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Can Empowered Nurses Decrease Catheter Associated Urinary Tract Infection (CAUTI) Rates?

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Regis University

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CAN NURSES DECREASE CATHETER URINARY TRACT INFECTIONS?

Abstract

Nurses lack knowledge about the use and importance of a nurse-driven urinary catheter removal protocol, an evidence-based tool empowering them to remove urinary catheters that are no longer needed or are inappropriate based on set criteria, without calling a physician. (Health Care Infection Control Practice Advisory Committee (HIPAC), 2009) Despite this autonomy, catheter-associated urinary tract infections (CAUTI) are one of the leading hospital-acquired infections in many institutions (Centers for Disease Control and Prevention [CDC], 2015).

A quasi-experimental pre post intervention in a medical-surgical telemetry floor of an acute hospital in North Carolina showed a statistically significant increase in knowledge among nurses after an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol. Pretest. (n=27) mean score 8.41 (SD=. 797) and posttest (n=24) mean score 9.75 (SD=. 442). t =7. 125, p <. 001, CI: 17.20, 9.462 with a p value set @ = 0.05. No direct link was noted between knowledge and CAUTI. However, the unit maintained a zero CAUTI rate three months after the intervention which is clinically meaningful. On further analysis on comparing the pre and posttest aggregate scores a 15% increase was noted.

The main limitation of the study was the small sample size and the low CAUTI rates prior to the intervention. The main implication of the study, however, speaks volumes: Nurses, empowered with education and motivated with new awareness and guided by an evidenced-based, nurse-driven protocol, may be the key to fighting high CAUTI rates, which makes them an asset in today's value-based health care market.

Key words: DNP Capstone, empower, urinary infection

Executive Summary

Can Empowered Nurses Decrease Catheter Associated Urinary Infection Rates?

Problem

Nurses lack knowledge about a nurse-driven urinary catheter removal protocol that empowers them to remove unnecessary or inappropriately placed urinary catheters (UC) without physician orders. Catheters are directly linked to infection (Donelli and Vuotto, 2014). This project will answer the following PICO question: Will education on the importance and use of a nurse-driven urinary catheter removal protocol increase nurses' knowledge and decrease CAUTI rates three months after the educational session?

Purpose

To evaluate the change in knowledge in nurses after an educational intervention on an evidence-based educational intervention on the use and importance of the nurse-driven urinary catheter removal protocol and to examine the relationship between knowledge and CAUTI rates.

Goal(s)

The project intends to empower nurses by increasing their knowledge in the appropriate use of the nurse-driven protocol to remove unnecessarily or inappropriately placed UCs without a physician order and, to ultimately decrease CAUTI rates.

Objectives

To increase nurses' knowledge on the study unit by 10%, decrease CAUTI rates by at least 90%.

Plan

Obtain IRB approval, use a quasi-experimental one-group, pre-/post- design with a sample of nurses. Develop and administer an evidence-based educational intervention and evaluate a pre- and post-test for changes in knowledge. Three months later, evaluate CAUTI rates to determine whether there was a relationship between knowledge and CAUTI rates.

Results

Twenty-seven participants completed the pretest with a mean score of 8.41(SD=.797) and 24 participants completed the posttest with a mean score 9.75 (SD=.442). A paired t test revealed a statistically significant difference between the pre and posttest scores for all participants (t =-7.125, p = .001) CI: 17.20, 9.46 with p value set @ = 0.05. CAUTI rates for September to November 2015 three months before for the educational intervention was 4.42 incidents per 1000 catheter days and a zero from January to March 2016. There was no direct link made between knowledge and CAUTI rates. Rate during the implementation month was zero. However, it can be surmised that there is a high probability that the sustained zero CAUTI rates after the education was due to the increase knowledge based on the unit history of high CAUTI rates. The overall conclusion indicates that education increased nurses' knowledge; however, it had an

indirect effect on CAUTI rates. Further research needs to be done to investigate the true effects of education on the CAUTI rates using a longer monitoring time.

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I want to dedicate this project to my parents, who have since gone. Without the strong foundation and sacrifice that they made, I would not have started this journey.

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I know that I can do anything through Christ, who strengthens me.

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Problem Recognition and Definition

This project was conducted in partial fulfillment of the requirements of the Regis University, Loretto Heights School of Nursing, Doctor of Nursing Practice (DNP) program. The practice issue identified was the lack of use of a nurse-driven catheter removal protocol, a tool recommended by the Centers for Diseases Control and Prevention (CDC) to assist in decreasing catheter-associated infections in patients. An educational intervention in the use and importance of the protocol was implemented to empower nurses to remove urinary catheters (UC's) that are not needed, with guidance from the protocol, without calling for a physician's order. The ultimate purpose is to increase nurse knowledge and decrease in catheter-associated urinary infection (CAUTI) rates.

Statement of Purpose

The purpose of this study was to evaluate the effectiveness of an educational intervention on nurses on a medical-surgical telemetry unit in an acute care hospital, namely, the use and importance of an evidence-based, nurse-driven, indwelling urinary catheter protocol. The study also examined the impact of knowledge on catheter-associated urinary tract infection rates on the unit three months after the intervention. The nurse-driven indwelling urinary catheter removal protocol empowers the nurse to remove urinary catheters without a physician's order if they are deemed unnecessary or inappropriately placed based on evidence-based guidelines. The unit was reported to have one of the highest CAUTI rates in the year before this study. The educational intervention was guided by evidence-based, updated literature from infection control agencies, evidenced- based research and governmental regulatory bodies which resulted in a knowledge increase for the nurses and a sustained zero CAUTI rate for the medical surgical unit. This project was relevant.

Problem Statement

At a nonprofit acute care hospital in North Carolina, hospital administration has identified CAUTI as a high-priority problem. The hospital leadership called for widespread audits to determine the contributing factors to high CAUTI rates. The resulting reports revealed that the total number of incidents of CAUTI in the non-ICU settings for fiscal year 2014 was 54 (Infection Control Report, 2014). Audits also revealed that 14 organisms ranging from *E. coli* to *P. aeruginosa* were the pathogens causing the CAUTIs (Infection Control Report, 2014). Another finding was that the rate of infection for males was greater than females, with males having an 85.7% infection rate and females a 12% rate in the previous six months (Infection Control Report, 2014). In addition, according to Hospital Compare 2014 figures, the organization's CAUTI rates when compared to other hospitals nationally read "worse than national benchmark." (Medicare.gov, 2015) That means the hospital CAUTI rates are greater than 14 CAUTI, which is the benchmark for the unit (National Healthcare Safety Network, 2015).

Audits also revealed that nurses are not using the existing protocol to remove unnecessarily or inappropriately placed UCs in the hospital. Seventy -five percent of the charts audited from November 2014 to Aug 2015 indicated the nurse-driven protocol was not implemented (Observation rounds, 2014: Observation rounds 2015), excluding the pediatric floor, pediatric ICU and the emergency room. Seventy-five percent of the charts during that same time had inappropriate criteria documented for the UC (Observation rounds, 2014; Observation rounds 2015). It also was revealed that nurses do not understand the evidence-based criteria recommended by the nurse-driven protocol and are therefore using inappropriate criteria and leaving UCs in place (Observation rounds, 2014; Observational rounds 2015). In addition,

the nurses have many misunderstanding about why patients should have UCs. One of these myths is that incontinent patients needed UCs.

Some administrative staff believe that the staff's lack of knowledge of the hospital's UC removal protocol is due to the hospital's staff turnover rates and their reliance on the employment of agency staff. According to their Human Resources Department, there has been a consistent turnover rate of direct patient care staff. At the end of fiscal year 2014, nursing reported a 27.48% turnover rate. In 2013 the rate was 27.14%, and in 2012 it was 31.4%. The physicians employed by the hospital in 2014 also had a higher turnover rate at 13.51%. Because of this staffing shortage, agency staff constituted more than 45% of the staff on some units (Human Resources Department, 2015).

In 2011, the Nurse Practice Committee and the Infection Control Department, as part of a bundle to prevent catheter-associated urinary tract infections, developed a nurse-driven indwelling catheter removal protocol based on Center for Diseases Control and Prevention (CDC) guidelines and recommendations. The guidelines gave the nurse a set of situations or indications/criteria wherein a urinary catheter (UC) could be used, ranging from acute urinary retention to end-of-life care (Umscheid et al., 2011). It also called for the nurse to document daily the need for the UC (Elpern et al., 2009). This was done by creating a hard stop in the computer charting for patient assessment that the nurse is required to complete every 12 hours. The guidelines also called for monitoring of the patient after catheter removal and for the use of a bladder scanner.

The current criteria for urinary catheter removal includes (Deidenfied Hospital, 2014):

- Neurogenic bladder dysfunction/retention/obstruction
- Urological/gynecological/perineal surgery
- Sacral/trochanter pressure ulcer Stage 3 or greater and incontinence
- Palliative care/hospice care measures and end-of-life
- Pelvic, hip and/or vertebral fractures
- Long-term catheterization history (greater than 28 days)
- Catheter inserted by a urologist
- Epidural catheter in place
- Non-ICU 48 hours or *less* after insertion for acute monitoring of urinary output
- ICU-ONLY—acute monitoring of urinary output for critical care patients
- ICU-ONLY—chemical paralysis OR deep sedation

The nurse is responsible for removing the urinary catheter if its use is not indicated by the specified criteria. The premise is that nurses, being in close proximity to the patient, would use their critical thinking and assessment skills in conjunction with the protocol to assist in the prompt and early removal of urinary catheters. The protocol was presented to the hospital medical executive committee and was subsequently approved. A quality improvement program was launched, and champions were selected for each unit. Staff nurses were given unit overviews at the beginning of each shift, and educational posters were placed in strategic positions throughout the hospital, with the education focusing on the insertion and maintenance of UCs. An algorithm was developed to assist nurses in the use of the nurse-driven protocol. No new policy was written, and the electronic documentation system was adjusted to require nurses to

assess the need and document the rationale for a patient's UC on each shift, every day. However, research showed that no documented, official education was given to the staff about the use and importance of the nurse-driven protocol. Also, the algorithm created was not being used.

Other impediments to the timely catheter removal were (a) that most of the time, physicians are not even aware that patients have catheters; (b) that nurses are in no hurry to remove catheters as this relieves them of some of their duties, a practice also noted in a study done by Meddling et al., in 2014 (Observation rounds, 2014). Given these factors, audits revealed that CAUTI rates posted in the previous six months showed no decrease, and in some units, CAUTI rates had actually increased, though part of this increase may be attributed to the fact that the number of offending organisms causing these infections was increased due to a change in CAUTI definition by the CDC. It was determined that nurses lacked knowledge in the use of the protocol and were unaware of the rationale for and importance of removing inappropriate UCs. It was therefore decided that an educational intervention should be implemented to evaluate nurses' knowledge on the proper use and importance of the protocol and, in so doing, evaluate its impact on CAUTI rates.

PICO Statement and Practice Question

After identifying the problem, the project utilized the acronym PICO to designate the study, where (P) represents the population under study or observation, (I) the intervention or issue, (C) the comparison being studied, and (O) the anticipated outcome (Melnyk and Fineout-Overholt 2005). PICO is the initial step in developing a study.

Population-Intervention-Control Group-Outcome (PICO) Format:

Population = Nurses on the medical-surgical floor in an acute care hospital

Intervention = Education about the importance and use of a nurse-driven indwelling urinary catheter removal protocol

Comparative = Nurses' knowledge before education

Outcome = Change in nurses' knowledge and in CAUTI rates

PICO question. For (P) nurses on a medical surgical telemetry who are caring for patients with urinary catheters, will (I) education on the importance and proper use of a nurse-driven indwelling catheter removal protocol (C), change knowledge on the use and importance of the protocol compared to knowledge before receiving the education as evidenced by (O), change in knowledge and CAUTI rates as evidence by pre- and post-test scores and, CAUTI audits after three months?

Project Significance, Scope and Rationale

Urinary catheters are the leading preventable cause of hospital-acquired infections (Health Care Infection Control Practice Advisory Committee (HIPAC), 2009). Urinary catheters, although essential in the care of the patient, place the patient at risk for infection if they are not removed when not needed (HIPAC). A patient with one CAUTI is costly in today's value-added health system, because healthcare facilities are not reimbursed if the infection occurs in their institution. The CDC recommends that urinary catheters be removed as soon as possible and have even suggested that the use of catheters be avoided if possible (Center for Disease Control and Prevention (CDC), 2014). To facilitate this improvement, the CDC recommends a nurse-driven protocol for the removal of urinary catheters using evidence-based criteria, enabling catheter removal without a physician's order. The lack of knowledge of its use and its importance may be a contributing factor to high CAUTI rates throughout the facility. It is important that nurses, who are the front-line caregivers, know how to use this protocol to ensure

safe and prompt removable of urinary catheters that are not placed appropriately or not needed. This project will determine whether increasing knowledge about the nurse-driven protocol will increase use of the protocol and result in a subsequent reduction in CAUTI rates

In addition, the goal of this DNP candidate is to answer the PICO question, according to Chism, (2013) one of the roles of the Doctor of Nurse Practice graduate, is to use their expertise to intervene and answer questions related to practice issues (Chism, 2013). Also, The Essentials VIII of the doctoral education for advance nursing practice (AACN, 2006), states that DNP graduate should be a guide, mentor and provide support for nurses to achieve excellence in practice. With the education of staff, this researcher would be guiding the staff in the use of the protocol and fulfilling that role (AACN). Not only will it allow the researcher to guide the project and mentor through education, but according to Terry, (2005) this DNP candidate would make recommendations based on research that would influence practice and ensure that the improvement in practice is sustained (Terry, 2005; AACN).

Rationale. Awareness through education will stimulate the nurse's moral obligation to use the protocol to remove inappropriate catheters, thus contributing as a powerful member of the health team in the solution of decreasing CAUTI rates. Also, utilization of a nurse-driven protocol to remove UC's is seen to be effective in improving the quality of care of the patient. The nurse-driven protocol eliminates the wait time in obtaining a physician-generated order to remove the catheters. This time saved by not calling the doctor is essential, as studies show that for each day the catheter remains in place the patient is at risk, being 3-7% more likely get an infection (Donelli & Vuotto 2014). Reports also indicate that most of the time physicians do not know that their patients have urinary catheters and are not aware of the appropriate need for the UCs (Apisarnthanarak et al., 2014). If education on the nurse-driven protocol decreases CAUTI,

the nurses who are on the front line would be the ideal persons to be educated about the proper use of the protocol. With knowledge comes power. Empowered with knowledge, nurses will be able to identify urinary catheters that are inappropriate and use the protocol to remove them without a physician's order. In addition**, t**his study will provide a better understanding of a cost-effective educational intervention process to increase nurses' knowledge and decrease CAUTI rates. The education utilized in the study will be used in a hospital wide educational program, placed in the hospital's and online orientation and, re-establish the use of the algorithm.

Theoretical Foundation for Project and Change

According to Zaccagnini and White, (2011), a framework is required for both nursing practice and research (Zaccagnini and White, 2014). The theoretical framework for this study is based on a combination of Hill and Hanchett Theory of Enlightenment and Kurt Lewin's Change Theory. These models will provide a theoretical framework for this DNP Capstone project. Knowledge is a powerful tool that drives change. Through knowledge derived from an educational intervention, nurses on the medical surgical telemetry unit were expected to experience change.

Kurt Lewin's theory was used to complete the educational intervention for the nurses on the importance of the nurse-driven protocol and its use, which is necessary to implement change. (Lewin 1947) The nurses lacked knowledge about the evidence-based protocol, they did not know when to use the criteria provided by the protocol, and had misunderstandings about the use of UCs. The educational presentation utilized the Lewin's Theory to instill knowledge in the nurses on the medical surgical telemetry unit.

Lewin's theory of planned change. Lewin's Theory of Planned Change (1947) identified three phases of change, which are: unfreezing, (freezing) moving and refreezing. The

premise is that if an individual does not understand the current situation and the components that drive or impede that situation, then change is not possible. (Burnes & Cooke, 2012) The Field theory allows individuals to take an inward look at themselves and their perception of those around them.

The first phase of Lewin's theory, unfreezing, begins with learning and becoming aware in order to start the change process (Lewin, 1947). Learning makes one aware of what is needed to change. With that knowledge, the individual can move on to the second phase in which concerted, collaborative and planned efforts and actions are taken—actions that are structured using guidelines and analysis while implementing the change. The final stage is refreezing, which focuses on maintaining that change through motivation, and solid actions, which entails making new paths to prevent the situation from returning "to previous level." (Lewin, 1947, p. 228)

Lewin's unfreezing phase is the inertia or the driving force that will move the change forward. (Lewin) For this Capstone project, the change was increasing nurses' knowledge about the nurse-driven protocol to remove unnecessarily placed urinary catheters, resulting in a potential decrease in CAUTI rates.

The unfreezing involved identifying the problem, which was the first part of the educational event. What was the nurses' position? What were they not doing that was evidence-based, and what was wrong with their current practice? The educational intervention presented the problem discovered and the unit's CAUTI rates. The results of the unit audits showed examples of the use of inappropriate reasons to maintain UCs. The education identified alternatives that were superior to their previous rationales for leaving the UCs in place. It also involved taking a pre-test to assess staff awareness.

