SIMULATION TO IMPROVE CONFIDENCE AND COMPETENCE OF THE NEONATAL NURSE PRACTITIONER

by

Julie E. Williams

Under Supervision of

Carmel A. McComiskey, DNP, PPCNP-BC, CPNP-AC, FAANP, FAAN

Second Reader

Claire Bode, DNP, RN, CRNP

A DNP Project Manuscript

Submitted in Partial Fulfillment of the Requirements for the

Doctor of Nursing Practice Degree

University of Maryland, School of Nursing

May 2019

Approval Sheet

Abstract

Background: Neonatal nurse practitioners must maintain competence in low-volume, high-risk procedures to provide timely, high-quality, and safe care. In institutions with multiple providers e.g. fellows, residents, and neonatal nurse practitioners, the number of procedures available per provider may be very low. Simulation education provides an opportunity to practice procedures without compromising the care of patients or competition.

Local Problem: The project institution is an academic center with a high level of procedural competition due to the presence of physicians, physician trainees, and nurse practitioners. The purpose of this quality improvement project was to implement and evaluate the impact of a needle thoracentesis simulation on the confidence and competence of neonatal nurse practitioners.

Interventions: A simulation was implemented for 15 full-time neonatal nurse practitioners in the Neonatal Intensive Care Unit. A pre-simulation survey to assess each neonatal nurse practitioner's perception of procedural confidence and competence was conducted. Subsequently, each neonatal nurse practitioner received PowerPoint slides with an embedded video on the correct performance of a needle thoracentesis. Following the pre-survey and PowerPoint slides, each neonatal nurse practitioner participated in the needle thoracentesis simulation. Utilizing a procedural checklist adapted from the National Association of Neonatal Nurse Practitioner Competency and Orientation Toolkit for Neonatal Nurse Practitioners, the nurse practitioners needle chest thoracentesis skills were assessed. After completing the simulation, the nurse practitioners received an identical post-simulation survey to re-evaluate their perception of their procedural confidence and competence.

Results: Neonatal nurse practitioners reported an increase in confidence in their 1) ability to determine when a needle thoracentesis was necessary versus allowing spontaneous resolution ($p<0.01$); 2) and in their ability to perform an emergency needle thoracentesis competently without or with minimal procedural guidance ($p=0.04$). They also reported an increase in confidence in their ability to troubleshoot unexpected problems that might occur during the procedure ($p<0.01$) and an increase in confidence in their ability to incorporate patient safety measures in the event of an emergency thoracentesis ($p=0.03$).

Conclusions: This quality improvement project provided support for the use of simulation to increase the confidence and competence of the neonatal nurse practitioner in performing a chest needle thoracentesis and to assist neonatal nurse practitioners in maintaining competency in low volume high risk procedures.

Neonatal nurse practitioners (NNP) are obligated to provide timely, high quality, and safe care. In 2007, the Joint Commission introduced the focused professional practice evaluation (FPPE) and the ongoing professional practice evaluation (OPPE) process (The Joint Commission, 2018). Together, FPPE and OPPE help hospitals and other healthcare organizations evaluate provider competence based on delineation of privileges and monitor ongoing competency. In 2010, the National Association of Neonatal Nurse Practitioners (NANNP), established a Competency and Orientation Toolkit to help NNPs institute a standardized means for assessing initial and ongoing competencies. Collectively, these organizations guide the delivery of safe, competent patient care.

In the Competency and Orientation Toolkit, NANNP identified three skills requiring competency for all NNPs: chest needle thoracentesis, umbilical line placement, and endotracheal intubation. NANNP also identified a minimum of three procedures or procedural reviews/simulations to maintain annual competency. In academic institutions where there are multiple providers including fellows, residents, and NNPs, the number of procedures available per provider for low-volume, high-risk procedures may be low. Given the procedural competition, it is conceivable that a new NNP could practice for many years and not establish or maintain competency.

Significance of the Problem

Infants have a higher risk for pulmonary air leaks, including pneumothorax, than any other population. The extremely premature infant with lung disease is especially at risk for a pneumothorax. Needle thoracentesis is a low-volume, high-risk procedure, and the provider's ability to recognize the symptoms and react quickly can be a matter of life and death. In 2013, the Vermont Oxford Network reported the incidence of pneumothorax to be 4.1% of 55,921 neonates with a birth weight of 500-1500 grams (Fernandes, 2017). In 2016, the incidence of pneumothoraces at a level IV NICU in Maryland was 0.5% for all birth weights. Though this number may appear relatively low, even one death from a treatable condition is too many. Given these statistics and recommendations from NANNP, simulation is one solution for the NNP to maintain annual competency.

Simulations allow the learner to experience high-risk situations safely and realistically (Cooper, 2015). Simulation training has led to increased procedural skill, competence, confidence, collegiality, collaboration and NNP self-efficacy (Augustine & Kahana, 2012; Butler-O'Hara, Marasco, & Dadiz, 2015; Reinarz, 2013). Sharma (2013) identified the achievement of higher standards in neonatal care through training in a controlled, multidisciplinary environment as a long-term goal of simulation. However, simulation programs are not without obstacles. Barriers to implementing simulation training include inadequate financial support, inadequate personnel to lead the simulation, and endorsement by leadership and the nurse practitioners (Cooper, 2015; Qayumi et al., 2014).

Project Purpose and Goals

The purpose of this DNP project was to implement and evaluate the impact of a needle thoracentesis simulation on the confidence and competence of performing a needle thoracentesis on neonates in a level IV NICU in an urban teaching hospital in the midatlantic. Competence is defined as the successful application of a combination of knowledge, skill, and judgment displayed by an individual in their daily practice or job (International Council of Nurses, 2009). Confidence is defined as a feeling of belief in one’s skills, decision, and talents (Oxford University Press, 2018). Both competence and confidence were measured through pre and post-simulation surveys. The short-term goals of the project included: the provision of education via

PowerPoint slides on the correct performance of a needle thoracentesis by 75% of the NNP group by October 2018; the successful identification of neonatal signs of distress from a pneumothorax by 75% of the NNPs by October 2018; and the self-report of an increase in competence and confidence in performing a needle thoracentesis by 75% of the NNPs by November 2018. The long-term goal of this project is to establish a process for all NNPs within the project hospital to have the opportunity to maintain competency of low-volume, high-risk procedures via simulation by 2020.

Theoretical Framework

For this doctoral project, the theory of Constructivism was utilized to guide implementation. At the very basis, the Constructivist approach places emphasis on the student's development of a deeper understanding of concepts presented in the learning material. Deeper understanding is best achieved when the student can develop his/her mental models of the information presented. The Constructivist theory highlights what the student learns by synthesizing new information with the knowledge they already possess (Olusegun, 2015). The learner builds knowledge and understanding of the world through experiences and reflection on these experiences (Olusegun, 2015). The student is an active participant, and learning is self-directed and internally motivated (Cooper, 2015). In nursing, this translates into real-world problem solving during the everyday care of patients. This can also translate to participation in simulation training.

The pedagogical goal of a constructivist learning environment encompasses seven traits (Olusegun, 2015): the environment should provide an experience that will allow the student to determine how they learn; the environment should allow for the appreciation of multiple solutions; the environment should be realistic; the environment should provide for studentcentered learning; there should be room for collaboration within the environment; the environment should incorporate multiple modes of representation including video and audio; and reflection and debriefing should be encouraged.

Simulation allows the learner to become an independent problem solver and decision maker. Learning through simulation is most reflective of the constructivist theory and was the guide for this project. Preexisting conceptions about needle thoracentesis were assessed through a pre-survey. Education through an online platform provided information about the correct techniques for these procedures and addressed signs and symptoms of neonatal distress from a pneumothorax. The NNPs then participated in a simulation training highlighting the infant in need of a needle thoracentesis. Here the NNPs were given the opportunity to participate in their learning actively. After the simulation, the NNPs participated in a debriefing session allowing the opportunity for self- reflection and further learning. They also participated in a post-survey.

Review of Literature

Simulation in healthcare education been utilized in a variety of clinical and nonclinical environments. There is minimal evidence regarding simulation designed specifically for the NNP. However, there is a larger pool of literature about the use of simulation with pediatric providers including pediatric residents, physicians, nurses, and nurse practitioners. This review discusses the evidence supporting the role of simulation in healthcare education, core components of a simulation, and the impact of simulation on the pediatric provider’s confidence and competence.

