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Ultrasound Guided Intravenous Access in the Emergency Department

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ULTRASOUND GUIDED INTRAVENOUS ACCESS IN THE EMERGENCY DEPARTMENT

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An Abstract of the Scholarly Project by
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One-quarter of all emergency department visits in the United States results in peripheral intravenous line (PIV) placement for parenteral fluid administration (Fields, Piela, Au and Ku, 2014). When PIV access is delayed, critical care measures are also delayed. Meyer et al. (2014), reports the first attempt PIV access failure rate is approximately 25%. In the critically ill patient, timely PIV access may be the difference between survival and death. Difficult venous access is present in approximately one in ten ED patients requiring PIV access (Fields et al., 2014). The purpose of this scholarly project is to implement a quality improvement project regarding ultrasound guided peripheral intravenous line (USGPIV) access for difficult PIV in the rural hospital setting. The goal of this project ultimately giving the local nurses options and increased confidence when presented with difficult access patients and confidence in using USGPIV.

Keywords: Ultrasound guided peripheral intravenous access (USGPIV), peripheral intravenous line (PIV) and difficult intravenous access (DIV).

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CHAPTER I

Introduction

The most common route of fluid and drug administration in the emergency department (ED) and the hospital setting is via the intravenous (IV) route (Emergency Nurses Association [ENA], 2012). Peripherally placed IV (PIV) catheters are a small, short plastic catheter placed through the skin into a vein, usually in the upper extremities (Lee, 2017). Several factors can influence the success rate of attaining this vascular access. The most common risk factors associated with difficult vascular access include advanced age, chronic illness, drug use, and obesity (ENA, 2012).

The Centers for Disease Control [CDC] (2019) reports the U.S. obesity rate at 39.8%. Obese individuals typically have increased fat layers with poorly visible and palpable veins. The increased prevalence of obese patients contributes to the higher rate of difficult peripheral intravenous access in emergency and routine settings. Additionally, Americans are living longer with an average life expectancy of 78.8 years in 2012, compared to 64.9 years in 1962 (CDC, 2019). Elderly patients typically have multiple comorbidities such as hypertension and diabetes making PIV placement more difficult. Another issue causing difficult PIV access is the escalation in intravenous (IV) drug use. The National Institute on Drug Abuse states illicit drug use increased from 8.3% in 2002 to 9.4% in 2013, affecting 24.6 million Americans (2015). Drug-abusing

patients have exhausted their veins until they are frail and useless. Fields, Piela, Au, and Ku (2014) report that patients with a history of IV drug abuse were 13.9% more likely to be a problematic IV start when compared to the general population. All these factors contribute to the challenge of successfully attaining intravenous access on the first attempt.

Difficult venous access is defined as multiple attempts or the anticipation of specific interventions needed to establish and maintain peripheral venous access (Kuensting et al., 2009). Presently one in ten presenting ED patients are difficult PIV access (Fields, et al., 2014). When PIV access is delayed this results in a delay in care. Meyer et al. (2014) says the first attempt IV access failure rate is approximately 25%. In the critically ill patient, having timely PIV access may be the difference between survival and death. The Sepsis Alliance (2019) state that the risk of death increases by 7.6% each hour treatment (including IV fluids and antibiotics) was delayed. It is essential to identify additional methods to improve overall IV access success in rural healthcare settings.

Patients with difficult PIV access are frequently subjected to repeated attempts by various practitioners and are more likely to have treatment delays because of the failed PIV attempts (Witting, 2012). Traditional options for the difficult PIV patients in the hospital setting vary based on a hospital's resources. These options include consulting a certified registered nurse anesthetist (CRNA), consulting an IV treatment team, placing a peripheral intravenous central catheter (PICC) or a placing a central line. Central line placement can be done by a properly trained provider or a surgeon. Providers or nurses trained and comfortable can place jugular IV access, use transillumination devices to help visualizes the veins, or place an interosseous (IO) line. Each of these options has

associated risks, costs, and time delays not acceptable to the critically ill patient. These alternatives are typically not utilized until after the staff has exhausted multiple attempts, resources, and time on the PIV start. Use of ultrasound for PIV access by bedside nurses may offer a quick, cost-effective solution for the difficult to access patient. Despite an enormous amount of research showing the benefits of ultrasound for PIV access in the hospital setting, it is not currently the standard of care, especially in rural hospital settings.

Description of the Clinical Problem

While multiple alternatives for difficult IV placement exist, rural hospitals in southeast Kansas are limited in their options for difficult PIV insertion. Rural hospitals may not have staff trained in alternative IV placements and some smaller institutions do not have access to on-call surgeons or CRNAs. Central lines, jugular lines, and IO lines are some options available in small hospitals; however, they have higher risks of complications and tend to be poorly tolerated by patients. Central line placement is costly, time-consuming, and involves significant risks. Au, Rotte, Grzybowski, Ku, and Fields (2012), report a 5-15% complication rate for central line access, including pneumothorax, arterial puncture, delayed infection, and thrombosis. IO access provides vascular access almost immediately, usually less than ten seconds. However, this method is very painful, associated with higher risks of complications such as infection, and cannot be used longer than 24 hours (Horton and Beamer, 2008). USGPIV insertion has been shown through literature to be less costly and tolerated better by patients (Partovi-Deilami, Nielson, Moller, Nesheim, and Jorgensen, 2016). The use of USGPIV

technology to place a PIV is a skill that can be taught and implemented in all size hospitals, from small rural to large urban hospitals.

Significance

Placement of PIV is a standard procedure performed in any hospital setting. The average time required for PIV cannulation is 2.5 minutes to 16 minutes and difficult PIV access has been shown to require as much as 30 minutes (Leidel, et al., 2012). The rural setting can add additional challenges for successful placement of a first time PIV by compounding novice skilled nurses, lack of advanced technology, and limited resources such as extra staff and specialist availability. The use of ultrasound-guided PIV access has been shown to improve first-time success rates compared to traditional techniques. When staff had higher success rates, patients perceived less pain, and had higher patient satisfaction rates (Partovi-Deilami, et al., 2016). When resources in small rural hospitals are limited the USGPIV can by a crucial skill set available to the nurses. Carter, Conrad, Wilson, and Dogbey (2015) found that adequately trained nursing staff can be equally successful as emergency residents in placing ultrasound guided PIV lines.

Purpose

The purpose of this scholarly project is to develop and implement clinical guidelines for USGPIV at a rural southeast Kansas hospital. A retrospective study of patient charts over a nine-month period will review, age, body-mass index (BMI), presence of diabetes diagnosis, history of IV drug use and number IV attempts needed for PIV access. If alternative treatments for PIV access were utilized the outcome of these treatments will also be reviewed. This chart review showed the demand for and benefits these guidelines could provide for a rural hospital setting. Upon chart review completion,

a protocol was developed for USGPIV access in this rural setting. ED RN's will be educated on the placement of USGPIV and the new protocol. A pre-education and post-education (Four weeks after the education and implementation) survey was given to the RN's. The staff was specifically be questioned if the education provided to them improved their daily confidence level in recognizing veins on US and placing USGPIV in the difficult patient.

Theoretical Framework: Benner's From Novice to Expert Nursing Theory

Dr. Patricia Benner introduced the concept that nurses develop through education at various levels of competency (Benner, 1982). Dr. Benner explains that know-how in nursing is made of practical knowledge through research and the understanding of this know-how is evident by clinical experience (Benner, 1982). Registered nurses will begin in the novice stage for USGPIV as the current nursing staff has no experience in ultrasound or ultrasound use for PIV access. Benner described five levels of nursing experience including novice, advanced beginner, competent, proficient, and an expert. The expert nurses are rare and should be valued highly. Lyneham (2008) felt the expert nurse was the highest level and most difficult to achieve. She states, "progression to the final stage of the expert is not as apparent or clear-cut as in the other stages. In this final stage, a nurse is not consciously aware of their practice because it has become part of their being. There is deep involvement in their environment, and the expert does not see a problem in a detached way" (Lyneham, 2008, p. 381).

Research Questions

Difficult IV access is a multifactorial issue, and several research questions emerge when considering implementing USGPIV for use in a rural health system.

1. What is the average attempt rate for a PIV placement in a rural hospital setting?
2. How often are alternative methods for IV access currently used in a rural hospital setting?
3. Will educating and implementing guidelines for USGPIV access actually improve a nurse's confidence level when placing a PIV?

Definition of Key Terms

Central Line: The CDC defines a central line, as a tube that providers place in a large vein in the neck, chest, or groin to give fluids, blood and medications or to do lab tests quickly. These long, flexible catheters empty in or near the heart, allowing the catheter to give the needed treatment within seconds (CDC, 2010). Also known as a central venous catheter, the execution of these lines requires extreme technical training and difficulty (Yang, Seok, Kong, & Kim, 2015), and typically placed by a surgeon.

