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Reducing Inpatient CAUTI via a Nurse-Driven Catheter Surveillance and Removal Protocol

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DNP Project

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Abstract

Title: “Reducing Inpatient CAUTI via a Nurse-Driven Catheter Surveillance and Removal Protocol”

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Purpose: The purpose of this project is to empower nurses to prevent nosocomial Catheter-Associated Urinary Tract Infection (CAUTI) via the implementation of a Nurse-Driven Protocol (NDP) for Indwelling Urinary Catheter Monitoring and Removal that provides the nurse with enhanced clinical autonomy associated with these devices.

Methods: This QI project was conducted at a major Level II Trauma Center where an evidence-based Nurse-Driven Protocol for indwelling urinary catheter surveillance and removal was implemented facility-wide. A retrospective analysis of CAUTI incidence was performed prior to implementation. Data from the 6-month historical control were compared to data from a 6-month intervention period.

Results: Prior to implementation there were 7 observed CAUTI events with 11.538 predicted events. In the six months following implementation there were 5 observed CAUTI events with 13.12 predicted. The Standardized Infection Ratio (SIR) was reduced from 0.60 to 0.38. Standardized Utilization Ratio (SUR) increased from 0.69 to 0.74. The CAUTI rate per 1000 catheter days decreased from 0.82 to 0.52.

Discussion: Observed CAUTI incidence and CAUTI rate were reduced. Moreover, the SIR decreased by 22%, which provides for a risk-adjusted comparison of observed CAUTI according to baseline national data and is the summary measure utilized to track CAUTI by the NHSN. This was accomplished despite an unanticipated nominal increase in catheter utilization according to the SUR. However, this would imply that Foley catheters were utilized much more efficiently in our high-risk population than previously.

Conclusions: A NDP driven by specific clinical indicators promotes enhanced device surveillance and removes barriers for prompt catheter removal. This QI project was successful in preventing CAUTI and adds to the literature supporting the use of NDPs in the prevention of CAUTI.

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Introduction

Urinary Tract Infection (UTI) is one of the most common Healthcare-Associated Infections (HAI) in the United States, with nearly all healthcare associated UTI’s being caused by instrumentation of the urinary tract (Centers for Disease Control and Prevention [CDC], 2022). Approximately 12-16% of all hospitalized patients regularly receive Indwelling Urinary Catheters (IUC) during their stay, and each subsequent day that a catheter remains in place will carry a 3%-7% increased risk for acquiring Catheter Associated Urinary Tract Infection (CAUTI) (CDC, 2022a). The prolonged use of IUC is the most important risk factor for developing a CAUTI, and so avoidance of their use is the most effective modifiable risk factor. Complications associated with development of CAUTI include prostatitis, epididymitis, orchitis, pyelonephritis, gram-negative bacteremia, endocarditis, and meningitis—prolonging the patient’s hospital stay, increasing healthcare costs, and patient mortality (CDC, 2022a). Therefore, if avoidance of IUC use is the most important risk factor in preventing CAUTI, then indwelling urinary catheters should be restricted for use only in appropriate indications and should be removed as soon as they are no longer needed. The development of CAUTI Prevention bundles that emphasize appropriate catheter use, prompt removal, and proper insertion and maintenance have become increasingly popular. Nurse-Driven CAUTI Prevention Protocols have consistently demonstrated significant decreases in both catheter utilization and CAUTI rates (Durant, 2016; Gyesi-Appiah, Brown & Clifton, 2020).

Healthcare-Associated infections (HAI) are one of the most common complications of hospital care and represent a major threat to the safety of patient. Despite consistent HAI reductions from 2015 to 2020, owing to the introduction of value-based-purchasing by the Centers for Medicare and Medicaid Services (CMS), increased awareness of factors contributing
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to HAI, toolkits introduced by the Agency for Healthcare Research and Quality (AHRQ) such as the Comprehensive Unit-Based Safety Program (CUSP) framework that promote systems change in healthcare facilities, and the development of more effective computer-based surveillance (CDC, 2020; Magill et al., 2018). Mortality associated with HAI is largely attributed to the predominance of Multidrug Resistant (MDR) bacteria in the hospital setting, where the prevalence of MDR bacteria is perpetuated by the inappropriate use of antimicrobial agents (Serra-Burriel et al., 2020). Risk factors for developing a HAI include invasive procedures, illness severity, poor adherence to best practices for prevention, and improper use of antibiotics (CDC, 2021a). Modifiable risk factors for CAUTI include prolonged catheterization, unnecessary insertion of urinary catheters, non-compliance with aseptic catheter care, and catheter insertion outside of the operating room; and general strategies to prevent CAUTI revolve around catheter removal and include the avoidance of unnecessary use of catheters, insertion using aseptic technique, maintenance of catheters based on recommended guidelines, and daily review of catheter necessity (Gesmundo, 2016). It is not surprising then, that 3 of the top 5 most common HAIs: Ventilator Associated Pneumonia, Central Line-Associated Bloodstream Infection, and Catheter Associated Urinary Tract Infection (CAUTI), and all are caused by the inherent microbial colonization of the indwelling devices of which they are named after.

