DNP Practice Scholarship

"Reduction of Unplanned Extubations in the Neonatal Intensive Care Unit"

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Abstract

Objective

Unplanned extubations (UE) are a preventable adverse event which occurs when intubated patients have their endotracheal tubes (ETT) accidentally dislodged from their airway. The method of securing the ETT has been identified as the most common reason for unplanned extubations (Veldman et al., 2006). The purpose of this project was to decrease the rate of UEs in the neonatal intensive care unit from 4.9 UEs per 100 ventilator days to less than two UEs per 100 ventilator days by implementing a standard method of securing the endotracheal tube with a securement device.

Methods

This was a prospective, controlled research design to compare outcomes for two groups. Data was collected in two phases; pre and post intervention. The population of interest was all staff within the Newborn Center. Data was collected on all intubated patients in the Newborn Center, Pavilion for Women NICU and West Tower NICU; over eight months looked to examine the rate of unplanned extubations. Data collected included gestational age, day of life at time of unplanned extubation, and weight at time of unplanned extubation. The intervention consisted of education followed by return demonstration on all staff within the Newborn Center and a standard method of securing the ETT with NeoBar™ as a securement device was implemented.

Results

A total of 418 patients were intubated during the project’s timeframe with 5,271 ventilator days. Control group had 81 unplanned extubations for a rate of 3.2 UEs per 100 ventilator days and experimental group had 88 unplanned extubations for a rate of 3.3 UEs per 100 ventilator days. There was no statistical difference in the rate of UEs,
gestational age, and weight between groups. While there was no statistical difference for the Newborn Center or for the West Tower NICU there were supportive changes in the Pavilion for NICU. There was a 34% decrease in the rate of unplanned extubations in the intubated neonates within the Pavilion for Women NICU. A statistical difference in the day of life at extubation with an increase in the age at time of UE from 12 days to 21 days ($p = 0.03$) in neonates with gestational age between 24-25 weeks control and experimental groups in the Pavilion for Women NICU only.

**Conclusions**

The results of this study indicate a clinically significant decrease in the rate of UEs after nurses were trained to use the securement device and it became the standard of care during the final phase of this study. In the smaller gestational neonates there was a trend downwards in the overall rate of UEs along with a statistically significant ($p=0.03$) increase in the day of life for an initial UEs. NeoBar™ does appear to decrease the rate of UEs in the smaller gestational neonates. In the larger neonates, another option needs to be available for the neonates who are in between available sizes for the NeoBar™.
Research Proposal

The Scholarship project looked at the current rate of unplanned extubations (UE) in the Newborn Center at Texas Children's Hospital. After reviewing current practice, an intervention regarding the method of securement for endotracheal tubes (ETT) was studied. The goal was to see if the overall rate of UEs could be decreased by a single implementation of a consistent method of ETT securement utilizing a commercially produced securement device specifically made for the neonatal population.

Introduction

In the neonatal intensive care unit (NICU) neonates are intubated with endotracheal tubes and placed on mechanical ventilation for multiple reasons which include respiratory distress, congenital anomalies, and prematurity. Accidental or unplanned extubations are defined as the unanticipated dislodgement of the endotracheal tube (ETT) in an intubated patient (Sadowski et al., 2004). Poor securement of the ETT is the leading reason for UEs in neonates (Veldman et al., 2006). Child Health Corporation of America (CHCA) identifies UEs as an adverse event; 40% of events are characterized as preventable (Sharek et al., 2006).

The consequences of adverse events can be mild and limited or severe with long-reaching implications for the neonate’s future healthcare. UEs can lead to substantial morbidity and mortality in neonates already at risk for harm related to intubation as part of their medical treatment (Loughead et al., 2008). Morbidity associated with mechanical ventilation can be immediate or occur over time and may include an increase in baseline oxygenation, hypoxemia, increased length of time on mechanical ventilation, bronchopulmonary dysplasia, and increased length of stay.
(Elverson & Samra, 2012; Ream et al., 2007; Veldman et al., 2006). Carvalho et al. (2010) noted a 3% risk of accidental extubation for each day the patient stayed on mechanical ventilation.

Review of the literature showed a limited amount of studies available regarding a standardized method of ETT securement for neonates. There was a paucity of studies available that reported a significantly reduced risk of UEs when a securement device for keeping ETTs in place was implemented. (Conley, 1989; Cussell et al., 1974; DeJonge & White, 1998; Loughead et al, 2008). A systemic review for UEs by Da Silva et al. (2013) reported the extubation rate ranging from 0.14 – 5.3 extubations per 100 ventilator days in the NICU. In 2012, the Vermont Oxford Network collaborative showed four NICUs with UE rates greater than four per 100 ventilator days were able to decrease their overall rates by implementing a standardized method of securing ETTs (Deakins, Smucny, & Nock, 2012; Janet Weiss Children’s Hospital, 2012; Merkel et al., 2012; Pavlichko et al., 2012). Unfortunately, no standard rate for UEs has been published for neonates. However, a recognized standard for pediatrics is <1 extubation per 100 ventilator days (da Silva & Carvalho, 2010).

