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Quality Improvement on the Long-term Care Ventilator Unit: Interventions to Increase Patient Safety and Prevent Patient Harm

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Quality Improvement on the Long-term Care Ventilator Unit: Interventions to Increase Patient Safety and
Prevent Patient Harm

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Abstract

BACKGROUND: Tracheostomy patients are susceptible to life-threatening emergencies when their airways are compromised. Epidemiologic data suggests that 3.2% to 30% of tracheostomy patients have a complication. The long-term care ventilator unit (LTCVU) is a 25-bed unit in a nursing home. It has noted that 40% of patients have a complication. A group of hospitals demonstrated a 90% reduction in complications through five interventions.

METHODS: The Johns Hopkins Nursing Evidence-Based Practice model was utilized to take the Global Tracheostomy Collaborative interventions and apply them to the LTCVU with the aim of reducing the number of airway complications on the unit by 50%.

INTERVENTIONS: Five interventions were implemented for this quality improvement project: Bedside multidisciplinary team rounds, nursing in-services, continued protocolization of care, tracking complication rates and active prevention measures. Pre- and post-education surveys were distributed to nurses. Pre-education surveys averaged a 49% score, while the post-education average was 98%.

RESULTS: Complications per patient per day were tracked pre- and post-intervention and a control chart compared pre- and post-intervention rates. Pre-implementation there were 0.00655 complications per patient per day over 22-weeks. Post-implementation there were 0.01012 complications per patient per day over 6-weeks.

CONCLUSIONS: While complication rates seem to have increased following implementation, there are many reasons that an increase may have been noted. During implementation, census increased while staffing did not. Also, several patients admitted to the unit were fragile and required frequent intervention, potentially detracting from others' attention. Additionally, the project was implemented during the winter season, when dry air often causes increased mucous plugging. Finally, the post-implementation period has only covered six weeks. Perhaps with extended monitoring, rates would decrease.

Keywords: *tracheostomy, protocol, harm reduction, quality improvement, nursing education, outcomes, complication, airway emergency.*

Introduction

Problem Description

Patients who require a tracheotomized airway are considered a vulnerable population that is at high risk for poor outcomes (Colandrea & Eckardt, 2016; Fisher, 2017; Lalabekyan, Donohue, & Burdett, 2016; Pritchett, 2016). Research has shown that the protocolization of care in addition to staff training can prevent harm to these patients (Bedwell et al., 2018; Klemm & Nowak, 2017). In fact, Bonvento et al., (2017) state that many of the complications seen with tracheostomies are preventable, and that there is a 60-70% chance of harm for a patient with a complication. They cite inadequate staff training, lack of appropriate safety equipment, lack of appropriate monitoring, and improper response to arising incidents as the cause of many of the harms to and deaths of patients with tracheostomies.

The increased potential for harms and death from tracheostomy complications were recognized by the administration of a long-term care tracheostomy and ventilator unit at a nursing facility in central New Hampshire. No programs in the facility currently exist to educate nurses regarding basic tracheostomy and ventilator skills, nor do programs exist to evaluate cases of airway emergency and actively attempt to prevent further episodes from occurring. A critical incident helped administrators and staff realize that new protocols were necessary to reduce variation in practice. To improve the quality of care that patients received on the unit, and to decrease the potential for patient harm, a quality improvement project was designed not only to track outcomes and protocolize patient care, but also to appropriately train nursing staff in emergency response.

Available knowledge

Over 100,000 tracheotomies are performed yearly in the United States (Bedwell et al, 2018), and there are an estimated 6.5 million tracheostomy patients residing in the U. S. (Yelverton, Nguyen, Wan, Kenerson, & Schuman, 2015). A tracheostomy is an artificial airway situated just below the thyroid on the anterior neck. It is created using either an open surgical technique or an endoscopic, dilatational technique. There are various reasons for a tracheostomy including airway obstruction, the need for prolonged mechanical ventilation, the inability to protect one's own airway and for severe respiratory disease (Doherty et al., 2018). According to Bedwell, et al. (2018), epidemiologic data suggests that in the US there are 1000 tracheostomy complications and 500 deaths annually. Furthermore, complication rates can vary from 3.2% (Bedwell et al., 2018) to 30% (McGrath et al., 2017). Other studies have reported that measurable harm occurs in 57-82% of those who have complications (Bonvento, Wallace, Lynch, Coe, & McGrath, 2017; Doherty et al., 2018). McGrath et al., (2017) cite British epidemiological reports that attribute complications and deaths to a lack of staff training, bedside equipment and infrastructure necessary to support patients.

Regarding tracheostomy complications, not all studies providing statistics have also provided a definition of complication. As noted above, Bedwell et al. (2018), cite a 3.2% patient complication rate, but they do not provide a denominator such as per year, and they don't disclose what constitutes a complication. The NCEPOD, as quoted by McGrath et al., (2018) claims that 30% of patients will have a complication, but once again, the researchers fail to clearly define complication. Other researchers (Colandrea et al., 2016) state that complications include accidental decannulation, bleeding, complete tracheostomy tube occlusion and tracheoesophageal fistulas. Because there is a large difference between a 3% complication rate and a 30% complication rate, it felt that either there is considerable underreporting of

complications in the 3% study, or the definition of a complication is widely divergent among studies.

In consideration of tracheostomy deaths, one group (Klemm & Nowak, 2017) completed a systematic review to compare the difference in complication rates between surgical tracheotomy and percutaneous tracheotomy. Though the authors found no difference in death rates between the two methods, they did note that the most common causes of death were related to hemorrhage, loss of airway and creation of a false passage. While this study evaluated newly created tracheotomies, and though the authors do acknowledge bias to the reporting of data in their systematic review, they do mention that good staff training and use of protocols can be utilized to decrease deaths among tracheostomy patients.

A highly publicized report in the United Kingdom, the National Audit Project 4 (March 2011), focused on airway complications after a few cases of patients with poor outcomes had been brought forth to the media (McGrath, Bates, Atkinson, Moore, & National Tracheostomy Safety Project, 2012). Publication of that report saw the formation of the National Tracheostomy Safety Project in the UK, which is a quality improvement initiative aimed at improving the outcomes of patients with tracheostomies and laryngostomies. From those quality improvement initiatives came a set of guidelines for tracheostomy and laryngostomy emergencies (McGrath et al., 2012), and soon the global community was interested in improving outcomes for their populations as well. While the National Tracheostomy Safety Project served the United Kingdom, the Global Tracheostomy Collaborative (GTC) was created in 2012 to serve the global community. This collaborative was a global quality improvement initiative as encouraged by the Institute for Healthcare Improvement (Bedwell et al., 2018). In addition to making recommendations to improve patient care, the GTC houses a patient database that can be used by

member facilities to track patient outcomes as well as facility outcomes and to compare them to outcomes at other facilities. Work with the GTC has helped member hospitals from Australia, the United Kingdom and the United States demonstrate a 90% decrease in inpatient critical events (Bedwell et al., 2018). Furthermore, four National Health Service hospitals in Manchester, U. K. (McGrath et al., 2017) also reported their success with the quality improvement initiative.