Prior to 2015, CAUTI incidence was typically monitored at the facility level via “CAUTI rate”. CAUTI rate is calculated by dividing the number of observed CAUTI by the number of catheter days and multiplying the result by 1,000. While this metric was useful in its own right, CAUTI incidence is now standardized by the CDC and National Healthcare Safety Network (NHSN) for monitoring with the Standardized Infection Ratio (SIR). SIR is a summary measure
to track HAIs over time, CAUTI being one of them. The SIR is derived by dividing the number of CAUTI reported by a facility, to the number that would be predicted. Predicted infections are calculated using probabilities from negative binomial regression models constructed from the most recent NHSN data. At the hospital level, predicted infections are calculated per unit and are based on the actual population observed by a facility, where the probability of infection in that population is compared to baseline NHSN population data via negative binomial regression. SIR values can be scaled up to monitor infection ratios per unit, unit type, facility, facility type, a group of facilities, and so on. The SIR has become the official summary measure of CAUTI analysis and over 3,800 hospitals in the United States now report standardized HAI-related data to the NHSN for analysis. Beginning in 2020, the US Department of Health and Human Services set a new national CAUTI SIR goal of 0.75 in response to successful reductions in CAUTI incidence at or below this level (HHS, 2021). The Standardized Utilization Ratio (SUR) is a similarly derived statistic that was introduced by the NHSN in recent years to allow facilities to monitor and trend device utilization (CDC, 2023). (CDC, 2022b)

The incidence of CAUTI is costly to both individual healthcare facilities as well as the greater healthcare system as a whole. A 2017 study sponsored by the AHRQ estimated that for each incidence of CAUTI, hospitals will incur an average $13,793 in additional costs caring for that patient (AHRQ, 2017). Comparably, an estimated one-fifth of laboratory tests are over utilized, unnecessarily adding on to healthcare costs with either no benefit or deleterious effect to patient care, where laboratory testing is the single highest volume medical activity and is noted to contribute to the largest growing segment of the US healthcare budget (Morado & Wong, 2022).
Despite their association with portal of infection, indwelling urinary catheters remain one of the most clinically necessary devices in contemporary healthcare, but continuous evaluation of their necessity must be performed to ensure that their benefit always outweighs their potential risks. The CDC recommends that QI programs focused on reducing CAUTI should involve Nurse-Directed programs providing for the prompt removal of catheters no longer meeting criteria. (CDC, 2009; Gyesi-Appiah, Brown & Clifton, 2020; Durant, 2016).

**Problem Statement**

In February 2022, a Site Assessment with regards to CAUTI incidence was conducted at a major Level II Trauma Center which had 23 CAUTIs in 2020, accounting for a SIR of 0.982. Not only did this not meet the 2020 NHSN National CAUTI SIR goal of 0.75, but it indicated that current CAUTI prevention strategies were failing. A review of the 23 CAUTI’s that had occurred in 2020 found that most of these events shared a few common themes: inappropriately long catheter dwell times in excess of 7 or greater days in patients who initially had indwelling catheters placed for management of acute urinary retention. Stakeholders in the Infection Prevention department, the Medical Executive committee, and Nursing Leadership committee agreed that a Quality Improvement initiative with the objective of reassessing current measures to reduce CAUTI incidence in the adult inpatient population was necessary.

A review of facility policies relating to CAUTI prevention found a lack of current evidence-based policies in place to prevent CAUTI. In 2017, a CAUTI minimization policy was published in response to with verbiage allowing for nurses to independently remove IUCs when they are no longer necessary and encourage use of external urinary catheter devices. However, this policy was not translated into a distributable protocol with explicit indicators for removal or insertion. Nursing Management and Infection Prevention agreed that there was a level of
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Disorganization within the facility where, although IUC use was being tracked daily by charge nurses, and a policy was in place to allow for independent removal of that device by the nurse, there was no protocol in place to stimulate a continuous consideration for necessity and removal of the device by nurses or physicians. It became evident that the introduction of a standardized protocol was necessary to ensure enhanced surveillance of IUC necessity at regular intervals and allow for prompt removal of that catheter by the nurse without delay. This project addresses the following clinical question: “How does the implementation of an evidence-based Nurse-Driven Indwelling Urinary Catheter Removal protocol, compared to current care, affect CAUTI incidence among adult inpatients over 6 months?”

**Purpose and Aims**

The purpose of this project is to empower nurses to prevent CAUTI in the acute care hospital setting via the implementation of a Nurse-Driven Indwelling Urinary Catheter Removal Quality Improvement (QI) program. The aims of the project were developed in conjunction with the TeamSTEPPS framework for implementation (AHRQ, 2018)

**Aims**

Clinical Outcome Aims:

1. Decrease CAUTI frequency, as measured by the CAUTI Standardized Infection Ratio (SIR), from current baseline of 98%, to less than 75% within 6 months of intervention implementation.

