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Practice VS. Evidence: Predicting Insertion Length and Verifying Placement of Feeding Tubes in Neonates

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PRACTICE VS. EVIDENCE: PREDICTING INSERTION LENGTH AND VERIFYING PLACEMENT OF FEEDING TUBES IN NEONATES

by

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I would like to thank Dr. Sharon Barton and Dr. Vicki Hines-Martin for their support and knowledge during this process.

Dedication

I would like to dedicate my work to my mother. She is the reason behind all that I have accomplished in life.

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Abstract

The placement of nasogastric (NG) and orogastric (OG) feeding tubes is one of the most common procedures performed in the Neonatal Intensive Care Unit (NICU). According to the literature, as many as 44% of feeding tubes are placed in the incorrect location in children (Parker, Withers, & Talaga, 2018). The purpose of this process evaluation project was to analyze the current processes and human factors in predicting insertion length and verifying placement of feeding tubes in neonates. The goal was to use the data obtained to compare current practices to current evidence. If warranted, the ultimate goal was for the data obtained to lead to a future practice change. The setting was Kentucky Children's Hospital NICU and the target population was registered nurses (RNs) in the NICU. Inclusion criterion was RNs employed by University of Kentucky Health Care that work in the NICU. RNs working all shifts were included, as well as full and part time nurses. Exclusion criterion was RNs still in orientation at the time of the project. Approval was obtained from the University of Louisville Institution Review Board and the University of Kentucky Nursing Research Committee. Data were collected via a survey distributed to the NICU nursing listserv using SurveyMonkey™. The data collected showed that non-evidence based practice continued to be used for predicting insertion length and verifying placement of feeding tubes. Findings from the project were presented to the nursing staff through a PowerPoint™ report format.

Key words: Nasogastric tube; orogastric tube; feeding tube; enteral tube; neonates; placement; verification

Practice vs. Evidence: Predicting Insertion Length and Verifying Placement of Feeding Tubes in Neonates

Feeding tube placement is one of the most common procedures performed in the NICU. Nasogastric (NG) and orogastric (OG) feeding tubes are commonly used in the NICU to provide nutrition, administer medications, and allow for gastric decompression; they are necessary for the care of most infants in the NICU (Wallace & Steward, 2014). Feeding tube placement is not a procedure without risks. According to the literature, as many as 44% of feeding tubes are placed in the incorrect location in children (Parker et al., 2018).

Ensuring correct location upon placement and before each use is necessary to minimize the risks associated with enteral tubes (Clifford, Heimall, Brittingham, & Davis, 2015). There are a wide range of consequences associated with incorrectly placed feeding tubes. Feeding tubes terminating in the esophagus can lead to gastroesophageal reflux, apnea, bradycardia, and/or desaturation events. Feeding tubes are also capable of causing a perforation in the esophagus. Feeding tubes advanced too far can cause a gastric perforation, or if placed in the small intestines, it can lead to GI disturbances. Placement of a feeding tube into the respiratory system is associated with significant mortality and morbidity. It can lead to aspiration, pneumothoraces, atelectasis, or pleural effusions. Incorrectly placed feeding tubes could also result in death (Parker et al., 2018).

Research has found that methods not supported by literature are still being used to determine insertion length and verify placement. These practices increases the risk of incorrectly placed feeding tubes and the associated complications. Parker et al (2018) surveyed nurses from 35 different states and found that 32% of RNs were still using the nose (or mouth) to ear to xiphoid process (NEX) method, even though research has shown it was unreliable. Twenty-two

percent of the nurses surveyed reported that their NICU had a protocol for feeding tubes and 30% of those protocols instructed nurses to use the NEX method to determine placement. This is concerning since the NEX method has been shown to incorrectly determine insertion length in up to 59% of insertion attempts. This survey also found that 98% of nurses reported using auscultation to verify placement, which evidence shows should no longer be used (Parker et al., 2018). These are significant findings for the foundation of my project.

Problem Statement

There is not a standard of practice for predicting insertion length or verifying placement of feeding tubes in the neonatal population, which places the neonate at risk for incorrect placement and potential complications.

Conceptual Framework

The Donabedian model was chosen as the conceptual framework because it is viewed as the standard in quality assessment. It uses three concepts to assess the quality of care: structures, processes, and outcomes. Structure describes attributes related to material and human factors, as well as organizational structure. Process describes what is actually done in providing and receiving care and outcome refers to the health status (Liu, Singer, Sun, Camargo, 2011).

Multiple structural factors affect the processes related to feeding tubes. Infants are at risk for mal-positioned feeding tubes due to frequent patient manipulation. Heavy patient load may also prevent a nurse from verifying placement before each feed. Lack of experience may also be a structural factor in the processes related to feeding tubes. High nursing turnover plays a role in lack of experienced staff. There is not a lot of evidence regarding feeding tubes in neonates, which limits the processes component. There is an evidence-based clinical practice guideline (CPG) for feeding tubes available in the NICU, which should be guiding processes.

The processes section of the model is related to the number of RNs who know about the available CPG, and the barriers to following the CPG. It is also important to look at the methods being used to predict insertion length and verify placement, if evidence-based practice is being utilized, and how often RNs are verifying placement. The survey examined the processes currently being used.

