

related to the procedure by reducing anxiety and assisting with developing the necessary skills for home care.<sup>15</sup> Referral to a speech language pathologist was felt to be important and something that can be easily overlooked. This should optimally occur prior to performing the tracheostomy so a treatment plan is established. The reader should also be aware of excellent teaching and learning plans for parents whose children have a tracheostomy.<sup>22,35</sup>

Several areas did not reach consensus and require further discussion (Appendixes A and B). These include a number of important topics related to tracheostomy tubes such as the frequency of tube change in a mature tracheostomy or whether children should have smaller or bigger size tubes for nocturnal ventilation. There was consensus among the panel that there was no evidence to support one practice over another, and this should be individualized to each patient.<sup>18</sup>

Also, the panel felt that the decision to use a tracheostomy cuff was dependent on factors that were patient specific and that there was no evidence to support one practice over another.

The panel also did not reach consensus on the need for bronchoscopy after tracheostomy tube replacement. Panel members felt that, although this was an option, patients clinically doing well after tube placement might not require this additional procedure and that a final decision may be left to the consulting or admitting service. There was no agreement on whether sutures and ties should be used routinely, whether inner cannula should be cleaned in a specific

way or solution (hydrogen peroxide vs saline), and whether suctioning should be limited to within the tracheostomy tube and no further than the tip.

There was no consensus about the requirement for caregivers to know cardiopulmonary resuscitation (CPR) prior to discharge. This may at first seem questionable. However, the primary concern was the term *CPR*. Some panelists felt that *CPR* was too vague and this statement would be too controversial, as many hospitals have their own standards for tracheostomy care and education regarding resuscitation techniques.

The strength of this study is in putting together a diverse and relevant panel of experts from a number of subspecialties with medical and nursing expertise in tracheostomy care. Members of this panel were provided from the following: the AAO-HNSF, American Association for Respiratory Care (AARC), American Society of Pediatric Otolaryngology (ASPO), American Broncho-Esophagological Association (ABEA), American Head and Neck Society (AHNS), American Laryngological Association (ALA), Society of Otorhinolaryngology and Head-Neck Nurses (SOHN), and emergency medicine. The methodology of obtaining expert opinions was rigorous and directed at achieving consensus on topics not addressed in the literature. A number of limitations need to be recognized, including the intrinsic limitation of the existing body of literature, the inevitable small group of experts, and the low strength of opinion-based evidence. Nonetheless, as part of this CCS, we have developed consensus statements that can be used by physicians, nurses, residents and trainees, and other health care stakeholders involved in the care of patients with a tracheostomy.

## Research Needs

Further research is needed in a number of areas highlighted in this document:

1. To define quality metrics related to tracheostomy care (optimal tracheostomy tube size, role of tracheostomy tube cuffs, role of sutures and ties in preventing accidental decannulation, cleaning and suctioning techniques, frequency and timing of tracheostomy tube change) that correlate to early hospital discharge.
2. To define important factors in patients with a tracheostomy that may influence the frequency of site infections, accidental tube displacement, emergency room visits, and readmission to the hospital. Important factors may include optimal cleaning and suctioning techniques, patient and caregiver education, frequency of follow-up care, training, and competency of home care nurses.
3. Determine whether trained APPs are able to perform initial tracheostomy changes with similar or fewer complication rates compared with experienced physicians.

## Summary

This CCS was based on expert opinion of a panel of experts from a variety of disciplines that are involved in the care of children and/or adults with a tracheostomy. The consensus panel made suggestions about a large number of statements that dealt with a variety of subjects, including the most appropriate tracheostomy tube type, suctioning, humidification, patient and caregiver education, home care, emergency care, decannulation, tube care (including use of cuffs and sutures), and overall clinical airway management. The panel also dropped a number of statements on the utility of tracheostomy ties or sutures, cleaning methodology, specific circumstances when the tube should be changed, utility of cuffs, and desired frequency of changing the tube.