2. Decrease Indwelling urinary catheter utilization, as measured by the CAUTI Standardized Utilization Ratio (SUR), by at least 5% within 6 months of intervention completion.

Team Process Aim:
3. Increase the percentage of nursing staff who have received team training to at least 80% within two months of protocol implementation.

Team Outcome Aim:

4. Increase ICU RNs perception of the intervention’s utility in clinical practice, as assessed by a Likert-Scale Questionnaire approved by FSU faculty, within 6-months of intervention implementation.

Review of the Literature

Questions regarding indwelling urinary catheter indications, utility and risks were formed, and a literature review was conducted. The search was completed using the Florida State University (FSU) online library database, using the keywords “catheter-associated infection”, “CAUTI”, and “nurse driven protocol”. Most of the included literature was published between 2017-2022. In the following literature review, a few common themes were discovered in the prevention of CAUTI: Appropriate catheter use, use of Nurse-Driven Protocols, use of antimicrobial stewardship programs, and various methods for inducing organizational change. Prior to exploring the literature on appropriate catheter use, it is necessary to first define CAUTI and the criteria.

CAUTI Definition and Criteria

CAUTI in adults is defined by the CDC and outlines specific criteria for its diagnosis. Though, it has been said that the CDC’s definition of CAUTI correlates poorly with clinical practice, where the rate of CAUTI incidence can be influenced heavily by the prevalence of fever and the frequency of urine culturing (Lo et al., 2014; Sampathkumar, 2016). Criteria for CAUTI include:
1. A IUC in place greater than 2 consecutive days in an inpatient location or had a catheter that was in place greater than 2 days and then removed the day before the date of event.

2. At least one of the following signs or symptoms: fever, suprapubic tenderness, costovertebral angle tenderness, urinary urgency, urinary frequency, or dysuria.

3. Urine culture with no more than 2 species of identified organisms, at least one bacterium of at least $10^5$ CFU/mL. (CDC, 2022a)

In an effort to reduce inappropriate antimicrobial use the IDSA popularly published standardized guidelines for management of asymptomatic bacteriuria in 2009, endorsed by the CDC, and updated in 2019, that detail indications for urinary culturing the catheterized patient.

Indications for prompt urine culturing include:

- Fever in a kidney transplant recipient
- Fever in a pregnant patient
- Neutropenic fever
- Fever after urologic procedure
- Fever and known urinary tract obstruction
- Unexplained suprapubic or flank pain
- Spinal cord injury patient with new or worsening spasticity, autonomic hyperreflexia, malaise, lethargy, or sense of unease
- At admission of chronically catheterized patient with new fever or unexplained mental status changes
- Septic Shock (Lin et al., 2019)

**Appropriate Catheter Use**
Defining the up-to-date and appropriate use of IUCs are a cornerstone of CAUTI prevention strategies. Guidelines regarding CAUTI prevention were first published in 1981 by the CDC. In 2009, the CDC’s Healthcare Infection Control Practices Advisory Committee (HICPAC) published a list of appropriate indications for indwelling urinary catheter use, though this was based on mostly low-level evidence and expert consensus (CDC, 2009). The HICPAC guideline was later refined and updated in the Department of Veterans Affairs sponsored: “The Ann Arbor Criteria for Appropriate Urinary Catheter Use in Hospitalized Medical Patients”, which picked up where the HICPAC left off, with an updated literature review and input from an expert panel, but further validated recommendations using the RAND/UCLA Appropriateness Method (AHRQ, 2015). According to the Ann Arbor Criteria, the primary indications for indwelling urinary catheter use include:

1. Acute urinary retention or obstruction
2. Accurate measurement of urinary output in critically ill patients
3. Perioperative use in select surgeries
4. Assistance with healing of stage III or IV perineal and sacral wounds in incontinent patients
5. Improve comfort for end-of-life care if needed
6. Required immobilization for trauma or surgery

Saint et al. (2016) identified 4 elements that should be included in a successful CAUTI prevention bundle: catheter reminders or stop orders integrated into the EHR, nurse-initiated discontinuation, portable ultrasound to determine post void residuals, and use of external collection devices in men. Nurse-Driven CAUTI prevention protocols generally incorporate all four elements (Durant, 2016; Gyesi-Appiah, Brown & Clifton, 2020).
Of note, the CDC guidelines for appropriate catheter use include “perioperative use in select surgeries.” Patients undergoing colorectal and pelvic surgeries have been identified as having an increased risk of Postoperative Urinary Retention (POUR). Evidence determining the most effective time for urinary catheters to be removed in these patients varies greatly, and current recommendations by the Enhanced Recovery After Surgery (ERAS) Society advocate for their delayed removal within 48 to 72 hours postoperatively (Gustafsson et al., 2018).