While having a tracheostomy increases the risks for certain airway emergencies, a great concern for patients with a tracheostomy or laryngostomy is the inability to verbalize one's needs and the inability to swallow (McGrath, et al, 2017). Both issues have a great influence on quality of life. Furthermore, patients who are unable to speak will have difficulty communicating problems such as shortness of breath. The Global Tracheostomy Collaborative recommended specific standards of care to increase the safety of patients. Member hospitals took the standards and implemented them in multiple performance improvement cycles. The five key interventions to improve care quality and decrease complications are the use of standardized care protocols, increased patient and family involvement, staff education, multidisciplinary rounds and the collection and utilization of data to guide improvement efforts (Bedwell, et al., 2018). McGrath et al (2017) also recognized the need for the training of staff to increase their self-efficacy to effectively respond to an emergent situation. Overall, McGrath and his team (2017) found that they had a 29.8% rate of adverse events, which included one death, but they found a decline in rates of harm as well as a decreased length of stay as their improvement project progressed. They also noted that patients were able to eat 5 days earlier with a new protocol for early speech pathologist referral. They were able to estimate a cost saving of 473,000 pounds through the implementation of their project.

Literature review was undertaken to find evidence for the most appropriate ways to decrease airway emergencies and patient harms for those with tracheostomies. Special interest was placed on nursing education interventions with the literature review, given that nursing education has been identified as one element that is lacking on the long-term ventilator unit. There were nine studies reviewed. Unfortunately, not all the studies comment on patient outcomes, and in fact, some of the studies focus solely on self-efficacy and knowledge improvement. Those studies that only tracked knowledge focused on standardizing patient and provider education and tracking knowledge improvement via pre- and post-education surveys. Four studies analyzed outcomes specifically regarding knowledge and were able to demonstrate improvement following their various education programs. Yelverton et al. (2015), created a rigorous 45-minute education session for staff and a patient care manual as well. Similarly, McDonough et al. (2016), used an online tutorial and 30-minute simulation session. Dorton et al. (2014), utilized a simulation session to increase self-efficacy and knowledge. Cowperthwait et al. (2015), developed a way to perform tracheostomy training with a tracheostomy overlay system on a structured patient. All studies commented that knowledge and self-efficacy improved through the education interventions. Five studies (Bonvento et al., 2017; Colandrea & Eckardt, 2016; Fisher, 2017; Masood, Farquhar, Biancaniello, & Hackman, 2018; McGrath et al., 2013) tracked patient outcomes with their interventions. Interventions included standardized equipment, standardized nurse training, standardized care protocols and order sets, augmentation of documentation systems, multidisciplinary rounds, utilization of a steering group, patient and family engagement and standardized patient training. Of those studies, Colandrea and Eckardt (2016) did not demonstrate statistically significant improvements because of the small numbers of patients admitted to the study. They did utilize bootstrapping to demonstrate improvement

with greater numbers of patients, however. All other studies were able to demonstrate improvement in patient outcomes with their interventions. Often, outcomes tracked included length of stay, rapid response calls, numbers of complications, severity of harm, improvement in knowledge and self-efficacy.

While none of the nine studies above were randomized controlled trials, the two studies by McGrath were able to demonstrate a reduction in harm by simply using didactic and simulation education in addition to protocolization of care. Other studies demonstrated gains in self-efficacy and knowledge when evaluating educational interventions. It is evident that simulation has become a popular model for education, since it allows application of didactic training and can reinforce it as well. There is some evidence that an education program along with standardized protocols can be utilized to help decrease harms and increase the knowledge and self-efficacy of staff regarding tracheostomy and ventilator patients. Quality of the studies above are of a lower level, since these are not randomized controlled trials (most of the studies were simple comparison studies and a few were performance improvement projects). There is likely some bias in the number of studies found. It is assumed that many studies with no improvement or negative outcomes were not reported.

Another article regarding the Global Tracheostomy Collaborative (GTC) (Bedwell et al., 2018) discusses the quality improvement initiative and five key components: multidisciplinary rounds, standardization of care, interdisciplinary education, patient and family involvement, and utilization of data for quality improvement. These are not unlike the branding standards that Genesis has outlined for its ventilator units (Genesis HealthCare, 2009). GTC member hospitals utilized these components to improve outcomes for their tracheostomy patients and were able to disseminate their findings and protocols so that other hospitals might benefit as well. These

studies, taken together, bring about an important concept—standardized protocols can lead to improved care and a decrease in harms for patients with tracheostomies. While the ventilator unit does have some standards for care, these studies suggest that there may be opportunities for improvement in the standards of care for reduction in patient harms. This, coupled with an education and simulation program to teach staff what to do in an emergency, may lead to better outcomes for patients.

Rationale

The evidence-based practice model to be utilized for this project is the Johns Hopkins Nursing Evidence Based Practice Model (Dang & Dearholt, 2017). This model has very clear guidelines for establishing a problem, creating a team, reviewing available evidence and then implementing the evidence. This is an iterative approach to problem solving like other models, such as the Model for Improvement. Appendix A contains a visual representation of the model. The goal of the model is to guide nurses to quickly implement research findings into patient care (Dang and Dearholt, 2017).

Specific Aims

The aim of this project is to reduce the number of complications on the unit by 50% in the period from February 1 to April 30, 2019. To do this, several steps will be taken:

1. Collect data regarding the number of complications that occur on the unit every week to establish a baseline.
2. Initiate an evaluation of processes and outcomes on the unit regarding airway emergencies.

3. Move multidisciplinary care team rounds from the office to the bedside to better engage patients and their families.
4. Continue protocols within the unit to maintain standardized care and utilize evidence-based interventions to decrease complications.
5. Educate nursing staff regarding response to tracheostomy and airway emergencies.

Methods

Context

This quality improvement project took place on the 25-bed long-term ventilator unit at Genesis Healthcare's Laconia Rehabilitation Center, in Laconia, New Hampshire. The population consisted of those patients residing on the ventilator unit who had an artificial airway (tracheostomy or laryngostomy). Diagnoses encountered include chronic obstructive pulmonary disease, obesity hypoventilation syndrome, obstructive sleep apnea, central sleep apnea, laryngeal cancer, anoxic brain injury, diffuse axonal injury, muscular dystrophy, syringomyelia, ischemic and hemorrhagic stroke, spinal muscle atrophy, amyotrophic lateral sclerosis, traumatic brain injury, and Parkinson's disease. Patient's ages range from 21 to 73.

Staffing on the unit consists of nurses, respiratory therapists and nursing assistants. There are eight nurses working on the unit, typically two nurses per shift, though there are times that there are not enough nurses to staff the unit and a medication assistant (nursing assistants trained to pass medications) works in the place of a nurse. The educational level for the nurses includes licensed practical nurses (one year of nursing school), associate degree nurses (two years of nursing school), and bachelor's degree nurses (four years of school). Because of difficulties

recruiting and retaining nurses, there are typically two to three travel nurses assigned to alternate onto the unit when needed. This can be problematic because travel nurses often accept a position at a nursing facility but are not told on which floor they will work. There are some nurses who are terrified to work with the tracheostomy and ventilator patients, and very few of them have experience with this cohort. Many of the staff nurses have some experience in critical care or are new nurses but are very motivated to learn. There are five full-time and five part-time respiratory therapists on the unit. Typically, it is staffed with a therapist working 7 am – 3 pm, an additional therapist from 1 pm – 9 pm, and a therapist from 7 pm to 7 am. There are times, especially over the weekend that there is one therapist from 7 am to 7 pm and one therapist from 7 pm to 7 am. Census does call for two therapists during the day and evening shifts, however, recruitment and retention of therapists has been difficult given a decreased rate of pay and decreased benefits package in comparison to the those of the local hospital. Most respiratory therapists have an associate degree in respiratory therapy, though the senior respiratory therapist has a bachelor's degree.

