Weaning per the Tracheostomy Management Protocol for Downsizing and Decannulation in Adults in a Long Term Acute Care (LTAC) Hospital

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Abstract

Tracheostomy tubes (TT's) may be used short and long term to maintain patent upper airways after the endotracheal tube (ETT) has been removed. Cost and complications are associated with the presence of TT's. Successful decannulation of short term TT's should occur in a timely manner. There are many different approaches to decannulation with no evidence based practice (EBP) guideline for TT decannulation. A retrospective chart review was conducted on 250 charts in an effort to identify, in adults with TT's in a long term acute care (LTAC) hospital in the Midwest United States, whether or not application of the TT downsizing portion of the Tracheostomy Management Protocol (TMP) impacted rates of successful decannulation. Final data analysis was conducted on 98 (39%) participants. The majority were White (N=94, 96%) and female (N=55, 56%). Most participants (78/98;79.6%) were on the TMP, downsized, and successfully decannulated, with a median time of six days from time of first downsizing to time of decannulation. This LTAC had higher rates of and shorter time to successful decannulation than reported in the literature. Based on these findings, downsizing the TT prior to decannulation improves patient success and shortens time to decannulation prior to discharge from the LTAC hospital. However, results of the Fisher's Exact analysis were not statistically significant (p = .484), suggesting that no statistical relationship exists between downsized and remained decannulated after 72 hours.

Research should be expanded to evaluate why downsizing prior to decannulation may play a role in successful removal of the TT. Research to assess the impact of psychological, social, and cultural status on shorter time to and higher rates of successful decannulation for this unique and growing patient population may prove to be useful. Findings from additional research

combined with the results of this study could be incorporated into development of a TMP EBP guideline for adults in LTAC hospitals throughout the world caring for patients with TT's. The EBP guideline could be incorporated into practice by advanced practice nurses, respiratory therapists, and physicians around the world.

Keywords: tracheostomy tube, weaning protocol, downsizing, decannulation, adults, long term acute care, evidence-based practice

Weaning per the Tracheostomy Management Protocol for Downsizing and Decannulation in Adults in a Long Term Acute Care (LTAC) Hospital

Maintaining adequate airway protection and uncompromised respiratory status are vital to survival. When airway protection is initially threatened, an endotracheal tube (ETT) can be placed to provide an avenue for delivering positive pressure ventilation and life sustaining oxygenation (Walls & Murphy, 2008). When extubation, or removal of the ETT, is not expected to occur within seven to fourteen days, a tracheostomy tube (TT) should be placed (Bickenbach et al., 2011; Marino, 2007).

Even though placement of the TT removes risks associated with ETT's, the presence of a TT poses risks as well. These risks include hemorrhage, pneumothorax, tube occlusion, infection, improper cuff inflation, tracheal ulceration, tracheoesophageal fistula, tracheocutaneous fistula, obstructive granulation tissue, tracheal stenosis, tube dislodgement, and scar formation (Christenson, Artz, Goldhammer, Spiegel, & Boon, 2008; Marino, 2007). In addition, frustration, anxiety, and depression may develop in relation to the presence of a TT (Christopher, 2005). Therefore, once the goal of timely weaning from mechanical ventilation (Bickenbach et al., 2011) has been attained, timely TT weaning and decannulation should occur.

While the cost of a tracheostomy procedure may total $1700.00, the hospital costs associated with a TT can range from $123,000.00 to $156,000.00 per patient (Seder, et al., 2009). For patients discharged home with a TT in place, additional initial costs may total $375.00 (CostHelper, 2011) with a monthly recurrence of expenses for ongoing home management of the TT. Other patients with TT's may be transferred from a short term acute care to a long term acute care (LTAC) hospital with a goal of decannulation, or removal of the TT,