**Quality Improvement Initiatives (CAUTI Bundles)**

*Nurse-Driven Surveillance and Removal Protocols*

Both the CDC and AHRQ agree that the most effect method of reducing CAUTI is to insert catheters only under appropriate circumstances, and to remove them promptly when no longer medically necessary (AHRQ, 2015; CDC, 2009). Similarly, the CDC and AHRQ recommend Nurse-Driven Protocols (NDP) as a best-practice for minimizing CAUTI incidence (AHRQ, 2015; CDC 2009). Nurse-Driven Protocols approach CAUTI prevention by facilitating the appropriate use of IUCs and ensuring their prompt removal as soon as is clinically indicated. They provide a concise protocolized checklist of circumstances that, when met, indicates to the nurse that the catheter no longer meets appropriate criteria for use and must be removed immediately. Nurses are key to reducing the inappropriate use of urinary catheters, and the use of Nurse-Driven Protocols for prompt removal of indwelling catheters has been demonstrated to be effective in reducing catheter use and the prevention of CAUTI (AHRQ, 2015). Nurse-Driven Protocols bypass the need to require an explicit physician order for discontinuation of IUCs, by standardizing the criteria for removal of IUCs, and inherently promote the enhanced surveillance for catheter necessity. Facilities implementing successful NDPs have estimated a cost savings of $50,000 to $100,000 (Tyson et al., 2018).
Efficacy of Nurse-Driven Protocols

A systematic review by Durant (2016) outlined the effectiveness of NDPs in reducing CAUTI in urban hospitals. In their review, eighteen studies found that when NDPs were implemented, urinary catheter utilization rate was reduced from 4%-50%. Fourteen studies found that CAUTI prevalence was decreased by up to 55% and in one case was eliminated altogether; though, one study found that CAUTI prevalence was ineffective at reducing CAUTI from their facility’s baseline, and another found that CAUTI incidence increased by 4% after implementation. Durant (2016) did clarify that four of the included studies mentioned did not specify if nurses could decide to independently remove catheters if the patient met criteria, or if nurses were still required obtain a physician order for removal which theoretically would diminish the effectiveness of the nurse-driven protocol. Only twelve studies presented use of a flowchart or checklist to ensure exposure of the protocol to nurses. Most studies did not recognize use of a QI model or framework for systematic process improvement. Additionally, none of the twenty-nine studies included randomized controlled trials, but instead were mostly quasi-experimental case-control studies.

An integrative review of studies published from 2013-2018 by Gyesi-Appiah, Brown and Clifton (2020) described other cases where NDPs proved effective. Nurse-Driven Protocols that include specific criteria for catheter use, daily review of catheter necessity, and prioritization of removal of an IUC before day 7 can be effective in reducing CAUTI. Prevention bundles that include indications for use, indications for removal, insertion techniques, reviews, and standardization of the practice of collecting urine specimens were able to reduce urinary catheter utilization by 9%, and CAUTI rate by over 33%. Bi-annual education programs that raise
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Awareness, increase nurses’ knowledge, and facilitate improvement in catheter care have demonstrated sustainable compliance and CAUTI incidence after implementation of a NDP.

Teal et al. (2020) integrated their NDP into the EHR and decreased CAUTI rates 65% over a 4-year period. Maxwell, Murphy and McGettigan (2018) similarly implemented a NDP that included integration indications for catheter use into the EHR and over a two-year period were able to reduce catheter usage by 17%, and CAUTI incidence by about 87%, eliminating CAUTI incidence for over 1 year during that time. Dy, Pegues and Bradway (2016) also integrated their NDP into their EHR across multiple hospitals and successfully decreased catheter usage by 6% and CAUTI by up to 28%. Zurmehly (2018) reduced CAUTI by 74% in a Long-Term Acute Care Hospital over 3 months. Other studies utilizing NDPS were able to successfully reduce CAUTI (Mori, 2014; Yatim et al., 2016; Tyson et al., 2018; Johnson, Lintner & Buckner, 2016; Alexaitis & Broome, 2014; Timmons, Vess & Conner, 2017; Quinn, 2015; Theobald et al., 2017).

Antimicrobial Stewardship

The goals of antimicrobial stewardship programs are to: 1. Ensure that urine cultures are only performed when there are appropriate indications present to determine if treatment with antibiotics is indicated, and 2. Develop education with an emphasis on IUC maintenance and correct collection of urine specimens using best evidence to promote sterility and prevent contamination of a specimen (CDC, 2019). For this reason, it is not uncommon for CAUTI QI initiatives that combine urine culture stewardship UCS programs with nurse-driven surveillance protocols (NDP).

