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Final DNP Capstone Report

An Evaluation of the Adherence to an Indwelling Urinary Catheter Maintenance Bundle

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College of Nursing

Spring 2015

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Introduction to Final DNP Capstone Report

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Introduction and Background

While the future of healthcare is uncertain, one thing remains certain - the complexity of healthcare continues to increase. The increasing complexity of care involves increased costs for hospitals, increased mortality, morbidity, and hospital length of stay. Hospital administrators, managers, and staff may not be able to foresee all changes and complexities in healthcare, but it may be possible to prevent occurrence of infections. It is vital that hospitals address issues that can be managed within the hospital setting. It is just as vital to evaluate the adherence to protocols, interventions, and initiatives developed to offset the rising incidence of hospital-acquired infections (HAIs).

A hospital-acquired infection -also known, as a nosocomial infection is an infection acquired during an acute hospital stay (Gould, Umsheid, Agarwal, Kuntz & Pegues, 2009). Hospital-acquired infections are one of the top 10 leading causes of mortality in the United States (Center of Disease Control, 2013) with 1.7 million people developing HAI's and 100,000 patients' deaths from related complications every year (Clarke et al. 2013). Moreover, there are approximately 1 million CAUTI occurrences per year in the United States, with an estimated cost to treat of $400 million dollars annually (Clarke et al., 2013). These statistics make it vital to incorporate evidence-based interventions to reduce the risk of CAUTIs within the acute care setting. It is just as vital to evaluate adherence to these practices to ensure that they are being completed, which ultimately can affect desired outcomes (Gould et al., 2009).

The CDC recommends defining, tracking, collecting and reporting data concerning urinary tract infections (UTIs), which are the most common HAIs, comprising roughly 30 - 40% of all infections occurring in acute care hospitals (Gould et al., 2009). Up to 380,000 infections, 9,000 CAUTI related deaths per year, and 17% to 69% of CAUTIs could be prevented with the

Centers for Disease Control & Prevention recommended infection control measures in place (Gould et al., 2009). A urinary tract infection is a fungal or bacterial infection within the urinary system, including the ureters, bladder, kidneys, and urethra (Mayo Clinic Staff, 2012). If bacteria enters the urinary tract and is not killed by the body's natural defenses it multiplies within the bladder, producing a bacterial infection (Mayo Clinic Staff, 2012). Bacteremia can be defined as bacteria in the bloodstream, which can lead to life threatening conditions including septic shock and death (Saint et al. 2009). Urinary tract infections associated with bacteremia can increase mortality up to 10% (Gould et al., 2009).

Catheter-associated urinary tract infections are diagnosed by the presence of bacteremia along with an elevated white blood cell count (WBC) on a urinalysis examination. In some cases, other signs and symptoms may present including an elevated serum WBC with two or more of the following symptoms: pain or burning in the region of the bladder, bladder spasms/leakage, catheter obstruction, change in mental status (confusion, lethargy, agitation, and delirium), fever (greater than 100.4F or 38C), urine odor, changes in color or characteristics of urine (including cloudy urine or increased sediment), and hematuria (Wound Ostomy and Continence Nurses Society, n.d.). Catheter associated urinary tract infections are the leading cause of secondary hospital associated bloodstream infection and about 17% of hospital-associated bacteremia is from a urinary source (Gould et al., 2009).

In the United States, about 15% of patients admitted into an acute care facility receive an indwelling urinary catheter at some point during their hospital stay (Saint et al., 2009). An indwelling urinary catheter is a drainage tube inserted into the urinary bladder through the urethra, and it is also referred to as a foley catheter (Centers for Disease Control, 2013). This drainage tube is connected to a drainage bag and is a closed-drainage system for obtaining an

accurate hourly urine output (Gould et al., 2009). A foley catheter does not include a condom catheter, suprapubic, or straight in and out catheters. By definition, a foley catheter only includes indwelling urethral catheters and does not include catheters used for continuous irrigation or intermittent catheterization (Centers for Disease Control, 2013). Annually, more than 30 million foley catheters are inserted in the United States, causing approximately 1 million CAUTIs (Saint et al., 2009).

Researchers have associated the use of indwelling catheters with increased patient acuity, increased complexities in healthcare, severity of illnesses, and decreased staffing (Saint et al., 2009). With the high utilization of foley catheters in acute care facilities, it is not surprising that they account for almost half of all HAIs and 80% of CAUTIs (Saint et al., 2009). Regardless of the rationale for increased catheter use, it may be important for hospitals to push to decrease catheter-associated urinary tract infections in order to decrease hospital costs and to avoid penalties from the federal and state agencies monitoring Medicare and Medicaid services.

Given the economic and clinical effects of CAUTI, there is a pressing need for interventions to decrease CAUTI rates. Research has shown 28% better patient outcomes and millions of hospital dollars saved when evidence- based interventions are incorporated into nursing practice (Fineout-Overhot, Melnyk & Schultz, 2005).

This quality improvement project is an evaluation to the adherence of a Catheter Associated Urinary Tract Infection Maintenance Bundle (CAUTI bundle) among staff nurses in a Level One Trauma Intensive Care Unit (TICU). The main objectives of this project were to: 1) describe staff adherence to practice guidelines outlined in an indwelling urinary catheter bundle, and, 2) examine associations between urinary catheter bundle adherence and patient

characteristics including age, gender, race, body mass index, and hospital length of stay for hospitalized patients in a Level One Trauma Intensive Care Unit.

This quality improvement evaluation project will provide insight and guide further research on effective strategies and factors that may affect adherence to practice guidelines to indwelling urinary catheter bundles. This evaluation project includes three manuscripts each of which discusses relevant aspects of catheter associated urinary tract infections, strategies in prevention, and the bundling process. Additionally, the evaluation to the adherence of a indwelling catheter urinary bundle in a TICU will be presented.

- Manuscript one is a review of literature on CAUTI prevention, specifically, interventions aimed at timely removal of indwelling urinary catheters. Studies that have been published evaluating interventions to reduce the duration of an indwelling catheter and CAUTIs in hospitalized patients were reviewed.
- Manuscript two describes the evidence based bundling process that is the foundation for catheter associated urinary tract infection (CAUTI) bundles. This manuscript also serves to describe evidence based interventions that when bundled together can decrease the hospital acquired CAUTI
- Manuscript three describes the evaluation of the adherence to an indwelling urinary catheter maintenance bundle and offers recommendations for future research in regards to CAUTI bundles.

Manuscript 1

Reducing the Duration of an Indwelling Urinary Catheters with Evidence Based Interventions

A Literature Review

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Abstract

Indwelling urinary catheters are frequently used in hospitalized patients and are often an appropriate measure of care. However, indwelling urinary catheters in hospitalized patients can increase the risk of developing catheter-associated urinary tract infections (CAUTIs). The greatest risk factor for developing a CAUTI is the duration of catheter placement.

The purpose of this manuscript is to review the published evidence in CAUTI prevention, specifically, interventions aimed at timely removal of indwelling urinary catheters. Studies evaluating interventions to reduce the duration of indwelling catheters and the incidence of CAUTIs in hospitalized patients were reviewed. The studies highlighted two types of strategies to reduce the duration of catheters and the incidence of CAUTI. The first was nursing- led interventions, and the second was informatics-led interventions. The informatics-led interventions included two subtypes: computerized interventions and chart reminders. Evidence supports the use of both informatics-led and nurse-led interventions to reduce the length of time the indwelling urinary catheter is in place and, consequently, to decrease CAUTI incidence.

Key Words: Hospital-Acquired Infections, Bacteremia, Informatics, Indwelling Urinary Catheters, and Catheter-Associated Urinary Tract Infection (CAUTI).

Background and Significance

Indwelling urinary catheters are used frequently among hospitalized patients and are often an appropriate mode of care management. However, indwelling urinary catheters may often be used without cause or indication (Gokula, Hickner, & Smith, 2004; Jain, Parada, David, & Smith, 1995; Joanna Briggs Institute, 2008). When catheters are used without a clear reason, they tend to be left in longer, increasing the risk of complications (Gokula et al., 2004). Indwelling urinary catheter complications may include psychological and physical discomfort, renal inflammation, bladder calculi, and the most common, catheter- associated urinary tract infection (CAUTI) (Gokula, Hickner, & Smith, 2007). Moreover, catheter- associated urinary tract infections can increase the incidence of delirium, falls, and immobility in the adult population (Hazelett, Tsai, Gareri, & Allen, 2006).

Urinary tract infections (UTIs) make up about 35% of all hospital-acquired infections (Hart, 2008). Eighty percent of urinary tract infections are associated with the use of an indwelling urinary catheter (Gokula et al., 2004). CAUTIs not only have an impact on quality of life, but they also place a financial burden on hospitals due to the increased cost of treatment and length of stay. The exact cost of treating a CAUTI is difficult to estimate because of the constant change in healthcare billing (Saint, 2000). In the U.S., the concern about CAUTIs has led to major reimbursement changes from the Centers for Medicare and Medicaid Services (CMS). The CMS reimbursement changes developed as a result of the view that a CAUTI is a preventable problem. Hospitals are no longer being reimbursed for the additional costs for treating CAUTIs if they were not present at the time of admission (Wald & Kramer, 2007). This is an incentive to hospitals nation-wide to implement strategies to decrease the prevalence of CAUTIs.