Lack of appropriate staffing levels increases both stress and workload, especially in the setting of a few patients who are labor intensive. During implementation, there was an increase in patient census, but not in staffing levels. Where respiratory therapists are traditionally caring for 9 patients each, now their workload has increased to 18. This doubling of the workload requires priority setting and contributes to missed care that is typically performed daily. Some patients were noted to have increased anxiety due to fears that staff would be unable to meet their needs given their harried activity. This was noted to cause a change in the communication dynamic for some patients.

Regarding the training of staff to begin work on the unit, respiratory therapists usually provide a quick orientation to a new respiratory therapist to show them the charting process, the ventilator flow sheets and the particulars of care for each patient. Orientation usually lasts a day or two. For nurses, there are a few weeks of orientation regarding passing medications to patients, learning which treatments need to be done and learning the charting systems. There is no educational program for nurses to learn about the respiratory care of the patients, this care typically left to the respiratory therapists. Nevertheless, many of the nurses have a previous experience in critical care or with tracheostomy and ventilator patients, so many of them are proficient at suctioning patients when needed, while others are even able to proficiently bag ventilate a patient in an emergency. The current training on the unit is much less than it had been when the unit opened about eight years ago. At that time, nurses received training in airway emergencies and basic tracheostomy and ventilator management.

One contextual element that had bearing on the project was the lack of a manikin to use for practice. Because the tracheostomy manikin was not located, demonstrations of suctioning, trach care, and trach changes were performed on a patient. Because it is not very comfortable for individuals who breathe spontaneously to be ventilated with a bag-valve, this skill was not demonstrated in real time. Had the tracheostomy manikin been located, teaching would have been easier initially, allowing for students to become comfortable with practicing skills on an inanimate object, then moving on to a real subject to perfect their skills.

The rounds process on the unit consists of the multidisciplinary care team that used to meet every other week to provide a brief overview of each patient and review or make any necessary changes in care plan. The team is made up of the ventilator program manager, lead respiratory therapist, unit nurse manager, bedside nurse, director of social services and center

nurse executive. Rounds used to take place in the unit manager's office. Any changes to the care plan could then be relayed to the patient at another time, but quite often, the patient was not actively included in planning. The role of the ventilator program manager is to oversee the pulmonary care of each patient on the unit and to oversee the operations of the respiratory therapy department. The lead respiratory therapist's role is to oversee respiratory care on the floor, while the respiratory therapist provides direct care to the respiratory patient, including assessments and interventions. The unit nurse manager oversees the nurses and aides on the unit. The director of social services helps communicate plans of care with patients and their families and oversees care planning meetings. The bedside nurse's role is to help the patient manage his medications and activities of daily living. The center nurse executive directs nursing care and care planning within the institution.

Another contextual element that may have affected this project was the season. This project was implemented during influenza and pneumonia season, and there was an increase in pulmonary infections and complications during this time related to mucous plugging from the dry winter air. While interventions are undertaken to prevent problems in the wintertime, problems this winter did contribute to complications for at least one patient.

Interventions

Concepts and interventions from the research and quality improvement projects from the Global Tracheostomy Collaborative, as noted above, were utilized for this quality improvement project since they very closely align with the Genesis Healthcare ventilator unit branding agreement (Genesis Healthcare, 2009). They were also utilized because they have been shown to improve self-efficacy around tracheostomy care and response to emergencies and have decreased patient harms. Interventions were:

1. Collect data regarding the number of complications that occur on the unit per week to establish a baseline.
2. Initiate an evaluation of processes and outcomes on the unit regarding airway emergencies.
3. Move multidisciplinary care team rounds from the office to the bedside to better engage patients and their families.
4. Continue protocols within the unit to maintain standardized care and utilize evidence-based interventions to decrease complications.
5. Educate nursing staff regarding response to tracheostomy and airway emergencies.

The first intervention was to create the continuous monitoring systems tracking complications and outcomes. The number of complications were tracked and recorded as they occurred. The ventilator program manager discussed the complications with the respiratory therapists. Complications were tracked before, during and after the implementation of the education sessions. Data was analyzed and a control chart was created to establish an average for complications per patient per day. Complication rates were compared from before the implementation and then during and after the implementation to determine if rates had improved.

The second intervention was to evaluate the unit's processes and outcomes regarding airway emergencies. Care protocols may require modification if there is evidence that a prevention measure could be utilized to avoid further complications. For example, protocols were put into place to provide for one to one observation for those patients whose ventilators may be disconnected from the overhead alarms. Other prevention protocols were put into place

for heated humidification and heated ventilator circuits if required. These prevention protocols are being taught to the unit's staff to ensure patient safety and to minimize patient harms.

The third intervention was to better engage patients and families regarding goal planning and progress by taking multidisciplinary care rounds from the confines of an office to the bedside. Initially, multidisciplinary rounds were held every other week, however, the ventilator unit branding agreement states that multidisciplinary rounds must occur weekly. Bedside rounds were taken from the unit manager's office and moved to patients' rooms. They went from occurring every two weeks to occurring weekly. The goal was to increase care team and patient/family communication to help them better understand interventions and goals of care from the care team's standpoint and to better understand what goals patients have so that staff can address their needs appropriately. It also helped them to understand their disease process, and what interventions the team felt were important to each patient's care. The hope was that with more discussion of goals and more education on what to report to the staff, the patient and family would be more accustomed to noticing subtle changes in condition and report them. It was also hoped that discussion of the team's goals, there would be increased compliance with interventions to decrease complications, for example, a patient would be more willing to wear the heated aerosol collar if he better understood that he wasn't getting enough humidity into his airway, which was causing mucous plugging issues.

The next intervention was to continue protocols within the unit to maintain standardized care and utilize evidence-based interventions to decrease complications. Already there existed a protocol to keep an emergency supply kit at each patient's bedside. This kit contains an Ambu-bag, a spare tracheostomy tube, lubricant, a tracheostomy securement device, spare tracheostomy dressings and a suction catheter. Then, in the case of an emergency, there was no need for

frantically gathering equipment. Also, the protocol for tracheostomy care was twice daily and as needed. This was continued on the unit. The one change that was ultimately added to the standardization of equipment was to keep the obturator taped to the head of the bed to facilitate easier replacement of the tracheostomy tube in the instance of a displaced tube. In the past, the obturator had been discarded, leaving staff with no obturator available to replace the tracheostomy tube, or stuck with opening a new tracheostomy. Also, staff were educated that it is *always* necessary to pass a suction catheter after insertion of a tracheostomy tube, to ensure that the tube is in appropriate position within the airway. This was in response to one gentleman's dislodgement and the ultimate creation of a false passage when the tube was replaced. The patient did not have respiratory distress, leading whomever replaced the tracheostomy tube to believe that it was in correct position, and no suction catheter was passed to confirm. The stoma had permanently closed by the time staff realized that his tracheostomy tube was in the wrong place. Fortunately, no harm came to this gentleman.