With the rapid proliferation of Multidrug Resistant bacteria, and the introduction of Pay-for Performance programs affecting reimbursement for hospitals with high HAIs, Antibiotic
Stewardship Programs attempt to optimize antibiotic administration to achieve best clinical outcomes while reducing the development of MDR organisms (Advani & Vaughn, 2021). The overuse of urine cultures is attributed to the inadvertent increase in inappropriate antimicrobial use in the treatment of asymptomatic bacteriuria (ASB), which can lead to antimicrobial resistance, Clostridium difficile infection, and adverse drug events. Stewardship programs have gained favor alongside Nurse-Driven Protocols as a method of decreasing CAUTI and are endorsed by both the CDC and AHRQ. Stewardship programs include enhanced process measures for standardizing the appropriate use of urine culturing and indwelling urinary catheters. (AHRQ, 2015)

Indwelling catheters can become colonized with biofilm containing sufficient CFU/mL with the potential of meeting CAUTI two days after insertion. This is exacerbated by poor adherence to aseptic insertion techniques and management practices. Poor adherence to specimen collection and storage can also contribute to specimen contamination. Urine cultures are frequently ordered by providers in response to non-specific symptoms that lack a clinical indication for culture. This popularly occurs in the workup of hospitalized patients with Fever of Unknown Origin, leukocytosis, or hemodynamic instability. The practice of “pan-culturing” is an entrenched habit in medicine that is driven by fear of missing an infection and an increasing reliance on laboratory testing over clinical findings. Pan-culturing in these cases often yield positive results and provides instant gratification for the provider; but these results are more likely to detect colonization and contamination than true infection, where IUC colonization is responsible for fever in only 2-3% of patients presenting with non-specific symptoms of infection and an IUC. Therefore, over-testing leads to overdiagnosis of CAUTI and increases the risk of inappropriate antimicrobial use in Asymptomatic Bacteriuria (ASB). Treating ASB with
antimicrobials can lead to patient harm, *Clostridioides (C) difficile* infection, and the proliferation of MDR bacteria. The CDC, IDSA and the American College of Critical Care Medicine recommend the evaluation of all other causes of infection before culturing a urinary catheter unless the patient meets specific initial criteria. (Advani & Vaughn, 2021; CDC, 2019; Lin et al., 2019; Morado & Wong, 2022)

Quality improvement antimicrobial stewardship programs can decrease CAUTI rates. Frontera et al (2021) implemented a urinary antimicrobial stewardship program with an emphasis on sterile sampling including urinary catheter reinsertion prior to collection and found that CAUTI incidence was reduced by 63%. Luu et al. (2020), implemented a stewardship program focused toward provider education and poster dissemination, found that CAUTI SIR decreased by over 50%, and were able to achieve a CAUTI SIR less than 1.0. Page et al. (2020) decreased CAUTI rate by 72%. Unexpectedly, Dougherty et al. (2020) found CAUTI rates to increase slightly by 0.2 Catheter Days. Watson et al. (2019) were able to decrease their SIR by .02.

When applied alongside catheter removal NDPs, Sampathkumar et al. (2016), who additionally integrated their protocols into the EMR, found that CAUTI rates decreased by 70%, and CAUTI SIR decreased from 1.0 to 0.24. Al-Bizri et al. (2021) similarly decreased their CAUTI incidence by approximately 40%. Mullin et al. (2017), who also measured their rates of HAI bacteremia, found CAUTI rates to decrease by 63% and bacteremia incidence decreased by 15%. Saint et al. (2016) were able to decrease CAUTI rate by 15%. Tyson et al. (2018) decreased catheter days from 5.1 to 2.0.

While culture stewardship programs have been shown to reduce the frequency of urine cultures and inappropriate CAUTI diagnoses, their influence on appropriate antimicrobial use remains unclear. Specifically, the use of urinalysis automation with “reflex to culture” has been
shown to decrease urine culturing and CAUTI rates; however, it has been demonstrated in other studies that urinalyses that reflex with culture recommendations have paradoxically led to an increase in urine culture orders and overtreatment of ASB. It is hypothesized that the unclear definition of pyuria (WBC/HPF) that varies on a per-facility basis is the greatest factor influencing an inappropriate reflex to culture indication. (Advani & Vaughn, 2021; Morado & Wong, 2022)

**Barriers to Implementation of NDPS**

**Organizational Culture**

Overcoming staff resistance to change was the single most frequent barrier to implementation identified in the literature (Advani & Vaughn, 2021; Al-Bizri et al., 2020; Gyesi-Appiah, et al., 2020; Maxwell, et al., 2018; Mori, 2014; Mullin et al., 2017; Sampathkumar, 2016; Saint et al., 2016; Theobald et al., 2017). DePuccio et al. (2020) identified three barriers to NDP implementation use in hospitals: nurse deference to physicians, physician push-back, and miscommunication about IUC removal. Facilitating factors that can contribute to the successful implementation of NDPs include training staff to use NDPs, discussing IUC necessity and purpose of NDP during daily rounds, and developing systematic reminders for staff to reference NDPs (DePuccio et al., 2020). Successful implementation of a NDP require both hospital leaders and physicians to empower nurses to utilize the NDP, ensuring there is an up-to-date list of patients who have IUC that must be assessed daily, and EHR nudges that prompt nurses to assess and acknowledge indicators for catheter removal on a regular basis (DePuccio et al., 2020).