once successfully weaned from mechanical ventilation. Long term ventilator patients cost $1988 per day at a LTAC hospital whereas long term ventilator patients with a tracheotomy cost $2355 per day (Kindred Healthcare Operating, Inc., 2012), an increase of $367 per day for patients with TT's. The average cost associated with TT's at an LTAC ranges from $46,000 to $48,000 per patient per stay (O'Connor, Kirby, Terrin, Hill, & White, 2009). Prolonged TT weaning, unsuccessful decannulation, and complications (both physical and psychological) associated with ongoing TT placement can cause a hospital stay to be longer and more expensive in nature. Tobin and Santamaria (2008) found a shorter time to decannulation was associated with shorter length of hospital stay ($p < 0.01$). Shorter hospital stays can lead to fewer health care dollars spent related to TT's, reinforcing the need for timely and successful TT decannulation.

The current approach to TT weaning and decannulation is not straightforward (Christopher, 2005), varies in both local and community practice, and results in varied patient outcomes (Ceriana et al., 2003; Johnson, 2010; Mestral et al. 2011; Veelo et al., 2008). As part of the weaning process, tracheostomy tubes may be downsized at regular intervals prior to decannulation. Some providers make such tracheostomy tube weaning decisions based on personal preference, standard care, or healthcare provider-driven protocols (Johnson, 2010; Mestral et al., 2011; Veelo et al., 2008, & Yaremchuk, 2003) while other providers choose not to downsize tracheostomy tubes as part of the weaning process prior to decannulation (Ceriana et al., 2003; Enorgen, Arslanian-Enorgen, & Fenn-Buderer, 2004; Fernandez et al., 2008; Gilyoma, Balumuka, & Chalya, 2011; Martinez et al., 2009; Mestral et al., 2011; O'Connor et al., 2009; Parker et al., 2007).

While many pediatric and adult guidelines and recommendations exist from such organizations as Johns Hopkins, Center for Clinical Effectiveness, Respiratory Care, and

Intensive Care Medicine regarding management of TT's, very few studies discuss an accepted standard of care regarding the weaning process and removal of TT's (Lagambina, Nuccion, & Weinhouse, 2011). Currently, there is no evidence-based practice (EBP) guideline for TT downsizing and decannulation, yet many report one is needed (Ceriana et al., 2003; Fernandez et al., 2008; Garrubba & Turner, 2009; Martinez et al., 2009; Mestral et al., 2011). There is a desire to identify more successful approaches to both immediate and long term success with TT decannulation (Carpene, Vagheggini, Panait, Gabbrielli, & Ambrosino, 2010; Gilyoma et al., 2011). The current approach to TT weaning prior to decannulation while following a Tracheostomy Management Protocol (TMP) was evaluated to help identify best practice and provide recommendation for further practice as there is limited data available on recommended intervals of TT downsizing prior to decannulation.

Statement of Purpose

The purpose of this research was to assess the impact of downsizing on successful decannulation in adults with TT's in an LTAC hospital in the Midwest United States. A retrospective chart assessment was implemented for ordering and application of the TT downsizing portion of the TMP. Successful decannulation was defined as recannulation not required within 72 hours after the TT had been removed (Chan, Jones, Chung, & Hung, 2010).

Review of Literature

Many reasons for unsuccessful decannulation, including lack of EBP guidelines (Garruba & Turner, 2009), have been cited in the literature without addressing the role of appropriately downsizing the TT prior to removal (Ceriana et al., 2003; Fernandez et al., 2008; Martinez et al., 2009; Mestral et al., 2011). Multiple descriptive studies conclude that EBP guidelines do not exist for TT downsizing, weaning, and decannulation (Ceriana et al., 2003; Fernandez et al.,

2008; Garrubba & Turner, 2009; Martinez et al., 2009; Mestral et al., 2011) and are needed to improve management during this phase of tracheostomy care in the adult.

