Fall 12-8-2017

Proposed Practice Change to Perform Ultrasound Lung Scans Immediately Following Upper Extremity Peripheral Nerve Blocks to Rule Out a Pneumothrax

Robert Gaston

PROPOSED PRACTICE CHANGE TO PERFORM ULTRASOUND LUNG SCANS IMMEDIATELY FOLLOWING UPPER EXTREMITY PERIPHERAL NERVE BLOCKS TO RULE OUT A PNEUMOTHORAX

by

Robert Adam Gaston

A Capstone Project
Submitted to the Graduate School,
the College of Nursing,
and the Department of Advanced Practice
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Nursing Practice

December 2017

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ABSTRACT

PROPOSED PRACTICE CHANGE TO PERFORM ULTRASOUND LUNG SCANS IMMEDIATELY FOLLOWING UPPER EXTREMITY PERIPHERALNERVE BLOCKS TO RULE OUT A PNEUMOTHORAX

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Regional anesthesia is a technique that can be used for a variety of surgeries. There are risks involved when regional anesthesia is performed. Specifically when upper extremity nerve blocks are performed a potential complication is a pneumothorax. The purpose of this DNP project was to propose a practice change to perform ultrasound (US) lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. A needs assessment was conducted at the host facility to determine if the anesthesia providers were aware that US was a method that could be useful for detection of a pneumothorax. Currently, the majority of anesthesia providers at the host facility where the practice change was proposed are unaware that US lung scans are a useful and accurate method to detect a pneumothorax. The information collected from the literature review revealed that US was a technique that was more accurate, sensitive, and specific to diagnose a pneumothorax than CT. An evidence based presentation was presented to 10 anesthesia providers at a level II facility in the southeastern United States. Following the presentation, anesthesia providers completed a pre intervention survey and were asked to implement the practice change for a month. After a month, a post intervention survey was completed to determine if a practice change occurred. The results were evaluated by using descriptive statistics. The results of the project determined that 25% of

the participants changed their practice to use US for detection of a pneumothorax following upper extremity nerve blocks.

ACKNOWLEDGMENTS

I would first like to thank Dr. Marjorie Giesz-Everson for her support and guidance throughout my project. With Dr. Everson's guidance, she has evolved me into the person and professional that I have become today. I would also like to thank my committee members Dr. Rayborn and Dr. Harbaugh for all their contributions throughout this process and setting me up for success. Lastly, I am thankful to the host facility for allowing me to carry out my project at their facility and the participants that were willing to participate in my project. Without their help, this DNP project would not have been possible.

DEDICATION

First and foremost, I would like to give God the glory for guiding me through this long and strenuous process. I dedicate this DNP project to my wife, Beth Gaston, and family. To my wife Beth, I want to thank her for her unfailing love and support throughout the last three year. Her words of encouragement and support made it possible for me to be successful. To my family, I would also like to thank you for the support, thoughts, and prayers throughout this process.

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LIST OF ABBREVIATIONS

CT	Computed Tomography
CXR	Chest X-RAY
DNP	Doctorate of Nursing Practice
E-fast exam	Extended Fast Examination
IRB	Institutional Review Board
TS	Transthoracic Sonography
US	Ultrasound
OR	Operating Room
QI	Quality Improvement

CHAPTER I - INTRODUCTION

Statement of the problem

Several techniques exist to provide safe anesthesia to patients. Regional anesthesia is one type of technique that can be utilized. There are risks involved when regional anesthesia is performed, specifically when upper extremity peripheral nerve blocks are utilized. One risk is a pneumothorax (Donmez et al., 2012). Daley (2016) defined a pneumothorax as "air or gas in the pleural cavity which can impair oxygenation and/or ventilation" (p. 1). The risk for obtaining a pneumothorax increases when using a landmark or nerve stimulator technique during administration of an upper extremity peripheral nerve block (Gauss et al., 2014). The prevalence of a pneumothorax when these particular methods are utilized is 0.2-0.7% for an infraclavicular block and 6.1% for a supraclavicular block (Gauss et al., 2014). Although the use of US for regional anesthesia decreases the risk of a pneumothorax, the chance of causing one is still present due to the close proximity of the lung (Gauss et al., 2014). While performing an upper extremity peripheral nerve block, the risk for a pneumothorax is higher due to the apex of the lung being very close to the needle insertion. The current methods to detect a pneumothorax are computed tomography (CT) or chest x-ray (CXR) (Kline et al., 2013). Alternative methods should be considered to detect a pneumothorax directly after performing upper extremity peripheral nerve blocks.

Background and Significance

US is a method that gives anesthesia providers the opportunity to detect and diagnose a pneumothorax in a timelier manner (Kline et al., 2013). The use of US to rule out a pneumothorax is a simple and quick technique. This technique may increase patient

safety, quality of care, has the potential to be more cost effective, and provide a proactive preventative approach. The current gold standard for the detection of a pneumothorax is CT (Kline et al., 2013). Traditional gold standards such as CT or CXR may not be possible to complete in perioperative areas (Kline et al., 2013). According to Barash et al. (2013), it is required that a CT must be obtained as a definite test, but an US lung scan may be utilized following procedures that increase the risk of obtaining a pneumothorax to initially rule out a pneumothorax (Barash et al., 2013). US is an alternative diagnostic method that can be utilized and presents multiple advantages. US provides the anesthesia providers with the opportunity to rule out life-threatening complications more quickly than CT (Kline et al., 2013). US advantages include US is more accurate than CT in diagnosing a pneumothorax, decreased amount of radiation exposure, reduced cost, ease of use, and radiologists are not required to diagnose a pneumothorax (Kline et al., 2013). The use of US for the detection of a pneumothorax is a more cost effective method than CT (Kline et al., 2013). The cost of a CT can range anywhere from $1,200 to $3,200 depending on the scan. Whereas, the cost of an US depending on the area examined, ranges from $100 to $1,000 (CT scan vs Ultrasound, 2017). Using US for detection of a pneumothorax would not only be more cost effective for the patients but also the healthcare facility. Since the anesthesia providers will already have the US readily available from performing upper extremity peripheral nerve blocks, a post procedural US lung scan would be beneficial to the patient to rule out a pneumothorax. This change in practice could increase the quality of care and safety provided to patients at no additional cost.