Certified Registered Nurse Anesthetist: A CRNA is one of four categories of the advanced practice registered nurse (APRN). The National Council of State Boards of Nursing (2019) defines an APRN as an RN who has a graduate degree and advanced knowledge. These nurses can diagnose illnesses, prescribe treatments and medications. A CRNA is required to have an advanced education such as a Master's degree or a Doctorate of Nursing Practice. Their focus is anesthesia and they are licensed by their state board of nursing. In the difficult PIV setting the CRNA would be consulted to help with a difficult PIV placement.

Difficult peripheral intravenous access: A study among urban emergency rooms in 2009 defined difficult IV access as having at least two failed IV attempts or a history of

difficult access plus the inability to visualize or palpate any veins on physical exam (Panebianco et al., 2009). Walsh describes the term difficult venous access to describe situations in which multiple attempts or specialist care is needed to establish IV access (2008).

Intraosseous Access: A 15 -gauge needle with a length of 15-45mm attached to a hub is drilled into a long bone. The intramedullary space of the proximal tibia, distal tibia, or proximal humorous, serves as a non-collapsible vein (Beilski et al., 2017) and are optimal sites. Typically, this is the last choice for venous access, and utilized only when the difficult IV patient needs emergent intervention to prevent clinical deterioration or during resuscitation efforts.

Peripheral Intravenous Access: IV canalization is a technique in which a cannula is placed inside a vein to provide access. IV access allows obtaining blood samples for lab, administration of blood products, fluids, medications, and nutrition (Shlamovitz, 2017). Access is placed in peripheral sites such as the arms, hands, and forearm. These catheters are usually inserted by palpating or directly visualizing the preferred vein (Aponte et al., 2007). Common peripheral sites include the cephalic, basilic and median veins of the upper extremity. Access can be obtained in smaller veins of the hands, scalp and feet if necessary.

Registered Nurse: The National Council of State Boards of Nursing (2019) defines a RN as an individual who has graduated from a state-approved school of nursing, passed the NCLEX-RN Examination and is licensed by a state board of nursing to provide patient care. The backbone staff of the hospital, a RN typically has a two to a four-year degree.

The RN at the bedside providing patient care in a rural hospital, ED or other, usually makes the initial PIV attempts.

Surgeon: A skilled physician who has completed a residency in surgery and is licensed by their respected board of medicine to perform procedures and operations.

"A general surgeon has expertise in the diagnosis and care of patients with diseases and disorders affecting the abdomen, digestive tract, endocrine system, breast, skin, and blood vessels. A general surgeon is also trained in the treatment of patients who are injured or critically ill, and in the care of pediatric and cancer patients" (The American College of Surgery, 2017). In the hospital and ED setting, when a difficult PIV patient presents the surgeon would be consulted when they are available and when they are needed to place a central line.

Ultrasound: Defined as a frequency above which the human ears can hear, more than 20,000 Hz (Moore & Copel, 2011). Standard point-of-care ultrasound is the use of a transducer head full of crystals to produce a two-dimensional image on a screen (Moore and Copel, 20011). "Ultrasound offers visual information about the size and depth of blood vessels potentially facilitating PIV placement" (Curtis, et al. 2015). Ultrasound penetrates well through fluid and solid organs, making visualizing vessels for PIV access using US particularly useful (Moore and Copel, 2011).

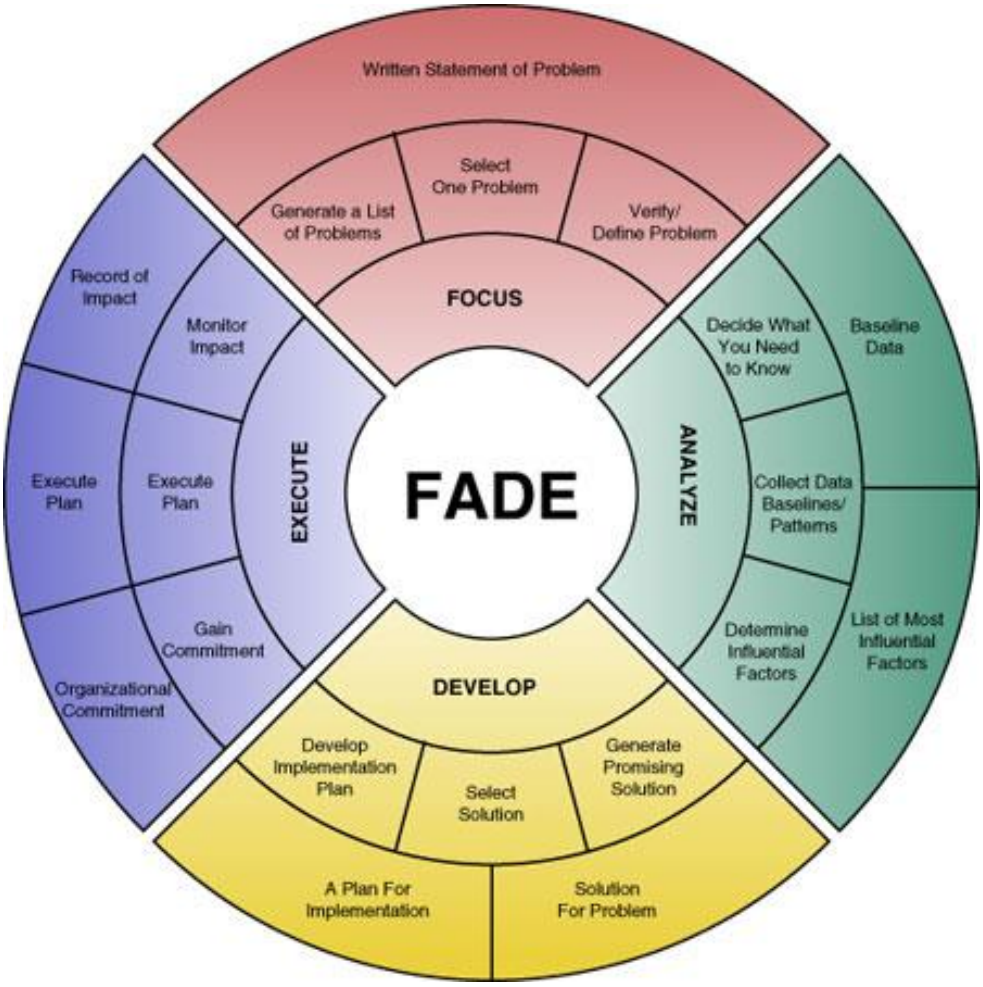
Logic Model: The FADE Model for Quality Improvement

Research and medicine are continually evolving to incorporate current evidence-based practice. New evidence is available to help govern nursing practice to assure that patients will receive quality and safe care. Sherwood and Barnester (2012) describe quality improvement as using data to monitor outcomes of care processes that help guide

improvement methods to design and test changes in the system to continuously improve results. Various models are available and can assist in the quality improvement process. This project will utilize the FADE model (figure 1) that consists of four steps in the quality improvement process, focus, analyze, develop, and execute (BHM Healthcare Solutions, 2016).

This project, focused on the problem of difficult PIV access, defined the problem, its clinical issue in the area of a rural hospital setting, and utilized the FADE model during the process. The data was analyzed in an extensive literature review and this was used to help identify barriers to this project and develop possible solutions to these barriers. Protocols were developed based on research to improve the current practice for difficult PIV access. These protocols were reviewed by the current medical board of GMC. Pending the medical board's approval, the protocols will be reviewed with participating ED RN's. The protocol was implemented into practice and a pre and post-education/implementation survey was completed to gauge the effect the training had on the nurse's clinical confidence levels with starting PIV's.

Figure 1: Fade Model of Quality Improvement



Adapted from Duke University Fade Model of Quality Improvement

Summary

The difficult PIV patient is a common presenting problem in rural and urban hospitals. Southeast Kansas rural hospitals are no exception. Traditional approaches to obtain access for these patients are limited and costly to both the healthcare facility and the patients. Time delays can influence a patient's health status and be the difference in the patient's survival. USGPIV access offers a cost-effective alternative for the difficult

PIV patient and will assist the staff in quickly gaining needed PIV access in the critical patient.

CHAPTER II

Review of Literature

Introduction

A review of the literature regarding difficult IV access, USGPIV access, and vascular access options was done to examine current definitions of difficult IV access. The review evaluated current available options for difficult PIV access patients, and determined if USGPIV assess is a viable, evidenced-based solution for difficult PIV access patients. An extensive search of the literature was conducted using multiple databases to including, ENA, Medline, PubMed, and CINAHL. Key terms used to identify potential articles included difficult IV patients, solutions for difficult IV, ultrasound IV access, and difficult IV in the ED.

Placement of a PIV catheter involves inserting a plastic cannula which is threaded over a needle and inserted in a peripherally located vein. PIV is the most common procedure performed on a hospitalized patient (ENA 2012). IV placement is known to be more difficult in patients with no visible or palpable veins (Aponte et al., 2007). Location of the PIV is at the provider's discretion and typically involves veins which are most directly visualized and palpable (Curtis et al., 2015). Several factors also challenging PIV access include the patient's medical history, body habitus, age, and fluid status (Aponte et al., 2007).