General TT weaning guideline recommendations identified in the literature suggest the first tracheostomy tube change occur at 10 to 14 days after placement to allow healing of the tract and decrease development of granulation tissue (Gilyoma et al., 2011; Johnson, 2010; Mestral et al., 2011; Yaremchuk, 2003). Subsequent changes with the same tube type and size is recommended weekly to decrease likelihood of granulation tissue and bacterial colonization (Johnson, 2010; Mestral et al., 2011; Veelo et al., 2008; Yaremchuk, 2003). Once the patient is clinically stable and requiring only nocturnal positive pressure ventilation, downsizing by one size with a cuffed TT is recommended (Ceriana et al., 2003; Johnson, 2010; Mestral et al., 2011; Veelo et al., 2008). Speaking valve trials may then be used with the aerosol tracheostomy collar during the day (Mestral et al., 2011; O'Connor et al., 2009). Once tolerating speaking valve trials during the day, the TT cuff should be deflated and red cap TT trials initiated during the day only (Mestral et al., 2011; O'Connor et al., 2009). Prior to red cap trials at night, the patient should have been without positive pressure ventilation for a total of four consecutive days and the TT should be changed to cuffless (Veelo et al., 2008).

When evaluating clinical status for decannulation, authors suggest a variety of determinants to take into consideration including age, comorbidities, etiology of respiratory failure, difficulty of intubation, level of consciousness, ability to tolerate capping, cough effectiveness, secretions, swallowing function, respiratory rate, and oxygenation level (Ceriana et al., 2003; Fernandez et al., 2008; Gilyoma et al., 2011; Martinez et al., 2009; Mestral et al., 2011; O'Connor et al., 2009; Parker et al., 2007; Stelfox et al., 2008). TT decannulation is considered

successful if recannulation is not required within 48 to 96 hours (Mestral et al., 2011; Stelfox et al., 2008).

Complications related to delayed TT downsizing result in increased cost for additional medical care and lengthened stay in the LTAC (Tobin & Santamaria, 2008). Enorgen, et al. (2004) conducted a study on 334 adult patients, ages 18-98 years, with TT's and respiratory failure. The study revealed that those decannulated prior to discharge from the short term acute care hospital had lower mortality rates (p value <0.001). Possible confounders that may contribute to lower rates of successful decannulation include pulmonary, cardiac, renal, neuromuscular, and psychological conditions. The desire to identify more successful approaches to both immediate and long term success with decannulation has been made evident in the literature (Carpene et al., 2010; Gilyoma et al., 2011).

There is limited and somewhat outdated research on TT weaning. Only one study (O'Connor et al., 2009) addressed successful approaches to decannulation in LTAC hospitals. In adult patients in a LTAC hospital with newly placed TT's, the question remains as to whether or not downsizing the TT prior to decannulation improves patient success with decannulation prior to discharge from the LTAC hospital.

Methods and Procedures

The TMP was written in 2008 by Dr. Johnny Venter, pulmonologist and LTAC medical director, for use in adults with TT's in an LTAC hospital. The protocol contains six sections: tracheostomy care, Passy-Muir Valve, tracheostomy tube change, tracheostomy tube downsizing, capping, and decannulation. The TT downsizing portion of the TMP describes criteria to be met prior to each downsizing procedure. The patient must be free from mechanical ventilation and have the tracheostomy for at least seven days with sutures removed. The TT must have been

placed for short term airway management, the patient must have no surgery scheduled in the foreseeable future, and there must be only a small to moderate amount of airway secretions. Additionally, the patient must have an adequate cough with low to moderate work of breathing and oxygen saturation levels must equal 90% or greater on no more than 40% supplemental oxygen. The patient must have passed a swallow study, must show signs of good aeration on the chest x-ray, and must be free of signs of respiratory infection.

