INTRODUCTION OF A BEST PRACTICE FOR VENTRICULOOSTOMY MANAGEMENT IN THE NEUROSCIENCE CRITICAL CARE UNIT

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Signed: Jennifer McDaniel
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ABSTRACT

BACKGROUND/OBJECTIVES: Ventriculostomy associated infections are a present burden on our healthcare system as well as patients and their families. Use of nursing led protocols to decrease the incidence of healthcare-associated protocols has been supported in previous platforms. The purpose of this study is to determine a need for a ventriculostomy protocol that aligns with the needs of the unit and the current best practice standard for ventriculostomy management and then to create that protocol and necessary nursing education.

DESIGN: Descriptive non-experimental study, which includes a retrospective chart review of 20 patients with ventriculostomies, placed in the neuroscience intensive care unit (ICU) and a focus group discussion of key stakeholders within the neuroscience ICU.

METHODS: List of subjects for retrospective chart review obtained through CPT codes for ventriculostomy placement and convenience sampled in reverse chronological order. Descriptive statistics completed on participant characteristics and frequency of documentation present in charts during retrospective review. Focus group participants obtained through non-probability quota sampling.

SETTING: 12-bed neuroscience ICU in a 337 bed ACS Level 1 certified trauma center and DNV Level I certified stroke center in Scottsdale Arizona

SUBJECTS: Retrospective chart review (n=20) most recent patients who had a ventriculostomy drain placed in the neuroscience ICU. Average age 54.6 y/o ±17.8 and average LOS 15.45 days ± 9.1. Focus group discussion included 1 ICU manager, 2 ICU supervisors, 1 ICU educator and 3 bedside RN’s. Informed consent obtained from all focus group participants.
RESULTS: Retrospective chart review of patients (n=20) showed 100% documentation on antibiotic administration within 30 minutes of insertion and daily site assessment. There was 0% documentation on team member attire in the room during insertion, accessing of the system, whether the port was scrubbed prior to accessing and changing of the sterile bag. Focus group discussion showed varying opinions on current thoughts related to the available ventriculostomy charting. Many comments included a need for more in depth charting to capture the care that the bedside RN provides on a daily basis in regard to ventriculostomy management. Major barriers to introduction of a ventriculostomy protocol included stakeholder buy in and nursing staff education in use of the protocol.

CONCLUSION: By determining a need for a ventriculostomy protocol, through a retrospective chart review of current documentation in the neuroscience ICU, and taking into account key stakeholder opinions, the JNM ventriculostomy management protocol was developed to improve standard of care within the neuroscience ICU and decrease infection rates. Educational information was created for nursing staff to learn the current best practice standards for ventriculostomy management as well as use of the JNM ventriculostomy protocol within their charting.
CHAPTER ONE: INTRODUCTION

Overview

Healthcare-associated infections are a serious and burden for patients, the health-care system, and its associated financial institutions. Health-care associated infections may include bloodstream infections, surgical site infections, urinary tract infections and ventilator associated infections (Centers for disease control and prevention [CDC], 2013). One healthcare associated infection is too many. Understanding the important impact of health-care associated infections as well as measures to prevent such infections is crucial to not only the wellbeing of our patients, but also to the healthcare system as a whole.

The Deficit Reduction Act of 2005, section 5001, specifically lists certain health-care associated infections that must be reported to the Centers for Medicare and Medicaid Services (Centers for Medicare and Medicaid Services [CMS], 2013). Criteria utilized to determine the conditions listed in the Deficit Reduction Act of 2005, include: “…conditions that could reasonably have been prevented through the application of evidence-based guidelines” (CMS, para. 1). Taking steps to prevent healthcare-associated infections by utilizing the most up to date best practice models should be kept a priority at all times. Medicare reimbursement for patients who suffer a healthcare-associated infection during hospitalization is steadily declining. In other words, when a patient obtains a healthcare-associated infection during their hospitalization they will be at risk for a longer hospital stay with decreased reimbursement for the hospital system. According to the Agency for Healthcare Research and Quality (AHRQ), healthcare-associated infections may increase a patients hospital length of stay by an average of 19 days (2010). In
addition, the mortality rate for patients who suffered a healthcare-associated infection was approximately six times higher than those who did not (AHRQ, 2010).

Neurosurgical patients are at a particularly increased risk of health-care associated infections due to their prolonged hospitalizations as well as their need for surgically placed devices such as ventriculostomies. Introduction of a foreign device can result in infection due to insertion technique as well as post-insertion management. Instituting protocols and ventriculostomy drain management tools to increase nurse awareness and compliance with the most up-to-date standards of care may significantly reduce the possibility of healthcare-associated infection in the neurosurgical population.

**Background and Significance**

A ventriculostomy describes a drain that is placed in the ventricle of the brain by way of a surgically created hole through the skull and Dura Mater (Chin, 2012). The ventriculostomy is used to monitor intracranial pressures (ICP) as well as therapeutically drain cerebral spinal fluid (CSF) (Dasic, Hanna, Bojanic & Kerr, 2006). As described by the Monro-Kellie Doctrine, the skull is a fixed space and changes in CSF, tissue or blood will result in a compensatory change in the other factors (Mokri, 2001). The ventriculostomy drain may be utilized in patients who suffer from a traumatic brain injury (TBI), cerebral edema or subarachnoid hemorrhage, resulting in the need to drain CSF and alleviate pressure within the skull (Camacho et al., 2011). The ventriculostomy may be externally managed in a temporary setting, or placed internally for permanent management of ICP and CSF drainage, also known as a shunt. For purposes of this DNP Project, the use of the term ventriculostomy will speak solely to the external (temporary) ventriculostomy.
The demographics of neurosurgical patients requiring the use of a ventriculostomy can vary greatly. Age, pre-existing conditions, current health status and cause of injury can allow for an array of patient scenarios and possible outcomes. In general, patients in the neurosurgical intensive care unit (ICU) that require placement of a ventriculostomy may be subject to extended stays in the ICU, increasing their risk of infection. The possibility for compromised immune systems from pre-existing health conditions is present in this population and further supports the concept that these patients are at increased risk for healthcare-associated infections. Patients in the ICU, as well as those who have undergone invasive device placement, are at a vastly increased risk of infection than those who did not (Collins, n.d.). This culmination of factors affecting these neurosurgical patients justifies the need for strict infection prevention protocols.

Ventriculostomy drains may be placed in the operating room, ICU or in the emergency department. A Neurosurgeon, Nurse Practitioner (NP) or Physician Assistant (PA) may place the ventriculostomy with the assistance of the Registered Nurse (RN) caring for the patient. The variables associated with insertion (location during insertion and practitioner experience) increases the likelihood of user error or variances in protocol to occur. The possibility of having an RN who is less familiar with the insertion and management process or a provider who inserts ventriculostomy drains less frequently may result in increased risk of infection for that patient. Insertion technique as well as management of the drain post-insertion needs to be consistent and compliant with the current best practice at all times.

Ventriculostomy drains may be accessed multiple times throughout a patient's hospital stay. This process includes interruption of the closed-sterile system through a port in the tubing, allowing for removal of CSF or instillation of normal saline for flushing of the system, as well as
administration of medication (Leverstein-van Hall et al., 2010; Lwin, Low, Choy, Yeo & Chou, 2012). Some hospital systems routinely sample CSF to monitor for infection, while others only obtain samples from the ventriculostomy if infection is highly suspected (Leverstein-van Hall et al., 2012). Any break in the sterile system opens the door for possible infection. Infection rates can vary greatly when patients have a ventriculostomy in place. As discussed, a major cause for this great variance in infection rates relates to insertion technique and management of the drain (Lyke et al., 2001). Multiple studies have cited the infection rate of ventriculostomy drains as being widely variable, ranging between 0% and 45% (Lyke et al. 2001; Camacho et al., 2011). The most common organism resulting in infection is a gram-positive organism such as coagulase-negative *Staphylococcus aureus* (Camacho et al., 2001). *S. Aureus* infections are commonly found in the nares, axilla and gastrointestinal tract and have a propensity to colonize on inanimate objects (Gordon & Lowry, 2008; Turnidge et al., 2008). This ability to colonize on non-human hosts significantly increases the possibility of ventriculostomy drain infection with *S. Aureus*. In addition, breaches in protocol by both practitioners and nursing staff may be the cause of many *S. Aureus* infections in this population. Although gram-positive organisms are the most common, gram-negative bacterial infection have been increasing and may be associated with a higher incidence of mortality (Lyke et al., 2001). Gram-negative bacteria such as *Klebsiella pneumonia* and *Enterobacter cloacae* have become increasingly more common and result in significantly longer hospitalizations as compared to gram-positive bacterial infection (Lyke et al., 2001). Determining the cause of these infections and creating management strategies to reduce incidence is of utmost importance.
The occurrence of ventriculostomy-associated infections, also known as ventriculitis, may have serious consequences, and every effort must be made to decrease this risk. Even one infection that could have been prevented is too many. Those unfortunate patients who acquire an infection secondary to their ventriculostomy, require long courses of antibiotics and have increased risk for complications such as increased intracranial pressures and severe febrile illness (Baddour, Flynn, & Fekete, 2014). Antibiotic therapy is directed at the specific organism found on CSF cultures, however, empiric therapy may be utilized while awaiting final culture results. Patients typically require 7 to 10 days of parenteral antibiotic therapy following sterilization of CSF or a negative culture results (Baddour, Flynn, & Fekete, 2014). In cases where the patient does not respond to parenteral therapy, the use of intraventricular antibiotics may be necessary (Baddour, Flynn & Fekete, 2014). With the need for prolonged parenteral antibiotic use, it is easy to see how the complication of ventriculitis may significantly increase patient’s hospital length of stay and risks for further infections and complications.