Difficult PIV Access

Difficult PIV access is a common problem and is defined as "multiple attempts and the anticipation of specific interventions being required to establish and maintain peripheral venous access" (Kuensting et al., 2009, p.419). Approximately one in every ten people undergoing PIV access in the ED is considered a difficult access patient (Fields et al., 2014). A 2009 study in urban emergency rooms defined difficult IV access as two failed IV attempts or a known history of difficult access (Keunsting et al., 2009), while failure to visualize or palpate any veins on exam defined the patient as a difficult start by Panebianco et al., (2019). Walsh uses the term, "difficult venous access" for situations in which multiple attempts or specialized services are needed to establish PIV access (2008).

Even with experience, and being able to palpate and visualize a vein, the failure rate on a first IV attempt is close to 25% (Meyer et al.,2014), and the success rate of the first attempt on a child is from 40-70% (Curtis et al., 2015). In a study of 593 pediatric patients, Kuensting et al. (2002) found that IV insertion required over 30 minutes and an average of 2.2 attempts; moreover, PIV access was found to be unsuccessful in five percent of the pediatric patients studied. As well, Au et al. report up to 23% of patients have difficult to cannulate veins (2012). These studies acknowledge the burden that difficult IV access plays in our hospital systems.

Causes of difficult PIV access

The evidence shows numerous factors contribute to the increase in the difficulty of starting PIV's in the hospitalized patient, including chronic conditions, history of IV drug use, acute illnesses such as dehydration, extremes of age, and extremes of weight

(Mahler et al., 2011); Oliveira and Lawrence (2016) note that patients who present for treatment are in fragile health and are often dehydrated, which may make PIV access more challenging. Fields et al. (2014) also found diabetes, sickle cell disease, and history of PIV drug abuse to be significant risk factors. Additionally, one of the most frequently identified causes for the development of difficult PIV access is recurring vascular trauma, this includes patients who are chronically ill, have a history of cancer, renal failure, or IV drug use (Fields et al., 2014). Studies have shown obesity to be an on-going risk factor for difficult PIV access. Mahler et al. found the rising obesity epidemic, higher PIV drug abuse rates, increasing life expectancies, and multiple co-morbid illnesses such as renal insufficiency were main contributors to difficult IV access (2015).

Globally the use of illicit injectable drugs is 11-21 million people aged 15-64 worldwide (United Nations Office on Drugs, 2010). Within the United States, the National Institute on Drug Abuse, places lifetime incident use of illicit drugs at 51-55% of the population ages over 18 (2018). Per the Kansas drug control update the number of methamphetamine lab seizures rose from 101 in 2007 to 142 in 2012, and 6.71 percent of Kansans admitting to illicit drug use in the last month (2012).

Kuensting et al. (2009) sought to identify risk factors for difficult PIV access in pediatric patients, and in fact, they were very similar to those in adults. Partovi-Deilami et al. found that difficult IV access was associated in pediatric patients with a history of IV drug abuse, steroid treatment, edema, obesity, and hypovolemia (2016). Nafiu et al. discovered in a study of 103 pediatric patients, obese children were more probable to have failed first attempts then lean children, and more likely to necessitate two or more attempts at PIV access compared to lean children (2010).

Adverse effects of difficult PIV access

Poor patient outcomes, time delays, patient comfort and satisfaction are all at risk with delays in PIV placement. “Patients with difficult access often experience discomfort because of failed attempts to place PIV,” (Partovi-Deilami et al., 2016, p.86). Duran, Pumarola, Borras, Punset-Font, & Sampol-Granes state that IV placement causes patients substantial pain and anxiety, and intensifies the patients’ fear of future interventions (2016).

Patients tend to equate a positive experience of their nursing care and quality of hospital experience if PIV placement goes well. If patients have a negative experience with their PIV placement, they may distinguish dissatisfaction with their nursing care and the hospital in general (Duran et al., 2016). Walsh (2008) noted the increase in family agitation with each unsuccessful IV attempt. Walsh also noted the effect of the sympathetic nervous system on failed IV attempts. The patient’s distress from a failed attempt can induce vasoconstriction, which makes each subsequent IV attempt more difficult (2008). These repeated attempts can cause the patient’s perception of the nurse to be technically incapable (Moore, 2013).

Lapostolle et al. found that IV access in the hands of a more experienced ED provider resulted in a higher success rate, as well as using a smaller caliber IV catheter was associated with cannulation failure (2007). Kuensting et al. (2009) noted success in placing PIV increases with the nurse’s level of experience. Time constrictions and overcrowded ED’s can make nurses feel hurried and theoretically lead to unsuccessful PIV attempts and potentially more needle-sticks (Keunsting et al., 2009). Nurses who

struggle to establish PIV access can feel incompetent and discouraged, therefore diminishing their self-confidence (Kuensting et al., 2009).

Difficult PIV patients expend multiple resources, cause stress to the patient, prolong treatment courses, and place the patient at risk for decompensation (Panduragandu, Tucker, Began, & Bahl, 2016). Curtis et al. summed it well stating failed PIV access guarantees additional painful procedures, interruptions in critical treatments, decreased productivity, efficiency, and increased the cost to the health care system in general (2015).

Options available for difficult PIV access

Several options currently exist, when PIV access is challenging; however, not all options are currently available at every facility. These include transillumination of the vein using a portable device, accessing a jugular line, consulting a CRNA or IV team as possible; obtaining IO access or consulting a trained provider for a central line, Ultrasound guided peripheral IV(USGPIV), or peripheral inserted central catheter (PICC) line. Traditionally, consulting a qualified provider to place a PICC line or a central line was usually the next step at most facilities when a standard PIV was unable to be placed (Miles, Salcedo, and Spear, 2012). Current alternatives such as central line placement, PICC lines, and IO placement, increase patients' pain and anxiety, increase risk of injury, increase the chance of infection, and strain resources (Maiocco and Coole, 2011).

Options available for the difficult IV patient depend on the size, location, and resources available at each hospital. In an Ohio teaching hospital, if the ED cannot access PIV, their only options are to forgo any venous access, request a trained physician to place a central venous catheter, or USGPIV (Carter et al., 2015). Small rural southeast

Kansas hospitals vary on their availability of surgeons, CRNAs, US equipment, as well as most small rural hospitals do not have access to IV teams. Some smaller rural hospitals have only their skilled nurses as their resource for PIV access, making USGPIV a possible solution for southeast Kansas hospitals, especially when surgeons and CRNAs are not available.

Transillumination

Light has always improved visibility and with PIV placement, light can help illuminate deeper hidden veins previously not seen. Per Girgis (2014), transillumination is a portable fiber-optic light that helps to visualize veins. The device is placed against the skin and illuminates this region of skin and subcutaneous tissues, the veins appear as darkened lines, and this technique is said to allow for easier cannulation of the vein (Girgis, 2014). Transillumination to help visualize venous access dates back to 1975 and is still widely used by anesthesia groups. One study by Atalay, Erbay, Tomatir, Serin, and Oner reported a success rate of 80% on 100 difficult-access children using such a device (2005). Girgis in 2014 published a study showing that transillumination did improve the success rate of PIV access in children. This study compared this technique with the use of USGPIV. The USGPIV use was associated with higher success rates, 92.5% vs. 80%, and had shorter access times. Transillumination appears to be helpful with difficult PIV access patients when the technology and training are available for the nurses.

Jugular Access

Jugular veins can be accessed for PIV in difficult IV patients using ultrasound; however, they tend to be very positional and uncomfortable to the patient. Most facilities also do not have policies allowing nurses to access external jugular lines. The external

jugular vein is a common vascular access site for emergency providers; however, when not easily identified, success rates decline significantly (Kiefer, Keller, and Weekes, 2015). Very few providers and nurses are comfortable placing jugular access and would require training similar to that needed for USGPIV. The external jugular placement has similar success rates as PIV access (Witting, Moayedi, Yang, and Mack, 2015). There is a small percentage of patients where external jugular access can be successful when PIV is not.

Anesthesia consult

Anesthesia departments are available at some small southeast Kansas hospitals, for anesthesia to be needed; the hospital must also have an active surgery department. Some southeast Kansas hospitals have neither. A study among nurse anesthetists found a success rate rose from 0 to 82% and median time of procedure decreased from 20 to 10 minutes when utilizing ultrasound for PIV verses traditional approach (Partovi-Deilami et al., 2016). Anesthesia availability can be an excellent resource for any small hospital; Anesthesiologists and CRNAs can place PIV access and typically have other more advanced technology available to them such as transillumination and US.

IV access teams

Larger hospitals and institutions with resources may have a team of professionally trained nurses and providers that specialize in difficult IV patients and are called upon when needed. “Successful and safe completion of infusion therapy requires much more than a successful insertion procedure. Infusion teams, commonly known as IV teams or IV therapy teams, have a wider scope of service. These teams are involved with safe insertion of all types of vascular access devices, as well as serving as the resource for

other infusion-related services" (Pyrek 2018, p.1). Pyrek states that the benefits of the IV team increase comfort and safety to patients, and save valuable healthcare dollars (2018). Hadaway et al. reports hospitals at both ends of the extremes, with those eliminating IV teams due to cost-cutting measures and other healthcare systems are sticking with the option of IV teams working toward better outcomes for their patients (2014). IV teams are eventually cost saving, beneficial for the patients, staff, and hospital systems.