The Role of Simulation in Healthcare Education: Literature Analysis and Synthesis

When compared to traditional teacher-centered education alone, high-fidelity simulation has been suggested as a useful educational modality for healthcare professionals caring for the pediatric population (Cheng et al., 2014; Cooper, 2015). Simulation is also a useful teaching modality for adult learners who are independent and self-directed students (Cates & Wilson, 2011). Simulation can help reduce clinical errors, facilitate the acquisition of knowledge, skill proficiency, and the assessment of critical thinking skills, while creating a safe environment free of patient harm (Cooper, 2015; Sharma, 2013).

Simulation training in healthcare education can be used to address an assortment of needs including the development and reinforcement of technical competencies, performance support for previously acquired competencies, assessment of high-stakes testing and certifications, innovation and exploration of health system problems, predictive and real-time modeling, and research (Rosen, Hunt, Pronovost, Federowicz, & Weaver, 2012). Five non-experimental studies and one meta-analysis utilized simulation to address skill and behavioral acquisition in the clinical environment, many of which addressed low-volume procedures. Augustine and Kahana (2012) in a nonexperimental study utilized simulation for a group of 72 pediatric residents in a pediatric hospital setting for low-volume procedures including airway management, chest tube placement, and lumbar punctures. In this study, residents spent 20-30 minutes at each procedure station. The trainees watched a demonstration of the proper technique for performing each procedure and then performed the procedure until deemed competent. In another nonexperimental study, 50 second-year medical students in the emergency department participated in a series of simulations to improve diagnostic reasoning skills for acute presentations like chest pain, abdominal pain, and headaches (Murray, Savage, Rang, & Messenger, 2018). The simulation was consistent with the content of the second-year curriculum.

The students were exposed to different patient actors with similar chief complaints but different vital features and diagnoses. The students evaluated the experience as positive and reported an improvement in diagnostic abilities that continued 18 months later.

Butler-O’Hara, Marasco & Dadiz (2015) developed a procedural simulation program in a medical center for 20 advanced practice neonatal providers, to assist them in maintaining annual competencies for credentialing in a variety of procedures including chest tube placement and abdominal paracentesis. Before the implementation of the simulation program, the author noted that providers required about five to ten additional procedures to maintain their annual credentialing requirements. Reinarz (2013) in an 18 NNP non-experimental quality improvement project, also utilized simulation to assess competency maintenance in needle thoracentesis. In a pre-simulation survey, the author noted that the majority of NNPs had not performed a needle thoracentesis in two years. Of the 18 NNPs, ten underwent procedural review before the simulation versus 8 NNPs who did not. The procedural review had a small influence on the total performance score. At another children’s hospital, 33 pediatric providers participated in a tracheostomy emergency and routine simulation program to improve their knowledge, confidence, and skills (Agarwal et al., 2016). In this study participants took a self-assessment survey, a nine-question exam on the management of tracheostomy complications and emergencies, and a clinical skill performance lab before the simulation. Participants reported the course and simulation prepared them for tracheostomy emergencies. Finally, in a metanalysis including 2,885 pediatric providers in 57 studies, simulation was associated with several provider benefits including skill, knowledge, and behavior (Cheng, Lang, Starr, Pusic, & Cook, 2014). The purpose of the study was to evaluate the effectiveness of technology-enhanced simulation

(TES) on pediatric education. TES had positive effects on the knowledge outcomes for the pediatric providers.

As noted previously, simulation has potential for use in a variety of clinical environments and a variety of situations including annual competency maintenance. While the settings of the studies varied by the clinical environment, they were consistent with the pediatric population. Another similarity between the studies is the focus on patient care related simulation training, highlighting the importance for the provider to exhibit competence.

Core Components of a Simulation: Literature Analysis and Synthesis

A simulation is not simply a skills lab. Cates and Wilson (2011) in an expert opinion article, identified three core areas for health care simulations: the scenario, the simulator, and the experience. The scenario ensures a realistic experience when planned and executed appropriately. When the scenario resembles real events, including near misses and sentinel events the maximum experience can be achieved (Cates & Wilson, 2011). The simulator includes the high-fidelity manikin, the equipment and the environment (Cates & Wilson, 2011). The more life-like the manikin and the environment, the greater the chance the learner will become engaged. Finally, the experience (including the sights, sound, and smells) must mimic the actual environment such that the learner can suspend disbelief and immerse himself into the scenario. Inclusive of the experience is the debriefing, wherein the learner can evaluate his/her behaviors. Cooper (2015) in an integrative review of eight articles, identified three major steps in high-fidelity simulation education: learner orientation to the simulation experience, the scenario, and the debriefing. The first step involves the orientation of the student to the space, manikin, and the introduction to the video recording for future use with debriefing (Cates & Wilson, 2011). Step two focuses on the scenario and the learner’s ability to suspend disbelief and participate in the simulation experience. Participant debriefing is the most important pedagogically. This step provides the chance for the learner to reflect on the integration of previous life experiences and form new knowledge to reinforce new concepts from the simulation through the process of debriefing.

Both sets of authors identified the scenario and the experience of the debriefing as important concepts for the simulation and critical to the learner's opportunity to integrate old and new information. The similarities included the need for the scenario to be realistic to encourage the participant's suspension of disbelief. The simulation must incorporate these key components to maximize the participant's learning.

Impact of Simulation on the Provider: Literature Analysis and Synthesis

Simulation has a positive impact on the provider. Four studies and one systematic review addressed the impact of simulation on providers. Augustine & Kahana (2012) reported an increase in self-reported procedure competence and confidence among pediatric residents after the completion of a simulation workshop. Chen et al. (2017) in a randomized control trial, identified a significant increase in the confidence and competency level of 31 novice nurse practitioners as well as a decrease in stress after the completion of a simulation program. In this study, the new graduate NNPs were randomized to either the interactive situated and simulated teaching (ISST) group, or the non-ISST group. NNPs in the ISST group received six follow up face to face interactive support sessions over three months after orientation. The non-ISST group underwent self-oriented learning. In addition, to increased confidence, NNPs within the ISST group expressed increased confidence in their professional competence. These sentiments were echoed by Reinarz (2013), who reported an increase in NNP self-efficacy after participation in a needle thoracentesis simulation. Agarwal et al. (2016), reported an increase in knowledge, confidence, and skill after the incorporation of a tracheostomy simulation. Finally, in a systematic review of *in situ* simulation literature, a positive impact on learning and organizational performance was seen with in-situ simulations (Rosen *et al*, 2012).

Simulation can have a positive impact on the provider. Increased procedural confidence and competence were reported in four of the five studies. Other positive results included decreased stress levels, increased self-efficacy, and an increase in knowledge. Overall, simulation is a useful teaching modality and can serve as an avenue to train pediatric providers.

Implementation Plan

Description of project

A quality improvement project designed to assess the competence and confidence of the NNPs in performing a needle thoracentesis was implemented in a level IV NICU in urban teaching hospital in the Mid-Atlantic. The inclusion criteria for this project included all full-time NNPs (n= 15) in this NICU.

Procedures and timeline

This quality improvement project took place over 11 weeks. During weeks one and two, a pre-simulation survey was sent to the NNPs via email utilizing Qualtrics. This survey (Appendix B), developed by the project leader, assessed NNP confidence and competence in performing a needle thoracentesis. At the beginning of week two, an email reminder was sent to those NNPs who had not completed the survey. Verbal reminders occurred during change of shift.

During week three, the project leader sent the PowerPoint slides about performing a needle thoracentesis to the NNP team. In the subsequent three weeks team members and team champions were asked to view PowerPoint slides. The team champions also reviewed the PowerPoint slides. After each NNP viewed the PowerPoint slides, the project leader signed each team member off via email. During week four, the project leader practiced the simulation and corrected any anticipated difficulties.

Each NNP completed the needle thoracentesis simulation (Appendix C) during weeks six through eleven. After each NNP completed the simulation, the post-simulation survey, identical to the initial survey, was emailed. The simulations were led by the project leader or a champion. Weekly email reminders to complete the post-simulation survey were sent out to those NNPs who had completed the simulation but who had not completed the post-simulation survey.

Data collection plan

A simulation scenario was created using the SMARTER tool and then approved by an expert in simulation (Appendix C). Validity and reliability of the simulation was evaluated using the Behavioral Assessment Tool (BAT) which was embedded into the SMARTER tool. The function of the BAT was to provide a documentation tool for the simulation observer to measure the ability of the NNP to achieve the targeted responses. Procedural competence for needle thoracentesis was assessed utilizing the Evaluation of NNP Procedural Competence: Required Skills, Table C.3.a Chest Needle Thoracentesis checklist from the Competencies and Orientation Toolkit for Neonatal Nurse Practitioners by NANNP (2014; Appendix E).