Identifying modes of transmission of organisms and how these modes can be eliminated may improve nurse awareness and significantly decrease ventriculostomy infections. Contact transmission can occur through direct contact of the healthcare worker and susceptible patient (Collins, n.d.). This type of transmission may be due to inappropriately accessing of the ventriculostomy system, changing of the bag, flushing of the system prior to initial insertion and a surgical site that is not kept clean. Droplet transmission may occur when organisms from the oral, nasal or respiratory system are expelled onto either the patient or an object that the patient may come in contact with (Collins, n.d.). This type of transmission may occur when a mask is not worn either during insertion, changing of the bag, or during accessing of the system. These
modes of organism transmission are simple to identify as well as prevent. Understanding how infection is transmitted, what links in the chain may be broken and how to fix them, may help increase nurse awareness of their practice and compliance.

The concepts of evidence-based practice (EBP) and best practice are not one in the same, but rather, dynamically related. Evidence based practice can be described as, practice that utilizes the current best research as well as clinical experience and patient factors in order to create the best possible outcomes for patient care (Duke University, 2013). Best practice can be viewed as a set of guidelines that are created from EBP and takes into account organizational resources and individual characteristics of users (Perleth, Jakubowski & Busse, 2000). A clinical practice guideline serves to translate current research into best practice activities at the bedside (Ploeg, Davies, Edwards, Gifford & Miller, 2007).

**Significance to Nursing Practice**

The art and science of nursing involves not only daily management of patients who may be critically ill, but also continued reflection on our own practice and knowledge. Utilization of best practice protocols and following standards of care may significantly decrease the likelihood of healthcare-associated infection. Understanding how our environment and practice impacts patient outcomes may lead to increased awareness and improved quality of care.

As nurses, awareness of our environment and practice can vary from day to day depending on our current assignment and workload. In addition, the aspect of continually changing requirements in terms of charting and procedure practices can make it difficult to recall all practice standards and protocols. The ability of the nurse to be knowledgeable on the
standards of care and follow-through with that standard 100% of the time can make a significant difference in patient care and infection rates.

Currently, the availability and detail associated with the charting of a ventriculostomy drain vary between organizations. This variance or lack of detailed charting may lead to an unawareness of the current best evidence of ventriculostomy care. Institution of a best practice standard for ventriculostomy drain management will provide bedside nurses with a constant reminder and guideline for not only the insertion, but also the daily care of these devices. Addition of such a protocol to the computerized charting may provide guidance to those nurses who are less comfortable with the daily care of a ventriculostomy. Providing a roadmap to care based on the current best evidence has proven to be an effective method of infection prevention in varying circumstances. For example, nursing instituted practice bundles to decrease infection rates related to urinary catheters and central line catheters have proven very successful (Oman et al., 2011; Warren et al., 2004). Providing nursing with education related to infection rates, current best practice standards and a protocol can significantly increase nurse awareness and compliance; subsequently decreasing infection rates.

**Purpose of DNP Project**

The purpose of this DNP Project is two-fold. Increasing nursing awareness and compliance with management of ventriculostomy drains and thus, decreasing infection rates and subsequent complications in neurosurgical patients is the priority. The process of increasing nurse competence and compliance with management of ventriculostomy drains in congruence with the most current evidence based practice and verification of this compliance will be assisted with the introduction and use of a protocol within the nurses charting. Nursing awareness and
nursing led interventions to decrease infection rates have demonstrated success in many different settings (Oman et al., 2011; Ploeg, Davies, Edwards, Gifford & Miller, 2007).

The use of a best practice protocol will provide the bedside nurses in a neurosurgical ICU with both increased knowledge and a guideline for care for the patient with a ventriculostomy. With the use of a retrospective chart review of the last twenty patients who had a ventriculostomy in the neuroscience ICU, it will be determined how often the current best-practice standards are being charted by nursing staff during both insertion and daily management of ventriculostomies. With the assistance of a focus group of key stakeholders within the unit, the current understanding of best practice of ventriculostomy management as well as needs of the protocol and possible barriers to the protocol will be discussed. Implementation of a best-practice protocol with the attained information and literature review will provide the nursing staff with a guideline for care that is evidence-based. Staff will be provided with education regarding the created protocol, which will include both a pre-test and post-test.

In completion of this DNP Project, the goal is to increase nursing awareness of infection prevention in neurosurgical patients. Creating a ventriculostomy best practice protocol and nursing education on use of the protocol that may be utilized in multiple hospital systems. Ultimately, decreasing infection rates in neurosurgical patients.

**Study Aims**

1. Evaluate the current compliance with charting of activities that are evidence-based in relation to ventriculostomy insertion and management (as discussed in the literature review).
2. Collaborate with key stakeholders (bedside RN’s, unit educator, unit supervisor and manager) to determine consensus on the need for a protocol within the nursing documentation and the possible barriers associated to this protocol related to ventriculostomy management.

3. Create an evidence-based best practice protocol that addresses the needs/concerns discussed by the focus group and the current best practice as discussed in the literature review.

4. Create a competency packet that is deliverable to the hospital staff that will include a pre-test and post-test as well as education related to the ventriculostomy protocol.
CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Overview of Neuroscience ICU and Ventriculostomy Management

The goal of this DNP Project is to determine nurse awareness of the current best evidence of ventriculostomy management as well as identify barriers to complying with this practice. Anecdotal evidence within the target population and setting highlights a gap in practice and documentation of ventriculostomy drains. These variances may be a result of a lack of knowledge of the current best practice in addition to the fact that there is no set protocol in place for management. The particular neuroscience ICU in which this DNP Project is being conducted has a relatively low rate of ventriculostomy infection, specifically, one incident within the last year. However, these discrepancies in practice and gaps in charting related to following of the current best practice in ventriculostomy drain management increase the risk for infection, subsequently resulting in increased morbidity and mortality for patients (AHRQ, 2010).

The neuroscience ICU is a 12-bed ICU within a facility that has both Level I Trauma as well as Level I Stroke designation. Core neuroscience nurses primarily staff the unit; however, nurses less familiar with neuroscience and ventriculostomies may be floated into the unit when the need arises. This mix of skill set and knowledge increases the likelihood that there may be a nurse less familiar with the current best evidence related to ventriculostomy management leading to possible deviations to the standard of care.

Conceptual Framework

The conceptual framework for this DNP Project is based on the premise that implementation of nursing led protocols and nurturing of an evidence-based environment can lead to improved health outcomes for neurosurgical patients. Maintenance of the patient’s
environment and health integrity by improving factors that may affect these, will lead to improved patient outcomes. By assessing the current nursing knowledge, educating the nursing staff on current best practice, and instilling a level of inquiry and motivation to maintain strict adherence to the protocol there will be subsequent improvement in the patient’s environment.

Levine’s Theory of Conservation speaks to the need to maintain an environment for optimal healing for the patient (Nursing Theories, 2012). Part of Levine’s Theory of Conservation includes the premise that “Nursing is expected to create an atmosphere…to encourage healing and to promote adaptation” (Meleis, 2012, p. 291). In addition, nurse’s recognition of the environment and their own personal interaction with it will aid in acceptance of the best practice protocol (Meleis, 2012). The concept of fostering an environment of conservation will need to be adopted by the care providers of the neuroscience ICU. Assessment practices in nursing such as administration of medication, nursing assessment, and maintenance of a hygienic, and aseptic environment not only speak to the ventriculostomy best practice protocol but also directly correlate with the goals of Levine’s Theory of Conservation (Nursing Theories, 2012). By imploring the tools necessary to assist staff in achieving this environment, the goal will be for an increased uptake of utilization of the best practice for ventriculostomy management. Levine’s Theory of Conservation has four main principles of conservation: conservation of energy, conservation of structural integrity, conservation of personal integrity and conservation of social integrity (Nursing Theories, 2012). These four principles with descriptions related specifically to a ventriculostomy protocol are displayed in Figure 1.

Levine’s Theory of Conservation has been used as a framework for studies such as Schaefer and Potylycki’s (1993) study on fatigue and congestive heart failure. Study variables
that impacted fatigue in heart failure patients were related to Levine’s four principals. These variables included measurement of vital signs, hemoglobin levels, blood gases, ejection fraction, mood and socialization. This framework provided researchers with the ability to assess the participants internal as well as external environment to determine sources of fatigue and areas for improvement. The principals were used as a guide for the nursing staff to determine areas for intervention or improvement (Schaefer & Potylycki, 1993).

Conservation of Energy

Conservation of energy may include providing the patient adequate rest and appropriate nutrition (Nursing Theory, 2013). More specifically to this DNP Project, conservation of energy may speak to fostering of a calm and peaceful environment through the use of stimulation reduction for the neurosurgical patient. The neuroscience ICU team must continue to strive to create this environment of healing and awareness of surroundings. In addition, measurement of the patients vital signs and laboratory data such as white blood cell counts (WBC) can lead to further inquiry into the patients current energy demands and needs for intervention. Utilizing these (vitals and WBC) can suggest need for further monitoring such as CSF sampling to rule out infection. Appropriate methods of CSF sampling can be further supported in the conservation of structural integrity principal.