The outcomes are directly related to the processes utilized. Feeding tube placement, incorrect or correct, is one of the associated outcomes. The optimal outcomes will be practice change to correlate with current evidence and to decrease the frequency of incorrectly placed feeding tubes.

Figure 1 in Appendix A.

Setting and Organizational Assessment

Setting

The setting for this project was the Kentucky Children's Hospital NICU in Lexington, KY. This is a 70 bed, Level IV unit located in central Kentucky which employs 197 staff RNs. The NICU care team consists of physicians, neonatal nurse practitioners, physician's assistants, registered nurses, dieticians, respiratory therapists, and social workers. The population includes infants that are inborn, as well as those that are transferred in from outside hospitals. This unit manages a wide variety of infants including surgical patients, infants requiring extracorporeal membrane oxygentation (ECMO), infants with cardiac defects, neonatal abstinence syndrome, and infants born prematurely.

Participants

The target population for the project was 197 staff RNs in the NICU. To be included, the RNs must be employed by UKHC and be an RN in the NICU. All full-time and part-time nurses

were included, regardless of the shift worked. RNs in orientation were excluded from the project.

Purpose

The purpose of this process evaluation project was to analyze the current processes and human factors in determining insertion length and verifying placement of feeding tubes in neonates. Findings from the evaluation would be used to improve patient safety.

Summary of Evidence

Methods for Predicting Insertion Length

Proper placement of enteral feeding tubes begins with the initial placement process. There are several different methods for predicting insertion length for enteral feeding tubes. Methods that are used are described below. According to one study, none of the available methods has 100% accuracy (Mahapatro, Mohanty, Panigrahi, Ray, & Saraswat, 2017).

Nose-ear-xiphoid method (NEX). One method discussed in multiple studies requires a measurement from the nose (or mouth for OG tubes) to the lobule of the auricle to the xiphoid process. This is known as the NEX method. Chen et al. (2014) conducted in adults found that 96.7% of NG tubes placed using the NEX method were not in the correct location. Several studies referenced a pediatric study that found 50% of tubes placed using the NEX method were in the incorrect location (Chen et al., 2014; Klasner, Luke, & Scalzo, 2002). Cirgin Ellett et al. (2012) reported that research conducted in infants found that using the NEX method only resulted in correctly place NG/OG tubes 59% of the time. It was reported that if NEX method was used rather than nose-ear-midumbilicus (NEMU) or age-related height-based (ARHB) methods, the tube was 5.47 times more likely to be incorrectly placed (Cirgin Ellett, et al., 2012).

The literature supports that the NEX method is the least accurate method for predicting insertion length (Nguyen et al., 2016).

Nose-ear-mid umbilicus method (NEMU). For this method, the distance from the nose (NG) or mouth (OG) to the earlobe to the midway point between the xiphoid process and umbilicus is measured. The limitation of this method is that research has mixed results showing that it does not place feeding tubes deep enough, but to be reasonably accurate by another. This particular study resulted in 97.1% accuracy when using the NEMU method (Cirgin Ellett et al., 2012). Guidelines set by the American Academy of Pediatrics Neonatal Resuscitation Program and the National Association of Neonatal Nurses currently recommend this method (Clifford et al., 2015).

Age-related height-based method (ARHB). This formula has been shown by one study to be the best predictor of NG/OG insertion length (Mahapatro et al., 2017). Clifford et al. (2015) conducted a RCT found that NG/OG feeding tubes placed using the ARHB method were in the correct location 89% of the time. However, Clifford et al. (2015) acknowledged that though this method is successful in the adult and pediatric population, it has not been adequately studied in the neonatal population.

Weight-based formula. In this method, a standard formula is used incorporating the patient's weight in kilograms (kg) to determine an estimated insertion length. The equation for an NG is (3 X weight (kg)) + 13cm or OG (3 X weight (kg)) + 12cm. Nguyen et al. (2016) included premature infants, and found that this method resulted in 84% of cases with correctly placed feeding tubes per abdominal radiographs (n= 195). In this same study, hospital policy was to predict the insertion length using the NEMU method and then verify with the weight-based formula. Although it was hospital policy, the formula was not always used. The formula

predicted approximately 71% of incorrectly placed feeding tubes. Considering this degree of compliance, if the formula had been used on all cases, accuracy could have reached 95% (Nguyen et al., 2016).

Methods for Verifying Placement

Accurately verifying placement of feeding tubes is necessary to avoid complications related to incorrectly placed tubes. There are a variety of different methods for verifying placement of enteral feeding tubes. Research findings identify that combining multiple methods to verify placement is best practice. However, there is not sufficient evidence to determine which combination of methods provides the most accurate information.

Radiograph. Most evidence supports abdominal radiographs as the "gold standard" for verifying placement of feeding tubes, but due to the associated risks with radiation exposure, providers prefer to limit the use (Metheny & Meert, 2014). Several studies used abdominal radiographs to check the accuracy of additional methods for verifying placement since it is the gold standard (Cirgin Ellett et al., 2012; Cirgin Ellett et al., 2014).