CAUTIs can be a financial burden to healthcare facilities, and they can affect a patient's quality of life. For example, through a systematic review of economic and clinical consequences of bacteremia from catheters, Saint (2000) found that 3.6% of patients with symptomatic UTIs developed bacteremia. Bacteremia is the presence of bacteria in the blood, and mortality from bacteremia is as high as 10% (Saint, 2000). According to Gould et al. (2009), morbidity and mortality rates associated with CAUTIs are low compared to other hospital-acquired infections; however, the wide use of urinary catheters in hospitalized patients can lead to a greater prevalence of CAUTIs and an increased risk for mortality. Due to the prevalence of CAUTIs and other serious complications associated with urinary catheters, efforts to restrict the use of these catheters by requiring clear indications for insertion and discontinuation are warranted (Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2009).

The purpose of this literature review is to evaluate the current literature for evidence-based strategies to reduce unnecessary catheter insertion and to assess the effect of such strategies on the duration of catheterization and the incidence of CAUTIs.

Indications for Indwelling Urinary Catheter Use

The indications for indwelling catheter use include urinary retention, close monitoring of urinary output in the critically ill patient, urinary incontinence in a patient with a stage III or greater pressure ulcer, obstruction to the urinary tract, and comfort care for terminally ill patients (Gokula et al., 2007; Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2009; Hooton et al. 2010; Nazarko, 2008). Though there are established guidelines and recommendations for catheter use, catheters are often inserted for inappropriate reasons or the reasons are not appropriately documented (Gokula et al., 2004; Munasinghe, Yazdani, Siddique, & Hafeez, 2001; Jain et al., 1995; Raffaele, Bianco, Aiello, & Pavia, 2008).

In the hospitalized patient population, the rate of unnecessary urethral catheterization is between 21% and 50% (Gardam, Amihod, Orenstein, Consolcaion, & Miller, 1998; Jain et al., 1995; Gokula et al., 2004; Saint, 2000). Gokula and colleagues (2007) and Munasinghe et al., (2001) found that the majority of inappropriately inserted catheters were placed during an emergency department visit. In one-third of hospitalized patients, urinary catheters are inserted without a physician's order and without an appropriate, documented rationale (Gokula et al., 2004; Gokula et al., 2007).

There are many reasons for the insertion of a urinary catheter; however, the assessment for the continued use of the catheter is, in many cases, overlooked. This leads to catheters remaining in place without appropriate indications (Jain et al., 1995; Dingwall & McLafferty, 2006). Dingwall and McLafferty (2006) reported that even though nursing staff are educated about appropriate indications for an indwelling catheter and associated risks, urinary catheters are still being used for personal preference and the reasons for continued use are not properly documented. According to Hooten et al. (2010) and Saint, Lipsky, and Goold (2002), with each day the urinary catheter is in place, the risk for infection increases from 3%-10%, even with the best nursing care. Hooten et al., (2010) and Saint et al., (2002) recommend that strategies should be developed to ensure that catheters are being used only when indicated and only for as long as needed. Hence a review of the literature is warranted to examine the effectiveness of existing strategies to reduce unnecessary catheter usage and reduce incidence of CAUTIs among acute care patients.

Methods

A search of the electronic databases MEDLINE, CINAHL, Cochrane Database, and Google Scholar was conducted. Grey literature, abstracts from conferences between 2000 and 2013, were also reviewed. Search terms included indwelling urinary catheters, foley catheter, and urinary catheter, UTI, bacteria, pyuria, CAUTI, catheter- acquired urinary tract infection, acute care, tertiary care, and hospital-acquired infections. Fifty-three abstracts were appraised, and only research studies that addressed acute care patients, the timely removal of catheters, the outcome measures of duration of indwelling urinary catheters, and incidence of CAUTIs were included in the review. Of the 53 abstracts reviewed, nine fit the inclusion criteria.

The nine studies focused on reducing the duration of catheter use and the incidence of CAUTIs (see Table 1). Most of the studies incorporated reminder systems to trigger the review for continuous use of a catheter. Two key interventions were identified as a result of this literature review: nurse-led interventions (Crouzet et al. 2007; Elpern et al. 2009; Fakih et al. 2008; Huang et al. 2004 2004; Robinson et al. 2007) and informatics-led interventions with two sub-types- computerized (Apisarnthanarak et al. 2007; Cornia, Armory, Frasor, Saint, Lipsky, 2003); Topal et al. 2005) and chart reminders (Loeb et al. 2008).

Results

Nurse-led Interventions

Nursing led interventions typically involve a variety of nurses including the charge nurse, clinical nurse specialists, and staff nurses. These nurses assess, after a specified period of time, whether or not the urinary catheters are still indicated for optimal patient care. The assessment of indication leads to the decision to discontinue or continue the use of the indwelling urinary

catheter. This happens through collaborative efforts with the physician and/or utilization of a standing order (Saint, 2000).

Additionally, Elpern et al., (2009) conducted a quasi-experimental design study in a medical intensive care unit (ICU) at the Rush Medical Center, in Chicago. The study sample included all patients with an indwelling urinary catheter or any patients with an indwelling catheter insertion during their stay at the medical center. The indication phase of the intervention was the identification of patients with an indwelling urinary catheter by a member of the nursing staff. On a daily basis, in consultation with the staff nurses and with the physicians, the investigators determined whether there were appropriate indications for the continuation of catheter use as defined in a literature review on the indications for use. Data were collected over a six-month period with outcome measures consisting of number of days of catheter use and rates of CAUTI. The prospective data was compared to the retrospective data from the 11-month pre- study initiation. Results indicated that the active intervention of daily consultation and review of the need for a catheter reduced the number of indwelling urinary catheter days from 311.7 days per month to 238.6 days per month ($p<0.001$).

Taiwanese researchers Huang et al., (2004) investigated a nurse-led intervention to discontinue indwelling urinary catheters. Participants were recruited from five ICUs including cardiovascular, surgery, coronary care, neuro-surgery, and medicine ICU. The study included a 12-month observational period that was then followed by a 12- month interventional period. Patients with indwelling catheters were identified through an order entry computerized system. All patients who had the urinary catheter were included in this study and indications for insertion and continuation of the urinary catheters were defined. The primary intervention in this study was a daily reminder to physicians by the nurses to remove catheters five days after the insertion.

Overall, there was a consistent decrease in the duration of catheters in situ from 7.0 +1.1 days to 4.6+ 0.7 days and a statistically significant reduction in the incidence of CAUTI from 11.5 + 3.1 to 8.3 + 2.5 per 1000 catheter days. Statistical analysis for this study included chi-square for categorical data, two-tailed students t-test was used for comparing continuous variables, and a linear regression was used to assess the relationship between the monthly average duration of catheterization and the rate of a CAUTI.

French researchers conducted a quasi-experimental study of a nursing-led intervention in several non-critical acute care units by assessing all patients with an indwelling urinary catheter (Crouzet et al., 2007). This six-month study included a three-month observational and three-month interventional period. During the observational period CAUTIs occurred on days 5 and 6 of catheterization. The target day for removal of the catheter was on day 4. There was no overall significant reduction in the length of time the catheters were in situ (8.4 days vs. 6.7 days), but there was a significant reduction in CAUTI rates (12.8% vs. 1.8%). The researchers linked the improvement in CAUTI rates to increased surveillance and a decrease in catheter days by utilizing logistic regression analysis (Crouzet et al., 2007).

In another study by Fakih et al. (2008), a quasi-experimental design was utilized to assess pre-existing nursing led multidisciplinary rounds within 10 nursing units. This study encompassed three phases: pre-intervention, intervention, and post-intervention phases. Each unit served as a control and was part of the intervention for one period of time. The nursing staff was provided instruction, which included the indications for urinary catheter use, outlined in the Centers for Disease Control and Prevention (CDC) guidelines (Gould et al., 2009). The nurses contacted the physicians if no indications existed for the catheterization, and if no indications were noted, an order was requested for discontinuation of the catheter. There was a significant

reduction in the number of urinary catheter days from 203 days per 1000 patient days to 162 days per 1000 catheter days (p= 0.002) However, it was reported that once the study was complete, there was a regression to the pre-intervention practices in the post-intervention phase. This study utilized the Mantel-Haenszel test and the *x2* test for statistical analysis. This study emphasized the need for on-going support of nursing staff to change practice.

In a mixed retrospective and prospective study by Robinson et al., (2007), patient records were reviewed retrospectively for two weeks to identify patients who had an indwelling urinary catheter. No appropriate reason could be found as to why the catheter was in place for the patients who were included in the study, and many of the patients developed CAUTIs. In the prospective review, the charge nurses identified patients without a clear indication for a catheter. The researchers concluded that the charge nurses' active interventions in requesting discontinuation of the unneeded catheters resulted in a 67% reduction in the number of catheter days and a 26% reduction in the number of CAUTIs when compared to the results from the retrospective segment of this study.