In 2013, the UE rate in the Newborn Center at Texas Children’s Hospital was 4.9 per 100 ventilator days; well above any recognized standard. Also noted was a variety of methods for securing the ETT; reported by Veldman et al. (2006) contributed to the rate of UEs. Based on available research, a securement device was selected as the standardized method of securement.
Project Problem or Research Question

At Texas Children’s Hospital, neonates in the Newborn Center experienced an unacceptable rate of 4.9 UEs per 100 ventilator days, well above the accepted standard of less than two UEs per 100 ventilator days. During this period of time, there was a lack of consistency in securing the ETTs which, based on the evidence, may have contributed to the rate of unplanned extubations. While there was supposed to be a standard method of securement, intubated neonates exhibited a variety of securement methods. While the way an ETT was taped was standard, the type of tape varied between brown tape, white tape, and silk tape. Research question: How did a commercially produced ETT securement device compare to only tape to secure the ETT affect the number of UEs in neonates requiring intubation?

Review of literature

Neonates admitted to the NICU are at risk of requiring endotracheal intubation due to prematurity, respiratory distress, and multiple congenital anomalies. All intubated neonates run the risk of experiencing an UE. The longer a neonate is intubated the higher the risk of an UE (Carvalho et al., 2010). Poor securement of the ETT remained the most common cause of UEs followed by staff handling of the patient and patient movement or agitation (da Silva et al., 2013; Veldman et al., 2006). In a review by da Silva et al., (2013), the rate for neonates experiencing an accidental or UE ranged from 0.14 – 5.3 extubations per 100 ventilator days. While published standards for rates of UEs for adults and pediatric patients existed, no published standard for the rate of UEs for neonates was identified. Current reports indicate that for the pediatric population, the acceptable rate of extubation is less than one event per 100 ventilator
days (da Silva & Carvalho, 2010). The Vermont Oxford Network (VON;[2011]) supported a collaborative initiative around unplanned extubations in four NICUs across the United States. The results from the participating NICUs helped set the current standard for neonatal UEs at less than two UEs per 100 ventilator days (unpublished data; Deakins, Smucny, & Nock, 2012; Janet Weis Children's Hospital, 2012; Merkel et al., 2012; Pavlichko et al., 2012; VON, 2013).

The risks from UEs were well documented. Risks included short term and long term morbidity and mortality. Short term morbidities included hypercarbia, hypoxemia, and increased intracranial pressure. Long term morbidities consisted of the extended need for mechanical ventilation, increased length of stay, increased risk of nosocomial infections, bronchopulmonary dysplasia, subglottic stenosis, cardiopulmonary resuscitation, increased risk of mortality, intraventricular hemorrhage, laryngeal or tracheal injury, and increased risk of mortality (Carvalho et al., 2010; da Silva et al., 2013; Klugman et al., 2013; Loughead et al., 2008; Manica et al., 2013; Sandowski et al., 2004; Stroustrup & Trasande, 2010).

A review of the literature on UEs revealed there were numerous articles for all intubated populations, including neonates. However, articles pertaining to prevention strategies for UEs in the neonatal population were limited. Even more limited were the research studies conducted on a standardized method for securing ETT in neonates. Several articles noted lack of consistent securement methods, patient movement, and staff interaction with patients as causes for UEs (Carvalho et al., 2010; da Silva et al., 2013; Klugman et al., 2013; Veldman et al., 2006). In a systematic review, Da Silva et al. (2013) reported UEs in the neonatal population. The review reported prevention,
outcomes, incidence, and risk factors and concluded there was a lack of randomized controlled trials and few studies on strategies to prevent UEs.

Various articles discussed the different way to secure the ETT; however, only a limited number of articles considered at how the ETT was secured. One of the first articles to review the securement device as a method of taping the ETT was Cussel, Levy, and Thompson in 1974. The authors discussed the utilization of a modified umbilical cord clamp for taping ETT in neonates. This method as well as using tape only to secure the ETT was employed in the 1970’s and 1980’s. Brown (1988) published one of the first research studies addressing the different methods of securing the ETT; concluding one method was not statistically significantly over another. Laughead et al. (2008) also looked at standardizing the method of taping the ETT with no statistical difference noted in the two methods they chose, Y method and H method. Wiener, Heimall, and Chuo (2011) presented their unpublished research study which also looked at different taping methods, Y method and H method, and showed no statistical difference between the two taping methods.

Conley’s thesis study in 1989 was one of the first studies to compare a securement device against a standard taping method for decreasing UEs. She concluded a statistical significance of 0.01 (p value) existed for UEs in neonates whose ETTs were taped incorporating a securement device. Two other studies incorporated a modified umbilical clamp as their securement device; DeJonge and White (1998) and Laughead et al. (2008). Both studies reported when a modified securement device was used to secure the ETT, a significant reduction in UEs occurred (p value <= 0.001). In the study by DeJonge and White (1998), their rate of accidental extubations declined
from 3.2 events to 1.8 events per 100 ventilator days while Loughead et al. (2008) demonstrated an overall rate for UEs of 0.7 events per 100 ventilator days.