Intraosseous access

The IO route enables the rapid delivery of a variety of fluids, blood products, and medications in emergencies. IO access is a last-minute alternative and it can be life-saving. Fowler et. al. (2007) places IO access as far back as the1920s when the sternum was found to be a possible site for transfusions. The IO route also proved during world war two to be life-saving option for injured, providing access for transfusions, medications, and fluid administration when patients were in shock and IV access was hindered (Fowler et al., 2007). Per Walsh (2008), IO access is relatively easy to obtain, however IO's are significantly more expensive and very painful to the patient. Average pain scores in a Glasgow Coma Score patient of 15, was an average of 4.5 on insertion and 3.8 with the administration of fluids (Payton, Knuth, and Klausner, 2009). The emergency nurse association assessed pain scores for patients with IO placement and medication administration and found a mean pain score during placement at 4.5/10 and 3.2/10 with infusion (2012). Complications with IO are considered rare with the most common being osteomyelitis (Walsh, 2008). IO is a viable access option when faced with patients with increased morbidity and mortality, especially when access is not immediately available.

Central line placement

Central lines have been a very reliable method for treating critical patients when a trained provider is available. Central venous catheterization via the subclavian or femoral vein (Yang et al., 2015) is a reasonable option in difficult PIV access patient. Ultrasound has been used for the placement of central venous catheters for many years and endorsed by the National Institute for Clinical Excellence in the United Kingdom (Aponte, et al., 2007). Complication risks of central lines are high, and their implementation requires remarkable technical training and difficulty (Yang et al., 2015).

Central line placement can be costly, time-consuming, and involve significant risks. Au et al. (2012) cite a 5-15% complication rate for central line access, including pneumothorax, arterial puncture, delayed infection, and thrombosis. The complication rate from central line placement per Oliveira and Lawrence is 5-19% and include pneumothorax, catheter-associated bacteremia, hematoma formation, and great vessel damage (2016). Au et al. (2012) place the complication percentage for central venous access at 15%. If applying this estimate for every eight patients who get USPIV access rather than a central line, one potential complication is evaded (Au et al., 2012). One of the most critical, dangerous, and expensive complications of central lines is central blood infections or sepsis. Cotogni and Pittiruti (2014) estimate approximately 80,000 cases per year of septicemia in the United States from central lines. With 14,000-28,000 related deaths, increasing hospital stays by seven days and a $29,000 cost per infection (Sepsis Alliance, 2014).

Meyer et al. (2014) studied 29 intensive care unit patients referred for central line placement. A USGPIV deep vein catheter was placed instead of placing a central line in

these patients. The lines were utilized for six days with two catheters removed early due to occlusion. The studied patients showed no complications, including thrombophlebitis, infection, or extravasation. The high risks accompanying central lines far outweigh the benefits for most emergency room patients. More patients are being treated and sent home than ever before, and to start a central line for a patient that may be dismissed home hours later is not worth the risk. Due to this, the need for successful PIV access has increased significantly (Moore, 2013). Maiocco and Coole found a decrease in central line referral by 20% after ten months of nurses using ultrasound as needed to insert PIV lines (2011). Alternatives for vascular access are often more practical, and desirable than a central line.

Ultrasound technology has decreased the need for central line placement, in turn reduced complications associated with these lines (Carter et al., 2015). Pandurangandu et al. state that by reducing the risk of incidence of infection, large artery puncture, and pneumothorax associated with these lines, we are significantly improving patient care (2016). Before USGPIV, difficult access patients frequently underwent central line placement, which shows a higher complication rate and involves increased resources and staff time (Mahler et al., 2011). Au et al. (2012) found that by utilizing USGPIV for difficult patients, there was an 85% reduction in the need for central line placement.

Peripheral inserted central catheters

PICC lines are a form of central line placed by a skilled professional. "Peripherally inserted central catheters are 50 to 60 cm long non-tunneled central catheters (silicone- or II-III generation polyurethane-made). PICCs are placed via a peripheral vein (*i.e.*, basilic vein, brachial vein, or -less frequently- cephalic vein) of the

arm" (Cotogni and Pittiruti, 2014, p.86). Radiologists typically place them. However, other trained professionals such as RNs, CRNAs, NPs, and surgeons can be proficient at placing them as well. Per Cheung (2009), PICC lines are for patients needing a week or up to six months of IV treatment such as fluids, antibiotics, nutrition, and/or chemotherapy. PICC lines require frequent maintenance, daily dressing changes, and flushes. Complications of PICC lines are dislodgement, occlusion, and deep vein thrombosis (Cheung, 2009). They do not however carry the risk of pneumothorax or hemothorax as they are inserted peripherally verses centrally in the chest. They also have lower infection rates than traditional central lines (Cheung, 2009). PICC lines are normally not appropriate for ED patients or patients' needing short-term inpatient stays.

USGPIV

Ultrasound is defined as a frequency above that which human ears can hear, more than 20,000 Hz (Moore and Copel, 2011). Medical ultrasound developed from sonar principles, pioneered in world war one, and the first image published of a human skull in 1947 (Moore and Copel, 2011). Over the decade's ultrasound was adopted by multiple specialties and point of care ultrasound came about in the 1990's (Moore and Copel, 2011). In the last twenty years, ultrasound has become very compact and more affordable. Point of care machines allow for real-time use at the bedside rather than having to transport the patient to the radiology department. "The use of ultrasound is advantageous because it lacks adverse biologic effects, provides real time images, gives quantitative imaging and measurement of blood flow and does not use ionizing radiation" (Aponte, et al., 2007, p. 213).

Bedside US uses a transducer with 128 crystals or more that generates a sound wave when the electric current is applied. When the waves return, the material produces a current that is visualized as an image on the screen (Moore & Copel, 2011). US waves penetrate well through fluid and solid organs, however the waves do not penetrate well through bone or air. Blood in veins or fluid-filled areas appear black on US images, making the US useful in differentiating fluids or vascular areas from solid structures (Moore & Copel, 2011). Miles et al. state US offers the benefits of imaging, visualization of veins/arteries, and their measurements (2012). USGPIV is endorsed in guidelines because of a decrease in the rate of complications (Partovi-Deilami et al., 2016). Ultrasonography offers visual information about the size and depth of blood vessels, facilitating PIV access in real time (Curtis et al., 2015). US reduced the attempt rate and lessened the overall time of the IV process in all patients (Scoppettulolo et al., 2016). US can be utilized on healthy IV access patients as well, as well as those patients classified as high risk.

Benefits to USGPIV

Ultrasound guidance for line placement is an accepted noninvasive medical procedure and is endorsed by the Agency for Health Care Research and Quality. US has primarily in the past been used by physicians to place central lines. However, US is starting to appear in ED's for use by nurses to start PIV lines in difficult patients (Maiocco and Coole, 2011). Several studies have established that bedside ultrasound can be used to place PIV access in difficult IV patients in the ER (Mahler et al., 2011). Miles et al. found physicians had a 97% success rate inserting a deep USGPIV (2012). Carter et al. found adequately trained nursing staff can be as equally successful as residents in

placing USGPIV, as well as there was no difference in success or complication rates, noted between resident and nurses in this study (2015). Meyer et al. (2014) cited no thrombophlebitis, infection, or extravasation. Use of ultrasound for peripheral PIV access can offer a quick, cost-effective solution for the difficult PIV access patient and complication rates are minimal with USGPIV.

Despite an enormous amount of research showing the benefits of ultrasound for PIV access in the hospital or ED setting, it is not currently the standard of care. Hadaway et al. (2014) state using US equipment for starting PIVs is ideal; They state that when given adequate training, the US device will allow a patient to go an entire ED or hospital stay with that just one stick. Patients have also been found to be very satisfied with USGPIV. Schoenfeld, Shokoohi, and Boniface (2011) found satisfaction rates of 9.2 out of 10 with USGPIV.

A Georgia level-one trauma center was one of the first hospitals to trial, and implement a protocol for USGPIV placed by an RN in an ED. In 2004, the nurses assessed 80% of their 258 patients as difficult starts; two years after implementation, the nurses only rated 11% as difficult access (Miles et al., 2012). When nurses can establish an IV with fewer attempts in more efficient times, on healthy patients and those with difficult access, nurse's confidence will rise. USGPIV enables faster treatment of pain, administration of IV medications and fluids. Moore found this improves emergency room quality of care, decreases patient ED length of stay, and improves the utilization of dwindling resources; moreover, they found that utilizing USGPIV, 90% of PIV were placed effectively and 81% of those on the first attempt (2013). A survey of 618 ED

patients established that nurse's technical performance incorporating PIV placement had a significant improvement in patient satisfaction (Pandurangadu, 2016).