Conservation of Structural Integrity

Conservation of structural integrity refers to maintenance of the environment for optimal healing and health promotion (Nursing Theories, 2012). This may include utilization of antibiotics prior to ventriculostomy insertion as well as sterile management of the drain post-insertion. This may include the practice of CSF sampling when absolutely necessary and
maintenance of the sterile system during this sampling. Nursing actions such as utilization of a best practice protocol can greatly increase the conservation of structural integrity to improve patient outcomes.

Conservation of Personal Integrity

Conservation of personal integrity may include respect and maintenance of the patient’s personal space and environment (Nursing Theories, 2012). For this DNP Project, this may include the requirement of appropriate sterile attire for all providers in the patient’s room during insertion and accessing of the ventriculostomy system. In addition, creating an environment within the unit focused on providing evidence-based care and supporting and encouraging practice of that evidence-based care at all times may conserve conservation of the personal integrity between the nurses.

Conservation of Social Integrity

Conservation of social integrity includes involvement of the patient’s family and promotion of social interactions (Nursing Theories, 2012). Involvement of the patient’s family in the goals of care and optimal healing environment will not only increase nurse compliance and awareness through articulation of goals of care, but also increase family support.
Figure 1. A Depiction of Levine’s Theory of Conservation and Nursing Led Protocols in Relation to Ventriculostomy Management in the Neuroscience ICU. Adapted and modified from the original Levine’s Theory of Conservation (Nursing Theories, 2012).

Review of the Literature

Ventriculostomy Best Practice Protocols

An increasing number of studies have been conducted to support the utilization of a best practice protocol or “bundle” for the management of ventriculostomies (see Table 1). These protocols have supported the premise that the presence of such a protocol increases staff compliance with the standard of care and decreases infection rates. Successful adoption and compliance of new guidelines is enhanced when providers (nurses, NP’s, PA’s, surgeons) are provided concrete guidelines as well as leadership support (Ploeg, Davies, Edwards, Gifford & Miller, 2007; Grol & Grimshaw, 2003; Lwin, Low, Choy, Yeo & Chou, 2012).
Infection rates have shown significant improvement when the use of a best practice protocol is implemented. Kubilay et al. (2012) demonstrated a significant decrease in infection rates from 9.2% to 0% (p<0.002) with the institution of a ventriculostomy protocol. The Kubilay et al. protocol focused on insertion technique and use of antibiotic impregnated catheters (2012). Utilization of a best practice protocol that provides nursing measures to prevent transmission of organisms and increase nursing knowledge of care of the drain has also proven successful with the implementing hospital extending past two years with zero infections following implementation of the protocol (Baker et al., 2012). Three key aspects and their supporting best-practice evidence of ventriculostomy insertion and management will be discussed, these aspects include: initial placement of the ventriculostomy, accessing of the system, and daily maintenance of the system.

**Initial Placement of the Ventriculostomy.** The risk of infection for neurosurgical patients requiring ventriculostomies begins with the initial insertion. The use of prophylactic antibiotics prior to placement has been frequently discussed and reviewed. The Cochrane Collaboration (2009) found that the use of prophylactic antibiotics does show a decrease in ventriculostomy infection via meta-analysis. In a study conducted in a neurosurgical ICU in which a ventriculostomy protocol was implemented to increase the use of prophylactic antibiotics, there was a significant decrease from 45% to 12% in positive CSF cultures post protocol implementation (p<0.002) (Lucey & Myburgh, 2003). Although prophylactic antibiotics may not always prevent gram-negative infections, research supports the use of prophylactic antibiotics for prevention of gram-positive bacteria such as *S. Aureus* (Leverstein-van Hall et al., 2010). Gram-positive bacteria such as *S. Aureus* are one of the most common organisms contributing to
ventriculostomy related infections. This effect on early infections from gram-positive organisms supports the need for prophylactic antibiotics to be administered in a timely fashion (within 30 minutes) (Leverstein-van Hall et al., 2010). Implementation of the ventriculostomy bundle, which included prophylactic antibiotics, resulted in a significant reduction in ventriculostomy infections (p<0.002) (Leverstein-van Hall et al., 2010).

In addition to the need for prophylactic antibiotics, the use of strict sterile precautions when placing ventriculostomies at the bedside is supported. Many ventriculostomy protocols have been implemented, which include the need for all participants and healthcare providers in the room to wear mask and hats during the procedure as well as the need to limit the number of staff in the room during insertion (Kubilay et al., 2012; Leverstein-van Hall et al., 2010; Lwin et al., 2012). It must be taken into account that these studies utilized a bundle approach in their intervention. Although these studies were not performed to solely measure incidence of infection related to sterile technique during insertion, they all included this requirement in their ventriculostomy study and were successful in significantly decreasing infection rates.

Accessing The System. Accessing the closed-sterile ventriculostomy drainage system opens the possibility for contamination within this system. The system may be accessed in order to flush the system to improve patency in the situation that it may clot off, as well as for CSF sampling. Recent studies have proposed that only providers such as NP’s or PA’s as well as neurosurgeons (rather than bedside RN’s) be permitted to access the system under aseptic technique; and should do so only when absolutely necessary, rather than on a routine basis (Baker et al., 2012; Lwin, Low, Choy, Yeo & Chou, 2012; Leverstein-van Hall et al., 2010). A risk analysis study of 228 patients concluded that the frequency of CSF sampling (or accessing
of the system) significantly increased the risk of infection from 0.8% to 7% (p<0.002) (Hoefnagel, Dammers, Laak-Poort & Avezaat, 2007). Another study decreased their CSF sampling practices from daily to every three days and noted a 50% decrease in infection rates with this change (p<0.005) (Williams, Leslie, Dobb, Roberts & van Heerden, 2011).

Although it is preferred that the ventriculostomy drain be accessed as infrequently as possible, it may be unavoidable at times. In these situations, proper technique should be implored to reduce the risk of infection as much as possible. The CDC suggests that when cleaning access ports, the provider allows adequate time for the cleaning solutions (chlorhexidine or providine-iodine) to dry completely prior to sampling (CDC, 2012). In addition, the use of providine-iodine solution would be acceptable in cleansing of the access port prior to sampling, as recommended by the National Guideline Clearinghouse (American Association of Neuroscience Nurses [AANN], 2011). This guideline suggest the use of sterile gloves and mask as well as scrubbing of the insertion site for at least 3 minutes prior to accessing for optimal infection prevention (AANN, 2011). A Level I Trauma institution, which enacted a protocol to include sterile cleansing of the access port with providine-iodine for at least 3 minutes, was able to successfully decrease their ventriculostomy infection rate from 55% to 0% (Bader, Littlejohns & Palmer, 1995).

*Daily Maintenance.* Daily site maintenance and monitoring for site infection is a necessity and standard practice for any indwelling catheter. This practice should be no different for ventriculostomy management. Daily assessment and documentation of the insertion site can be utilized to help intervene in a timely manner should infection become a concern. The
Leverstein-van Hall (2010) study included sterile management and handling of the insertion site in their bundle, which led to a significant decrease in infection rates from 20% to 9% (p<0.002).

Changing of the sterile drainage bag should also be approached in a similar fashion to accessing the drainage system. The drainage bag should only be changed when absolutely necessary and be done with sterile gloves, mask and hat (AANN, 2011). A study conducted in a level 1 trauma center demonstrated a 0% infection rate following institution of a protocol that required daily site care and sterile management of the drain (Bader, Littlejohns & Palmer, 1995). One of the most common offenders of ventriculitis is staphylococcus and use of a facemask to prevent contamination from oral flora will help to reduce this risk (Siegel, Rhinehart, Jackson & Chiarello, 2007).

*Nurse Awareness and Improved Patient Outcomes.* Use of nursing led protocols and bundles have demonstrated success in decreasing infection rates in the prevention of central line associated infection, ventilator associated pneumonia (VAP) and urinary catheter associated infections (Marschall et al., 2008; Oman et al., 2011; Ploeg et al., 2007). Increasing the education and awareness of nurses managing these indwelling lines has not only increased the nurses knowledge and improved practice, but also led to nurses becoming advocates for their patients when provider practices are not in-line with the current best practice (Kleinpell, Munro & Guiliano, 2008).

Use of an intervention that included education and awareness assessment of nurses in regard to VAP resulted in a decrease in VAP rates of over 57% (p<0.001) (Kleinpell, Munro & Guiliano, 2008). Use of an educational session has also proven successful in decreasing catheter-associated urinary tract infections on medical surgical units in an academic medical center.
(Oman et al., 2011). In addition, these interventions must focus on the current best practice as well as assessment and intervention related to nurse knowledge of these practices. Increasing nursing knowledge and awareness with the assistance of a best practice protocol can then decrease healthcare-associated infections.