US is an inexpensive, time efficient, and portable way to diagnose a pneumothorax (Goodman et al., 1999). US allows clinicians to diagnose a pneumothorax and treat in a timelier manner, thus, increasing patient safety and quality of care. The time to diagnose a pneumothorax is approximately 5 to 7 minutes using US, where as it could potentially take 80 minutes when CXR or CT is used (Kline et al., 2013). CT or CXR are also more difficult to complete in the perioperative areas (Kline et al., 2013). The reason it would be beneficial to utilize US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. US appears to be an efficient and safe option to detect a pneumothorax after upper extremity peripheral nerve blocks. The purpose of this DNP project was to propose a practice change to perform US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. Using a proactive preventive approach to detect a pneumothorax before the symptoms present may increase the quality care and patient safety.

US utilizes soundwaves from 2-16 MHZ (Kline, 2011). The seven characteristics that describe US are period, frequency, propagation speed, amplitude, power, intensity, and wavelength (Kline, 2011). The two types of US probes available are linear and curved probes. A curved probe allows for greater depth but the resolution is lost. Whereas, a linear probe has clearer resolution but cannot penetrate tissues as deeply as the curved probe (Kline, 2011). The type of probe that is best to use for detection of a pneumothorax is a high frequency linear probe. This type of probe would allow anesthesia providers to have a clearer picture of the lung tissues. According to Kline (2011), the two types of resolution are longitudinal and lateral. Longitudinal resolution pertains to the ability to separate two or more distinct objects that are shallow or deep to

one another. Lateral resolution relates to the ability to differentiate two or more objects that are located next to each other but are close to the same depth (Kline, 2011).

The three main steps in the use of US are image acquisition, image interpretation, and needle placement (Kline, 2011). When clinicians are performing and interpreting US lung scans, they must understand that bones are dense material that inhibit sound waves (Kline et al.2013). Understanding this concept is essential to performing a successful scan. Anesthesia providers must know that the lung scans must be performed away from the bones at the intercostal spaces to evaluate for a pneumothorax (Kline et al. 2013). A critical concept to understand when scanning the lung tissues is that pneumothorax air rises to the highest point (Kline et al., 2013).

In order for anesthesia providers to accurately view the lung tissues with US, there are two different modes that are available on US. The modes are B-mode or "brightness mode" and M- mode or "motion mode" (Kline et al., 2013). B-mode is the most commonly used mode by anesthesia providers. This particular mode is useful in visualizing the anatomy. The brightness parallels the amplitude of the sounds being reflected. B-mode offers real-time imaging of lung tissues that are visible (Kline et al., 2013). M- Mode or "Motion mode" is an additional mode that is available on US that is required to detect a pneumothorax. M- Mode uses acoustic waves to reveal the lung tissue movements (Kline et al, 2013).

US gives anesthesia providers the ability to interpret images of the lung tissue and identify the proper signs to rule out a pneumothorax. When using US to assess for a pneumothorax, there are specific criteria that excludes a pneumothorax. Anesthesia providers must be familiar with specific signs US produces in the lung parenchymal to

effectively rule out a pneumothorax. These signs are bat sign, lung sliding, B lines, lung point, seashore sign, and stratosphere/barcode sign (Kline et al., 2013).

Bat sign (Figure 1), is an important characteristic that must be identified. It is a landmark that describes a certain pattern seen when the lung fields are scanned. This sign can be detected quickly and represents normal chest anatomy (Kline et al., 2013). The bat sign is made up of an upper rib, lower rib, and pleural line. The outer portion of the parietal pleura forms the body (Kline et al., 2013).

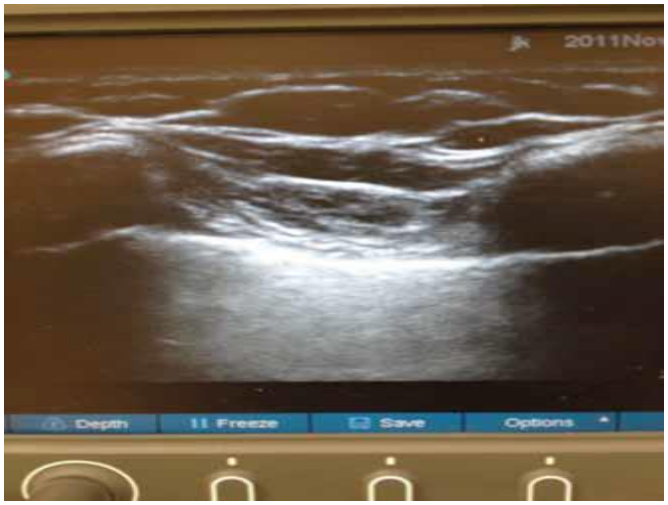

Figure 1. Normal lung image that shows bat sign

Note: (From Kline et al., 2013 p.267) reprinted with permission

Lung sliding is another sign that can be seen on US to rule out a pneumothorax. It is defined as the movement of the parietal pleura as it connects with the visceral pleura (Kline et al., 2013). Lung sliding is a normal physiological finding and can be seen during respiration. When a pneumothorax forms, it separates the two pleural layers. When air separates the two pleural layers, it inhibits normal lung sliding (Kline et al., 2013). If air is visualized instead of lung sliding or lung sliding is absent, a pneumothorax is suspected (Kline et al., 2013).

B-Lines are characteristics that are essential in ruling out a pneumothorax with US. B-lines appear as a vertical light or comet tail artifact (Kline et al., 2013). During respiration, B-lines may or may not move. Other names that describes B-lines are lung rockets or laser beams (Kline et al., 2013). According to Kline et al. (2013), B-lines are not only utilized to rule out a pneumothorax, but B-lines can indicate elevated pulmonary artery occlusive pressure and pulmonary edema.

Lung point (Figure 2) is a characteristic visualized on US that is critical when scanning for a pneumothorax. This signifies the border of the pneumothorax. According to Kline et al. (2013), "Lung point is the border at which normal parietal and visceral pleural separates to become a pneumothorax" (Kline et al., 2013 p. 269). The presence of lung point is a positive sign for a pneumothorax and visualizing lung point is 100% specific for ruling a pneumothorax (Kline et al., 2013).

