IMPLEMENTATION OF A NURSE-DRIVEN EDUCATIONAL INTERVENTION FOR PROMPT REMOVAL OF URINARY CATHETERS IN THE NEURO-ICU

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ABSTRACT

Elizabeth A. Ouma: Implementation of A Nurse-Driven Educational Intervention for Prompt Removal of Urinary Catheters in the Neuro ICU
(Under the direction of Diane Caruso)

Background: Catheter-associated urinary tract infections (CAUTIs) are the most prevalent, yet preventable hospital acquired infections that are associated with adverse outcomes. CAUTIs have been linked to increased morbidity and mortality; increased healthcare cost, and extended hospital stays. Patients in the neurological intensive care units are at higher risk of acquiring CAUTIs due to their complex conditions requiring extended hospital stay and prolonged use of an indwelling urinary catheter.

Purpose: The purpose of this quality improvement project was to implement a unit-wide nurse-driven educational intervention using recommended guidelines to improve best practices related to prompt removal of the indwelling urinary catheter.

Methods: A quasi-experimental design was used to test the impact of nurse-driven educational intervention on practices related to prompt removal of the urinary catheter in the neuroscience intensive care unit. Records of patients admitted between August 1st 2016 and October 30th, 2016, were randomly reviewed retrospectively. Staff was educated on the importance of adherence to unit CAUTI bundle with emphasis on prompt removal practices. A 3-month post implementation chart review was conducted for comparison with pre-intervention data.

Results: Mean duration of time to urinary catheter removal post order for removal (n = 54 pre-intervention, n=54 post intervention) decreased from 241.26 minutes to 104.07 minutes. Although not statistically significant, the mean rate of CAUTIs decreased from 5.8 to 1.5 per 1,000 catheter days. Catheter reinsertion rates increased from 3.1 to 4.6 percent.

Conclusion: Nurse-driven educational intervention led to a decrease in time to urinary catheter removal. Based on these findings, emphasis should be placed on decreasing the duration of catheterization which is the single most important risk factor for CAUTI particularly in at risk group such as patient with neurological injuries who require vigilant monitoring to prevent CAUTIs.

To my late dad Michael Ouma who instilled the value of education in us and taught us the true meaning of being highly educated.

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LIST OF ABBREVIATIONS AND SYMBOLS

APIC	Association for Professionals in Infection Control and Epidemiology
ANA	American Association of Nurses
ASAH	Aneurysmal Subarachnoid Hemorrhage
CAUTI	Catheter Associated Urinary Tract Infection
CDC	Centers for Disease Control and Prevention
CST	Clinical Support Technicians
CMS	Centers for Medicare &Medicaid Services
CFU	Colony- Forming Units
CLABSI	Central Line Associated Blood Stream Infection
df	Degree of Freedom
EBP	Evidence-Based Practice
HICPAC	Healthcare Infection Control Practices Advisory Committee
HHS	Department of Health and Human Services
HAI	Hospital Acquired Infection
ICP	Intracranial Pressure
IHI	Institute for Healthcare Improvement
IOM	Institute of Medicine
ICU	Intensive Care Unit
IDSA	Infectious Disease Society of America
NSICU	Neuroscience Intensive Care Unit
NHSN	National Healthcare Safety Network
NR	No Response

M	Mean
PICCO	Pulse Contour Cardiac Output
P	Probability
SD	Standard Deviation
SHEA	Society for Healthcare Epidemiology of America
SSI	Surgical Site Infection
TBI	Traumatic Brain Injury
TJC	The Joint Commission
t	T-test Statistic
UTI	Urinary Tract Infection
UNC	University of North Carolina
VAP	Ventilator Associated Pneumonia
$\chi 2$	Chi-Square test

CHAPTER 1: INTRODUCTION

Background and Significance

Catheter associated urinary tract infections (CAUTI) are the most prevalent, yet preventable healthcare-associated infections (HAIs) reported to the National Healthcare Safety Network (NHSN) (Centers for Disease Control and Prevention [CDC], 2015). It is estimated that more than 560,000 CAUTI cases occur annually leading to extended hospital stay, additional cost of hospitalization, and increased morbidity and mortality (American Nurses Association [ANA], 2015). Complications related to CAUTI have been linked to more than 13,000 deaths annually (CDC, 2015).

According to the recent annual HAIs progress report by the CDC, there was no overall decrease in CAUTI in intensive care units (ICUs) between the year 2009 and 2014, an indication for additional preventative efforts (CDC, 2016). Reducing the risk of HAIs is identified as a priority goal by the U.S Department of Health and Human Services [HHS](2015); and also a Joint Commission National Patient Safety Goal (The Joint Commission (TJC), 2015).

The Institute of Medicine (IOM) report *To Err is Human* showed that thousands of hospitalized patients had adverse events leading to injury and or death each year as a result of preventable errors (Association for Professionals in Infection Control and Epidemiology Inc. [APIC], 2014). CAUTI is one of the HAIs recognized as a leading cause of these preventable events, causing significant patient harm and poor patient outcome (APIC, 2014).

CAUTI occurrence in a healthcare setting is considered a preventable event and is not reimbursed by the Centers for Medicaid Services (CMS) (APIC, 2014). Unreimbursed costs

related to CAUTI can exceed $10,000 per infection (Hoffman, 2015). Because of the financial impact of the nonpayment policy and tremendous human burden, healthcare organizations have made CAUTI prevention a priority (APIC, 2014).

Problem Statement

Despite the widespread use of evidence based practices, and expert opinion guidelines to assist in implementing strategies to prevent CAUTI in acute care settings, there is a lack of evidence-based quality improvement initiatives that have been effective in the prevention of CAUTI among patients in the neuroscience intensive care unit (NSICU) (Titsworth et al., 2012). The prospect of reducing CAUTI in the NSICU is particularly challenging and requires a novel approach (Schelling et al., 2015). CAUTI rates in the NSICU are typically higher than other hospitalized patients due to their higher risk for, and barriers to reducing CAUTI (Schelling et al., 2015).

A key factor to CAUTI prevention in the NSICU is adherence to evidence-based practices and unit specific protocols, such as implementing and adhering to a unit specific CAUTI bundle (Appendix 1) consisting of educational interventions that have been effective at preventing CAUTI in the neurological patient population. Evidence based practices such as sterile insertion and maintenance, hand hygiene, indwelling urinary catheter avoidance and prompt removal protocols, use of reminders techniques such as daily rounding to create catheter existence awareness, and use of specific technologies such as bladder ultrasound have been effective in preventing CAUTI in the NSICU (Schelling et al., 2015; Titsworth et al., 2012; Meddings J, Krein SL, Fakih MG, et al., 2014). Even though research has demonstrated success with the use of evidence based practices and guidelines developed to prevent CAUTI, infection rate from CAUTI remains at 40% of all hospitalized patients (ANA, 2015).

Purpose Statement

The purpose of this quality improvement project was to implement a unit-wide nurse-driven educational intervention using the CAUTI bundle to improve best practices related to indwelling urinary catheter use, and prompt removal according to general recommendations by the CDC, the Society for Healthcare Epidemiology of America, and the Infectious Diseases Society of America (SHEA/IDSA) Compendium (Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2010; Yokoe et al., 2014; Hooton et al., 2010). While there has been improvement made in the prevention of CAUTI in the NSICU at the University of North Carolina medical center (UNC) since 2014, practices related to prompt removal of the urinary catheter are inconsistent.

In the NSICU at UNC medical center, three practices are required for the urinary catheter to be removed (1) catheter necessity is discussed during multidisciplinary rounds to determine clinical indication for continued use; (2) if not clinically indicated, an order is transcribed to remove the urinary catheter; (3) a registered nurse is responsible for removing the urinary catheter. However, sometimes hours may elapse before the catheter is removed resulting in unnecessary extended duration of catheterization. Because duration of catheterization is an important risk factor for CAUTI acquisition, interventions that create awareness and importance of prompt removal of unnecessary catheters can have a positive impact on CAUTI rates (Meddings et al., 2014).

The primary goal of this project therefore, is to maintain practices such as hand hygiene, sterile insertion, catheter maintenance and avoidance, and assessing daily necessity of the urinary catheter that are already effective in preventing CAUTI in the NSICU, while improving practices related to prompt removal of the urinary catheter. Prompt removal of the urinary catheter when not clinically indicated is an important step in reducing the risk of CAUTI (CDC, 2014).

Implementation and consistent use of evidence-based practices requires collaboration of the entire healthcare team (providers, nurses, assistive personnel) to prevent CAUTI (Hooton et al., 2010; Magers, 2013; Lo et al., 2014). Specifically, this project will address the following clinical questions:

1. Will an educational intervention that focuses on improving unit specific practices related to prompt removal of the urinary catheter reduce the mean duration of urinary catheterization?
2. Will decreasing the mean duration of catheterization, thereby promoting adherence to all components of the unit CAUTI bundle reduce CAUTI rates?
3. Will decreasing the mean duration of urinary catheterization by prompt removal result in higher re-insertion rates?

CHAPTER 2: LITERATURE REVIEW

Urinary Tract Infection

Urinary tract infection (UTI) is an inflammatory response to colonization of the urinary tract due to invasion of pathogens, most commonly Escherichia coli*,* Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis and Staphylococcus saprophyticus (Flores-Mireles, Walker, Caparon, & Hultgren, 2015). These bacteria can invade any of the organs or structures of the urinary tract including the kidneys, ureters, bladder, and urethra causing a wide range of symptoms such as hematuria, fever, suprapubic or flank pain, change in urine color, and altered mental status, especially in the elderly population (Gray, 2010)

UTI may be classified as uncomplicated or complicated (Flores-Mireles et al., 2015). Uncomplicated UTIs usually affect individuals with intact immunity who do not have structural or neurological urinary tract abnormalities (Flores-Mireles et al., 2015). Complicated UTIs are associated with risk factors such as a compromised immune system, urinary obstruction, renal failure, renal transplant, pregnancy, calculi, or the use of indwelling urinary catheters or other drainage catheter abnormalities (Flores-Mireles et al., 2015). The use of indwelling urinary catheters is the cause of 70-80% of complicated UTI in the United States (Lo et al., 2014).