Panebianco et al. (2016) found patient features that characteristically make PIV access difficult such as obesity and a history of IV drug abuse do not exist when using USGPIV, they did find that larger vessel size rather than depth increased the success rate of the USGPIV. Because of this, providers can focus on the US images rather than the direct visualization and palpation of the vein. Studies of USGPIV access patients with difficult IV access has persistently demonstrated a higher success rate and lower complication rate compared to traditional techniques. The use of USGPIV on patients with failed PIV attempts has been shown to prevent unnecessary central line placements and complications associated with them (Mahler et al., 2011). A Veterans medical center study utilizing USGPIV access by RNs over ten months found feedback from staff and patients to be overpoweringly positive, and to date, no complications have been documented (Maiocco and Coole, 2011). With appropriate use, point of care US for USGPIV can be particularly cost-effective in a reimbursement based on episodes of care. From 2000-2006, fees billed for medical imaging in US by non-radiologists increased at a very rapid rate (Moore and Copel, 2011). Teaching RN's to utilize US for PIV access may help eliminate the need for more resource intensive services by surgeons and CRNA's.

The ENA developed clinical practice guidelines for patients with difficult IV access in the emergency room; USGPIV access was given a level A-high recommendation by the ENA committee for its use. Level A recommendation reflects a

high degree of clinical certainty and is based on consistent and high-quality evidence, as well as proving more beneficial to the patient (ENA, 2012).

Summary

USGPIV has repeatedly shown to improve patient satisfaction and prevent avoidable central line placements in the hospital setting (Scoppettulolo et al., 2016). USGPIV access has established an advantage over all other options available for difficult PIV patients, especially when limited resources are available such as small rural hospitals.

CHAPTER III

Introduction

The purpose of this quality improvement project was to improve nursing practice in reference to evidenced based practice for peripheral IV placement. This three-step pilot project aimed to identify the need for the implementation of an USGPIV protocol, develop and educate emergency department nursing staff on a USGPIV protocol. Lastly, a pre and post survey was used to evaluate nursing confidence levels regarding USGPIV in daily work routines in the ED.

Project Design

The quality improvement (QI) pilot project incorporated the FADE model (focus, analyze, develop, execute). The FADE model is a cyclic process used to measure the QI process and outcomes. The first cycle focused on discovering if a current PIV protocol exists. The second cycle included a retrospective chart review using the data retrieval tool (Appendix B). The third cycle was the development of an evidence-based step-by-step protocol for USGPIV placement. The fourth cycle was online training, didactic and hands-on education to ED registered nurses for implementation of the USGPIV protocol.

Methods

A random retrospective chart review of 50 charts between January 1st, 2019 to September 30th, 2019 of participants between 18 and 100 years of age who received PIV

access in the ED were reviewed. Data was collected regarding age and BMI of the patient, if they had a history of diabetes or IV drug use, number of insertion attempts, whether alternative methods for venous access, and the outcome of these methods. The rate of alternative methods used for IV access including central venous access, anesthesia consults, and IO access was gathered.

Five emergency department RN's were selected to review the USGPIV protocol, receive training, implement, and evaluate the protocol. The pre and post-surveys were used to assess the nurse's confidence level in placing PIV's, recognizing a difficult access patient, recognizing a vein on US and using USGPIV for difficult access patients. The results of the study may be used to develop a hospital wide training for medical surgical and intensive care units.

Project Site and Population

This quality improvement project was executed at the GMC ED located in Girard, Kansas. Approval was obtained from the board at GMC prior to implementation of the project. GMC is classified as a critical access hospital with a 16-bed capacity. The ED is designated as a level IV trauma center through the Kansas Department of Health and Environment. The ED evaluates 3-4,000 patients a year. Due to its small size, there are limited resources available to patients identified as difficult PIV access. Witting (2012), states providers typically have a harder time finding PIV access in an ED patient (39%) compared to the overall hospital setting (22%). With providers having this much difficulty starting PIV, alternatives needed to be available for the RN to ensure the patient has adequate access and timely treatment. The ED does have access to a CRNA and

surgeon who are on-call for consult 24 hours a day. They have a call back of up to 30 minutes which can cause a critical set back in care.

The quality improvement education was implemented with five RN's, each with no known previous ultrasound experience. The nurses were educated of the new protocol as well as an educational you-tube video instruction on USGPIV placement. A pre and post-participation survey will be completed by nursing staff prior to education day one and upon completion of the education at days 21-28. Participation in the quality improvement project was voluntary. Nurses were asked to participate prior to the initiation of the QI project. Consent was be obtained on written consent forms and provided to nurses prior to initiation of the USGPIV education.

Population Recruitment

A randomized sample of 50 charts was used for retrospective chart review. All patients reviewed were selected from emergency department visits at Girard Medical Center between January 1, 2019 and September 30th, 2019. A convenience sampling of five nurses was determined by the number of nurse's willing and available to participate.

Inclusion and Exclusion Criteria

The inclusion criteria for the chart review was a patient between the ages 18-100 years of age, seen in the emergency department between January 1, 2019 to September 30th, 2019, and had a need for PIV access. Exclusion criteria for the chart review were any patient outside the ages of 18-100 years, patients who did not require PIV access, and those patients who required pre-hospital PIV and IO starts. For the education and survey portions of this project, inclusion criteria included willing participant RN's working part-

time or full-time in the emergency department at GMC. The vulnerable populations of pregnant women and pediatrics were excluded in each phase of this project.

Protection of Human Subjects

IRB approval was obtained from Pittsburg State University, beginning with the Irene Ransom Bradley School of Nursing. The risks and benefits were reviewed prior to initiating USGPIV education. Participants had the option to withdraw at any time during the project. No identifying information was included in the reporting of the data, and no compensation was given to RN participants.

Procedures

Mutual agreement was obtained from GMC, Girard, Kansas to do a retrospective chart audit from January 1, 2019 to September 30, 2019 on 50 random patients seen in the emergency department as previously outlined. Data was collected regarding age, BMI, history of diabetes or IV drug use, number of insertion attempts, alternative methods for venous access, and the outcome of these methods. A protocol to address the difficult PIV patient using US was developed. Nurses were given a pre-survey to evaluate confidence level prior to receiving education. All five nurses were trained individually regarding the USGPIV protocol. An educational 20-minute video by the New England Journal of Medicine from 2015, was viewed after protocol review. The nurse's were then be required to place five witnessed successful USGPIV's per protocol, using a venipuncture IV training pad model or live patient for completion of the education.

Timeline

The researcher collected data from patient charts retrospectively as stated. This data collection occurred between January 15, 2020 to February 15, 2020, after IRB

project approval was obtained. The RNs participating in the project then completed a pre-participation survey, and completed education as previously outlined between December 15, 2019 and February 1, 2020. The post participation study was completed no later than February 29, 2020.

Budget

There was a small cost of providing a simulated USPIV training pad. This pad was purchased online for around $150 dollars. Girard Medical Center provided the use of the existing ultrasound machine and provided PIV supplies needed for successful implementation of the project. Supplies included alcohol pads, gloves, PIV catheters, and ultrasound gel.

Strengths and Weakness of the Project

Strengths of the projects included its simplicity and the proposed improved nursing practice that was implemented. The improvement to patient care and improved patient outcomes were suspected. Weaknesses of the project included the limited sample size of the nurses available for education, the rural location of the project and the convenience sample available for data collection.

Summary

The pilot project design includes the FADE model for quality improvement implementation. A retrospective chart review examined current PIV practices, with regards to age, BMI, history of diabetes or IV drug use, number of insertion attempts, alternative methods for venous access, and the outcome of these methods. After completing the retrospective chart review a USGPIV protocol was developed for GMC. The RN's were educated and trained on this protocol and completed a pre- and post-

participation survey. The goal of this project was to improve the participating RN's knowledge base of alternative vascular access methods for difficult PIV patients while improving the RN's confidence level with difficult IV patients and placing USPIV access.

CHAPTER IV

Evaluation Results

Purpose

PIV access is the most common ED procedure and is vital in providing life-saving and adequate care. The goal of this project was to give the staff additional options for starting PIV's, as options are typically very limited in these small hospital settings. There were three project questions addressed in this project. The purpose of this policy implementation project was to implement a new USGPIV policy, while answering three key research questions regarding PIV placement.

1. What is the average attempt rate for a PIV placement in a rural hospital setting?
2. How often are alternative methods for IV access currently used in a rural hospital setting?
3. Will educating, and implementing guidelines for USGPIV access improve a nurse's confidence level when placing a PIV?

A random retrospective chart review of 50 patients requiring IV placement in the ED was completed to determine the average attempt rate for a PIV placement in this rural hospital ED setting. This chart review also served to answer the second research question; "how often are alternative methods for IV access currently used in this rural hospital

setting?" After implementing a USGPIV policy, a survey was given to the RN staff to evaluate the effect of the USGPIV guidelines on the overall confidence level of the nurses by answering question number three "will educating and implementing guidelines for USGPIV access actually improve a nurse's confidence level when placing a PIV?"