The next stage in Lewin's theory is the period of transition wherein the nurses received new information: how to implement and use the evidence-based protocol and the rationale for each criterion on the protocol. The old ways and ideas were displayed as undesirable, while the effectiveness and benefits of proper use of the protocol were introduced as the evidence-based norm (evidence). The nurses reviewed the existing evidence-based criteria and rationales, and during the question-and-answer session, many myths about UCs were dispelled. The staff was educated on the importance and use of the protocol as currently endorsed by the hospital. Scenarios were provided to emphasize the new way and the importance of the use of the protocol as well was used to dispel the unit's myths about UCs, one being that incontinent patients need urinary catheters. The nurses were also allowed to share their thoughts.

The last stage is refreezing. In this stage the post-test was given, along with support via verbal reminders and prompts. Lead charge nurses were the CAUTI champions on the medical surgical telemetry unit, ensuring that the protocols were appropriate on each shift and reminding staff to use the protocol. Data was given on the unit CAUTI rates, and the unit's overall increase in scores was discussed. The nurses were supported with verbal encouragement, praise and motivation. The unit was visited weekly, during which time questions were answered about the protocol. The protocol was utilized early-on by the nurses, who learned to rely upon alternate methods of urine collection. Also in the refreezing phase the change, which is the effective use of the protocol, was reinforced as a norm. The post-test was taken during the refreezing phase. The infection control manager made a bid to introduce the missing algorithm back into the protocol, and unit nurses were invited by the infection control nurse to assist in making the new policy and making the protocol more user-friendly. On daily rounds, the infection control specialist reinforced the use of the protocol, while teaching the routine maintenance of the catheters.

Education on the use and the importance of the nurse driven protocol was implemented in nursing orientation, remove unit specific information and apply for continuing education credits and the plan is to add it to a station at the mandatory bi- annual competency fair for all licensed employees.

After three months, all data were analyzed, including data collection on CAUTI rates. Results will be shared with staff and other hospital stakeholders. The performance data obtained will be utilized to monitor and evaluate compliance and correct use of the nurse-driven protocol, as made evident through the CAUTI rate. The three stages of change in Kurt's change theory, taking into consideration the restraining forces that exist, assisted in bringing about changes in the nurses' knowledge to promote the proper use of the protocol and indirectly decrease CAUTI rates.

Hill and Hanchett's Enlightenment Theory. Hill and Hanchett's Enlightenment Theory was also a framework for this study. The concept of Enlightenment Theory was developed following the worldview of Rogers (Hill and Hanchette 2001). His principals of hemodynamics focus on the individual going through life changes. As the individual makes life transitions, he or she becomes one with the environment. This Rogers calls "field patterns." (Hill and Hanchette, 2001). The processes of change are seen in Rogers' concept of Enlightenment Theory as: awareness, wakefulness and human field motion (Hill and Hanchette, 2001). In this theory, as the individual becomes aware of changes, self- reflection and reflection on the others and presenting issues takes place. This new awareness, stimulates an awakening within. The individual moves with the flow of change, and as the change is experienced the individual moves to a better state of well-being. With increased knowledge, the nurses' new awareness created a sense of obligation. The new knowledge caused an awakening in the nurses that challenged their inner

morals, which lead to an increase in the appropriate utilization of the nurse-driven protocol. Nurses were engaging physicians in conversation on the need for urinary catheters (Observational rounds, 2015). They spoke freely of catheters that were inappropriate and showed concern when inappropriate catheters had been placed in patients that they received from the ED. (Observational rounds, 2015) The nurses were eager to remove the catheters, checking to ensure that the protocol was used correctly. They were encouraging each other to use alternative methods of urine collection (Observational rounds, 2015). Enlightenment is seen as a positive change process that can achieve positive outcomes. In the nurses it increased knowledge, which resulted in increased safety for patients and a decrease and a sustained zero CAUTI rate for the institution. Both of these theories focused on attaining increase knowledge that would result in change and positive outcomes. Lewin's theory is suitable for planned change, and it is also easy to follow (Burnes and Cooke, 2012).

Literature Selection/Systematic Process

According to Terry (2012), literature reviews are conducted in order to evaluate inconsistencies or gaps that exist in that literature (Terry, 2012). A systematic approach was undertaken to analyze the existing data addressing the use of the nurse-driven protocol for the removal of urinary catheters without a physcian order. A literature search for the key word "nurse-driven" was conducted on the following search engines: Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, Academic Search Primer and Pub Media. The search turned up 2,164 articles. With the key words "nurse-driven" and "urinary" added, 949 articles were retrieved. With the key word nurse-driven protocol, "catheter," and the date 2009-2014, there were 14 articles. Adding "infection" yielded ten articles. "Knowledge" yielded only

six articles that were relevant to the Capstone project with only one measuring knowledge after an intervention.

In the studies reviewed on the nurse-driven indwelling urinary catheter removal protocol, some of them utilized cohort studies and none used randomized control study designs. The 58 articles used to support this Capstone project were from expert opinion, systematic reviews, meta- analysis, national governing bodies, infection control organizations such as the CDC and CMS, established nursing authorities, nursing and other health care journals. The majority were evidence-based quality improvement programs that used pre- and post- study designs.

The aim of this Capstone project was to address the removal of urinary catheters without a doctor's order by following evidence-based criteria. Many recommended interventions have been developed with the same goal: the prompt removal of unnecessary urinary catheters. The recommended interventions after educational events in these studies resulted in decreased CAUTI rates, yet the rate of CAUTI remained constant over the last five years throughout hospitals in the United States (Kennedy et al., 2013).

The abstracts of the relevant articles were appraised to see whether the articles were relevant to the PICO question and had validity and reliability (Melnyk, and Fineout-Overholt 2005). They were placed in a table and organized according to their level of significance. Level 1 represented the highest quality, which includes systematic reviews or meta-analysis, to level VI, which includes qualitative or descriptive studies. There were few studies directly related to the education of nurses on removal of UCs instead of calling physicians for orders. All studies either provided education on recommended interventions that prompted physicians and reminded nurses to request an order to remove the UC or that reminded the physicians via EMR that the

UC had to be removed (Fuchs et al., 2011; Lo et al., 2014 ; Carter, Reitmeier and Goodloe, 2014; Voss, 2009; Meddlng et al., 2014).

Scope of Evidence

The scope of this study is to develop and implement an evidence-based educational intervention on the use and importance of a nurse-driven protocol with a small sample of nurses from an acute-care hospital in Fayetteville, NC. Inclusion criteria for this study included interventions that prompted the removal of urinary catheters. The pediatric population was excluded, as the rate of CAUTI in that group was not comprised in the facility. In addition, articles related to insertion and maintenance of UCs were excluded, as the goal of the project was to focus on the nurses, gaining knowledge about the use and the importance of the nurse-driven protocol for removal. Most of the studies reviewed for this project were pre-/post- studies, which, according to Melnyk and Fineout-Overholt (2010) falls under evidence-based category VI.

Review of the Evidence

Background of the Problem

A nurse-driven indwelling catheter removal protocol is an evidence-based tool recommended by infection control organizations and experts for the early removal of unnecessary or inappropriately placed urinary catheters (UCs). Evidence shows that urinary catheters are the source of CAUTIs (Donelli and Vuotto, 2014; Center for Disease Control and Prevention, 2010). CAUTI is the leading cause of hospital-acquired infections in the United States (Institute for Health Care Improvement (IHI), 2011). Seventy-five percent of urinary tract infections in hospitalized patients are associated with urinary catheters, and more than 50% of these infections are preventable (Centers for Disease Control and Prevention [CDC], 2015

(Health Care Infection Control Practice Advisory Committee(HIPAC), 2009); A urinary catheter is a device inserted into the bladder for emptying urine. Roughly 25% of hospitalized patients in the United States and about 18% in Europe receive urinary catheters as part of their medical treatment. (Lindsay, 2014) Reports have revealed that about 5 million catheters are inserted annually. (Institute for Health Care Improvement [IHI], 2011)

Catheter use is sometimes necessary in the care of patients. Evidence indicates that catheters used for appropriate reasons and inserted appropriately should be removed as soon as possible to prevent infection. (Health Care Infection Control Practice Advisory Committee [HICPAC], 2009). However, most of the problem with catheters arises when organisms enter the urinary tract via the catheter, causing an infection (Donelli & Vuotto, 2014). Urinary catheters pose a threat to patient safety, as bacteria can travel up the tube from the collection bag. Thirty percent of catheter-associated urinary tract infections (CAUTI) are caused by this type of lumen contamination. (Donelli & Vuotto, 2014; Center for Disease Control and Prevention, 2010) The longer the catheter remains in place, the more the surfaces of the catheter become colonized by bacteria and grow a bio-film that causes infection. (Donelli & Vuotto, 2014) Just the insertion of a catheter into the urethra places the patient at risk for infection. Studies show that urinary catheters left in place more than 48 hours are directly associated with CAUTI. (Meddings et al., 2014; Carter et al., 2014)

According to the CDC (2015), CAUTI is a urinary tract infection that occurs two days after a catheter is inserted or one day after the catheter is discontinued (Centers for Disease Control and Prevention [CDC], 2015). CAUTI can cause infections almost anywhere in the body. It can lead to infections including but not limited to prostatitis, epididymitis, cystitis, endocarditis, septic arthritis, urosepsis, sepsis, and meningitis. (National Healthcare Safety

Network, 2010; CDC, 2015) CAUTI can also increase mortality, increase the length of a hospital stay, foster the unnecessary use of antimicrobials and contribute to patient discomfort. (Center for Disease Control and Prevention, 2010; CDC, 2015; American Nurses Association (ANA), 2013) Some studies show that 30% of hospital-acquired infections are caused by CAUTI (Centers for Disease Control and Prevention [CDC], 2015). Improper insertion and maintenance as well as lack of staff training and education about UC management also contribute to CAUTI (Health Care Infection Control Practice Advisory Committee (HIPAC), 2009). The recommendation by all experts and studies is to limit the use of catheters and to remove them as soon as possible; in fact, it was suggested that catheters should be placed only if necessary (HIPAC, 2009; American Nurses Association (ANA), 2013).

Studies reveal when nurses are empowered to remove these catheters without a physician's order, there is a decrease in infection rates and number of catheter days (Meddings et al., 2014). Adams, Bucior, Day and Rimmer, 2012; Roser et al. (2012), Wenger (2010), Marigliano et al. (2012), and Schultz and Aljawawdeh (2011), directly link education on the nurse-driven protocol to decreased CAUTI rates.

The review of the evidence supporting the use of a nurse-driven protocol and its impact on CAUTI is linked to knowledge and competency (American Nurses Association (ANA) 2013). These studies resulted in a statistically significant decrease in CAUTI rates and number of catheter days (Adams, Bucior, Day, and Rimmer, 2012; Roser et al., 2012; Wenger, 2010; Marigliano et al., 2012; Schultz and Aljawawdeh, 2011). It is clear that the education of nurses on the true meaning of the criteria in the protocol will empower them to independently remove UCs without danger to the patient and, in fact, in support of the improved patient outcomes.

In addition to issues of patient care and safety, there are financial implications in the adoption of the protocol. With the present emphasis on patient safety, quality care and outcomes, and controlling health care costs, the prevention of CAUTI has taken a front seat in the health industry (American Nurses Association (ANA), 2013). In 2011, the CAUTI Joint Commission, an organization that monitors the safety of U.S. health care systems and grants hospital certification, deemed the incidence of CAUTI a safety and quality issue. CAUTI also falls under The Joint Commission Hospital National Safety Goal NPSG.07 (The Joint Commission, 2014). Not only is CAUTI considered a safety issue, but it also points to the quality of care rendered by an institution. This quality issue, if negative, can result in a backlash from the public. CAUTI is also listed as a preventable event by the Center for Medicare & Medicaid (CMS); hospitals are not being reimbursed for hospital stays caused by CAUTI (Kennedy et al., 2013). As mentioned before, CAUTI increases hospital lengths of stay (Center for Disease Control and Prevention, 2010: CDC, 2015). It has been estimated that a patient remains two to four days longer in the hospital when they acquire a CAUTI (CDC, 2015). With Medicare's non-reimbursement policy for patients with CAUTI, healthcare systems are faced with new financial burdens. The non-payment by CMS, potential ligation from patients, and possible sanctions imposed by accrediting bodies can financially affect the bottom line for health institutions.

All of these factors, therefore, call for front line workers to know how to utilize the nurse-driven catheter removal protocol, without calling for an order, an intervention that can directly reduce and eliminate CAUTIs. Education about the nurse-driven protocol will not only increase nurses' knowledge, but will give the nurses a sense of ownership and more responsibility for the safety of their patients. This study will support the contention that education is the least expensive intervention and the possible missing link in the effort to

decrease CAUTI rates. With knowledge comes power. Empowered with knowledge, nurses on the medical surgical telemetry unit at a non-profit hospital in NC were able to identify urinary catheters that were inappropriately placed and implement the nurse-driven catheter removal protocol to remove them without a physician's order (Observational rounds, 2016).

Systematic Review of the Literature

A search for the key word "nurse-driven" conducted on the search engines Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, and Academic Search Primer and Pub Media resulted in 2,164 articles. With the key words "nurse-driven" and "urinary" added, 949 articles were retrieved. With the key words "nurse-driven protocol, "catheter," and the date 2009-2014, 14 articles were found. Adding "infection" yielded ten articles. Also reviewed were infection control guidelines by national governing bodies. Only six articles supported the Capstone project. In those articles about the nurse-driven indwelling urinary catheter removal protocol, none of the studies utilized cohort studies nor randomized control study design. All studies were evidence-based, quality improvement programs that used a pre- and post- design. After careful analysis of all data 58 articles were used.

The aim of the nurse-driven protocol in this Capstone project is to address the removal of urinary catheters without a doctor's order, following evidence-based criteria. Many articles recommended interventions that were developed with the same goal of prompting the removal of urinary catheters; however, in all of them a physician's order was needed. In the studies reviewed, interventions that were implemented after educational events resulted in a decrease CAUTI in rates, yet CAUTI rates have remained constant over the last five years throughout hospitals in the United States (Kennedy et al., 2013). It was clear, then, that education was

needed on a protocol that primarily involved the nurse in the process of early catheter removal to prevent infection. The recommended interventions were reviewed.

Recommendation—early removal. The CDC recommends that urinary catheters be avoided or removed immediately if not needed (Centers for Disease Control and Prevention [CDC], 2014; Health Care Infection Control Practice Advisory Committee [HIPAC], 2009). Reports show that urinary catheters are directly linked to infection. Infection control agencies advocate that health care workers need to be vigilant in the care of patients with catheters. Even more important is the fact that reimbursement and accreditation are tied to infection rates. All interventions are now geared toward the early removal of these catheters, although catheter maintenance and insertion are also important. Studies indicate that early removal of UCs decreases infection rates (Carter, Reitmeier, and Goodloe, 2014). Given that the results of early removal are promising, it has been recommended that nurses, who are constantly at the patient's bedside and are in constant contact with them, remove the catheters if they are not needed. Medding et al. (2014) was skeptical that empowering nurses to remove catheters without orders would accomplish a decrease in infection rates, but studies reveal that when nurses are empowered to remove these catheters without an order, a drop in the infection rate and the length of catheter days were noted (Adams, 2012; Mori, 2014; Roseret al., 2012; Schultz, 2011; Wenger, 2010; Parry et al., 2013).

Recommendation—limiting use. In the systematic literature review of the interventions to prevent CAUTI, studies indicated that limiting catheter use was the key to preventing CAUTI. Most of the studies that supported limiting the use of catheters were nurse-driven, but they required physician orders (Voss, 2009). Studies by Lo et al. (2014) and Alexaitis and Broome (2014) revealed that after education on using alternative methods, CAUTI rates were decreased.

Fuchs et al. (2011) also concluded that education about the proper use of a checklist decreased the CAUTI rate (Fuchs, et al., 2011).

All these studies supported the fact that implementation of a nurse-driven urinary catheter protocol decreases CAUTI rates. These studies also support the action by the Center for Medicare and Medicaid Services (CMS) in listing CAUTI as a "preventable" event. CMS has encouraged quality care from healthcare institutions by instituting a non-reimbursement policy for infections occurring in the hospital, and, as of January 2015, a reduction in reimbursement for hospitals that report hospital-acquired infection rates greater than 25%. (Centers for Medicare & Medicaid Services, 2014) The policy shifted to pay based on good performance. It also moved to hospital process-based measures to enhance patient safety and quality of care into the public arena, by providing information about adverse events such as CAUTI rates.

In light of this new link between, money and quality care, HICPAC developed a set of recommended evidence-based guidelines to follow to determine the need for catheterization. The guidelines or criteria are as follows:

Acute urinary retention or obstruction

Accurate measurement of urinary output in critically ill patients

Perioperative use in selected surgeries

To assist in the healing of perineal and sacral wounds in incontinent patients

For comfort in palliative care

For immobilization related to trauma or surgery

These guidelines have been incorporated in what is called a nurse-driven urinary catheter protocol that can be used to authorize the nurse to remove urinary unnecessary catheters without

an order. It also includes a daily assessment of the need for the urinary catheter and suggestions for the use of less invasive alternatives to catheterization.

However, as with all things, in order to accomplish this, nurses must be well educated and must become competent to independently remove catheters. A promising fact supporting the use of the nurse-driven indwelling urinary catheter removal protocol is that educational interventions on alternative methods undertaken to increase nurses' knowledge (require calling to obtain an order) had significant results. Education appears to be the key.