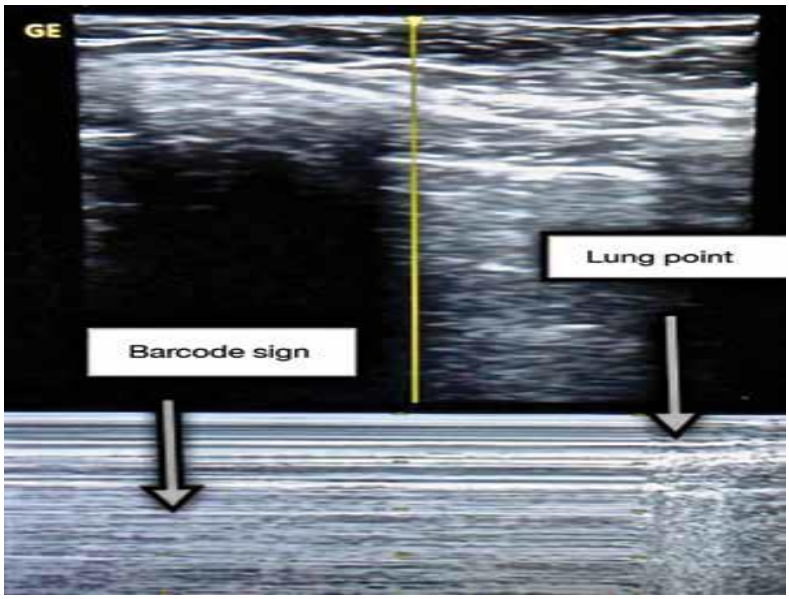

Figure 2. Lung Point

Note: (From Kline et al., 2013 p. 270) reprinted with permission

The last two signs that are important to locate with US to rule out a pneumothorax are seashore sign and stratosphere/barcode sign (Figure 3). A seashore sign is a sandy appearance under the pleural line. When a seashore sign is seen, it indicates normal lung tissue and a pneumothorax can be excluded (Kline et al., 2013). Whereas, a stratosphere or barcode sign is the absence of normal seashore sign below the pleural line, and it is replaced by multiple horizontal line that resemble a barcode. This sign indicates the presence of a pneumothorax (Kline et al., 2013). By understanding these specific signs, the anesthesia providers would be able to use US directly after administering upper extremity peripheral nerve blocks to exclude a pneumothorax. US lung scans could decrease the time it takes to detect and diagnose a pneumothorax, leading to better outcomes for the patient.

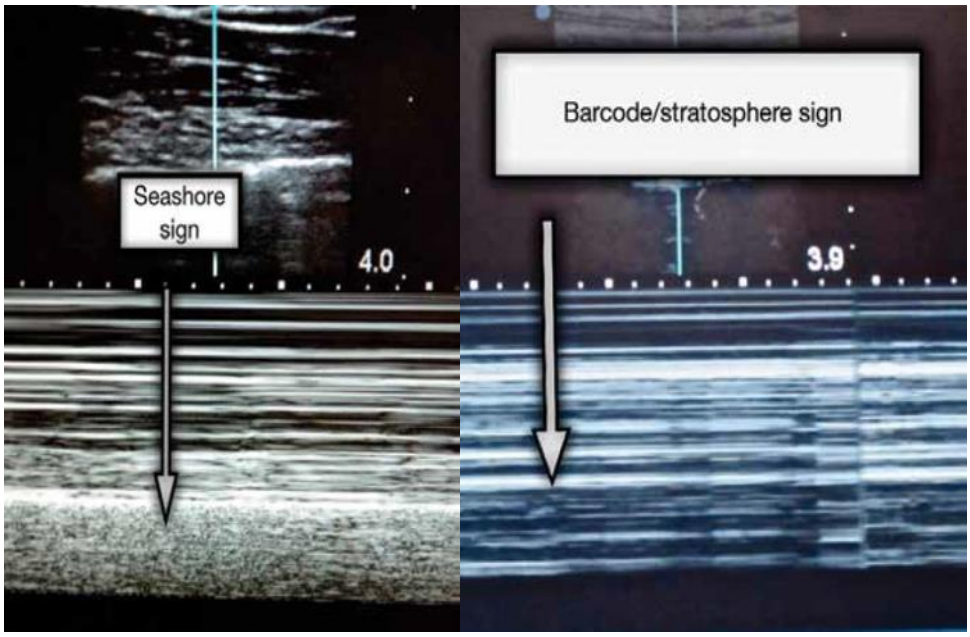

Figure 3. Seashore sign and Barcode sign

Note: (From Kline et al., 2013 p. 269) reprinted with permission

The assessment that is utilized when using US to detect a pneumothorax is the extended fast (e-FAST) examination. The e-Fast examination assesses for five comorbidities including pleural effusion, pneumothorax, free fluid in the pelvis, pericardial fluids, and intraperitoneal fluid (Moore & Copel, 2011). The e-FAST assessment may be performed in 5 minutes or less with a sensitivity of 73-99%, specificity of 94-98%, and overall accuracy of 90-98% (Moore & Capel, 2011). Utilizing the e-Fast assessment has been shown to decrease the need for CT. Utilization of the e-Fast assessment decreased the time for appropriate interventions, resulting in shorter hospital stay, lower cost, and lowers mortality (Moore & Capel, 2011).

When scanning the lungs for a pneumothorax, the anesthesia provider must take a slow thorough approach. The anesthesia provider must assess the patient and consider their history for any recent lung diseases, surgeries, or trauma that could alter the images on the US (Kline et al., 2013). Another important aspect when performing a US lung scan is the position of the patient. The patients must be positioned where the anesthesia provider has the greatest access to the area of the lung that is suspected of being affected. It is important for the anesthesia provider to begin the US lung scan in the area where the pneumothorax is most likely present. For a patient in the supine position, it would be the anterior chest region (Kline et al., 2013). The anesthesia provider must be familiar with the use of US. A high- frequency linear probe must be used and the depth be set to allow deep viewing of the lung tissues. For adult patients, the depth should be set at 4 cm (Kline et al., 2013). The US lung scan should be initiated by selecting B-mode and place the probe on the anterior chest wall. A bat sign should be obtained and identify the pleural line. Also, assess for lung sliding during respiration (Kline et al., 2013). The

anesthesia provider should scan all aspects of the lung and each time an irregularity is visualized the US should be changed to M-mode to assess for seashore sign or barcode sign (Kline et al., 2013). If no anomalies are visualized, move the probe over the next intercostal spaces until all the lung fields are scanned.