Urinary Catheter Use

An indwelling urinary catheter (commonly known as Foley) is a drainage tube that is inserted into the urinary bladder through the urethra and left in place and connected to a closed collection system (CDC, 2015). The Society of Healthcare Epidemiology of America and Infectious Disease Society of America (SHEA/IDSA) (2014) recommends that indwelling

urinary catheters be used under certain circumstances, including:

- Preoperatively, for selected surgical procedures such as urologic surgery or surgery on contiguous structures of the genitourinary tract; prolonged surgery; need for large volume infusions or diuretics during surgery; intraoperative monitoring of urine output needed;
- Monitoring hourly assessment of urine output in patients in intensive care units (ICU);
- Management of acute urinary retention and urinary obstruction;
- Assistance in healing of open pressure ulcers or skin grafts for selected patients with urinary incontinence;
- As an exception, at patient request to improve comfort (e.g., end-of-life care).

The prevalence of UTI in the hospital setting, specifically CAUTI has been widely attributed to the inappropriate use, or overuse, of an indwelling urinary catheter (Hooton et al., 2010).

CAUTI

CAUTI is a UTI occurring as a result of an invasion of bacteria, or sometimes fungi, in the urinary tract of a person who has an indwelling urinary catheter or has been catheterized within the previous 48 hours (Hooton et al., 2010). An indwelling urinary catheter acts as a conduit for the attachment of microbial adherence and migration into the bladder (Chenoweth & Saint, 2013). The device provides an atmosphere ideal for bacterial attachment and formation of biofilm, a complex organic material consisting of microorganisms growing in colonies (Nicolle, 2014). Organisms in the colonies are protected by the biofilm from antimicrobials and the host's weakened defense system, and with each day the urinary device is left in place, new organisms continue to colonize the bladder (Nicolle, 2014). The risk for UTI is estimated at 3% to 7% per day of catheterization (Tominaga et al., 2014). Duration of catheterization is therefore an independent risk factor for developing CAUTI (Lo et al., 2014).

The IDSA defines the clinical diagnosis of CAUTI as the presence of symptoms or signs compatible with UTI in a patient with no identifiable source of infection other than an indwelling urinary device that has been removed within the previous 48 hours in addition to 10^3 colony-forming units (cfu)/mL of 1 bacterial species in a single catheter urine specimen or in a midstream voided urine specimen from the patient (Hooton et al., 2010).

A general practice at UNC Medical Center in diagnosing a suspected CAUTI is to first perform a urinalysis for a patient with urinary catheter with symptoms of UTI. Symptoms may include a fever of unknown etiology, purulent drainage from catheter, suprapubic tenderness or costo-vertebral angle pain. A urine culture is obtained only if the urinalysis shows positive nitrites and esterase, white blood cells (WBCs) >15-25, and if the patient remains febrile or is septic (UNC Hospitals Neuroscience ICU, 2015).

More specifically, in the NSICU at UNC hospitals, patients with fever of unknown etiology and a rise in the serum WBC by 20%, or the development of leukopenia (WBC < 3.5) since last cultures (within 72 hours) were sent are evaluated for a UTI (UNC Hospitals Neuroscience ICU, 2015). If a UTI is suspected a urinalysis is performed, and a urine culture is sent only if the urinalysis demonstrates either WBC > 20 or positive leukocyte esterase and positive nitrites (UNC Hospitals Neuroscience ICU, 2015**).** A CAUTI is diagnosed in those patients with urinary catheters in place or if the indwelling urinary catheter was removed in the last 48 hours with symptoms of fever of unknown source, recent blood work shows a rise in the WBCs by 20% or leukopenia since last cultures, and positive urine cultures with greater than 100,000 colony forming units (CFU)/mL of one type of bacteria.

CAUTI Prevention in the ICU Settings

According to the Society for Healthcare Epidemiology of America (SHEA), CAUTI rates

in 2011 from ICUs that reported to National Healthcare Safety Network (NHSN) ranged from 1.2 to 4.5 per 1,000 urinary catheter–days in adult ICU (Lo et al., 2014). Guidelines for preventing CAUTI and evidence-based practice have been established to provide strategic guidance for preventing CAUTI in the ICU. However, there are still gaps in knowledge as to which strategies are more specific and effective in preventing CAUTI in the ICU. (Galiczewski, 2016).

According to Chenoweth & Saint (2013), up to 95% of UTIs in the ICU setting are related to the use of an indwelling urinary catheter. ICU patients are at a greater risk of acquiring CAUTI because of their critical conditions requiring the use of an indwelling urinary catheter for an extended period (Hagerty et al., 2015). Decreasing the risk of CAUTI in the ICU is therefore an inevitable organizational priority. Strategies that have been used to decrease the risk of CAUTI in the ICU include implementation of the CAUTI bundle (Appendix 1), nursing education, a daily rounding goal sheet to improve communication and remind providers of the existence an indwelling urinary catheter, (Meddings et al., 2014; Houston, Anderson, & Larson, 2013; Gordon, 2015; Centofanti et al., 2014; Snyders et al., 2014).

CAUTI Bundle. A bundle is a multi-modal set of interventions that was originally created by the Institute for Healthcare Improvement (IHI) to assist health care providers in delivering the best possible care for patients at risk of an unexpected event from a medical intervention (IHI, 2011). This concept has been used successfully in the prevention of HAIs such as central line associated blood infections (CLABSI), ventilator associated pneumonia (VAP), surgical site infection (SSI), and also in CAUTI prevention (APIC, 2014).

A CAUTI bundle consists of evidence-based practices to prevent CAUTI that when used consistently, can improve patient outcome, quality of life, and lower health care costs (Magers,

2013). It incorporates the best evidence from clinical studies and expert opinions from the Centers for Medicare &Medicaid Services (CMS), the CDC, and Healthcare Infection Control Practices Advisory Committee (HICPAC) (Magers, 2013). Components of the bundle vary with use, but typically include appropriate use of catheters, proper techniques for insertion, proper techniques for maintenance, prompt removal, hand hygiene, use of bladder ultrasound, use of closed drainage system, continued nursing education on prevention of CAUTI, and use of catheter alternatives (Chavez et al., 2011; T. L. Houston, D. Anderson, & D. Larson, 2013; Mulye, Saldhana, & Pandit, 2014; Rosenthal et al., 2012)

In an integrative review completed to examine the existing evidence on preventative interventions and protocols being implemented in the ICU and the impact they had on the CAUTI rates and ultimately patient outcomes, Galiczewski, (2016) found that implementation of interventions that included criteria for catheter use, daily review of catheter necessity, and prompt discontinuation of catheter were successful in decreasing CAUTI rates. In another review of literature by Chenoweth and Saint (2013), implementation of a CAUTI bundle that included interventions such as educational strategies, catheter avoidance, policies for catheter insertion, catheter selection, daily necessity review, and limiting catheter days were reported to be associated with decreased CAUTI rates in the ICU.

Nursing Education. An important and yet underutilized factor in preventing CAUTI in the hospital setting is the socioadaptive component of prevention (Saint et al., 2016). Changes in behavior and culture play an important role in quality improvement (Saint et al., 2016). Nurses are in central position to contribute to the development and implementation of EBP to prevent CAUTI (Connor, 2011). Therefore, their involvement in the process and practices are an important factor in patient safety initiatives. Changing nursing practices around CAUTI

prevention has been found to require ongoing education, the identification of barriers that prevent catheter removal and ongoing support throughout the process before buy-in and sustainable change is achieved (Houston et al., 2013).

Gordon (2015) found that nursing education on current CDC guidelines for appropriate indications for usage, proper insertion techniques, prompt removal and re-insertion avoidance, and use of alternative devices such as the condom catheter was effective in decreasing CAUTI rates from 10.40 pre-intervention to 0.00 post- intervention ($p < 0.05$) (Gordon, 2015). The outcomes of this study demonstrate that nursing education on best practices to prevent CAUTI may impact CAUTI rates and create social change that improves patient safety and quality outcome.

Daily Goals Tool. Critically ill patients have multiple medical problems, and solutions to these problems are dependent on a team of clinicians working collaboratively to address these issues (Centofanti et al., 2014). In order to ensure clear communication among team members, a streamlined method of communication is necessary to improve care coordination. The Joint Commission identified ineffective communication as one of the root causes of sentinel events in a hospital setting (TJC, 2015). Hospital acquired infections were among the sentinel events identified by TJC (2015) as a type of event that occurs because of ineffective communication among health care providers.

A daily goal tool is an effective communication tool used among all members of the interdisciplinary team to achieve optimal patient outcomes (Centofanti et al., 2014). The main focus of the tool is on what needs to be accomplished that day to safely move a patient closer to discharge (Centofanti et al., 2014). The daily goal sheet has many different elements of the patient's care plan including adequacy for discharge, ventilator and sedation weaning, pain

management, prevention of harmful events such thromboembolic events, ventilator associated pneumonia (VAP), CAUTI, central line bloodstream infections (CLABSI), and family update of the plan of care (Centofanti et al., 2014). This tool is particularly important in reminding the providers of an existing device such as the urinary catheter that could predispose a patient to CAUTI acquisition. The goal sheet serves as a proactive approach for reducing catheter days, and minimizing the risk of infection by prompting providers to determine the appropriateness of continuing urinary catheter use (Centofanti et al., 2014).

The NSICU Patient

Patients with neurological injuries are at higher risk of acquiring CAUTI and have the highest CAUTI rates compared to other patient populations (Schelling et al., 2015). This difference is largely credited to their complex conditions requiring the use of an indwelling urinary catheter (Saint et al., 2016; Schelling et al., 2015). Certain conditions that compel the use of an indwelling urinary catheter, thereby placing NSICU patients at high risk of acquiring a CAUTI includes strokes, particularly aneurysmal Subarachnoid Hemorrhage (aSAH), being in a comatose state with limited mobility, and neurogenic bladder (Hagerty et al., 2015; Vigil & Hickling, 2016).