The final intervention for this project was to educate nursing staff regarding artificial airways and how to appropriately respond to tracheostomy and airway emergencies. There was no education process that existed in the facility to teach nurses how to respond in the event of an airway emergency, and it was hoped that an education program would help decrease complications and help increase self-efficacy among nurses on the unit (see Appendix C for the teaching plan). A YouTube video was created regarding tracheostomies and laryngectomies and the differences among tracheostomy tubes on the unit. A pre-intervention survey was conducted on the unit, after which the nurses were instructed to watch the video. Then a face-to-face session was held with the nurses regarding emergency response to complications that may occur on the unit. Tracheostomy care, tracheostomy tube changes, and suctioning techniques were all

demonstrated with the nurses. A post-education survey was then conducted to determine whether nurses' knowledge and self-efficacy improved.

Study of the Interventions

One of the measured interventions with this project was the knowledge of nurses before and after the education session and video. The initial survey was a 33-item survey, with the first 15 questions linked to the nurse's opinion or experience regarding tracheostomies or laryngectomies. Questions 16 – 33 were knowledge-based questions. The second survey was a repeat of questions 16 – 33 and the addition of five final questions (See Appendix B). No psychometric testing was performed. It was hoped that nurses would be able to demonstrate improvement in their knowledge after going through a training course and watching a video that was tailored to the questionnaire. While nurses were questioned about self-efficacy, they were not extensively queried. Other studies had used a Likert Scale to help establish self-efficacy. This is helpful in that it allows the nurse to give a rating to her self-efficacy rather than just a true or false ("I am comfortable"). However, self-efficacy was not heavily tested with this questionnaire because it seemed obvious that in order to increase self-efficacy, one must practice. It was therefore felt that a single learning intervention alone would not be enough to increase self-efficacy, but education must be completed regularly. On the survey, there were a few questions pertaining to self-efficacy, "Do you feel that you are better prepared to deal with an emergency?" and "Do you feel more comfortable in dealing with tracheostomy patients?" These were yes/no questions given with the post-education survey.

Seven nurses took the pre-education survey. The average score was 8.86 points out of 18 or 49%. Three nurses completed the post-education assessment. The average score was 17.67 or 98%. Unfortunately, small sample size prevented the use of statistics to determine if there was a

statistically significant change in knowledge. There was, however, a considerable improvement in knowledge after the face to face education session and YouTube video. Of the three nurses that completed the post-education survey, two of them felt that the video and education session were helpful and that they were better prepared to respond to an airway emergency. They also believed that their self-efficacy had increased. The third nurse did not respond to the final five questions (she reported that she did not watch the video). One nurse suggested that the education sessions be continued and that a trach manikin be utilized for simulation.

The pre-implementation survey included several questions that were not included on the post-education survey (questions 1-15, see Appendix B). Questions and their answer distributions are noted:

Question	True	False	I don't know	No answer	Correct answer
Question 1: I have been trained in trach care	5	1	1	0	N/A
Question 2: I have been trained to respond to airway emergencies with trach patients	5	1	1	0	N/A
Question 3: I know how to assess for respiratory distress	7	0	0	0	N/A
Question 4: I have been in a code blue situation before	5	2	0	0	N/A
Question 5: I have been in a rapid response before	5	2	0	0	N/A
Question 6: I know how to clear a mucous plug	4	1	2	0	N/A
Question 7: I know how to change a tracheostomy tube	3	2	2	0	N/A
Question 8: I know the difference between a laryngectomy and tracheostomy	7	0	0	0	N/A
Question 9: I am comfortable with bag valve mask ventilation	6	0	1	0	N/A
Question 10: I am comfortable with bag-trach ventilation	6	1	0	0	N/A
Question 11: I am interested in further education regarding trach care	7	0	0	0	N/A
Question 12: I am interested in learning how to care for patients with an airway emergency	6	0	0	1	N/A
Question 13: Respiratory therapists should be solely responsible for trach care	1	6	0	0	N/A
Question 14: I know how to change an inner cannula	4	3	0	0	N/A

Question 15: I know how to suction a patient with a trach	7	0	0	0	N/A
Question 16: Trach care is provided twice a day and prn	6	0	0	1	TRUE
Question 17: Part of trach care is evaluating the stoma	6	0	0	1	TRUE
Question 18: Patients can use a PMV or cap with the cuff inflated	0	5	2	0	FALSE
Question 19: A Bivona TTS trach balloon is inflated with saline	1	3	3	0	FALSE
Question 20: A Shiley trach balloon is inflated with sterile water	2	2	3	0	FALSE
Question 21: A Portex trach balloon is inflated with sterile water	2	2	3	0	FALSE
Question 22: An 8 Shiley has the same dimensions as an 8 Portex1	1	1	5	0	FALSE
Question 23: The balloon of a Bivona TTS must be completely deflated for PMV use	3	0	4	0	TRUE
Question 24: The balloon of a Portex must be completely deflated for PMV use	3	4	0	0	TRUE
Question 25: The balloon of a Shiley must be completely deflated for PMV use	3	0	4	0	TRUE
Question 26: If a patient is in respiratory distress, one should try to bag them	3	2	2	0	TRUE
Question 27: The first thing to do for a patient in respiratory distress is take out the inner cannula	1	4	2	0	TRUE
Question 28: All trach tubes have a balloon	0	6	0	1	FALSE
Question 29: A patient who aspirates will have respiratory distress	5	2	0	0	FALSE
Question 30: A PMV is a valve that allows patients to talk	4	2	0	1	FALSE
Question 31: The trach balloon must be deflated to use a PMV or cap	6	0	1	0	FALSE
Question 32: Bagging a patient with the cuff down allow air to escape the mouth	2	1	4	0	TRUE
Question 33: Use the obturator to put the trach in the stoma	2	1	4	0	TRUE

The answers to questions 16 – 33 above were all correct for the three nurses taking the survey post-education session except for one question: One nurse answered that Question 21 was true rather than false. Hence, if there were larger numbers, it is most likely that a 49% score and a 98% score would be statistically significant. Obviously the nurses demonstrated knowledge improvement. They will need to practice their skills regularly to maintain their knowledge. Repeat testing could be undertaken in a few months to determine if they had retained what they had learned.

There is missing data in this study in the form of completed questionnaires. Every effort was made to collect all eight post-education surveys however, two travel nurses had moved to new contracts and two nurses were not available while repeat surveys were being collected. This left a disappointing three out of eight completed surveys. It is difficult then to determine if the three completing the survey are representative of the entire group. Obviously they had higher scores on the post-test, but it is undetermined whether the rest of the group would have scored as well. Two of those who completed the post-test were highly motivated to learn more about tracheostomies and laryngectomies, where the same enthusiasm had not been as high in others.