Informatics-led Interventions

Informatics led interventions utilize technological information systems that automatically prompt health care providers to action on a particular indicator. In this review, two studies described two different types of order entry systems. The first was a computerized order entry and charting system that prompts providers to assess and continually reassess the indication for the need of an indwelling urinary catheter (Topol et al., 2003). The second study involved documenting the use of a catheter in an electronic database with automatic stop and entry orders (Apisarnthanarak et al., 2007; Cornia et al., 2003).

Computerized Interventions

Topal et al. (2005) conducted a quasi-experimental design study using a computerized order-entry and charting system in an acute care setting. This experiment was completed over three collection cycles including a pre-intervention and intervention phase at two points; each of these cycles lasted 53 days. Within each cycle, the researchers measured and recorded the incidence of CAUTIs, the use of antimicrobials, and the duration of catheterization. The intervention phase included two separate strategies; entering the indications for the catheter being ordered into the computerized system, and, allowing the nursing staff to discontinue catheters that no longer had an indication for use based on their assessment. The nursing staff were educated on the indications for a catheter, the alternatives, and bladder scanning after removal to assess retention. These interventions resulted in a 42% reduction in the duration of catheterization. A follow up was completed one year after this study and data revealed a 79% reduction in the duration of catheterizations.

Cornia et al. (2003) conducted a quasi-experimental design study to determine the effect of a computerized reminder system on the duration of catheterization. This study focused on patients who were admitted to two medical and cardiovascular floors, each containing its own wards. One floor and its ward was the intervention group and the other floor with its wards was the control group. The intervention included the adoption of computerized order-entry systems that required the physician to indicate the rationale for initiating the insertion of a catheter and after three days an added daily reminder to determine if the catheter was still needed. In the control ward the catheters were initiated as written orders, with no reminders. The number of UTIs and the number of days of catheterization in the intervention and control units were compared after the first day of catheterization. A significant reduction in the number of

catheterization days, 8 days to 5 days, was documented in the intervention wards with no changes noted in the control ward. However, there was no significant reduction in CAUTI rates in the intervention wards.

Another study in an inner-city hospital in Thailand tested the effect of a computerized order-entry system in reducing indwelling urinary catheter use (Apirsarnthanarak et al., 2007). A pre- and post- measure was used to evaluate the efficacy of a program that focused on nurses reminding physicians to order the removal of unneeded urinary catheters. The intervention was a daily reminder to the nurses on the computerized order entry system to identify patients with catheters that had been in place for more than three days. The reminders then notified the attending physicians if the catheters were not indicated. The nurses were educated on appropriate indications for catheter use. The outcome measure was the development of a CAUTI pre- and post-intervention. At the end of the study, there was a significant reduction in the number of catheter-utilization days, with a mean reduction from 11 days to three days, and there was a significant reduction in CAUTIs from a mean rate of 21.5 infections per 1000 catheter-days to 5.2 infections per 1000 catheter days ($p< 0.001$) (see Table 2).

Chart Reminders

A randomized controlled trial was performed in three acute care hospitals in Ontario among all patients with indwelling urinary catheters (Loeb et al., 2008). This study utilized automatic stop orders through the medication order-entry system. The participants were assigned to either a group with the automatic stop orders or the control group where the current practice was performed. The intervention consisted of an automatic pre-written stop order to discontinue the use of the urinary catheters if no longer needed. The nursing staff was required to select an indication if they wished to maintain the indwelling catheters. The potential

indications for continued catheter use included urinary obstruction, urinary retention, neurogenic bladder, urological surgery, open sacral wound for incontinent patients, and urinary incontinence in terminally ill patients. There was a significant reduction in CAUTIs from an occurrence of 20.2 % to 19%, and inappropriate use of catheter utilization decreased from -1.69 to -1.23 ($p<0.001$) (see Table 2).

Discussion

The purpose of this literature review was to examine the evidence on strategies for the timely removal of indwelling urethral catheters and to assess the strategies on their effectiveness and impact on CAUTI incidences. In this review, nine research articles that addressed the topic met the inclusion criteria. The evidence supported the use of nursing-led interventions or chart reminders. These two strategies included consistent daily assessment of the continual indication for urinary catheters and promoted the removal of catheters as soon as possible. Only one study (Loeb et al., 2008) was a randomized controlled trial. The experimental design was possible because of the computerized charting system in the study setting. This allowed for identification and randomization of patients included in the study.

With the exception of Crouzet et al. (2007) and Robinson et al. (2007), the studies reviewed showed significant reductions in the duration of catheter days with a planned removal. Of the nine studies reviewed, Fakih et al. (2008) and Robinson et al. (2007) were the only two research teams who demonstrated a significant reduction in CAUTI rates. Despite these findings, the studies highlighted the potential of interventions to decrease catheter use. Early removal of a catheter reduces nursing care time and increases patient comfort and mobility. This alone justifies the early removal of a catheter, regardless of whether or not CAUTIs are being

measured. These outcomes were not addressed in this literature review, however, their exploration is recommended for future research.

Limitations of this review include the lack in consistency in defining short-term catheter use. Two common definitions that were identified included 1-14 days (Joanna Briggs Institute, 2008; Fernandez & Griffiths, 2006) and 1-30 days (Gould et al., 2009; Cochran, 2007). The CDC guidelines for CAUTI prevention recommend 30 days as a baseline for short-term catheterization (Gould et al., 2009). In addition, only one study used a randomized controlled design. Furthermore, a factor that reduced the quality of the reviewed studies [with the exception of Apisarnthanarak et al. (2007), Cornia et al. (2003), and Loeb et al. (2008)] was the lack of reported confidence intervals, which makes it difficult to accurately assess the magnitude of outcome effects. Another factor that could have affected the results of the review was that selected studies were conducted in a number of different countries and healthcare specialties where healthcare practices and resources vary. Regardless, it is important to note that all interventions including nurse-led and informatics-led strategies were associated with a reduction in the duration of catheter days.

Implications for Practice

The participation of nurses and the involvement of their care in the reviewed studies demonstrate their strong role in reducing complications from urinary catheters (Gokula et al., 2007). These studies incorporated different strategies and interventions; nonetheless, they all involved nursing staff with nursing-led interventions that systematically monitored patients. They also included reminders for the physicians of patients who had indwelling catheters. Further research should include the investigation of the benefit of targeted education for nurses

regarding indwelling urinary catheters and the effect of the education on early catheter removal at appropriate times (Saint et al., 2002).

These findings have implications for practicing registered nurses and undergraduate nursing education. This is because the knowledge base regarding appropriate catheter use is well established and should be included at every level of nursing education. Urinary catheter principles should be integrated in undergraduate education including indications, dangers, and skills of insertion (Saint, 2000). It is important to teach new graduate nurses the indications, continual use, and early removal guidelines for indwelling urinary catheters upon beginning their practice in hospital settings.

There is a hospital wide need, in many settings, to better understand the indications of catheterization and to implement this knowledge into practice (Dingwall & McLafferty, 2006). Dingwall and McLafferty (2006) explained that in many instances a nurse's knowledge is extensive but does not always translate into practice. Further research can address the factors that influence the translation of knowledge into practice and explore the impact of nursing culture on the proper use of an indwelling urinary catheter (Dingwall & McLafferty, 2006).

Conclusion

It is important to not overlook the potential and serious health outcomes of an indwelling urinary catheter. Indwelling urinary catheters can lead to increased morbidity and mortality in hospitalized patients (Saint, 2000). There is evidence based research that describes the indications for catheter use in the acute care setting (Gokula et al., 2007; Saint, 2000; Saint et al., 2002); however, there is still a need to determine the best methods for ensuring the timely removal of an indwelling urinary catheter in a variety of settings. The studies selected for this review indicate that both nurse-led and informatics-led interventions succeed in the reduction of

unnecessary catheter use that can play an important role in reducing the incidence of CAUTI events. More research is needed to investigate barriers of translating knowledge about catheter-associated urinary tract infections into practice. An understanding of these barriers is important in the application and integration of these interventions into acute care settings.

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Manuscript 2

A Urinary Indwelling Catheter Bundle to Decrease Catheter- Associated Urinary Tract Infections: The Evidence Based Bundling Process

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Abstract

The purpose of this manuscript is to define the evidence based bundling process that serves as the foundation for catheter- associated urinary tract infection (CAUTI) bundles. This manuscript also describes evidence based interventions that, when bundled together, can decrease the hospital acquired CAUTI. Patients are endangered by hospital-acquired infections (HAIs) nationwide. Increasing complexities in healthcare along with HAIs have resulted in rising costs of medical care. Most of these infections, about 23%-49% of them, occur within the urinary tract system, and 65%-76% of these cases involve an indwelling catheter. It is critical to investigate interventions on how to prevent these infections.