The pre- and post-simulation level of confidence and feelings of competence were assessed using the pre- and post-simulation survey (Appendix B). Because the project leader developed the survey, validity and reliability was not assessed. The survey consisted of a combination of multiple choice and Likert scale questions. The Likert scale questions were ranked from 1 (strongly agree) to 5 (strongly disagree). Following the project completion, the pre-simulation survey was compared to the post-simulation survey.

Data analysis

The quantitative data was collected primarily from the survey and the needle thoracentesis checklist. When the survey data was received, Qualtrics provided a report of all of the demographic information as well as the results of the Likert portion of the survey. The information from the Likert scale questions from the pre- and post-simulation survey were analyzed using descriptive statistics and compared using a paired t-test. The demographic information obtained from the survey was used to describe the group's diversity. The needle thoracentesis checklist provided an objective measure of competence and displayed whether the NNPs were able to meet the vital steps of the procedure. The BAT also measured the target responses of the NNPs. This information was classified as "inadequately performed/not performed", or "adequately performed" procedure competence.

To minimize risk during this project, confidential information was stored on a password-protected computer. All Qualtrics survey results were also password protected within the survey program. Individual simulation evaluations were de-identified and stored in a locked cabinet which was only accessible to the project leader. A project description was submitted for IRB approval. Approval to implement the DNP project as a quality improvement project or exempt status was also sought from the organization and obtained.

Plans for sustainability

Several steps were taken to promote the sustainability of the project. The most significant step to sustainability was the engagement and desire of the NNPs. It was essential for the NNPs to see a benefit from the project for it to last. Others methods to improve sustainability included the involvement of core team members including the NICU simulation team, the NNP medical director, and the champions. The requirement of the NNPs to maintain annual competence in low volume, high-risk procedures by NANN and credentialing also played a role in sustaining the project.

Results

Sample

A total of 15 NNPs were eligible to participate in the evidence-based simulation project. Fourteen of the 15 NNPs participated in the pre-survey. However, only 10 NNPs participated in the simulation and were eligible to complete the post-survey. Of those NNPs, 3 had less than five years of experience, four NNPs had between six and ten years of experience, one had between 11-15 years of experience, and two had 16 plus years of experience. Seven of the ten participants had only worked at the project medical center as an NNP. The other three participants worked as NNPs at another medical center before employment at the project facility. In the year prior to the needle thoracentesis simulation, one of the 10 NNPs did not perform any needle thoracentesis, four NNPs performed one successful needle thoracentesis, four NNPs performed two successful needle thoracenteses, and one performed three successful needle thoracenteses.

Needle Thoracentesis Survey Results

The goal of the survey was to assess NNP confidence and competence in performing a needle thoracentesis before and after the simulation. The pre-survey indicated a high baseline level of confidence in identifying the signs and symptoms of a tension pneumothorax, identifying indications and contraindications of a needle thoracentesis, identifying the signs and symptoms of an infant in distress secondary to a tension pneumothorax, equipment assembling, and performing a needle thoracentesis in an emergency while incorporating patient safety measures (Appendix F). An equal number of NNPs were confident (n=5) or self-doubting (n=5) in their ability to troubleshoot unexpected problems.

While each area within the survey noted improvement in the confidence of at least one nurse practitioner, four areas were statistically significant, post-simulation. NNPs reported increased confidence in their ability to determine when a needle thoracentesis was necessary versus allowing spontaneous resolution ($t = 4$, $p < 0.01$, one-tailed). NNPs also reported increased confidence in their ability to perform an emergency needle thoracentesis competently with or without minimal procedural guidance ($t = 1.96$, $p = 0.04$, one-tailed) and increased confidence in the ability to troubleshoot unexpected problems that might occur during the procedure was reported and significant ($t = 3$, $p < 0.01$, one tailed). Finally, NNPs reported increased confidence in their ability to incorporate patient safety measures in the event of an emergency thoracentesis; ($t = 2.24$, $p = 0.03$, one tailed).

Simulation Results and Observations

The simulation provided an opportunity for the NNPs to perform a needle thoracentesis after having reviewed the PowerPoint slides and video. The group (n=10) was successful in performing the procedure. Utilizing a performance rubric scoring chart, the average performance score was 83% (15 out of a total of 18 points) (Appendix G). There were four consistently missed areas that required prompting: (3) Performs a time out to ensure right time, right patient and right procedure, (5) Addresses pain management, (6) Uses appropriate sterile technique/ maintains sterility, and (9) Assembles needle thoracostomy setup appropriately.

Change in Practice

The simulation garnered a great deal of support from the NNPs, and many expressed a desire for additional simulation exercises. Many have also expressed a need to create a process to maintain competency. Further discussions are underway regarding the development of a competency day.

Unexpected Events

There were a few unexpected events throughout the project. To increase staff participation, the simulations were held in the NICU. This was both a benefit and a barrier. Proximity to the NICU allowed staff easy access to the simulation. However, participation in the project depended on the census and the acuity of the unit. Additionally, two providers were unable to participate due to scheduling conflicts.

Another unexpected event was the failure of the simulation manikin. On a few occasions the manikin did not connect to the computer. Therefore, the scenario required a lot of improvising. Despite equipment failure, the NNPs were able to continue the simulation with minimal disturbance.

Discussion

This quality improvement project provided support for the use of simulation to increase the confidence and competence of the NNP in performing a chest needle thoracentesis and to assist NNPs in maintaining competency in low-volume, high-risk procedures. The PowerPoint slides provided a procedural review and learners were able to ask questions and solidify their knowledge before participating in the simulation. All participants successfully identified the appropriate landmarks and completed the needle thoracentesis. Despite the overall high baseline level of confidence for completion of the procedure, there was less comfort with troubleshooting. This finding may be due to their infrequent exposure to the procedure. The average number of needle thoracentesis performances within the group was 1.5 per year, not enough to maintain competency according to the NANNP Competency and Orientation Toolkit for Neonatal Nurse Practitioners.

The absence of a formal time out was attributed to the lack of prompting. NNPs were comfortable with performing the procedure without a formal time out because they had identified the pneumothorax on x-ray and the infant was symptomatic. However, a formal time out is required for all invasive procedures and often is prompted by the nurse documenting in the electronic medical record. Although the infant was symptomatic and required urgent evacuation, a verbal announcement of the procedure, the site and the name of patient would have met the time out requirement.

Pain management was commonly missed or required prompting during the simulation. NNPs were unanimous in reporting the lack of pain control or hesitance to provide pain management as related to the emergent nature of the scenario. The NNPs did report that pain medication would be provided if the infant were stable and time allowed. Reinforcement of the use of additional nursing staff to retrieve the medication was provided.

The utility of sterile technique during the procedures was also addressed. NNPs verbalized the break in sterility was related to the emergent nature of the scenario. A common notion was that the emergent scenario required a clean technique although they would make efforts to be as sterile as possible. Practicing sterile technique during procedural simulation may improve the NNPs ability to remain sterile in the future. However, there is support for clean technique during emergent procedures.

The appropriate assemblance of the needle thoracostomy setup required prompting. The nursing staff at the project facility often assembles the equipment for certain emergent procedures. It was the responsibility of the NNP to assemble the thoracentesis kit in this project. All NNPs were successful in assembling the unit after some adjustments. The lack of familiarity with the setup and available equipment caused delays, despite the equipment being a replica of the kit utilized at the project institution. Increased exposure to the thoracentesis kit could improve the NNP familiarity with equipment and decrease assembly time.

Post-simulation survey results reported an overall increase from the baseline level of confidence and competence. It is possible that the post simulation improvement was due to procedural review or the combination of procedural review and simulation. As noted in Reinartz (2013), a small impact is possible from procedural review. There is also evidence in the literature to support multimodal learning to reinforce the acquisition of knowledge to improve competency (Cates & Wilson, 2011; Murray, 2018).

The literature supports the use of simulation to improve provider confidence and competence (Augustine, E. M., & Kahana, M., 2012; Butler-O'Hara, M., Marasco, M., & Dadiz, R. 2015 & Chen et al., 2017). This notion was echoed by the results of this quality improvement project. The literature also supported the use of various activities to maintain competency (National Association of Neonatal Nurse Practitioners, 2014; Reinarz, S.,2013). This was reflected in this project through a variety of comments regarding the usefulness of the PowerPoint slides and the embedded video.