A review of the literature has provided detailed information on the success associated with key aspects of ventriculostomy care. Mainly, antibiotic administration within 30 minutes of drain insertion, maintaining sterile measures during insertion by having all team members wear a mask and hat while in the room, limiting access to the closed system and only doing so when absolutely necessary, scrubbing the port for 3 minutes prior to accessing of the system, daily site assessments, and sterile changing of the drainage bag. In addition, the use of evidence-based protocols within the nursing charting has demonstrated effectiveness in decreasing infection rates (Kleinpell, Munro & Guiliano, 2008; Oman et al., 2011).

Table 1

**Review of the Literature**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Setting/Design</th>
<th>Subjects</th>
<th>Intervention</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker et al. 2012</td>
<td>Level I Stroke Center</td>
<td>Patients with ventriculostomies in the hospital between April 2008 and September 2011</td>
<td>Implementation of an improvement plan which included: Checklist for sterile insertion, sterile dressing applied to site, flushing only by advanced practice provider, scrubbing site for 3 minutes prior to accessing system</td>
<td>Infection rates decreased from 16 per 1000 ventriculostomy days prior to implementation to 1.3 per 1000 ventriculostomy days after implementation.</td>
</tr>
<tr>
<td></td>
<td>Pre/Post Intervention</td>
<td></td>
<td></td>
<td>At time of publication, hospital maintained an infection rate of zero for 25 months.</td>
</tr>
<tr>
<td>Authors and Year</td>
<td>Intervention Design</td>
<td>Participants</td>
<td>Methodology</td>
<td>Outcome</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>Cochrane Collaboration</td>
<td>Meta-analysis of randomized control trials and quasi-randomized control trials</td>
<td>2134 participants</td>
<td>Evaluation of systemic prophylactic antibiotics</td>
<td>Antibiotic prophylaxis for surgical introduction of intracranial ventricular shunts, Decrease in infection with OR: 0.52 and a 95% CI 0.36-0.74</td>
</tr>
<tr>
<td>Hoefnagel, Dammers, Laak-Poort &amp; Avezaat, 2008</td>
<td>Pre/Post Intervention</td>
<td>228 Patients</td>
<td>From January 1993 to April 2005</td>
<td>Observational study of risk factors for ventriculitis, included frequency of sampling and length of EVD duration, Decrease in infection rates with frequent CSF sampling p&lt;0.001</td>
</tr>
<tr>
<td>Kubilay et al., 2012</td>
<td>Pre/Post Intervention</td>
<td>2928 Patients</td>
<td>Retrospective analysis followed by post-implementation observation</td>
<td>Ventriculostomy insertion checklist, Decrease in infection rates pre-implementation: 9.2%. Infection rate post-implementation: 0.46%</td>
</tr>
<tr>
<td>Leverstein-van Hall et al., 2010</td>
<td>Pre/Post Intervention</td>
<td>579 drains placed between 2004-2006</td>
<td>Intervention strategy to increase awareness, SOP, therapeutic algorithm for infection suspicion, antimicrobial prophylaxis and new drainage system</td>
<td>Decrease in drain related infections during phase II of implementation from 13.7% to 7.2% (p&lt;0.05) with increase to 8.7% during phase III</td>
</tr>
<tr>
<td>Lucey &amp; Myburgh, 2003</td>
<td>Pre/Post Intervention</td>
<td>27 patients</td>
<td>Implementation of a drain management protocol and antibiotic use</td>
<td>Decrease in number of positive cultures post-implementation: 45% to 12% (P&lt;0.002)</td>
</tr>
<tr>
<td>Lwin et al., 2012</td>
<td>Pre/Post Intervention</td>
<td>234 patients</td>
<td>Between January 2007 and June 2008</td>
<td>Competency skills checks, education on drain management and SOP for ventriculostomy management, Decrease in infection rates from 6.1% to 0% (p&lt;0.05)</td>
</tr>
<tr>
<td>Oman et al., 2011</td>
<td>Pre/post intervention design</td>
<td>273 patients</td>
<td>Between December 2008 and October 2009</td>
<td>Nursing led education and protocol to prevent catheter associated UTI’s, Decrease in CAUTI rates with education and management protocol (p&lt;0.05)</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>N</td>
<td>Intervention</td>
<td>Outcome Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------</td>
<td>-------</td>
<td>--------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>Williams et al., 2011</td>
<td>Pre/post intervention</td>
<td>407 Patients</td>
<td>Decrease in frequency of CSF sampling</td>
<td>5% decrease in rate of ventriculitis following a decrease in sampling frequency. Not statistically significant</td>
</tr>
</tbody>
</table>
CHAPTER THREE: METHODS AND DATA COLLECTION

Increasing Nurse Awareness Through Implementation of a Best Practice Protocol

Implementation of a best practice protocol allows for inclusion of comprehensive best practice standards to be simultaneously introduced and adopted in the neuroscience ICU. Based on the cited evidence that nursing led protocols improve patient outcomes and nurse awareness, this DNP Project proposed implementation of a best practice protocol for ventriculostomy drain management with the goal of increasing nursing awareness of current practice standards and decreasing infection rates. The ventriculostomy management protocol provides nurses with a guideline for insertion as well as daily management of the ventriculostomy. The short-term outcome for this DNP Project included determination of current needs and barriers related to best-practice management of ventriculostomies in the neuroscience ICU and creation of a best-practice protocol to address these needs. The intermediate outcome of this study is to have an overall increase in nursing awareness and charting of their compliance with the current best practice. Finally, a long-term outcome goal for this DNP Project is to decrease ventriculostomy infections in the neuroscience ICU.

Methods

Chart Review

A retrospective chart review of nurses charting was conducted on the twenty most recent patients who had a ventriculostomy placed in the neuroscience ICU. The chart review evaluated whether evidence-based guidelines were being documented, specifically, the discussed aspects of ventriculostomy management, which include: administration of antibiotics within 30 minutes prior to insertion, documentation that all team members in the room during insertion are wearing
a mask and hat, documentation of when the system is accessed and by whom, whether the access port was scrubbed for 3 minutes prior to accessing, daily site inspection and changing of the drainage bag with sterile technique. These aspects of care were compiled based on the current literature in regard to risks for ventricular drain associated infections and previous studies utilization of these aspects within ventriculostomy protocols. In addition, these aspects take into account the current available charting for the specific facility at which this study was conducted. It was assessed as to whether each of these aspects were charted at any point during the ventriculostomy insertion or daily management. However, a lack of documentation does not necessarily indicate the practice standard was not completed, but rather demonstrates that these aspects are not being documented. The nursing narrative notes, assessment notes, medication administration records, laboratory results and procedural notes were utilized to assess for compliance with charting of these standards. International Review Board (IRB) was obtained through the facility at which the research is conducted, as well as through the University of Arizona.

**Focus Group of Key Stakeholders**

Following the retrospective chart review. A focus group was conducted to generate a consensus between key stakeholders within the unit on the current level of knowledge of best practice ventriculostomy management, need for a protocol within the nursing charting and possible barriers associated with institution of a protocol. The major themes from this focus group were utilized to aid in formation of a best-practice ventriculostomy management protocol. Major concepts from the focus group discussion were based on a narrative analysis of the responses following transcription of the group discussion. The questionnaire (Table 2) utilized to
guide discussion during the focus group consists of four open-ended questions. These questions were created by the principle investigator and takes into account concepts of Levine’s Theory of Conservation, specific study aims of this DNP Project, and clinical experience of the principle investigator.

Table 2:

*Focus Group Questionnaire*

<table>
<thead>
<tr>
<th>Questions for Discussion</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you feel there is a gap in the charting for ventriculostomy insertion and management?</td>
<td></td>
</tr>
<tr>
<td>2. What aspects of ventriculostomy insertion and management do you think would be helpful to include in a protocol and checklist within the nursing charting?</td>
<td></td>
</tr>
<tr>
<td>3. Do you feel well informed on the current best practice standards for both insertion and daily management of the ventriculostomy drain in regard to infection prevention?</td>
<td></td>
</tr>
<tr>
<td>4. What barriers do you foresee with the implementation of a best practice protocol within the nursing charting?</td>
<td></td>
</tr>
</tbody>
</table>

*Nursing Education Packet*

Following the retrospective chart review and focus group. A best practice protocol was developed utilizing the current evidence-based research discussed in the literature review and the findings from the focus group. After creation of this protocol, a nursing education packet was created to instruct bedside RN’s on the use of the protocol within the nursing charting (Appendix A). In addition, the packet provides information on the utility and evidence supporting each section of the protocol. The packet consists of a pre-test to measure RN awareness of the current
standards of care related to ventriculostomy management as well as a post-test to re-test their knowledge following education. The education packet specifies when to utilize each section of the protocol and how to correctly chart each protocol aspect.