Aneurysmal Subarachnoid Hemorrhage (aSAH). Patients presenting with aneurysmal subarachnoid hemorrhage (a SAH) in the NSICU often have extended lengths of stay to monitor for complications. The critical nature of their illness and need to maintain euvolemic state and normal circulating blood volume is essential in increasing cerebral perfusion and preventing complications from cerebral vasospasm (Hagerty et al., 2015). These treatment modalities require strict hourly monitoring of fluid status, hence an increased likelihood of urinary catheter placement. While the use of urinary catheter in these patients is necessary, a risk factor for

CAUTI among these patients is prolonged use of the indwelling urinary catheter (Hagerty et al., 2015). Therefore, careful daily assessment of urinary catheter use in the management of patients with aSAH at risk for complications from cerebral vasospasm, or the use of alternative fluid status and hemodynamic monitoring with Pulse Index Contour Continuous Cardiac Output (PICCO) monitors, for those patients in vasospasm could be considered as alternative means to prevent CAUTIs.

A retrospective study to determine the risk factors for CAUTI in critically ill patients with aSAH found that the rate of CAUTIs was 20.7 per 1,000 catheter days, six times higher than the reported national average (Hagerty et al., 2015). According to Hagerty et al. (2015), the high CAUTI rate was associated with prolonged use of the indwelling urinary catheter. These findings suggest that diligent monitoring is needed regarding the use of indwelling urinary catheter in aSAH patients (Hagerty et al., 2015). Currently there is no study that has evaluated the best strategies to prevent CAUTI in the aSAH population (Hagerty et al., 2015). However, attempts should be made to remove the urinary catheters as soon as possible, especially for those patients who can void and when urine output can be accurately monitored using alternatives means of collection, or use of alternative monitoring system, like the PiCCO device.

Comatose Patients. Comatose patients and patients with limited mobility, especially those that have had devastating neurological insult, are in a medically induced coma to control elevated intracranial pressure (ICP), and those that are sedated may require an indwelling urinary catheter (Feneley, Hopley, & Wells, 2015). In most cases, the use of urinary catheter in these patients is for wound protection from an existing pressure ulcer that is higher than stage 3, and to monitor accurate intake and output (Feneley et al., 2015; Hooton et al., 2010). In medically induced coma, catheter use maybe indicated to prevent constant manipulation or stimulation

from incontinence care that could in turn increase ICP levels.

Neurogenic Bladder. Preventing UTI in patients with neurogenic bladder dysfunction caused by neurologic damage to the central nervous system is challenging (Vigil & Hickling, 2016). These patients are usually managed with indwelling catheterization or clean intermittent catheterization, both of which predispose them to an increased risk of acquiring CAUTI (Vigil & Hickling, 2016). However, despite the compelling need for urinary catheter in these patients to prevent retention, evidence shows that intermittent catheterization is associated with fewer complications when compared with indwelling urethral catheterization (Hooton et al., 2010). Neurogenic bladder is therefore not a true indication for indwelling urinary catheter (Hooton et al., 2010). Based on this information, it is recommended that patient with neurogenic bladder be safely managed with intermittent catheterization, as opposed to the use of indwelling catheters, to reduce the risk of acquiring CAUTI (Hooton et al., 2010).

CAUTI Prevention in the NSICU

Preventing CAUTI in the NSICU is particularly challenging due to the complex nature of patients and their comorbidities, requiring a novel approach to CAUTI reduction (Schelling et al., 2015). Despite broad implementation of relevant bundles to prevent CAUTI that have shown positive outcome in other ICUs, there are limited studies that have highlighted a particular approach that has been proven to be effective at preventing CAUTI in the NSICU (Titsworth et al., 2012).

In a retrospective study conducted in one NSICU, Halperin et al. (2016) found that reviewing urinary catheter use, including indications and alternatives, and instituting daily rounds, continuously questioning the ongoing need for a catheter, re-educating neurocritical care personnel on insertion and maintenance technique and introducing a new kit that simplified and

standardized sterile insertion decreased CAUTI rates by 55 %, ICU length of stay 1.5 days, and risk-adjusted mortality by 11% (Halperin et al., 2016).

In another quasi-experimental study by Regagnin et al. (2016), implementation of a CAUTI bundle that included catheter insertion by a dedicated catheter insertion team, hand hygiene, urethral meatus care with chlorhexidine, sterile single attempt at insertion, adequate urinary catheter balloon inflation, and daily review of indication and prompt removal was found to decrease CAUTI rates from 14.9 to 1.0 per 1,000 catheter days ($P < .001$).

A quality improvement study conducted in a neuro-spine ICU revealed that there was a significant decrease in the CAUTI rate from 8.18 to 0.93 per 1,000 catheter-days and standardized infection ratio from 2.16 to 0.37 (Schelling et al., 2015). This study evaluated CAUTI rates during a 12-month period following implementation of a nursing education on the CAUTI bundle, daily rounding with clinicians, conducting practice audits, and sharing of real-time data outcomes, new securement device, and a bowel management program to reduce diarrhea prevalence among neurological patients.

CHAPTER 3: THEORETICAL FRAMEWORK

Background of Lippitt's Theory of Change

Lippitt's theory of planned change was chosen for the conceptual framework for this study (Lippitt, Watson & Westley, 1958). This theory was created with the purpose of presenting general principles and techniques for working to secure change through interaction with individuals, groups of people, organizations, and societies (Harris, 1963).

Lippitt's theory has been used effectively in nursing to effect change in behavior that is influenced by a work environment that must continually adapt to new demands and changes required by management, policies, EBP guidelines, and advanced technology (Orr & Davenport, 2015). It is most commonly used in leadership and nursing care management to provide a structured approach to planned change that encourages acceptance to change rather than resistance (MacDonald, 2013).

Lippitt's theory of change is based on the concept of an external agent creating change through careful planning (Mitchell, 2013). It incorporates the familiar steps of the nursing process (assessment, planning, implementation, and evaluation) and can be applied in virtually any nursing setting (Geraci, 1997). The seven steps have been widely interpreted as: diagnosing the problem, assessing the motivation and capacity for change, assessing the change agent's motivations and resources, selecting progressive change objectives, choosing the appropriate role for the change agent, maintaining the change once it has started, and terminating the helping relationship (Orr & Davenport, 2015).

Application of Lippitt's Theory in the NSICU

To effect change in the NSICU, the seven steps were used to assist with framing a process in order to change practices related to prompt removal of the urinary catheter

Problem identification. A problem related to prompt removal of the urinary catheter was identified and awareness created regarding the problem.

Assessing motivation and capacity for change. Creating awareness was done through meeting and assessing the stakeholders' motivation for change, and providing support to improve the problem.

Assessing the change agent's motivations and resources. Because the change agent's (in this case the primary investigator) initiated the project**,** it was clear that they were motivated to bring about change**.** Additional resources to support the change agent were sought through the site's nursing quality and research department and the school of nursing.

Change objectives. Another important step in this project was selecting the change objectives. The main change objectives were to decrease the mean duration of urinary catheterization and improve CAUTI rates without increasing re-insertion rates.

Choosing the appropriate role for the change agent. An appropriate role for the change agent to meet these objectives was to educate staff on best practices related to prompt removal of the urinary catheter.

Maintaining the change. Once implementation was complete, the next task was to maintain change through process re-evaluation, encouraging and empowering staff to adhere with prompt removal and by providing feedback to staff.

Terminating relationship. Once change was assimilated, the change agent terminated the relationship and became part of the process.

CHAPTER 4: METHODOLOGY

Design

This quality improvement project used a quasi-experimental design to compare pre- and post-intervention mean duration of urinary catheterization (Time to urinary catheter removal post order for removal), CAUTI rates, and re-insertion rates. The intervention consisted of educating staff on the importance of consistently using the NSICU CAUTI bundle (Appendix 1) using evidence and prevention guidelines from the CDC, and SHEA/ISDA. A reminder steps for prompt Foley removal (Appendix 4) was developed to prompt nurses to remove the urinary catheter as soon as no longer indicated. Additional resources were provided to nurses by educating nursing support staff on how to use the bladder scanner. Providers were also encouraged to enter catheter removal orders in the electronic medical record as soon as deemed necessary. In addition, providers were encouraged to remind staff during rounding to remove urinary catheters if still in place after an order had been placed to discontinue the catheter.

Setting

This project took place in the NSICU at UNC Health Care, located in Chapel Hill, North Carolina. The NSICU is a Level I Trauma Center and Joint Commission designated comprehensive stroke center as well as a regional referral center for neurologic emergencies. It is one of UNC Health Care's seven ICUs and has a 16-bed occupancy capacity. This unit manages a large population of critically ill patients including those with intracranial hemorrhages, ischemic strokes, and severe brain injuries along with other acute neurological injuries requiring ICU care.

Subjects

This project used a voluntary convenience sample of approximately 47 registered nurses employed full or part time in the NSICU, 10 clinical support staff (CST), nine Acute Care Nurse Practioners (ACNPs), and three attending physicians. In order to have a 90% confidence level with a 5% margin of error, a sample size of 45 subjects was needed to consider the educational intervention component successful.