Purpose of the Project

The purpose of this DNP project was to propose a practice change to perform US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. The change in practice may increase patient safety and improve quality of care by detecting a pneumothorax prior to the onset of symptoms. Being proactive in detecting a pneumothorax before symptoms occur would allow the clinicians to intervene before a pneumothorax advances to a more serious situation or before the start of the procedure.

Needs Assessment

Currently, the majority of anesthesia providers at the host facility where the practice change was proposed were unaware that US lung scans were a useful and accurate method to detect a pneumothorax. An informal poll was given to anesthesia providers at the host facility to assess if they were aware of the use of US for detection of a pneumothorax. It was found that a majority of anesthesia providers were unaware that US was a useful and accurate tool for detecting a pneumothorax. The goal of this DNP project was to propose a practice change to use US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. The change in practice could increase the quality and safety of care given to patients. The benefits of using US is that it has been shown to be easier to use, leads to shorter hospital stays,

lowers the cost, mortality, and decrease the amount of radiation the patient and staff are exposed to (Moore & Capel, 2011). This DNP project provided evidence that US is a technique that is an accurate, specific, and sensitive way to detect a pneumothorax, and it can be utilized immediately after an upper extremity peripheral nerve block to rule out a pneumothorax. The strengths of this project was that a pneumothorax could be ruled out immediately after upper extremity peripheral nerve blocks by completing a US lung scan. This would be beneficial for the patient by ruling out a pneumothorax earlier rather than waiting for the patient to exhibit symptoms. A possible weakness of the project was the difficulty to persuade practitioners to use US lung scans after initiation of regional anesthesia. The argument was that using US to place upper extremity peripheral nerve blocks already decreases the chances of a pneumothorax. Although using US significantly decreases the chances of a pneumothorax, the incidence of a pneumothorax is still present (Gauss et al., 2014). Another weakness was that performing a US lung scan would add more time for the anesthesia provider before initiating anesthesia possibly prolonging the time the patient is in the operating room(OR). A threat that posed a challenge for this project's success was if the anesthesia providers were unwilling to participate in performing US lung scans.

Clinical Question

Will anesthesia providers change their practice after receiving an evidence-based educational intervention related to the use of US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax? A pneumothorax is a potential complication when upper extremity peripheral nerve blocks are administered. If anesthesia providers are willing to change their practice to perform US lung scans

immediately following upper extremity peripheral nerves blocks it could increase the quality of care and safety given to patients.

Doctor of Nursing Practice Essentials

As a Doctoral level nursing DNP project, completing the doctoral nursing practice (DNP) essentials are required to be incorporated in the project. All DNP Essentials for this DNP project were met and can be found in Appendix A along with an explanation on how each essential was achieved. The DNP essentials that were most closely related to this DNP project were DNP essentials I, II, VI, and VIII.

Theoretical Framework

The objective of this DNP project was to facilitate a practice change. The literature that this most closely relates to is the model for change to evidence based practice by Rosswurm and Larrabee (1999). According to Rosswurm and Larrabee (1999), "this model is developed from theoretical and research literature related to evidence base practice, research utilization, and change theory" (p.317). Rosswurm and Larrabee's model guides practitioners through the change to evidence based practice beginning with the assessment of the need to change and ending with the integration of an evidence based protocol (Rosswurm & Larrabee, 1999). While using Rosswurm's model for change, there are six steps that are required. The six steps are assess the need for change in practice, link the problems with interventions and outcomes, synthesize best evidence, design a practice change, implement and evaluated the change in practice, and integrate and maintain the change in practice (Rosswurm and Larrabee, 1999). The Model for changes to evidence base practice offers a reliable guide for assessing and implementing a change in practice.

The model related to this DNP project because it proposed a practice change that is supported by evidence. A needs assessment was conducted by using an informal poll investigating if anesthesia providers were aware that US was a useful tool to detect a pneumothorax. It was found that the majority of anesthesia providers were not aware that US could be utilized. This practice has the ability to increase patient safety and quality of care. The second step of Rosswurm's change theory is linking the problems with interventions. The third step is to synthesize the evidence. A thorough literature review was conducted and articles were found that supported the use of US lung scans to detect a pneumothorax and its benefits. This information was presented to the anesthesia providers educating them use of US for the detection of a pneumothorax. The next two steps were to design a practice change and implement and evaluate the change. The purpose of this DNP project was to propose a practice change to use US lung scan immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. The current literature supported the use of US for detection of a pneumothorax. Next, the anesthesia providers were asked to implement this practice change for 4 weeks immediately following the evidence-based presentation. A post survey was given 4 weeks after implementation assessing if they utilized US after upper extremity peripheral nerve blocks. The survey asked the anesthesia providers what barriers they faced when implementing the change. After the survey was completed, the results were evaluated. From the data collected, it was determined if a practice change occurred.

Review of Literature

The following section is a narrative review of literature regarding the use of US for the detection of a pneumothorax. The online databases utilized to obtain scholarly articles related to the clinical question was PubMed and Google Scholar. The mesh words used were accuracy, detection, pneumothorax, and ultrasound. After reviewing the articles six were found that were pertinent to this DNP project. Citation chasing was utilized to find one article. An additional article was obtained at a Mississippi Association of Nurse Anesthetists mid-year summer meeting during a lecture pertaining to US.