**Setting**

This DNP Project took place in a 337-bed non-profit hospital. This hospital is American College of Surgeons Level I Trauma certified as well as Det Norske Veritas (DNV) Level I Stroke certified. The neuroscience ICU consists of 12 beds and is primarily staffed by core neuroscience nurses. These nurses may or may not have obtained additional certifications in neuroscience care such as the Certified Neuroscience Registered Nurse (CNRN). In addition, many RN’s within the ICU are considered multisystem RN’s and carry certifications such as Critical Care Registered Nurse (CCRN) and/or have obtained certification through the Trauma Nurse Core Course (TNCC) (see Table 3). Ventriculostomies are routinely placed at bedside in the neuroscience ICU by neurosurgeons and PA’s within the neurosurgery group (currently no NP’s are employed by the neurosurgical team at this facility) and with the assistance of the neuroscience ICU RN’s. Appropriately staffing the unit with skilled neuroscience ICU nurses (particularly those who are managing a patient with a ventriculostomy) is standard in this unit. However, with day-to-day staffing changes as well as fluctuations in patient acuity, the possibility of multisystem critical care nurses managing patients in the neuroscience unit and those with ventriculostomies, is present.
Table 3

*Unit Demographics*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total #</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU RN’s</td>
<td>130</td>
</tr>
<tr>
<td>Core Neuroscience ICU RN’s</td>
<td>21</td>
</tr>
<tr>
<td>ICU RN’s with certification (CCRN, CNRN)</td>
<td>40</td>
</tr>
</tbody>
</table>

**Sample**

*Chart Review*

A non-probability convenience sample of twenty charts was utilized for retrospective review. The sample was obtained by compiling a list of patients who were over the age of 17 and had a CPT code for ventriculostomy placement. A total of 50 charts were obtained of patients who had ventriculostomy drains between November 2013 and September 2014. Of these 50 charts, twenty patients met inclusion criteria of having the drain placed in the neuroscience ICU. The chart review included the most recent twenty patients who had a ventriculostomy placed in the neuroscience ICU. Patients under the age of 17 and those patients, who had their ventriculostomy placed in the OR, rather than the ICU, were excluded from the sample.

*Focus Group Discussion*

A non-probability quota sample was obtained of key stakeholders for focus group discussion. Consideration as a key stakeholder depended on the participant’s involvement in the neuroscience ICU, frequency of managing patients with ventriculostomies and availability and willingness to be involved in the study. Bedside RN’s who do not regularly manage patients with
ventriculostomies were excluded from this study. Participation was voluntary and informed consent was obtained from all focus group members prior to involvement in the focus group discussion. The focus group discussions were audio recorded to allow for ease and flow of discussion. Questions were asked in an open-ended manner and participants were able to interact with each other and discuss their thoughts on the questions. All information obtained in the audio recording was then transcribed and only job title was associated with their comments, rather than name.

Data Analysis

A descriptive non-experimental design was utilized for this DNP Project. There is no intervention, but rather an assessment of the current charting related to best practice management of the ventriculostomy drains in the neuroscience ICU and the current thoughts and barriers related to implementation of a protocol. Patient information was de-identified prior to placement into an excel format spreadsheet. After completion of the initial chart review, descriptive statistics were utilized to obtain a percentage for how often each activity related to ventriculostomy management is carried out and appropriately documented.

Although this is a quantitative study, a qualitative approach to the focus group was utilized with open-ended questions rather than numerical data. This information was utilized to help guide creation of the ventriculostomy protocol and education packet. Responses to each question were audio-recorded and then transcribed in order to organize responses. Responses to the questions were then summarized in the form of paragraphs, highlighting the more prevalent comments from each question. Specific quotations may be used from the recordings; however, individual participants were not identified either on the recordings or in the transcription.
CHAPTER FOUR: RESULTS

Sample Characteristics

Chart Review

The compiled list of patients who met inclusion criteria provided a list of 40 patients, 20 of which had their drain placed in the operating room and 20 who had their drain placed in the ICU. Information obtained from the charts was de-identified prior to utilization in data analysis and all information was obtained through facility password protected computers.

Characteristics of the subjects included in the chart review are found in Table 4.

Table 4

Sample Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n=20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>13 (65%)</td>
</tr>
<tr>
<td>Female</td>
<td>7 (35%)</td>
</tr>
<tr>
<td>Age</td>
<td>54.6 years ± 17.8</td>
</tr>
<tr>
<td>Hospital Length of Stay</td>
<td>15.45 days ± 9.1</td>
</tr>
</tbody>
</table>

n=20, ± = standard deviation

Focus Group Discussion

The focus group consisted of 7 key stakeholders obtained through non-probability quota sampling. These key stakeholders include: 3 bedside RN’s, 3 ICU supervisors/manager, and 1 ICU unit educator. The bedside RN’s involved in the focus group consisted of two core neuroscience RN’s as well as one multisystem RN who manages patients with ventriculostomies on a frequent basis.
Current Charting for Ventriculostomies

In completing study aim 1, a retrospective chart review of the most recent twenty patients who had a ventriculostomy drain placed in the neuroscience ICU was conducted. During the chart review, it was found that there is some charting specifically related to the ventriculostomy drain within the current charting system. This charting included: type of drain (ventriculostomy vs. wire or bolt monitoring), drain status of being open or closed, level at which the drain is open and color and quality of the CSF drainage and site inspection. None of the aspects of ventriculostomy care, discussed previously (other than site inspection), were included in this charting section. Ventriculostomy care would need to have been documented in additional sections, such as nursing narrative notes, procedural notes and Medication Administration Records (MAR). A summary of the results of the chart review may be found in Table 5.

Chart Review of Key Aspects of Ventriculostomy Management

Antibiotic Administration

Information related to the administration of antibiotics within 30 minutes of insertion was obtained through the nurses MAR. The antibiotic delivered to the patient is scanned into the system at the time the patient receives the medication. This time of administration was then compared to the time of ventriculostomy insertion that is documented in the charting section for procedures. No other documentation was present related to initiation of antibiotics prior to insertion.
Of the twenty charts included in this study, 100% of the charts had documentation of antibiotic administration prior to insertion. Of these occurrences, 95% of charts had cefuroxime utilized as the pre-procedure antibiotic and 5% Vancomycin.

**Team Members Attire**

Information related to the attire worn by team members who were present in the room during ventriculostomy insertion was obtained through review of the nurse’s narrative notes as well as procedural notes. Of the twenty charts reviewed, none were found to have documentation related to team member’s attire in the room at time of insertion.

**Port Accessing**

Information related to whether a ventriculostomy port was accessed was obtained through two methods. One method was determining whether it was documented by the nurse that the port was accessed for sampling, medication instillation or “flushing” of the system. The second method was through indirect measures by determining whether a CSF sample was ever sent to the laboratory (as this would indicate that the port was accessed at some point).

Of the twenty charts reviewed, none of charts had specific documentation stating that the ventriculostomy drain had been accessed. It was found that 40% of the subjects had CSF that was sent to the laboratory at some point during their hospital course, indicating that the ventriculostomy had been accessed. However, there was no direct documentation related to this within the nursing notes.

In addition, 15% of the subjects had documentation in their record of issues with patency of the drain. This documentation indicates that an intervention, such as flushing of the drain may
need to occur. However, there is no documentation of whether the drain was flushed and if so, by whom, or for what reason.

*Daily Site Inspection*

Information pertaining to the daily site assessment of the ventriculostomy was obtained through review of the nurse’s narrative notes, skin inspection and charting of drains within the advanced neurological section of the chart. Charting a detailed skin inspection in at least one of these sections would be considered sufficient for documentation of the drain site.

Of the twenty charts reviewed, 100% of the charts had documentation of site care as well as daily site assessment documented. This assessment included both insertion site and CSF quality/color.

*Sterile Bag Change*

The occurrence of bag changes varies for each patient dependent on the amount of CSF drained via the ventriculostomy. The information was obtained solely from the presence of nursing narrative notes indicating that the bag was changed.

Of the twenty charts reviewed, none of the charts had documentation related as to whether there was a sterile bag change that took place. There was no designated place to chart this action, however, there were also no nursing narrative notes related to it.
Table 5

**Summary of Results**

<table>
<thead>
<tr>
<th>Ventriculostomy Aspect of Care</th>
<th>N</th>
<th>Compliance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics administration within 30 minutes</td>
<td>20</td>
<td>100%</td>
</tr>
<tr>
<td>All team members wearing appropriate attire during insertion</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Accessing of the port and by whom</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Port scrubbed for 3 minutes</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Daily site assessment</td>
<td>20</td>
<td>100%</td>
</tr>
<tr>
<td>Sterile bag change</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Focus Group**

Study aim 2 focuses on input provided by key stakeholders in the neuroscience ICU in regard to thoughts and barriers related to a ventriculostomy protocol. This focus group discussion was held after completion of the retrospective chart review. The focus group meetings lasted approximately 30 minutes. Focus group discussion was split up due to time constraints of participating members. The findings of the focus group discussion have been summarized and have been separated by each question.

Do You Feel there is a Gap in Charting for Ventriculostomies?

Five out of seven participants believed there is a gap in charting of best practice standards for ventriculostomy drains, including both insertion as well as management charting. Major
themes associated with this discussion topic included the concern that a majority of the documentation is based on free-text or narrative charting on the nurse’s part, leading to the possibility of variances in charting from patient to patient. One bedside RN states, “…the charting is just event/procedure and then whatever we as nurses decide to say…I do believe there is a gap.” Management participants stated that the charting does not take an adequate picture of everything the bedside nurse is doing on a daily basis to manage the drain appropriately.

In addition, two participants stated that the charting was adequate and provided enough options related to CSF drainage and type of drain to be sufficient. One participant stated that “I’m happy with it”, while another states “I don’t think we are missing anything”.

What would be Helpful to Include in the Protocol?