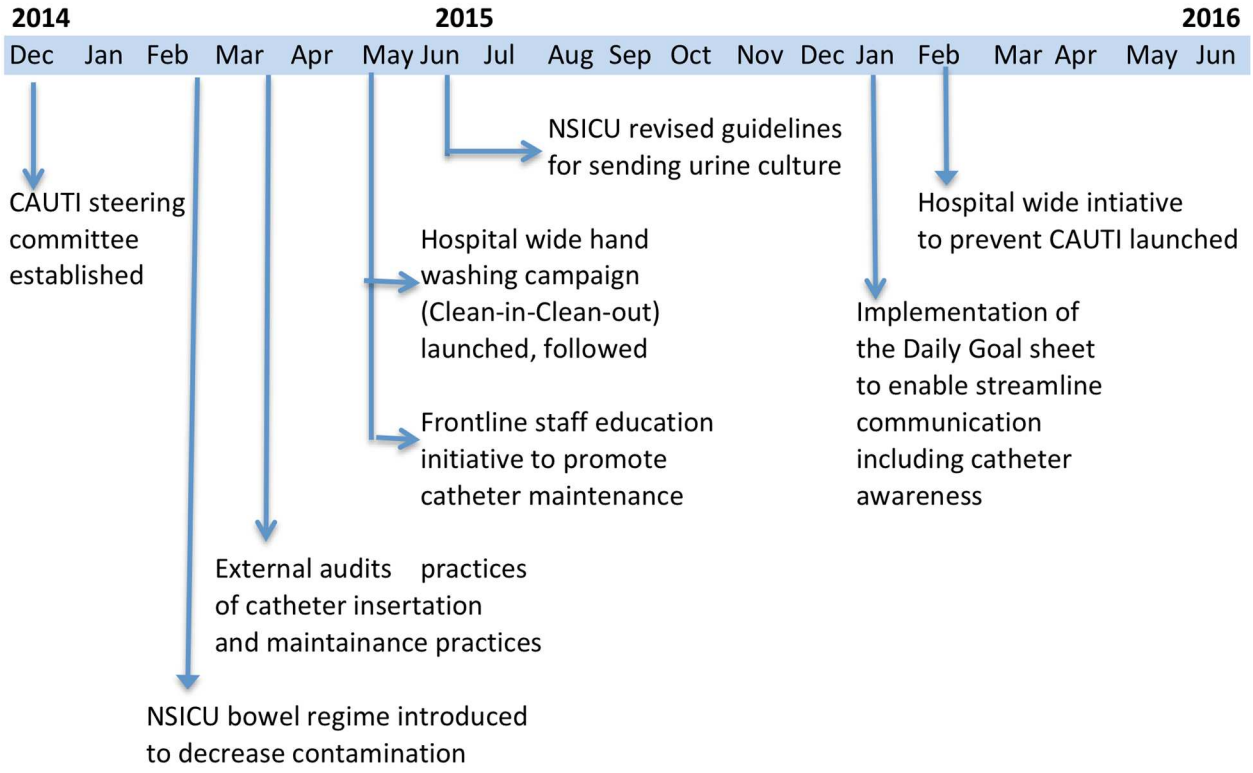
Ethical considerations

This project was approved by the hospital Nursing Research Council and was determined by the Institutional Review Board to meet criteria as a quality improvement initiative. Neither patient nor staff identifiers were collected, thus assuring patient and staff confidentiality and anonymity.

Procedure

Prior to implementation of this project, previous interventions to reduce CAUTI in the NSICU were reviewed to identify areas for improvement. As shown in Figure 1, there were multimodal team-driven interventions that were initiated from December 2014 to February 2016. These interventions resulted in a decrease in CAUTI rates by almost 50%. However, it was noted that prompt removal practices was an area that still needed improvement in order to ensure consistency in practice and to reduce or even eliminate CAUTIs. Therefore, this project introduced an educational intervention that was implemented in seven phases over a three-month period from November 15, 2016 through February 28, 2017.

Figure 1: **NSICU Team-Driven Interventions to Reduce CAUTI**



Olm-Shipman et al. (2016). Impact of implementing team-driven interventions to reduce catheter associated urinary tract infections in the Neuroscience-ICU. Poster session presented at the 14th Annual Neurocritical Care Society Meeting.

Phase I: Problem identification. Prior to implementation of the intervention, a needs assessment was performed as part of Lippitt's initial phase of problem identification. A random retrospective chart review was performed in patients who had a urinary catheter removed while admitted to the NSICU between August 1, 2016 and October 31, 2016. Charts were reviewed to determine the total time it took to remove the urinary catheter once an order for removal was in place. Charts were also reviewed for independent variables such as patient's age (Nurses are less inclined to remove a catheter in older patients for fear of falls), gender (Unlike female patients, external catheter can used be in male patients as an alternative to urinary catheter), and diagnoses (Certain diagnoses like SAH require strict intake and output monitoring hence use of catheters) that could influence urinary catheter removal time. Pre-intervention CAUTI rates and catheter

reinsertion rates data sets were obtained from the hospital's infection control department and labeled data set 1 for comparison with post data, which was labeled data set 2.

Phase II: **Assessing motivation and capacity for change.** The second phase involved gaining buy-in from stakeholders. An important aspect of this step was identifying the stakeholder's motivation and capacity for change as well as gaining their trust for the project to proceed. An initial meeting was held with nursing management and the director of the unit to discuss the proposed project. After gaining buy-in and permission from the department's nurse manager, a pre-intervention CAUTI survey linked to an invitation to participate (Appendix 3) was sent out to staff via Qualtrics tool to obtain data on the barriers to urinary catheter removal and to identify any educational needs or knowledge deficits related to urinary catheter removal and documentation. The survey was conducted from November 15, 2016, to November 21, 2016.

Phase III: Assessing the change agent's motivations and resources. The third phase of change involved identifying a change agent to implement the proposed change. Nurses are ideal candidates to act as change agents because they possess the skills and unique knowledge needed to implement EBP to prevent CAUTI. The original plan was to recruit unit CAUTI champions to change the culture around CAUTI prevention practices and improve compliance with these practices. However, the decision to recruit champions was not feasible due to other quality improvement projects in the unit requiring the use of unit champions. The primary investigator therefore, took the sole responsibility of implementing the change with additional resources and guidance from the unit management, nursing quality research, and the infection control department.

Phase IV: Change objectives. The fourth phase in the process of change involved specifying the objectives of change and the actual implementation of the intervention,

which was conducted from November 21, 2016 through to December 1st, 2016. It was expected that catheter re-insertion rates would be unchanged as a result of this project while CAUTI rates will be decreased due to decrease in mean duration of catheterization.

To meet the objectives of this project, a survey was developed to gain information for use in developing and refining educational interventions for project implementation. The 11-item survey assessed nurses' knowledge, attitude, barriers, and resources related to prompt removal of the urinary catheter using Likert-type 5-point response vectors of strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), strongly agree (5) (Appendix 2).

Knowledge. When asked questions on knowledge related to CAUTI prevention in the NSICU, an average of 69% of nurses strongly agreed that they are familiar with CAUTI prevention practices in the NSICU. The rest either agreed (20%) or chose neither agree or disagreed (4%), with two nurses (2.6%) each choosing either disagree or strongly disagree (Table 1).

Attitude. When asked questions on attitude related to prompt removal of the urinary catheter in the NSICU, 34.2% of nurses strongly agreed, 36.8% agreed, 15.8% disagreed, and 2.6% strongly disagreed that they remove the catheter as soon as an order existed for removal. When asked questions on attitude related to documentation of the urinary catheter in the NSICU, an average of 69.7% strongly agreed while the rest either agreed (17.1%) or neither agreed nor disagreed (2.6%) (Table 1).

Barriers. When nurses were asked to list barriers to prompt removal of the urinary catheter in the NSICU, six (15.8%) nurses listed concerns for reinsertion, six (15.8%) were concerned about patient injury, 27 (71.1%) thought other tasks such as procedures, tests, or patient transportation were a priority to catheter removal, 10 (26.3%) nurses cited lack of

resources to help with incontinence care or bladder scanning once urinary catheter is removed, and one (2.6%) nurse listed being a female patient as barrier to prompt removal (Table 1).

Resources. Questions were asked regarding the availability of resources to facilitate prompt removal of the urinary catheter in the NSICU. Nurses were asked to list the resources they felt would assist them with prompt removal of the urinary catheter after an order for discontinuation was placed in the EMR. There were variable responses across the subjects regarding the resources they would need to assist with prompt removal of the urinary catheter (Table 2). Most nurses who chose to leave a comment listed the need for adequate staffing to help with incontinent care once the catheter is discontinued. Some nurses felt that there was lack of communication between the nurses and the providers regarding when the urinary catheter should be removed. They suggested that providers should more clearly communicate their order, or write an order for a specific time for catheter. For example, one nurse wrote: "*The LIP to write the order when they want it out. They say in rounds after MRI the Foley can come out, but then write the order at 0930 then I look like I was not doing it".*

Another important factor that some nurses suggested was the use of a reminder strategy using the daily goal sheet (Appendix 9). One nurse believed that removing the catheter was not a problem if she was made aware that an order for removal exists, implying that a reminder would be useful. For example, one nurse wrote: "*More follow up- PM rounds has helped with this when catheters are DCed on day shift because it reminds us that we need to do it*". This comment and others indicated that a meeting with providers was necessary to discuss the importance of communication, reminder for removal, and consistency with order transcription for urinary catheter removal.

Table 1: Knowledge, Attitude, and Barriers Survey Results

Domain	Question	NR	Strongly Disagree N (%)	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Knowledge	**1.** I am familiar with evidence-based practices to prevent catheter associated urinary tract infections (CAUTI)	3 7.9%	0	0	0	3 21.1%	27 71.1%
	2. I am aware of the risk factors for CAUTI acquisition in the NSICU patient.	3 7.9%	0	0	0	4 10.5%	31 81%
	3. The CAUTI guidelines recommendations are relevant to NSICU patients	3 7.9%	0	0	0	10 26.3%	25 65.8%
	4. I am familiar with CAUTI preventions bundles and its relevance in the NSICU	3 7.9%	1 2.6%	0	0	9 23.7%	25 65.8%
	5. I am familiar with the prompt removal component of the CAUTI bundle	0	1 2.6%	1 2.6%	2 5.3%	7 18.4%	24 63.2%
	6. I understand the importance of prompt urinary catheter removal in the prevention of CAUTI	3 7.9%	0	0	1 2.6%	8 21.1%	26 68.4%
Attitude	**7.** I remove urinary catheters as soon as an order for discontinuation exists.	4 10.5 %	0	1 2.6%	6 15.8%	14 36.8%	13 34.2%
	9. Documentation related to urinary catheter removal is important	4 10.8 %	0	0	0	6 15.8%	28 73.7%
	10. I document urinary catheter removal as soon as it is discontinued?	0	1 2.6%	0	1 2.6%	7 18.4%	25 65.8%

Barriers	Reasons For Delay in Removal	Number of Responses
	Concerns of reinsertion	6 (15.8%)
	Risk for patient injury	6 (15.8%)
	Other important tasks	27 (71.1%)
	Lack of enough resources, such as assistance with incontinence care Patient's altered mental status	10 (26.3%)
	Female patient	1 (2.6%)

Table 2: Nurses' Response to Resource Availability Survey Result

Q 11: List the resources you feel you would need to assist you with prompt removal of the urinary catheter after order for discontinuation exist