Ultrasound Detection of a Pneumothorax

A pneumothorax may be a life threatening condition that needs prompt attention. US is an alternative tool available with the ability to rule out a pneumothorax by assessing lung function (Goodman et al., 1999). Goodman et al (1999) conducted a benchmark study to determine if the use of US was more accurate in detecting a pneumothorax than CT. The study was conducted to compare US vs CT for the detection of a pneumothorax. The sample included 29 patients following 41 CT guided lung biopsies. In this study, US exams of the chest were limited to a pneumothorax caused by a biopsy needle puncture (Goodman et al., 1999). From the 29 patients who underwent lung biopsies, 13 patients developed a pneumothorax. Seven of the pneumothoraxes were detected by US, whereas, the other six were visible by CT.

When US was utilized there were no false positive diagnoses for a pneumothorax. It was determined from the study that there was 100% positive predictive value and a negative predictive value of 82% when US was used. The results of the study determined that US was more sensitive in detecting a pneumothorax than CT. Goodman et al (1999)

suggests that US is a valuable tool for rapid detection of a pneumothorax for first line therapy when US is readily available. This study provides evidence that using US lung scan to detect a pneumothorax immediately after interventions that place patients at an increased risk of a pneumothorax is a valuable tool that is accurate and efficient.

Point of Care Ultrasonography

Healthcare professionals have utilized US for diagnostic purposes and guidance during procedures such as upper extremity peripheral nerve blocks (Moore & Copel, 2011). According to Moore and Copel (2011), "Point-of-care ultrasonography is defined as ultrasonography brought to the patient and performed by the provider in real time. Point-of-care US images can be obtained almost immediately, and the clinician can use real-time dynamics, allowing findings to be directly correlated with the patient's presenting signs and symptoms" (p.750). Another advantage of point of care ultrasonography is it can be used for diagnostic purposes. A focused e- fast examination is a tool that is useful to rule out a pneumothorax when patients are exhibiting signs such as hypotension, dyspnea, or shortness of breath, which are common signs and symptoms of a pneumothorax (Moore & Copel, 2011).

An e- Fast examination is a tool that is used to focus on five examinations for the detection of: free intraperitoneal fluid, free fluid in the pelvis, pericardial fluid, pleural effusion, and a pneumothorax (Moore & Copel, 2011). The e-Fast examination can be completed in 3 to 5 minutes and has a sensitivity of 73-99%, specificity of 94-98%, and overall accuracy of 90-98% (Moore & Copel, 2011). This test has the ability to decrease the use of CT and reduce time for interventions, making it more cost effective by resulting in shorter hospital stay, lower cost, and lower overall mortality and morbidity.

Also since the anesthesia provider had the US available from performing an upper extremity block, a post procedure US lung scan had no additional cost. US has been shown to be more accurate than auscultation or CT for detection of pleural effusion or a pneumothorax (Moore & Copel, 2011). Using US lung scans to detect and rule out a pneumothorax after upper extremity peripheral nerve block can increase patient safety and improve the quality of care that the patients receive. Using US lung scans to rule out a pneumothorax would decrease the amount of radiation exposure for the patient and staff and reduces the time for appropriate intervention which result in increased quality and safety (Moore & Copel, 2011).

Value of Ultrasound in Diagnosis of a Pneumothorax

Jalli et al (2012) evaluated the effectiveness of US in detecting a pneumothorax. US is a useful method for detecting a pneumothorax and to evaluate lung function. The goal of this study was to compare the accuracy of US in detecting a pneumothorax compared to CT. The gold standard for the detection of a pneumothorax is CT (Jalli et al., 2012). The sample included 197 participants who were suspected of having a pneumothorax. US was performed and compared to the CT findings. The sensitivity, specificity, and accuracy of US were then compared to CT. Out of the 197 patients CT detected pneumothoraxes in 92 patients. US found 74 pneumothoraxes. The statistical analysis of this study determined the US's sensitivity to be 80.4%, specificity 89% in detecting a pneumothorax with an accuracy of 85%. CT showed that it was 61% sensitive, 98% specific, and 80% accurate. The author determined from this study that US as a tool is more sensitive, specific, and accurate than CT in detecting a pneumothorax. (Jalli et al., 2012).

Use of Ultrasound at Beside

Donmez et al (2011) evaluated whether US was an effective technique to detect a pneumothorax. The population studied were 240 patients suspected of having a hemithorax who were assessed with chest x-ray and bedside US expecting of having a pneumothorax. CT was utilized on 68 patients who were suspected to have a pneumothorax. 52 patients were excluded from the study because they did not undergo CT examination. The sensitivity, specificity, and accuracy of the chest x-ray and US were then determined. 136 hemithoraces were assessed in 68 patients (Donmez et al., 2011). 35 pneumothoraxes were found in 33 patients, and US correctly diagnosed 32 pneumothoraxes. The study discovered that US's sensitivity was 91.4%, specificity was 97%, and overall accuracy of 97%. The results of the study found that the sensitivity of CT was 82.7%, specificity was 68.5%, and overall accuracy of 89.5%. The researchers concluded the bedside US is an accurate technique that can be used to rule out a pneumothorax rather than chest x-ray (Donmez et al., 2011). The evidenced gathered by this study supports that US is a useful tool that is accurate to detect a pneumothorax. Utilizing US after upper extremity nerve blocks would rule out a pneumothorax in the early stages and provide time to intervene and correct the problem before it becomes more serious. Based on the evidence presented, using this practice could increase the quality of care given to patients.

Lung Ultrasound in Critical Ill Patients

Xirouchaki et al. (2011) piloted a study to compare the performance of lung US and bedside chest x-rays in ICU patients. CT was used as the gold standard. The population was made up of 42 ventilated patients that where scheduled for a CT. Four comorbidities were being studied, which were consolidation, interstial syndrome, pneumothorax, and pleural effusion (Xirouchaki et al., 2011). In the OR setting, US is an important tool that has the ability to diagnose a pneumothorax without transporting the patient. US lung scans are safer for the patient because it can decrease the amount of time it takes to detect a pneumothorax. US lung scans have been utilized with great success to detect comorbidities such as a pneumothorax, pleural effusion, and interstitial syndrome (Xirouchaki et al., 2011). The results of the study revealed that when chest x-ray was utilized, the sensitivity was 0%, specificity was 99%, and accuracy 89% in detecting a pneumothorax. Whereas, when US was used on the same population the sensitivity was 75%, specificity was 93%, and overall accuracy 92 %. It was determined that the possible causes for low sensitivity of US could be from the small number of cases and the population having lung diseases. The researchers concluded that US has noticeably better diagnostic performance than chest x-ray and may be used to detect a pneumothorax (Xirouchaki et al., 2011).