Measures

In order to measure the complication rate, it was first necessary to define a complication. A complication was defined as an accidental decannulation, episode of bleeding from the airway, creation of a false lumen, respiratory arrest, or an airway occlusion (mucous plug). To calculate complications, a rate was documented, defined as the number of complications per patient per day. This number was documented for each week and the data was utilized to create a control chart for the pre-implementation phase and another chart for the post-implementation phase so that comparison of rates could take place.

Analysis

Data analysis was performed by taking the complication rates and creating a control chart using JMP software. Next the raw number of complications was used to create a control chart to evaluate for differences. Complication rates were plotted on a weekly basis and analysis of pre-implementation rates were compared with post-implementation rates.

It was hoped that differences in groups could be analyzed as well, however, given that the total number of patients encountered during this project was only twenty, there weren't enough patients involved to analyze for statistically significant differences between groups. Similarly, it was hoped that a t-test could be utilized to analyze for differences between the pre- and post-education survey, but given the small numbers of nurses involved, statistics wouldn't be able to detect differences reliably.

Ethical considerations

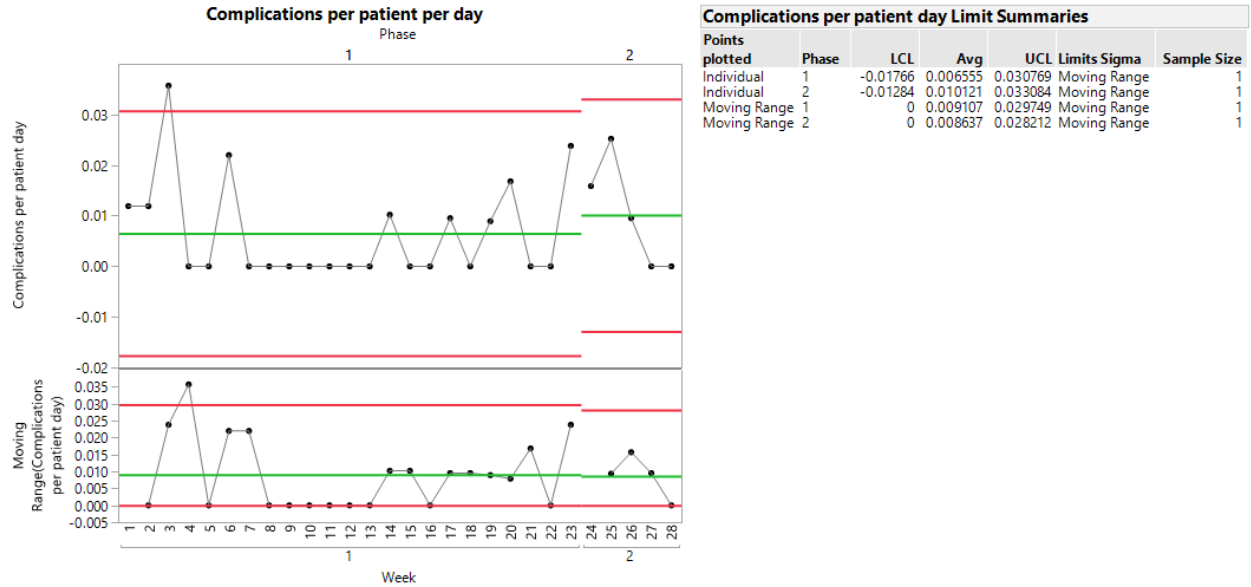
The approval of Institutional Review Board of Genesis Healthcare was granted for this quality improvement project. The project was also presented to the University of New Hampshire Nursing Quality Review Committee and received its approval as a quality improvement project, exempt from formal University of New Hampshire IRB review.

Results

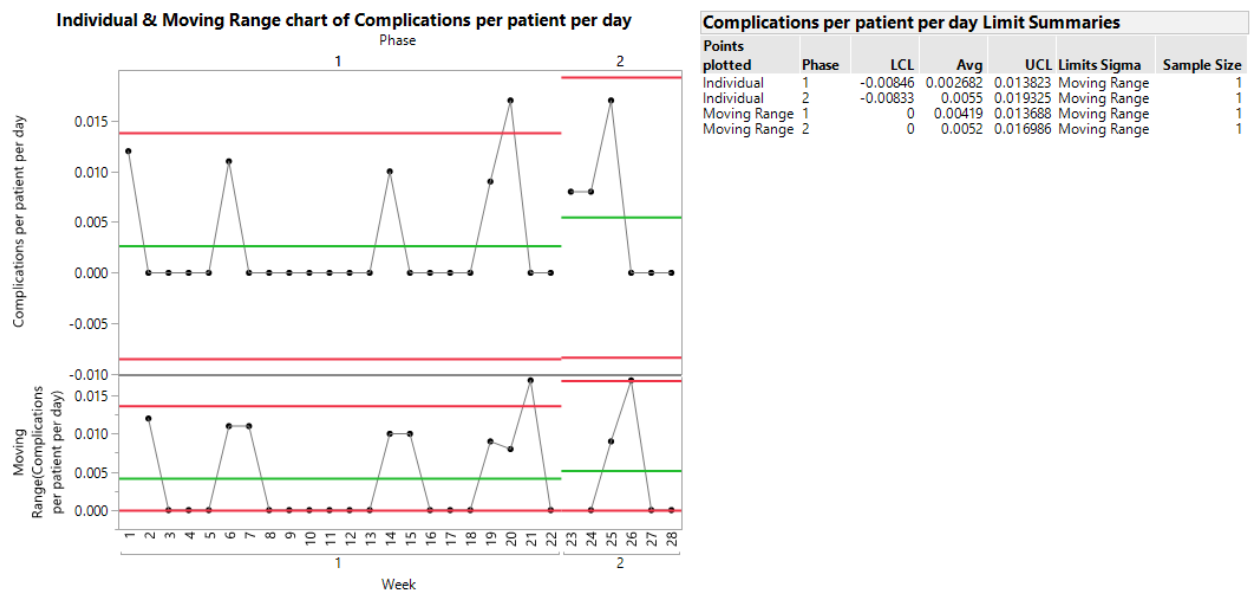
On the 25-bed long-term care ventilator unit, there were a total of 20 patients whose complications were tracked in the 28 weeks over which data collection occurred. There were 22 weeks of data collection pre-implementation and 6 weeks post implementation. There were 20 patients who were included in the data with the initial evaluation, then two patients were excluded from data analysis on secondary analysis because they were outliers. Of the 20 patients included in initial data analysis, 13 patients were men. Ages ranged from 21 to 73, six of those patients required use of a ventilator for at least part of the day. Of the two patients who were excluded, one was female, and one was male; one required use of the ventilator and one did not. Complications tracked were airway obstruction, tube dislodgement, bleeding, respiratory distress and respiratory arrest. There were 21 complications in 28 weeks of data collection. Nine complications were due to obstruction, four were due to dislodgement, six were due to bleeding,

three were due to respiratory distress, and four were due to respiratory arrest (note that some complications met more than one criterion and were therefore included in more than one category). Unfortunately, given the small scope of this project, statistical analysis by group isn't possible.