		Frequency	Percent
	Responses	17	44.7
		1	2.6
	Additional staff to initiate clean ups.		
	Adequate staffing	1	2.6
	Assistance not needed to remove catheter itself. Assistance with incontinence care (including frequent bathing, linen changing, etc.), bladder scanning and I/O cathing would make prompt removal more feasible	1	2.6
	Communication. Correctly record Why patient need the catheter.	1	2.6
	Foley: Place by Urologist, retention urine		
	Condom catheter or pure wick, knowledge of procedures happening soon afterward,	1	2.6
	CST help greatly appreciated	1	2.6
	CSTs	1	2.6
	Depends on patient (if difficulty discontinuing) 2nd set of hands	1	2.6
	enough staff to help with incontinence care, bladder scan or for I & O cath if the nurse is busy with other pt.	1	2.6
	I don't think removing a Foley catheter within one hour is a problem. If we turn patients every two hours, we should be able to clean a patient within that time.	1	2.6
	MD letting me know the order has been created. Available NA if it is a combative patient.	1	2.6
	More follow up- PM rounds has helped with this when catheters are DCed on day shift because it reminds us that we need to do it.	1	2.6
	N/A	1	2.6
	N/A	1	2.6
	None	1	2.6
	Nursing assistant's availability to assist	1	2.6
	Pending no MRI, angio, etc ordered	1	2.6
	Policy	1	2.6
	The LIP to write the order when they want it out. They say in rounds after MRI the Foley can come out, but then write the order at 0930 then I look like I was not doing it	1	2.6
	Verbal notification of order	1	2.6
	Whether there is enough help to assist the patient for bedpan or get to commode	1	2.6
	Total	38	100.0

Staff Education

Nursing. The survey results were used as a guide to design a 15-20 minute presentation that introduced the specifics of the unit CAUTI bundle (Appendix 1). The session emphasized that protocols were already in place and have been effective in reducing CAUTI rates, and that the purpose of this step was to create awareness on the importance of adherence to all components of the CAUTI bundle to further reduce CAUTI in the NSICU. Educational material for presentation included:

- Results from retrospective chart review indicating longer duration of catheterization
- Hospital data on current CAUTI rates obtained from infection control share point website
- Survey Results
- CAUTI Bundle components (Appendix 1)
- NSICU reminder steps for prompt removal and documentation of the Foley (Appendix 4)
- IDSA guidelines for CAUTI prevention (Appendix 5)
- CDC guidelines for CAUTI prevention (Appendix 6)
- CAUTI facts (Appendix 7)
- SHEA/IDSA (2014) Recommended Indications for Urinary Catheter Use (Appendix 8).

Educational sessions took place at different times of the day and included weekends and nights to provide convenient opportunities for staff working on all shifts. Most of the education occurred at the beginning of the shift when nurses were waiting to get a shift report. Since most nurses arrive 15-20 minutes before the start of shift, this was an ideal time to offer a group

educational session. Additional efforts included meeting with nurses individually, during staff meetings, and during unit practice council meetings. A total of 18 sessions were offered during a period of 2 weeks to ensure that most staff attended. Nurses were asked to sign the education materials after the educational session was completed.

Clinical Support Technicians. CSTs are important members of the nursing support team. Their role in the unit includes assisting nurses in delivering patient care by performing duties such assisting with incontinence care, performing EKGs and mobilizing patients among other duties. Their involvement in this project was very important in impacting practice change in the unit. With permission from the unit nurse manager, CSTs were educated on the importance of prompt urinary catheter removal, reasons for assessing urine retention, and how to properly perform bladder scanning.

Neurocritical Care Team. A meeting was held with the Neurocritical Care team to discuss project goals and ways they could help to improve practice related to urinary catheter removal. It is an expectation that providers should be discussing indications for indwelling urinary catheter, and readiness for removal during rounds, and placing an order for removal as soon as criteria for removal is met. Based on the survey results, providers agreed to transcribe an actual order to discontinue the urinary catheter rather than give a verbal order or discontinue previous order for insertion. This would be helpful in alerting the nurses that a task is pending through the work list in electronic medical record charting. Providers also agreed to remind nurses to discontinue the urinary catheter if not already done during the PM rounding using the Daily Goal sheet (Appendix 9).

Phase V: Change agent's role. Defining the role of the change agent (in this case the primary investigator) during the fifth phase of change process was critical to the success of the

project. The change agent was responsible for educating, monitoring, and encouraging compliance with the CAUTI bundle while placing emphasis on prompt removal and documentation of the urinary catheter. The role of the change agent was active until the completion of the project. Compliance was monitored by the principal investigator using the process audit tool to collect data on the timeliness of the urinary catheter removal. Data from the process audit tool was used for improvement purposes and to communicate with staff on how the project was progressing. This role was critical to how change was implemented and accepted by the NSICU staff.

Phase VI: **Maintaining change**. Once change had begun to take place, the sixth phase was to maintain the change by keeping lines of communication open. Frequent, ongoing discussions regarding the change continued throughout the implementation process. Nurses were also approached individually or as a group for feedback regarding the process. Most nurses agreed that step six of the NSICU reminder for prompt Foley removal and documentation (Appendix 4) was cumbersome. This concern was evaluated, and revised to indicate "when possible". A monthly email was sent to nurses to thank and encourage them for their good work as an incentive for sustaining the change.

Phase VII: **Terminating relationship**. In the final phase when change became integral to the day-to-day functioning of the unit, and staff became familiar with the process, the role of the change agent was gradually withdrawn to mark project completion in February 28, 2017.

Data Collection

A retrospective chart audit was used to collect pre-intervention data. Patient characteristics collected included variables such as age, gender, and diagnoses. Data on the Foley catheter removal process included the total time taken to remove the urinary catheter, from

the order time and date of removal. Pre and post data on CAUTI rates and catheter re-insertions rates were obtained from the infection control department for comparison.

Data Analysis

Data were analyzed using the statistical package for the social sciences (SPSS) software, version 24.0 (IBM SPSS). Quantitative variables were expressed as means and standard deviations and were compared using a *t* test or Chi-square test. Simple frequency tables and cross tabulation were generated to describe the data. Chi-square and *t*-tests were used to compare categorical and nominal data, respectively. Data on CAUTI rates and reinsertion rates are monitored and tracked by the hospital's epidemiology department. The department is responsible for collecting and analyzing these data using the NHSN formula for calculating and reporting these data. The CAUTI rate per 1000 urinary catheter days is calculated by dividing the number of CAUTIs by the number of catheter days then multiplying the result by 1000. Urinary catheter reinsertion rates are calculated and reported as a percentage.

CHAPTER 5: RESULTS

A random retrospective and prospective chart audit was performed on a total of 108 charts. Of the 108 charts, 54 charts were completed pre-intervention, and 54 were completed post intervention. Charts were excluded for auditing if the urinary catheter was discontinued by a flex or float nurse, or if an order for removal did not exist. Independent sample t-tests were used to compare mean differences in age, time to urinary catheter removal post order for removal, and to determine whether the mean time differed based on gender. Cross tabulation was performed on gender and diagnoses and a Chi-Square ($\chi 2$) test used to determine the distribution of data across pre and post groups for each variable (See table 3). Data were evaluated for statistical significance, which was set at *P*-value <0.05 and results described below.

Table 3. NSICU Patient Characteristics

Pre-Intervention Group (n=54)		Post-Intervention Group (n=54)	
Mean Age		**Mean Age**	
52		58	
Gender		**Gender**	
M=28		M=24	
F=26		F=30	
Mean Total Time to Removal		**Mean Total Time to Removal**	
241.26 minutes		104.07 minutes	
Number of CAUTIs/1000 days		**Number of CAUTI/1000 days**	
12.19		4.55	
Catheter Re-insertion Rates		**Catheter Re-insertion Rates**	
3.1 %		4.6 %	
Diagnosis Groupings (n)		**Diagnosis Groupings (n)**	
SAH	15	SAH	19
Other Strokes	18	Other Strokes	17
TBI/Trauma	1	TBI/Trauma	2
Seizures	2	Seizures	4

Pre/Post Comparison on all Independent Variables

Age. As shown in table 4 below, the mean age in the post intervention group was found to be higher (58.22) than the mean age in the pre intervention group (52.07) ($t = -2.04$, df = 106, P =0.044).

Diagnoses. In evaluating the various diagnoses that might affect mean time to urinary catheter removal in the pre and post groups, results indicated that the distribution of diagnoses were similar across pre and post groups. Therefore, there was no difference in the types of diagnoses for each time period. ($\chi 2 = 3.13$, df = 5, P =0.67) See table 4.

Table 4: Results of Independent Variables (Age, Gender, Diagnoses)

	Pre-Intervention	Post-Intervention			
Variables	M (SD)	M (SD)	Test Statistic	Df	*P*
Age	52.07(16.5)	58.22(14.83)	t = -2.03	106	0.04
Diagnoses			$\chi 2 = 3.13$	5	0.67
Gender			$\chi 2 = 0.59$	1	0.44

Note. t =Sample t-test statistic; $\chi 2$ = Chi-Square test; df = Degree of freedom; P = Probability value set at 0.05.

Gender. As shown in table 4 above, the Chi-Square test of whether there was significant difference in gender distribution between the two groups was measured and found not to be statistically significant ($\chi 2 = 0.59$, df = 1, P =0.44) (Table 4). Therefore, gender distribution umor Tumor

Other Neurological Disorders 4 Other Neurolog

Total **54** **Total**

was essentially the same in the pre and post-intervention groups. An independent samples t-test to examine gender differences in the time to urinary catheter removal found that time was reduced significantly in both groups (Male, $t = 3.28$, df = 50, $P < 0.01$; female, $t = 4.62$, df = 54, $P < 0.01$). See table 5 below.

Table 5: Differences in Mean Time to Catheter Removal by Gender

	Pre-Intervention	Post-Intervention			
Gender	M (SD)	M (SD)	Test Statistic	Df	*P*
Male	219.50 (146.0)	107.83 (87.26)	t = 3.28	50	< 0.01
Female	264.70(167.15)	101.07 (91.70)	t = 4.62	54	< 0.01

Note. Interaction effect was calculated at -0.52

Pre/Post Comparison on Dependent Variable (Time to Catheter Removal after Order)

The mean time to urinary catheter removal after an order is in place for patients in the pre-intervention period was 241.26 minutes versus 104.07 minutes for those catheterized in the post-intervention period. This result indicated that there was statistically significance difference between the two groups ($t = 5.59$, df = 106, $P < .01$) as shown in table 6.