Strengths

One major strength of the project was the onsite assistance of the simulation technologist from the simulation lab. The simulation technologist provided the preconstructed manikin allowing the NNP the ability to palpate landmarks and pierce the manikin skin. They also provided an additional monitor to display vital signs and operated the manikin based on cues from the NNP and the scenario.

Limitations

One limitation to this study was the small sample size and limited generalizability. A goal of 11 NNPs (75% of the team) was set but the limited simulation dates and high unit acuity restricted some NNPs from participating in the simulation. The provision of dedicated simulation time might increase participation. Prescheduling the simulation lab at least six months ahead of time would also ensure more available times for the simulations.

Another limitation to the project was the project design. The simulation was held on the unit with the goal of increasing NNP participation. While more NNPs were able to participate, because of the simulation's proximity to the NICU, some were distracted with a full clinical assignment at the same time they were attempting to complete the simulation. NNP concerns for their availability to carry out their assignment also hindered their dedicated time towards debriefing. The utilization of an off-unit location like the simulation center would have improved the NNP's focus on the debriefing session.

Conclusion

The use of simulation is one way to facilitate the provision of safe and competent care. The NNPs who completed the simulation reported increased confidence and competence in their performance of a needle thoracentesis. As research on competency maintenance continues to emerge it is important to consider the varying factors that may preclude the NNP from maintaining competency including the lack of resources, level of care and procedural competition. While the development of an annual competency program is recommended, it may not be feasible for smaller centers. The development of a smaller unit-based simulation like this project can fulfill skill and competency needs. Utilizing this quality improvement project as a template could provide a base to build and expand.

Simulation can help NNPs remain confident and competent in the performance of low-volume, high-risk procedures. The combination of several procedural skills into a semi-annual competency day would facilitate NNP skill maintenance, and competency requirements. Expanding the context from skill acquisition to communication is also feasible. The incorporation of a multidisciplinary team with variable of experience can improve the simulation and provide multiple perspectives.

Sustainability of this quality improvement project is associated with increased time and cost. Extensive resources and personnel are necessary to implement a successful simulation. Cost and resources associated with a simulation include the use and or acquisition of a simulation center with the appropriate manikins and equipment, personnel to develop and staff the simulation and protected time for providers to participate in the simulation.

Future quality improvement projects should include communication with parents surrounding a procedural simulation. The involvement of actors or NICU personnel who were also NICU parents would create a realistic environment. Another implication for future projects includes the correlation of simulation to practice and patient care. Does a successful performance in the simulation correlate to a successful performance in a real situation? The development of a simulation competency day which includes procedural and communication simulation would be the next steps for developing the safe, confident and competent NNP.

References

Adam Cheng, Tara R Lang, Stephanie R Starr, Martin Pusic, & David A Cook. (2014). Technology-enhanced simulation and pediatric education: A meta-analysis. *Pediatrics, 133*(5), e1323. 10.1542/peds.2013-2139 Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24733867

Agarwal, A., Marks, N., Wessel, V., Willis, D., Bai, S., Tang, X., . . . Carroll, J. L. (2016). Improving knowledge, technical skills, and confidence among pediatric health care providers in the management of chronic tracheostomy using a simulation model. *Pediatric Pulmonology, 51*(7), 696-704. 10.1002/ppul.23355

Augustine, E. M., & Kahana, M. (2012). Effect of procedure simulation workshops on resident procedural confidence and competence. *Journal of Graduate Medical Education*, *4*(4), 479. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24294425

Butler-O'Hara, M., Marasco, M., & Dadiz, R. (2015). Simulation to standardize patient care and maintain procedural competency. *Neonatal Network: NN, 34*(1), 18-30. 10.1891/0730-0832.34.1.18 Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/26803042

Cates, L. A., & Wilson, D. (2011). Acquisition and maintenance of competencies through simulation for neonatal nurse practitioners: Beyond the basics. *Advances in Neonatal Care: Official Journal of the National Association of Neonatal Nurses, 11*(5), 321-327. 10.1097/ANC.0b013e31822a34a0 Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22123401

Chen, S., Chen, S., Lee, S., Chang, Y., & Yeh, K. (2017). Impact of interactive situated and simulated teaching program on novice nursing practitioners' clinical competence, confidence, and stress. *Nurse Education Today, 55*, 11. 10.1016/j.nedt.2017.04.025 Retrieved from https://www.sciencedirect.com/science/article/pii/S0260691717301016

Cooper, A. (2015). High-fidelity simulation for neonatal nursing education: An integrative review of the literature. *Neonatal Network: NN, 34*(6), 345-354. 10.1891/0730-0832.34.6.345 Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/26803016

Fernandes, C. D. (2017). Pulmonary air leak in the newborn. In M. S. Kim (Ed.), *Uptodate* () Retrieved from https://www.uptodate.com/contents/pulmonary-air-leak-in-the-newborn/print

International Council of Nurses. (2009). *ICN framework of competencies for the nurse specialist.* Geneva, Switzerland.

Murray, H., Savage, T., Rang, L., & Messenger, D. (2018). Teaching diagnostic reasoning: Using simulation and mixed practice to build competence. *CJEM: Journal of the Canadian Association of Emergency Physicians, 20*(1), 142. 10.1017/cem.2017.357 Retrieved from https://search.proquest.com/docview/1987352795

National Association of Neonatal Nurse Practitioners. (2014). *Competencies and orientation tool kit for neonatal nurse practitioners.* Glenview, IL: National Association of Neonatal Nurse Practitioners.

Qayumi, K., Pachev, G., Zheng, B., Ziv, A., Koval, V., Badiei, S., & Cheng, A. (2014). Status of simulation in health care education: An international survey. *Advances in Medical Education and Practice, 2014*, 457-467. Retrieved from https://doaj.org/article/ab958149e27742ed81e7dc086c64d979

Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education, 5*(6), 66-70. 10.9790/7388 - 05 61 66 70

Oxford University Press. (2018). *Confidence| Definition of Confidence in English by Oxford Dictionaries*. Retrieved from English Oxford Living Dictionaries: https://en.oxforddictionaries.com/definition/confidence

Reinarz, S. (2013). Initiation of a neonatal nurse practitioner competency activity in needle thoracostomy. *Advances in Neonatal Care, 13*(4), 238-246. 10.1097/ANC.0b013e31828e55aa Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=n&CSC=Y&PAGE=fulltext&D=ovft&AN=00149525-201308000-00005

Rosen, M. A., Hunt, E. A., Pronovost, P. J., Federowicz, M. A., & Weaver, S. J. (2012). In situ simulation in continuing education for the health care professions: A systematic review. *Journal of Continuing Education in the Health Professions, 32*(4), 243-254. 10.1002/chp.21152 Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/chp.21152

The Joint Commission. (2018). *Standards Interpretation| Joint Commission*. Retrieved from The Joint Commission:

https://www.jointcommission.org/standards_information/jcfaq.aspx?ProgramId=5&ChapterId=74&IsFeatured=False&IsNew=False&Keyword=FPPE&print=y

Sharma, A. (2013). From evidence to implementation: Introducing neonatal simulation to a tertiary neonatal centre in the UK. *Open Journal of Pediatrics*, *3*(1), 10-16. 10.4236/ojped.2013.31002

Appendix A

Evidence Review Table

Author, year	Study objective/intervention or exposures compared	Design	Sample (N)	Outcomes studied (how measured)	Results	*Level and Quality Rating
Augustine & Kahana, 2012	To examine 1) the number and types of procedures performed by pediatric residents, 2) the relationship between the number of procedures and self-reported procedural confidence and competence 3) the effect of a procedure simulation workshop on self- reported procedural confidence and competence.	Non-experimental	72 pediatric residents from the Lucile Packard Children's Hospital at Stanford.	Procedural confidence and competence Self-report	1. The average number of procedures performed increased from intern to senior year. 2. Resident self-reported procedure competence and confidence improved with procedure simulation workshops.	IV B
Cooper, 2015	To compare traditional teacher-centered education to high fidelity simulation education.	Integrative review of the literature	8 articles were reviewed	Not applicable	Compared to traditional teacher-centered education high fidelity simulation education may be an effective educational approach to learning in neonatal nurses. However, more research is necessary to determine its efficacy.	VII C
Cheng et al., 2014	To describe the qualities and evaluate the efficacy of technology-enhanced simulation (TES) for pediatric education.	Meta-analysis	N = 2885 includes postgraduate physician trainees n= 1641, physicians in practice n= 562, nurses or nursing students n= 447, and medical students n= 235.	Simulation vs. no intervention Simulation vs. non-simulation instructional methods	TES for pediatrics is associated with positive effects of varying magnitudes for knowledge outcome, performance in a simulated setting, behaviors with patients and task completion time when compared to no intervention.	I A