**Implementation Strategies and Overcoming Barriers**

Education about evidence-based practices to reduce CAUTI should be the first action to begin a CAUTI prevention protocol. Use of hands-on demonstrations, posters and case scenarios,
peer-to-peer education, and train-the-trainer formats have proven to be effective pedagogical strategies. Furthermore, involving staff in matters related to reducing catheter use increases ownership of the CAUTI prevention effort, and providing staff with an evaluation tool to record their perceptions of the new processes and equipment enhances the education process and identifies knowledge gaps. Having physician champions in the development of a QI initiative is also key. These individuals should serve as role models during the implementation phase and assist with the dissemination of information. Sharing information of successful outcomes with staff can promote continuous staff buy-in, where measuring and displaying the number of IUCs and CAUTI per month via statistical process control charts can empower and inspire nurses when they realize that their evidence-based care can make a difference. (Johnson, et al., 2016; Maxwell, et al.2018; Teal et al., 2020)

Gyesi-Appiah, Brown and Clifton (2020) describe the use of senior nurse audits on IUC necessity that can empower the healthcare and promote continuous discussions that involve new staff members. While NDPs commonly include use of checklists, to some they are easily bypassed and ignored without consideration. Additionally, the inclusion of link nurses as auditors can improve buy-in, where link nurses are perceived to be closer to the team, and can continuously audit, challenge, prompt and create awareness among the team to change the culture. (Gyesi-Appiah, et al., 2020)

Mori (2014) found that nurses feared the consequences of patient incontinence, like compromising skin integrity, pressure ulcers, and frequent linen changes; but determined that face-to-face communication proved to be the most effective method of overcoming resistance to change. Zurmehly (2018) developed a self-study guided online module with a 10-item questionnaire, in addition to implementing a NDP into the EHR with great success. Yatim et al.
Reducing Inpatient CAUTI (2016) also developed computer-based online education regarding NDP criteria, catheter maintenance practices, and bladder ultrasound indications prior to implementation of an NDP. Quinn (2015) credits their success with designating a senior nurse with accountability for compliance with the NDP, having a physician champion, tight collaboration with infection control and the Information Technology department, and the integration of the checklist criteria into the EHR.

**Sustainability of Change**

A 2014 study by the NHSN found that only 6% to 27% of hospitals reported adherence to CAUTI prevention programs (Stone et al., 2014). Nurses generally view catheter management as task-oriented, where decisions related to catheter removal are reliant on physicians; but that the provision of other standardized protocols that provide for nurses’ discretion for catheter removal, like Enhanced Recovery After Surgery (ERAS), empowered nurses to remove catheters and better care for their patients. Their use of a 40-minute lecture focusing on knowledge deficits identified with a focus group, a pretest, and a post-test, was successful in improving nurses’ knowledge regarding catheter insertion techniques, maintenance, and CAUTI surveillance measures. Conducting regular in-service education in a similar fashion can promote sustainability of CAUTI prevention programs (Gesmundo, 2016).

Quality Improvement interventions in the hospital setting range from strong systems-based interventions to weaker persons-based interventions that focus on education alone. Systems-based changes include forced functions, automation, nudges/reminders, and standardization of processes and order sets in the EHR. Persons-based changes include policies, rules and education that promote more autonomy for staff. While education is a core element of any CAUTI QI program, general education alone is usually insufficient to promote long-term
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compliance and sustainability. Education coupled with EHR changes has been shown to be more impactful (Advani & Vaughn, 2021).

Justus, Wilfong and Daniel (2016) minimized CAUTI incidence through their development of a blended learning model that included computer-based online modules and hands-on simulations that were custom designed for the unique roles of nursing, nursing assistants, and transporters, providing education related to daily cleaning, proper position, and emptying the collection bag, that were specific to their medical role. Maxwell, Murphy and McGettigan (2018) were able to sustain successful CAUTI prevention and induce cultural change at their facility by providing regular in-service education to staff, displaying statistical process control charts indicating decreases in CAUTI, introducing staff recognition and rewards, and integrating CDC criteria for catheter continuation into their EHR. Teal et al. (2020) attained sustainability in their program by use of a multidisciplinary team of nurses, nurse assistants, physicians, pharmacists, performance improvement specialties and administration to promote buy-in, and continued peer audits of foley catheter necessity allowing for feedback and “just in time education” to other nurses. An integrative review by Kranz et al. (2020) found that, in addition to typical lecture-based education, CAUTI can be reduced by up to 52% when a reminder system or defined catheter removal timepoint was integrated into the EHR. Similarly, Rea et al. (2018) found that integration of their existing NDP criteria into the EHR increased staff satisfaction, increased compliance and staff ownership of the protocol and decreased catheter utilization below what was already accomplished with the existing paper-based measures.