## Disclaimer

Clinical consensus statements are provided for informational and educational purposes only. They are based on the opinions of carefully chosen expert panels and are promoted as such. The purpose of the expert is to synthesize information, along with possible conflicting interpretations of the data, into clear and accurate answers to the question of interest. Clinical consensus statements may reflect uncertainties, gaps in knowledge, opinions, or minority viewpoints, but through a consensus development process, many of the uncertainties are overcome, a consensual opinion is reached, and statements are formed. Clinical consensus statements are not clinical practice guidelines and do not follow the same procedures as clinical practice guidelines. Clinical consensus statements do not purport to be a legal standard of care. The responsible physician, in light of all the circumstances presented to the individual patient, must determine the appropriate treatment, diagnosis, and management. Consideration of clinical consensus statements will not ensure successful patient outcomes in every situation. The American Academy of Otolaryngology–Head and Neck Surgery emphasizes that these clinical consensus statements should not be deemed to include all proper diagnosis/management/treatment decisions or methods of care or to exclude other treatment decisions or methods of care reasonably directed to obtaining the same results.

## Appendix A

### Dropped Statements Achieving *Near* Consensus

Statement	Mean	Median	Mode	IQR	Range
Fresh tracheostomies should be replaced using a sterile technique.	6.67	7	3, 7, 8, 9	4	3-9
Tracheostomy tube cuffs should be used routinely among adult patients requiring mechanical/assisted ventilation.	7.22	7	7	3	5-9
Caregivers should know basic CPR prior to discharge.	7.22	8	9	3	3-9
Tracheostomy tube cuffs should be used among patients experiencing recurrent respiratory infections or aspiration.	6.78	7	7	2	5-9
A minimal leak test should be used to aid in tracheostomy tube cuff deflation.	6.56	7	7	1.5	3-8
During hospitalization, a nondisposable plastic or metal inner cannula should be cleaned with half-strength hydrogen peroxide and rinsed with sterile normal saline.	6.67	7	7	1	5-8
Velcro tracheostomy tube ties should be used for children and adults if available.	6.89	7	7	2	4-9

Abbreviations: CPR, cardiopulmonary resuscitation; IQR, interquartile range.

## Appendix B

### Dropped Statements Achieving No Consensus

Statement	Mean	Median	Mode	IQR	Range
Following the initial tracheostomy tube change, the tracheostomy tube should be replaced weekly or biweekly based on physician preference and patient circumstances.	5.78	7	7	4	2-9
In a patient with a compromised airway, a tracheostomy tube should not be replaced until the infection has resolved.	5.33	5	5	3	3-8
If a patient has an excessive increase in secretions that may lead to a mucus plug, the tracheostomy tube should be replaced.	5.89	7	7	3	3-9
Physicians should consider using a smaller diameter tracheostomy tube in children requiring nocturnal ventilation.	5.56	5	5, 7	3	3-8
Physicians should consider using a larger diameter tracheostomy tube in children requiring nocturnal ventilation.	5.00	5	3, 5, 7	4	3-7
Tracheostomy tube cuffs should be used postoperatively to prevent air leaks and aspiration.	6.22	6	5, 6, 7	2.5	3-9
In an emergency setting, patients with a dislodged tracheostomy tube that cannot be reinserted should be intubated.	6.44	7	9	4	1-9
In an emergency setting, a bronchoscopy should be performed after reinsertion of the tube.	6.00	6	5, 7	2	5-7
Tracheostomy tube cuffs should be used routinely among pediatric patients requiring mechanical/assisted ventilation.	5.89	6	5, 6	3	3-9
Tracheostomy tube cuffs should be used among patients requiring pulmonary toilet.	5.00	5	5	2.5	2-7
The tracheostomy tube should not be suctioned past its tip.	4.44	3	3	4	2-9
During hospitalization, a nondisposable plastic or metal inner cannula should be cleaned with sterile normal saline.	5.78	7	3, 7	4.5	3-9
Sutures are NOT necessary unless the patient has had reconstructive free flap surgery or other major neck surgery.	4.89	5	5, 7	4	2-7
Sutures are necessary in adults to secure the tracheostomy tube.	4.78	3	3	4.5	3-9
Sutures are necessary in children to secure the tracheostomy tube.	4.11	3	3	2.5	2-9
Tracheostomy tube ties should be used among patients with sutures in place.	6.44	7	7	1.5	3-9
Prior to tracheostomy tube cuff deflation, supplemental oxygen should be used.	6.11	6	5, 8	3.5	3-9