				Simulation vs. other types of TES		
Sharma, 2013	Describes a simulation model for medical education in neonatal simulation.	Expert Opinion	Not applicable	Not applicable	The long-term goal of simulation is the achievement of higher standards in neonatal care through training in a controlled, multidisciplinary environment.	VII C
Cates & Wilson, 2011	To review the evidence supporting simulation, describe the main elements of health care simulation, define the bodies that regulate advance practice nursing, identify the principle areas for neonatal nurse practitioners(NNPs) to maintain competence and expertise, illustrate how simulation is used to acquire and maintain competency for NNPs in one NICU.	Expert Opinion	Not applicable	Not applicable	Simulation is an effective teaching method for adult learners when used in conjunction with traditional teaching methods. More research needs to be done to determine whether there is a direct correlation between simulation and NNP competency level.	VII C
Murray, 2018	To describe a practice-based simulation program used to teach diagnostic reasoning to undergraduate medical students	Non-experimental	50 second year medical students	Competence in diagnostic reasoning was measured. Self-report via survey immediately following simulation and 4 months prior to graduation.	Simulation, mixed case practice, and immediate feedback were beneficial in teaching diagnostic reasoning to medical trainees.	IV C
Chen et al., 2017	To improve novice nurse practitioner clinical competence, promote self-	RCT	31 new graduate nurse practitioners	Clinical competence, stress and confidence level	Novice nurse practitioners experienced significant improvement in their competency level, less stress, and increased	II A

	confidence and reduce the number of work-related stressors.			Nursing Competency Questionnaire, A Stress scale, and Satisfaction in Learning scale	confidence in their professional competence after the interactive situated and simulated teaching program.	
Butler-O'Hara et al., 2015	To describe the development and implementation of a Simulation Procedural Program at the University of Rochester Medical Center.	Nonexperimental	20 advanced practice providers including 18 neonatal and pediatric nurse practitioners, one physician assistant, and one hospitalist.		The program increased procedural skills, confidence, collegiality, and collaboration.	IV C
Reinarz, 2013	To apply a procedure review process for neonatal nurse practitioner NNP competency maintenance in needle thoracostomy for a tension pneumothorax and to evaluate the efficacy of procedure review on competency through simulation.	Non-experimental – quality improvement project	18 Neonatal nurse practitioners	NNP procedural competence and self-efficacy Procedural observation Self-Efficacy survey	Simulation increased NNP self-efficacy. There was a small positive impact on performance from procedural review.	IV B
Agarwal et al., 2016	To assess the knowledge and confidence levels of pediatric residents, pediatric internal medicine residents, fellows, advanced practice registered nurses and pediatric hospitalist faculty physicians at Arkansas Children's Hospital in 1) routine and	Non-experimental	33 participants including 22 pediatric and pediatric internal medicine residents, 3 fellows, 6 hospitalist faculty physicians and 2 advanced practice registered nurses.	Knowledge, comfort, and confidence were measured. Pre and post-educational course questionnaires, Pre and post-test scores and observational data from the simulations	The integration of simulation in the tracheostomy education program leads to an improvement of knowledge, confidence, and skills.	IV A

	emergency tracheostomy and 2) the value of a comprehensive simulation-based tracheostomy educational program.					
Rosen et al., 2012	This is a systematic review of in situ simulation literature; it compares the state of the science principles of effective education and training design, delivery and evaluation.	Systematic Review	29 full articles	Not applicable	In situ simulations have a positive impact on learning and organizational performance.	I A

Appendix B

NNP Confidence and Competence Survey

1. How many years have you been a neonatal nurse practitioner?
   a) 0-5
   b) 6-10
   c) 11-15
   d) 16+

2. Have you worked as an NNP at a facility other than this institution?
   a) Yes
   b) No

3. In the last year, how many times have you performed needle thoracentesis (If you performed a needle thoracentesis twice on one patient within a 30-minute period it is considered one episode)?
   a) 0
   b) 1
   c) 2
   d) 3
   e) 4
   f) 5+

4. Of those needle thoracentesis performed, how many did you successfully remove air from the infant's chest?
   a) 0
   b) 1
   a) 2
   b) 3
   c) 4
   d) 5+

5. Please answer the following questions using the following choices.
   1. Strongly disagree, 2. Disagree 3. Neutral, 4. Agree, 5. Strongly agree

Appendix B

A. I am confident that I can identify the signs and symptoms of a tension pneumothorax.
B. I am confident that I can identify the indications and contraindications of needle thoracentesis.
C. I am confident that I can identify the signs and symptoms of an infant in distress secondary to a tension pneumothorax.
D. I am confident that I can determine when a needle thoracentesis is necessary versus allowing spontaneous resolution.
E. I am confident that I can quickly and accurately assemble the required equipment for a needle thoracentesis in the event of an emergency.
F. I am confident that I can perform an emergency needle thoracentesis competently without or with minimal procedural guidance.

G. I am confident that I can perform a needle thoracentesis whenever necessary without procedural review.
H. I am confident that I am able to troubleshoot unexpected problems that may occur during a needle thoracentesis.
I. I am confident that I am able to incorporate patient safety measures in the event of an emergency thoracentesis.

6. Do you think simulation can improve procedural competency?
   a) Yes
   b) No

Appendix C

Clinical Simulation Laboratory

Simulation Planning Form – SMARTER (Rosen, et al, 2008, Simulation in Healthcare 3(3), 170-179)

Please use this form to provide the simulation staff the essential information needed to build your simulation case and behavioral assessment tool that will be used to guide debriefing discussions.

Simulation planning should follow the steps in order on the grid, beginning with higher-level competencies such as AACN Essentials of Baccalaureate or Master's Education, competencies from Professional Organizations, course outcomes, etc.
Following the empty grid, there are two examples of simulation planning forms as they might be used for an entry level simulation and a nurse practitioner simulation.

How have students been prepared for this simulation (e.g., didactic content, previous simulations, etc.): The NNPs received a PowerPoint slides on needle thoracentesis three weeks prior to the training session.

Course Number: NDNP 811 Proposed date of simulation: October 1st – 31 Date for run-through 2 weeks before simulation: September 17, 2018

Neonatal Nurse Practitioner Core Competency (NANNP, 2014)	**Learning Objectives**	***Clinical Context***	***Knowledge, Skills, Attitudes (KSAs)***	**Pre-Planned Triggers**	**Sample Targeted Responses (note: *based on standard neonatal care, neonatal resuscitation program)***
I. Independent Practice Competencies	1. Uses advanced health assessment skills to differentiate between normal, variations of normal, and abnormal findings		1. Performs the appropriate initial physical assessment including auscultation of lungs, visual inspection, and palpation of infant's body.	1. 1.260 kg Infant admitted to NICU and placed on the conventional ventilator CMV 25/5 x 40 100% 2. Infant placed on the	NNP will order: 1. CXR 2. Labs: ABG, CBC, Type & Screen, blood cultures 3. umbilical lines, 4. PIV-intravenous fluids – (D10 @ 80-100 mls/kg) 5. Abx- Ampicillin and Gentamicin 6. Maintenance meds ordered: Vitamin K, and erythromycin ophthalmic ointment.