Sample

A randomized sample of 50 charts was reviewed for a retrospective chart review. The inclusion criteria for chart review were patients between the ages 18-100 years of age, evaluated in the emergency department between January 1, 2019 to September 30, 2019, and required PIV access. Exclusion criteria for the chart review included any patient outside the ages of 18-100 years. Patients who did not require PIV access, and those patients who required pre-hospital PIV were also excluded. This process allowed the researcher to gather data regarding the number of IV attempts required for the average ED patient as well as whether alternative methods for IV access was needed. Data acquired included demographics of the patient including, their age, BMI, history of diabetes, and history of IV drug use. No specific names or identifying information was gathered.

Demographic data

The data found during the period of this chart review identified patients who were typically older (mean age 57.24 standard deviation 21.9), overweight and obese (mean BMI 31.22, standard deviation 9.51), and had a history of diabetes (26%). (See Tables 1-3). Only one patient chart contained history of IV drug use. This number may not represent the actual data of people using IV drugs since this date was dependent on the willingness of the patient to provide this information.

Table 1. Age of patient requiring PIV

		Frequency	Percent
Age	18-30	10	20.0
	31-40	3	6.0
	41-50	5	10.0
	51-60	5	10.0
	61-70	11	22.0
	71-80	6	12.0
	81-90	8	16.0
	91-100	2	4.0
	Total	50	100

Note. Mean 57.24, SD 21.899

Table 2. BMI of patients receiving PIV

		Frequency	Percent
BMI	15-20	5	10.0
	21-25	9	18.0
	26-30	13	26.0
	30-35	5	10.0
	36-40	9	18.0
	>40	9	18.0
	Total	50	100

Note. Mean 31.22, SD 9.519.

Table 3. Presence of diabetes in patients requiring PIV

	Frequency	Percent
History of diabetes	13	26.0
No history of diabetes	37	74.0
Total	50	100

Analysis of Project Questions

Research Question One

What is the average attempt rate for a PIV placement in a rural hospital setting?

Table 4. Number of IV Attempts

	Frequency	Percent
1	39	78.0
2	8	16.0
3	1	2.0
4	1	2.0
Total	50	100

Note. Mean 1.27, SD = .605

Based on a random retrospective chart review, the average attempt rate for PIV placement in this ED setting is 1.27 attempts (SD= .605). This represents a cumulative average mean based on documentation by the RN on duty caring for the patient. Meyer et al. (2014) place first attempt failure rate at 25%, the chart review done at GMC places the rate at 20-21% first attempt failure.

Research Question Two

How often are alternative methods for IV access currently used in a rural hospital setting?

Table 5. Use of alternative methods for IV access

	Frequency	Percent
Regular IV line	45	90.0
Central Line	1	2.0
CRNA consult	3	6.0
Interosseous access	1	2.0
Total	50	100

The retrospective chart review revealed five of 50 patients required alternative measure to be utilized. This would be a 10% rate of alternative methods used. This average rate of 10% is consistent with the research that presently one in ten presenting emergency department (ED) patients is a difficult PIV access (Fields et al., 2014) requiring alternative or specialized service.

Research Question Three

Will educating, and implementing guidelines for USGPIV access improve a nurse's confidence level when placing a PIV? The RN's were given a survey pre-education and post-education and asked to rate their confidence level on four questions, 1) establishing a peripheral IV, 2) identifying a difficult access patient, 3) identifying a vein on ultrasound, and 4) placing a USGPIV.

Table 6. Survey results

Confidence in	Mean	Std. Deviation
Pre-education placing a PIV	4.0	.70711
Pre-education identifying a difficult IV patient	3.4	.54772
Pre-education identifying a vein using US	1.0	.00000
Pre-education placing a PIV using US	1.0	.00000
Post-education placing a PIV	4.2	.44721
Post-education identifying a difficult IV patient	4.0	.00000
Post-education identifying a vein using US	3.0	.00000
Post-education placing a PIV using US	3.0	.00000
Pre-education Mean	2.35	.28504
Post-education Mean	3.55	.11180

For observed means, 1=not confident, 2=slightly confident, 3=moderately confident, 4=very confident, 5=extremely confident.

Using a five-point Likert scale from not-confident to extremely confident the participant's responses to each particular question was analyzed. The following scores evaluated the responses: Not confident (1), slightly confident (2), moderately confident

(3), very confident (4), extremely confident (5). On questions, one and two, the mean individual responses fell between moderately confident to extremely confident and on the pre-education survey with a standard deviation of 0.7 and 0.5. On questions three and four, the mean individual response was one (not confident) from all five participants. The standard deviation was 0.0 and was consistent with the assumption that the nurses had no prior experience placing USGPIV.

A post-education survey was administered using the same Likert scale. The answers to the survey questions one and two remained consistent pre and post survey likely due to these nurses are very experienced and are comfortable when placing an PIV and in identifying a difficult IV patient. Questions three and four post-education improved to a mean average of very confident from not confident in the pre-education survey, with a standard deviation of 0.0. While this researcher did not go on the gather post satisfaction patient rates, based on the evidence use of US for PIV is the standard of care. Use of US has shown to improve patient satisfaction rates (Schoenfield et al., 2010) decrease the use of alternative methods for PIV and decrease complications of these alternative methods (Au et al., 2012).

Table 7. Rankings

		N	Mean Rank	Sum of Ranks
Postmean-Premean	Negative Ranks	0	.00	.00
	Positive Ranks	5	3.00	15.00
	Ties	0		
	Total	5		

a.postmean<premean
b.postmean>premean
c.postmean=premean

Wilcoxon -2.041, probability .041.

When comparing the overall premeasure (M=2.35, SD=.28504) to the overall post-measure (M=3.55, SD=.11180), it was found that there was a statistical difference between the two (Wilcoxon = -2.041, p = 0.041). The post-measure was higher than the pre-measure, which indicates that the nurses are more confident in using the US for PIV attempts after they have received education in this area.

CHAPTER V

Discussion

Relationship of Outcomes

This project addressed three research questions related to PIV access in the ED as discussed in chapter four. This research discovered the average success rate on first attempt in this rural ED setting was 78%, with a 22% first attempt failure rate. This compares closely to the research review where Meyer et al. found a 25% failure rate in first attempt sticks (2014). With regards to patients being difficult access, Fields et al. found that one in ten ED patients were difficult access, requiring more than two attempts or alternative access. In this study the researcher found that 10% alternative methods such as CRNA consult, IO placement, or Central Line placement were needed.

This study did also reveal that education on USGPIV increased nurse's confidence levels in starting PIV access, as evidenced by the post-survey results where all five nurses increased confidence level in placing an USPIV from not confident to moderately confident. These survey results were consistent with Miles et. al. Georgia trauma center study that nurse's confidence level to place an IV improve post USGPIV training by them rating fewer patients as difficult access (2012).

Observations

Several important observations were found during this study implementation. First, because the nurses included are so experienced, they rarely require more than one to two attempts for starting a PIV and even seldom required USGPIV or alternative methods. Also, because of their experience and resistance to change, they were hesitant to utilize the ultrasound equipment and change their current practice. The youngest RN trained had the least experience, is currently in school, and was the most open to the new policy. Mechanically learning to hold the ultrasound probe during the IV placement process was very difficult for the RN's, and this skill is still being discovered.

The medical board consists of a large group of young to older physicians and administrative staff. The project received approval from the director of nursing, emergency department medical director, and chief executive officer of Girard Medical Center. No expected resistance from the hospital board or staff was expected. The hospital was very supportive from the very beginning of this project and felt it could be an excellent resource for the ED staff and potentially improve patient care and patient satisfaction levels. When the policy was presented to the board, there was some resistance from the radiologist, who was very concerned that my procedure was not being performed under sterile conditions. This project used ultrasound equipment owned by the ED, not the radiology department. The radiologist voiced his concerns to the medical staff and the department of nursing which resulted in a delay for several weeks while the concerns of the radiologist were addressed. While a PIV start is not a sterile procedure, his concerns regarding using a more aseptic technique were valid. The competency check

list was updated (See appendix I) to include the use of a sterile probe cover and sterile gel with each USGPIV start.

The electronic health system (EHR) utilized by Girard Medical Center was an obstacle to the chart review, in the EHR the nurses were not required to be consistent in documenting IV attempts, which meant additional charts were needed to gather adequate data. If a patient IV was attempted and was not successful the current documentation does not adequately capture the attempts. The EHR system also does not consistently document the use of alternative methods such as central line placement or anesthesia consult.

The ultrasound machine made available for this project was initially acquired to place PICC lines and the machine was donated to the facility for this purpose. While it is easy to view the veins for USGPIV placement using this machine, it did not have some features that would have been helpful during implementation. The US device does not have color doppler options that can help differentiate between arterial and venous blood flow, nor was there an orientation line on the vascular screen to help the staff with the probe orientation. Both of these US features affected the learning curve for using the machine and for the procedure in general.