Auscultation. This method involves inserting air via the feeding tube, while listening over the stomach for a "swoosh" sound with the stethoscope. The "swoosh" has been identified as the sound of the air entering the stomach (Clifford et al., 2015). Several studies state auscultation is not an accurate method for verifying feeding tube placement and this method should not be used (Clifford et al., 2015; Irving et al., 2014; Klasner at al., 2002). A review examining published case reports of pulmonary placed nasogastric tubes in children found that the auscultation method was used to verify placement in seven of the 15 case reports suggesting that it is not a reliable method (Metheny & Meert, 2014).

Examining tube aspirate. Characteristics of secretions aspirated from the NG/OG feeding tube may help the provider decide if the tube terminates in the stomach or intestines. However, inability to aspirate fluid may be an issue, even in correctly placed tubes (Cirgin Ellett et al., 2014). Evidence shows that the presence of gastric aspirate is not a reliable indicator of feeding tube placement, but Parker et al. (2015) reported that 83% of neonatal nurses use this method to verify placement. Metheny & Meert (2014) claimed examining the aspirate for visual attributes has limited value in distinguishing between gastric and respiratory placement.

Testing the pH of tube aspirate. This method is based on the idea that secretions aspirated from different parts of the body have different pH values. Research suggests that pH values can help differentiate between gastric and respiratory tract placement and gastric and intestinal placement, but the method is unable to differentiate between respiratory trace and intestinal placement because the pH is typically greater than five in both places. This method is not capable of ensuring the tube is not in the esophagus, so it cannot be used as the only method of placement verification (Cirgin Ellett et al., 2014). Research does not show a statistically significant difference in the pH value of aspirates due to feeds or acid-blocking medications (Clifford et al., 2015; Martin & Wade, 2015). Studies show that gastric aspirate with a pH value of five or less indicates stomach placement 90-92% of the time (Clifford et al., 2015; Irving et al., 2014). However, Irving et al. (2014) showed that using the same limits of five or less, on radiography, 54% of tubes were not located in the stomach. This study reported a sensitivity of 54% and specificity of 69% with a pH limit of 5.15 (Irving et al., 2014). Another study conducted in the pediatric emergency population reported that an abdominal radiograph should be obtained if the pH value of the gastric aspirate is greater than four or if no aspirate is obtained (Irving et al., 2014). A prospective descriptive study was performed in a neonatal population and

reported that a cut off point of 5 or 5.5 for pH of gastric aspirate could not rule out esophageal or small-bowel placement. These authors suggest that pH testing can only reasonably rule out respiratory placement. They suggest radiography be used whenever possible upon insertion before initial use. If this is not an option, a cut off point of 5.5 indicates the tube is likely not in the lung (Meert, Caverly, Kelm, & Metheny, 2015).

Marking the exterior location of the NG/OG feeding tube. Most feeding tubes have numbered markings. Upon measurement and placement, the number at the lip or nares is commonly marked. Checking that the marking has not moved is a common method for verifying placement, although research does not support this method. Marking location should only be used in combination with other methods (Clifford et al., 2015).

CO_2 detection method. While measuring for CO_2 from an NG/OG tube has been proven accurate in adults and shown success in the neonatal population, some authors claim it has not been adequately studied in the pediatric or neonatal population (Clifford et al., 2015). The other issue with the CO_2 detection method is it only confirms the tube is not in the respiratory tract, it cannot confirm stomach placement (Clifford et al., 2015). In a study conducted in a convenience sample of children from newborn to 18 years of age, 3/60 tubes were removed due to the detection on CO_2. However, a tube confirmed by radiography to be terminating in the stomach tested positive for CO_2. The authors believed that CO_2 entered the stomach from the infant crying. The authors of this study stated that further research was needed and that this method does not eliminate the need for an abdominal radiograph to confirm placement (Gilbert & Burns, 2012).

Ultrasonography. This method utilizes ultrasound to determine the location of the enteral tube tip. Research is emerging on this method, but no literature on use in the pediatric population was found (Irving et al., 2014).

Combined methods. Cincinnati Children's Hospital Medical Center uses a combined method for verifying NG/OG feeding tube placement as their standard of care. The gastric tube aspirate is tested for both pH and bilirubin values. Studies have shown this method to be highly sensitive (100%) to respiratory tract placement (Cirgin Ellett et al., 2014). One pediatric study found that combining pH testing with examination of the appearance to the aspirate to be an indicator of stomach placement. The study repots a gastric aspirate with a pH of six or less and clear, tan, or green color indicated stomach placement 87% of the time (Irving et al., 2014). Most studies conclude that combining multiple methods for verification is currently the best approach, but do not specify which methods to combine.

Gaps in Literature

Additional research is needed on this topic as a whole, as there is a lack of evidence available to establish consistently safe practices (Dias et al., 2017). Ultrasonography, CO2 detection, and combining methods require additional research before they become standard of care for verifying placement. The height-based and weight-based equation methods for determining insertion length need additional research before they are implemented. From the literature available, it seems research in combining placement verification methods is the most promising.

Conclusion

Based on the literature review, the NEMU method should be used to determine insertion length of feeding tubes. Radiograph is the only proven method to verify placement, but this is

not a reasonable option due to the frequency required and the potential to add to radiation exposure in neonates. Currently the evidence for methods to verify placement is lacking. The measurement of pH is useful to determine the tube is not in the respiratory tract, so it should be used in conjunction with marking the exterior location of the tube and examining tube aspirate. If gastric aspirate is unable to be obtained, the provider should be notified and a radiograph should be obtained.