As noted above, complications for the tracheostomy and laryngectomy patients were recorded by the respiratory therapists in conjunction with the ventilator program manager. The log was evaluated daily and a solution was tried for every patient with a complication, i.e., patients who had a mucous plug had saline nebulizer treatments to see if it would thin out the secretions, or a heater was placed on their humidified aerosol mask. From the data gathered for each complication, a control chart was built to show the number of complications per patient per week. It had been hoped that there would be enough data that a comparison of those patients with complications to those patients without complications could take place. Unfortunately, because of short follow-up, there are not enough data points to truly determine whether rates of complications were different between the pre-implementation phase and the post-implementation phase. Below is the control chart comparing the two periods:



Again, not enough data points to make a sound conclusion regarding rates of complication. Two patients accounted for half of the complications. Patient #5 had six complications and patient #10 had five complications. These two patients were deemed as special cause variation and removed to gain an appreciation of common cause variation.



This control chart continues to show that the mean number of complications per patient per day was higher for the second phase of the project than the first. Unfortunately, there weren't enough weeks post-implementation to gather more data points to discern whether the third data point (week 25 spike noted on graph during phase 2) is special cause variation or normal variation. The data point at week 20 during phase one was deemed special cause variation by the statistical software. Week 20 was one in which the dry winter air was causing problems with mucous plugs for two different patients. Week 25 was similar. There were several patients on the unit who were having breathing difficulties that week. The newness of the complication tracking mechanism prevents staff from retrospectively analyzing years past, but it may help provide insight into seasonal variations into the future.

Missing data

While every effort was made to collect all complications, there is one patient on the unit who frequently decannulates herself due to dementia. Because this occurs frequently, staff quickly replace the tracheostomy tube; it's become so commonplace that staff don't recognize this as a complication. This problem has been occurring for a few years, although it has gotten worse recently with worsening of the dementia. This is one of the outlier patients that was excluded from analysis. It is suspected that several incidents were missed because decannulations have not been accurately recorded for this patient.

Discussion

Summary

The objective of this project was to determine whether five elements utilized by the Global Tracheostomy Collaborative could decrease the number of complications noted on the long-term ventilator unit. The elements implemented in this project were weekly bedside multidisciplinary rounds, staff training, increased patient and family involvement in care (with multidisciplinary rounds), maintaining the obturator at the head of the bed, and the use of data to help drive improvement efforts. Review of each intervention is noted below.

Multidisciplinary rounds were successfully taken to the bedside, but no satisfaction data was collected surrounding this intervention. Ultimately, the hope is to determine whether patient and family satisfaction improves with bedside rounds and more open lines of communication between the patient and the care team. Though there were some staff who were somewhat resistant regarding the change in rounds, most have been accepting of the change. Furthermore, the team is learning how to set limits with some patients' behaviors during rounds.

Nurse training went well. It would have been more easily facilitated if the training had been provided outside of their clinical time and appropriate manikins were utilized for simulation training. In a dedicated in-service time, the video could be watched as well. Unfortunately, nursing in-services outside of clinical time in the facility is an investment which is something that a facility surviving on shrinking Medicaid reimbursements has trouble supporting. In a dedicated in-service time, the video could be watched as well. Instead, training occurred quickly at the beginning or end of a shift or during a brief downtime. Most nurses had answered that they'd received care regarding tracheostomies, and indeed, most schools provide basic instruction regarding tracheostomies, but performing skills on a live person is a bit different than performing them on a manikin. It is helpful to learn in a realistic setting. Once they have learned the skill on a manikin they can then focus on real time feedback from the patient and the

educator and can fix their techniques. Nevertheless, nurses completing the second survey had positive comments about the experience. It was good to get some positive feedback, as it was felt that the nurses may not be receptive to the education, as many of them are uncomfortable with airway issues and were felt to defer airway issues to the respiratory therapists.

The intervention to begin maintaining the obturator at the head of the bed did not bring need for data collection, it was simply an intervention to attempt to facilitate easier reinsertion of a displaced tracheostomy tube. So far, its use has not been required, but hopefully staff will find this is a useful intervention. The need to pass a catheter after insertion of a tracheostomy tube will be reinforced frequently to ensure the safety of patients.

The project was able to successfully demonstrate that data collection can take place, though respiratory therapists had to be reminded to collect data, and which data to collect. It was helpful to convene a daily discussion between the respiratory therapists, nurses and ventilator program manager to determine if any events occurred that required recording or attention. A great deal of data regarding change in condition, outside of the definition of complications, was collected. While this data was helpful in tracking a patient's condition, and attempts could be made to prevent further deterioration, this data was not helpful to the project, and ultimately was discarded. Nevertheless, data was successfully collected by the respiratory therapists in collaboration with the ventilator program manager, proving that data collection could take place with periodic reminders to staff regarding the complications that are being analyzed for outcomes. Posting of complications data on the unit may be a helpful reminder to staff.

It was not possible with the small number of data points on the control chart to identify whether improvements were realized as a result of this project. Certainly, the project produced an increased awareness and reporting of events. Continued outcomes analysis is warranted, along

with continued documentation of different types of complications, so that eventually group analyses can be undertaken. Perhaps with continued analysis, one can determine if the increase in complications that were seen over the six weeks during the post-implementation phase were a seasonal variation, special cause variation, or related to a few special cause patients. Periodic reminders will be provided regarding which complication data is to be captured, and a control chart can be posted on the nursing unit that shows complications per patient per day. The GTC does have a standardized calculation for complications (per 1000 tracheostomy days), which could be utilized if comparisons are wanted in the future.

A consideration to make is that the GTC is centered in hospitals. There have been no published nursing home studies. A facility can purchase a membership into the GTC, and then outcomes and data can be tracked and plotted against those of other facilities. An opportunity to compare benchmarks might lead to some insights into why the complications listed above have not been reduced. As had been commented in the beginning of this paper, Bedwell et al., (2018), cited a 3.2% complication rate but did not give the definition of complication. It was assumed that the rate of complications would have been higher if decannulations and mucous plugs were added to their epidemiologic data. It is assumed that the present study's definition of complications is different, given that this small long-term ventilator unit had roughly 30% of its patients with a complication, when a complication was defined as noted above. This rate is comparable to what McGrath et al., (2017) has cited. If, instead, one were only to consider significant harm on the long-term ventilator unit, there are only four instances of complication, three if one counts those instances where a patient required transfer to a different level of care, and two of them occurred after implementation of the project. Therefore, complication rates would be quite similar, and each complication occurred in a different patient. That still would

equate to 20% of the patients having had a complication. It is difficult to make the numbers similar when comparing a tertiary care center or group of hospitals to a 25-bed long-term care unit. Additionally, resources and protocols are different when comparing a hospital to a nursing home, so while one can perform a comparison of rates, the comparison is really apples to oranges. This is a novel study performed in a nursing home environment. Nevertheless, all hope is not lost. Continued monitoring of complication rates and continued attempts at increasing the quality of care provided to patients on the unit can lead to improved outcomes as long as there is a push toward evidence-based care and continuous iterations along the continuous quality improvement practice model.

Strengths of the project are that it has created a stronger team that is ready to improve the lives of the patients that are being served on the unit. It helped the staff feel valued and saw some of them really embrace the idea of continued education regarding tracheostomies and ventilators. It made others aware that patient outcomes are often in the hands of the staff caring for them. It motivated the aides on the floor to begin to learn about tracheostomies and ventilators as well. It helped the patients understand that staff was interested in their thoughts and concerns regarding their care.