To evaluate the impact of the TT downsizing portion of the TMP in successful decannulation, a retrospective descriptive study design was used. Data were collected from 250 medical records of adults with TT's who were admitted to an LTAC hospital in the Midwest between the dates of January 31, 2009 and January 31, 2012. Charts were identified by using code V55.0 Attention to Tracheostomy to generate a list of patients with TT in the list of diagnoses. Sampling criteria included adults age 18 and older with TT's who were successfully weaned from mechanical ventilation with the goal of decannulation. Fourteen data points retrieved included patient number, gender, race, age, date TT placed, TT size, reason TT placed, ICD 9 codes/diagnoses, date admitted to LTAC, was patient on weaning portion of the TMP, dates of downsizing with TT size, date of decannulation, if remained decannulated after 72 hours, and any reasons for recannulation before 72 hours.

Of the original 250 cases, sixty-two (25%) were removed because of chronic TT's without ventilator dependence. Twenty-five charts (10%) were removed because they remained ventilator dependent when they were discharged from LTAC. Nineteen cases (8%) were removed because they expired either while on the ventilator or less than 24 hours after being taken off the ventilator. Another 46 cases were removed due to other reasons (see Table 1). Final data analysis was conducted on 98 (39%) of the total charts reviewed.

Table 1

Frequencies and percentages on reasons why participants were removed (N = 152)

Reason	*n*	%
Chronic TT without ventilator dependence	62	25
Remained ventilator dependent when discharge from LTAC	25	10
On ventilator *or* off ventilator < 24 hours and expired	19	8
Duplicate patient chart	16	6
Improperly coded V550 chart	10	4
Kept TT due to pre-existing chronic vent dependence	5	2
Chart in legal review	3	1
Discharged home before 72 hour status post decannulation	3	1
TT present and transferred to ICU or ER for higher level of care	3	1
TT kept for scheduled surgery	2	1
TT kept due to dysphagia	2	1
Self decannulated	1	<1
TT kept due to halo vest	1	<1

Results

Of the 98 charts examined, the majority were White (N=94, 96%) and female (N=55, 56%). Participants' ages ranged from 20 to 88 years, with a mean (*M*) of 62.01 and standard deviation (*SD*) of 14.92. Upon admission to the LTAC, the most common size TT was eight (82, 84%). Frequencies and percentages on participants' demographics are listed in Table 2.

Table 2

Frequencies and percentages on participants' demographics

Demographic	*n*	%
Race		
White	94	96
Asian	1	1
Black	1	1
Latino	2	2
Gender		
Male	43	44
Female	55	56
TT size upon admission		

4	3	3
6	10	10
7	2	2
8	82	84
9	1	1

The number of days between first downsize and decannulation ranged from 1 to 375, with $M = 12.05$ and $SD = 41.20$. The mean number of days that transpired from TT to LTAC was 7.51. Mean number of days from LTAC to downsizing was 17.23. The mean number of days from TT to decannulation was 26.22 and the mean number of days from LTAC to decannulation was 23.01. Means, medians, and standard deviations for variables of interest are presented in Table 3.

Table 3

Means, medians, and standard deviations on participants' ages and number of days between procedures

Variable (Procedures)	*M*	*Mdn*	*SD*
Age	62.01	63.00	14.92
Number of days between first downsize and decannulation	12.05	6.00	41.20
TT to LTAC	7.51	5.00	6.92
LTAC to downsizing	17.23	10.00	41.92
TT to decannulation	26.22	24.00	12.54
LTAC to decannulation	23.01	18.00	39.19

Of the sample ($n = 98$), a total of 94 (96%) were successfully decannulated with only four (4%) participants unsuccessfully decannulated. Eighty-two (84%) participants were downsized and sixteen (16%) were not. Of those 82 participants who were downsized, 80 (98%) were downsized from size 8 to 6, one (1%) from size 8 to 7, and one (1%) from size 7 to 6. Seventy-eight (80%) of the 94 were downsized prior to successful decannulation. Of those 78, 76 (98%) were downsized from size 8 to 6 and successfully decannulated, one (1%) was downsized from size 7 to 6 and successfully decannulated, and one (1%) was downsized from an 8 to a 7 and

successfully decannulated. Sixteen (16%) of the 94 participants were not downsized prior to successful decannulation. Of those participants, 10 (63%) were successfully decannulated from a size 6, three (19%) were successfully decannulated from a size 4, one (6%) was successfully decannulated from size 7, one (6%) from size 8, and one (6%) from size 9.