This evidence was the foundation for the CPG created to guide the nurses at this institution on how to determine insertion length and verifying placement of feeding tubes in neonates. It was used as the evidence-based practice to compare current practices utilized by staff nurses.

Intervention

Measures/Instruments

Figure 1 in Appendix B.

The survey tool utilized in this project was adapted from another study (Parker et al., 2018). The survey consisted of ten questions surrounding demographic data and methods utilized for determining insertion length and verifying placement. There was a comment section, which allowed the participant to free-text any additional information pertaining to feeding tubes.

Human Subjects Protection

Approval was obtained from the University of Louisville Institutional Review Board and UKHC nursing research council to conduct my project. A statement was included in the survey explaining that consent was assumed upon completion of the survey. When appropriate, HIPAA procedures were followed. Confidentiality and anonymity were maintained because the survey was performed anonymously. No protected health information was collected for this project.

Implementation

To implement this project, a survey was compiled using SurveyMonkey™. The survey was administered to nursing staff via a listserv. The survey did not include identifiers, so participants remained anonymous.

Data Collection and Analysis

The DNP student conducted the data collection via SurveyMonkey™. The analysis of the data was conducted using Excel™ and consisted of frequencies and percentages to synthesize the data obtained from the survey. Data were used to determine if current practices are evidence-based. Data collected was maintained on an encrypted, password protected personal laptop.

Dissemination

The findings were disseminated to all stakeholders. The stakeholders consist of RNs, neonatologists, neonatal nurse practitioners, physician assistants, and clinical nurse specialist. Education was administered to the nursing staff via the listserv. A PowerPoint™ was created to provide information to the stakeholders. Information synthesized from the survey, a copy of the CPG, and a summary of the current evidence was included in the PowerPoint™.

Results

Of 197 nurses, 100 completed the survey. Majority of the participants were female (Table 1), age 20-30 years (Table 1), with a BSN degree (Table 3), and 0-2 years of neonatal nursing experience (Table 4). Majority of the participants were aware of a unit CPG for predicting insertion length and verifying placement (74%), 4% were unaware of any CPGs related to feeding tube placement, and the remaining 22% were unaware of a CPG for either predicting insertion length or verifying placement of feeding tubes (Table 5). Most of the participants reported using the NEMU method to predict insertion length, which has been shown to be the

most accurate (68%). However, 31% reported using the NEX method, which is not supported by evidence. Eleven percent of nurses reported using a combination of methods for predicting insertion length. Seven percent of participants use the weight-based calculation and the NEMU method together, which is recommended in the CPG (Table 6). Sixty-five percent of participants reported to use a different measurement when placing an oro-gastric versus naso-gastric feeding tube, 33% did not, and 2% were unsure. Approximately 74% of nurses reported verifying feeding tube placement before each feed, 36% verify placement with each care time, 10% verify once per shift, and 23% verify before each feeding and with each care time (Table 8). Nurses reported auscultating for the "whoosh" sound to verify placement 47% of the time, which is not supported by evidence. Checking for residual stomach contents was reported to be used 67% of the time, 64% of nurses use pH analysis of feeding tube aspirate, and 85% assess the number marking at the nare/gum. Eighty-one percent reported using a combination of methods to verify placement. The most common combination utilized was pH analysis of feeding tube aspirate, assess number marking at nare or gum, and pulling back on the tube to assess for residual stomach contents (21%).

Discussion

Interpretation

Approximately half of the eligible nurses at UKHC participated in the study. While there is a protocol at UKHC to standardize predicting insertion length and verifying placement of feeding tubes using evidence-based methods, many nurses are not aware of this protocol. The data also showed that many nurses are not using evidence-based methods, but are using methods proven to be inaccurate. This could be related to multiple things. It may be related to the lack of knowledge related to the available protocol, inadequate orientation, high turnover, years of

nursing experience, resistant to change, and/or level of education. It is also evident that many nurses are not verifying placement before each use, as the literature recommends. It is promising that most of the nurses reported using a combination of methods to verify placement, which has been found to be the most accurate, compared to use of just one method. Ultimately, unsafe practices are being utilized in relation to feeding tubes, which may be the reason for the feeding tube related accidents. It is evident intervention is needed, potentially at multiple levels of the system, to increase evidence-based practice related to feeding tube placement.

Limitations

A limitation of this study was it was only conducted at one institution. Another limitation is a small sample size, as only approximately 50% of nurses responded to the survey. There is also the possibility that there was a social desirability bias. Self-selected participation and self-reported outcome measures are additional limitations.

Conclusion

Research shows that a lack of standard of practice increases the risk of incorrect placement and potential complications. A protocol is in place to aid in standardizing practice to improve patient safety. Research has shown that unsupported methods are currently being used to predict insertion length and verify placement of feeding tubes in neonates, and the results of this study were in agreement with that. It is evident that education was needed to improve compliance with the protocol. The goal for the PowerPoint™ disseminated to staff nurses was to emphasize and motivate staff to follow evidence-based practices related to feeding tubes in neonates. Ultimately, the hope is for a quality improvement project to be implemented to increase compliance to the existing CPG to improve patient safety.