Evidence based practice (EBP) has evolved over the past few decades transforming the way patients receive nursing care. 'Bundles of care' are being considered the radically new avenue to improve the provision of care for patients. These bundles of care usually consist of four to five elements of EBP carried out as a complete set of activities. Bundles are supported by clinical evidence and provide a framework for improving patient care.

The implementation of a "CAUTI bundle" can decrease CAUTIs, improve catheter care practices, and spare hospitals millions of dollars by preventing these hospital-acquired infections. By organizing EBP into a bundle, healthcare facilities can decrease the rates of CAUTI events and improve everyday catheter care practices with the ultimate goal of decreasing the cost of treating CAUTIs while improving patient care.

Key Words: Catheter, Indwelling Catheter, Urinary Tract Infection, Foley Catheter, Bundles of Care, Foley Bundles, Urinary Tract Infections, Catheter- Associated Urinary Tract Infections, Hospital acquired infections.

Background and Significance

As complexities in health care continue to rise, healthcare facilities and administrators are eager to implement interventions to cut the ever-rising cost of hospital- acquired infections (HAIs). An HAI is an infection acquired during an acute hospital stay (Gould, Umsheid, Agarwal, Kuntz, & Pegues, 2009). HAIs are one of the top ten leading causes of mortality in the United States (CDC, 2013). Healthcare administrators feel the financial strain of treating HAIs and increased pressure to avoid these complications from strict insurance reimbursement plans.

Beginning in 2008, the Centers for Medicare and Medicaid Services (CMS) instituted the concept of *value based purchasing*, no longer reimbursing hospitals for additional treatment for patients who acquired a HAI (Saint et al., 2009). "Value-based purchasing" is a quality improvement strategy that links payment with healthcare outcomes. In essence, hospitals are reimbursed more for better healthcare and less for second-rate care. The concept evolved from the theory that value-based purchasing could improve the quality of health care while lowering health care costs (Saint, Meddings, Calfee, Kowalski, & Krein, 2010). The goal of value-based purchasing is to hold hospitals financially accountable for failing to prevent complications in patient care (Saint et al., 2010).

The CMS labeled catheter- associated urinary tract infections (CAUTIs) a high priority related to their high volume and cost since these infections can be reasonably prevented by incorporating evidence based interventions (Titsworth et al., 2012). In the United States, as many as five million urinary catheters are placed annually and 12%-25% of hospitalized patients receive a urinary catheter (Gardam, Amihod, Orenstein, Consolacion, & Miller, 1998; Goolsarran & Katz, 2002; Weinstein, 1999). Many facilities and hospital stakeholders have turned to up-to-date research supporting the use of bundles of care as an avenue to improve patient safety and the quality of healthcare provided.

The purpose of this manuscript is to define the evidence based bundling process that serves as the foundation for CAUTI bundles. This manuscript also describes evidence-based interventions that, when bundled together, can decrease catheter- associated urinary tract infections.

Descriptions of Evidence Based Practice and Care Bundles

Evidence based practice (EBP) has evolved recently and is transforming the way patients receive nursing care. Research from the National Quality Forums (NQF) has created initiatives that are moving many health care practices toward an evidence-based paradigm (Goode, Fink, Krugman, Oman, & Traditi, 2011). Through the NQF's research the CMS identified health care events that should never take place including HAI's. These unwanted events are considered hospital-acquired conditions/illnesses (HAIs). Since the Centers of Medicare and Medicaid are now tying these adverse outcomes to payment system penalty, many healthcare facilities have instituted EBPs to prevent HAIs and avoid financial penalties (Goode et al., 2011). Hence, healthcare facilities are not only feeling the push to institute evidence-based practices but also the need to evaluate their effects in order to change processes and improve practice.

Bundles of care are an evidence-based strategy to improve the provision of care for patients (Benneyan, 2010). These bundles usually consist of four to five elements of EBP that are grouped as a complete set of activities. According to Jain, Miller, Belt, King, and Berwick (2006), "such care bundles provide a framework backed by clinical evidence for improving the effectiveness and safety of patient care" (p. 63). These EBPs require a high level of compliance to reach the goals desired (Clarkson, 2013). Bundles of care are practices for quality improvement and a hallmark of a bundle of care is that when the care is implemented and

utilized appropriately, the strategies can be used across multiple healthcare systems (Clarkson, 2013).

In the past years, bundles of care have become well known in the healthcare world as an intervention to fight commonly known HAIs. Examples of some commonly used bundles are the central venous catheter bundle, the peripheral intravenous cannula care bundle, the renal dialysis bundle, the ventilator associated pneumonia bundle, and the urinary catheter care bundle (Clarkson, 2013). The philosophy of care bundles is based on a systematic approach of a Plan, Do, Check, and Act cycle. This cycle provides a monitoring system of compliance that is ongoing with the carrying out of bundle components and the monitoring of patient outcomes (Jain et al., 2006). In the ongoing monitoring of the effects of care bundles, desired patient outcomes are measured as well as the level of compliance with the component elements of a particular bundle (Clarkson, 2013).

The "plan" phase of this systematic approach begins prior to the actual implementation of a 'care bundle' in which details of the bundle and desired outcomes are outlined. Levels of activity with information about outcomes are incorporated in the "check" phase. Information about outcomes from the "check" phase together with the detailed direction from the "plan" phase correspond to trigger action in the "act" phase ultimately to improve patient outcomes and effectiveness of care (Meddings et al., 2013). Research 'care bundles' are grounded in level one evidence from randomized controlled trails in which the evidence-based elements of a bundle are all essential and appropriate (Benneyan, 2010; Clarkson, 2013; Meddings et al., 2013).

CAUTI bundles, referred to interchangeably with bladder bundles, are a recently new approach to achieving desired outcomes. They were developed from a statewide initiative out of the state of Michigan in response to the financial and clinical burden of catheter- associated

urinary tract infections (CAUTIs). The Michigan Health and Hospital Association (MHA) Keystone Center for Patient Safety and Quality developed a successful initiative focusing on safety and quality of care for intensive care patients (Saint et al., 2009). This initiative focused on a collaborative use of practice bundles to decrease blood stream infections. The MHA saw dramatic decreases in blood stream infections, and in 2007 decided to expand the practice bundle initiative to prevent device associated HAIs, including CAUTIs (Saint et al., 2009). The CAUTI bundle was conceived by MHA to fight the ever-growing issue of CAUTIs (Wald, Bratzler, & Kramer, 2008).

The CAUTI bundle includes the education of staff members and evidence-based practices that have been proven to decrease CAUTIs. The bundle itself does not decrease CAUTI rates, it is the interventions within the bundle that play a role in enabling early removal of an indwelling catheter and decreasing infection. The CAUTI bundle was initiated to educate those caring for indwelling catheters and subsequently improve catheter care. Elements of a CAUTI bundle are used as interventions to decrease the numbers of catheter days, decrease inappropriate use of catheters, and ultimately decrease CAUTI rates.

The major rationales for the implementation of CAUTI bundles are for surveillance and maintenance care purposes. Many catheters are placed without appropriate reasons and are left in longer than needed which increases the risk for a CAUTI. A CAUTI bundle can bring attention to the healthcare staff caring for those with a urinary catheter in assuring proper care is implemented (Saint et al., 2009). The implementation of a CAUTI bundle can decrease CAUTIs, improve catheter care practices, and spare hospitals millions of dollars by preventing these HAIs (Saint et al., 2009; Saint et al. 2008). By combining the use of EBPs into a bundle,

healthcare facilities can decrease the rates of CAUTI events, decrease the cost of treating CAUTIs, and improve everyday catheter care practices.

Methods

Using a predefined strategy to extract the most current and relevant research articles from the existing literature, a comprehensive search of the Medical Literature Analysis and Retrieval System Online (MEDLINE), Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PUBMED databases was conducted using various combinations of the following key words: urinary catheter, indwelling catheter, urinary tract infection interventions, foley catheter, bundles of care, foley bundles, urinary tract infections, catheter- associated urinary tract infections, hospital acquired infections.

The goal of this review was to identify published clinical research to evaluate strategies and interventions for decreasing CAUTIs. Inclusion criteria were as follows: full text, peer reviewed nursing or medical journal articles published in English after the year 1999. Additionally, the selected studies included randomized controlled trials, before and after trials, and retrospective chart reviews. These studies evaluated the impact of evidence based interventions and 'care bundles' in decreasing catheter- associated urinary tract infections. The articles extracted from the database search were then systematically reviewed for clinical significance and relevance. References from the selected articles were also reviewed and evaluated for potential application to the topic.

Findings

The main objective of bundling practices is to translate multiple pieces of evidence into practice (Saint et al., 2009). A bundle can be a combination of many different EBPs; a review of

literature was conducted to examine available research on four EBPs and how they can decrease CAUTIs when put together as a "bundle."