Frequencies and percentages were calculated for rates of those downsized and successfully decannulated (78/98; 79.6%) and those not downsized and successfully decannulated (16/98; 16.3%). Both groups were on the TT downsizing portion of the TMP. These findings are presented in Table 4.

Table 4

Frequencies and percentages for downsizing and decannulation on the TMP

Demographic	n	%
Downsized	82	84
8 to 6	80	98
7 to 6	1	1
8 to 7	1	1
Decannulated		
Successfully decannulated	94	96
Not successfully decannulated	4	4
Downsized and successfully decannulated----------	78	80
8 to 6	76	97
7 to 6	1	1
8 to 7	1	1
Not downsized but successfully decannulated----------	16	16
Decannulated from a size 6	10	63
Decannulated from a size 4	3	19
Decannulated from a size 7	1	6
Decannulated from a size 8	1	6
Decannulated from a size 9	1	6

The Fisher's Exact Test of Probability was performed and interpreted to compare the relationship between those cases who did or did not have a TT downsized and those who remained successfully decannulated after 72 hours and those who did not. The results of the Fisher's Exact analysis were not statistically significant (p = .484), suggesting that no statistical relationship exists between having the TT downsized and remaining decannulated after 72 hours. The results are presented in Table 5.

Table 5

Fisher's Exact Test between Downsized and Remained Decannulated after 72 Hours

	Remained decannulated after 72 hours				
	No		Yes		
Variable	Obs.	Exp.	Obs.	Exp.	*p*
Downsized					.484
No	0	0.7	16	15.3	
Yes	4	4.0	78	78.7	

Note. Obs. = observed frequency. Exp. = expected frequency.

Discussion

Placement on the TMP prior to decannulation was associated with higher rates of successful decannulation when compared to studies in the literature. That is, 79.6% (78/98) of those successfully decannulated had been placed on the TMP and downsized prior to removal of the TT with a median of 24 days from placement of TT to time of decannulation and six days from time of first downsizing to time of decannulation. Overall, this decannulation success rate was 45.2% higher, as well as 53.3% shorter in duration (24 versus 45 days), than that reported by O'Connor, et al. (2009). O'Connor, et al. (2009) found successful decannulation in 34.8% (47/135) of patients transferred to an LTAC for ventilator weaning with a median of 45 days following placement of the TT. In a related study, Enorgen, Arslanian-Enorgen, & Fenn-Buderer (2004) reported a 29.8 % (57/191) decannulation success rate in hospitalized patients

who had been weaned off of the ventilator, a rate 50.2% lower than that identified with this study. Downsizing prior to decannulation was not discussed in either related study; therefore, it cannot be said that downsizing of the TT was solely responsible for the improved rate of successful decannulation. The results of this study suggest TMP and downsizing prior to decannulation should continue as practiced at the LTAC studied, and be considered for use at other similar LTAC adult hospitals nationwide.

The small sample size raises concern for sample limitation. A longer time span of five years for data collection may have resulted in a higher number of cases to strengthen the study. Admission diagnoses, body mass indices, lengths of hospital stay prior to transfer to LTAC, and comorbidities, are possible confounders to this study.

Prior similar research on this topic is extremely limited. Additional research is needed on the relationship of downsizing prior to successful decannulation in the LTAC adult population. Larger sample sizes are needed and in multiple LTAC hospitals worldwide to further assess for other factors that might impact rates of successful decannulation in an effort to optimize positive outcomes for this patient population. Evaluation of cost-benefit ratio in relation to earlier successful decannulation may prove beneficial for patients, hospitals, and insurance companies.