(continued)

## Appendix B. (continued)

Statement	Mean	Median	Mode	IQR	Range
In adults, tracheostomy tube cuffs may be inflated with normal saline or water.	3.89	4	5	2	1-5
In adults, if tracheostomy tube cuffs are inflated with water, pressure should be maintained between 0.20 and 0.25 cm.	6.00	7	7	2	3-8
In children, water should not be used to inflate tracheostomy cuffs.	4.89	5	3, 5, 7	4	2-8
In adults, tracheostomy tube cuffs should be inflated with sterile water.	4.11	5	5	2	3-5
In children, tracheostomy tube cuffs should be inflated with sterile water.	4.56	5	5	2	3-7
In adults, tracheostomy tube cuffs should be inflated with normal saline.	3.67	3	3	2	3-5
In children, tracheostomy tube cuffs should be inflated with normal saline.	3.89	3	3	2	3-5

Abbreviation: IQR, interquartile range.

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### Author Contributions

**Ron B. Mitchell**, chair, primary writer; **Heather M. Hussey**, project coordinator, data analysis, primary writer; **Gavin Setzen**, consultant, primary writer; **Ian N. Jacobs**, primary writer; **Brian Nussenbaum**, primary writer; **Cindy Dawson**, primary writer; **Calvin A. Brown III**, primary writer; **Cheryl Brandt**, secondary writer/reviewer; **Kathleen Deakins**, secondary writer/reviewer; **Christopher Hartnick**, secondary writer/reviewer; **Albert Merati**, secondary writer/reviewer.

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### References

- Hameed AA, Mohamed H, Al-Ansari M. Experience with 224 percutaneous dilatational tracheostomies at an adult intensive care unit in Bahrain: a descriptive study. *Ann Thorac Med*. 2008;3:18-22.
- Al-Ansari MA, Hijazi MH. Clinical review: percutaneous dilatational tracheostomy. *Crit Care*. 2006;10:202.
- Freeman BD, Isabella K, Lin N, Buchman TG. A meta-analysis of prospective trials comparing percutaneous and surgical tracheostomy in critically ill patients. *Chest*. 2000;118:1412-1418.
- Delaney A, Bagshaw SM, Nalos M. Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients: a systematic review and meta-analysis. *Crit Care*. 2006;10:R55.
- Griffiths J, Barber VS, Morgan L, Young JD. Systematic review and meta-analysis of studies of the timing of tracheostomy in adult patients undergoing artificial ventilation. *BMJ*. 2005;330:1243.
- ANZICS. *Percutaneous Dilational Tracheostomy Consensus Statement*. 2010. [http://www.anzics.com.au/downloads/doc\\_download/411-the-anzics-percutaneous-dilatational-tracheostomy-consensus-statement](http://www.anzics.com.au/downloads/doc_download/411-the-anzics-percutaneous-dilatational-tracheostomy-consensus-statement)
- Ministry of Health (MOH). *Nursing Management of Adult Patients with Tracheostomy*. Singapore: Ministry of Health; July 2010.
- Woodrow P. Managing patients with a tracheostomy in acute care. *Nurs Stand*. 2002;16:39-46; quiz 47-48.
- Durbin CG Jr. Tracheostomy: why, when, and how? *Respir Care*. 2010;55:1056-1068.
- Pereira KD, MacGregor AR, Mitchell RB. Complications of neonatal tracheostomy: a 5-year review. *Otolaryngol Head Neck Surg*. 2004;131:810-813.
- Rudnick EF, Mitchell RB. Tracheostomy in children. In: Pereira KD, Mitchell RB, eds. *Pediatric Otolaryngology for the Clinician*. Totowa, NJ: Humana Press; 2009:159-163.
- Garrubba M, Turner T, Grieveson C. Multidisciplinary care for tracheostomy patients: a systematic review. *Crit Care*. 2009;13:R177.
- Cetto R, Arora A, Hettige R, et al. Improving tracheostomy care: a prospective study of the multidisciplinary approach. *Clin Otolaryngol*. 2011;36:482-488.
- Hettige R, Arora A, Ifeacho S, Narula A. Improving tracheostomy management through design, implementation and prospective audit of a care bundle: how we do it. *Clin Otolaryngol*. 2008;33:488-491.
- Arora A, Hettige R, Ifeacho S, Narula A. Driving standards in tracheostomy care: a preliminary communication of the St