A national random sample of non-federal hospitals was selected to perform a survey of how many hospital intensive care units actually monitor for CAUTIs. Shockingly, 30% did not have a surveillance system in place to monitor CAUTIs (Saint et al., 2009). A national study of randomly selected group of hospitals showed that more than 50% of the intensive care units did not have a system to monitor whether or not patients had urinary catheters. Of those with monitoring systems, 70% did not monitor for insertion duration and the discontinuation of the indwelling catheters (Saint et al., 2008). This indicates that many facilities do not have protocols in place for implementing and monitoring indwelling catheter care and incorporating a CAUTI bundle would most likely be beneficial (Saint et al., 2008).

One of the key elements of a CAUTI bundle is a "needs assessment." If the need for an indwelling catheter is not indicated, the catheter should be discontinued (Blodgett, 2009). A daily assessment for the need for an indwelling catheter can decrease the catheter duration by 7 days which correlates to a 9.4% decrease in inappropriate use of indwelling catheters and a 75% decrease in CAUTI rates (Apisarnthanarak et al., 2007; Blodgett, 2009; Fakih et al., 2008). According to Blodgett (2009), the duration of catheter use is one of the most useful predictors of CAUTI occurrences. Saint, Lipsky, and Goold (2002) found that the incidence of CAUTIs increases 3% to 10% per day of catheterization. The sooner the catheter comes out, the less likely that the patient will develop a CAUTI. A study by Wald and Kramer (2007) showed that reducing the duration of an indwelling catheter is essential to reducing CAUTI incidence.

There is a correlation between a "needs assessment" of indwelling catheters, a decrease in catheter days, and a decrease in CAUTI rates (Apisarnthanarak et al., 2007; Blodgett, 2009;

Fakih et al., 2008). A daily review of a patient's "need" for a catheter and a review of the rationale for continued use bring the need for a catheter to the nurse's attention. This is extremely important in intensive care units where the evaluation of catheter needs may not be on the daily priority list. However, evaluating the need for a catheter daily can decrease catheter days by bringing the issue to the attention of the healthcare team (Goetz, Kedzuf, Wagener, & Muder, 1999; Apisarnthanarak et al., 2007; Fakih et al., 2008). Moreover, weekly reminders, daily rounding, and monthly in-services have all been effective ways of educating staff on proper catheter care (Goetz et al., 1999; Gokula, Hickner, & Smith, 2007; Huang et al., 2004). Educating the staff members is a major part of bundling the EBPs. Studies have shown increased appropriate catheter use, decreased catheter days, decreased CAUTI rates, and a decrease in unnecessary use as a result of education (Goetz et al., 1999; Gokula et al., 2007; Huang et al., 2004).

The evidence speaks to two EBPs involved in a CAUTI bundle: 1) addressing the need for catheter removal, and, 2) a daily needs assessment of the indwelling catheter. Studies conducted in medical intensive care units have shown that 21%- 54% of urinary catheters are inappropriately placed and 30%-50% of those are placed without a clear indication, suggesting the requirement for a "needs assessment" (Gardam, Amihod, Orenstein, Consolacion, & Miller, 1998; Gokula et al., 2004; Blodgett, 2009). By decreasing the duration of a catheter, optimizing the use of an indwelling catheter, and maintaining research based catheter care, the risk of CAUTIs decreases (Blodgett, 2009; Saint et al., 2009).

A third EBP included in a CAUTI bundle is correct positioning of the catheter. The bag should be below the level of the bladder to ensure proper drainage and to prevent backflow of urine to the patient (Tenke & Nagy, 2004). Two prospective studies that investigated infection

risk factors related to CAUTIs suggested that drainage bags above the level of the bladder were associated with risk of developing a CAUTI (Tambyah, 2004; Tenky & Nagy, 2004).

A fourth EBP involved in a CAUTI bundle is the use of a securement device to hold the catheter in place so it does not move from side to side as the patient moves. To reduce the risk of infection, keeping the indwelling catheter bag at the level of the bladder and utilizing a securement device has been effective at reducing CAUTI rates by 70% (Gould, Umsheid, Agarwal, Kuntz, & Pegues, 2009; Wald, Bratzler, & Kramer, 2008).

Two studies of a CAUTI bundle to prevent urinary tract infections were completed on neurosurgical patients and a significant decrease in CAUTIs rates from 73%-100% was noted (Schumm & Lam, 2008; Topal et al., 2007; Chenoweth & Saint, 2007). These studies also found a correlation between a decrease in the use of indwelling catheters and CAUTI rates (Schumm & Lam, 2008; Topal et al., 2007; Chenoweth & Saint, 2007). These studies examined four different evidence based practices to decrease CAUTIs including a needs assessment, early catheter removal, positioning of the catheter, and the use of a standardized securement device.

Some indications for the appropriate use of indwelling catheters include perioperative use, hourly urine output monitoring, management of acute urological concerns, bladder retention, pressure ulcer healing, and end of life (Titsworth et al., 2012). Many products have been examined for the purpose of product standardization to increase catheter use. Standardized products can entail the use of a single closed catheter, meaning the catheter is one unit and not separated in parts (Nicolle, 2008). Standardized products may also be silver hydrogel indwelling urinary catheters and the use of a StatLock stabilization piece to secure the catheter to the patient's leg to reduce urethral damage. The CDC proposes strong recommendations for securing the urinary foley catheter to the leg (CDC, 2013). Research has shown that the use of a

securing device such as a StatLock prevents urethral trauma and bacteremia (Darouiche et al. 2006; Todd, Turner, Anderson, Mhoon, & Brendler, 2000).

Summary of Findings

If a urinary catheter is inserted for appropriate reasons, then evidence-based maintenance of catheter care should be initiated. Catheter care guidelines should follow the recommendations from the American Hospital Association, the Joint Commission, and the CDC. Every effort should be made to place the catheter with sterile technique, the collection bags should remain below the level of the bladder to prevent reflux of urine into the bladder, and the bag should be emptied routinely as well as have a stabilization piece (Titsworth et al., 2012).

When utilizing evidence-based practices in the use of a CAUTI bundle, studies revealed a significant decline in the utilization of catheters ranging from 70-100% (Titsworth et al., 2012; Nicolle, 2008; Gokula et al., 2004). These studies also revealed a drastic decline in catheter-associated UTI rates from 13 infections per 1000 catheter days to a rate of 4 infections per 1000 catheter days (Titsworth et al., 2012; Nicolle, 2008; Gokula et al., 2004). Catheter infections are assessed by the definition from the National Healthcare Safety Network of the Centers for Disease Control Safety and Prevention. Hospital-acquired infections are measured through the operational definition set forth by the CDC. They are measured in infections per 1000 catheter days. So results are sometimes described in percentages and infections per 1000 catheter days (CDC, 2013).

Bundles of interventions have escalated in the literature as proven, multimodal approaches to decreased urinary catheter infections. Many bundles of care focus on interventions that have been outlined from the CAUTI bundle implemented by the Michigan Health and Hospital Association Keystone Center for Patient Safety and Quality. These

approaches focus on adherence to general infection and control principles (e.g. hand hygiene, surveillance, proper maintenance, and education), not using an indwelling catheter unless absolutely needed, and early removal of the catheter. Several studies support these interventions in decreasing inappropriate catheter use and CAUTI events (Andressen, Wilde & Herendeen, 2012; Knoll et al. 2011; Titsworth et al., 2012; Jain, Miller, Belt, King & Berwick, 2006).

Implications for practice

EBP is widely known throughout healthcare facilities, having become the standard of healthcare practices. According to National Nursing Practice Network (n.d), "Evidence-based practice is the application of findings from research, along with other types of evidence such as case reports, in conjunction with your clinical expertise and patient values in delivering care to your patients" (National Nursing Practice Network (NNPN, n.d.).

The primary goal of utilizing EBP is that patients receive the best care that is based on evidence to achieve the highest quality in outcomes (NNPN, n.d).

EBP institutes a culture for change. Multiple studies support the use of EBPs to improve patient outcomes and decrease adverse patient outcomes (Saint et al., 2009; Saint et al., 2008; Titsworth et al., 2012). Empirical evidence assists with guiding practice from the "traditional" way of doing things to the scientific avenue of practice (NNPN, n.d.; Saint et al., 2009). Ultimately, EBP is important because it empowers nurses to direct their own practice, it guides clinical decision making, and it affords patients the best healthcare (NNPN, n.d.). EBP is at the core of implementing and developing a CAUTI bundle.

Recommendations for Improving Practice

Indwelling urinary catheter maintenance bundles should be implemented as a standard of care for all patients. This will, however, require a practice change within hospital institutions.

To do this effectively, it is important to recognize that implementing such a change might be a challenging task. Implementation of such a bundle will require strategically planned interventions and a detailed plan to increase buy-in from the staff. It is recommended that educational interventions should be designed to bring awareness of strategies to decrease CAUTIs. The implementation of a bladder bundle can increase nursing knowledge of catheter associated UTIs to improve bundle compliance and institute practice change.