While the collection tool for the chart review was useful, it was difficult to answer whether alternative methods were used or if they were successful. The pre and post participant survey was beneficial and gathered practical data. However, due to the small sample size, it is possible that the results are biased due the RN's relationship with the researcher and their desire for this policy implementation to be successful.

Evaluation of theoretical framework

The data from this research supports Benner's From Novice to Expert Nursing Theory. Dr. Patricia Benner explained that know-how in nursing is made of practical knowledge through study and is made evident by experience (Benner, 1982). All five nurses started in the novice phase for USGPIV placement, as evidenced by their survey responses. However, as per Benner's theory, all five nurses gained knowledge through their education and competency training on the policy. This was proven by the nurse's responses to questions three and four on the post-education survey. Prior to the education, the nurses educated rated their experience with USGPIV at the non-confident level, as well as their confidence to identify a vein pre-education was rated at the non-confident level. Post education, the nurses all rated their confidence level with USGPIV access and vein identification at the moderately confident level on the survey.

Evaluation of logic model

This project, utilized The Fade Model for Quality Improvement as its logic model. Sherwood and Barnester (2012), describe quality improvement as using the data to monitor outcomes of care processes that help guide improvement methods for patient care. This project focused (F) on a clinical problem of difficult IV access patients in the ED. The project analyzed (A) the data utilizing a retrospective chart review process, developed (D) a new hospital policy to address the clinical problems offering a solution and executed (E) this new policy by educating the RN's in the ED of the new policy and recorded the impact it had on their practice.

Limitations

The EHR significantly limited my retrospective chart review as it is challenging to navigate. To ensure my numbers were accurate, opening the chart review to a larger

sample size may have given additional data. The limited sample size on the training of only five nurses limited the survey results. If it had been possible to train a larger sample of RN's, that would have improved the impact of the project as well as gotten a larger sample size of survey results.

Implications for future practice

Education of this protocol for the ED RN's of this practice will continue to allow the staff to become more proficient in placing USGPIV. Other RN's in the hospital have expressed interest in being educated on the new policy, so a goal is to allow all hospital RN's the option of gaining clinical competency in this skill. In the future this researcher plans to continue to educate and train RN's at GMC and future practice sites on the skill of placing an USGPIV. The evidence has shown improved patient satisfaction and this skill can benefit the staff and patients at these small rural practice sites.

Conclusion

The goal of implementing this project was to expand the GMC ED RN's knowledge and experience with difficult IV access and give them another option for getting PIV access when resources are limited. Overall the implementation of this policy was very successful and will directly improve the care provided by RN's at GMC.

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APPENDIX

Appendix A. Pre/Post Participant Survey

Please complete the following questions using this scale for your responses.

(1) Not confident
(2) Slightly confident
(3) Moderately confident
(4) Very confident
(5) Extremely confident

1. What is your current confidence level in placing peripheral IV's?	1	2	3	4	5
2. What is your current confidence level in identifying a difficult access patient?	1	2	3	4	5
3. What is your current confidence level in identifying a vein for IV placement using portable ultrasound?	1	2	3	4	5
4. What is your current confidence level in placing ultrasound guided peripheral IV's in difficult access patients?	1	2	3	4	5

Appendix B. Data Retrieval Tool

	Age	BMI	Diabetes	Hx IV drug use	# IV attempts	success	Alt method used	success
1			yes / no	yes / no		yes / no		
2			yes / no	yes / no		yes / no		
3			yes / no	yes / no		yes / no		
4			yes / no	yes / no		yes / no		
5			yes / no	yes / no		yes / no		
6			yes / no	yes / no		yes / no		
7			yes / no	yes / no		yes / no		
8			yes / no	yes / no		yes / no		
9			yes / no	yes / no		yes / no		
10			yes / no	yes / no		yes / no		
11			yes / no	yes / no		yes / no		
12			yes / no	yes / no		yes / no		
13			yes / no	yes / no		yes / no		
14			yes / no	yes / no		yes / no		
15			yes / no	yes / no		yes / no		
16			yes / no	yes / no		yes / no		
17			yes / no	yes / no		yes / no		
18			yes / no	yes / no		yes / no		
19			yes / no	yes / no		yes / no		
20			yes / no	yes / no		yes / no		
21			yes / no	yes / no		yes / no		
22			yes / no	yes / no		yes / no		
23			yes / no	yes / no		yes / no		
24			yes / no	yes / no		yes / no		
25			yes / no	yes / no		yes / no		

	Age	BMI	Diabetes	Hx IV drug use	# IV attempts	success	Alt method used	success
26			yes / no	yes / no		yes / no		
27			yes / no	yes / no		yes / no		
28			yes / no	yes / no		yes / no		
29			yes / no	yes / no		yes / no		
30			yes / no	yes / no		yes / no		
31			yes / no	yes / no		yes / no		
32			yes / no	yes / no		yes / no		
33			yes / no	yes / no		yes / no		
34			yes / no	yes / no		yes / no		
35			yes / no	yes / no		yes / no		
36			yes / no	yes / no		yes / no		
37			yes / no	yes / no		yes / no		
38			yes / no	yes / no		yes / no		
39			yes / no	yes / no		yes / no		
40			yes / no	yes / no		yes / no		
41			yes / no	yes / no		yes / no		
42			yes / no	yes / no		yes / no		
43			yes / no	yes / no		yes / no		
44			yes / no	yes / no		yes / no		
45			yes / no	yes / no		yes / no		
46			yes / no	yes / no		yes / no		
47			yes / no	yes / no		yes / no		
48			yes / no	yes / no		yes / no		
49			yes / no	yes / no		yes / no		
50			yes / no	yes / no		yes / no		

Appendix C. Survey Responses

	Pre Q1	Pre Q2	Pre Q3	Pre Q4	Post Q1	Post Q2	Post Q3	Post Q4
Nurse 1								
Nurse 2								
Nurse 3								
Nurse 4								
Nurse 5								

Appendix D. Consent Form

Pittsburg State University

Committee for the Protection of Human Research Subjects (CPHRS)

INFORMED CONSENT FORM INSTRUCTIONS – Research Using Human Subjects PROJECT TITLE: Ultrasound Guided Peripheral Intravenous Access in the Emergency Department

APPROVAL DATE OF PROJECT & EXPIRATION DATE OF PROJECT: December 15, 2019, July 31, 2020.

PRINCIPAL INVESTIGATOR: Lynieta Leisure, APRN, DNP Candidate

CO-INVESTIGATOR(S): None

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Lynieta Leisure, 417-283-1703

IRB CHAIR CONTACT/PHONE INFORMATION:

• Brian Peer, Chair, Committee for the Protection of Human Research Subjects, 112 Russ Hall, Pittsburg State University, Pittsburg KS 66762-7526, (620) 235-4175

SPONSOR OF PROJECT: none

PURPOSE OF THE RESEARCH: To educate emergency room RN's at GMC regarding USPIV protocol and practice.

PROCEDURES OR METHODS TO BE USED: Video and hands on education

ALTERNATIVE PROCEDURES OR TREATMENTS, IF ANY, THAT MIGHT BE ADVANTAGEOUS TO SUBJECT: none.

LENGTH OF STUDY: One to two months.

RISKS OR DISCOMFORTS ANTICIPATED: none.

BENEFITS ANTICIPATED: increased knowledge and skill regarding alternative methods for placing a PIV.

EXTENT OF CONFIDENTIALITY: Your name will not be associated in any way with the information collected about you or with the research findings from this study. The researcher(s) will use a study number, initials, or a pseudonym instead of your name. The researches will not share information about you with anyone not specified above unless required by law or unless you give written permission.

IS COMPENSATION OR MEDICAL TREATMENT AVAILABLE IF INJURY OCCURS: In the event of injury, the Kansas Tort Claims Act provides for compensation if it can be demonstrated that the injury was caused by the negligent or wrongful act or omission of a state employee acting within the scope of his/her employment.

PARENTAL APPROVAL FOR MINORS: NA

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits or academic standing to which I may otherwise be entitled. I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

Participant Signature: _____ Date: _____

Witness to Signature _____ Date: _____

Appendix E. IRB Approval Form

Pittsburg State University
Application for Approval of Investigations
Involving the Use of Human Subjects

This application must be completed by the Investigator and sent to the Office of Graduate and Continuing Studies by the first Tuesday of the month during the fall and spring academic semesters to be considered for full review on the second Tuesday of the month.

Expedited and exempt reviews can be turned in any time. For questions about the review process contact Brian Peery in Russ Hall, #112, Ext. 4175.

1. Investigator(s) Name(s): Lynieta Leisure
2. Department: Nursing
3. Local Address: 21540 S 1456 Rd Nevada MO 64772
4. Phone: 4172831703
5. E-mail Address: lynieta@hotmail.com
6. Project Title: Ultrasound guided intravenous access in the emergency dep
7. Expected Completion Date: July 2020
8. Expected Starting Date December 15, 2019

9. Is this project (check all that apply): Use review criteria in Form CR-1 to determine which category of review applies.