	2. Employs screening and diagnostic strategies in the development of diagnosis			cardiorespiratory monitor. Opening vital signs: T: 37.4 ax, HR 144, BP 54/34, saturation 73% on 100% FIO2.	7. Assess respiratory effort, breath sounds and other signs of respiratory distress including oxygen saturation, FIO2, and heart rate. 8. Order Surfactant: Infrasurf 3.8 mls (3 mls/kg),
	3. Provides the full spectrum of healthcare services to include disease prevention, health protection, anticipatory guidance, and disease management		2. Orders appropriate diagnostic tests		See number 1-8 above.
	4. Prescribes medications within scope of practice			Surfactant administered	1. Adjustment to ventilator settings or change ventilator.
				Cxr: ETT just above the carina, NGT in the stomach, mildly streaky opacities without focal consolidation, pleural effusion or pneumo.	
	1. Demonstrates leadership that uses critical and			VBG: 7.17/75/39/28/-1	

II. Leadership	reflective thinking 2. Communicates practice knowledge orally			Vitals: HR: 168, BP: 56/33, Sats 79% on 100% FIO2 HFJV: pip 34, peep 10, rate 420 FIO2 100% Sats rise after surfactant administration Infants then begins to desaturate and remains in the high 70's. Removes 33 mls of air from the right side of chest. VS: HR: 157, BP 39/26 (RUE) sats 77% Saturations never reach above 85%	Request a transilluminator. Transilluminates both side of the chest. 1. Recognizes signs and symptoms of a potential pneumothorax. - Auscultates and does not hear breath sounds in the right side of the chest. - Heart Sounds are muffled. - persistent cyanosis, change in VS: bradycardia and hypotension - Upon transillumination, the right side of the chest lights up more than the left. 2. Identify ways to determine/confirm a pneumothorax. - auscultation, vital signs, transillumination, and chest xray. 3. Time Out performed 4. Perform a needle thoracentesis. – Identify the approach and procedure. Anterior axillary or anterior mediastinal 5. Orders/administers pain medication. Morphine 0.5 -

					1mg/kg/dose or Fentanyl 1mcg/kg/dose 1. Assess for the persistence of pneumothorax. 2. Place a chest tube using the proper technique. – Identify the equipment necessary for placement. 3. Update parents Switch ventilator – HF jet ventilator if not done yet.

Appendix C

Report to students (note any items to be purposely left out): not applicable

Interval History: 29w3d Asian female infant born via C-Section to a 40-year-old woman. Di-di twin gestation with selective reduction of twin b at 17 weeks gestation due to multiple anomalies. Maternal prenatal labs were unremarkable except for GBS positive. Mother mandarin speaking only.

Maternal Past Medical History: anemia

Maternal Pregnancy history: notable for intermittent vaginal bleeding characterized as polyp vs hemangioma vs chronic abruption since 21.2 weeks gestation. She was admitted and sent home multiple x 2. She received 2 full courses of BMZ at 23 and 25 weeks gestation.

Maternal Family History: none

Maternal Social History: Mother denies tobacco, alcohol, or drug use.

Maternal Medications: ferrous sulfate, prenatal vitamins, Colace. She received magnesium sulfate for neuroprotection and penicillin for GBS positive status.

Mother went into preterm labor at 29.3 weeks gestation. The infant was breech, and a c section was performed. APGAR scores were 1 and 6 at one and five minutes respectively. BW 1.26 kg AGA. Time of birth 0418.

Delivery: ROM at delivery for pink/bloody fluid. Resuscitation included deep suction, PPV with PIPs as high as 25-30. Successfully intubated at 18 minutes of life after 4 failed attempts. Infant transferred to the NICU for management of prematurity at 30 minutes of life.

Neonate's Initial Vitals: T: 37.4 ax, HR 144, BP 54/34, saturation 73% on 50% FIO2.

Neonatal EXAM:

Premature Asian infant

HEENT: Eyes open without deformities, normocephalic, atraumatic

RESP: symmetrical breath sounds with mild subcostal retractions

CV: regular rate and rhythm. No murmur

FENGI: abdomen soft and nontender. Patent anus.

MUSC: Spine intact without deformities

Appendix C

PREPARATION/SET-UP

Armband info: Name: BG Xang MR# JH 123456 DOB: today 30 minutes prior to arrival on unit.

SIMULATOR:

Premie Hal vs Sim Paul intubated

Supplies:

Warmer
Code Cart – medications epi 0.1 mg/ml concentration
Xray of pneumothorax
Umbilical line kit plus venous and arterial catheters size 5
Pneumothorax kit – 22-to 24- gauge angiocatheter or 23 or 25 gauge butterfly, three-way stopcock, intravenous extension tubing, 10 – 20ml syringe, antiseptic- betadine, sterile gloves
Sterile setup – 2 sterile drapes, mask, cap
Stethoscope
Transilluminator
Lab report – VBG

Scenario Set-up

- Set up room to look like a NICU room including isolette, ventilator, IV pump
- Set up a Pop-top isolette (see isolette photo)
- Ensure that the supplies necessary for umbilical lines, needle thoracentesis, and thoracostomy are available. (See specifics above)

Appendix C

Preparation of Simulator, supplies, meds, etc:

Armband info: Name: BG Xang MR# jh123456 DOB: today 30 minutes prior to arrival on unit MM/DD/XX

Medications & supplies to be available during simulation:

Ventilator -conventional vent

Sterile gowns, gloves and masks

Umbilical catheters -venous and arterial umbilical line catheters size 5

Needle thoracentesis kit

Peripheral IV supplies (tourniquet, alcohol, 2x2 gauze, tape, Tegaderm, 24 gauge IV needle, T-piece, heplock, prefilled normal saline syringe

Oxygen: conventional ventilator

Chart forms to be at the bedside:

none

Roles of Participants other than students (nurses, family members, etc):

One participant will play the role of the bedside nurse.
One participant will play the role of the Respiratory Therapist.

Appendix C

Laboratory Test	Result	Normal Range
Time Drawn: 0606 am (1.5 hrs after birth.)		
pH	7.17	7.30 -7.40
pCO2	75	42-48 mmHg
pO2	39	35 – 45 mm Hg
Calculated HCO3	28	24 to 30 mEq/L
Base excess of blood	-1	-10 - -2 mmol/L
Sodium	134	135-148 mmol/L
Potassium	3.9	4.0 – 5.9 mmol/L
Chloride	103	99 – 111 mmol/L
Glucose	101	45 – 110 mg/dl
Lactate, whole blood	0.8	0.5 – 2.2 mmol/L
Calcium, ionized whole blood	1.55	1.13 – 1.32 mmol/L
Hemoglobin, Total WB	14.9	14.1 – 20.1 g/dl
Oxyhemoglobin	68.8	91.0 -100%
Methemoglobin	1.8	0.0 – 1.5
Carboxyhemoglobin	1.2	0.0 – 2.0%

Appendix C

	Pre-planned triggers	Targeted Responses	Cues
1st 5 minutes	Infant admitted to NICU and placed on the conventional ventilator Infant placed on the cardiorespiratory monitor. Opening vital signs: T: 37.4 ax, HR 144, BP 54/34, saturation 73% on 50% FIO2. Cxr : ETT just above carina, NGT in stomach, mildly streaky opacities without focal consolidation, pleural effusion or pneumo.	NNP will assess respiratory effort, breath sounds and other signs of respiratory distress. NNP will order: 1. CXR 2. Labs: ABG, CBC, Type & Screen, blood cultures 3. umbilical lines, 4. PIV-intravenous fluids – (D10 @ 80 -100 mls/kg) 5. Abx- Ampicillin and Gentamicin 6. Maintenance meds ordered: Vitamin K, and erythromycin ophthalmic ointment. 7. Assess respiratory effort, breath sounds and other signs of respiratory distress.	- The infant should have circumoral cyanosis.

		8. Order Surfactant: Infrasurf 3.8 mls (3 mls/kg),	
5-10 minutes	VBG: 7.17/75/39/28/-1 Vitals: HR: 168, BP: 56/33, Sats 79% on 100% FIO2 Surfactant administered	NNP will implement the following: 1. Adjustment made to ventilator settings. Potential changes: Change vent, increase PIP, increase PEEP	- Infant continues with circumoral cyanosis.
10-20 minutes	Sats rise after surfactant administration Infants then begins to desaturate and remains in the high 70's. Removes 33 mls of air from the right side of chest. VS: HR: 157, BP 39/26 (RUE) sats 77%	NNP: 1. Recognizes signs and symptoms of a potential pneumothorax. 2. Identify ways to determine/confirm a pneumothorax. 3. Time Out performed 4. Perform a needle thoracentesis. – identify the	

	Saturations never reach above 85%	approach and procedure. 5. Orders/administers pain medication. Morphine 0.5-1.0 mg/kg/dose IV or Fentanyl 1mcg/kg/dose IV 6. Assess for the persistence of pneumothorax. (continued desaturation, HD instability, decreased breath sounds) 7. Place a chest tube using the proper technique. – Identify the equipment necessary for placement. 8. Update parents	

Appendix C

Simulation Scenario: Needle Thoracentesis
Learners: NNPs
Competencies/Objectives: To assess competence in the performance of needle thoracentesis

Scoring:
Hits = score as: Y = done correctly N = not done or done incorrectly
IG = instructor guided (i.e., instructor provided prompts through simulator or confederate to elicit the desired action from learner)

Use the comments section to record points for debriefing discussion

Pre-Planned Triggers	Targeted Response	Hits Y/N	IG	Comments
Admission to the unit Infant admitted to NICU and placed on the conventional ventilator CMV 25/5 x 40 100% Infant placed on the cardiorespiratory monitor.	CXR			
	Labs: ABG, CBC, Type & Screen, blood cultures			
	Plan for umbilical lines			
	PIV-intravenous fluids – (D10 @ 80 - 100 mls/kg)			
	Abx- Ampicillin and Gentamicin			
	Maintenance meds: Vit. K, and erythromycin ophthalmic ointment.			