Conclusion

There is a clear message throughout the literature that emphasizes that the most effective strategy in the prevention of CAUTIs is the avoidance of foley catheters all together (Nicolle, 2008; Saint et al.,2010; Fakih et al., 2008; Meddings et al., 2013). However, in some patients this is not possible, so early removal is the key intervention for CAUTI prevention (Nicolle, 2008). Multiple studies have shown a strong correlation between a decrease in the number of days the catheter is in place and a decrease in CAUTI events (Saint et al., 2010; Fakih et al., 2008; Meddings et al., 2013).

A CAUTI bundle can help in preventing CAUTIs by optimizing the use of indwelling catheters with emphasis on education of staff, continual assessment of catheter use, early removal, and catheter care (Saint et al., 2009). Many bladder bundles focus on continuous quality improvements, nurse and physician reminders for early catheter removal, maintenance, proper indication for the need, and product standardization.

These actions have shown to significantly reduce urinary catheter use and significantly decrease CAUTI rates (Saint et al., 2009; Saint et al., 2008; Titsworth et al., 2012; Goolsarran & Katz, 2002). Studies suggest that with the use of a CAUTI bundle, a long lasting and durable culture of change can be formed (Titsworth et al., 2012; Meddings et al., 2013). Following the

ever-growing need to decrease healthcare costs, it makes sense to incorporate EBP, especially the use of CAUTI bundles, throughout healthcare facilities.

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Manuscript 3

An Evaluation to the Adherence of an Indwelling Urinary Catheter Maintenance Bundle: A Retrospective Electronic Medical Record Review

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Abstract

Purpose: The purpose of this project was to evaluate the adherence to a Catheter- Associated Urinary Tract Infection Maintenance Bundle (CAUTI bundle) among the staff in the Trauma Intensive Care Unit (TICU) at the University of Kentucky Chandler Hospital (UKCH). The objectives of this project were to: (1) describe adherence to practice guidelines of a CAUTI bundle in TICU through the examination of de-identified data one year after bundle implementation (data was obtained from the records of patients hospitalized during a twelve-month period - May 2013 through May 2014); and, 2) examine the associations between adherence to practice guidelines of a CAUTI bundle and specific patient characteristics (age, gender, race, ethnicity, body mass index, and hospital length of stay).

Setting: This project was implemented in the TICU of an 875-bed level 1 Trauma and Multi-Organ Transplant Center located in central Kentucky.

Population: Among the sample (*N*=100), 55% were male and 45% were female. Eighty-six percent were Caucasian. Those selected had an average age of 57.6 years (SD=17.1), the mean body mass index was 25.6 (SD=5.9), and the mean length of stay was 13.7 days (SD=14.1).

Inclusion criteria: All individuals in the medical record documentation system that had a documented indwelling foley catheter upon day 1 of admission to the TICU between May 2013 and May 2014 were included.

Design & Methods: A retrospective study of de-identified electronic medical record data was used to evaluate staff adherence to a CAUTI bundle during a twelve-month period. Randomly selected and de-identified medical record numbers (*N*=100) were obtained by the Information Technology Business Intelligence Department at the University of Kentucky. The data review, included the documentation of: 1) contradiction for catheter removal; 2) maintenance of

unobstructed urine flow (tubing catheter at or below the level of the bladder); 3) a securement device for the urinary catheter tubing; and, 4) whether or not foley care was completed at least 1 time in a 24 hour period. The data obtained also included demographics (age, gender, ethnicity, race), body mass index, and total hospital length of stay.

Results: When examining the daily adherence to CAUTI bundle guidelines and specific criteria, daily adherence significantly decreased between days 1- 5 (day 1=92.0%, day 2=53.0%, day 3=40.0%, day 4 =24.0%, day 5 =13.0%). Only 5.0% of the electronic records of the sample provided evidence of complete adherence to the CAUTI bundle over the 5 days. Adherence to each specific CAUTI bundle criteria decreased over the 5 days. The criterion with the least adherence for each assessment day was the completion of foley care in a 24-hour period. Moreover, there were no significant differences in adherence rates to the CAUTI bundle by patient characteristics over the first five days of the patient's admission with the exception of the following: a) greater adherence among males on day 2 (63.6%), b) lower adherence among underweight patients (70.0%) on day 1, and, c) lower adherence among obese patients (85.5%) on day 1.

Introduction

While the future of healthcare is uncertain, one thing remains definite - the complexity of healthcare continues to increase. Hospital administrators, managers, and staff may not be able to foresee all changes in healthcare, but it may be possible to prevent the occurrence of infections. It is important that hospitals address issues that can be managed within the hospital setting. It is just as vital to evaluate the adherence to protocols, interventions, and initiatives developed to offset the rising incidence of hospital-acquired infections (HAIs).

In the state of Kentucky alone, the cost of treating a HAI is estimated around $462 million dollars a year and results in approximately 1,400 deaths per year (Musgrave, 2011). In February 2013, University of Kentucky Chandler Hospital (UKCH) made drastic changes to the current Catheter Associated Urinary Tract Infection (CAUTI) prevention standards by instituting a CAUTI Maintenance Bundle to prevent the incidence of CAUTIs. This CAUTI bundle was initiated to improve already used strategies in preventing costly hospital acquired urinary tract infections, improve foley catheter care by the nursing staff, and improve the documentation of catheter care.

It is important to understand that a bundle of care is usually any set of 4-5 elements of evidence-based practice implemented as a complete set of activities (Benneyan, 2010). It is not limited to what UK's CAUTI bundle consisted of. However, UK's CAUTI bundle gives an example of elements that could be incorporated into any CAUTI bundle. Bundles of care are an evidence-based strategy to improve the provision of care for patients (Benneyan, 2010). Bundles of care are practices for quality improvement and a hallmark of a bundle of care is that when the care is implemented and utilized appropriately, the strategies can be used across multiple healthcare systems (Clarkson, 2013).

UK HealthCare's CAUTI bundle encompassed educating staff nurses on preventive measures of decreasing CAUTIs by holding in-services, instituting bedside rounding, utilizing educational posters, and simplifying indwelling urinary catheter care documentation in the electronic medical records. For example, the documentation of catheter care was designated to one section, instead of multiple places, in the electronic medical records (with the exception of foley care). Education of staff nurses included recommendations from the Institute of Healthcare Improvement regarding documentation, proper insertion, the duration of placement, the proper securement, and the maintenance of a urinary catheter with foley care (Marra et al. 2011).

Background

Hospital acquired infections (also known as a nosocomial infections) are infections acquired during an acute hospital stay (Gould, Umsheid, Agarwal, Kuntz & Pegues, 2009). Hospital acquired infections are among the top 10 leading causes of mortality in the United States (Center of Disease Control, 2013) with 1.7 million people developing HAI's and 100,000 patients' deaths from related complications every year (Clarke et al. 2013).

A urinary tract infection is a fungal or bacterial infection within the urinary system, including the ureters, bladder, kidneys, and urethra (Mayo Clinic Staff, 2012). If bacteria enters the urinary tract and is not killed by the body's natural defenses it multiplies within the bladder, producing a bacterial infection (Mayo Clinic Staff, 2012). CAUTI's are urinary tract infections diagnosed when a urinary catheter is in place. CAUTI's are diagnosed by the presence of bacteria in the urine, an elevated white blood cell count (WBC) on a urinalysis examination, and a positive urine culture. In some cases, other signs and symptoms may be present including an elevated serum WBC with two or more of the following symptoms: pain or burning in the region of the bladder, bladder spasms/leakage, catheter obstruction, change in mental status (confusion,

lethargy, agitation, and delirium), fever (greater than 100.4F or 38C), urine odor, changes in color or characteristics of urine (including cloudy urine or increased sediment), and hematuria (Wound Ostomy and Continence Nurses Society, n.d.). CAUTI's are the leading cause of secondary hospital associated bloodstream infection and about 17% of hospital-associated bacteremia is from a urinary source (Gould et al., 2009). Moreover, approximately 1 million CAUTI's occur every year in the United States, costing an estimated $400 million annually to treat (Clarke et al., 2013).

In the United States, about 15% of patients admitted to an acute care facility receive an indwelling urinary catheter at some point during their hospital stay (Saint et al., 2009). An indwelling urinary catheter, also referred to as a "foley catheter", is a drainage tube inserted into the urinary bladder through the urethra (Centers for Disease Control, 2013). This drainage tube is connected to a drainage bag, a "foley" catheter, and is a closed-drainage system for obtaining an accurate hourly urine output (Gould et al., 2009).

By definition, a foley catheter only includes indwelling urethral catheters and does not include catheters used for continuous irrigation or intermittent catheterization (Centers for Disease Control, 2013). Annually, more than 30 million foley catheters are inserted in the United States, causing approximately 1 million CAUTIs (Saint et al., 2009). The use of indwelling catheters has been associated with increased patient acuity, increased complexities in healthcare, severity of illnesses, and decreased staffing (Saint et al., 2009). With the high utilization of foley catheters in acute care facilities, it is not surprising that they account for almost half of all HAIs and 80% of CAUTIs (Saint et al., 2009).