Interpretation

It would be interesting to know if the interventions truly had any bearing on the outcomes of this project. Most likely, more time is required for staff to become more adept at the new processes. It is likely that bedside mentoring may also impact the care provided to the patients. The key is that continued monitoring and further iterations around the plan-do-study-act cycle should be undertaken until there are several points of data post-implementation to provide a

better baseline. Further data calculations can be made to factor staffing levels into the complication rate to determine if these influence mean complication rates.

Limitations

There were several limitations to the project. Regarding the survey, it is necessary to state that the survey test questions were not subjected to psychometric scrutiny. Also, self-efficacy questions would have provided more information if a Likert scale were used to help nurses rate their self-efficacy. This would have given a better picture of whether self-efficacy improved. Also, question 8, “I know the difference between a tracheostomy and laryngectomy,” is a true/false question, but it doesn’t test whether the nurse’s knowledge is correct. Nurses may have answered this question without truly knowing the answer. More time spent on creating a better questionnaire would have helped provide better insight into the education process and whether it improved self-efficacy and knowledge. Even so, there is always the possibility that the nurses may have been prompted to do extra reading and research on their own, and that their knowledge improvement is a result of their own research, rather than that of the education provided by this project. During the data analysis phase of the project, it was noted that one nurse missed only four out of 18 questions, then on the second page she commented that she had to look up many of the answers and asked the respiratory therapist that was working that night, even though they were specifically asked not to do this. So, it is expected that the average score on the pre-education survey would have been lower. Given that one nurse has done this, it is likely that other nurses may have done the same.

The video was only 14 minutes long, and it was placed on YouTube to make it easily accessible so nurses could watch it at home. Nevertheless, several nurses commented that they had not watched the video. One of the nurses who completed the post-education survey

commented that she was unable to find the YouTube video. The PowerPoint used to create the video was printed out and placed on the unit for nurses' reference as well, though copies of the PowerPoint have disappeared from the nurses' station, making it impossible for nurses to have a quick-reference available.

Another limitation is the time constraint for this project. If it had been implemented earlier, there would be more post-implementation data to evaluate and there would be a better picture of complication rates post-implementation. Currently there are only six weeks of post-implementation data, making it difficult to tell if the complication rate would have decreased over time. Continued monitoring is warranted.

Conclusions

The goal of this quality improvement project was to decrease airway complications using staff education measures and standardization of care. While nurses demonstrated an improvement in knowledge related to the education session and video provided, short-term follow up of complication rates has failed to demonstrate improvement. Nevertheless, the long-term care ventilator unit has seen positive changes including the better education of nurses regarding response to airway emergency and increased patient and family engagement. Continued monitoring of complication rates is warranted to determine if there were special factors at play in the post-intervention complications. If nothing else, the project has taught the primary author a great deal about quality improvement, and the next quality improvement project undertaken will have a better design.

The project itself has been very useful in helping the nurses feel valued and that their education is important. It has helped show that the nurses are, indeed, receptive to education and

new concepts regarding the care of this complex group of patients. In a discussion between the unit nurse manager and the ventilator program manager, there is great interest in continuing these short education sessions to help augment nursing knowledge. Usefulness has also been noted for the multidisciplinary care team in moving the rounds to the bedside. Direct engagement and discussion with the patients themselves help patients feel that their concerns are being addressed in a timely fashion, and that the team is concerned for their welfare. The next step is to measure patient satisfaction with bedside rounds, and to get their opinions on how we can improve.

It is felt that the interventions noted above are sustainable if the team continues to embrace the change. It is realized that periodic reminders to respiratory staff regarding what data is being collected will be useful to data analysis. Additionally, posting of the rates of complications may provide more motivation for the team to continue their work. The ventilator program manager and nurse manager will need to spend more time together planning the education interventions that will continue for the nurses. Education should also expand to the aides, including the medication assistants, so that all feel prepared to respond appropriately in an emergency. In time, the staff will adjust to changes in protocols and practices. Changes in practice are certainly supported by the facility's administrative team.

Other ventilator units may find this work useful. Certainly, it is very important to have an education program for nurses to learn about artificial airways, and it is assumed that most units have a program for education. There is no standardized education program for Genesis ventilator facilities. Perhaps there should be a standard education platform that is evidence-based that could be developed and used at all facilities. This would be limited if each facility uses a different type of ventilator, but a basic education plan can be addressed and applied to the orientation of new nurses and the continuing education of the existing nurses. While the outcomes of this project

have not shown immediate improvement using the interventions outlined, continued monitoring is warranted, and perhaps a decrease in rates will be seen in time. Again, there may be other factors at play in the complication rates seen immediately post-intervention. Only continued monitoring will be helpful in discerning whether there is special cause variation affecting the results.

While we can define quality of care many ways, such as better patient satisfaction, decreased complication rates, and increased nurse knowledge, how quality of care is defined is up to the institutions and accrediting bodies. One can ask whether quality of care has improved with this project. While patient satisfaction with bedside rounds has not been measured, patient concerns are being addressed in a more open manner. Also, with daily discussions regarding complications and changes in patient condition, the team is attempting to prevent complications and has been more active in utilizing evidence-based guidelines and methods for patient care. For example, one patient was insisting that he be decannulated, but he was not adequately able to manage his secretions, a sign that decannulation should not be attempted. Evidence was consulted and discussed with the patient. There was difficulty reasoning with this gentleman and he had expressed some dissatisfaction with his care, the team realized that his concerns were not actively being addressed, prompting the realization that evidence-based care is important, and should be discussed with patients frequently, especially the reasons that the patient cannot be decannulated, or reasons they should have a modified diet, or that they should not be started on swallowing trials, as eating tends to be a large component of quality of life in tracheostomy and laryngectomy patients. The team sees that attempts to address quality of life concerns, discharge plans, reasons for not decannulating, reasons for not completely weaning off a ventilator are very important and do increase quality of care. In this case, quality of care can equate on some level to

quality of life and satisfaction. How well the team assists the patient and family to understand the disease process and the expectations for disease progression and the resultant plan of care, the happier patients are. That is the reason for bedside rounds. Implications for practice are to continue open lines of communication with patients, families and with their primary care team so that everyone can collectively make suitable decisions. With future iterations of this project, better attempts will be made to communicate with the guardians, as this was not well-addressed in the initial iteration of the project.

Additional long-term care studies addressing all five GTC criteria for tracheostomy and laryngectomy patients are warranted. It would help to have some criteria for long-term care. While many tracheostomy patients can be maintained at home, those who reside in the nursing home are a typically a fragile group of patients without adequate resources to provide for their care at home. Perhaps the increase in complications is related to patient complexity and fragility rather than to poor care. A large pool of many long-term care centers implementing the same interventions would be helpful in determining what factors make a statistically significant difference in complication rates for patients.

It is suggested for future study that a multicenter long-term care project be undertaken to increase the number of program participants so that statistical analysis can be performed. While this study is a small study, certain changes can be made to this project to improve outcomes for a larger study, such as performing initial patient satisfaction studies and psychometrically testing a better version of the pre- and post-education assessment. A definition of quality of care, with appropriate measures can be developed to determine if, indeed, the five steps implemented here improve quality of care.