Table 6: Differences in Mean Time to Catheter Removal Post Order

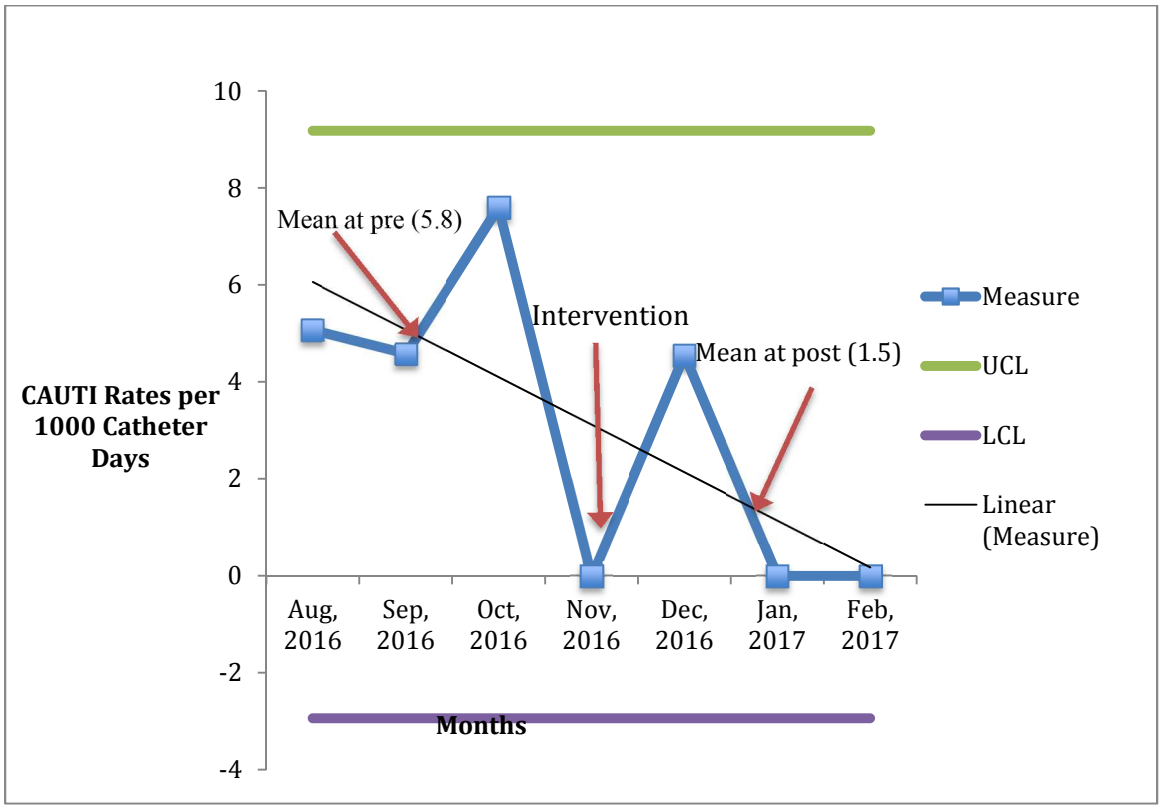
	Pre-Intervention	Post-Intervention			
Variable	M (SD)	M (SD)	Test Statistic	Df	*P*
Time	241.26	104.07	t = 5.59	106	< 0.01

	(156.71)	(88.97)

CAUTI Rates

Catheter associated urinary tract infection rates data from August 2016 to October 2016 (Pre-intervention data) and from December 2016 to February 2017 (Post-intervention data) was obtained from hospital's epidemiology department. As shown in figure 1, the average CAUTI rate decreased from 5.8 to 1.52 per 1000 catheter-days. $P = 0.08$; $t = 2.38$; $df = 4$). However, the decrease was found not be statistically significant.

Figure 2. Results of CAUTI Rates

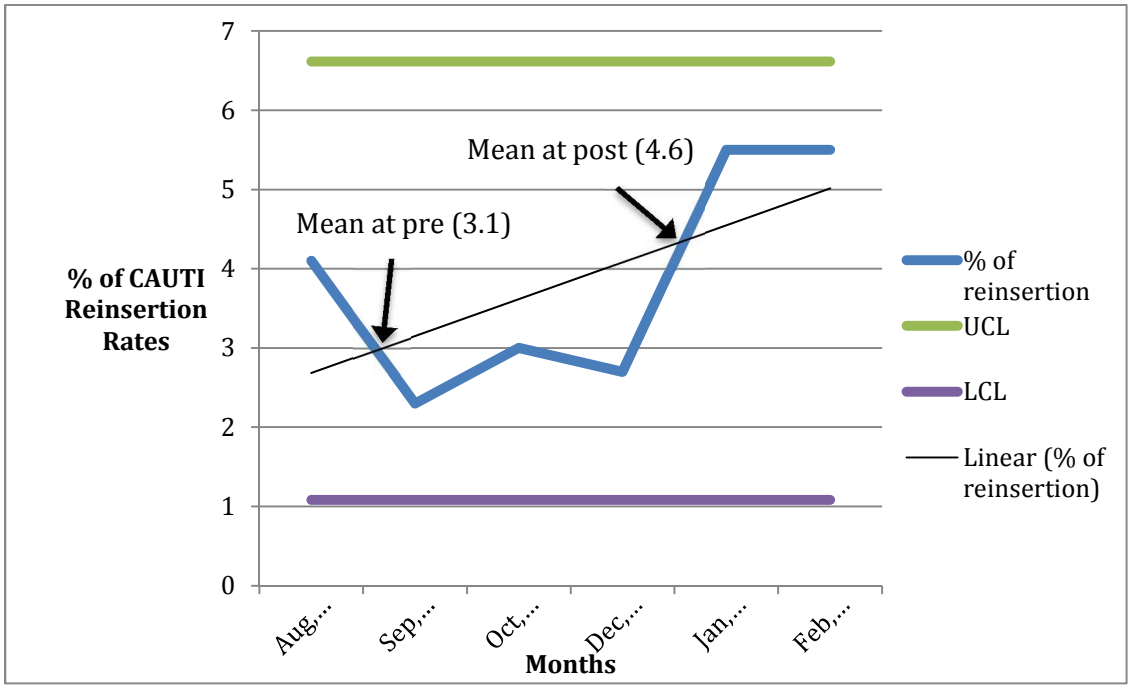


Note. The month of November is the intervention period, therefore not included. Abbreviations: CL, control limit; UCL, upper control limit; LCL, lower control limit

Catheter Reinsertion Rates

Catheter reinsertion rates data from August 2016 to October 2016 (Pre-intervention data) and from December 2016 to February 2017 (Post-intervention data) were obtained from hospital's epidemiology department. As indicated in Figure 2, the mean percentage of CAUTI reinsertion rates increased from 3.1 in the pre-intervention group to 4.6 in the post-intervention group. The difference in reinsertion rates between the two groups was found to be statistically significant ($t = -1.33$, $df = 4$, $P = 0.025$).

Figure 3. Results of CAUTI Reinsertion Rates



Abbreviations: CL, control limit; UCL, upper control limit; LCL, lower control limit

CHAPTER 6: DISCUSSION

Duration of urinary catheterization as a risk factor for CAUTI is well known. Hagerty et al. (2015) found that patients catheterized for a significantly longer duration were at much higher risk for CAUTI. The goal of this project was to decrease the mean duration of urinary catheterization post removal order thereby potentially reducing CAUTI rates in the neurological patient population. This project compared the mean time to urinary catheter removal in the pre-intervention period with post-intervention period, and also compared differences in age, gender, and diagnoses distribution in pre/post groups. Results of this project found that there was a significant decrease in time to urinary catheter removal post order in the post intervention period by 40%, with the time decreasing from 241.26 minutes to 104.07 minutes. This finding suggests that educational intervention aimed at decreasing the time to urinary catheter removal was effective.

Patient Age and Mean Time to Urinary Catheter Removal Post Order

Previous studies have associated age with higher risk for CAUTI and caregiver's concern for removal due to risk of a more serious event like falls (Hagerty et al., 2015; Krein et al., 2013;Lee et al., 2013; Termiz et al., 2012). In this project, older age was expected to have an impact on the duration of catheter removal due to nurses' possible reluctance to remove an indwelling urinary catheter on an older patient. However, it was found that the mean time to urinary catheter in the post-intervention period was shorter despite this group being older than the pre-intervention group. Therefore, increased age did not likely influence the time to urinary catheter removal in the post-intervention period.

Gender and Mean Time to Urinary Catheter Removal Post Order

The association between gender and duration of urinary catheterization was examined because of the female gender association with high risk of CAUTI. Studies have shown that female gender is a risk factor for CAUTI due to anatomical differences predisposing them to contamination (Lee et al., 2013; Termiz et al., 2012). This project however, was concerned with nurses' reluctance to remove the catheter on female patients because unlike their male counterparts, there is no alternative urine collection device for female patients. Despite the potential for differences, this project found that gender distribution was similar across pre and post groups and therefore, would have not likely influenced the mean time to urinary catheter removal. Perhaps a possible explanation for this finding could be the recent introduction of an alternative urine device for female patients, which was being piloted in the unit during the study period. This device offered an alternative means of collecting urine similar to the male external catheter commonly known as condom catheter.

Diagnoses and Mean Time to Urinary Catheter Removal Post Order

Patients in the NSICU are diagnosed with conditions that may require prolonged use of the urinary catheter to manage their conditions. In addition, these patients are critically ill and often meet the criteria for urinary catheter use. This project found that the distributions of diagnoses were nearly the same in the pre and post-intervention group. Therefore, it is unlikely that these diagnoses played a role in the reduction of mean time to urinary catheter removal in the post intervention period. Of utmost importance was the diagnosis of SAH, which was expected to play the biggest role in impacting the time to urinary catheter removal. Due to the nature of their illness and need for strict monitoring of fluid status, patients with SAH often remain catheterized for much of their hospitalization (Hagerty et al. 2015).