Recommendation—reminders. In many studies, physician reminders were implemented to prompt removal of the catheter (Voss, 2009). However, nurse-driven protocols where the nurse independently made the decision to remove the UC based on guidelines were not utilized in these studies. This finding justifies the need for increasing nurses' knowledge about the nurse-driven protocol. Harrod et al. (2013) states that more attention has to be paid to how the decisions are made by clinicians to remove catheters. Catchpole (2013) also emphasized that understanding the process is the master key in making clinical decisions. Increasing knowledge of the nurse-driven protocol is essential. Above all, the nurse-driven urinary catheter removal protocol is an intervention that is recommended by authorities in infection control such as The Society for Healthcare Epidemiology of America (SHEA), Infectious Diseases Society of America (IDSA), the Association for Professionals in Infection Control and Epidemiology (APIC), the American Hospitals Association (AHA) and The Joint Commission.

Nurse-driven protocol implementation without orders. After careful review of all literature, only six studies supported this Capstone project; that is, only six studies had a design in which the nurses were given power to remove catheters without a physician's order. All

studies revealed an impact on CAUTI rates and catheter utilization. In all studies, education was intentional, as the responsibility was placed on the empowered nurses' decisions to remove UCs.

In a quality improvement project by Moir (2014), a nurse-driven protocol for indwelling urinary catheter removal was implemented in a 150-bed hospital. A three-month retrospective chart review was done on catheter use. An educational intervention that included online education and face-to-face instruction was completed one month prior to the intervention. The results were followed after three months of intervention. Catheter days prior to the intervention were 37.6% with a dwell time of 3.35 and CAUTI rate of 77%. After the intervention, catheter days decreased to 27.7% with a dwell time of 3.46 and a CAUTI rate of 0.35%. Although results were significant, no knowledge assessment was reported.

Adams, Bucior, Day & Rimmer (2012) implemented a nurse-driven protocol in three units in hospitals in England using the nurse-driven catheter removal protocol based on the popular HOUDINI acronym: **h**ematuria, **o**bstruction, **u**rologic **s**urgery, **d**ecubitus ulcer, **i**nput and output measurement, **n**ursing end of life care, and **i**mmobility. Nurses were empowered to discontinue the catheters without a physician's order if this set of criteria based on the HOUDINI acronym was met. Education about the protocol was provided on the units during meetings, and posters were placed in visible areas. Catheter prevalence data were collected as well as data on the growth of *Escherichia coli* (*E. coli*) in urine samples. *E. coli* is the most common pathogen associated with urinary tract infections. This intervention led to a decrease in catheter use by 17%. The incidence of *E. coli* urine samples was decreased by 70%.

Wegner et al. (2010) implemented a nurse-driven protocol to reduce CAUTI by launching an educational program. The protocol allowed the daily assessment of the need for the UC and gave the nurse the authority to remove the UC if the reason for its presence did not meet

the criteria; a resulting decrease in UC rates was also noted. Education was the key component allowing the nurse to embrace a new role. The nurse-driven protocol gave the nurse the latitude to use her judgment, and with knowledge and confidence, catheters were removed.

Roser et al. (2012) implemented an educational intervention for staff in a medical surgical unit on the appropriate reason for the insertion of a catheter and empowered nurses to remove urinary catheters when they were not necessary. A decrease in the unit's CAUTI rate was also reported. Education once again was essential in empowering the nurses.

Schultz et al. (2011) developed a nurse-driven protocol to empower nurses in a Midwestern critical care unit to remove urinary catheters without orders, thus decreasing the use of UCs. This unit was listed in the 90th percentile in the National Health Care Safety Network database. Nurses were educated by clinical educators on the appropriate use of the nurse-driven protocol, nurses' hesitancies were addressed, and a backup plan for urinary retention was formulated. Nurses were held accountable for patient assessments within 48 hours after admission to the unit. The rates of use of IUC devices (IUC days/patient days) ranged from 0.95 to 0.90 for the 9 months preceding implementation of the protocol and from 0.84 to 0.76 for the 3 months following implementation. This rate improved the hospital's standing in the National Health Care Safety Network, one of the national monitoring agencies. The hospital moved from the 90th percentile in March to the 50th percentile in August. The nurse-driven protocol empowering the nurse to remove catheter again was favorable.

Delay in removing urinary catheters caused by waiting for a physician's order when in the nurse's judgment based on protocol criteria the catheter could appropriately be removed is one obstacle that can be clearly eliminated.

According to Parry, Grant and Sestovic (2013), by changing the culture of nursing, providing education and using an EMR system, a 50% reduction in CAUTI rates over a 36-month period in a 300-bed community hospital was achieved. CAUTI rates per catheter days decreased by 3.3% per month over 36 months, and CAUTI rates per patient days fell by 5.29%. Aggressive use of a nurse-driven protocol was implemented that gave the nurse the power to remove unnecessarily place UCs without a physician's order.

Utilization of a nurse-driven protocol to remove indwelling urinary catheters has repeatedly been seen to be effective in improving the quality of patient care. The nurse-driven protocol eliminates the wait time in obtaining a physician-generated order to remove urinary catheters. This time saved is essential, as studies show that for each day the catheter remains the patient is placed at risk and is exposed to a 3-7% chance of getting an infection (Donelli & Vuotto, 2014). Reports indicate that most of the time physicians do not know that the patients have urinary catheters and are not aware of the appropriate need for the UC (Apisarnthanarak et al., 2014), and nurses keep the catheters in patients as a means of decreasing their workload and making patient care more convenient (Meddings et al., 2014). The common theme in these studies was that an educational intervention was provided before implementation of a change in the management of UCs. A convincing study by Marigliano et al. (2012) proves that education is a good investment. In their study, an education on urinary catheter use showed a statistically significant improvement CAUTI incidents (p = 0.0 5). Prior to the education, 46 cases of CAUTI were detected with an incidence rate of 6.6/1,000 catheter days. After education, CAUTI cases had fallen to 19 with an incidence rate of 5.8/1,000 catheter days (95% CI: 3.5-9.0).

It was noted that the study by Marigliano et al., is the only study that measured the before and after knowledge of the nurses when a nurse-driven protocol was implemented. According

the study, a McNemar test to compare the pre and post education paired answers, and concluded that was a gain in nurse's knowledge, however, the knowledge was in catheter care and maintenance not on the nurse driven urinary catheters removal protocol. The study concluded that education increased knowledge and CAUTI rates and catheter usage decreased. The amount of knowledge gained was not reported. The study eluded that change in behavior due to motivation had a bearing on the decrease in catheter usage and CAUTI rates. This indicates that there is a need for further studies to evaluate nurse's knowledge after an education on the use and importance of the nurse driven urinary removal protocol.

Education on the nurse-driven protocol to remove urinary catheters without orders may not only increase nurses' knowledge, it will give nurses ownership and more responsibility for the safety of their patients. It is therefore essential to study the effectiveness of education on the nurse's knowledge, to determine whether increasing knowledge decreases in CAUTI. Moreover, it may justify the assertion that education is the cheapest health care intervention, and it can be the major factor that is capable of decreasing the CAUTI rate.

The review of the evidence supporting the use of a nurse drive protocol and its impact on CAUTI is linked to knowledge and competency. While most of the studies that were reviewed were pre and post design, not randomized, double- blinded, controlled studies, they demonstrated a decrease in CAUTI rates with the use of a nurse-driven protocol. Although most of the studies focus on other intervention other than staff education, these studies resulted in a statistically significant decrease in CAUTI rates and length of catheter days. From the literature review, it is clear that there is a need for further research on measuring knowledge after the education of nurses on the true meaning of a nurse-driven protocol, i.e.: Removing urinary catheters based solely on the criteria without calling for a physician's order.

Project Plan and Evaluation

Market/Risk Analyses

Upon review, there were no market risks identified in this study to the institution: CAUTI rates are public knowledge. A conceptual model was created to better understand the problem (Appendix B). A timetable was also established to carry out this project (Appendix C). Approval for this project was granted by the nurse manager and the clinical coordinator for research. Access was given to CAUTI rates and the hospital infection control data by the Director of Infection Control Department. Nurses who participated gave their consent. The plan was for the nurse to follow the hospital's protocol if she/he were to remove a urinary catheter that was necessary. The unit was to follow the hospital protocol for incidents of that nature. There were no issues that was identified that placed nurses who participated at risk.

Project Strengths, Weaknesses, Opportunities, Threats

This project offered an educational program from which the effectiveness of knowledge received was evaluated. The expected outcome was to increase nurses' knowledge in order to achieve quality nursing. The institution's goal was to use evidence-based nursing principles to carry out safer nursing care. The hospital's mission is to create a culture of research and ensure that all practice is steeped in research. A SWOT analysis was completed for this project to assess project its strengths, weakness, opportunities and threats. With the SWOT the project was able to be successful and processes put in place to anticipate and handle threats and maximize the use of the opportunities and strengths that existed. This project's strengths, weakness, opportunities and threats were assessed as depicted in Table 1.

Table 1. SWOT

Strengths	**W**eaknesses
Evidence-based education Addresses a hospital priority problem Manager buy-in Administration buy-in and support Staff support May decrease hospital costs Staff buy-in	Implementation time Staff turnover Space for education Physician lack of knowledge
Opportunities	**T**hreats
Improved practice/quality care Collect data and see trends More competent/confident staff Decreased CAUTI rates Potential decreased costs for the facility	Attrition missing post test Skewed data-population Sample size Physician lack of knowledge Missing incentive Change in management

The program's main strength was that it addressed a problem that was a high priority in the hospital: high CAUTI rates. This component was the nurse-driven catheter removal protocol, which is an important part of the hospital's CAUTI prevention bundle that was not being implemented. Being a high priority problem, the support of the manager was readily obtained.

Another strength of this project was the support from the staff members of the participating unit. They were willing to listen, as the project directly related to the unit's high CAUTI rates, which were posted throughout the hospital on quality improvement boards. Organizational stakeholder support was also an identified strength of this project. Support was received from the infection control director and her team who served as advisors, monitors and staff motivators. Weekly meetings were scheduled to discuss the CAUTI problem. Decreasing CAUTI has become a high priority according to the Director of Infection Control, and evidence-based staff education was essential and a main priority in all aspects of CAUTI prevention. The project offered an evidence-based educational intervention with hopes of implementing it in other units if successful.

Another major strength was that an established, evidence-based protocol based on CDC guidelines already existed, so there was no need to develop a new protocol. The knowledge base and researcher's role as an educator with a Master's Degree in Nursing Education and DNP candidate was also deemed as a strength of this project.

Many weaknesses of this project involved time. Implementing the educational event was time-consuming for the researcher, since with the ongoing staff shortage, the unit was busy on both days and nights, and it took a long while to get the educational program completed. On occasion, only one person attended the session. Another weakness was staff distraction. Nurses had their unit cell phones, which they answered during the presentation, even to the point of leaving the classroom and coming back later. The site of the educational intervention was another area of weakness. The sessions were scheduled to be held near the unit on both shifts, but were ultimately moved per staff request into the unit's break room to make it easier for staff to attend while at the same time facilitating their quick access to their patients, should the need arise, because due to lack of staffing sometimes it was hard for staff to get coverage for their patients. A total of 27 out of 31 staff members attended. The unit has a high staff turnover rate and was not fully staffed during the period of this study. Collecting data was a tedious process, as the education was offered near major holidays, and the start date of the intervention was delayed due to a visit to the hospital by The Joint Commission.

However, the project provided a great opportunity to the institution. The participating unit nurses were given a chance to improve their knowledge in the proper use and importance of the nurse-driven protocol. A consistent, evidence-based education was provided that - translated into nursing practice in order to achieve positive outcomes for patients and the institution. Patients received safe, quality care, and the institution will regain its reputation by potentially

decreasing its CAUTI rates on this medical, surgical telemetry unit, while simultaneously decreasing the threat to the hospital Medicare reimbursement. Knowledge provided by this project also gave the staff confidence in their decision-making ability that created in them a greater sense of accountability, more motivation, and more buy-in with regard to helping solve the CAUTI problem. This directly follows the theoretical framework for the refreezing phase of Kurt Lewins' change theory.

Another weakness was the lack of physician knowledge of the nurse driven protocol There were no physicians included in this project. Although a physician champion was identified by the infection control nurse to assist in CAUTI prevention, education about the nurse-driven protocol did not filter down to the primary physicians, among whom most of the education was focused on catheter maintenance and insertion.

Potential threats to the project were the physicians' lack of knowledge about the nurse-driven protocol. Staff shortages caused a drain on the unit nurses who were already educated and on the newly hired staff nurses who had no knowledge of the use and importance of the nurse-driven protocol, which had to potential to affect the results data. Non-completion of the post-test and the possibility of nurses taking the post-test too quickly also posed a threat to data collection.

With the SWOT analysis completed prior to the project, a better plan was able to be made in order to ensure a successful project. These improvements included motivating the staff, moving the venue, using resource nurses as champions, and implementing the educational component during new staff orientation.

Driving, Restraining and Sustaining Forces

Driving forces. It is important to understand barriers and facilitating forces in the development of effective and targeted guideline implementation strategies for projects. (Ploeg et

al., 2007) Individual, organizational and environmental factors can influence this Capstone project. The main driving force or facilitating force in any project is leadership support. This project received support from the education department and infection control department, because CAUTI is listed as a priority in the hospital. The educational intervention was an opportunity to evaluate the effectiveness of education on the nurse-driven protocol that may affect CAUTI rates. Buy-in from the unit manager and the floor's clinical educator was obtained. This was a positive driving force that helped with the project implementation. The clinical educator also attended the session and became a champion for the use of the protocol. A collaboration between the Infection Control Department and this researcher was a major driving force for this project, for their support and knowledge of infection control issues helped guide it. The infection specialist was willing to help present the classes for the staff. They also monitored the protocol and its proper use. The director of Infection Control lent her expertise to the project as well. She suggested the participating unit for the protocol, as she deemed it needed the most education given that their CAUTI rates were high.

The use of the existing protocol was another driving force behind this project, because the tool was already developed and approved. The tool to collect CAUTI data after education is also an established tool that is used in all hospitals to report CAUTI rates to NHSN. This facilitated completion of this project. There was no need for the IT team to become involved. No planned changes were to be made in the IT system, as the hospital was in the process of looking for a new documentation system. A 10-question test validated by experts was given before and after an evidence-based education session to establish baseline knowledge and check for knowledge increase

Restraining forces. Restraining forces are called barriers and include any opposition to the project. The workload due to staff shortages posed a problem. Coaching, reminders and motivation helped win the staff over. Staff time calculated in dollars and cents could have been a problem for the manager, but with persuasive argument and by comparing the cost of one CAUTI event to the cost of class time for all her employees, her resistance decreased. Staff was allowed to participate while at work, which produced no additional cost for the unit; however, some staff remained overtime to attend educational sessions, which translated into cost for the unit. Some staff were not able to attend because absence from a unit that is short-staffed could cause workflow issues and could have compromised patient care. The researcher ensured that the units were adequately covered before nurses were pulled to attend the session. The Power Point presentation and the scenarios for new staff that may have missed the class were placed in the hospital orientation program. Food was provided as an incentive for staff to attend. Another incentive was created by planning to apply for continuing education credits (CEUs) for the event, however, using the hospital protocol as part of the project did not qualify the project at that time for CEUs. The plan going forward is to remove all hospital data and make the education generic and apply for credit.

Difficulty in implementing policy changes to reflect workflow was also a restraining force. Development of a new algorithm in collaboration with infection is in progress. Another major restraining force was organizational and system-level changes. As a system change priority, many changes were being implemented that threatened to cause burnout and induce resistance by staff. The unit manager transitioned into a new role, and the educator who took on the manager's role as an interim helped in facilitating the project.

Another factor that created a potential barrier was physician of knowledge of the protocol. Physicians are sometimes not aware that their patients have catheters (Apisarnthanarak et al., 2014). Most of the physicians were not aware that a nurse-driven protocol for catheter removal existed; this was likely due to physician turnover. The plan is to present the project results to the physician group and ensure that all physicians had the new algorithm after the tool is reviewed and adjusted by Infection Control and approved by the nursing practice committee and the physicians. A physician champion has already been solicited by the infection control manager to educate other physicians and staff about the CAUTI prevention protocol.

Sustaining forces. Plans were set in place to ensure that the project was sustained by implementing both short-term and long-term strategies. Sustainability is manifested by the capability to maintain the mechanisms of the project. Timely feedback data is to be provided to the manger and the stakeholders to reinforce the importance of monitoring the use of the protocol. Data, both negative and positive, will be shared with staff. The pre- and post- scores will be shared with each staff member. The results of knowledge derived from the test will also be shared with the unit manager, line director and the infection control team officially.

Another strategy that was employed to achieve sustainability was identifying a facilitator or facilitators who would take responsibility for reinforcing the process after the initial intervention was completed. This was someone who was committed to this role. The nurse educator and the resource nurses became the unit champions for ensuring the continued proper use of the nurse-driven protocol.

To ensure continuation and integration, the education on the nurse driven protocol was placed into the new employee orientation program. It will hopefully be made a mandatory annual competency after the project results are in. Application for continuing education hours is

to be made after all hospital-specific data is removed. As a means of avoiding resurgent CAUTI rates, a self-paced educational module is to be placed online in order to be readily available for transfers and agency staff who come to the unit.