Other Information

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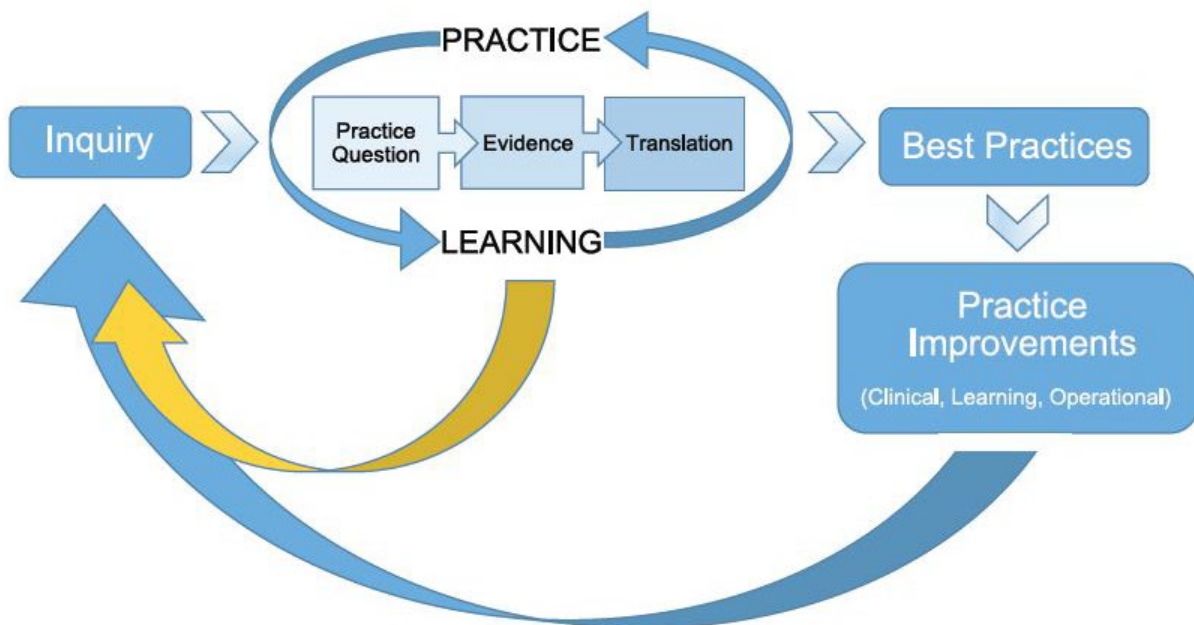
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APPENDIX A

The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model is a powerful problem-solving approach to clinical decision-making and is accompanied by user-friendly tools to guide individual or group use. It is designed specifically to meet the needs of the practicing nurse and uses a three-step process called PET: practice question, evidence, and translation. The goal of the model is to ensure that the latest research findings and best practices are quickly and appropriately incorporated into patient care.



APPENDIX B

Tracheostomy and airway emergency evaluation

	T = True	F = False	IDK = I don't know			
1. I have been trained in trach care.....	T	F	IDK			
2. I have been trained to respond to airway emergencies with trach patients.	T	F	IDK			
3. I know how to assess for respiratory distress.....	T	F	IDK			
4. I have been in a code blue situation before.....	T	F	IDK			
5. I have been in a rapid response before.....	T	F	IDK			
6. I know how to clear a mucous plug.....	T	F	IDK			
7. I know how to change a tracheostomy tube.....	T	F	IDK			
8. I know the difference between a laryngectomy and tracheostomy.....	T	F	IDK			
9. I am comfortable with bag valve mask ventilation.....	T	F	IDK			
10. I am comfortable with bag-trach ventilation.....	T	F	IDK			
11. I am interested in further education regarding trach care.....	T	F	IDK			
12. I am interested in learning how to care for patients with an airway emergency	T	F	IDK			
13. Respiratory therapists should be solely responsible for the tracheostomy care	T	F	IDK			
14. I know how to change an inner cannula.	T	F	IDK			
15. I know how to suction a patient with a trach.....	T	F	IDK			
16. Trach care is provided twice a day and prn.....	T	F	IDK			
17. Part of trach care is evaluating the stoma.....	T	F	IDK			
18. Patients can use a PMV or cap with the cuff inflated.....	T	F	IDK			
19. A Bivona TTS trach balloon is inflated with saline.....	T	F	IDK			
20. A Shiley trach balloon is inflated with sterile water.....	T	F	IDK			
21. A Portex trach balloon is inflated with sterile water.....	T	F	IDK			
22. An 8 Shiley has the same dimensions as an 8 Portex.....	T	F	IDK			
23. The balloon of a Bivona TTS must be completely deflated for PMV use...T	T	F	IDK			
24. The balloon of a Portex must be completely deflated for PMV use.....T	T	F	IDK			
25. The balloon of a Shiley must be completely deflated for PMV use.....T	T	F	IDK			
26. If a patient is in respiratory distress one should try to bag them.....T	T	F	IDK			
27. The first thing to do for a trach patient in respiratory distress is take out the inner cannula.....	T	F	IDK			
28. All trach tubes have a balloon.....	T	F	IDK			
29. A patient who aspirates will have respiratory distress.....	T	F	IDK			
30. A PMV is a valve that allows patients to talk.....	T	F	IDK			
31. The trach balloon must be deflated to use a PMV or cap.....	T	F	IDK			
32. Bagging a patient with the cuff down allows air to escape from the mouth	T	F	IDK			
33. Use the obturator to put the trach in the stoma.....	T	F	IDK			

1. Do you feel that the educational videos were helpful? Y N
2. Do you feel that the simulation session was helpful? Y N
3. Do you feel that you are better prepared to deal with an airway emergency? Y N
4. Do you feel more comfortable in dealing with tracheostomy patients? Y N
5. Do you have additional educational needs or suggestions for future education (please elaborate below)?

Appendix C

Objectives	Content	Materials and Methods	Evaluation Method
<ol style="list-style-type: none"> 1. Identify differences in tracheostomy tubes 2. Demonstrate how to change a trach 3. Demonstrate appropriate bag ventilation 4. Demonstrate how to change inner cannula 5. Demonstrate appropriate suctioning technique 6. Identify physical signs of respiratory distress 7. Identify appropriate interventions for someone with respiratory distress. 	<ol style="list-style-type: none"> 1. Different trachs on the unit <ol style="list-style-type: none"> a. Portex b. Bivona c. Shiley standard and XLT p & d d. Cuffed/differences in cuffs e. Uncuffed 2. How to change a trach 3. How to perform bag ventilation 4. How to change the inner cannula 5. How to suction 6. How to determine if someone is in respiratory distress <ol style="list-style-type: none"> a. Tachypnea b. Accessory muscle use c. Stridor d. Tripod e. Poor skin color f. Appears restless or agitated g. 7. How to treat someone with respiratory distress <ol style="list-style-type: none"> a. Call for help b. Listen to lung sounds c. Check for appropriate trach placement d. Check sats e. Remove inner cannula and look for plug. f. Suction. g. Bag h. Turn up oxygen. 	<p>Video Simulation/Demonstration</p>	<p>Pre-/Post-education survey</p>