Commercially available securement devices also had very limited research available. Volsko and Chatburn (1997) presented a research article pertaining to utilization of the Logan Bow as a securement device for ETTs with a statistical reduction in unplanned \( (p \text{ value} < 0.0001) \) when compared to only tape for securement of the ETT. Brinsmead and Davis (2010) published a retrospective study comparing tape versus NeoBar™ for ETT positioning with no statistical difference noted between methods for ETT placement as verified by x-ray. The literature review showed only two securement devices produced commercially, the Logan Bow and NeoBar™. Of note were other devices commercially produced, NEO-fit™ and Rottenrow, with no published articles found. While some NICUs do use the Logan Bow to secure their ETTs, this device was originally created to help secure ETTs for neonates undergoing cleft palate and cleft lip repairs and is not widely used as a securement device. The Rottenrow was a device reportedly used in Scotland and England but not within the United States (Kerr, 1983). The Logan Bow was created to help secure ETTs for infants with cleft lip and palate repairs that remained intubated after surgical repair and was adapted for other intubated neonates.

**Project Framework**

The IOWA model of evidence-based practice provided the best framework for this research proposal. This model integrated repeated cycles of problem-focused initiatives with a feedback loop that stimulated quality outcomes (Melnyk & Fineout-Overholt, 2011; Titler et al., 2001). The IOWA model helped determine which triggers
were of importance, problem or knowledge. In the case of UEs there were both problem and knowledge focused triggers. The problem focused triggers included internal and external benchmarking date, identification of a clinical problem, and process improvement data. The knowledge focused triggers included philosophies of care and national standards of care. A literature review showed there was evidence to support the implementation of a consistent method of securing the ETT with a securement device (Conley, 1989; DeJonge & White, 1998; Loughead et al., 2008). The next step in the IOWA model incorporated a pilot intervention for a change in practice which was the introduction of the securement device as the standardized method of securing the ETT. Once the project was implemented, data was collected and evaluated and a decision to permanently adopt a change occurred. The last step is the dissemination of results to the staff at Texas Children’s Hospital.

**Project Objectives**

The main objective for this project was to decrease the overall rate of unplanned extubations in the NICU to less than two per 100 ventilator days. Secondary objectives were to standardize the securement device for intubated patients and provide education to all staff within the Newborn center.

**Project Design**

This was a prospective, controlled, quasi-experimental design. The independent variable was training the nurses to use the securement device and the dependent variable was the rate of UEs. The data were reported in events per 100 ventilator days (Loughead et al., 2008). Data collection came from chart reviews, UEs worksheets, and
safety scoops. Safety scoop is the current adverse event reporting system at Texas Children's Hospital. Current data was collected on all neonates intubated in the Newborn Center, including all artificially maintained airways with an ETT or a tracheostomy tube. The patients with a tracheostomy tube were excluded from reporting to be consistent with previous studies on UEs. See Appendix B for design study diagram.

**Population and Sampling Plan**

The population of study for this project was the nurses caring for the neonates requiring intubation for mechanical ventilation who were admitted to the Texas Children's Hospital Newborn Center. The sampling plan was one of convenience. It consisted of all RNs employed in the Newborn Center. The intervention consisted of staff education which included usage of the NeoBar™ as the only securement device for ETTs, a return demonstration on the application of the NeoBar™, and reinforcement of OG placement not secured to the NeoBar™. All staff including nurses, respiratory therapist, nurse practitioners and physicians was provided with the educational materials (Appendix C – G).

**Timeframe**

The project timeframe lasted approximately 10 months. The project planning included a review of literature, project design, and Internal Review Board (IRB) approval which lasted approximately four months, January through April 2014. Based on the nature of this study, it was determined IRB approval was not needed for this project. However, based on intent to publish, IRB approval from Texas Children's Hospital was
obtained. Data collection encompassed eight months. Control group data was collected from January 1\textsuperscript{st}, 2014 through April 30\textsuperscript{st}, 2014. Education of staff occurred in March and April which was separated out for potential contaminated data. It took approximately six weeks to educate the entire staff on the NeoBar\textsuperscript{TM}. Staff was able to switch to the securement device at any time but on May 1\textsuperscript{st}, 2014, a securement device was required for all intubated patients. Experimental group data was collected May 1\textsuperscript{st}, 2014 through August 31\textsuperscript{st}, 2014. Data analysis occurred in September and October 2014. Submission of completed project was November 2014 with final presentation in December 2014.

**Measurement methods**

The measurement methods for UEs included code sheets, UE worksheets, safety scoops, and chart reviews. Code sheets were completed for every intubation in the Newborn nursery. The UE worksheet was completed after each UE with a phone call to the Assistant Director on call. A safety scoop was required for each adverse event including any potential near miss events. Chart audits were completed weekly on all intubated patients to review documentation for procedure notes on intubation events, obtain gestational age, and day of life and weight at time of unplanned extubation. The daily RN charge sheets were reviewed monthly to capture the total number of patients intubated in the Newborn Center during the project.