CAUTI Rates

When compared with the pre-intervention group, the number of CAUTIs in the post-intervention group decreased from four CAUTIs to one during the project period (5.8 to 1.5 per 1000 catheter-days). Although not statistically significant, this difference is likely to be of some clinical significance especially in a unit where any occurrence of a CAUTI is unacceptable. Perhaps with a larger sample and longer intervention period, the decrease in CAUTI rates would have been statistically significant to support other previous studies that have shown that an educational intervention that uses the CAUTI bundle and stresses the importance of prompt removal is effective in reducing CAUTI rates (Marigliano, Barbadoro, Pennacchietti, D'Errico, & Prospero, 2012; Rosenthal et al., 2012; Titsworth et al., 2012).

Catheter Reinsertion Rates

Although catheter reinsertion rates are not generally a common outcome that is tracked by the National Hospital Safety Network (NHSN), the hospital recently started tracking this data to ensure that urinary catheters were not being removed too soon leading to a high reinsertion rates which could in turn lead to high infection rates. There is a possibility that other factors could have contributed to higher reinsertion rates. For example, a change in patient status requiring reinsertion of catheter for vigilant fluid status monitoring could have contributed to higher reinsertion rates given that prior reinsertion rates were higher than the current rates.

Limitations

This project had several imitations. First, this project was conducted at a single unit with a small convenience sample size. Therefore, results are not generalizable to other patient populations, given differences in patient populations and care practices. Second, any findings in this study could have been influenced by several other factors in the unit such as the use of the

daily goal sheet that has enabled providers and nurses to effectively recognize and remove the urinary catheter, hospital wide initiatives that were rolled out in January 2016, and current unit practices that emphasize maintainance and monthly audits on measures (Appendix 10). Specifically, in the months of August, September and October when high rates of CAUTI were reported, there were no audits performed, and this could have led to higher rates of CAUTI in that time period. Third, this project did not look at catheter utilization ratio. Catheter utilization ratio gives a measure of how many urinary catheters are used on a given unit and is calculated by dividing the number of catheter days by the number of patient days. A reduction in catheter utilization during this quality improvement project period could have potentially influenced results. Lastly, This project assumed that unit staff understood and retained educational information provided on unit protocol on the CAUTI bundle and prompt removal requirements. A follow up survey would have better elicited nurses's perception of the CAUTI bundle principles on prompt removal protocol adherence.

Recommendations

The findings from this project offer some new insights on the use of multi modality interventions in the prevention of CAUTI in the neurological patient population. Of particular interest, this project highlighted the potential need for using an alternative means of monitoring strict intake and output in the NSICU. Considering the lack of published research on the prevention of CAUTI in the SAH population, future research should explore other means of monitoring strict intake and output in this patient population such as the use of a pulse contour cardiac output monitor (PiCCO), a device that enables assessment of the patient's hemodynamics status to guide fluid or vasoactive drug therapy. There are also limited studies on improving compliance with prompt removal of the urinary catheter in the neurological patient population,

particularly female patients. Future studies might examine the use of female external catheter and its effectiveness in preventing CAUTI and promoting compliance with prompt removal of the urinary catheter.

Implication for Practice

The significant of preventing CAUTI in the neurological patients cannot be overemphasized. Although challenges exist in the management of CAUTI in these patient populations, efforts should be made to prevent avoidable harm, morbidity and mortality, and healthcare costs related to CAUTI. This project has demonstrated that educational interventions aimed at improving prompt removal of the urinary catheter can be an effective means of decreasing duration of urinary catheterization in the NSICU patients and improve compliance with such practices that are important in preventing CAUTIs. Nurses are capable of implementing measures directed at quality improvement when empowered as frontline staff, and engaged in active educational interventions to improve adherence with evidence-based practices to prevent CAUTI.

APPENDIX 1: NSICU CAUTI BUNDLE COMPONENTS

Adherence to general infection control principle	❖ Education of staff on evidence-based best practices to prevent CAUTI ❖ Hand hygiene ❖ Sterile catheter insertion using insertion checklist and second personnel present. ❖ Catheter maintenance: catheters care with Johnson & Johnson soap and water once a day and PRN ❖ Urinary catheter use surveillance and feedback ❖ Catheter dependent loop. Use double Stat lock ❖ Maintain closed drainage system
Bladder Ultrasound	❖ Use protocol in place such as performing bladder scanning every 6 hours to check for retention. ❖ Perform intermittent catheterization only if there is >400 cc in the bladder.
Use catheter alternatives	❖ Intermittent catheterization ❖ External condom catheter for men and external female catheter for women (Purewick) with urinary incontinence.
Indwelling Catheter Avoidance	❖ Refer to appropriate indications for insertion. ❖ Insert only with a provider's order
Prompt Removal	❖ Use of reminder system such daily rounding tool ❖ Remove as soon as no longer indicated

Table adapted from Saint, S., Olmsted, R., Fakih, M., Kowalski, C., Watson, S., Sales, A., & Krein, S. (2009). Translating health care-associated urinary tract infection prevention research into practice via the bladder bundle. *Joint Commission Journal On Quality & Patient Safety*, *35*(9), 449-455.

APPENDIX 2: NSICU FOLEY CATHETER REMOVAL SURVEY

1. I am familiar with evidence-based practices to prevent catheter associated urinary tract infections (CAUTI)
(a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

2. I am aware of the risk factors for CAUTI acquisition in the NSICU patient.
(a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

3. The CAUTI guidelines recommendations are relevant to NSICU patients
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

4. I am familiar with CAUTI preventions bundles and its relevance in the NSICU
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

5. I am familiar with the prompt removal component of the CAUTI bundle
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

6. I understand the importance of prompt urinary catheter removal in the prevention of CAUTI
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

7. I remove urinary catheters as soon as an order for discontinuation exists.
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

8. I have sometimes delayed urinary catheter removal as soon as an order for removal exist due to

i) Concerns of reinsertion
j) Risk for patient injury
k) Other important tasks (procedures, tests, going to OR, or transport)
l) Lack of enough resources, such as assistance with incontinence care
m) Patient's altered mental status and unable to communicate need to void
n) Female patient

9. Documentation related to urinary catheter removal is important
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

10. I document urinary catheter removal as soon as it is discontinued?
a) Strongly disagree (b) Disagree (c) Neither agree or disagree (d) Agree (e) Strongly agree

11. List the resources you feel you would need to assist you with removing Urinary catheter as soon as an order exists for discontinuation.

1.
2.
3.
4.

APPENDIX 3: SURVEY CONSENT AGREEMENT

Dear staff:

You are invited to participate in a web-based online survey on Nurse-Driven Educational Intervention For Prompt Removal of Urinary Catheter in the Neuroscience Intensive Care Unit. This is a research project being conducted by Elizabeth Ouma, a student at the University of North Carolina at Chapel Hill. If you choose to consent to participate in this project, please complete the survey, which should take approximately 5-10 minutes to complete.

Your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty. You are free to decline to answer any particular question you do not wish to answer for any reason. To thank you for your participation, an incentive of $5 STARBUCKS gift card will be offered randomly to 20 responders who complete the survey.

There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life. Your survey answers will be sent to a link via qualtrics.com where data will be stored in a password protected electronic format. Qualtrics does not collect identifying information such as your name, email address, or IP address. Therefore, your responses will remain anonymous. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study.

Thank you so much for considering my request.

Link to Survey

Sincerely,

Elizabeth Ouma, BSN, RN
Doctoral Student
University of North Carolina at Chapel Hill
School of Nursing
Email: lizodidi@email.unc.edu

APPENDIX 4: NSICU REMINDER STEPS FOR PROMPT FOLEY REMOVAL AND DOCUMENTATION

NSICU Reminder for Prompt Foley Removal and Documentation

Step 1: Foley removal discussed during daily rounds

Step 2: RN clarifies any obstacle to Foley removal delay such as possibility for a test, procedure or advancing to comfort care.

Step 3: Order for Foley removal transcribed in the Electronic medical

Step 4: Discontinue Foley within as soon as an order exist

Step 5: Document Foley removal at the time of discontinuation in intake and output section of the flowsheet. Document the following:

- Date,
- Time
- Reason for removal, such as no longer necessary or per protocol

Step 6: This step applies if unable to complete step 4. Document reasons for delay when possible in the comment box such as:

- Patient in MRI/CT/VIR
- Procedure in progress
- Possible advancement to comfort care discussed during rounds.

Step 7: Communicate Foley discontinuation to CST who will help with bladder scanning and incontinence care.

APPENDIX 5: IDSA GUIDELINES FOR CAUTI PREVENTION

A. Discontinuation of Catheter Recommendations

- Indwelling catheters should be removed as soon as they are no longer required to reduce the risk of CA-bacteriuria (AI) and CA-UTI (A-II).

B. Limiting Unnecessary Catheterization

- Indwelling catheters should be placed only when they are indicated (A-III). I. Indwelling urinary catheters should not be used for the management of urinary incontinence (A-III).
- Institutions should develop a list of appropriate indications for inserting indwelling urinary catheters, educate staff about such indications, and periodically assess adherence to the institution-specific guidelines (A-III).
- Institutions should require a physician's order in the chart before an indwelling catheter is placed (A-III).

Hooton, T. M., Bradley, S. F., Cardenas, D. D., Colgan, R., Geerlings, S. E., Rice, J. C., Nicolle, L. E. (2010). Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clinical Infectious Diseases, 50*(5), 625-663.

APPENDIX 6: CDC PREVENTION GUIDELINES OF CAUTI

I. Appropriate Urinary Catheter Use

A. Insert catheters only for appropriate indications and leave in place only as long as needed. **(Category IB)**

B. Consider using alternatives to indwelling urethral catheterization in selected patients when appropriate.

- ❖ Consider using external catheters as an alternative to indwelling urethral catheters. (Category II)
- ❖ Consider alternatives to chronic indwelling catheters, such as intermittent catheterization, in spinal cord injury patients. (Category II)
- ❖ Intermittent catheterization is preferable to indwelling urethral or suprapubic catheters in patients with bladder emptying dysfunction. (Category II)

Systems of Documentation

Consider implementing a system for documenting the following in the patient record: indications for catheter insertion, date and time of catheter insertion, individual who inserted catheter, and date and time of catheter removal. (Category II)

- ❖ Ensuring that documentation is accessible in the patient record and recorded in a standard format for data collection and quality improvement purposes is suggested. Electronic documentation that is searchable is preferable. **(Category II)**

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APPENDIX 7: CAUTI FACTS

Facts about CAUTI:

1. Patients‘ risk for getting a CAUTI is about 3% to 7% every day the indwelling urinary catheter is left in place (Tominaga et al., 2014).