When asked about suggestions for additions to the current ventriculostomy charting, participants varied in their responses. Suggestions for additions included documentation of patency of the drain as well as an option to specify who placed the drain. In addition, the manager again brings up the fact that a majority of documentation is narrative driven and may or may not be capturing all care provided to the patient related to their drain. Three participants stated that they have no suggestions for what could be added to the current charting.

Do You Feel Well Informed on the Current Best Practice for Ventriculostomy Management?

Four participants stated that they felt they were knowledgeable on the current best practice standards and two of those four cited that they have a low infection rate as their reasoning. Other participants felt that they know the basics, however, are not sure if they are up to date on the current best practice standards. A major theme that emerged from this question seemed to be focused on infection rates and the quality of the surgeons as an assurance that they
were up to date on current best practice standards. In addition, three participants stated that they may or may not be up to date on current best practice standards.

*What Barriers Do You Foresee With the Implementation of a Best Practice Protocol?*

Two major themes were associated with this last and final question. The first theme was, physician or stakeholder buy-in, and the second was, the logistics and training associated with implementing a new protocol within charting. The unit educator as well as a bedside RN states that “it must be easily accessible” and “people will need to learn how to use it”. Another bedside RN mentions the issues with the current surgeons being supportive of a nursing driven protocol related to ventriculostomy drains. The bedside RN states that the “…physicians will need to be on board with it…” and agree that it is the current best practice.
CHAPTER FIVE: DISCUSSION

Discussion of Chart Review Results

Antibiotic Administration

The results of the antibiotic administration query in the chart review were positive, with a 100% compliance rate. However, all information obtained was through indirect measures with the use of the MAR, rather than directly from the bedside RN charting. The physician orders the preferred antibiotics prior to insertion of drain and the medication is then scanned into the patients electronic MAR. However, timing of the scan may not necessarily indicate that the medication was administered at that exact moment. Highlighting of the need for antibiotics to be given within a certain time frame through a ventriculostomy protocol may indirectly educate nursing staff on this best practice. Although the results for antibiotic administration were exceptional, addition of an option within the nursing charting may increase awareness of this aspect of care as a current best practice standard, thus, maintaining compliance in the future.

Team Members Attire

There was no documentation of team member’s attire in the room during insertion. This lack of data does not indicate that team members were not wearing the appropriate attire, but rather, it is not recorded and therefore, cannot be confirmed. As discussed in the literature review, all team members present in the room should be wearing a hat as well as a mask during insertion of the drain. Addition of this aspect of care directly in the nursing charting will provide a reminder to the nursing staff to not only adhere by this standard of care but to also document it. Previous studies, which have implemented a ventriculostomy bundle or protocol, have included
aspects such as team member’s attire and have supported the importance of this aspect of care within the documentation (Kubilay et al., 2012).

Port Accessing

The data obtained related to port accessing was obtained indirectly and lacked details related to who accessed the port, why, when, and whether the port was scrubbed. There was some documentation within nursing progress notes related to troubleshooting the drain and a need for intervention such as flushing, however, it was never clearly documented that the drain was flushed and if so, by whom. Additionally, 40% of the patients had CSF in the laboratory, signifying that the drain was in fact accessed, however there is no documentation by the nursing staff detailing this action. Within the particular hospital that this DNP Project was completed, drains can be accessed by the neurosurgeon as well as physician assistant (PA) or Nurse Practitioner (NP) working alongside the neurosurgeon. In addition, being that information regarding accessing the port was not documented, it is also understood that the port being scrubbed for 3 minutes was also not documented. Accessing the sterile system has been cited as a significant cause or risk for infection and appropriate measures should be taken to prevent these risks (Lwin, Choy, Yea, Chou, 2012). Whether or not these measures are being taken should be clearly documented in the nursing progress note or in the advanced neurologic charting.

Daily Site Inspection

Daily site inspection was clearly documented on every chart and on a daily basis. This charting is currently included in the advanced neurologic section of the nursing charting and allows for easy documentation. Noting that this measure was documented 100% of the time as a
result of it being within the charting, speaks to the notion that easily accessible documentation helps to improve compliance and adherence to the current standard of care.

**Sterile Bag Change**

Throughout the retrospective chart review, there was no documentation related to sterile bag change. It cannot be assumed that these patients did or did not have their bag changed, as every patient may drain different amounts of CSF and have their drain for different periods of time. However, given the average length of stay of the patients, it is highly likely that at least a few of the patients included in this chart review did require a bag change on their ventriculostomy drain. Currently, there is no policy within this hospital in regard to the process of changing the sterile bag. Adding of a policy or prompt within the charting system, may increase awareness of this standard of care and improve documentation of it.

**Focus Group Discussion**

*Do You Feel there is a Gap in Charting for Ventriculostomies?*

There was a wide variance in responses to this question, which were described in the results section. It appeared that those who were utilizing the current charting on a daily basis (bedside RN’s) as well as management noted a significant lack in charting, while those who are away from the bedside (unit educator and supervisors) feel it is adequate. The bedside RN’s had ideas for aspects that should be included in the charting and felt the current options were minimal. It is possible that when answering these questions, those that are away from the bedside are not as familiar with what goes into the daily management of these drains and what is being done without appropriate documentation. It appears that the bedside RN’s who are directly involved with necessary procedures and interventions, believe that there is not an adequate place
to document these actions. The current charting system is not capturing the entire role as well as responsibilities of the nursing staff.

*What would be Helpful to Include in the Protocol?*

Bedside RN’s contributed more input related to aspects that should be included in a ventriculostomy protocol within the charting. Interestingly, two aspects that were brought up as possible additions to current charting, directly relate to the lacking information in the retrospective chart review. One suggestion made by a bedside RN, was to add charting to signify evaluation of drain patency on a daily basis. This concept correlates with the need to document whether drains are being flushed or accessed. It is possible that addition of this aspect of care into the charting, may improve documentation of the actual accessing of the system if warranted.

In addition, another suggestion made during the focus group discussion by another bedside RN, was the option to document more information during initial placement, such as provider placing the drain etc. This concept may also be expanded on to add documentation of assisting RN’s and sterile measures taken in the room during insertion.

*Do You Feel Well Informed on the Current Best Practice for Ventriculostomy Management?*

A majority of participants felt that they are up to date on the current best practice standards. However, justification of this thought was based on the infection rate at the facility. Some care providers did state that they may not be up to date on current information and that they have not looked into the current research in some time. Two participants brought up the belief that the caliber of surgeons operating at this facility, leads nursing staff to feel comfortable that they are following the current best practice standards. Overall, the consensus on knowledge and comfort level related to current best practice standards appeared to be based on other
variables (infection rates, caliber of surgeons and hospital status), rather than direct research and knowledge obtained through continuing education. Based on the documentation reviewed, it is possible that the current best practice standards are not widely known within this setting and implementation of a protocol could significantly increase this knowledge level.

What Barriers Do You Foresee With the Implementation of a Best Practice Protocol?

There was a general consensus related to possible barriers associated with implementing a protocol within the nursing charting. The most common barriers included stakeholder buy-in as well as ease and accessibility of the protocol. Nursing education was brought up frequently when discussing implementation of the protocol and possible barriers associated with it. It was stated that increasing nursing knowledge and understanding of the protocol might increase support from nursing staff. Research has supported that nursing driven protocols can be effective in decreasing infection rates and improving compliance with following standards of care (Oman et al., 2011). Educating nursing staff and gaining the support of the nursing staff and management for a ventriculostomy protocol may significantly increase the likelihood of its use and success.

JNM Ventriculostomy Protocol

Each aspect of the ventriculostomy protocol is evidence based and the protocol was originally created by the principle investigator and titled the JNM Ventriculostomy Management Protocol. The results of the retrospective chart review and focus group discussion were taken into account when satisfying study aim 3, creation of a best practice ventriculostomy protocol for the neuroscience ICU. The evidence-based practices listed in the protocol, placed in combination with each other, are designed to improve the quality of care. The JNM Ventriculostomy
Management Protocol (Figure 2) will provide the nurses as well as providers with the guidance needed to successfully deliver a high quality of care.

The JNM Ventriculostomy Management Protocol consists of three sections. Section one addresses techniques to be taken during initial placement of the ventriculostomy to reduce the risk of infection. The use of antibiotics, more specifically, Cefuroxime, within 30 minutes prior to insertion has been discussed in the literature review and is supported through evidence. Cefuroxime is a broad-spectrum second-generation cephalosporin that is effective in treatment of both gram-positive and gram-negative infections (RxList, 2014). Some of the most common neurosurgical infections include *staphylococcus aureus* (a gram-positive organism) as well as *klebsiella pneumoniae* and *enterobacter* (gram-negative organisms); Cefuroxime adequately covers these particular organisms. Additionally, Cefuroxime has been shown to cross the blood-brain barrier, which makes it particularly effective, and the choice antibiotic in neurosurgical procedures (Holloway et al., 1996). One dose of Cefuroxime 1.5 grams intravenous is the suggested dose. If concern for infection is high, the patient may receive three doses of Cefuroxime in six-hour intervals. A section in the ventriculostomy charting will be available for the RN to chart whether antibiotics were administered within 30 minutes of insertion. If not administered, a prompt may present on the screen to indicate a reason for not administering.