**Data Collection Plan**

The data collection plan included gestational age at birth, day of life (DOL) and weight at time of UE, number of patients intubated, number of UEs, number of ventilator
days, and method of ETT securement. Data was reported in number of events per 100 ventilator days. An Excel™ spreadsheet was created to keep track of information and to run data analysis (see Appendix E). Data was collected retrospectively to establish the current rate of UEs prior to implementation of the independent variable; standard securement devices to secure the ETTs in intubated neonates. Data was collected prospectively after implementation of securement device.

**Data analysis plan**

The data analysis plan compared the difference in UE rates before and after a standard securement device was implemented to secure the ETT. An independent t-test was used to determine if a statistical difference existed in the gestational age, day of life at UE, weight at time of UE, and rate of UE events when a single, consistent method of securing the ETT was implemented. The UE data included the overall number of patients intubated, as well as the total number of ventilator days, and the number of UEs. The statistical significance of the project was expected if $p$ value was less than or equal to 0.05; this was in comparison to statistical significance established in previous studies.

**Project Limitations**

During and after the project some limitations were identified. These limitations included combining the two units into a single population, too few numbers to prove statistical significance for the Pavilion for Women NICU, NeoBar™ sizes, census and staffing, and the introduction of tracheostomy guidelines. A major limitation was combining all intubated patients in the Newborn Center. The data showed the two units
within the Newborn Center, West Tower NICU and Pavilion for Women NICU, had distinct demographic populations which needed to be compared separately and not as a single group. This led to the second major limitation; the Pavilion for Women NICU had a lower total number of intubated patients but needed a larger number in order to reach statistical significance of 0.05.

Another limiting factor was the NeoBar™ and the limited number of sizes available for larger neonates. The lack of different sizes for larger infants prompted the usage of tape to secure the ETT with certain patients in West Tower. The NeoBar™ had several incremental options for the smaller neonates which was not available for larger intubated patients. Census and staffing caused another limitation to be identified. Overall staffing in the Newborn Center was increased with the rise in average daily census during the post intervention phase. While this was an anticipated problem, the overall acuity and higher number of patients was more than expected during July and August. This led to staff working in the unit who did not participate in the education the regular staff received in March and April. While some of the staff may have had previous experience with using NeoBar™, their training could not be verified prior to caring for any intubated patients.

The introduction of tracheostomy guidelines in March 2014 limited participation of older intubated patients in this project. With the implementation of these guidelines, patients who remained intubated at 40 weeks gestation age or older and continued to require mechanical ventilation after one month of age were to consider transitioning to a tracheostomy tube to maintain an airway for continued mechanical ventilation. This led to an overall increase of 250% in tracheostomy patients by August 2014. While these
guidelines did not affect the smaller neonates the Pavilion for Women NICU, it did have an impact on the number of patients intubated in the West Tower NICU. In the control phase the average number of tracheotomy patients was two. After the guidelines were implemented in March 2014, the number of tracheostomy patients continued to grow with 14 patients during the last month of the experimental phase. The total number of ventilator days from these patients was 1,540 days which would have impacted the overall rate of UE.

**Results/Findings**

The study started in January 2014 and completed in August 2014. All intubated patients within the Newborn Center were included. The Newborn Center is comprised of two NICUs; Pavilion for Women NICU and West Tower NICU provided care for patients requiring intubation. The study was divided into two phases; control group phase and experimental group phase. There were a total of 200 patients intubated during the control group phase and 218 patients during experimental group phase. The division of patients was similar in Pavilion for Women NICU and West Tower NICU. Pavilion for Women NICU had 40 patients intubated during the control group phase and 58 patients intubated during the experimental group phase. West Tower NICU had 160 patients intubated control group phase and 160 patients experimental group phase (Table 1).

The demographics for the study looked at gestational age, day of life (DOL) for UE, and weight (Table 2). Control group demographics for the Newborn Center showed the gestational age ranged from 23 5/7 weeks to 40 weeks with a mean gestational age of 28.7 weeks. DOL ranged from zero to 160 days with a mean of 49 days. Weigh
ranged from 485 grams to 4,900 grams with a mean of 2,258 grams. Experimental group gestational age ranged from 23 5/7 weeks to 40 6/7 weeks with a mean of 29.2 weeks. DOL ranged from zero to 133 days with a mean of 50.1 days. Weight ranged from 515 grams to 4,800 grams with a mean of 2,286 grams. Breakdown of demographics between the Pavilion for Women NICU and West Tower NICU showed similar results with no statistical significance noted except for the DOL for unplanned extubation in the Pavilion for Women. The mean DOL for UE lengthened from 13 days to 21 days ($p = 0.03$, 95% CI = -15.53 to -0.63). There was also a difference in the means for weight between the Pavilion for Women NICU and West Tower NICU. The mean weight for neonates in the Pavilion for Women NICU was 922 grams in the control group and 834 grams in the experimental group. The mean weight for neonates in the West Tower NICU was 2,587 grams for the control group and 2,686 grams the experimental group (Table 2).