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Appendix A

Conceptual Framework

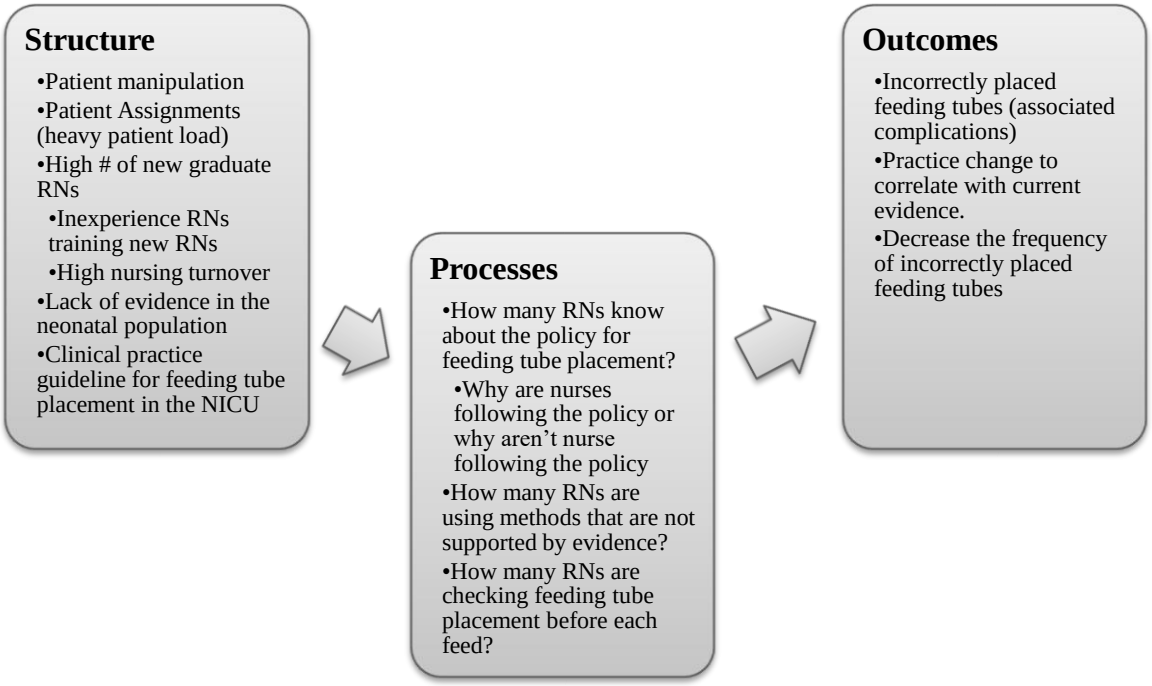

Figure 1: Conceptual framework- Donabedian model.

Appendix B

Survey Tool

1. What is your age (years)?
   a. 20-30
   b. 31-40
   c. 41-50
   d. Over 50

2. What is your sex?
   a. Male
   b. Female

3. What is your highest degree
   a. ASN
   b. BSN
   c. MSN
   d. Other

4. Total years' experience in neonatal nursing
   a. 0-2
   b. 3-5
   c. 6-10
   d. 11-15
   e. Over 15

5. Is there a policy for determining gastric feeding tube insertion lengths?
   a. Yes
   b. No
   c. Unsure

6. What method do you use to determine gastric feeding tube insertion lengths?
   a. Nose to ear to xiphoid
   b. Nose to ear to mid-way between the xiphoid and umbilicus
   c. It is based on the height of the infant
   d. It is based on the weight of the infant

7. Do you use a different measurement when placing an oro-gastric versus a naso-gastric feeding tube?
   a. Yes
   b. No
   c. Sometimes

8. Is there a policy for verifying placement of feeding tubes?
   1. Yes
   2. No
   3. Unsure

9. How often do you verify placement of your patient's feeding tubes?
   1. Once a shift
   2. Before each feed
   3. With each care time
   4. Other

10. What method do you utilize to verify gastric placement of the feeding tube? (check all that apply)
    1. Pull back on the tube to assess for residual stomach contents
    2. Push air into the tube and listen for an air whoosh in the stomach
    3. pH analysis of feeding tube aspirates
    4. Assess number marking at nare or gum

Figure 2: Survey tool administered to nursing staff.