- Mary's ENT-led multi disciplinary team approach. *Clin Otolaryngol*. 2008;33:596-599.
16. Garner JM, Shoemaker-Moyle M, Franzese CB. Adult outpatient tracheostomy care: practices and perspectives. *Otolaryngol Head Neck Surg*. 2007;136:301-306.
  17. Shah RK, Lander L, Berry JG, Nussenbaum B, Merati A, Roberson DW. Tracheotomy outcomes and complications: a national perspective. *Laryngoscope*. 2012;122:25-29.
  18. Zhu H, Das P, Brereton J, Roberson D, Shah RK. Surveillance and management practices in tracheotomy patients. *Laryngoscope*. 2012;122:46-50.
  19. Vonk Noordegraaf A, Huirne JA, Brolmann HA, van Mechelen W, Anema JR. Multidisciplinary convalescence recommendations after gynaecological surgery: a modified Delphi method among experts. *BJOG*. 2011;118:1557-1567.
  20. Dalkey NC. *The Delphi Method: An Experimental Study of Group Opinion*. Santa Monica, CA: RAND Corporation; 1969. RM-5888-PR.
  21. Intensive Care Society. *Standards for the Care of Adult Patients with a Temporary Tracheostomy: Standards and Guidelines*. London: Council of the Intensive Care Society; 2008.
  22. Cincinnati Children's Hospital Medical Center. *Tracheotomy Care Handbook*. Cincinnati, OH: Cincinnati Children's Hospital Medical Center; 2010. KN-00209.
  23. Sherman JM, Davis S, Albamonte-Petrick S, et al. Care of the child with a chronic tracheostomy. *Am J Respir Crit Care Med*. 2000;161:297-308.
  24. Das P, Zhu H, Shah RK, Roberson DW, Berry J, Skinner ML. Tracheotomy-related catastrophic events: results of a national survey. *Laryngoscope*. 2012;122:30-37.
  25. De Leyn P, Bedert L, Delcroix M, et al. Tracheotomy: clinical review and guidelines. *Eur J Cardiothorac Surg*. 2007;32:412-421.
  26. National Health Service (NHS). *Caring for the Patient with a Tracheostomy*. 2nd ed. Edinburgh: NHS Quality Improvement Scotland; 2007.
  27. Lewis S, Hetikemper M, Dirksen S. *Medical-Surgical Nursing: Assessment and Management of Clinical Problems*. 5th ed. St. Louis, MO: Mosby; 2000.
  28. Black RJ, Baldwin DL, Johns AN. Tracheostomy 'decannulation panic' in children: fact or fiction? *J Laryngol Otol*. 1984;98:297-304.
  29. Gray RF, Todd NW, Jacobs IN. Tracheostomy decannulation in children: approaches and techniques. *Laryngoscope*. 1998;108:8-12.
  30. Tunkel DE, McColley SA, Baroody FM, Marcus CL, Carroll JL, Loughlin GM. Polysomnography in the evaluation of readiness for decannulation in children. *Arch Otolaryngol Head Neck Surg*. 1996;122:721-724.
  31. Heffner JE, Miller KS, Sahn SA. Tracheostomy in the intensive care unit, part 2: complications. *Chest*. 1986;90:430-436.
  32. Sue RD, Susanto I. Long-term complications of artificial airways. *Clin Chest Med*. 2003;24:457-471.
  33. Wood DE, Mathisen DJ. Late complications of tracheotomy. *Clin Chest Med*. 1991;12:597-609.
  34. Heffner JE, Hess D. Tracheostomy management in the chronically ventilated patient. *Clin Chest Med*. 2001;22:55-69.
  35. Joseph RA. Tracheostomy in infants: parent education for home care. *Neonatal Netw*. 2011;30:231-242.
  36. Roland PS, Rosenfeld RM, Brooks LJ, et al. Clinical practice guideline: polysomnography for sleep-disordered breathing prior to tonsillectomy in children. *Otolaryngol Head Neck Surg*. 2011;145(1)(suppl):S1-S15.