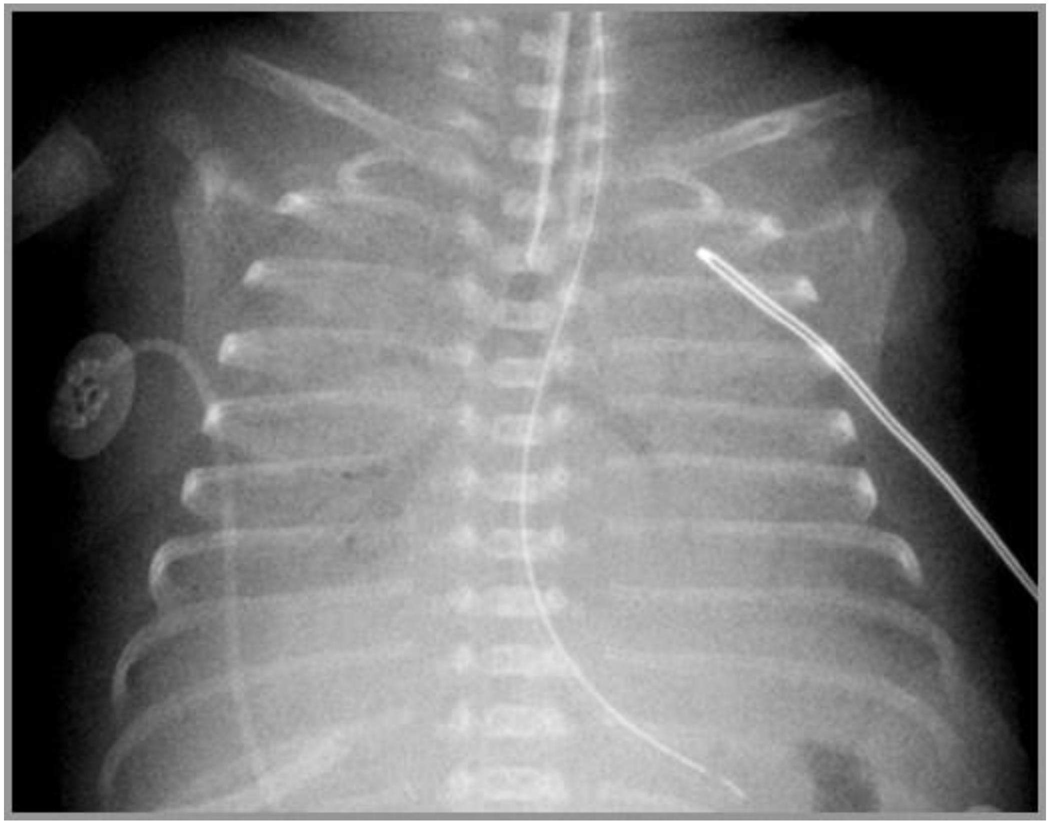
Opening vital signs: T: 37.4 ax, HR 144, BP 54/34, saturation 73% on 50% FIO2.	Asses respiratory effort, breath sounds and other signs of respiratory distress.			
Cxr: ETT just above the carina, NGT in the stomach, ground glass opacities consistent with RDS without focal consolidation, pleural effusion or pneumo.	Order Surfactant: Infrasurf 3.8 mls (3 mls/kg)			
VBG: 7.17/75/39/28/-1 Vitals: HR: 168, BP: 56/33, Sats 79% on 100% FIO2 Surfactant administered	Adjustment made to ventilator settings.			
	Potential changes: Change vent			
	increase PIP			
	increase PEEP			

Sats rise after surfactant administration Infants then begins to desaturate and remains in the high 70's.				
	Request a transilluminator. Transilluminates both side of the chest.			
	Recognizes the signs and symptoms of a potential pneumothorax. - Auscultates and does not hear breath sounds in the right side of the chest.			
	- Heart sounds are muffled.			
	- persistent cyanosis, change in VS: bradycardia and hypotension			

	- Upon transillumination, the right side of the chest lights up more than the left.			
	Identify ways to determine/confirm a pneumothorax. - auscultation, vital signs, transillumination, and chest x-ray.			
	Time Out performed			
	Perform a needle thoracentesis. – identify the approach and procedure: Anterior axillary			
	Anterior mediastinal			
	Orders/administers pain medication.			
Removes 33 mls of air from the	Assess for the persistence of pneumothorax.			

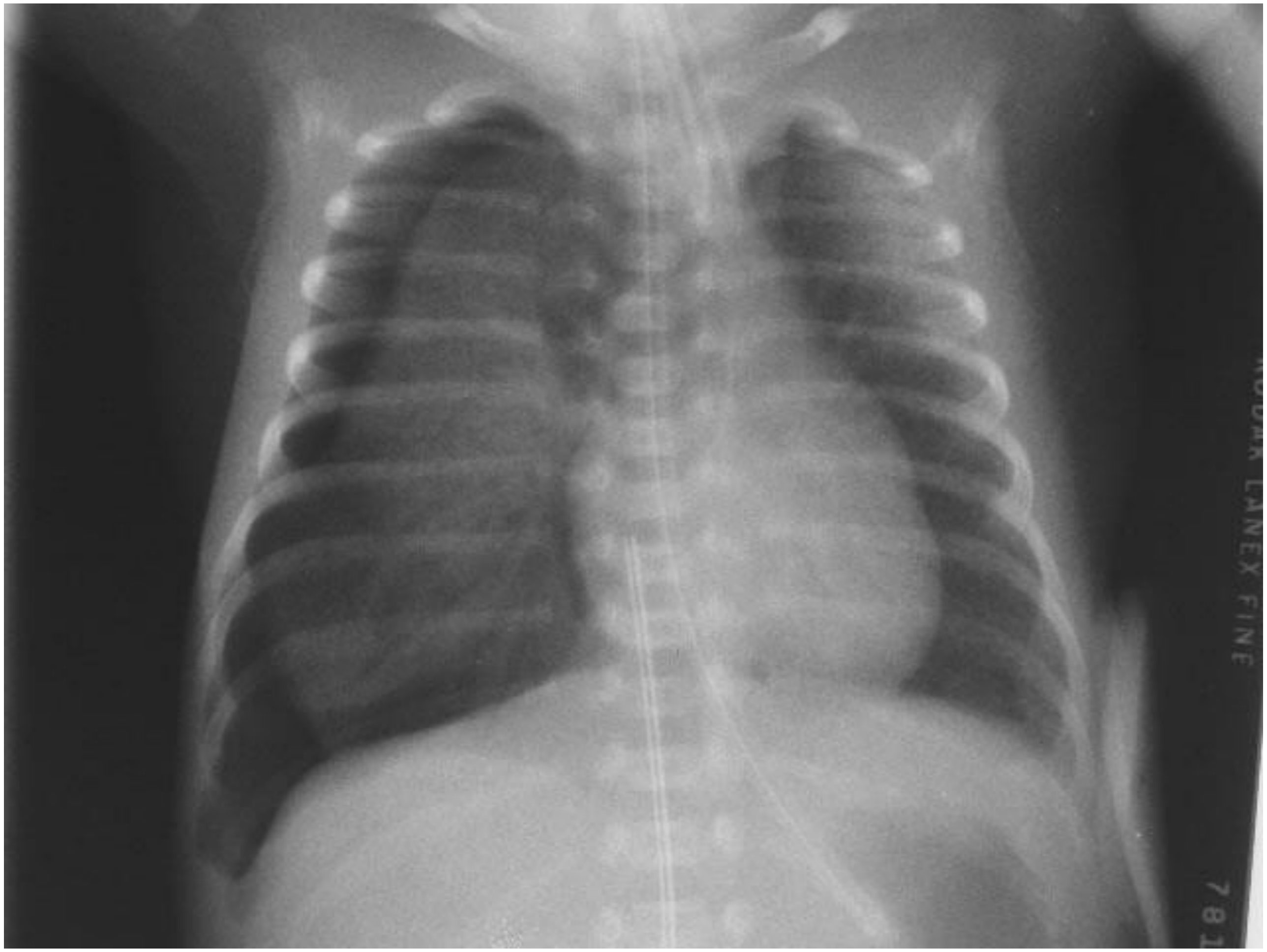
right side of the chest. VS: HR: 157, BP 39/26 (RUE) sats 77% Saturations never reach above 85%	Place a chest tube using the proper technique. – Identify the equipment necessary for placement.			
	Update parents			
	Switch ventilator – HF jet ventilator if not done yet.			