Table 1

Age of Participants

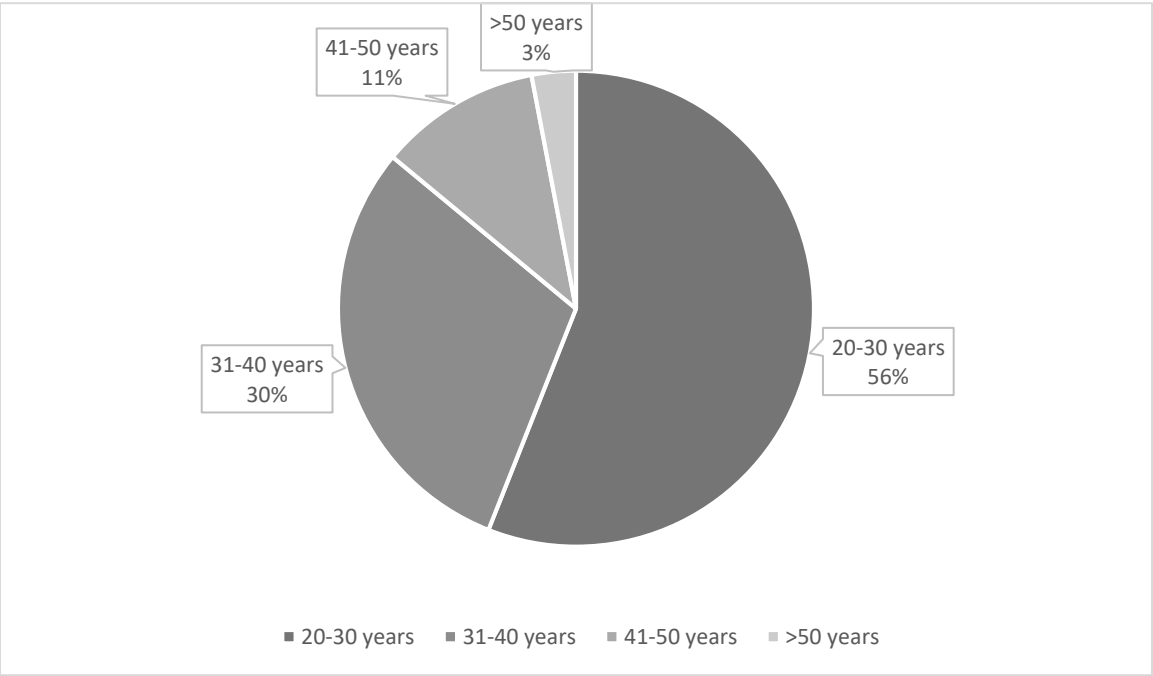

Table 2

Gender of Participants

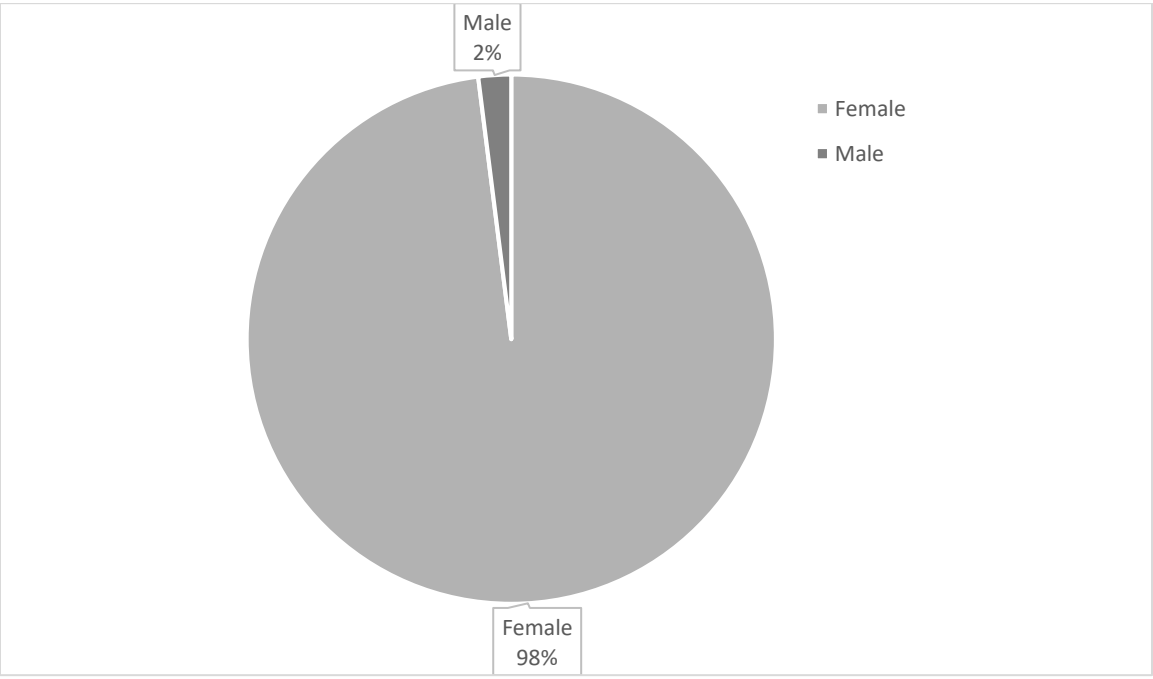

Table 3

Highest Degree Completed

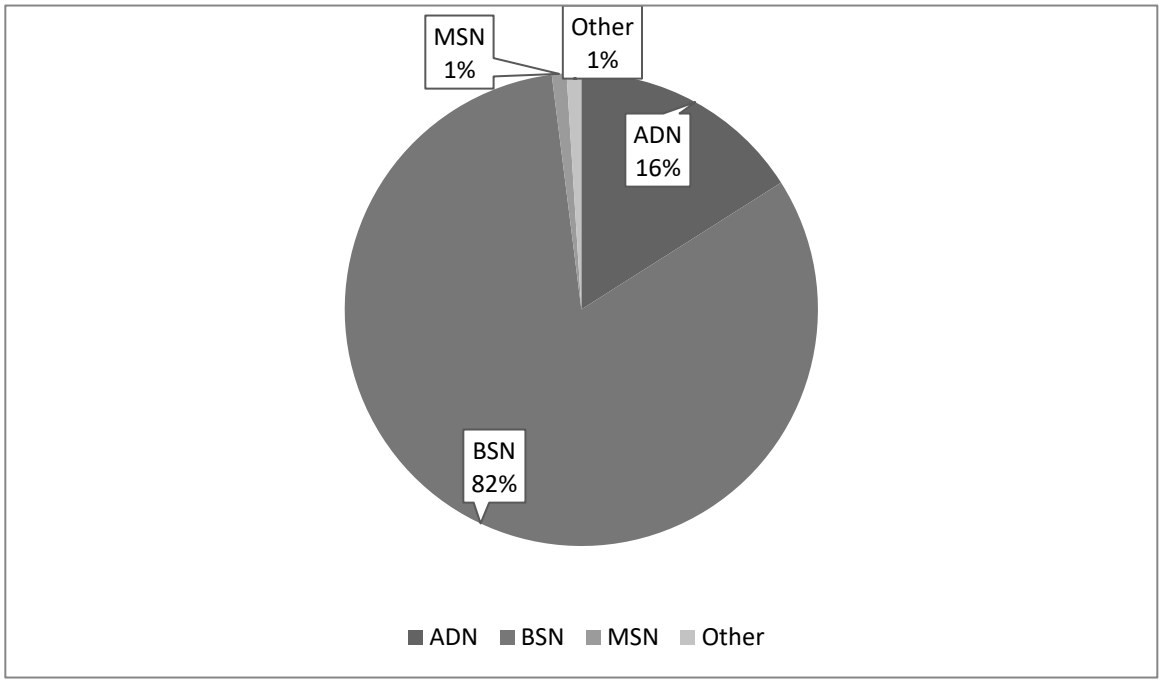

Table 4

Years of Experience

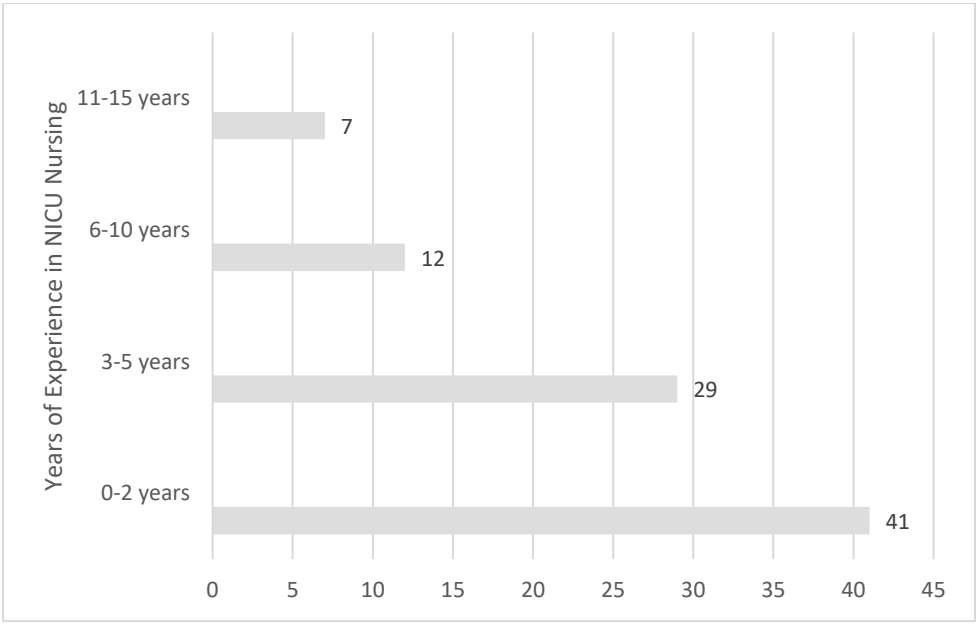

Table 5

Participant Responses to Survey Question 5

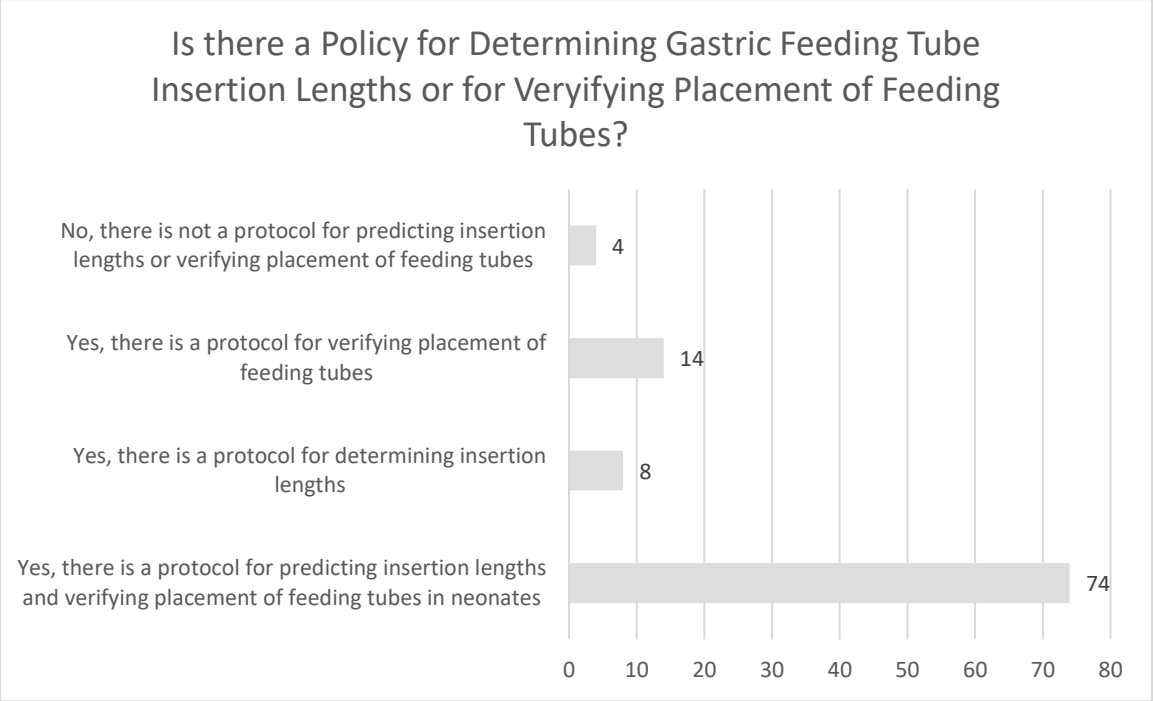

Table 6

Participant Responses to Survey Question 6

What methods do you use to determine gastric feeding tube insertion lengths?	**Percentages**
Nose to ear to xiphoid process	31%