Research should be expanded to evaluate why downsizing prior to decannulation may play a role in successful removal of the TT. Research to assess the impact of psychological, social, and cultural status on shorter time to and higher rates of successful decannulation for this unique and growing patient population may prove to be useful. Findings from additional research combined with the results of this study could be incorporated into development of a TMP EBP guideline for adults in LTAC hospitals throughout the world caring for patients with TT's. The

EBP guideline could be incorporated into practice by advanced practice nurses, respiratory therapists, and physicians around the world.

Conclusion

TT's are placed to maintain patent airways either short or long term. To decrease risk for complications in TT's placed short term, TT weaning and successful decannulation should occur in a timely manner. Current approaches to TT decannulation differ greatly and result in varied outcomes. When compared to other studies, the current study demonstrated that patients on the weaning portion of the TMP experienced 53.3% shorter time to decannulation and 45.2% higher rates of successful decannulation prior to discharge from the LTAC. Based on these findings, downsizing the TT prior to decannulation improves patient success and shortens time to decannulation prior to discharge from the LTAC hospital. However, results of the Fisher's Exact analysis were not statistically significant ($p = .484$), suggesting that no statistical relationship exists between downsized and remained decannulated after 72 hours.

The study recommendations are to continue with consistent use of the weaning portion of the TMP and downsizing prior to decannulation and evaluate the effectiveness of its use in other similar LTAC hospitals. Downsizing the TT prior to decannulation improves patient success with decannulation prior to discharge from the LTAC hospital. Best practice in this approach should be established through development of an EBP guideline for TT downsizing and decannulation.

References

Bickenbach, J., Fries, M., Offermanns, V., Von Stillfried, R., Rossaint, R., Marx, G., & Dembinski, R. (2011). Impact of early vs. late tracheostomy on weaning: A retrospective analysis. *Minerva Anestesiol, 77,* 1176-83. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21617598

Carpene, N., Vagheggini, G., Panait, E., Gabbrielli, L., & Ambrosino, N. (2010). A proposal of a new model for long-term weaning: Respiratory intensive care unit and weaning center. *Respiratory Medicine, 104,*1505-1511.

Ceriana, P., Carlucci, A., Navalesi, P., Rampulla, C., Delmastro, M., Piaggi, G., Mattia, E., & Nava, S. (2003). Weaning from tracheotomy in long-term mechanically ventilated patients: Feasibility of a decisional flowchart and clinical outcome. *Intensive Care Medicine, 29,* 845-848.

Chan, L.Y., Jones, A.Y., Chung, R.C., & Hung, K.N. (2010). Peak flow rate during induced cough: A predictor of successful decannulation of a tracheostomy tube in neurosurgical patients. *American Journal of Critical Care, 19*, 278-284. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19435950.

Christenson, T.E., Artz, G.J., Goldhammer, J.E., Spiegel, J.R., & Boon, M.S. (2008). Tracheal stenosis after placement of percutaneous dilatational tracheotomy. *The Laryngoscope, 118*, 222-227. Retrieved from www.biomedicalfindings.com/bmfgs/g4/2005

Christopher, K. (2005). Tracheostomy decannulation. *Respiratory Care, 50*, 538-541.

CostHelper (2011). Tracheostomy cost. http://health.costhelper.com/tracheotomy.html

Enorgen, M., Arslanian-Enorgen, C., & Fenn-Buderer, N. (2004). Hospital and long-term outcome after tracheostomy for respiratory failure. *Chest, 125*, 220-227.

Fernandez, R., Bacelar, N., Hernandez, G., Tubau, I., Baigorri, F., Gili, G., & Artigas, A. **(**2008). Ward mortality in patients discharged from the ICU with tracheostomy may depend on patient's vulnerability. *Intensive Care Medicine, 34,* 1878-1882.

Garrubba, M. & Turner, T. (2009). Evidence-based practice guidelines for tracheostomy patients. *Center for Clinical Effectiveness,* 1-7.