Accuracy of Ultrasound Compared to CT

ReiBig and Keroegel (2004) studied the accuracy of transthoracic sonography in ruling out a pneumothorax and hydropneumothorax compared to chest radiography. Transthoracic sonography (TS) has become an alternative method for diagnosing and detecting pulmonary disorders such as a pneumothorax. This study was conducted in

Europe and the term transthoracic sonography is synonymous with ultrasonography. The purpose of this study was to determine whether TS could replace CT in diagnosing a pneumothorax (Reibig & Kroegel, 2004). The sample included 53 patients in which 35 underwent transbronchial biopsy. 18 patients were also included in the study that had obtained chest tube placements. TS was completed after transbronchial biopsy or when chest tubes were removed. A chest x-ray was performed after each TS.

The results of the study showed that a pneumothorax occurred in 4 out of the 53 patients. One out of 35 patients of the population developed a pneumothorax. The study found that the sensitivity, specificity, and accuracy of TS was 100% in ruling out a post interventional pneumothorax (Reibig & Kroegel, 2004 p. 1). The authors concluded TS is a useful method for the diagnosis of pneumothoraxes. Chest sonography provides a cost-effective, safe, and non-invasive technique that permits an instant exclusion of a pneumothorax (Reibig & Kroegel, 2004). This article provides evidence that US is a useful tool that can be utilized to detect a pneumothorax after procedures such as upper extremity nerve blocks. US lung scans could increase the safety and quality of care the patient receives.

Detection of a Pneumothorax with Ultrasound

Kline et al (2013) agreed that the use of US for the detection of a pneumothorax is a cost effective technique. A review of the literature was completed to determine which method, US vs CT, was more accurate, sensitive, and specific to detect a pneumothorax. Kline et al. (2013) found that bedside US was a more sensitive screening test for detecting a pneumothorax than CT. It was determined that US has the ability to separate different sizes of pneumothoraxes, and its diagnostic value matched CT scans. Another

advantage that Kline noticed was that US equipment is much easier to transport and it produces higher quality images at a faster rate. Having US close to the bedside allows the anesthesia providers to use US in the perioperative area to rule out a pneumothorax. US is an effective diagnostic tool that has the ability to rapidly intervene if a pneumothorax develops into a life-threatening situation. CT scans may not be available to the anesthesia provider in a timely manner (Kline et al., 2013). By having the ability to rapidly detect a pneumothorax, it may increase the quality of care and safety that is available for patients. Kline et al. (2013) also stated there is less radiation exposure to the patient and staff and US provides a faster diagnosis of a pneumothorax. Faster detections of a pneumothorax is a positive quality of US because an US lung scan can be performed after the placement of upper extremity regional block and a pneumothorax can be ruled out before initiating anesthesia.

Conclusion

From the literature review, it was found that US is a safe and effective alternative to detect a pneumothorax. US is a useful method to expose a pneumothorax due to US being more accurate, sensitive, and specific than CT or CXR. An additional advantage found from the literature review was that US is portable and easier to transport. Being portable makes using US a better option to use in the OR setting because the equipment to detect a pneumothorax can be brought to the patients rather than transporting the patients. From the evidence presented, US may increase the quality of care and safety of patients in the perioperative setting by giving anesthesia providers the ability to perform a US lung scan immediately following upper extremity blocks. The literature revealed US to be more accurate, sensitive, and specific than CT. The information from the literature

review shows that US is an attractive alternative to use for a post procedure scans to rule out a pneumothorax. Another added benefit is that US can be done much quicker than CT. Having the ability to diagnose a pneumothorax faster it may increase the quality of care and safety provided to the patients by allowing anesthesia providers to perform post procedural US lung scan immediately after upper extremity nerve blocks. Another benefit of US found from the literature review was that US's ability to detect pneumothoraxes without exposing the patient or staff to radiation, decreased cost, easy to use, and a radiologist is not needed to diagnosis a pneumothorax. The articles reviewed presented evidence that the use of US after upper extremity nerve blocks may increase the quality of care and safety to patients.

CHAPTER II – METHODOLOGY

Overview

The goal of this DNP project was to propose a practice change to perform US lungs scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. The specific upper extremity nerve blocks that US lung scans will be performed after are interscalene, supraclavicular, and infraclavicular blocks. Anesthesia providers were asked to change their practice to use US lung scans after these procedures to rule out a pneumothorax for a period of 4 weeks. A literature review was conducted and revealed that US is a useful technique that can be utilized that is accurate, specific, and sensitive in detecting a pneumothorax. The main goal of this DNP project was to provide evidence-based research to anesthesia providers regarding the use of US to detect a pneumothorax after upper extremity nerve blocks with the desires of initiating a practice change. The second objective of this DNP project was to improve the quality of care and safety to patients by using US lung scans immediately following an upper extremity peripheral nerve blocks to rule out a pneumothorax.

Sample/Setting

The participants for this DNP project were 10 anesthesia providers employed at a level II 512 bed facility in the southern United States. The host facility offers a variety of surgeries such as intrathoracic, orthopedic, vascular, general, and regional anesthesia. The inclusion criteria for participation in this DNP project were licensed anesthesia providers who perform upper extremity peripheral nerve blocks. All anesthesia providers who participated in the project must be currently employed by the host facility. Healthcare providers who were excluded from the project were the anesthesia providers

who refused to participate in using US lung scans immediately following upper extremity peripheral nerve blocks. A convenience sample was used.