To sustain the knowledge and to continue this evidence-based practice, a plan was made to assist in refining the existing policy and the documentation system to better support the practice. Weekly CAUTI meetings were called to discuss policy changes and practice issues in relation to CAUTI. The policy is now under reviewed by the CAUTI team. This plan was to include the Information and Technology (IT) department to assist if documentation changes were needed and to create easy, nurse-friendly documentation processes. Recommendations for changes in the documentation system for this project was placed on hold as other projects were in the pipeline, and the hospital has plans to look at a new documentation system

Needs, Resources, and Sustainability

The need for this project was to evaluate the change in nurses' knowledge after an educational intervention on the use and importance of an indwelling urinary catheter removal protocol among nurses on a medical surgical telemetry unit in an acute care hospital in North Carolina. The need was determined because this unit's CAUTI rates was one of the highest in the hospital at the inception of the project. The protocol was not being implemented and when implemented, criteria for UC's were inappropriately made; it was also found, that nurses had myths about the need for urinary catheters. In addition, the hospital was listed in an unfavorable manner in reference to its CAUTI rates on a national web site that monitors hospital quality. The study provided an evidence-based educational session for the nurses that addressed the use of the protocol, the importance of it in patient care and safety, its implication in reducing the hospital's CAUTI rates, and corrected the myths pertaining to urinary catheters.

The resources used for this project included time spent to create the educational intervention, time for its implementation, collecting the data for pre- and post-tests, correcting both tests and running the data. The researcher visited the unit weekly to support staff and attend weekly CAUTI team meetings. Time also included the nurses' time to attend the presentation and to take the pre- and post-tests. Other resources were the projector, computer, and paper products, all of which were provided by the institution. No monetary reward or incentive was provided to this researcher by the institution. Money spent on food for the staff came from the researcher's personal funds. The human resources involved in this project was the primary researcher, the nurses who participated, the nurses mentor, the capstone chair and the Research Coordinator who gave approval to the project. The infection control team offered support and expert advice and was also an integral resource for the project.

Sustainability of this project will be obtained and will be maintained by:

- Sharing the study findings with nurses involved in this project and nurse leaders
- Seeking champions to maintain a watch over the protocol use
- Adding materials on the use and importance of the nurse-driven protocol for the removal of unnecessary urinary catheters to new employee orientation
- Surveillance with daily rounding and weekly audits
- Reinforcing the norm with newsletters and posters
- Measuring outcomes

Feasibility/Risks/Unintended Consequences

This project was made feasible by the nurses who participated in the project, the unit manager at that time, the clinical educator and the clinical research coordinator who approved the project. Full IRB approval was also obtained from both the institution and the Regis IRB.

The feasibility of offering the educational intervention to all inpatient units in the hospital is good, since the need to decrease CAUTI rates is a hospital priority. There is no risk to nurses in attending the educational intervention. There is always a risk that a catheter that was appropriately placed would be removed inadvertently. To address this, the hospital standard of care will be instituted and the usual follow-up done per the hospital protocol. There are two unintended consequences that may increase as a result of this intervention. First, a bladder scanner to assess post catheter retention, which is covered in the protocol, may need to be purchased for the unit as at present it is shared with other units. Secondly, the use of alternatives to urinary catheters: urinals, condom catheters and white under pads may increase. Incontinence is not a criterion for UC insertion.

Stakeholders and Project Team

Key stakeholders. The stakeholders identified in this project are the people who are ultimately affected by the education. Many people were interested in eliminating CAUTI within the hospital. The primary stakeholder is the researcher who developed, create and monitor this project. The main stakeholders in this project were the manager and the clinical educator on the medical surgical telemetry unit where the educational intervention was implemented. The unit's CAUTI rates could not be lowered, thus this was a unit whose catheter infection no doubt posed a threat to patient safety; the unit's reputation was at stake. Other stakeholders were the frontline nurses, the infection control department leader, education department educators, clinical educators, patients, patient families and hospital leadership.

The hospital leadership is one of the biggest stakeholders, as the CAUTI rates not only affect the good reputation of the hospital, but threaten the financial bottom line of the institution. Each stakeholder's needs were considered in this project. Incorporating them in the educational

opportunity allowed for a more collaborative educational program. With the emphasis on quality care and the threat of decreased reimbursement to hospital due to hospital-acquired infections, the education of the core staff with the ultimate goal of decreasing CAUTI rates made them even bigger stakeholders.

Project team. Team members identified in this project were the primary researcher, who guided, implemented the project and collected the initial data (the pre-/post- scores). The unit educator and unit manager assisted by encouraging staff attendance, followed up by ensuring compliance, and provided the most obviously necessary human resource: space to hold meetings in the break room. The Infection Control Department staff who collected the data, as customary, provided expert advice. They were willing to assist in initiating policy change to correlate with the process if the need arose. The infection control team assisted by creating CAUTI champions on the units, sending newsletters about CAUTI to the staff, and allowing the researcher to attend planning meetings to share ideas and assist in policy creation. The clinical mentor provided support, encouragement and critical feedback, and the hospital research coordinator made it possible to start and complete this research by assisting in the preparation of the proposal to the IRB and will help in disseminating the results. The capstone chair also served as a consultant on this project.

Cost-Benefit Analysis

The costs and the benefits. In 2015 the annual cost of CAUTI was estimated to be $0.4-0.5 billion a year (Gourd, 2015) The cost of CAUTI is increasing and reimbursement is decreasing with new governmental and insurance policies that emphasize pay for performance and value-added reimbursement. In January 2015, Medicare reduced hospital reimbursement dollars by 1-2% when hospital-acquired infection rates are in the 25th percentile. This is

estimated to be about a $2.8 million dollar loss for some hospitals (CMS, 2014). Length of stay increases by 1-3 days due to CAUTI (CDC, 2010). The cost of providing care for one patient for one day is estimated to be $3,200, which, multiplied by the estimated 2 extra days of hospital stay due to CAUTI, means an added expense of $6,400 for every patient. This is a cost that is not reimbursed by CMS, a cost the hospital has to absorb. Also the estimated hospital cost for one CAUTI is $1,200-$28,200 (Umscheid et al., 2011). If the CAUTI rate is decreased by one a month, this would result in about an annual cost savings of $14,400-$56,400. A decrease in CAUTI rates could thus mean millions of dollars in savings annually for any hospital (Kennedy et al., 2013). The benefits of staff education clearly outweigh the cost of CAUTI.

The cost of this study is negligible compared to the cost of one CAUTI. There was no need to change forms, as the protocol already existed and it clearly incorporated CDC guidelines. The estimated cost for educating 27 nurses based on salary, time and resources needed was estimated at $5,386 (Appendix E)

The benefits of this education program are great for the institution and outweigh the cost of one CAUTI. A knowledgeable staff that effectively utilizes the nurse-driven protocol appropriately to remove unnecessary catheters promptly without waiting for a physician's order would result in: Decreased CAUTI risk, decreased catheter days, and decreased length of stay for the patient. In addition, the hospital may regain its reputation, that is: not listed as being worse than the national benchmark, and the anticipated reduction of 1% of Medicare benefits may be averted (about 1.7 million dollars based on reported infection rates, including CAUTI), patients will receive improved quality of safe care, and patient satisfaction scores may increase. It will also reestablish the institution's standing in the public eye, produce a motivated, competent staff and meet national goals.

Mission/Vision/Goals

Mission statement. The mission of the project is to use evidence-based education to increase nurses' knowledge on the importance and use of a nurse-driven indwelling urinary catheter removal protocol, to encourage early and prompt removal of urinary catheters that are unnecessary or are inappropriately placed and thus to eliminate catheter-associated urinary tract infections.

Vision. The vision of this project is to see empowered nurses using evidence-based interventions to promote safe care.

Goals. The goal of this DNP Capstone project is to increase nurses' knowledge to assist them in making evidence-based decisions to remove urinary catheters that are unnecessary or inappropriately placed without a physician's order.

Process/Outcomes, Objectives

Outcome measurement refers to the systematic collection and analysis of information used in the evaluation of the efficacy of an intervention (Gironda, Clark, & Young, 2003). Outcome measures and variables for this quality improvement project were obtained by performing a systematic literature search and reviewing published evidence-based guidelines on the use of the nurse-driven protocol and CAUTI prevention

Establishing process objectives and expected outcomes are essential to accomplish a set goal. Measuring outcomes is essential, as some of the metrics are those that are specified by the National Health Safety Network, who serves as an overseer whose goal is to decrease CAUTI rates in the United States by 25% in five years (National Healthcare Safety Network, 2015).

Defined outcomes. Catheter-associated urinary tract infections (CAUTI) are the leading cause of hospital-acquired infections (CDC, 2014). Urinary catheters, when left in place longer

than is necessary, result in poor patient outcomes (CDC, 2014). Some studies show that about 21% to 55% of patients with urinary catheters do not need to have them (Fakih et al., 2010; Knoll et al., 2011). This means that these people are being placed at risk unnecessarily. The need for a method to induce clinicians to stop the practice of inserting or leaving unnecessary UCs is great. As previously noted from the literature review, a nurse-driven protocol to remove unnecessary or inappropriate UCs has been greatly supported.

In a nonprofit hospital in NC, a program for CAUTI prevention was implemented hospital-wide. Bundles were started that included UC care and maintenance as well as a nurse-driven protocol to improve patient safety and improve outcomes. The goal was to decrease the hospital's increasing CAUTI rates. This included creating policies and procedures to empower the nurse to remove unnecessary or inappropriately placed UCs without a physician's order. Nursing leaders in the Infection Control Department and the Nurse Practice Committee were concerned by the increasing CAUTI rates at the institution. Based on the National Healthcare Safety Network (NHSN) definition of CAUTI, the facility was above the national average for CAUTI rates (number of infections/number of device days multiplied by 1000) (National Healthcare Safety Network, 2015). Audits revealed that from January 2014 to August 2014 there were 54 incidences of CAUTIs. Audits also revealed that infections per device-day were the highest on days 1-5. Subsequent chart audits revealed that the staff nurses did not implement the evidence-based recommended tool for the removal of unnecessarily placed UCs to help prevent CAUTIs. Audits based on all units (excluding the ED, pediatrics and the NICU) to check for compliance in the use of the protocol revealed that 75% of the charts had no protocols, 80% of the charts audited had no physicians' orders for urinary catheters, and 50% of the catheters were inappropriately inserted (Rounds report, May 2014- June 2015). The nurses on the medical-

surgical telemetry care unit was among those not utilizing the protocol. CAUTI rates were extremely high on that unit; in fact, it had one of the highest CAUTI rates in the hospital.

Process outcomes. An information sheet was given prior to the session the participants completed a demographic sheet. Participants were notified that completing the demographic sheet was deemed consent. This researcher ensured that the data was collected in the manner prescribed by the law. Anonymity and confidentially was assured to the participants. This researcher emphasized that participation was voluntary and had no bearing on their employment status if they chose not to participate. A pretest was given and two weeks later a post test. Data was collected by the researcher and stored in a locked cabinet in a private office which will be kept for the next five years after which it will be destroyed.

The Primary Outcome Objective

Outcome objectives outline specific strategies to achieve specific outcomes or results The primary outcome objective of this educational intervention is to increase nurse's knowledge about the use and importance of the nurse-driven protocol for the removal of UCs as measured by an improvement of at least 10% on their post-test scores after an educational intervention.

The independent variable for this project was the educational intervention on the use of the nurse-driven protocol. The education consisted of a comprehensive review of CAUTI. It covered all practice guidelines and the proper use of the protocol. The identification of inappropriate and unnecessary UCs and alternatives to UC were reviewed. The test consisted of 10 questions based on the education session. Some of the questions were true and false and others were multiple-choice. The question measured nurses' knowledge about the criteria for catheter removal on the nurse-driven protocol, its importance and myths about the use of UCs.

The simple dissemination of information has been found to be ineffective in achieving or changing practice. To initiate change, clinicians have to understand the reason for, the evidence behind the practice and the practice process itself (Oman, Makic, Fink et al., 2012). The dependent variable was the knowledge how and when to use the nurse-driven protocol. With new knowledge, nurses will be more inclined to use the protocol. Education can affect compliance and knowledge.

The Secondary Outcome

The secondary objective outcome is a clinical one. It was expected that with improved education, CAUTI rates would decrease by at least 90% three months after the educational intervention. With knowledge, the expectation was that the nurses would use the nurse-driven protocol to remove urinary catheters that were inappropriately placed or unnecessary, using the protocol criteria, without a physician's order. The association between education and CAUTI rates was examined.

The CAUTI rates, which measures clinical outcomes, were evaluated. An extraneous variable staff experience has been identified as a potential variable that may affect the results of the study. Staff experience may contribute to the lack of use in assessing the need for catheter removal (Meddings et al., 2014).

Logic Model

Application of the logic model. The logic model obtained from the Evaluation Logic Model Guide, W.K. Kellogg Foundation, was used to conceptualize the educational program and provide a guide for achieving the expected outcomes. The model presents logical steps in identifying available resources, which includes the stakeholders, experts, essential personnel, as well as the expected barriers or people and factors that may contribute to the program's

outcomes (Appendix C). The planned activities, considered as input under the heading "activities," followed the recommended national guidelines from the CDC and the IHI for implementing a quality improvement project. The output guided the activities in the program and gave more meaning to the activities planned. In addition, the defined output was the educational intervention and the strategies used to implement the intervention. The model showed that the immediate outcome was to increase the nurses' knowledge in the use of the protocol. Furthermore, it was expected that the nurses' increased knowledge would result in an increase in the use of the protocol to remove UCs that were inappropriately placed. Specifically, the long-term outcome or impact is to create a culture of safety and reduce the CAUTI rate by 25% in three years (CDC, 2014; IHI, 2011).

The model helped identify goals, outcomes, and the opportunity to plan the best course of action based on evidence by the given benchmarks that measure progress. (W.K. Kellogg Foundation, 2004) In meeting the expected outcomes, external factors and influences that could interfere with the program were identified as: staff, knowledge, resistance to change, time and equipment. (Meddings et al., 2014) All of these external factors were planned for and acknowledged. Lewin's change model was utilized as a framework to guide this model to bring about change and achieve the expected outcome.

Research Design

The purpose of this project was to evaluate the effectiveness of an educational intervention regarding the importance and use of a nurse-driven protocol to increase nurses' knowledge in order to empower them to remove unnecessary urinary catheters without calling the physicians, as well as to investigate the relationship between education and CAUTI rates. The study method, design, instrumentation and method of data collection were addressed. The

education of the nurse is important when efforts are being made to bridge gaps in practice or to measure the effectiveness of evidence-based guidelines. The nurse-driven UC protocol is a recommended tool to assist nurses in their practice by assisting them in making critical decisions to promote patient safety and decrease patient risk of having a catheter-associated infection.

Project design. This was a quality improvement project to assess the effects of the implementation of an educational program on the use of and importance of a nurse-driven indwelling urinary catheter removal protocol. This project used a quasi-experimental pre-intervention, post-intervention evaluation model. The educational intervention program was developed using the guidelines and educational material from the CDC, IHI and HSNS. Evidence-based information was taken from these organizations, and the existing hospital policy and data were utilized in the education program.

Nursing knowledge was measured before and after the educational intervention to evaluate the effective of the education. The design was effective at capturing or measuring changes in factual knowledge and not perceptions (Gouldthorpe & Israel, 2013). It will also helpful in refocusing educational information using the post-test scores.

Project objectives. Will nurses, after attending an educational intervention on the importance and use of the nurse-driven protocol, have increased knowledge about the use and the importance of this protocol and subsequently remove UCs that are inappropriate or unnecessary without a physician's order? Moreover, will that new knowledge result in a decrease in CAUTI rates? The project objectives are the planned activities that guided the Capstone project, over a period of 2 years.

Winter of 2014

- Developed study questions
- Developed educational intervention
- Meet stakeholder

Spring/Summer/Winter 2015

- IRB application completed and submitted
- IRB approval both received
- Nurse recruitment/flyers
- Recruitment and space allocated for the study
- Education implemented
- Data Collection begins

Spring/Fall 2016

- Test corrected
- Data Collection
- Data to excel and SPPS
- Data interpretation
- Preliminary data to stakeholders
- Present to nursing administration
- Electronic Dissemination

Population/Sampling Parameters

Sample. A convenience sample of 27 nurses on medical the surgical-telemetry unit from all shifts volunteered to participate in the project. Full-time and part-time registered nurses (RNs), agency nurses and licensed practical nurses (LPNs) were eligible to participate. The

manager and the clinical educator were excluded from the sample. Their involvement was in the form of monitoring and educating staff and helping with data collection, if needed. This was to prevent bias. Nurses on vacation, nursing students, hospital floats, and staff who worked less than 24 hours a week or had been employed less than two weeks were excluded. This exclusion ensured that adequate data was available and prevented attrition. The level of experience of the nurses on the floor was varied, from a novice nurse with six months' experience to expert nurses with up to 30 years nursing experience. The population involved master's-prepared registered nurses, nurses with associate degrees and one licensed practical nurse.

The total number of staff on the unit at time of the study was 31. Only 27 participated. Power of 80% was established for this project. One registered nurse was on leave. The LPN did not participate; the only male member of the staff did not participate, as he had been in the unit for only 2 weeks. To ensure statistical power a sample size of 28 was calculated with the level of significance set at p =0. 05. To achieve power of 80% and effect of 20% with a confidence level of 95%. All 31 nurses were encouraged to participate as the larger the population the more significant will be the results of the study (Suresh & Chandrashekara, 2012).