☐ Application for Full Review	☐ Protocol Change	☐ Thesis/Special Investigation
☐ Being submitted for external support	☐ Continued Review	☐ Application for Expedited Review
☐ Being conducted in a foreign country	☐ Faculty Research	☑ Application for Exempt Review
☐ Publishable research	☐ A Class Project	

10. If notification of human subject approval is required give date required: _____

Name of agency: _____

11. If you are a student, complete the following:

Faculty Sponsor: _____

Department: _____

Phone: _____

**** If submitted externally, a complete copy of the proposal must be submitted to the IRB.****

Appendix F. USGPIV Protocol GMC

GIRARD Medical Center — Girard, KS	Date First Created: 11/20/2019
Title: Ultrasound Guided Peripheral Intravenous Access	
Department: Nursing	Date: 12/03/2019
Approved by: Chief of Staff, APRN, Department Director, CEO	Pages: 2

POLICY: Ultrasound-guided peripheral intravenous (PIV) access placement.

PURPOSE: To assist with PIV placement in difficult access patients.

RESPONSIBILITY: The staff registered nurse who has completed the appropriate education and has completed the competency check list.

PROCEDURE:

- Determine the need for ultrasound guided PIV access based on history of difficult access or two unsuccessful PIV attempts.
- Gather needed supplies including PIV start kit and appropriately sized IV access needle.
- Clean ultrasound machine with alcohol free wipes.
- Perform hand hygiene and put on clean gloves.
- Select the linear (vascular) transducer.
- Under exam use the vascular icon. Assure you are in the direct line of sight of screen so you do not need to turn your head.
- Place tourniquet on the selected extremity.
- Apply ultrasound gel to the linear transducer.
- Correctly orient ultrasound transducer in the transverse or short axis view to locate the vein. Optimize depth (most superficial).
- Clean site with iodine or chlorohexidine prep 30 seconds.
- Identify artery, vein, bone and muscle tissues. Once suitable vein is located, compress down on the vessel gently to visualize the round shaped vein collapsing. Always perform compression test, as arteries are thick walled, pulsatile and should not compress with minimal compression.
- Understand how to locate the appropriate insertion site based on the depth of the target vessel.
- After identification of an appropriate vessel, locate the target vessel and place in the center of the screen, adjusting the depth and gain appropriately.
- Hold catheter in dominant hand and insert needle at the center of the transducer, immediately adjacent to the transducer, and perpendicular to the transducer.
- Visualize needle tip at as a grey-white image while still very superficial on the ultrasound screen. Make adjustments as needed based on visualization of the needle tip in relation to the target vessel. Consider re-puncturing the site if too far from target vessel.
- Identify and follow the needle tip progression on the ultrasound machine.
- Guide needle to the target vessel, while looking for the blood flash in the catheter.
- Advance the catheter into the vein.
- Attach extension tubing or luer-lock device per protocol.
- Draw blood as appropriate.
- Remove the tourniquet.
- Dress the IV site with clear op-site dressing, time, date and initials on dressing

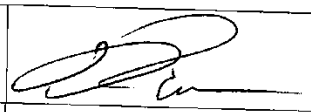
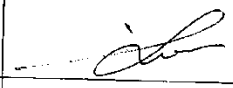
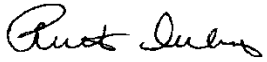
DOCUMENTATION:

- In the patient's medical record, date and time of catheter insertion.
- Documentation of the use of USGPIV protocol for the IV start.
- Catheter size/length and number of attempts.
- Patient's tolerance of procedure.

MAINTINENCE:

- Site needs cleaned and dressed every 24 hours, documentation in chart.
- Monitor and document each shift for erythema, signs of infiltration
- If not used routinely, flush with normal saline 3cc every 8 hours.
- Site may be used safely 5 days, up to 7 if needed.
- Documentation of IV catheter removal in chart, site evaluation.

APPROVAL:

Position	Printed Name	Signature		Date
ED Medical Director:	*Dr. Adam Paoni*		*Date:*	12/18/19
Chief of Staff:	*Dr. Rachel Stevens*		*Date:*	12-11-19
APRN/CRNA:	*Simon Howayek, APRN*		*Date:*	12-3-19
Department Director:	*Joyce Geier, BSN,RN Director of Nurses*		*Date:*	12-3-19
Administrator:	*Ruth Duling, CEO*		*Date:*	12-03-19

Appendix G. Letter CEO, GMC

GIRARD Medical Center
GirardMedicalCenter.com
302 North Hospital Drive • Girard, KS 66743 • PHONE 620.724.8291 • FAX 620.724.6332
#1 In Service

November 26, 2019

Re: Lynieta Leisure, APRN, Doctoral student

To whom it may concern:

Lynieta Leisure has approval from the Hospital CEO/Administrator, the Emergency Department Medical Director, the Administrative Team, the Corporate Compliance officer, the HIPAA compliance officer, and the Risk Manager to conduct her study. These individuals, in their respective positions, approve of her methods of data collection.

Girard Medical Center accepts the Pittsburg State University IRB and will not be using an IRB from the Girard Medical Center.

Thank you.

Respectfully,

Ruth Duling

Ruth Duling, CEO
Girard Medical Center
302 N. Hospital Drive
Girard, KS 66743

620-724-8291, ext. 268
Fax: 620-724-5195

Appendix H. Letter Risk Manager, GMC

GIRARD Medical Center
GirardMedicalCenter.com
302 North Hospital Drive • Girard, KS 66743 • PHONE 620.724.8291 • FAX 620.724.6332
#1 In Service

November 26, 2019

Re: Lynieta Leisure, APRN, Doctoral student

To whom it may concern:

Lynieta Leisure has approval from the Hospital CEO/Administrator, the Emergency Department Medical Director, the Administrative Team, the Corporate Compliance officer, the HIPAA compliance officer, and the Risk Manager to conduct her study. These individuals, in their respective positions, approve of her methods of data collection.

Thank you.

Respectfully,

Joyce Geier

Joyce Geier, BSN, RN
Risk Manager, Quality Director
Director of Nursing
Girard Medical Center
302 N. Hospital Drive
Girard, KS 66743

620-724-8291, ext. 512
Fax: 620-724-5195

Appendix I. GMC USGPIV Competency check list

Girard Medical Center Ultrasound Guided Peripheral Intravenous Line Insertion Competency					
Outcome: Correctly and safely utilize ultrasound for peripheral intravenous catheters.					
Employee name:					
Reviewed existing protocol and watched video on insertion technique Date completed:					
	Meets Criteria				
Knowledge and Skill Demonstration	1	2	3	4	5
• Gather needed supplies including PIV start kit and appropriately sized IV access needle.					
• Clean ultrasound machine with alcohol free wipes.					
• Perform hand hygiene and put on clean gloves.					
• Select the linear (vascular) transducer, and apply appropriate sterile cover.					
• Under exam use the vascular icon. Assure you are in the direct line of sight of screen so you do not need to turn your head.					
• Place tourniquet on the selected extremity.					
• Apply sterile ultrasound gel to the linear transducer.					
• Correctly orient ultrasound transducer in the transverse or short axis view to locate the vein. Optimize depth (most superficial).					
• Identify artery, vein, bone and muscle tissues. Once suitable vein is located, compress down on the vessel gently to visualize the round shaped vein collapsing. Always perform compression test, as arteries are thick walled, pulsatile and should not compress with minimal compression.					
• Understand how to locate the appropriate insertion site based on the depth of the target vessel.					
• After identification of an appropriate vessel, locate the target vessel and place in the center of the screen, adjusting the depth and gain appropriately.					
• Clean site with iodine or chlorhexidine prep 30 seconds.					
• Hold catheter in dominant hand and insert needle at the center of the transducer, immediately adjacent to the transducer, and perpendicular to the transducer.					
• Visualize needle tip at as a grey-white image while still very superficial on the ultrasound screen. Make adjustments as needed based on visualization of the needle tip in relation to the target vessel. Consider re-puncturing the site if too far from target vessel.					
• Identify and follow the needle tip progression on the ultrasound machine.					
• Guide needle to the target vessel, while looking for the blood flash in the catheter.					
• Advance the catheter into the vein.					

• Attach extension tubing or lure-lock device per protocol.					
• Draw blood as appropriate.					
• Remove the tourniquet.					
• Dress the IV site with clear op-site dressing, time, date and initials on dressing					

Demonstrate (5) successful insertions direct observation by ED Provider/Preceptor following the competency checklist:

(1) Evaluator signature_____

Date: _____ Live or Simulation

(2) Evaluator signature_____

Date: _____ Live or Simulation

(3) Evaluator signature_____

Date: _____ Live or Simulation

(4) Evaluators signature_____

Date: _____ Live or Simulation

(5) Evaluators signature_____

Date: _____ Live or Simulation

I have reviewed and performed the above procedure independently. I am responsible for applying the procedure correctly. I agree to utilize this procedure when appropriate and as for resources and assistance as needed.

Preceptor Name: (print)_____
(signature)_____

Employee Name: (print)_____
(signature)_____

Employee #_____ Unit_____