Appendix C



Initial chest xray

Appendix C



Right pneumothorax

Appendix C

Pop top isolette

Appendix C

Room set-up

Appendix D

Evaluation of NNP Procedural Competence: Required Skills

Table C.3.a Chest Needle Thoracentesis

NNP:	yes	No	N/A
Patient: Date			
Explains the indications for doing the procedure			
Discusses the contraindications for the procedure			
Ensures the correct procedure is being done on the correct patient at the correct site (time-out procedure completed)			
Uses appropriate sterile techniques according to protocol			
Sets up the sterile field appropriately			
Appropriately cleans and drapes infant			
Places patient affected side up at a 45-degree angle for air and affected side down for fluid			
Orders sedation and/or pain control if patient vital signs are stable			
Connects 20 ml syringe with IV extension tubing and three-way stopcock (needle aspiration kit)			
Inserts thoracentesis needle at fourth intercostal space (ICS) anterior axillary line or second ICS midclavicular line (affected side) over the top of the rib using a 23g butterfly, 18-20 gauge IV catheter, or introducer needle (pigtail) with 10 ml syringe attached			
Draws back on syringe, causing negative pressure, while slowly advancing thoracentesis needle into pleural cavity			
Stops advancing thoracentesis needle when rush of air obtained in syringe or “pop” of entering pleural is felt			
If using IV catheter, withdraws the needle/stylet and advances the catheter at the appropriate time			
Applies short extension or IV site tubing with three-way stopcock and 20 ml syringe (needle aspiration kit) to thoracentesis needle/catheter			
With stopcock on to patient, draws back on syringe and removes air and fluid from pleural space			
Turns stopcock off to patient, expels air and fluid obtained from the pleural cavity (states amount expelled to documenting staff)			
Turns stopcock back on to patient and then draws back on syringe and removes (air and fluid) from pleural space			
Repeats previous three steps until all air of fluid is removes or decision toe place pleural drainage device is made making sure to pay close attention to stopcock position			
Once procedure is completed, thoracentesis needle or catheter is withdrawn from patient and covered with petroleum gauze and small dressing			
Evaluates vital signs and infant’s tolerance of the procedure throughout the procedure and proceeds or intervenes appropriately			
Evaluates post procedure chest xray			
Documents Procedure			
Comments Reviewed with NNP on ______________________by _________________			

Adapted from “Thoracostomy” by K.Rais-Bahrami & M.G. MacDonald, J.Ramasethu, & K Rais-Bahrami (Eds.), Atlas of procedures in neonatology (5th ed., pp280-281), 2013. Philadelphia, PA: Lippincott Williams & Wilkins. Adapted with permission.

Appendix E

Project Proposal Summary

Description of the problem: Neonatal nurse practitioners (NNP) are obligated to provide care that is timely, high quality, and safe. In academic institutions where there are multiple providers including fellows, residents, and NNPs the number of procedures available per provider for low-volume, high-risk procedures may be very low. Given the procedural competition, it is conceivable that a new NNP could practice for many years and not establish competency. Simulation education provides an opportunity for neonatal nurse practitioners (NNP) to practice low-volume, high-risk procedures without compromising the care of patients or competition.

Project purpose statement: The purpose of this DNP project is to implement a simulation competency activity in needle thoracentesis.

Project goals: The goal of this project is to determine whether the use of simulation will increase the confidence and competence of the NNP in the performance of a needle thoracentesis.

Implementation Plan: A quality improvement project designed to assess competence confidence of the NNPs in performing a needle thoracentesis will be implemented in a level IV NICU in Baltimore, MD. The simulation will be implemented for an estimated 16 full-time neonatal nurse practitioners in this NICU.

Procedures and timeline: This quality improvement project is anticipated to take place over 11 weeks. During weeks one through two a survey will be sent to the NNPs via email utilizing Qualtrics survey. The survey will assess NNP confidence and competence in performing a needle thoracentesis and was developed by the project leader. During week three, a PowerPoint slides on performing a needle thoracentesis will be sent out to the NNP team. The team will be given weeks three through five to complete the PowerPoint slides. Once each NNP completes the PowerPoint, they will be required to email the project leader to be signed off. During week four the project leader will lead a simulation run through for the champions. Each NNP will complete the simulation weeks six through eleven. After each NNP completes the simulation, they will retake the survey previously administered. All simulations will be led by the project leader or a champion.

Data collection: Data will be collected from the Likert style pre and post-simulation survey and compared. Objective data regarding competence will be collected from the Behavioral Assessment Tool (BAT) and the Evaluation of NNP Procedural Competence: Required Skills, Table C.3.a Chest Needle Thoracentesis checklist from the Competencies and Orientation Toolkit for Neonatal Nurse Practitioners by NANNP (2014).

Analysis plan: The quantitative data collected from the surveys will be organized by common themes and patterns. Data from the needle thoracentesis checklist and the BAT will be organized according to whether the NNP met or did not meet procedure competence. A project description will be submitted for IRB approval from the University of Maryland Baltimore Institutional Review Board for a Non-Human Subjects Research and the Johns Hopkins Hospital IRB. All data will be stored on a password-protected computer or locked cabinet.

Appendix F

NNP Confidence and Competence Survey Results		
Variable	**Pre-simulation Mean Rating (SD)[a]**	**Post-simulation Mean Rating (SD)[a]**
Confidence in identifying the signs and symptoms of a tension pneumothorax.	1.3 (0.48)	1.1 (0.32)
Confidence in identifying the indications and contraindications of needle thoracentesis.	1.5 (0.97)	1.3 (0.48)
Confidence in identifying the signs and symptoms of an infant in distress secondary to a tension pneumothorax.	1.2 (0.42)	1.1 (0.32)
Confidence in determining when a needle thoracentesis is necessary versus allowing spontaneous resolution	2 (0.94)	1.2 (0.42)
Confidence in quickly and accurately assembling the required equipment for a needle thoracentesis in the event of an emergency	1.6 (1.07)	1.3 (0.48)
Confident in performing an emergency needle thoracentesis competently without or with minimal procedural guidance.	1.9 (1.29)	1.3 (0.48)
Confidence in performing a needle thoracentesis whenever necessary without procedural review	2 (1.33)	1.5 (0.53)
Confidence in troubleshooting unexpected problems that may occur during a needle thoracentesis.	2.6 (1.43)	1.6 (0.52)
Confidence in incorporating patient safety measures in the event of an emergency thoracentesis.	1.8 (1.03)	1.3 (0.48)

[a] 5-point Likert scale: 1= strongly agree; 2 = somewhat agree, 3 = neither agree nor disagree; 4 somewhat disagree; 5= strongly disagree

Appendix G

Performance Rubric Scoring
0=inadequate performance/not performed, 1= adequately performed 1. Diagnosis tension pneumothorax (physical examination, chest x-ray, transillumination) 2. Requests needle thoracentesis supplies 3. Performs a time out to ensure the right time, right patient and right procedure 4. Identifies insertion approach 5. Addresses pain management 6. Uses appropriate sterile technique/ maintains sterility 7. Appropriately positions the patient for the procedure and maintains position 8. Cleans skill per hospital protocol 9. Assembles needle thoracostomy setup appropriately 10. Identifies appropriate landmarks 11. Inserts catheter into the appropriate intercostal space over the top of the rib 12. Inserts catheter into the pleural cavity to a depth at which air is obtained 13. Manipulates stopcock appropriately to remove air from the chest 14. Manipulates stopcock to expel air from syringe appropriately 15. Continues until all air expelled or a chest tube is placed. 16. After the completion of the procedure, the petroleum jelly gauze and dressing is placed 17. Evaluates tolerance of the procedure throughout the procedure and intervenes appropriately 18. Obtains and evaluates post-procedure chest x-ray