The study intervention was the standardization of a securement device for all intubated patients. Prior to this implementation, there were two methods, NeoBar™ and tape. The tape included two different types, brown and white. For the purposes of this study, tape was considered as one method, regardless of the type of tape used to secure the ETT. Methods for securing ETTs were NeoBar™ and tape (Table 3). The control group had 70% secured with NeoBar™ and 30.8% secured with tape. The experimental group had 79.5% secured with NeoBar™ and 21.5% secured with tape. Pavilion for Women NICU had 99% of endotracheal tubes secured with NeoBar™ pre and post intervention while West Tower NICU had 63.6% pre-intervention and 74.2% post intervention, an increase in 10.6%.
The extubation rates were compared between the Newborn Center combined as well as each unit, West Tower NICU and Pavilion for Women NICU (Table 4). The Newborn Center control group rate for UEs was 3.2 events per 100 ventilator days; 81 UEs during 2606 ventilator days. Experimental group rate was 3.3 events per 100 ventilator days; 88 UEs during 2665 ventilator days. There was no change in the rate of UEs between the control and experimental group. Pavilion for Women control group UE rate was 5.6 events per 100 ventilator days; 16 UEs during 283 ventilator days (Table 4). Experimental group rate was 3.7 events per 100 ventilator days; 19 UEs during 510 ventilator days. This was a 34% decrease in the rate of UEs in the experimental group. West Tower control group UE rate was 2.9 UEs per 100 ventilator days; 66 events during 2323 ventilator days. Experimental group UE rate was 3.2 events per 100 ventilator days; 70 UEs during 2155 ventilator days. There was a 10% increase in the rate of UEs in the experimental group.

Discussion

The goal of this project was to decrease the overall rate of UEs in the Newborn Center. No change in the rate of UEs was noted in the Newborn Center but differences between the control and experimental groups were noted in each NICU. A 34% decrease in the UE rate for the Pavilion for Women NICU occurred while an increase of 10% in the UE rate for the West Tower NICU. What the project did clarify was a clear distinction of two different patient populations in the Pavilion for Women NICU and West Tower NICU (Table 2). This was evident in the smaller gestational age and lower weight for neonates admitted to the Pavilion for Women NICU as compared to the West Tower NICU. A majority of the patients were admitted to the West Tower NICU during
this project which caused the data to be more representative of that population instead of an equal distribution of patient demographics between the two units.

During the project, NeoBar™ was successfully implemented as the standard securement device for ETTs in the Pavilion for Women. This implementation was not as successful in the West Tower NICU. As patients continued to grow, they outgrew the available NeoBar™ sizes. In several cases, this led to the continued use of tape as a potential securement device. The overall rate of tape usage in the West Tower NICU was 36% during the control group phase and 26% during the experimental group phase.

The UE worksheets continued to show an educational deficit in using the NeoBar™ in both NICUs. Several patients experienced an UE because the ETT was no longer in proper placement as the neonate had grown but the ETT was not adjusted for that growth. Improper placement has been identified as a risk factor for UEs (Rachman, Watson, Woods, & Mink, 2009). The UE worksheet also identified the continued use of tape to secure the ETT which highlighted the inadequate number of different sizes of NeoBar™ available for larger neonates. Several UEs occurred on patients who were between NeoBar™ sizes in the older, larger neonates. This discrepancy in sizes did not occur for the smaller gestational neonates in the Pavilion for Women NICU.

In a NICU with various weights and gestational ages one standard method of ETT securement for everyone may not be the best practice. Practice protocols should be developed based on specific populations within the NICU. Extreme low birth weight and gestational age neonates should continue with NeoBar™ as the standard method of securement. An algorithm for older and larger neonates should be developed based
on the same criteria established in the literature for small pediatric patients. This algorithm would include elements such as sedation, oral care, standard method of securement as either tape or NeoBar™, standard weaning protocols, identification of neonates at a greater risk for UEs, and decreased staff to patient ratio for infants for those identified at risk (da Silva, de Aguiar, Neto & de Carvalho, 2008; da Silva & de Carvalho, 2010; Marcin et al., 2005; Merkel et al., 2014; Rachman, Watson, Woods, & Mink, 2009).

One unexpected complication was the overall number of ventilated patients with an increase in the average daily census (ADC) for the Newborn Center. The control group phase ACD was 86.3 patients and the experimental group phase ACD was 100.2 patients. Also noted was the increased number of tracheostomy patients during the experimental group phase which had a 47.5% increase in the total number of ventilator days for tracheostomy patients (control group 639 ventilator days, experimental group 1217 ventilator days). This resulted in an increased acuity level and an increased number of nurses to staff the units which led to tight staffing across the Newborn Center. Staffing from agency, travelers, float pool, cardiovascular intensive care unit (CVICU), and pediatric intensive care unit (PICU) were added to help cover the increase in Newborn Center patients. None of these staff participated in the securement device education in March and April. Some staff had previous experience using the NeoBar™ while other staff had no previous knowledge with this type of securement device and were unfamiliar with its use.
Conclusions

There was a 34% decrease in the rate of UEs for the Pavilion for Women NICU with the implementation of the NeoBar™ as a standard securement device for securing endotracheal tubes. A downward trend in the smaller gestational age patients was noted but not enough patients were enrolled in the Pavilion for Women NICU to show a statistical significance. An increased length of time is needed to determine if the downward trend in UEs for the smaller gestational age population would be significant.