Summary of the Literature
While Nurse-Driven urinary catheter surveillance protocols have independently proven useful in the minimization of both catheter utilization and CAUTI incidence, the combination of nurse-driven urinary catheter removal protocols and urine culture stewardship programs can be synergistic (Al-Bizri et al., 2021; Mullin et al., 2017; Saint et al., 2016; Sampathkumar et al., 2016; Tyson et al., 2018). Barriers to the implementation of NDPs and antimicrobial stewardship programs are almost always attributable to an organizational culture that is resistant to change. There are pedagogical strategies that can be utilized to help bridge this gap in knowledge and promote buy-in from physicians and nurses for CAUTI prevention bundles. Education, senior mentors, champions, and enhanced persons-based and systems-based communication are strategies for implementation and facilitators of change. There is a lack of randomized controlled trials concerning the use of Nurse-Driven Protocols in the literature. While certain RCTs on subject do exist, they are generally either greater than ten years old, or do not incorporate a NDP that allows for the independent decision by the nurse to remove a IUC per CDC guidelines.

**Conceptual and Theoretical Framework**

Change Theory, postulated by Kurt Lewin (1951), conceived a model for enacting change in three stages: Unfreezing, Change, Refreeze. Lewin further identifies three major concepts: Driving Forces, Restraining Forces, and Equilibrium. Driving Forces facilitate change by disturbing equilibrium and thrusting the patient in the desired direction of change. Restraining Forces resist the driving forces to return to the previously defined equilibrium. Equilibrium is a stagnant state where driving forces equal restraining forces, and no change occurs. Unfreezing involves enacting the interventions that promote the desired change. The Unfreezing interventions must be systemic in nature, as to oppose resisting forces from every possible direction. Unfreezing can be accomplished by increasing driving forces and minimizing
restraining forces. Change is defined as movement that is evidenced by observing a change in thoughts, feelings, and behaviors. Refreezing is the establishment of change as the new equilibrium (Kaminski, 2011).

Concepts of Change Theory can be applied to both the patient and the organization. A resistant organizational culture and the notion of “that’s the way it’s always been done” is a moderating barrier that has commonly been identified in the implementation of quality improvement programs. As it applies to the aims of this study, the objective of the Nurse-Driven Protocol, and the concept of unfreezing-change-refreezing, illustrates the idea of facilitating the “unfreezing” of a patient with an indwelling urinary catheter and removing it. Similarly, a multitude of educational strategies will be performed with the intention of unfreezing the organization, inducing culturing change, and refreezing in a state where there is compliance with the NDP that is perceived as useful by staff.

Hussain et al. (2018) describe the application of Change Theory in inducing cultural change, and illustrate a looped process model comprised of leadership, management, and organization. Transformational leadership was identified as the most important factor for change, where transformational leaders should be placed in key positions prior to launching any of the three stages. Management that is pitched toward change is described as having a process of continually renewing the direction, structure, and capabilities of an organization to meet the ever-changing internal and external needs of customers. In the case of this project, the needs of the facility are to decrease CAUTI and minimize associated costs, which already are driving forces for change. Employee involvement involves increasing employee input into decisions that affect the organization’s performance and employee well-being. The attitudes that induce change among employees can be broken down into four components: power, information, knowledge
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and skill, and rewards. Promoting employee participation in the decision-making process can encourage knowledge sharing and buy-in from staff. Furthermore, leaders embodying the role-modeling and transparency aspects of the transformational leader will be placed in key positions during the education process, and employees will be invited to monthly Charge Nurse committees where their insights and recommendations will be recorded and deliberated. Change Theory of Nursing assists in providing an over-arching mission to guide the implementation plan and directly aligns with the AHRQ’s TeamSTEPPS framework for intervention implementation in large hospital systems where a team-based collaborative effort is necessary to enact change across multiple systems (AHRQ, 2018). (Hussain et al., 2018)

Methodology and Implementation

Design, Setting, Participants and Resources

The project evaluated the implementation process of a Quality Improvement program’s effect on CAUTI frequency utilizing a retrospective chart review control group. The study was conducted at a 563-bed Acute Care Hospital Level II Trauma Center. Units included in the QI project are the Surgical and Medical Intensive Care Units, and Adult inpatient wards. Units excluded from the project are the Emergency Department, Labor & Delivery, Pediatrics, Pediatric ICU, and the Neonatal Intensive Care Unit. Members of the Change Team were assigned specific roles. The nurse and physician champion attended Team Training sessions and engage staff in the education process. Charge nurses and nurse educators monitored for daily compliance with the NDP for each unit while auditing the line list. A case review for each sustained CAUTI was performed by the Infection Prevention team consistent with AHRQ’s CAUTI Event Report Template to determine where and what process measures failed (AHRQ,
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2015). An executive summary report for each CAUTI was then provided by the infection prevention team to the Change Team, detailing which processes failed.