Gilyoma, J. M., Balumuka, D. D., & Chalya, P. L. (2011). Ten-year experiences with tracheostomy at a university teaching hospital in northwestern Tanzania: A retrospective review of 214 cases. *World Journal of Emergency Surgery, 6,* 1-7.

Johnson, W. A. (2010). Tracheostomy tube change. *Medscape Drugs, Diseases, & Procedures.* Retrieved from http://emedicine.medscape.com/article/1580576-overview

Kindred Healthcare Operating, Inc. (2012). 2011 Quality and Social Responsibility Report. Continue the care: Driving integrated, cost-effective care across the post-acute continuum. http://www.kindredhealthcare.com/uploadedFiles/_Global_Content/Quality_Report/QualityReport2011.pdf

Lagambina, S., Nuccio, P., & Weinhouse, G. L. (2011). Tracheostomy care: A clinician's guide. *Hospital Practice, 39,* 161-167. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed

Langley, G. J., Moen, R., D., Nolan, K.M., Nolan, T.W., Norman, C. L., & Provost, L.P. (2009). The improvement guide. (2nd ed.). San Francisco, CA: Jossey-Bass.

Marino, P.L. (2007). The ICU Book, 3rd ed. Lippincott, Williams & Wilkins: Philadelphia.

Martinez, G., Fernandez, R., Casado, M., Cuena, R., Lopez-Reina, P., Zamora, S., & Luzon, E. (2009). Tracheostomy tube in place at intensive care unit discharge is associated with increased ward mortality. *Respiratory Care, 54,* 1644-1652.

Mestral, C., Iqbal, S., Fong, N., LeBlanc, J., Fata, P., Razek, T., & Khwaja, K.(2011). Impact of a specialized multidisciplinary tracheostomy team on tracheostomy care in critically ill patients. *Canadian Journal of Surgery, 54,* 167-172.

O'Connor, H.H., Kirby., K.J., Terrin, N., Hill, N.S., & White, A.C. (2009). Decannulation following tracheostomy for prolonged mechanical ventilation. *Journal of Intensive Care Medicine, 24,* 187-194.

Parker, V., Archer W., Smith, K., Shylan, G., McMuller, P., Giles, M., Morrison, J., &. Austin, N. (2007). Trends and challenges in the management of tracheostomy in older people: The need for a multidisciplinary team approach. *Contemporary Nurse, 26,* 177-183.

Seder, D.B., Lee, K., Rahman, C., Rossan-Raghunath, N., Fernandez, L., Rincon, F., Claassen, J., Gordon, E., Mayer, S.A., & Badjatia, N. (2009). Safety and feasibility of percutaneous tracheostomy performed by neurointensivists. *Neurocritical Care, 10,* 264-268. http://www.ncbi.nlm.nih.gov/pubmed/19130311

Stelfox, H.T., Crimi, C., Berra, L., Noto, A., Schmidt, U., Bigatello, L.M., & Hess, D. (2008). Determinants of tracheostomy decannulation: An international survey. *Critical Care, 12.* Retrieved from http://ccforum.com/content/12/1/R26

Tobin, A.E. & Santamaria, J.D. (2008). An intensivist-led tracheostomy review team is associated with shorter decannulation time and length of stay: A prospective cohort study. *Critical Care, 12.* Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2447599/

Veelo, D. P., Schultz, M. J., Phoa, K. Y., Dongelmans, D. A., Binnekade, J. M., & Spronk, P. E.. (2008). Management of tracheostomy: A survey of Dutch intensive care units. *Respiratory Care, 53,* 1709-1715.

Walls, R.M. & Murphy, M. F. (2008). Manual of emergency airway management. (3rd ed.). Lippincott, Williams & Wilkins: Philadelphia.

Yaremchuk, K. (2003). Regular tracheostomy tube changes to prevent formation of granulation tissue. *The Laryngoscope, 113.* 1-10.