Design

The method used to carry out this DNP project was a quality improvement (QI) project. Evidence-based research information on the use of US for detection of a pneumothorax was collected from a thorough literature review. Following the literature review, a practice change was proposed to use US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax. The proposed practice change was developed using a thorough literature review related to the benefits of the use of US to detect a pneumothorax to increase patient safety. The anesthesia providers were educated on the use of US lung scans for the detection of a pneumothorax prior to implementing this change. A PowerPoint presentation was given to the anesthesia providers related to the importance of US lung scans and the specific signs to look for to rule out a pneumothorax. The anesthesia providers who agreed to partake in the project were asked to complete a pre-intervention survey. The goal of this survey was to assess if they attempted to detect a pneumothorax following upper extremity nerve blocks; their current technique of detecting a pneumothorax immediately following upper extremity peripheral nerve blocks if one is suspected and if they were aware that US is technique that can be utilized. The participants were notified that they were providing consent to participate in this DNP project by completing the pre-intervention survey. The pre and post intervention surveys were collected, stored in a locked file to which the author had the only key, and analyzed once the project concluded. Descriptive statistics were utilized to describe the population.

The anesthesia providers were asked to implement a practice change over a period of 4 weeks. After 4 weeks had expired the participants were given a post-intervention survey to complete. This post intervention survey evaluated whether the anesthesia providers performed an US lung scan immediately following upper extremity peripheral nerve blocks and if any barriers were faced during the implementation. A frequency count was performed comparing the pre intervention survey and post intervention survey to assess if a practice change occurred.

Ethical Considerations

This DNP project was approved by the Institutional Review Board (IRB) by The University of Southern Mississippi (Protocol number CH17071403). Approval by the host facility's Nurse Research Council was obtained prior to implementation of the DNP project. Participants' identities were protected by their pre and post intervention surveys being stored in a locked box only accessible by the author. In addition, no identifying information was collected.

Assumptions

One assumption made during the project was that the anesthesia providers would agree to attend the educational meeting to learn about the method being presented in the project. Another assumption was there was a need for another method for detection of a pneumothorax following upper extremity peripheral nerve blocks. The assumption was also made that the facility would allow the participants to utilize an US machine to perform the scans during this time as well.

Resource Requirements

For data collection, willing anesthesia provider participants were needed as well as the OR. Another requirement was the equipment needed to perform the lung scans including an US machine. An additional requirement was the extra time needed in order to administer the lung scans.

CHAPTER III - RESULTS

Overview

A pre and post intervention survey was utilized to collect the data need for this DNP project. A pre-intervention survey was administered and collected prior to the evidence-based presentation to obtain demographic information on the anesthesia providers such as age, gender, years of experience, and their knowledge of US for the detection of a pneumothorax. An evidence-based educational presentation was presented in the anesthesia break room to the anesthesia providers at the host facility on the use of US for detection of a pneumothorax. After one month, the author brought the post-intervention surveys back to the hospital for the participants to complete. The post-intervention survey assessed if the anesthesia providers performed US lung scans to rule out a pneumothorax and if the evidence-based presentation persuaded their decision to utilized US for the detection of a pneumothorax. After one month, the author collected the post-intervention surveys and compared them to the pre-intervention surveys to determine if a practice change had occurred. All data that was collected whether on paper or electronic will be shredded or deleted 6 months after graduation requirements have been met.

Analysis of Data

The aim of this project was to propose a practice change to perform US lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax from the evidence collected from the literature review. Descriptive statistics were used to describe the population, and a frequency count was conducted between the pre-intervention survey and post-intervention survey to assess if a practice

change occurred over the month. After gathering data, there were 10 participants in all. All 10 of the participants were males ranging from 28 to 63 years old with years of experience in practice ranging from 1 year to 34 years. According to the pre-surveys, none of the participants had a method they used to rule out a pneumothorax routinely; however, if a patient was exhibiting signs of a pneumothorax, all the participants used chest x-ray to examine the patient. 60% of the participants were unaware US lung scans were a technique used to rule out a pneumothorax.

Eighty percent of the participants returned the post intervention survey. It was determined that 25% of the participants used US to rule out a pneumothorax during the one month period. Seventy-five percent of the participants reported the educational intervention would influence them to utilize US to assess for a pneumothorax following an upper extremity nerve block. One participant reported there was a decreased opportunity to use this method. It was determined that 75% of the participants felt that US was an accurate and effective method to assess for a pneumothorax. During the one-month period, all the participants reported that no pneumothoraxes detected.

CHAPTER IV –DISCUSSION

Implications

As a result of the project, 2 participants reported using US lung scans to detect a potential pneumothorax in patients who had received upper extremity peripheral nerve blocks. 6 participants reported after the education process they were aware that US is an effective and accurate method for the detection of a pneumothorax. Six participants also reported that although they did not utilize US lung scans during this time, they were influenced by the presentation to begin using US lung scans to detect a pneumothorax in the future. Of the 2 participants who utilized the US detection method during this time, no pneumothoraxes were detected. As a result of the project, a practice change was made by 2 anesthesia providers. Due to limitations of the project, it is not known whether this change will be sustained or implemented by other providers.

Limitations and Barriers

One limitation of this study was the small sample size of participants. This limited the responses available; therefore, the conclusions that can be drawn from the information is limited. A barrier identified by a participant during the collection of data was that there were a limited number of opportunities to use the method due to a small number of cases requiring upper extremity nerve blocks. Due to these limitations and barriers, the application of this project may not translate to other facilities or future nursing practice.

Recommendations

The next step needed in this project would be to determine if the practice change made by the participants was effective as well as maintained. Further projects could be

done with a larger sample size in order to make the results more easily generalized to other facilities. A continuation of this project at other facilities could also analyze the benefits of long-term application of the practice change.

Conclusion

Due to the education process and implementation of the project, there was a small practice change at the facility. Literature supports the method of using US for detection of a pneumothorax after an upper extremity nerve block. Although it was found that the education portion of the project was effective based on participants reporting knowledge gained about the method, future projects are needed to determine the long-term benefits of the implementation of this practice change for the patients and providers. A continuation of the project as well as a broader sample size should be tried and tested at other facilities to assess if a practice change occurs.