Section one of the protocol also discusses the need for all providers in the room to wear a mask throughout the insertion process. This includes not only the provider who is placing the ventriculostomy (whether it be the neurosurgeon or midlevel provider who is also in sterile gown/gloves and hat), but also any nurse, tech, student or assistant present in the room. The initial insertion of ventriculostomy drains is a critical time for possible infection to occur and all
measures must be taken to promote sterile technique. The use of facemasks will help to prevent the transmission of oral and nasal flora (such as staphylococcus) from contaminating the sterile field and insertion site (Siegal, Rhinehart, Jackson & Chiarello, 2007). A section in the ventriculostomy charting will be present to allow the RN to indicate that all team members in the room at time of insertion wore a mask at all times.

The second section of the JNM Ventriclestomy Management Protocol addresses the process of accessing the system when necessary. The protocol suggests that only a neurosurgeon or providers such as a PA or NP, who are properly trained, access the system. In addition, accessing of the system should only be done when absolutely necessary. Such instances may include: high suspicion of infection and need to obtain CSF cultures, flushing of the system to maintain patency, or instillation of medications in the event of known infection. The National Guidelines Clearinghouse suggests the access port be scrubbed for a minimum of three minutes with providine-iodine solution in order to ensure removal of any organisms (2011). There will be a place present in the charting to indicate that the system was accessed, discussed precautions were taken, and who specifically accessed the system.

The third section of the ventriculostomy protocol includes daily maintenance of the ventriculostomy. This section focuses primarily on RN practice and maintenance techniques. More specifically, the site should be inspected daily for signs and symptoms of infection followed by documentation of assessment. In addition, the RN dons sterile gloves, hat and mask when changing the ventriculostomy bag. In order to maintain sterility of the system, this may require assistance from another RN. The National Guidelines Clearinghouse and the American Association of Neuroscience Nurses support this process of sterile bag exchange (2011). A
checkbox will be placed in the RN charting system to indicate that the bag was changed under sterile technique.

<table>
<thead>
<tr>
<th>JNM Venticulostomy Management Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Placement (Chart at time of insertion)</strong></td>
</tr>
<tr>
<td>• Antibiotics within 30 minutes of insertion</td>
</tr>
<tr>
<td>• Provider performing procedure in full sterile attire. All other care providers present in room wearing mask and hat</td>
</tr>
<tr>
<td><strong>Accessing System (Chart only when system is accessed)</strong></td>
</tr>
<tr>
<td>• System accessed by PA/NP/Surgeon</td>
</tr>
<tr>
<td>• Access site scrubbed with chlorhexidine or providine-iodine for at least 3 minutes and allowed to dry completely</td>
</tr>
<tr>
<td><strong>Drain Maintenance (Chart daily and when bag is changed)</strong></td>
</tr>
<tr>
<td>• Daily site inspection</td>
</tr>
<tr>
<td>• Use of sterile gloves and mask to change drainage bag</td>
</tr>
</tbody>
</table>

*Figure 2. JNM Venticulostomy Management Protocol Within the Nursing Charting. Check boxes present to indicate an action has been taken or completed.*

**JNM Venticulostomy Management Protocol and Similar Protocols**

The JNM Venticulostomy Management Protocol was created based on the current literature as well as findings from the retrospective chart review and focus group input. Given this information, the protocol may be considered site specific. Previous studies that were mentioned in the literature review discussed protocols that have been implemented with success at other facilities. These protocols were also considered site specific, as they took into account the hospital’s current practice on routine sampling of CSF or the specific brand of ventricular...
catheter used (Baker et al., 2012; Leverstein-van Hall et al., 2010; Lwin et al., 2012). The Williams et al. (2011) study focused solely on decreasing CSF culturing from daily to every 3 days. In addition, some protocols were specifically aimed at practices during initial insertion and thus, geared more towards the provider performing the procedure alone, rather than all team members involved in the patients care throughout hospitalization (Kubilary et al., 2012). These studies have supported the use of a ventriculostomy practice protocol in decreasing infection rates.

Factors from each of these practice bundles were taken into account when creating the JNM Ventriculostomy Management Protocol, such as precautions to be taken during sampling, prophylactic antibiotic administration and team member attire in the room during insertion. However, modifications were made as needed, making the JNM Ventriculostomy Management Protocol specifically tailored for the hospital at which this study was conducted. Given that the site regularly uses antibiotic impregnated catheters and does not routinely access the systems for CSF sampling, these aspects would not have been necessary for inclusion in the protocol. The retrospective chart review and focus group discussion did signify a need for further documentation related to details of insertion as well as port sampling; these aspects were included to meet the needs of the facility.

**Nursing Education Packet**

Following focus group recommendations and creation of the JNM Ventriculostomy Management Protocol, an education packet was created to help teach the nursing staff about the aspects and use of the protocol. Creation of this education packet aligns with study aim 4 and with the goal of increasing nurse awareness. The education packet consists of a factsheet on the
current best practice recommendations of ventriculostomy management as well as use of the protocol and will be disseminated to all nursing staff in the ICU (both multisystem and neuroscience RN’s). A copy of this education packet can be found in Appendix A. The information discussed above, outlining the JNM Ventriculostomy Management Protocol, will be the information that is disseminated to the nursing staff. Information related to the specific use of the protocol within the charting system will also be discussed (such as when to check which boxes and how often to assess these factors). In addition to the explanation of the JNM Ventriculostomy Management Protocol and factsheet about ventriculostomy care (Appendix A, Figure 6), the education packet will contain both a pre-test (Appendix A, Figure 7) and a post-test (Appendix A, Figure 8) to determine the effectiveness of the education packet.

The pre-test will consist of a five-question survey, administered in a yes/no format, measuring staff knowledge and thoughts towards best practice guidelines for ventriculostomy management. The pre-test incorporates aspects of the ventriculostomy protocol in a multiple-choice format. The post-test will consist of similar questions regarding knowledge of ventriculostomy management; however, in addition, the nurses will be asked in a yes or no format, whether they felt the protocol improved their knowledge and helped guide their practice when managing ventriculostomies.

**Missing Data and Study Limitations**

This DNP Project was a retrospective study, which places it at risk for issues such as selection bias and missing data. In order to reduce the possibility of selection bias compromising the study, specific inclusion and exclusion criteria were placed and utilized in the selection of
charts. Once the list was compiled, charts were selected in reverse chronological order, removing the risk of bias.

Since this DNP Project is focused on determining whether there is a lack in charting, the issue of missing data plays a large role in the significance of study results. Data was obtained from the nursing charting; hence, a lack of data may or may not indicate a lack in adherence to practice standards but rather a lack in documentation. In regard to the nurses documenting that all team members in the room where wearing masks and hats during insertion of the ventriculostomy, it is possible that all team members were wearing appropriate attire even though it is not documented. In regard to accessing of the system, information was obtained based on if there was a CSF sample that was sent to the laboratory, as there was no direct documentation within the nursing notes about accessing. However, no documentation related to flushing of the system does not necessarily indicate that these patients did not have their system accessed and flushed, it only indicates that this is not documented; conversely, it is possible that the patient simply did not have their drain flushed at any point. Finally, as changing of the ventriculostomy bag was never documented in any chart, it cannot be certain whether this is due to the fact that no patient in the sample had their ventriculostomy bag changed or if this was simply not documented. Moving forward, utilizing the protocol in a prospective observational approach study may help to decrease the concern for missing data.

The possibility that actions did or did not occur based on the documentation is unclear, however it is clear that an increase in documentation of these actions may help to increase adherence to the standards of care. Studies such as the Marschall et al. (2008) study on preventing central line associated infections cited both education and compliance with
documentation of the best practice as strategies to decrease central line associated infections. These factors must be taken into account when reviewing the data and determining the need for a change in practice.

This DNP Project successfully identified a need within the current nursing charting in relation to ventriculostomy insertion and maintenance documentation. However, this study does have some limitations that affect its external validity, such as sample size and generalizability. The retrospective chart review included 20 patients who had a ventriculostomy placed in the neuroscience ICU. However, many patients were excluded from this study due to the fact that their drain was placed in the operating room. These patients still had their daily drain maintenance completed in the neuroscience ICU and daily charting completed in the same fashion as those who had their drain placed in the ICU. By excluding these patients, many charts were bypassed in the retrospective review process. With the larger sample size that could have been obtained by including patients who had their drain placed in the OR, the generalizability of this study to similar Level I Trauma Centers could be increased. Another measure to increase sample size while maintaining the same exclusion criteria would have been to require more than 20 patients in the review by reviewing charts older than the past year. In addition, given the large variation in responses during the focus group discussion, it is possible that a larger sample size of participants, with a particular increase in bedside RN’s, may have been helpful in obtaining a more generalizable consensus on the current charting and needs.

Conclusion

The current best practice standards of care for ventriculostomy management have been outlined and supported with current literature. These practices include: administration of
antibiotics within 30 minutes of insertion, limitation of accessing the ventriculostomy system and taking necessary precautions should the drain need to be accessed, as well as daily site assessments and sterile management. In addition, the correlation between nursing led protocols and improved patient outcomes/decreased infection rates supports the need for a nursing led ventriculostomy protocol to be placed within the nursing charting.

A total of twenty charts that met inclusion criteria were reviewed for the presence of documentation related to what is outlined as the current best practice standards for ventriculostomy drain management. It was determined that many aspects of the current standard of care are lacking within the nursing documentation. A focus group discussion with seven key stakeholders was also conducted to determine nurses’ current thoughts about their ventriculostomy charting, suggestions for improvement, feelings about their own knowledge as well as possible barriers to implementation of a protocol.