NeoBar™ was not an ideal securement device in larger neonates due to a limited variation in sizes available for larger infants. While many variations in size were available for the small premature neonates, this variety disappeared for term neonates and neonates greater than four kilograms. This highlights a problem for larger neonates, infants, and children up to six years as no commercially produced securement device is available for this patient population.

Implications

Implications for this project are both local and national. The project will continue with the Newborn Center population compared within their separate units; Pavilion for Women NICU and West Tower NICU. In the West Tower NICU, we will develop and implement a standard approach securing the ETT based on age and size. Once implemented, we will follow the intubated patients to see if this approach will decrease the overall rate of UEs to less than two UEs per 100 ventilator days. The Pavilion for Women NICU will continue with the current standard securement device and follow the rate of UEs to see if the decreased trend is supported with more patients. Once these studies have been completed, both projects will be submitted for publication.
continues to be a limited amount of data available regarding UEs. A recent article by Merkel, Beers, Lewis, Stauffer, Muijsce, and Kresch (2014) recommended the benchmark rate for UEs should be less than one per 100 ventilator days. The authors felt this could be accomplished by staff education and implementing a bundle of care practices. By redefining the study for West Tower NICU patients could add to available data.

Another implication involves the company who produces NeoBar™. A plan is currently underway to approach the company regarding the need for more size variations in the larger NeoBar™ sizes for larger neonates, infants, and toddlers. By creating more sizes, a standard securement device would be available for those patients who are in between the small NeoBar™ sizes and the next product which is available for children six years and older.
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Table 1: Population of intubated patients in the Newborn Center

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n)</th>
<th>Experimental Group (n)</th>
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<td>29.2</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td><strong>Day of Life (X)</strong></td>
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<td></td>
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<tr>
<td>Pavilion for Women NICU</td>
<td>13</td>
<td>21</td>
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<td>59</td>
</tr>
<tr>
<td>Texas Children’s Hospital</td>
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<td>50</td>
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<tr>
<td>Newborn Center</td>
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<td></td>
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<tr>
<td><strong>Weight (X)</strong></td>
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</table>

Independent T-Test was used for t-test for Equality of Means; two-tailed. Gestation age is in weeks and is the patient’s gestational age at birth. Weight is in grams.
Table 3: Securement Device for endotracheal tubes

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=81</td>
<td>N=88</td>
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<tr>
<td>Pavilion for Women NICU</td>
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<td></td>
</tr>
<tr>
<td>NeoBar™</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Tape</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1</td>
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<tr>
<td>West Tower NICU</td>
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<td></td>
</tr>
<tr>
<td>NeoBar™</td>
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<td>52</td>
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<td>Tape</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Unknown</td>
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<td>4</td>
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<td>Texas Children’s Hospital Newborn Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NeoBar™</td>
<td>57</td>
<td>70</td>
</tr>
<tr>
<td>Tape</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Unknown</td>
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<td>5</td>
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Table 4: Rate of Unplanned Extubations in the Newborn Center

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<tr>
<th>NICU Location</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavilion for Women NICU –</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rate per 100 ventilator days</td>
<td>5.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Number of events</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Total number of ventilator days</td>
<td>283</td>
<td>510</td>
</tr>
<tr>
<td>West Tower NICU –</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rate per 100 ventilator days</td>
<td>2.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Number of events</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>Texas Children’s Hospital Newborn Center –</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rate per 100 ventilator days</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Number of events</td>
<td>81</td>
<td>88</td>
</tr>
<tr>
<td>Total number of ventilator days</td>
<td>2606</td>
<td>2665</td>
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</table>
Appendix A: Model of IOWA Framework
Appendix B: Project Design Graph

Prospective Control Design

Current rate of unplanned extubations → Staff education Change to standard securement device → New rate of unplanned extubations
Appendix C: Demonstration of Application of Securement Device

Neobar

**Ensure that the skin is clean and dry**

* Hold the measuring tape to the face at the midline septum (the arrow should be midline), bring the tape back to the opening of the ear canal and the color that the tape ends on is the color NeoBar you select.

**NOTE:** If the tape borders between two colors always use the larger NeoBar.

Be sure to check the NeoBar box to ensure that the product has not expired.
Appendix C: continued

Write the current date and time on one of the Neobar tabs.

Perform hand hygiene. Warm the Neobar tabs in your hands for 60 seconds or hold them under the radiant warmer.

Position the Neobar across the center of the mouth between the upper and lower lip.

Keep in mind that the Neobar and ETT should not come in contact with the lips.

Apply the tabs over the bony prominences in front of the ears, where the skin is less mobile, and hold the tabs against the skin for 60 seconds to ensure proper adhesion.
ETT placement

Using white tape wrap the tape completely around the platform, then tape around the platform and the ETT. Tab the end of the tape for easy removal.

Apply the Cavilon No Sting Barrier on the top of the cheek pads

Read the ETT number in line with the inner lip for ETT placement

The blue line should point to the left
Appendix C: continued

NOTE:
For patients arriving from Transport or from the OR with the ETT secured with tape - the ETT will be secured with a Neobar at the next bundle Assessment check.