Nose to ear to mid-way between the xiphoid and umbilicus	68%
It is based on the height of the infant	1%
It is based on the weight of the infant	9%
NEMU + weight	7%
NEX + weight	3%
NEMU + height	1%

Table 7

Do you use a different measurement when placing an oro-gastric versus a naso-gastric feeding tube?

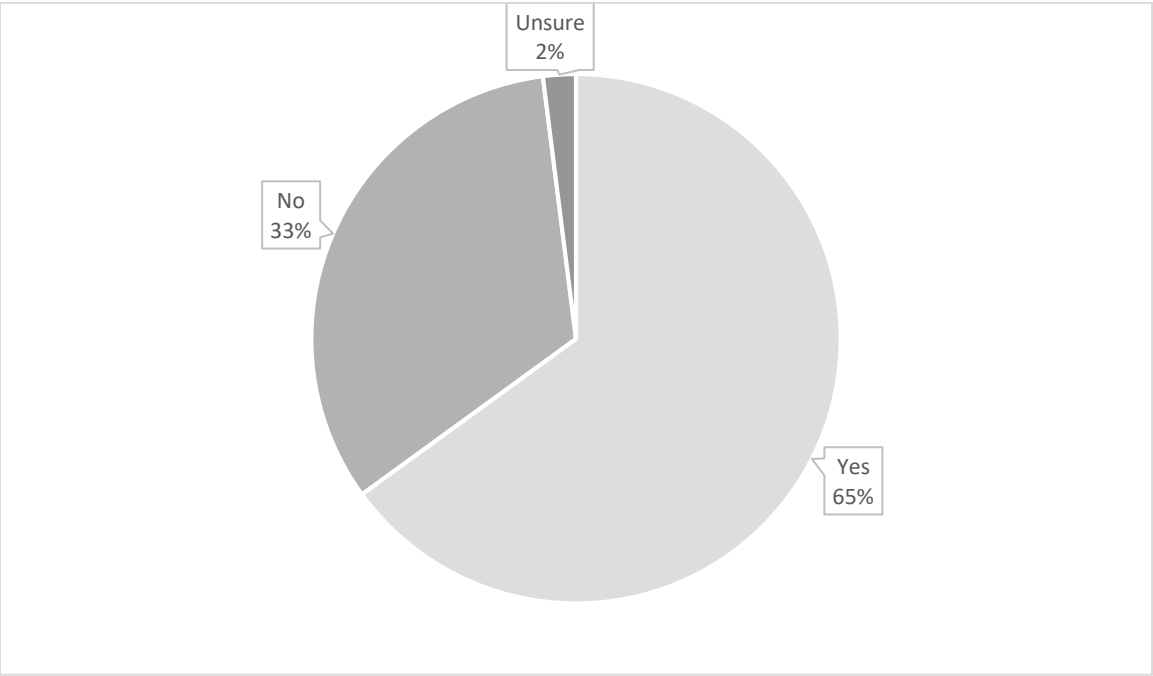

Table 8

Participant Responses to Survey Question 8

How often do you verify placement of your patient's feeding tube?	Percentage
Once a shift	10%
Before each feeding	74%
With each care time	36%
Before each feeding & with each care time	23%
Once a shift & Before each feeding	1%
Once a shift & Before each feeding & with each care time	1%

Table 9

Participant Responses to Survey Question 9

What method do you use to verify gastric placement of the feeding tube?	**Percentage**
1. Pull back on the tube to assess for residual stomach contents	67%
2. Push air into the tube and listen for an air whoosh in the stomach	47%
3. pH analysis of feeding tube aspirate	64%
4. Assess number making at nare or gum	85%
1-4	17%
1 & 2	1%
1 & 3	2%
1 & 4	6%
2 &4	1%
2 & 3	2%
3 & 4	9%
1, 2, & 3	1%
1, 2, & 4	17%
1, 3, & 4	21%
2, 3, & 4	4%