Factors that increase the risk of CAUTI occurrence include: a foley catheter left in place for more than 6 days, a catheter not inserted under sterile technique, the catheter not being

positioned correctly with the level of the drainage bag being above the level of the bladder, failure to provide daily foley care, and failure to maintain a closed system. Foley care can be described as washing the genital area and the foley catheter tubing at the site of insertion with soap and water everyday (Clarke et al., 2013). Some institutions have implemented the use of Castile wipes to provide foley care. These wipes are PH balanced cleansing agents used in replacement of soap and water for foley care purposes (Clarke et al., 2013). A closed system refers to the connection point of the catheter tubing and tubing entering the patient, often the primary suspected point of entry of pathogens (Clarke et al., 2013). These risk factors make it important to evaluate if measures are being completed to reduce the risk of a CAUTI.

Healthcare providers often perceive CAUTIs as unfortunate, but acceptable, consequences of patient care. However, along with the financial burden, CAUTI's are associated with serious infections, such as sepsis and acute pyelonephritis, and other adverse outcomes (such as prolonged hospital stay, increased morbidity, increased mortality) (APIC, 2008). In the 2008 Association for Professionals in Infection Control Guide to the Elimination of Catheter Associated Urinary Tract Infection document, chart audits revealed the inappropriate use of urinary catheters in 285 patients (APIC, 2008). Of the health records reviewed, 46% of the patients had inappropriate indications for catheterization (APIC, 2008). This is a prime example for the need of interventions to guide staff in recognizing the need for catheterization, understanding the important of maintenance care with documentation, and having evaluative guidelines set in place (APIC, 2008).

Description of the Practice Inquiry Project

Nurses play a key role in the CAUTI bundle implementation process in that the responsibility for insertions, maintenance, and documentation rests on the nursing staff. An evaluation of adherence to the CAUTI Bundle is critical in assessing nurse adherence to the University of Kentucky Hospital's Trauma Intensive Care Unit (TICU) CAUTI bundle for the purpose of informing future implementation and evaluative plans in other facilities. As such, this capstone project involved the evaluation of an indwelling urinary catheter maintenance bundle that was implemented in an 875-bed, Level-1 trauma and multi-organ transplant center located in central Kentucky. The project took place in the 12-bed TICU. A retrospective review of de-identified medical data from the records of 100 TICU was collected from the University of Kentucky's Technology and Intelligence department to evaluate nursing adherence to UK's CAUTI bundle over a five-day course of catheter placement.

Goals and Objectives

The purpose of this project was to evaluate adherence to a CAUTI bundle among staff nurses in the TICU at a UKHC Hospital. The main objectives of this project were to: (1) describe adherence to practice guidelines of a CAUTI bundle in a trauma intensive care unit through the examination of de-identified data one year after bundle implementation was completed (May, 2013 through May, 2014); and 2) examine the associations between adherence to practice guidelines of a CAUTI bundle and patient characteristics including age, gender, race, body mass index, and hospital length of stay.

Methods

Study design and selection of participants

Following authorization from my capstone committee, approval was obtained from the University of Kentucky (UK) nursing research council (Appendix B). A proposal was then submitted and subsequently approved by the hospital's Institutional Review Board (IRB) (Appendix A). Nurse administrators, service line directors, and the ICU manager were informed of the project via face-to-face meetings and email communications. Approval was obtained from the director of Trauma Surgical Services (Appendix C). A waiver of the requirement for documentation of informed consent was obtained because only de-identified information was collected retrospectively from patient records. This research involved minimal to no risks to participants.

Study Setting

The 12-bed TICU patient population is comprised of critically ill adult patients who are ≥ 18 years of age. The hospital is accredited by The Joint Commission for Accreditation of Hospitals and is currently working toward Magnet re-designation by the American Nurses Credentialing Center (ANCC).

Study Procedure

A retrospective review utilizing de-identified electronic medical record data was used for this evaluation project. The data was transferred to an SPSS spreadsheet once received. Demographic data included age, gender, ethnicity, race; in addition Body Mass Index (BMI) and hospital length of stay were also retrieved from medical records. The CAUTI bundle documentation requirements include the documentation of: 1) any contradiction for catheter removal; 2) maintenance of an unobstructed urine flow (tubing catheter at or below the level of

the bladder); 3) securement of the urinary catheter tubing; and, 4) whether or not foley care was completed at least once in a 24 hour period. These data points are specifically listed in the electronic documentation, and the nurses caring for the patient check the box associated with each criterion as completed (yes) or not completed (no). These data points are requirements listed within the CAUTI bundle to be completed by the registered nurse. The goal of the CAUTI bundle was to improve nursing adherence to the CAUTI bundle requirements and the documentation on catheter care provided. The CAUTI bundle documentation requirements were obtained at 8:00AM (considered the 7am shift) the first day of admission for up to five days of patient hospitalization.

Data Analysis

Sample characteristics were described using frequencies and percentiles for categorical variables and means with standard deviations for continuous variables. Daily adherence to the practice guidelines of the CAUTI bundle and specific CAUTI bundle criteria were examined with percentages. Associations between daily adherence to practice guidelines and demographic variables (i.e., day 1, day 2, day 3, day 4, day 5) were examined using chi-square analyses for categorical variables. McNemar tests were used to examine the differences in adherence rates from day 1 compared to each subsequent day-to-day up to day 5 of the catheter being in place. Bonferonni corrections were applied to account for potential type 1 error as a result of multiple testing.

Results

Sample Characteristics

Table 1 presents the sample characteristics based on daily adherence. The sample was primarily male (55%) and White (86%), with a mean age of 57.6 years (*SD*=17.1), a mean body mass index of 25.6 (*SD*=5.9), and a mean length of stay of 13.7 days (*SD*=14.1).

Daily adherence to CAUTI bundle guidelines and specific criteria

Only 5.0% of patients had complete adherence to the CAUTI bundle over the 5 days. Daily adherence significantly decreased between days 1- 5 (day 1=92.0%, day 2=53.0%, day 3=40.0%, day 4 =24.0%, day 5 =13.0%). Adherence to each specific CAUTI bundle criteria decreased over the days. The criterion with the least adherence for each assessment day was 24-hour foley care (see Figure 1).

Associations between daily adherence to practice guidelines and patient variables

There were no significant differences in adherence rates to the CAUTI bundle in patient characteristics over the first five days of the patient's admission with the exception of greater adherence among males than females on day 2 (63.6% vs. 40.0%, p = .027) and lower adherence among underweight and obese individuals as compared to normal and overweight in day 1 (70.0% vs. 85.0% vs. 100.0% vs. 93.1%, p = .007) (see table 1).

Discussion

It should be understood that the foundation of infection prevention and control are the necessary roots of programs, protocols, and policies that impact HAIs, including CAUTIs. The Management of Multidrug-Resistant Organisms in Healthcare Settings (MDRO) produced by the CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC) in 2008 recommends that systems be in place to promote the highest quality of treatment to prevent

CAUTIs (APIC, 2008). The MDRO and HICPAC also recommend the implementation, performance measurements, and surveillance of such interventions (APIC, 2008). This study was performed to describe adherence to practice guidelines of UK's CAUTI bundle, and to examine associations between adherence to practice guidelines of the CAUTI bundle and patient characteristics including age, gender, race, body mass index, and hospital length of stay.

When examining the associations between daily adherence to practice guidelines and patient variables in my current study, there were no significant differences in adherence rates to the CAUTI bundle in patient characteristics over the first five days of the patient's admission with the exception of the following: a) greater adherence among males on day 2 (63.6%), b) lower adherence among underweight patients (70.0%) on day 1, and c) lower adherence among obese patients (85.5%) on day 1. When examining the daily adherence to CAUTI bundle guidelines and specific criteria, daily adherence significantly decreased between days 1- 5 (day 1=92.0%, day 2=53.0%, day 3=40.0%, day 4 =24.0%, day 5 =13.0%). Only 5.0% of those reviewed patients had complete adherence to the CAUTI bundle over the 5 days. The results reveal an overall lack of consistent catheter care over a course of 5 days. The results also showed that adherence to each specific CAUTI bundle criteria decreased over the days with the least adherent criteria being 24hour foley care.

In the acutely ill adult population, CAUTIs pose a great challenge to hospital safety and the quality of health care provided, as they are the most common HAI (Tambyah, Knasinski, & Maki, 2002). The bundle acts as a complete and consistent reminder system to prevent infection (Venkatram, Rachmale, and Kanna, 2010). It is important to note that several published research studies on the effects of a CAUTI bundle on CAUTI rates. However, in this present study, it is noteworthy to emphasize that the performance of a specific list of elements of a CAUTI bundle

were evaluated for adherence and CAUTI rates were not examined. There is limited published research on evaluative projects looking specifically at a CAUTI bundle. There is also limited published research on the adherence to such bundles Mauger et al. (2014). However, research does exist on different approaches for evaluating the effectiveness of CAUTI bundles in decreasing the incidence of a CAUTI. This research is important as it provides different strategies useful in creating CAUTI bundles that can be utilized in formulating standardized evaluative studies across different healthcare facilities.