Routine changing of Neobars will occur every 5 days, according to the date/shift written on the Neobar tab.

Removing the Neobar
Saturate the tabs with water or saline and gently peel back the tabs.

In an emergency, simply cut the thin portion of the junction of the bar with blunt scissors.
Appendix C: continued

**ETT Securement Bundle**

Conducted Q3 hours by the RN/RT together

* Device - Neobar
  - in correct position? (yes or no)
  - What number is the ETT taped @ inner lip? (number)
  - Is device dated? (yes or no)
* Oral Care done? (yes or no)
* Patient developmentally positioned? (yes or no)
* OG secured to chin? (yes or no)
* Document- check box on flow sheet in FPIC
Appendix D: NeoBar™ Checklist

Hold the measuring tape to the face at the midline septum (the arrow should be midline), bring the tape back to the opening on the ear and the color that the tape ends on is the color NeoBar you select. 
NOTE: if the tape borders between two colors always use the larger NeoBar.

- The back adhesive tabs should be well secured in front of the ear.
- It is okay if the front portion of the NeoBar raises up a little.
- OG tube should be secured to the chin, not to the NeoBar.
- The NeoBar should clear the lips and be midway across the mouth.

NeoBar Checklist
* Is the ETT area clean, dry and intact?
* Is the correct size NeoBar in use?
* Are the back tabs of the NeoBar well adhered to the skin?
* Is the NeoBar well positioned?
* Is the ventilator circuit supported?
* Is the date/time of last change documented?
Appendix E: Unplanned Extubation Weekly Tracking Tool

<table>
<thead>
<tr>
<th>Week of</th>
<th>Total # Unplanned Extubations Captured</th>
<th>Vent Days</th>
<th>Rate/100 Vent Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/28/2013</td>
<td>6</td>
<td>127</td>
<td>4.7</td>
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<tr>
<td>8/4/2013</td>
<td>7</td>
<td>156</td>
<td>4.5</td>
</tr>
<tr>
<td>8/11/2013</td>
<td>10</td>
<td>151</td>
<td>6.6</td>
</tr>
<tr>
<td>8/18/2013</td>
<td>7</td>
<td>168</td>
<td>4.2</td>
</tr>
<tr>
<td>8/25/2013</td>
<td>7</td>
<td>199</td>
<td>3.5</td>
</tr>
<tr>
<td>9/1/2013</td>
<td>9</td>
<td>181</td>
<td>5.0</td>
</tr>
<tr>
<td>9/8/2013</td>
<td>3</td>
<td>208</td>
<td>1.4</td>
</tr>
<tr>
<td>9/15/2013</td>
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<td>200</td>
<td>2.5</td>
</tr>
<tr>
<td>9/22/2013</td>
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<td>149</td>
<td>2.7</td>
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<tr>
<td>9/29/2013</td>
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<td>4.9</td>
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<tr>
<td>10/6/2013</td>
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<td>199</td>
<td>5.0</td>
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<tr>
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<td>11/24/2013</td>
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<tr>
<td>12/1/2013</td>
<td>5</td>
<td>159</td>
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<tr>
<td>12/22/2013</td>
<td>5</td>
<td>152</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Appendix F: Unplanned Extubation Worksheet

Unplanned Extubation Worksheet

For QI Project Only: This project is aimed at reducing the number of unplanned extubations in the NICU. Nurses and RTs are uniquely positioned to observe, assess and recommend solutions to this problem. This is your opportunity to participate in the process.

Date extubated: Time: Location: WT Bed: PFW Bed: Other:
1. How was the patient positioned? prone supine side holding other: 
2. Was the patient swaddled? Yes No
3. Was the patient sedated? Yes No
4. Was the patient agitated prior to extubation? Yes No
5. How was the ventilator circuit supported?

6. If OG tube in place was it secured to the ETT? YES NO
7. What device was used to secure the ETT?
   Prior to extubation: NeoBar™ Brown Tape White tape other: 
   After reintubation: NeoBar™ Brown Tape White tape other: 
   Not reintubated: Placed on: BCPAP NC Hood Other

8. Were chest compressions needed? YES NO
9. Medications required? YES NO List: ______________

10. Root cause of extubation-circle appropriate answers, expand on details below
    a. Securement (play in ETT, loose tape, extubate during re-taping)
    b. Circuit (unsupported, secured to stationary device when patient moved)
    c. Secretions (copious secretions requiring frequent re-taping, tape loosened by clear secretions, patient agitated by secretions in tube or water in tube)
    d. Movement (RN, RT, OT/PT, NNP, MD or ___________ moved patient). Two to move? Yes No
    e. Holding (extubated while parents holding-use movement when transferring to or from parents)
    f. Vomiting (emesis that causes tape to come loose)
    g. Patient (patient pulls tube out with hand, agitation)
    h. Plug in ETT
    i. Other
    j. Additional details

11. Suggestions for avoiding a similar event in the future: ________________________________

12. Worksheet completed by ________________________________

13. Mandatory:
    □ Complete Safety Scoop on Connect
    □ Complete CPR form if patient is reintubated
    □ Notify AD: Sharon Fassino Jae Hernandez Tanya Williams Kim Davis
    Other: __________
Appendix G: Staff Education Critical Comps – Unplanned Extubations

Station #12 ETT Securement
You are caring for a 1700 gm patient who is orally intubated with a 3.0 ETT, secured at 8cm at the lip with a peach colored NeoBar™. During your assessment, you assess if the NeoBar™ is secure.