Information obtained through the literature review, retrospective chart review, and focus group discussion, helped to guide the creation of a best practice protocol for ventriculostomy management in the neuroscience intensive care unit. This protocol was developed with the use of the most current literature as well as the lack of current documentation noted during the retrospective chart review and input from key stakeholders during focus group discussion. A nursing education packet including a factsheet to educate nursing staff and inform them on findings from retrospective chart review, a pre-test, and a post-test was also created to address the concern of stakeholder buy-in of the protocol. “Early recognition, identification, and elimination of preventable infections using evidence-based practices are a necessity to improve patient outcomes and provide safe patient care” (Baker et al., 2012, para. 20). Through the study
aims discussed previously, proper measures have been taken to decrease the likelihood of even one single ventriculostomy associated infection.
APPENDIX A

NURSING EDUCATION PACKET
APPENDIX A: Nursing Education Packet Factsheet

• **Ventriculostomy Protocols and Decreased Infection Rates**
  
  o Healthcare-associated infections increase morbidity, mortality, and may increase hospital length of stay an average of 19 days (AHRQ, 2010).
  
  o Implementation of best practice protocols can increase staff awareness and knowledge of current standards of care, thus, decreasing infection rates (Ploeg, Davies, Edwards, Gifford & Miller, 2007; Grol & Grimshaw, 2003; Lwin, Low, Choy, Yeo & Chou, 2012).
  
  o Nursing led protocols have demonstrated success in decreasing healthcare associated infections due to central lines, urinary catheters and ventilator-associated pneumonias (Kleinpell, Munro & Guiliano, 2008).
  
  o Nursing led protocols increase nurse awareness and advocacy for their patient (Kleinpell, Munro & Guiliano, 2008).
  
  o The use of a ventriculostomy practice protocols in one study demonstrated decrease in infection rates from 16 per 1000 patients down to 1.3 per 1000 patients, while another noted a decrease from 9.2% to <1% after implementation of a ventriculostomy protocol (Baker et al., 2012; Kubilay et al., 2012).
  
  o JNM Ventriculostomy Protocol has been created with the current best evidence related to ventriculostomy care.
  
  o The JNM Ventriculostomy Management Protocol will be included with the current ventriculostomy charting in the advanced neurologic section of the electronic medical record.

• **Initial Insertion**
  
  o Administration of prophylactic antibiotics within 30 minutes of insertion of a ventriculostomy drain has shown to decrease the risk of infection against the most common offending organisms (Cochrane Collaboration, 2009; Leverstein-van Hall et al., 2010; Lucey & Myburgh, 2003).
  
  o Requiring all team members to wear a hat and mask in the room during ventriculostomy insertion has shown positive effects in regard to infection prevention in previously implemented ventriculostomy bundles or protocols (Kubilay et al., 2012; Leversetein-van Hall et al., 2010; Lwin et al., 2012).
  
  o Retrospective chart review showed a 0% documentation rate of team member attire in the room during insertion.
  
  o Retrospective chart review showed 100% compliance with antibiotics being administered within 30 minutes of insertion.
  
  o A check box will be available in the charting to signify that antibiotics have been given to the patient within 30 minutes of insertion.
  
  o A check box will be present to signify that it was confirmed that all team members present in the room were wearing a hat and mask during time of insertion.
• **Accessing of Drain**
  
  o Drains should only be accessed when absolutely necessary (CSF sampling to rule out infection, instillation of medication or for flushing of the system to improve patency) rather than on a routine basis (Baker et al., 2012; Lwin, Low, Choy, Yeo & Chou, 2012; Leverstein-van Hall et al., 2010).
  
  o Sterile gloves, mask and hat are to be worn when accessing the system (AANN, 2011).
  
  o Port should be scrubbed for 3 minutes and allowed to dry completely prior to accessing (by MD/NP/PA) (AANN, 2011; Bader, Littlejohns & Palmer, 1995; CDC, 2012).
  
  o A section within the protocol will be available to document who accessed the drain and why, this section will allow the RN to expand on any troubleshooting issues with the drain if needed (patency etc.).
  
  o Focus group discussion highlighted a need and desire for further documentation related to patency of the drain as well as accessing of the drain.
  
  o Drains are not to be accessed by RN’s.
  
  o A check box will be present to confirm that the port was scrubbed by the provider for approximately 3 minutes and allowed to dry prior to accessing.
  
  o Retrospective chart review showed a 0% documentation rate for details related to accessing of the drain (who accessed it, why and what precautions were taken).

• **Daily Management**
  
  o Daily site inspection is to be completed to help with quick intervention if necessary.
  
  o One of the most common offenders of ventriculitis includes staphylococcus, which can be prevented with the use of sterile gloves and masks (Siegel, Rhinehart & Chiarello, 2007).
  
  o Drainage bags should only be changed when absolutely necessary and done so in a sterile manner; this includes, hat, mask, gloves (AANN, 2011).
  
  o A check box will be available to confirm that daily size assessment has taken place.
  
  o Retrospective chart review showed a 100% documentation rate for daily site assessment.
  
  o Retrospective chart review showed a 0% documentation rate for sterile bag change.
  
  o A check box will be present and utilized if the patient required a CSF drainage bag change. This section should only be used if the bag was changed and will be utilized to confirm that staff member changing the bag wore a hat, mask and sterile gloves.
APPENDIX A: Nursing Pre-Test of Awareness of Current Best Practice

1. When assisting with insertion of a ventriculostomy, when should antibiotics be administered?
   A. Within 1 hour
   B. Within 30 minutes
   C. Whenever they are available
   D. Anytime before or after depending on the situation

2. During bedside insertion of ventriculostomy drains, all healthcare providers assisting the provider in the patient’s room should…
   A. Wear a hat and mask
   B. Wear a mask
   C. A mask should be worn if the healthcare provider will be near the sterile field

3. When changing the ventriculostomy drainage bag….
   A. A hat, mask and sterile gloves should be worn
   B. A mask and sterile gloves should be worn
   C. The procedure should remain sterile but you do not need to wear a mask and hat

4. When the ventriculostomy system is being accessed for CSF sampling or flushing, the access port should be scrubbed?
   A. For 3 minutes
   B. For 30 seconds to 1 minute
   C. However long the provider accessing the system scrubs it for

5. Nursing led protocols improve patient outcomes and increase nurse awareness of practice
   A. True
   B. False
APPENDIX A: Nursing Post-Test on Awareness of Current Best Practice

1. When assisting with insertion of a ventriculostomy, when should antibiotics be administered?
   A. Within 1 hour
   B. Within 30 minutes
   C. Whenever they are available
   D. Anytime before or after depending on the situation

2. During bedside insertion of ventriculostomy drains, all healthcare providers assisting the provider in the patient’s room should…
   A. Wear a hat and mask
   B. Wear a mask
   C. A mask should be worn if the healthcare provider will be near the sterile field

3. When changing the ventriculostomy drainage bag…
   A. A hat, mask and sterile gloves should be worn
   B. A mask and sterile gloves should be worn
   C. The procedure should remain sterile but you do not need to wear a mask and hat

4. When the ventriculostomy system is being accessed for CSF sampling or flushing, the access port should be scrubbed?
   A. For 3 minutes
   B. For 30 seconds to 1 minute
   C. However long the provider accessing the system scrubs it for

5. Do you feel the implementation of a ventriculostomy best practice bundle will help increase your knowledge and awareness of ventriculostomy management?
   A. Yes
   B. No
REFERENCES

Agency for Healthcare Research and Quality [AHRQ]. (2010). New AHRQ data show
healthcare-associated infections greatly increase length of stay and cost of hospital stay.

*Patient safety and health IT newsletter*, Issue 60

American Association of Neuroscience Nurses [AANN]. (2011). Care of the patient undergoing
intracranial pressure monitoring/external ventricular drainage or lumbar drainage.

*American association of neuroscience nurses* p. 37: Glenview: IL

other devices. Retrieved from:
http://www.uptodate.com.ezproxy2.library.arizona.edu/contents/infections-of-central-
nervous-system-shunts-and-other-
devices?source=machineLearning&search=ventriculitis&selectedTitle=1%7E28&section
Rank=1&anchor=H11#H11

monitoring: In search of a 0% infection rate. *Issues in infection control* 124: 162-172

multidisciplinary approach to end external ventricular drain infections in the neuro-

Camacho, E.F., Boszczowski, I., Basso, M., Jeng, B.C.P., Friere, M.P., Guimaraes, T., Teixeira,
related to external ventricular drain. *Infection* 39: 47-51


Staphylococcus aureus. Retrieved from:
http://www.antimicrobe.org/sample_staphyloccus.asp


of Levine’s conservation model. Journal of advanced nursing 18: 260-268

precautions: Preventing transmission of infectious agents in healthcare settings. Retrieved

Quality health research 16:547

(2004). The effect of an education program on the incidence of central venous catheter-
associated bloodstream infection in a medical ICU. Chest 126: 1612-1618

proven ventriculitis by reducing the frequency of cerebrospinal fluid sampling from
extraventricular drains. Journal of neurosurgery 115: 1040-1046