Setting for the EBP Project

The project took place on a unit known at a nonprofit acute care hospital in North Carolina for its high CAUTI rates. This was a 37-bed medical, surgical telemetry unit that admits an average of 100 people per month, with an average length of stay of 3-7 days. The patient population ranges from those with migraine headache to those with congestive heart failure to patients with sepsis and open-heart surgery post-op six days. More than 50% of the patient population had urinary catheters, and CAUTI rates for fiscal year 2014 were 3.99, based on a benchmark rate of 1.00 a total of 11 incidences for that year. The unit was chosen to complete

this project because it was deemed by the Director of Infection Control to be one of the units with the highest CAUTI rates in the hospital.

The site is an acute care, private, not-for-profit hospital in North Carolina. It is the ninth largest system in the state, serving a six county region in the southeast corner of the state. It is composed of more than a 100 caregiver sites, including an acute care hospital, which sees about a million people annually in its Level II trauma center, two access hospitals, an LTACH, five ambulatory care centers, a rehab center, a cancer center, 15 primary care centers, a diagnostic center, a comprehensive fitness and wellness center, a heart and vascular center, a pediactric emergency room, nine outpatient care facilities and a clinic in all six surrounding counties. It provides mental health services for a tri-county area. It is also served by 6,000 employees, which includes about 1800 nurses and 580 multispecialty physicians. Its newest acquisition was Harnett Health, a nearby failing health system. (Didentified Health System, 2015)

It is an Accountable Care Organization that participates in the Medicare Shared Saving Program. Individual providers are reimbursed on a fee-for-service basis. The system also uses a bundled payment method. The health system's payer sources include private insurance companies such as Blue Cross and Blue Shield and Tricare for the military population. The hospital faces challenges, since 20% Medicaid and 7% self-pay is part of its payer mix. Financially, at the end of fiscal year 2014, the hospital was listed as A3, "outlook stable," by Moody Investor's Service, with $266 million of rated debt outstanding. (Moody's, 2014) The health system is considered the one of the most wired health systems in North Carolina. It uses an information technology infrastructure to improve communication among its providers and ensure that quality and cost-effective care is given.

The hospital's goal is to provide quality care that is cost-effective. The health system uses leading practice protocols and focus on quality improvement. It utilizes evidence-based protocols for pnuenomia, stroke, acute myocardial infarction, congestive heart failure, hip and joint replacements and sepsis. The institution has received disease-specific certification in those areas.

EBP Design Methodology

This was an improvement project using a pre-post design. In this quantitative study, results were able to be measured and generalized (Burns & Groves, 2009). Its results allowed recommendations to be made for practice. The purpose of this project was to evaluate the changes in nurses' knowledge after attending an educational program on the use and importance of a nurse-driven protocol for the removal of urinary catheters without a physician's order. This project took a quantitative approach and utilized a formal, objective and systematic process in which data was utilized to answer the PICO question: Will education on the importance and use of a nurse-driven protocol for indwelling urinary catheter removal affect the knowledge of nurses taking care of patients with urinary catheters and the CAUTI rates in an acute care hospital in North Carolina three months after the educational session?

Demographic data were reported using, mean, average, standard deviation, and percentages to describe the sample. Level of measurement for these variables will be nominal and ordinal: Level of experience, job status, education level, and gender. Paired t-test and percentage were used to evaluate changes in knowledge, and retrospective data three months prior to intervention and three months after intervention was compared using percentage.

Early removal of urinary catheters (UCs) is recommended by the Centers for Disease Control and Prevention (CDC) in the prevention of catheter-associated urinary tract infections (CAUTI). A nurse-driven indwelling urinary catheter removal protocol is a tool that empowers

the nurse to remove unnecessary or inappropriately placed UCs without a physician's order based on evidence-based guidelines. The Institute of Medicine (IOM) advocates that nurses should work alongside physicians and other health professionals. However, in order to do this the nurse should be highly educated and trained and be able to identify problems and follow evidence-based practice guidelines while evaluating the effectiveness of their actions. (Institute of Medicine, 2011) Therefore, the training as suggested by IOM is an educational intervention was developed using evidence-based guidelines and educational material from the CDC, IHI, and HSNS, and the existing hospital protocol and policy was also incorporated in the educational intervention.

After receiving IRB approval from the hospital and Regis University, a convenience sample of registered nurses on the medical-surgical telemetry floor was recruited via word of mouth and flyers). Multiple educational sessions lasting 30 minutes were held. A pre- and post-test lasting ten minutes was administered to nurses who participated (Appendix D). The education was presented via Power Point. The CAUTI problem on the unit, the units' CAUTI rates, the implications for the patient and the hospital, and a review and explanation of the criteria in the protocol were presented. Myths about catheter use were addressed. Scenarios were given, and a question and answer session followed. This researcher hoped that education will increase staff knowledge and with increased knowledge nurses will remove catheters that are inappropriate, decreasing catheter use overall, thus decreasing the risk of infection, hence decreasing CAUTI rates. With the awakening of knowledge, the expected outcome based on Lewin's Theory of planned Change and the Enlightenment Theory will be positive change.

Evidenced-based measurement. Descriptive statistics were utilized to describe and analyze demographic data: gender, job status, educational level and years of experience. A paired

t-test was utilized to evaluate the knowledge change after the educational intervention by comparing the pre- and post-test results, and descriptive statistics, percentage and frequency was used to report changes in CAUTI rates before and after the education. The project results were used to answer the hypothesis question and evaluate whether the objectives were met. This quasi-experimental pre-post design was utilized to test the following hypothesis:

Alternate Hypothesis$_1$: There will be an increase in knowledge among nurses on the medical-surgical telemetry floor after an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol.

***H0$_2$*:** There will be no increase in knowledge among nurses on the medical-surgical telemetry floor and CAUTI rates three months after an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol.

Alternate Hypothesis$_2$: There will be a decrease in CAUTI rates three months after nurses attend an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol.

***H0$_2$*:** There will be no decrease in CAUTI rates three months after nurses attend an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol.

At the time of the study, the unit had a census of 37 patients, with a total of 31staff members. The study criteria excluded the clinical educator, any staff who did not work at least 24 days per pay period, new staff on the job less than 2 weeks and any staff floating into unit from other floors. One registered nurse (RN) was out on leave, the only male staff member had been there less than 2 weeks, and one licensed practical nurse (LPN) did not participate. Therefore, an estimated sample size of 27 nurses participated. Establishing a power of 80% to detect an effect size of 20% with $p = 0.05$ using a two-tailed t-test required a sample that was not

attainable. Effect size was calculated, taking into account two sample sizes for pre-test and post-test; due to missing post-test data, an effect size of *d= .2.0* which denotes a large significant difference caused by the intervention.

The pre- and post-tests, were corrected with a prepared answer sheet. The test was matched, and the data was coded and placed on an Excel spread sheet. Coding is process in which the quantitative data is placed into categories to facilitate analysis (Polit, 2010). All the nominal, scaled and ordinal data was given designated codes to allow interpretation (Polit, 2010). The demographic data was also coded for easy entry into IBM Statistical Package for the Social Sciences (SPSS) version 23 software.

Descriptive statistics, which are nonparametric tests, are widely used to study and describe populations (NCSS.com, 2015). The collected data were entered into SPSS V 23, which provided output on mean, median, standard deviation, and percentage of the group's pre- and post- scores. The paired *t*-test and descriptive statistics, percentage and frequency was used to report changes in CAUTI rates before and after the education.

Protection of Human Rights

A CITI course was completed on 02/02/2015 to meet IRB education recommendations: Reference #15203782 (Appendix I). This education ensured that this researcher was knowledgeable about the research project process and could protect the rights of participants in the study.

After completion of the CITI course, an application was made to the Regis University IRB and to the participating hospital's IRB to carry out this study with an "exempt" status claiming exemption criteria in categories two and four. Even if the project was a quality improvement project, IRB approval was needed. The project had to use human subjects, and the

educational intervention may have produced data that could contribute to an alteration in the quality or efficiency of care at the participating facility (IRB Guidelines [version 2012], 2011). The data collected may have to be used for educational purposes with the intent to contribute to general human knowledge.

Category 2. Research involving the use of educational testing is eligible for exempt status certification. (IRB Guidelines (Regis University), 2011, p. 6) For Category 2 educational testing will be done; knowledge pre-/post-test was tested. Staff scores may have been very low on the pre- and post-tests, which may have denoted that they had not learned or perhaps a matter of incompetence existed, which could possibly place staff members at risk regarding their employment and/or reputation if the results were made public or revealed to management. It could also place the institution's reputation at risk for having hired incompetent nurses, if the data were revealed to the public.

Category 4. Research involving the collection or study of existing data also requires exempt status. (IRB Guidelines (IRB Guidlines(Regis), 2011, p. 6).The study unit CAUTI rates three months prior/after the intervention were to be collected, reviewed and analyzed.
After receiving approval by both IRB boards (Appendix I) (Appendix J), this researcher project carried out the educational intervention. An information sheet was given prior to the session and the participants completed a demographic sheet. A pre-test was given and two weeks later a post-test. Data was collected by the researcher and stored in a locked cabinet in a private office; it will be kept for the next five years; after which it will be destroyed.

Instrumentation Reliability/Validity and Intended Statistics

Instrumentation. Two tools were utilized to collect data. The first tool was a demographic sheet that collected data on gender, years on the job, shift worked, job status,

highest qualification and credentials (Appendix D). The second tool was a test consisting of multiple-choice questions and true/ false items with scenarios to assess the nurses' knowledge of the nurse-driven protocol to remove unnecessary or inappropriate UC without physician's orders. Each correct answer earned a 1 mark, wrong answers earned zero marks and unanswered questions also earned a zero mark. The hospital utilized an evidence-based tool established by the National Hospital Safety Network (NHSN) to collect the CAUTI data used in the study.

The demographic sheet collected data to describe the characteristics of the population or sample, which is important in order to denote trends, make inferences, and make comparisons (Polit, 2010). Demographic data was used to make inferences, describe the nurses on the study unit, and to convey the similarities and the differences between the nurses. In the study, nominal measurements were used to label variables on the demographic form for nursing caring for patients with urinary catheters'. The nominal scales, also called categorical variables, included such items as gender, job and description (Polit, 2010). Most of these data were dictomous and could not be treated mathematically and therefore had no quantitative component (Polit, 2010). Ordinal measurement was used to classify the sample because numbers can be used to designate ordering attributes such educational attainment, job status, and shift worked. These ordinal-level variables can be be ordered, but the spaces between each variable may not be the same (Polit, 2010). The test scores were entered as scale data.

For statistical analysis, SPSS, Version 23, was used. When data is analyzed it is assumed that the variables have specific levels of measurements. Therefore, data was analyzed based on the dependent variable and the nature of the variables. Descriptive statistics were used to describe and summarize the sample demographic information in an informative manner. SPSS

was used to compute the mean, median and standard deviation, which allowed this researcher to describe, compare and characterize relationships in the sample (Polit, 2010).

A paired t-test was used to compare the pre- and post-test scores to determine whether there was an overall change in knowledge in those who completed the pre- and post-test. The difference in the aggregate score was also calculated to further determine if there was an increase in knowledge using the total sample. The results were used to test the null hypothesis that there was no change in the nurses' knowledge after the educational intervention. Descriptive statistics was used to report retrospective data from the study units' infection control report in order to compare CAUTI rates three months before the educational intervention and data three after the intervention.

Validity or reliability. A questionnaire was developed to test the nurses' knowledge on the use of the nurse-driven protocol and CAUTI rates. The test consisted of 10 questions that were based on recommended guidelines from the CDC and NSHS. To test the content validity of the questions, a panel of five experts was asked to rate the test questions on a Likert scale of 1 to 5, where one meant most appropriate and 5 meant least appropriate. Fifteen questions were submitted for review. Questions that received rankings of ones and twos were used to create the test. Some questions were reworded and others were not used. Ten questions were finally selected to be used as the pre- and post-test for the project. According to the College Board, content-related evidence of validity comes from the judgment of experts in a given field. (CollegeBoard, 2016)

A pre-/post-test design was utilized for this project. Descriptive statistics were used to summarize the key demographic information for the population. The data was analyzed using SPSS Version 23.0, and standard deviations, means, and percentages were calculated. The results

are displayed in Table 2 and Figures. To evaluate the change in knowledge of the nurses, a paired t-test was used to analyze the difference in test scores before education and after education. An increase by 10% in post-test scores denoted that knowledge was gained and the intervention was successful on that measure. Change in CAUTI rates before and after was reported using the data reported to NHSN rates per 1000 catheter days. To assess the incidence of CAUTI before and after the educational intervention, retrospective data from the hospital database three months before the educational event was retrieved and compared with CAUTI data three months after the intervention. The data revealed a decrease in CAUTI rate from 4.42 from September to November 2015 to 0.00 January to March 2016. Entering the project, the unit reported a zero rate with 2 incidences that quarter. A sustained zero rate was noted from January to March. There were zero rates to run through SPSS. A direct causal effect of knowledge on CAUTI was not seen.

Data Collection and Treatment Protocol

The educational intervention was done over week 12 sessions, each for one hour. At each session ten minutes was taken to read the information sheet and fill-in demographics. This was followed by a 30-minute presentation, a 10-minute scenario and a 10-minute question and answer session This varied with the amount of staff in attendance. A verbal review of the information was done and nurses were encouraged to participate, and share stories. Each participant was given an identifying letter. Two weeks after the intervention the post test was given. Participants were also reminded that this was voluntary and all information would be kept confidential. Three months after the CAUTI rates was retrieved from the Infection Control Department. This researcher had no part in this data collection.

Project Findings and Results

Demographics

Participants were licensed RNs who worked on a medical-surgical telemetry unit in an acute care hospital in NC. Twenty-seven nurses completed the pre-test and 24 nurses completed the post-test. One licensed practical nurse did not participate. The only male on staff, a new graduate and new hire at the hospital, also did not participate. One full-time registered nurse was out on leave, and the clinical educator was excluded. At the time of the study, many nurses had resigned from the floor, leaving the unit with many vacancies that were being filled by agency nurses. Data was collected following IRB guidelines and entered into SPSS. The characteristics of the nurses who participated were analyzed under the following headings: gender, education level, years of experience, job status and shift worked.

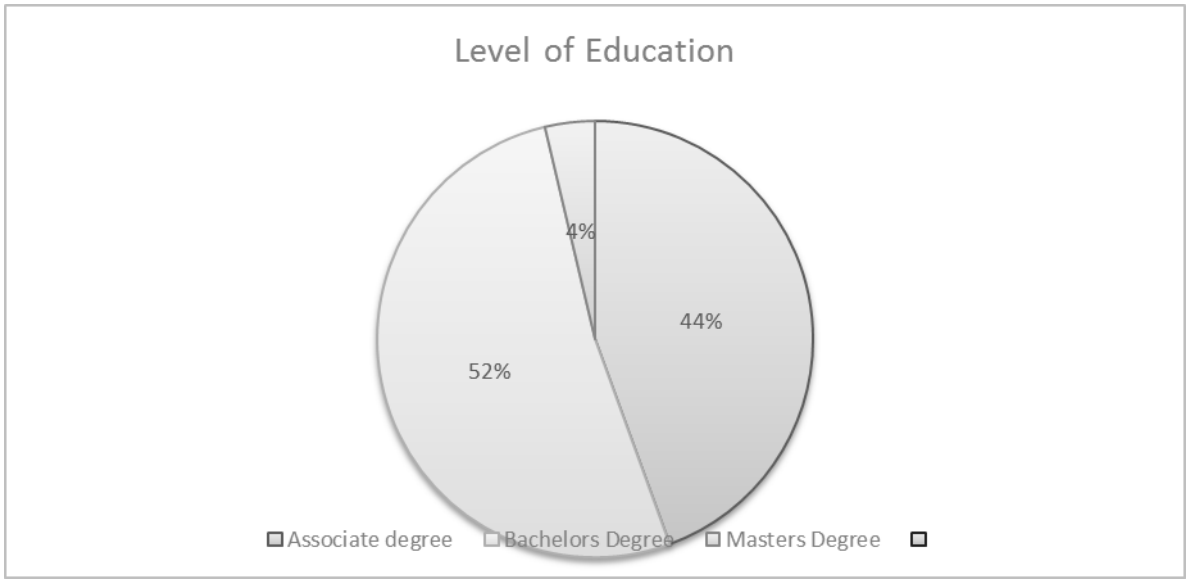


Figure 1. Pie Chart Diagram shows the Distribution by Level of Education

The demographic data analyzed showed that the majority of the nurses had bachelor's degrees (*n* = 27. [51.9%]), while associate's degrees were held by *n* = 27 (44.4%) and master's degrees were held by *n* = 1 (3.1%). Data displayed on pie chart for clarity. One hundred percent of the nurses who participated in the study were female. There were no male participants. There

was *n* = 14 (51.9%) full-time employees, *n* = 3 (11.1%) part-time employees and *n* = 10 (37%) full-time agency employees. The night and day shifts had almost the same number of staff. The day shift had *n* =15 (55.6%) and night shift, n = 12 (44.4%). More than half of the staff (n = 16) had up to three years' experience. One had one year of experience, six nurses had two years and six nurses had three years. Two nurses had five years and 6 nurses had between 7-17 years' experience (Figures 1 and 2). Five staff members had 20 years or more of experience as nurses. The most experienced staff member had been a nurse for 27 years. The sample of nurses had a mean years of experience of 8.67 (SD = 8.68). This showed that the unit had a varied degree of experience.