Based on a review of studies by Mauger et al., (2014), the best approach in evaluating any care bundle is when interventions are grouped together in a multi-model approach. Although single strategies have been found effective, but a multi approach including chart audits, bedside rounding, feedback from staff, and comparing these findings to the incidence rates of the HAI bundle being evaluated seems to be most effective (Mauger et al., 2014). The multi model approach is useful in evaluating the adherence, implementation, and effectiveness of a quality improvement project such as a CAUTI Bundle.

Mauger et al., (2014) also found the strongest evidence in evaluating compliance to a bundle include investigating adherence, infection rates, and observing potential links between implementation of a specific strategy. These elements of evaluation can demonstrate the association between a given interventions and the reduction in HAI's. Ranji et al. (2007) and Grimshaw, Thomas, and MacLennnan (2004) agree that the best evaluative initiatives include a multi model approach including for example chart audits, provider and staff feedback, face-to-face interaction with those involved in the interventions, and the investigation of infection rates and incidences of a CAUTI. Similarly, Jamtvedt, Young, and Kristoffersen (2006) investigated types of audits and feedback strategies and concluded that the use of both combined alone can

improve professional practice. This finding is important to note because evaluative projects can facilitate accountability to the health care provider personally responsible for carrying out the interventions. The most universal strategy in adherence evaluation is conducting a chart audit and comparing these findings to incidence rates of any specific HAI being investigated.

Similar to my current study, other studies have assessed adherence to CAUTI bundles, by assessing compliance. For example, Amine, Helal, and Bakr (2014) focused on educational in-services, slide presentations, and videos to nurses on a newly implemented CAUTI bundle. Amine et al., (2014) then evaluated the CAUTI bundle with chart audits to determine compliance and compared those results with CAUTI rates developed during the study period. Amine et al., (2014) found that adherence improved after education. However, this study by Amine, Helal, and Bakr (2014) differs from the present study, as they did not strictly focus on adherence to specific components of a CAUIT bundle. This is important to note because components in a CAUTI bundle can differ among facilities.

Few studies have examined whether adherence to CAUTI bundles are associated with patient characteristics. However studies have found that examining patient characteristics is important in understanding CAUTI's. For example, Passos et al. (2005) and Kobayashi, Fernandes, Miranda, Sousa, and Silva (2004) examined the correlation with different age groups and CAUTI rates. They found that 58.2% of CAUTI cases involved patients who were more than fifty years of age and that the elderly seemed to be more susceptible to infections than younger individuals. They also found CAUTI bundle compliance decreased with increased age groups. Although few significant differences in patient characteristics and CAUTI bundle compliance was found in my current study, it may be important for future research to continue exploring patient characteristics such as gender and BMI status.

Limitations

This study had several limitations that could potentially affect the validity of reported results. First, the use of utilizing electronic documentation as a reliable source of data collection is an ongoing topic of research in the nursing profession (Westra, Delaney, Konicek, & Keenan, 2008). Clinical documentation of data being used for program evaluation and research is consistently being investigated for reliability and validity. However, it is understood that nurses must be able to document and describe practice through documentation of their intervention (Westra et al., 2008). The ability to use documentation as a source of information allows researchers to show how nursing interventions can affect patient outcomes (Westra et al., 2008).

Second, this study had a small sample size, and the results may have been different if a larger sample of de-identified information had been retrieved. Additionally, the study was not powered to evaluate long term adherence to the CAUTI bundle or nurse perception factors associated with adherence. Investigating nurse perception associated with the compliance to the CAUTI bundle was not feasible related to time constraints. This study did not aim to evaluate nursing understanding of CAUTI bundle knowledge and prevention factors. This study assumed that staff nurses understood and retained unit protocol information on the CAUTI bundle requirements. Further investigation should include an examination of the role of staff perception and understanding of CAUTI bundle principles on protocol adherence.

Third, using a more rigorous study design, such as a randomized controlled trial, could have enhanced the validity of my findings. It would be important to further design a study that also accounts for practice trends, potential cofounders, increasing the length of time data is collected, reporting and analyzing infection rates, and standardizing approaches in measuring adherence (Mauger et al., 2014). The use of creating tool kits and accessible consultation

services in setting up evaluative programs would be meaningful in contributing knowledge about successful evaluative projects in the health care system. In evaluative projects, the context of an intervention- the leadership structure, the safety culture, the type of health care setting, and the openness to the innovation can have a vital influence on whether or not these prevention interventions can be transferred form 1 setting to another (Shekell, Pronovost, & Wachter, 2010).

Implications for Practice

Hospital acquired infections are a substantial burden for health care systems and for patients; therefore they wield significant and far-reaching implications for the nursing discipline (Nicolle, 2007). The frontline participation of registered nurses in their critical role of decreasing the ever so prevalent CAUTI is vast. Evaluating nurses' adherence is critical in assessing the effectiveness of a particular intervention, such as the CAUTI bundle. The results of this study suggest that TICU nurses are compliant with the CAUTI bundle in the first two days of catheter placement; however, the compliance vastly decreases the longer the catheter is in place. In the high stress environment of an ICU this might suggest that the length of patient stay may adversely affect adherence. However, in this study the total length of stay was not significantly associated with adherence. The least adherent component of the bundle was the documentation of 24-hour catheter foley care. In the UK's electronic documentation this section is separate from all other CAUTI bundle criteria. The separation of the 24-hour catheter foley care documentation section from other CAUTI bundle criteria could suggest that the "ease" of charting CAUTI bundle components may play a role in overall adherence. In other words, when all aspects of a bundle are in visible site to the RN, it potentially could remind the nurse to perform an individual task. This could be a rationale for the decrease in the documentation of the 24-hour foley care.

The evidence obtained from the findings of this study may facilitate changes in the electronic documentation of the CAUTI bundle at UK. The findings from this study also suggest the potential need for more education among nursing staff to promote the performance of all aspects of the CAUTI bundle consistently during a patient's ICU stay. Finally, the results of this study are useful when considering the implementation and evaluation of the CAUTI bundle in other areas of the setting institution and other healthcare facilities. By examining specific adherence factors that could be elements in any CAUTI bundle, hospital personal and private consultant groups may be able to use this data to develop standardized elements in a CAUTI bundle. Also by examining individual elements of a treatment protocol, a hospital facility can determine components that should be altered to improve patient care. This information could be helpful when implementing such a bundle in a variety of hospital facilities.

Implications for Education

This study provides important evidence to support the evaluation of evidence-based interventions performed by ICU nurses as an avenue for improving knowledge related to CAUTIs, CAUTI prevention, empowering nurses on their impact in healthcare, and enhancing the quality of care delivered to patients. Further research should assess the benefit of targeted education for nurses about indwelling urinary catheter care. It is recommended that CAUTI bundle education be incorporated in new nurse orientation sessions. The knowledge base behind the indication for a catheter and catheter care is well established; nurses need to think critically about the indicated need of a catheter, and catheter care maintenance. The transfer of knowledge into practice is imperative in this ever-changing health care system. In regards to nurses who have knowledge about catheter care maintenance and the CAUTI bundle, their knowledge does not necessarily transfer into practice. Further research may examine, "What in the culture of

nursing practice prevents the translation of knowledge into practice on adherence to a CAUTI bundle and proper use of an indwelling catheter."

Implications for Future Inquiry

Considering the lack of published research in the evaluation of adherence to a CAUTI bundle, ongoing evaluation is highly recommended. Future studies could consider a different setting, a different study design, a larger population size, and incorporate other factors that may affect CAUTI bundle adherence. Based on the results of this study, future studies may take an in-depth look at barriers to adherence including: nurse to patient ratio, nursing tech to patient ratio, severity of illness of the patient, the knowledge base of nursing staff in regards to the CAUTI bundle, and a nursing self report survey of factors that may affect adherence. This information can be used to measure the impact/influence on practice and patient outcomes. Findings of such studies could be used as a guide for future implementation and evaluative programs of a CAUTI bundle.

Conclusion

Indwelling urinary catheterization is an invasive intervention with potentially serious outcomes such as a CAUTI. Although there is clinical agreement on the use and indication for a urinary catheter, more evidence is required to determine appropriate evaluation tools for a CAUTI bundle. CAUTI risks in patients with an indwelling urinary catheter are high, thus requiring the attention of every healthcare personnel providing care for these patients. Based on the findings from this study, TICU nurses are adherent to the CAUTI bundle, but this adherence decreases during the length of catheter days. Due to the limitations of this study, this researcher was not unable to determine specific factors that influenced the nursing staff's adherence to the CAUTI bundle. However, increasing nursing knowledge on the importance of the CAUTI bundle

and providing evaluative tools for the bundle could improve the effectiveness and ultimately improve patient care. Given the lack of published literature on the evaluation to adherence of CAUTI bundles and published evaluation tools in assisting evaluative research, further research is recommended to build on this evidence-based intervention. Future research can be instrumental to designing, implementing and evaluating future bundles that are effective in decreasing catheter- associated urinary tract infections.

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