As the mission operative, please use the supporting documents in the case file to discuss elements of the case.

1. What are the key components of the new ETT Securement Bundle?
- Answers:
  - Device (NeoBar™)
    - In correct position? (yes or no)
    - What number is ETT device taped @ inner lip? (number)
    - Is device dated? (yes or no)
  - Oral Care done? (yes or no)
  - Patient developmentally positioned? (yes or no)
  - OG secured to chin? / NG secured to the cheek? (yes or no)
  - Documentation – check box on flow sheet in EPIC

Station #13 Unplanned Extubation
Your 1500gms intubated patient is 3 days s/p abdominal surgery and is in need of a bath and weighing. All of your pod mates are busy with their patients and you are eager to complete your assessment because the parents for your other baby are coming for the next feeding. You bathe your patient on the radiant warmer without incident and prepare to transfer to the weight scale. You weigh your patient and when you transfer the patient back to the warmer, the baby begins to brady & desat. You determine that the patient is now extubated and call the team to reintubate. The patient is successfully reintubated and the ETT is secured with a new NeoBar™.

As the mission operative, please use the supporting documents in the case file to discuss elements of the case.

1. What nursing interventions could have been done to prevent the patient from extubating?
   - Answer: Utilizing a second person to assist with the transfer of patient to the weight scale
2. With this unplanned extubation, what is the patient now at risk for?
   - Answer:
     - Increased days of intubation. Each unplanned extubation adds 5 additional days of ventilation for the patient.
     - Trauma to the trachea
     - BPD
     - Subglottal stenosis
     - Increased length of stay and cost of hospitalization
     - Increased cranial pressure which could lead to IVH, hypoxia and hypoxemia
April 30, 2014

To Whom This May Concern,

Sharon Fassino, our Assistant Director of Advanced Practice Providers in our Special Care areas here at Texas Children’s Hospital, has asked that I write a letter of support for her DNP project related to the important work of preventing unplanned extubations in our neonatal population. The project will specifically be focused on reducing the rate of unplanned extubations by consistently implementing an endotracheal securement device in the neonatal population.

I fully support Sharon’s DNP project within our Newborn Center here at Texas Children’s Hospital. This is an important effort to undertake to improve our rate of unplanned extubations and reduce airway harm related to the unplanned extubations that occur in the neonatal population.

Please feel free to contact me with any questions or concerns about this project.

Regards,

Patricia G. Bondurant, DNP, RN
Nursing, Newborn Center
Texas Children's Hospital

6221 Fannin St, WT6104 | Houston, TX 77030 | Phone 832-824-3462
To Whom It May Concern:

I am writing this letter in support of Sharon Fassino's Scholarship Project, "Reduction of Unplanned Extubations in the Neonatal Intensive Care Unit." Unplanned extubations is a significant problem in the NICU and represents a challenge in the delivery of safe quality care. I have known Ms. Fassino in the capacity of peer, colleague and now as her leader for over 10 years. I have full confidence that she will complete this project and make a difference in the care of the infants in the NICU. She is a capable clinician and scholar and as the Director of the Advanced Practice Providers of Texas Children's Hospital, I am in full support of this project.

Sincerely,

Charley Elliott (electronic signature)

Elizabeth "Charley" Elliott  MSN RN NNP-BC
Director, Advanced Practice Providers
Texas Children's Hospital
Instructor, Pediatric Newborn Section
Baylor College of Medicine
6621 Fannin
Houston, Texas 77039
832-824-1693 Office
Appendix I: IRB Approval Letter

Sharon Fassino
College of Nursing
University of Texas at Arlington

IRB Approval Inquiry

Sharon Fassino,

Thank you for contacting the Office of Research Administration; Regulatory Services regarding a project aimed at reducing the rate of unplanned extubations in neonates by changing to a single, consistent method of securement for endotracheal tubes. Upon reviewing the procedures involved with the study it appears they would not meet the definition of, "research with human subjects" as defined by the Office for Human Research Protections (OHRP) and would therefore not be subject to review or approval by the Institutional Review Board (IRB) at UT Arlington. OHRP defines research as:

- A systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge. A human subject in research is defined as, "A living individual about whom an investigator conducting research obtains data through intervention or interaction with the individual, or identifiable private information.

It appears from the description of procedures that the data being collected are not for the purposes of contributing to generalizable knowledge through a systematic investigation. If the procedures that have been outlined and provided to our office change such that IRB approval might be necessary or you have any questions regarding this determination please do not hesitate to contact me at robind@uta.edu.

Thank you,

Robin Dickey, MA, CIP
Regulatory Services Specialist
Office of Research Administration; Regulatory Services