Table 2. Demographic Characteristics

Years of Experience	**Number of Nurses**	**Percent**
1	2	7.4
2	6	22.2
3	6	22.2
5	2	7.4
7	1	3.7
9	1	3.7
10	1	3.7
15	1	3.7
16	1	3.7
17	1	3.7
20	1	3.7
21	1	3.7
22	1	3.7
27	1	3.7
28	1	3.7
Total	27	100.0
Job Status	**Frequency**	**Percent %**
Full Time	14	51.9
Part Time	3	11.1
Agency	10	37.0
Total	27	100.0

Table 3. Demographic Table

Shift Worked	**Frequency**	**Percent %**
Day	15	55.6
Night	12	44.4
Total	27	100.0
Level of Education		
ADN	12	44.4
BSN	14	51.9
MSN	1	3.7
Total	27	100.0
Gender		
Male	0	0
Female	27	100.0
Total	27	100.0

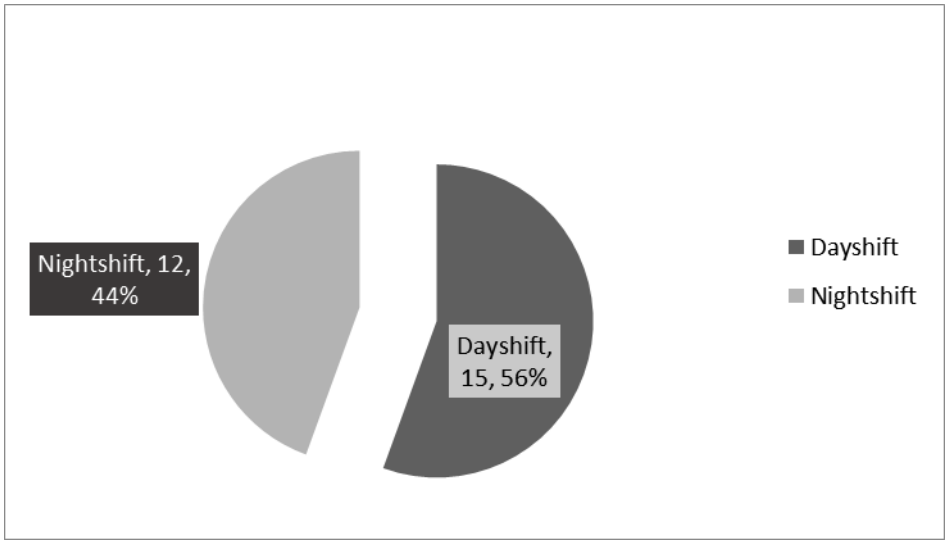


Figure 2. Distribution of Staff by Shift

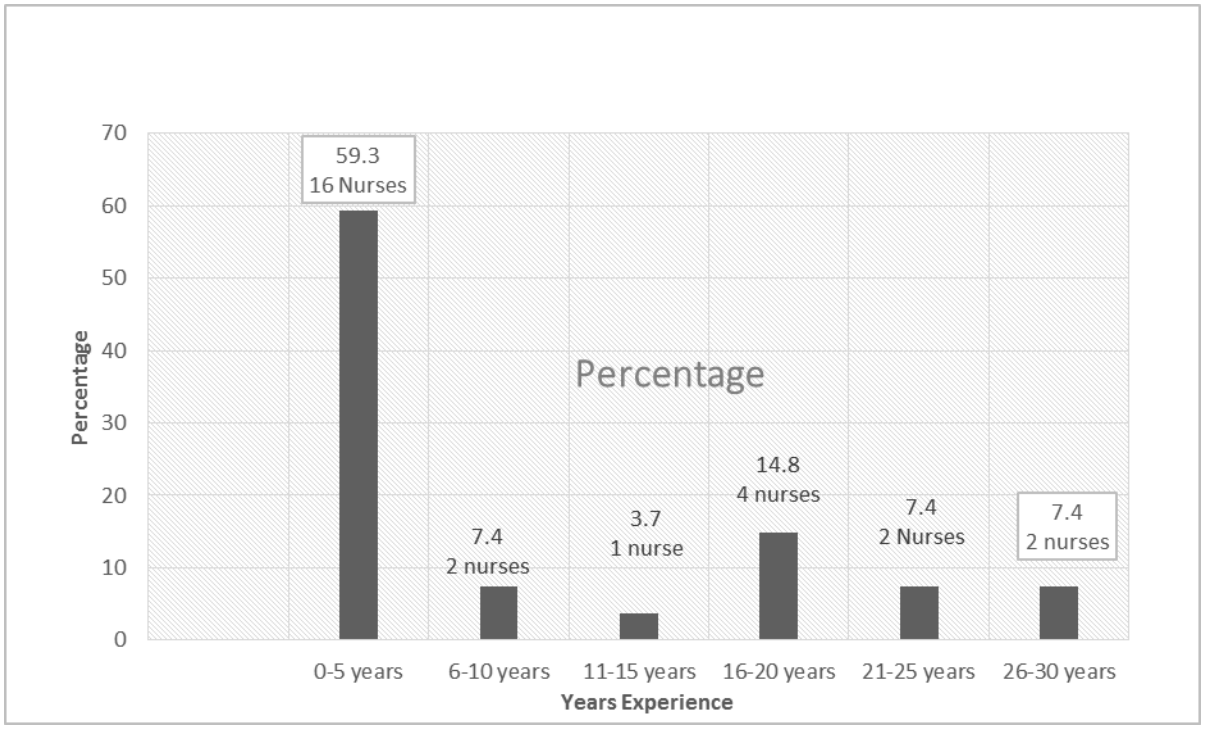


Figure 3. Nurses Years of Experience

The study outcomes/objectives were to:

1. Implementation of an educational intervention on the use and importance of a nurse driven urinary catheter removal protocol on medical surgical telemetry of an acute care hospital NC.
2. Increase medical surgical telemetry unit nurses' knowledge on the importance and use of nurse driven indwelling urinary catheter removal protocol to remove inappropriately place UC without a physician's order as evident by a 10% raise in post test scores.
3. Decrease medical surgical telemetry unit CAUTI rates by at least 90% evident by posted CAUTI rates three months after an educational intervention

The finding will be displayed according to the project process objectives and outcomes. There was no previous study where knowledge was measured after a nurse drive protocol.

Objective I

Implementation of an educational intervention on the use and importance of a nurse-driven urinary catheter removal protocol on the medical-surgical unit in an acute care hospital in NC.

For this objective, an evidence-based PowerPoint was developed that included an algorithm for the use of the protocol (Appendix E). Twelve educational sessions were scheduled for 1 week. There were multiple visits to the unit to support and motivate and remind staff. Two weeks after the intervention the posttest was administered. The scheduled sessions were delayed due to a TJC visit. The first session was difficult to get staff to attend, since the units were busy. Although the class was held just 3 doors down from the unit, the session was moved to the unit break room at staff request. There, the second session was better-attended. All were asked to take

a pre-test, but not all staff on the shift attended. The presentation was accepted by the staff and generated much discussion. Questions were centered on the myths about UCs. Scenarios were given, and the protocol was reviewed step by step. The subsequent sessions were long waits, teaching 2 or sometimes even one person at a time, however each session generated much discussion. On return for the post-test, it was difficult to pin down some nurses. In all, 27 nurses participated. There were 3 post-tests missing, and two subjects discarded information as they did not belong to the unit. On return to the unit, the staff was excited to share how many catheters they had removed utilizing the protocol and their opportunities to educate the physicians.

Objective II

Increase nurses' knowledge on the importance and use of a nurse-driven indwelling urinary catheter removal protocol to remove inappropriately placed UCs without requiring a physician's order, as evidence by a 10% increase in post-test scores.

For this objective, the test was graded and results reviewed. Twenty-seven pre- and twenty -four post-tests were completed. Three post-tests were missing. 27 demographic sheets were reviewed, coded and tabulated. Information was placed in an Excel spreadsheet. A paired *t*-test was completed to assess the group's mean score pre- and post- scores. Statistical testing was done using, Wilcoxon, and Spearman, which yielded no meaningful results. The level of data measurement (nominal) did not support these tests.

On the pre-test, 4 nurses had 7 out 10 questions right (14.8%), 13 nurses had 9 out 10 questions right (33%) and one person had a perfect score of 10 out 10 (100%). On the post-test, 6 nurses had 9 questions right (13%), and 18 nurses had 10/10 right (100%). The mean score on the pre-test was M= 8.41 (SD = .797) and on the post-test M= 9.75 (SD = .442). The mean difference was 13.3 (SD .9163), SE (d) = 1.876, with three people not completing the post-test.

Using a paired t-test to compare pre- and post- results, indicated that there was a statistical significant difference between the pre-test and post-test scores for the total group (t, 7.125), p = < 001 (CI: -17.20, 9.462) with alpha set at 0.05, which, means there was an increase in knowledge. The aggregate pre- and post- scores, when tabulated, also showed a total increase by 15% from pre- to post- scores, which also signifies that knowledge was gained and the objective of increasing knowledge by 10 % had been met. The effect size was d=2.0 which means that the effect was large (Cohen ,1988).

Therefore**, $H0_1$:** There will be no change in knowledge among nurses on the medical-surgical telemetry unit after an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol. The null was rejected.

Alternate Hypothesis$_1$: There will be an increase in knowledge among nurses on the medical-surgical telemetry unit after an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol. The null was accepted.

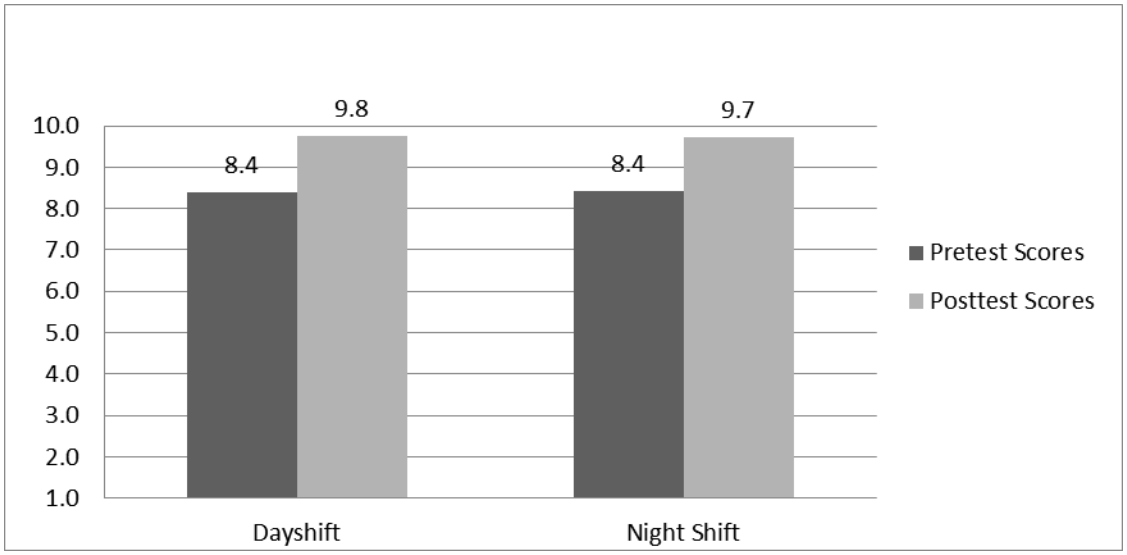


Figure 4. Average Pre and Post Test Scores by Shifts

Table 4. Pre/Posttest Scores Statistics

		Paired Differences					t	df	Sig. 2-tailed	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	pretest - posttest	-13.333	9.168	1.871	-17.205	-9.462	-7.125	23	.000	
Pretest scores					Percent %					
Valid	7	4			14.8					
	8	99			33.3					
	9	13			48.1					
	10	1			3.7					
	Total	27			100.0					
		Frequency			Percent 5%					
Valid	9	6			22.2					
	10	18			66.7					
	Total	24			88.9					
Missing	System	3			11.1					
Total		27			100.0					

Objective III

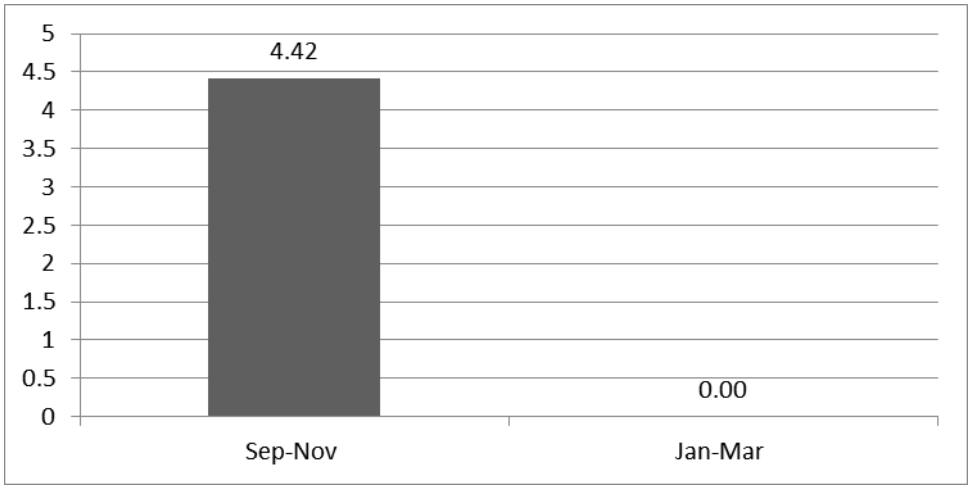
Decrease in CAUTI rates on a medical surgical telemetry unit in an acute hospital in NC by at least 90% as evidenced by CAUTI rates three months before compared to three months after an educational intervention.

For this objective, the CAUTI rates as reported by the infection control department for the month of September 2015 to November 2015 were used, based on the NSHS reporting guidelines. The Director of Infection Control provided this researcher with the pre- and post-educational intervention rates. The rates for the three months before December 2015 showed CAUTI rate of 4.42 to a 0.00 from January 2016 to March 2016. Although this data showed that there was a 100% decrease in CAUTI rates, there is no direct link showed between CAUTI rates and education. The unit CAUTI rate was at zero entering the educational intervention.

$H0_2$: There will be no difference in medical surgical telemetry unit in an acute hospital in NC CAUTI rates three months after nurses attend an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol. **The null was-accepted.**

Alternate Hypothesis$_2$: There will be a decrease in CAUTI rates three months after nurses attend an educational intervention on the importance and use of a nurse-driven urinary catheter removal protocol. **The null was rejected.**

Nurses' knowledge had significantly increased. The aggregate score also showed more than a 10% increase, indicating that nurses on the study unit did gain knowledge. The decrease in CAUTI rates implied that knowledge may have had an effect on the CAUTI rates. The goal of this project was to increase knowledge by at 10% and decrease CAUTI rates. This was not achieved.



CAUTI Rates are calculated as number infection/ of catheter days per month x multiplied by 1000 catheter days

Figure 5. CAUTI Rates per 1000 Catheter Days 3 Months before and after the Intervention

Key Elements/Instrumentation Findings Detailed

Effect size/power/sample. Having an adequate sample size lends power to a study. In quantitative studies like this study one, sample size is important. In order for a sample size to be determined, the researcher had to establish the level of significance, power and effect size (Polit, 2010). The significance level denotes the probability that any results obtained in the study occurred by chance. For this study, as previously mentioned, significance level with alpha set at p= 0.5 was established. This therefore means that the probability that results are due to chance alone is 0.05 or 5% and 95 % of the time is due to the difference found between the experimental group and the treatment or intervention will be statistically significant. The power of level 0.8 was established for this study. Eighty percent is usually the level for most studies (Polit, 2010). This means that 80 % of the time the experiment will detect any difference between the control group and the experimental group if a difference truly exists. The effect is also very important and must be established to lend more validity to a study. The effect size quantifies the difference between two groups and emphasizes the size of the difference. It indicates how big the difference

is. An effect size which is 2.0 or greater is described as moderate to large and is acceptable. An effect size of 2.0 and less is acceptable. The effect size for this study taking into account the difference in sample size for the pretest of 27 and posttest on 24 is d = 2.0 which suggested that the difference in the pre and post test scores was large. The sample size for this study was calculated to be 29 which would the minimum amount of participants to establish adequate power for the study.

Discussion

Project findings. The study goal of this DNP project was to evaluate the effectiveness of education on the importance and use of a nurse-driven protocol for indwelling urinary catheter removal among 24 nurses on, a medical-surgical telemetry floor, by measuring changes in knowledge on those who completed the posttest and the overall relationship between the knowledge and CAUI rates on the medical surgical telemetry unit. This researcher utilized both descriptive statistics and inferential statistics to answer the study question:

For nurses (P) on medical surgical telemetry unit caring for patients with urinary catheters, will education on the importance and proper use of a nurse-driven indwelling catheter removal protocol (I) change knowledge about the use of the protocol, as compared to knowledge before receiving this education (C), as evidenced by (O) pre- and post-test scores, and CAUTI rates, as evidenced by CAUTI audits three months after the intervention?