APPENDIX A – DNP Essentials

Doctor of Nursing Essentials	**How the Essentials are achieved?**
I. Scientific underpinning for practice	Used the most recent evidence to use US immediately following upper extremity peripheral nerve blocks to increase patient's safety and satisfaction.
II. Organizational and systems leadership for quality improvement and systems thinking	Reconstructing the older practice to use US for first line therapy to rule out a pneumothorax immediately after upper extremity peripheral nerve blocks.
III- Clinical scholarship and analytical methods for evidence-based practice	Used evidence base practice that was found through literature to support the evidence that US is a safe and effective alternative to detect a pneumothorax.
IV- Information systems /technology and patient care technology for the improvement and transformation of health care	Changing anesthesia practice that uses the most up to date technology for detection of a pneumothorax to increase patient safety, satisfaction, and quality of care.
V- Healthcare policy for advocacy in health care	The DNP project proposed a practice change to use US lung scan immediately following upper extremity peripheral nerve blocks to improve quality of care and safety to patients. I will be advocating for the patients and to better the health care system by using the most recent practice for detecting a pneumothorax.
VI- Interprofessional collaboration for improving patient and population health outcomes	Worked together with stakeholders to revise a new plan to use US for detection of pneumothoraxes for first line therapy immediately after procedures that puts patients at risk for a pneumothorax.
VII- Clinical prevention and population health for improving the nation's health	Increasing patient safety and quality by detection a pneumothorax in timelier manner.
VIII- Advanced Nursing Practice	Used the most recent evidence based practice to propose a practice change to enhance the health of many patients by detection of pneumothorax faster and decreasing the morbidity and mortality of patients that develop a pneumothorax.

APPENDIX B – Pre-Intervention Survey

Pre Intervention Survey

By completing this survey you are consenting to this project and you are not required to participate and may withdraw from the study at any time. If you have any questions you may contact me Adam Gaston at (Robert.Gaston@usm.edu) or Marjorie Giesz-Everson at (Marjorie.GeiszEverson@usm.edu)

Pre Intervention Survey

1. What is your age?

   _____
2. What is your gender
   a. Male
   b. Female
3. How many years have you practiced anesthesia?

   _____
4. Do you currently rule out a pneumothorax after you perform upper extremity nerve blocks?
   a. Yes
   b. No
5. What method do you use to rule out a pneumothorax if one is suspected?
   a. Chest X-Ray
   b. Computed tomography
   c. Ultrasound
6. Are you aware that ultrasound is a technique that can be utilized to detect a pneumothorax?
   a. Yes
   b. No

APPENDIX C – Post Intervention Survey

Post Intervention Survey

By completing this survey you are consenting to this project and you are not required to participate and may withdraw from the study at any time. If you have any questions you may contact me Adam Gaston at (Robert.Gaston@usm.edu) or Marjorie Giesz-Everson at (Marjorie.GeiszEverson@usm.edu)

Post Intervention Survey

1. What is your current age?

   _____
2. What is your gender?
   a. Male
   b. Female
3. How many years have you practiced anesthesia?

   _____
4. Did you utilize US lung scans immediately after upper extremity nerve blocks?
   a. Yes
   b. No
5. Did the evidence-based educational intervention influence you to utilize US to assess for a pneumothorax following upper extremity nerve blocks?
   a. Yes
   b. No
6. Were there any barriers that prevented you from using US to detect for pneumothorax following upper extremity nerve blocks?
   a. Yes
   b. No

   If yes, what were they?
   c. Did not feel comfortable doing it
   d. Not enough time to perform the scan
   e. Felt like more education was needed
   f. Other_____
7. Do you find US an accurate and effective method to assess for a pneumothorax?
   a. Yes
   b. No
8. Did you detect a pneumothorax with ultrasound while implementing the use of ultrasound?
   a. Yes
   b. No

APPENDIX D – Permission to use Ultrasound Images

Hi Robert,

Thanks for contacting us regarding image/text use. You're most welcome to use any and all images of ours that you come across. We ask that you adhere to the strict code of publication ethics and source them properly. We also hope that the flowchart decision tree will be of use to you. Again, please source it properly.

We wish you well in your academic endeavors, and please let us know if we can be of service to you. Please forward us a copy of you work. We may incorporate it into our presentations as well.

All the best,

All the best,
Jonathan Kline, CRNA
Director of Education
Twin Oaks Anesthesia
twinoaksanesthesia@gmail.com
www.TwinOaksAnesthesia.com
813-857-5559

APPENDIX E – Nursing Review Board Approval Letter

[redacted]

Patient Care Services—Research Committee

RESEARCH PROPOSAL LETTER OF AGREEMENT

TO: **Adam Gaston**
FROM: Research Committee
RE: Proposed project/study entitled: Proposed practice change to perform ultrasound lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax

On August 8, 2017 your research project/study proposal was approved by the Nurse Practice Council to be conducted within Patient Care Services at [redacted]
You are free to proceed with your project/study within the following guidelines:

1. You are required to complete an online non-employee orientation that is administered though our Education Department (601-288-2677).
2. A *Non-Employee Confidentiality and Nondisclosure Agreement* must be signed during the online orientation process.
3. Any modifications to this approved study must be re-routed to the Research Committee. All activity on this project must stop until you are notified by the Research Committee Chair of Committee's decision regarding proposed changes
4. Data Collection Period:
5. Inform Research Chair when data collection is initiated and when completed (via e-mail)
6. Provide results of study to committee (may provide presentation or written documentation of findings)

Sincerely,

[redacted]

I, Adam Gaston, have reviewed the above guidelines and agree to comply with the terms of this *Research Proposal Letter of Agreement.*

Signature: [signature] Date: 8/16/17

Facility/School/Other Association: USM CRNA

APPENDIX F – Letter of Support

Letter of support

June 19, 2017

I [redacted] support Adam Gaston's DNP project to propose a practice change to perform ultrasound lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax.

Sincerely,

[redacted]

[redacted]

APPENDIX G – IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: CH17071403
PROJECT TITLE: Proposed practice change to perform ultrasound lung scans immediately following upper extremity peripheral nerve blocks to rule out a pneumothorax
PROJECT TYPE: Change to a Previously Approved
Project RESEARCHER(S): Robert Adam Gaston
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: Advanced Practice/Nurse
Anesthesia FUNDING AGENCY/SPONSOR:
N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 07/18/2017 to 07/17/2018
Lawrence A.
Hosman, Ph.D.
Institutional
Review Board

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