2. The cost of treating a single episode of CAUTI varies from $980 to $2900 with associated bacteremia (Gray, 2010).

3. CAUTI is among the hospital acquired infections that are no longer reimbursed by the Centers for Medicare and Medicaid Services (CMS) (Gray, 2010).

4. Duration of catheterization is the single most important risk factor for CAUTI (Lo et al., 2014).

CAUTIs can cause major harm and can increase cost for all.

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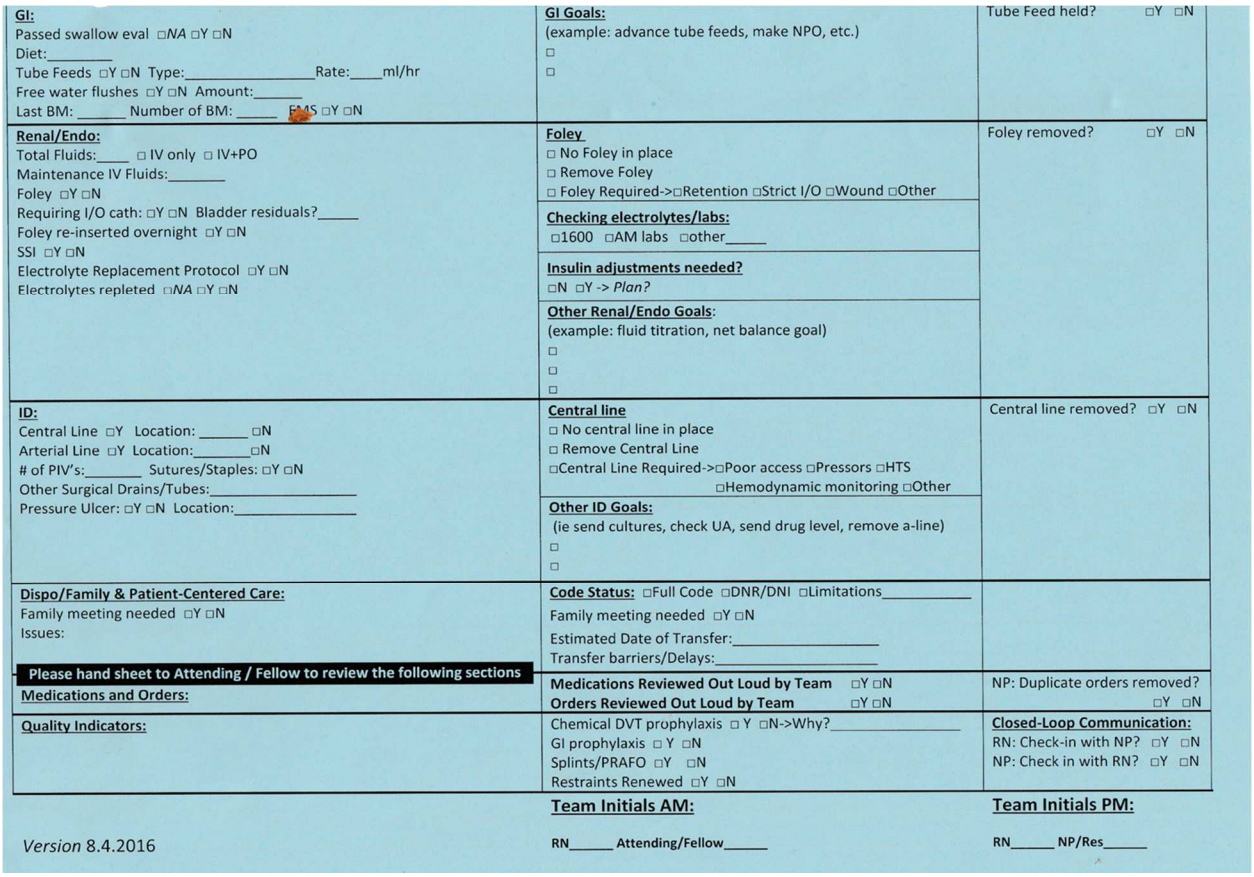
APPENDIX 8: SHEA/IDSA (2014) RECOMMENDED INDICATIONS FOR URINARY CATHETER USE**.**

- Preoperatively, for selected surgical procedures such as urologic surgery or surgery on contiguous structures of the genitourinary tract.
- Prolonged surgery
- Need for large volume infusions or diuretics during surgery
- Intraoperative monitoring of urine output needed
- **Monitoring hourly assessment of urine output in patients in intensive care units (ICU).**
- Management of acute urinary retention and urinary obstruction
- Assistance in healing of open pressure ulcers or skin grafts for selected patients with urinary incontinence.
- As an exception, at patient request to improve comfort (e.g., end-of-life care).

Lo, E., Nicolle, L.E., Coffin, S.E., Gould, C., Maragakis, L.L., Meddings, J., Pegues, D.A., Pettis, A.M., Saint, S., & Yokoe, D.S. (2014). Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals: 2014 Update. Infection Control and Hospital Epidemiology, 35(5), 464-479. doi:10.1086/675718

APPENDIX 9: NSCIU DAILY GOAL SHEET (BACK VIEW)



GI: Passed swallow eval □*NA* □Y □N Diet:_____ Tube Feeds □Y □N Type:_____Rate:____ml/hr Free water flushes □Y □N Amount:_____ Last BM: _____ Number of BM: _____ FMS □Y □N	**GI Goals:** (example: advance tube feeds, make NPO, etc.) □ □	Tube Feed held? □Y □N
Renal/Endo: Total Fluids:____ □ IV only □ IV+PO Maintenance IV Fluids:_____ Foley □Y □N Requiring I/O cath: □Y □N Bladder residuals?_____ Foley re-inserted overnight □Y □N SSI □Y □N Electrolyte Replacement Protocol □Y □N Electrolytes repleted □*NA* □Y □N	**Foley** □ No Foley in place □ Remove Foley □ Foley Required->□Retention □Strict I/O □Wound □Other **Checking electrolytes/labs:** □1600 □AM labs □other_____ **Insulin adjustments needed?** □N □Y -> *Plan?* **Other Renal/Endo Goals**: (example: fluid titration, net balance goal) □ □ □	Foley removed? □Y □N
ID: Central Line □Y Location: _____ □N Arterial Line □Y Location:_____□N # of PIV's:_____ Sutures/Staples: □Y □N Other Surgical Drains/Tubes:_____ Pressure Ulcer: □Y □N Location:_____	**Central line** □ No central line in place □ Remove Central Line □Central Line Required->□Poor access □Pressors □HTS □Hemodynamic monitoring □Other **Other ID Goals:** (ie send cultures, check UA, send drug level, remove a-line) □ □	Central line removed? □Y □N
Dispo/Family & Patient-Centered Care: Family meeting needed □Y □N Issues: **Please hand sheet to Attending / Fellow to review the following sections** **Medications and Orders:**	**Code Status:** □Full Code □DNR/DNI □Limitations_____ Family meeting needed □Y □N Estimated Date of Transfer:_____ Transfer barriers/Delays:_____ **Medications Reviewed Out Loud by Team** □Y □N **Orders Reviewed Out Loud by Team** □Y □N	NP: Duplicate orders removed? □Y □N
Quality Indicators:	Chemical DVT prophylaxis □Y □N->Why?_____ GI prophylaxis □Y □N Splints/PRAFO □Y □N Restraints Renewed □Y □N	**Closed-Loop Communication:** RN: Check-in with NP? □Y □N NP: Check in with RN? □Y □N
	Team Initials AM:	**Team Initials PM:**
Version 8.4.2016	**RN_____ Attending/Fellow_____**	**RN_____ NP/Res_____**

Olm-Shipman et al. (2016). Implementation of a daily goals tool improves team communication surrounding quality & safety practices in a neurosciences ICU. Poster session presented at the 14th Annual Neurocritical Care Society Meeting.

APPENDIX 10: NSICU CAUTI MEASURES COMPLIANCE AUDIT

NSIU

Audits Completed for each Measure*	**Sep-16**	**Oct-16**	**Nov-16**	**Dec-16**	**Jan-17**	**Feb-17**
Unobstructed urine flow	0	0	0	10	16	
Catheter properly secured	0	0	0	10	16	
Seal between bag and catheter	0	0	0	10	16	
Collection bag lower than the bladder	0	0	0	10	16	
Collection bag not touching the floor	0	0	0	10	16	
Absence of dependent loop	0	0	0	10	16	
Daily foley care charted last 24 hours	0	0	0	4	16	
Daily pericare charted last 24 hours	0	0	0	8	16	
Daily assessment of need charted	0	0	0	10	16	
Indication for daily assessment of need charted	0	0	0	10	16	

**number of audits completed may vary since each measure may not be able to be assessed during every audit*

Compliance Percentage					
Unobstructed urine flow	0.0	0.0	0.0	100.0	93.8
Catheter properly secured	0.0	0.0	0.0	80.0	100.0
Seal between bag and catheter	0.0	0.0	0.0	80.0	87.5
Collection bag lower than the bladder	0.0	0.0	0.0	100.0	100.0
Collection bag not touching the floor	0.0	0.0	0.0	100.0	100.0
Absence of dependent loop	0.0	0.0	0.0	90.0	37.5
Daily foley care charted last 24 hours	0.0	0.0	0.0	75.0	81.3
Daily pericare charted last 24 hours	0.0	0.0	0.0	75.0	87.5
Daily assessment of need charted	0.0	0.0	0.0	100.0	81.3
Indication for daily assessment of need charted	0.0	0.0	0.0	100.0	68.8

90-100 % Compliance
80-89% Compliance
<80% Compliance

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