Inferential results. Using an alpha level of 0.05, a paired t-test was used to evaluate the nurses on the medical surgical unit knowledge on the use and importance of the nurse driven urinary catheter removal protocol. There was statically significant difference in pre and post test scores (M= 8.41, SD = .797) n=27 pretest and on the post-test (M=9.75, SD = .442), n=24, d=2.0, t=-720, $p < .001$ r=.07. Confidence interval for the means difference was - 17.20, and -

9.46 results establishes that education does increase the nurses' knowledge as seen in mean pre and post scores.

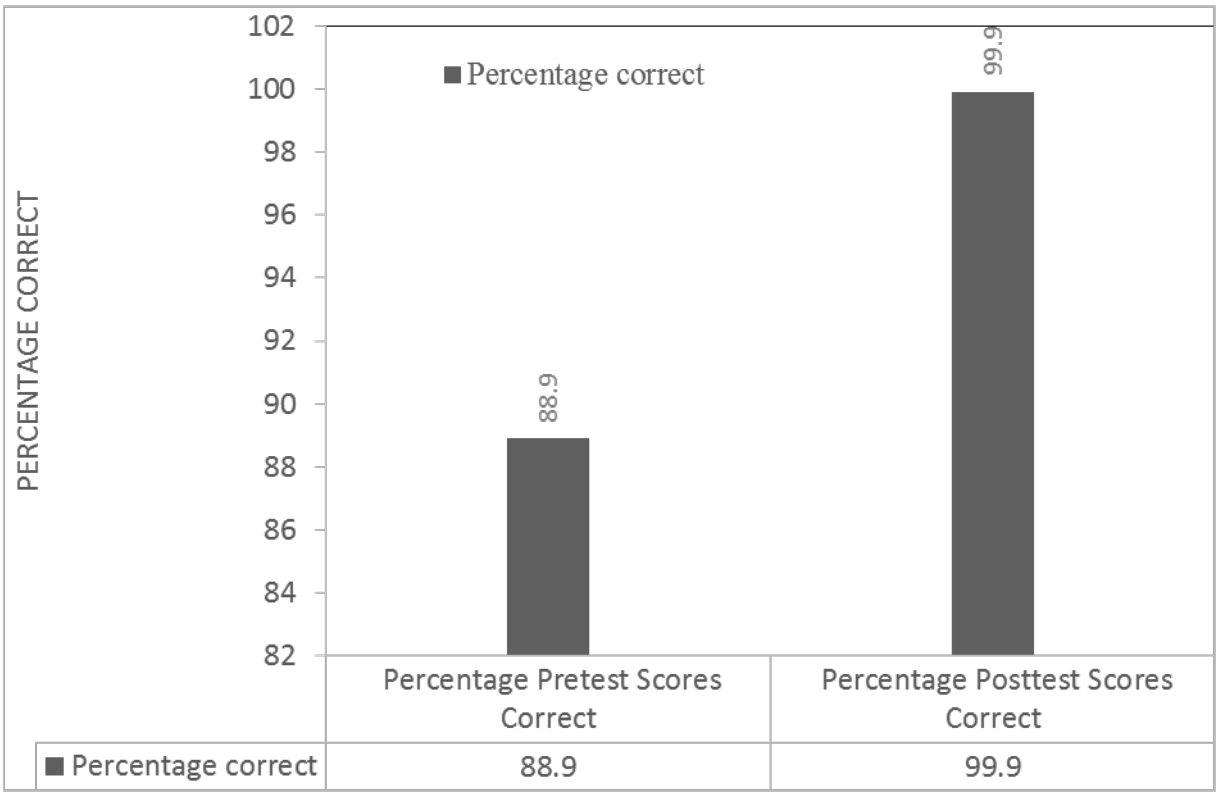


Figure 6. Comparison of Means Pre and Post Test

The purpose of the project was to evaluate the of nurse's knowledge after an intervention The only other study that measured increase knowledge also showed that the education on the nurse-driven protocol also increase the nurses' knowledge (Marigliano, et al, 2012). The nurse, being on the front line, must be equipped with knowledge to act without fear to ensure that inappropriate urinary catheters are removed promptly based on the protocol without calling the physicians. With one factor that delays catheter removal eliminated (calling the physician), these catheters, when removed on a time, based on the given criteria, will decrease infection rates. With knowledge, the myths that nurses had about urinary catheters were also dispelled. In order

for the nurse to remove offending catheters, the nurse had to first understand how and when to use the protocol. The dissemination of evidence-based knowledge is essential in nursing.

In reference to objective III, the goal was to decrease CAUTI rates by 90% three months after the intervention. The data collection period from September to November three months before the intervention showed the unit with two CAUTI's: An infection rate of 13.25% according to data obtained from the infection control nurse. The rate for October and November remained at zero. One cannot establish a direct link between CAUTI and education. According to Dr. Kruschke (Personal conversation, April 4 2016) there is no data to run. The CAUTI rate was already at zero. However, it can be surmised that there is a strong possibility that the increase in knowledge due to education may have cause a sustained zero CAUTI rate for the unit. For this unit, a sustained zero CAUTI rate is important as they were known for having high CAUTI rates. This result is still, however, clinically meaningful. On rounds the staff was motivated and was engaged in ensuring catheters were removed. They have established a unit icon to oversee all CAUTI issues and processes to monitor not only use of the protocol but catheter care and maintenance. There was a great awareness since the education. According to the Enlightenment Theory on which this project was based: With increased awareness becomes a sense of moral obligation. One can therefore surmise, moral obligation, increase knowledge, and myths dispelled about urinary catheters may have motivated the nurses to utilize the protocol to remove catheters that were not appropriate, thus decreasing the risk of infection thus sustaining a zero CAUTI rate, indirectly decreasing the units' overall CAUTI rates.

In order to maintain positive outcomes, education must be ongoing and protocols must be updated frequently. According to Lewin's Theory and Enlightenment Theory, staff motivation through praise encourages and enhances change (Hill & Hanchette, 2001). The makeup of the

floor staff in this unit suggests that the staff is transient, with 33% being agency nurses. Therefore, the effort to increase nurse knowledge in the use of the protocol must be continuous. With the staff turnover that appears to plague the hospital, education to prevent CAUTIs has to be constant as new nurses arrive. It can be said that with knowledge becomes awareness thus power.

Limitations, Recommendations and Implications for Change

In research, threats to the study's reliability and validity always exit when analyzing the data and must be considered.

Limitations. The statistical power given the low sample size and low CAUTI rates prior to the intervention are two main considerations. The sample size was small the size limits the generalizability of the study to a larger population (Polit, 2010). A sample size of 29 would have achieved better results. The similarities and differences that exist can threaten the validity of the study when comparing groups for this project. A major factor also was monitoring time after the education was too short to evaluate the true CAUTI rate. The makeup of the sample may not have been the best representation of all nurses and may raise a concern that biases exist. The sample size was 100% women (n = 27). There were no men or LPN's represented in the sample. There are extraneous variables that need to be considered that may have had an effect on the study result variable, for example, nurses' experience, attitudes and compliance, use of contract workers, and staff lack of attention during presentation may have affected test scores. The CAUTI rates and test scores could have been affected also by the launching of a hospital wide education on the insertion and maintenance of urinary catheters. A Hawthorne effect may have taken place as the staff had knowledge that they were going to be monitored before the project started in November, 2015. The education was implemented in the Month of December 2015.

Study recommendations. The literature mentions other interventions to prevent CAUTI. These interventions need to be investigated. Variables such as nurse experience and the use of agency nurses need to be further investigated. In the study, 33% of the nurses were contract workers, and half of the staff had less than six years of nursing experience. For a more robust analysis, studies to measure staff compliance in the use of the nurse-driven protocol after the education, evaluating staff attitudes about the nurse-driven protocol and correlation of length of catheter days with CAUTI rates should be done. The study should also be replicated using a larger sample size with both genders and LPNs. It also recommended that the study should be replicated on other units in the hospital, and allow for a longer monitoring time after the educational intervention to ascertain that no Hawthorne effect occurred and to evaluate the true effect of knowledge on CAUTI rates.

Nursing recommendation. For the nursing practice, it is recommended that education on the nurse-driven indwelling catheter removal protocol be made a part of new employee orientation, just as other sensitive indicators such as restraint and wound care. This education should also be made a mandatory requirement for all staff nurses. When facilities use contract workers from outside agencies, these staff members should attend an initial mandatory class on the use and the importance of the nurse-driven protocol.

It is important that infection prevention and the proper insertion and maintenance of urinary catheters be taught, as this is recommended by the CDC, NHSN and other infection control agencies. However, the use of the protocol is just as essential, because the timely removal of unnecessary catheters minimizes the risk of infection. The CDC (2015) also recommends that urinary catheters should not be used unless necessary and should be removed promptly if not needed (Centers for Disease Control and Prevention [CDC], 2014). The importance of educating

nurses on the criteria recommended in the protocol for the prompt removal of urinary catheters must be taught separately and given equal education time.

For the facility, the emphasis is product, the use of new catheter kits is being considered. A CAUTI champion program to control the maintenance and monitor the insertion of the urinary catheters has been started, all of which are important in the prevention of CAUTI's. However, there is no written policy with guidelines on use of the protocol. An easy-to-read policy should be created and an easy-to-use algorithm, as the one presented could be implemented hospital wide. Based on the results from this project, the researcher recommends a focused educational approach, which is a cheap tool that can have a great impact on CAUTI rates. The fact that previous education failed, as evidenced by the lack of use of the protocol and sustained high CAUTI rates, requires a hospital-wide educational campaign for all nurses, emphasizing the importance and use of the nurse-driven indwelling urinary catheter removal protocol. Sustained and continuing education would have a better impact on CAUTI rates. A nurse champion program to monitor the appropriate use of the protocol should also be implemented. The CDC recommends that not only maintenance and care be taught, but suggests that it is essential that nurses know how to make decisions to remove urinary catheters based on the evidence-based guidelines (Centers for Disease Control and Prevention [CDC], 2015).

Implications for change. This study supports the use of education to decrease CAUTI rates. This study emphasizes the fact that nurses' knowledge is the driver in achieving positive outcomes in nursing and that evidence-based knowledge and practice guidelines creates a safe environment for patients. Use of an evidence-based protocol and education facilitates a timelier attention to a given problem and achieve positive patient outcomes as they work autonomously alongside their peers and members of the health team (Institute of Medicine (IOM), 2015). The

study supports the fact that empowering nurses with the knowledge of when and how to remove unnecessary or inappropriately placed urinary catheters without a physician's order will ultimately decrease the length of catheter use, thus decreasing the risk of urinary infection. In addition, raising awareness and increasing knowledge on the use of the protocol may increase nurse autonomy that may translate to improve patient care and possible decrease CAUTI rates. Nurses, if given the power, can ultimately assist health institutions in meeting national benchmarks and decrease hospital overall expenditures. Educated nurses are the keys to the survival of health institutions in a value-added, evidence-based health environment

Conclusion

CAUTI is the leading cause of hospital-acquired infection. The literature makes it clear, as do all governmental, infection control and quality care entities that this is a preventable problem. Education on a recommended tool that will decrease the length of time a urinary catheter is left in the patient is essential. This study showed that there was a significant difference in knowledge post- educational intervention. After the educational intervention, the nurses on the medical surgical, telemetry unit nurses' knowledge increased, and the nurses were more engaged as they were enlightened with knowledge and their awareness was awakened. Nurse leaders must take into consideration that nurses, when given the autonomy, such as the use of an evidence-based protocol to make nursing decisions, and equipped with the proper education, they can have a phenomenal effect on nursing outcomes and practice issues. The empowered nurse can decrease CAUTI rates, which can lead to increased patient satisfaction scores, higher-quality, safe care, better institutional reimbursement rates, and highly skilled knowledgeable nurses.

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Appendices

Appendix A

Systematic Review Evidence Table

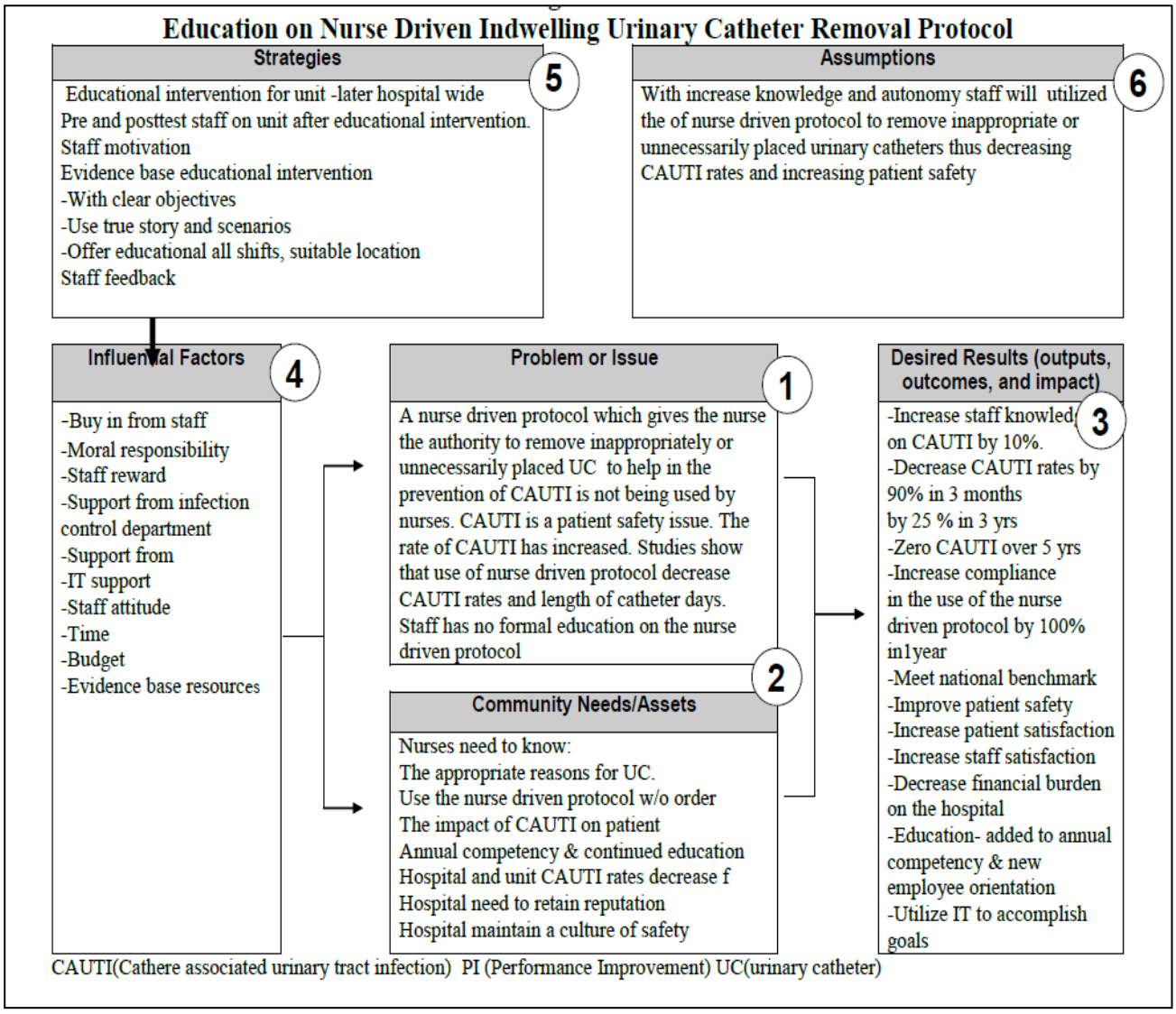
One example

[Adapted with permission from Thompson, C. (2011). Evidence table format for a systematic review. In J. Houser & K. S. Oman (Eds.), Evidence-based practice: An implementation guide for healthcare organizations (p. 155). Sudbury, MA: Jones and Bartlett.]

Article/Journal	A-Voiding Catastrophe: Implementing a nurse-driven protocol *Medical Surgical Nursing*
Author/Year	Moir, 2012
Database/Keywords	CINAHL Nurse driven protocol, catheters, infection CAUTI
Research Design	Retrospective chart review, and pre and post Quality improvement project
Level of Evidence	V1
Study Aim/Purpose	To evaluate the use of nurse driven protocol in the reduction of CAUTI
Population/Sample size Criteria/Power	N=any inpatient with UC excluding obstetric units
Methods/Study Appraisal Synthesis Methods	The educational intervention included online hands on and post- test and verbal statement to evaluate staff learning. New orders placed in the EMR, doctors updated One month after education protocol implemented. Chart review was done retrospectively to assess prevalence 3 months before and 3months after intervention. The use of CDC guidelines used to calculate length of catheter days, and the total amount of catheter days, each month to obtain CAUTI rates
Study tool/instrument validity/reliability	Chart review

Primary Outcome Measures/Results	Prior to the nurse driven protocol catheter use was at 37.6%, length of catheter day was 3.35 days and CAUTI rates at 0.77% after protocol usage decreased to 27.7%, length of catheter days was 3.46 days and CAUTI rates dawn 0.35%
Conclusions/Implications	Supports data that nurse driven protocol can decrease of catheter day and use of catheters. This will decrease CAUTI and improve patient care. Physician buy-in, helped the success of the protocol.
Strengths/Limitations	Limitation: Sample size was small. All patients were included, including those with preexisting UC
Funding Source	None
Comments	Resistance to change was addressed with daily rounding, education and evidence. Face- to- face communication by CNS had to be done. Management buy in is a must. Those not measure knowledge gain.

Appendix B



Conceptual Model

Appendix C

Logic Model

RESOURCES/ INPUTS	**ACTIVITIES**	**OUTPUTS**	**SHORT- & LONG-TERM OUTCOMES**	**IMPACT**
Funding/Budget **-Time** **-27 Staff** **-Education review material** **Evidence-based literature** **-Research support** **Protective factors** -Collaboration with PI and infection control -Use of established audit tools -Learning management system -Dissemination of knowledge -IT support -Leadership engagement	**Engage Stake Holders-recruit-** Meeting, emails, discussion **- Develop Educational Intervention** Pre-post- test, Answer sheet, Demographic sheet **-Voluntary recruitment** -Flyers, staff meetings, word-of-mouth -Motivate staff, snacks **-Review /redesign policy** **-Didactic class -close to unit** **-Multiple education sessions cover all shifts** -12 one-hour classes over 2 weeks -30-minute Power Point -5 min demographic forms -10-minute pre-test -10-minute case scenario -Give post-test 2 weeks after education -Collect post-test and check for increase in scores -Compare CAUTI audits after three months -Disseminate data to stakeholders'	100% attendance of staff -0% class cancellation Posters in unit -100% staff utilizes -10% increase in knowledge -90% decrease in CAUTI rates in 3 months -Educational intervention -Established standard process for monitoring use of protocol -Online module -Mandatory annual check-off -Champion per shift -Motivated/engaged -Mandatory education for new employees/agency -Monthly feedback from staff and stakeholders	Increase staff knowledge by 100% Increase staff awareness of impact of CAUTI -100% staff documentation use of protocol for UC -Decrease LOS due to CAUTI -Increase compliance in use of protocol by > 90 % -Decrease use of inappropriate use of UCs by 50 % -Decrease UC utilization by 50% -Policy change -Sustained CAUTI education -Feedback -Surveillance -Reinforcing norms -Accountability **-No adverse report on national websites**	**Improved quality of care** E.g., increase patient safety -Achievement of national benchmark for preventing of CAUTI -Decrease institutional cost of CAUTI more than 75%. -Decrease CAUTI rate to < 25% over 3 yrs. -Increase patient satisfaction to the 95 % percentile for 5 years - > 90 % decrease in mortality rate due to Urosepsis for 5yrs -Zero CAUTI rates for 5 years -Improved patient experience **-Improved staff satisfaction**

		-Initial data analysis of pre- and post-intervention to stakeholders		-Create a culture of safety

UC=Urinary Catheter, CAUTI =Catheter -associated Urinary Tract Infection,
IT=Internet Technology

Appendix D

Measurement Tool/Instrument

Demographic Sheet

Demographic Information Sheet -Nurse-driven Urinary Catheter Protocol Study

Place given number here →

Please answer each question by placing a check mark in the appropriate box.

1. What is your highest nursing degree?

☐ **Associate Degree** ☐ **Diploma** ☐ **Certificate** ☐ **Bachelor Degree**

☐ **Master's Degree** ☐ **Doctorate Degree**

2. Present position

☐ **RN** ☐ **LPN**

3. What is your work status?

☐ **Part time** ☐ **Full Time** ☐ **Agency**

4. How many years of nursing experience do you have? _____

5. What shift do you work?

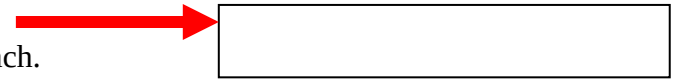
☐ **Day shift** ☐ **Night Shift** ☐ **Weekends**

6. What is your gender?

☐ **Male** ☐ **Female**

NURSE-DRIVEN INDWELLING URINARY CATHETER REMOVAL PROTOCOL PRE-TEST / POST-TEST

DATE: _____

Please place your given number here 

Each correct answer carries 1 point each.

DIRECTIONS: Please **CIRCLE** the best suitable answer

1. Billy Rubin is 36 y/o male patient admitted for left foot cellulitis. Past medical history includes diabetes, paraplegia and hypertension. Physical assessment reveals that the patient is alert and oriented x4 with stable vital signs. All systems are negative except for the left foot cellulitis. A Foley catheter is in place. Pt normally uses routine clean intermittent catheterization to manage his chronic urinary retention. The VMA. (Hospitalist) has ordered the Foley to obtain a urine culture and for immobility. The best course of action for this patient would be to:
    a. Remove the Foley catheter per the Nurse-driven Catheter Removal Protocol and allow the patient to perform clean intermittent self-catheterizations.
    b. Leave the Foley catheter in place for neurogenic bladder
    c. Assess the patient's ability to perform clean intermittent catheterizations and provide instruction as needed
    d. Both A and C are correct

2. Leesa Hart is a 38 y/o Female admitted 4 days ago was transferred from SICU with a DX of pneumonia and sepsis. Past medical history includes morbid obesity weighing 320lbs, diabetes and congestive heart failure. Her SAT is 98 % oxygen 2L via NC, NS IVF of 50ml per hour and antibiotic infusions. The patient has had stable vital signs for the last 48 hours and remains afebrile. Her WBCs have been trending down for the last 3 days. A Foley has been in place since admission and Nurse-driven Removal of Foley catheter protocol was initiated in SICU. The best course of action for this patient is:
    a. Remove the Foley catheter per the Nurse-driven Indwelling Urinary Catheter Removal protocol.
    b. Provide the patient resources to void such as a bedpan or bedside commode.
    c. Wait another day until you are familiar with the patient, and reassess her need before removing the catheter.
    d. Both A and B are correct

NURSE-DRIVEN INDWELLING URINARY CATHETER REMOVAL PROTOCOL PRE TEST /POSTTEST

3. When the "Nurse-driven Catheter Removal Protocol" is implemented, the nurse is responsible for assessing the patient every shift for the need for continued catheterization. If an assessment reveals that the patient does not meet criteria for the catheter, then the nurse will discontinue the catheter promptly

True/False

4. After a Foley Catheter has been removed per the "Nurse-driven Catheter Removal Protocol", the nurse must monitor the patient closely for urinary retention. If the patient is unable to void within six hours after the catheter is removed, the nurse will perform a bladder scan. The bladder scan results will determine the next action for the nurse to follow.

True/False

5. If any complications occur while following the directions for the "Nurse-driven Indwelling Catheter Removal Protocol", the physician is to be notified for further action.

True/False

6. An order for a Foley Catheter means that the physician does not want the Foley removed?

True/False

7. All of the following are accepted indications for urethral catheterization *except*

    a. Acute urinary retention or bladder outlet obstruction
    b. Accurate measurement of urine output in critically ill patients in ICU setting
    c. Inability to move due to a disease process
    d. Selected perioperative situations; for example, for urologic surgery,
    e. When intra-operative monitoring of urine output is needed, and when large-volume infusions or diuretics during surgery are anticipated
    f. To assist in healing of stage III or perineal wounds in incontinent patients

NURSE-DRIVEN INDWELLING URINARY CATHETER REMOVAL PROTOCOL PRE TEST/POSTEST

8. The patient is transferred to the floor from the ED with a urinary catheter. There is no order written on admission for the urinary catheter. What is the nurse best action?

    a. Leave the Foley in because it was already ordered in the ED.
    b. Activate the nurse-driven protocol for removal and assess if patients meet the criteria on the protocol
    c. Call the physician for an order to discontinue the UC
    d. Ask the patient if they would like to keep the catheter

9. Pt admitted to the floor from ED with a diagnosis of CHF exacerbation. The patient is receiving Lasix 20mg every day. The patient is short of breath when moving. The patient is alert, vital signs are stable O2 sat is 97 % on 2 Liters of oxygen

a. Implement Nurse-driven indwelling catheter removal protocol
b. Discontinue Foley
c. Provide bed pan every 2 hours and educate the patient on monitoring output
d. Monitor urinary output for the next 24 hours
e. All of the above

10. Dr. Joe the urologist inserted Foley or Mr. Biotic before surgery. It is post op day 2

a. Use protocol and remove the urinary catheter (Foley)
b. Call doctor to discuss catheter removal
c. Leave catheter as it was ordered by the urologist until discharge, no reassessment needed
d. Reassess the need for the Foley daily
e. B and D

NURSE-DRIVEN INDWELLING URINARY CATHETER REMOVAL PROTOCOL PRE TEST /POSTTEST

ANSWER SHEET

a

d

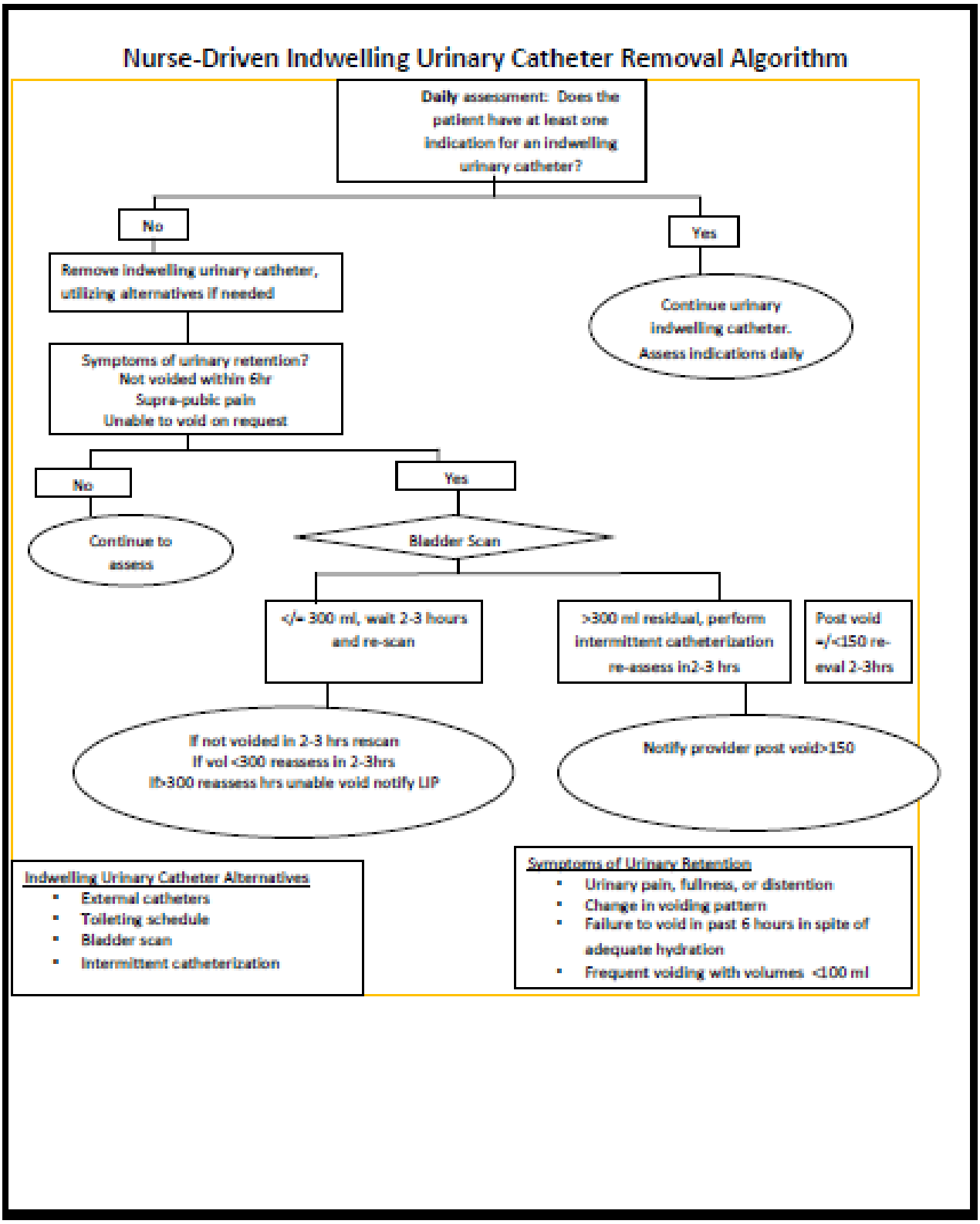
T

T

T

T

c
b
e
e


Nurse-Driven Indwelling Urinary Catheter Removal Algorithm
Daily assessment: Does the patient have at least one indication for an indwelling urinary catheter?
No
Yes
Remove indwelling urinary catheter, utilizing alternatives if needed
Continue urinary indwelling catheter. Assess indications daily
Symptoms of urinary retention?
Not voided within 6hr
Supra-pubic pain
Unable to void on request
No
Yes
Continue to assess
Bladder Scan
</= 300 ml, wait 2-3 hours and re-scan
>300 ml residual, perform intermittent catheterization re-assess in2-3 hrs
Post void =/<150 re-eval 2-3hrs
If not voided in 2-3 hrs rescan
If vol <300 reassess in 2-3hrs
If>300 reassess hrs unable void notify LIP
Notify provider post void>150
Indwelling Urinary Catheter Alternatives
External catheters
Toileting schedule
Bladder scan
Intermittent catheterization
Symptoms of Urinary Retention
Urinary pain, fullness, or distention
Change in voiding pattern
Failure to void in past 6 hours in spite of adequate hydration
Frequent voiding with volumes <100 ml

Appendix E

Timeline

Capstone Project: Lime line June 2014- June 2016			
TASK	START DATE	PROJECTED DATE TO COMPLETE	Percentage completed
Phase 1			
Recognition of Practice Problem			
Create PICO	7/2/2014	7/6/2014	100%
Problem Statement	7/2/2014	7/15/2014	100%
Select Variables	8/1/2014	8/25/2014	100%
PICO Schematic	7/2/2015	8/8/2014	100%
Begin Literature Review	7/25/2015	11/25/2014	100%
Population assessment	8/25/2014	12/30/2014	100%
Phase 2			
Needs assessment			
Refine PICO	8/25/2014	10/17/2013	100%
PICO approval by Faculty	8/25/2014	10/30/2014	100%
Population assessment	8/25/2014	12/30/2014	50%
Systematic Literature Review	8/25/2014	11/25/2014	100%
Comparative Analysis/Need	8/25/2014	11/25/2014	100%
Identify Sponsors / Stake-holders	8/25/2014	12/30/2014	100%
Phase 3			
Organizational assessment			0%
Assessing available resources	12/15/2014	1/15/2015	100%

Identify desired outcomes	12/15/2014	1/30/2014	100%
Assessment of Barriers/Strengths/Opportunities	1/15/2014	2/15/2015	100%
Define Scope of project	1/15/2015	2/15/2015	100%
Cost -Benefit analysis	1/15/2014	2/25/2015	100%
0	1/30/2014	3/30/2015	100%
Identify key front line stakeholders/Super Users	11/11/2014	3/30/2015	100%
Phase 4			
Methodology			
Development mission statement/goals/objects	7/25/2014	3/28/2015	100%
Theoretical Framework/support -Change Theory	7/29/2014	3/28/2015	100%
Plan of evaluation	7/29/2014	3/28/2015	100%
Expected outcomes	2/2/2015	3/28/2015	100%
Create Budget/Seek Financial support	2/2/2015	3/28/2015	100%
Identification of methodology/Design/project proposal	7/29/2015	3/28/2015	100%
Presenting to IRB for approval	4/19/2015	9/19/2015	100%
Phase 5			
Implement of an educational intervention			
Select venue/date and times	11/1/2015	11/8/2015	100%
Post educational flyers and posters	11/15/2015	12/15/2015	100%
Education intervention week1-day shift	12/13/2015	12/29/2015	100%
Education intervention week2 -Night Shift	12/13/2015	12/29/2015	100%

Reminders, motivation, rounds	12/13/2015	5/29/2015	100%
Phase 6			
Data Collection	12/14/2015	4/10/2016	75%
Data Analysis	1/15/2016	4/10/2016	75%
Phase 7			
Dissemination and Utilization of results			
Evaluate educational intervention	12/15/2015	4/1/2016	75%
Present results to Organizational Stakeholders /recommendations	3/30/2016	4/30/2016	25%
Present results to Participants-Oral dissemination	3/1/2016	4/22/2016	0%
Publish results-Electronic dissemination	4/22/2016	6/30/2016	0%
Implement intervention hospital wide if significant finding	4/1/2016	5/1/2016	0%
Integrate educational intervention in Nursing orientation	12/1/2016	4/1/2016	100%
Seek policy change for mandatory annual educational intervention	2/1/2016	4/1/2016	50%

Appendix F

Budget

Researchers Cost		**Costs to Replicate**	
Projector	$150.00	Projector	$150.00
Lap top	$199.00	Lap top	$199.00
Cost per staff @ $26.50 per hour x 27 @ (average staff hourly rate)	$715.00	Cost per staff @ $26.50 per hour x 27 @ (average staff hourly rate)	$715.00
Cost of 50% staff in overtime @ $13.25 /hr.x13hours	$172.00	Cost of 50% staff in overtime @ $13.25 /hr.x13hours	$172.00
Researchers time in hours $40.00/hr. x70 hours	$0.00	Researchers time in hours $40.00/hr. x70hours	$3,200
Cost for printing at $10 x 80 pre/posttest, information, sheet	800.00	Cost for printing at $10 x 80 pre/posttest, information, sheet	800.00
Miscellaneous cost- Food	150.00	Miscellaneous cost- Food	150.00
Total	2,186	Total	$5,386