**Instruments/Tools**

In consideration of sustainability, there was an interest in developing a strategy to assess nurses’ perception of the NDP’s impact on clinical practice both before and after implementation strategies began. To that end, a customized staff perception survey specific to perceived knowledge, teamwork, and efficacy of the tool was developed to briefly capture these attitudes (Appendix C). It was felt that a concise tool tailored to attitudes toward the NDP would promote attrition, especially while surveying nursing staff while on duty. This survey questionnaire was approved by senior FSU faculty for use in the project. Use of a perception-based survey would assist in determining if the implementation strategy was sufficient to induce cultural change in favor of the new practice-altering intervention within the organization. Use of the 6-point Likert-scale was chosen based on a recent analytical review published by Joshi et al. (2015) who suggest avoidance of the use of answers that allow for a “neither agree nor disagree” otherwise known as a *null* response.

**Intervention and Data Collection**

The intervention being implemented is the Nurse-Driven Protocol for indwelling urinary catheter removal. The aims of the project are developed in a way as to evaluate the expected clinical outcomes associated with the intervention, as well as evaluation of the various strategies utilized in the implementation process (Appendix A).

The Infection Prevention department records the monthly SIR and SUR via the NHSN Patient Safety Component Data Entry tables, in addition to the many variables that are required to derive these statistics, like patient days, catheter days, and CAUTI incidence. For patients who
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sustained a CAUTI, a the AHRQ’s CAUTI Event Report was utilized by the Infection Prevention team as a method of performing a focused Root Cause Analysis and allowed the Change Team to continuously reevaluate our month-to-month focus based on a Plan-Do-Study-Act cycle (AHRQ, 2015). This data was utilized with the intent of preparing a control chart to compare month to month variability of CAUTI incidence, comparing means, and identifying any potential trends in the data associated with CAUTI frequency. The NDP Staff Perception Survey was disseminated before and after educational strategies were performed. Basic demographic information was recorded from the survey to assess the heterogeneity of the sampled population.

Implementation Plan

The AHRQ’s TeamSTEPPS Initiative was adopted to guide the implementation process. This occurs in three continuous phases, Phase One: Assessment, Phase Two: Planning, Training, and Implementation, and Phase Three: Sustainment.

In Phase 1, a Quality Improvement meeting was conducted at the facility, identifying the incidence of CAUTI as a problem. A team of key leadership and staff members were formed and included the Director of Nursing, Director of Infection Prevention, Infection Prevention staff, Nursing Education staff, a nursing champion, and a Physician Champion. Phase One was completed in March 2022.

Phase Two included the finalization of the Action Plan, developing and performing nursing staff education across multiple modalities, and implementation of the NDP for testing. Multiple techniques for education and cultural change were instituted in short phases during this process. The physician champion and infection prevention attended each monthly 4–5-hour Team Training session to provide teach-back education to nursing attendees. The nurse champion and nursing educators attended regular nursing huddles to provide in-person inquiry-
based education regarding the purpose of the protocol in promoting patient safety and to remove any ambiguity associated with the introduction of this new protocol. A computer-based online education module was developed that introduces NDP, along with a 10-question multiple choice test reflecting how the NDP should be utilized in specific scenarios (Appendix D). All staff nurses employed by the included units were required to complete a Team Training session, as well as the online education module prior to introduction of the intervention July 2022. The NDP was then physically disseminated among all participating units as well as integrated into the EHR (Appendix B). Phase Two was completed at the end of the 6-month testing period in December 2022.

Phase three was comprised of the continued monitoring, coaching, and enhanced integration of the NDP into additional systems processes to promote sustainability of the intervention across the facility. Staff Team Training sessions with members of the Change Team continued throughout the entire implementation phase. At this point, nurses had physical access to the NDP flyer at nurses’ stations, the NDP was integrated into the EHR, and as a result charge nurses now had a streamlined process for auditing NDP compliance. Team training with attendance of the infection prevention team would continue after the implementation phase, and the online learning module then became an annual completion necessity. Phase 3 was completed in April 2023.

**Human Subjects and Informed Consent**

The project proposal was submitted to the Florida State University (FSU) Institutional Review Board (IRB) who determined that this experiment is of Quality Improvement in nature, and project approval was obtained. The healthcare facility is clinically affiliated with the FSU College of Nursing DNP Program, approval for research was obtained with permission from the
Director of Infection Prevention at the healthcare facility, and no facility IRB approval was required. Regarding data collection, convenience sampling was utilized based on those patients who were diagnosed with CAUTI, and no private information or patient identifiers were collected nor supplied to the primary investigator. Data was supplied from the facility’s Infection Prevention department and subsequently codified into a codebook. The codebook data was stored on a password-locked personal computer until the end of Phase Three of the project, which ended in April 2023.

Results

Data was retrieved and reviewed monthly for the duration of the 6-month implementation period. A total 12-month data set was compiled in which the experimental 6-month implementation phase group was compared retrospectively to the 6-month control group, where a total of 12 CAUTI events occurred during the entire 12-month period. A data table visualizes this data in Appendix G. Prior to implementation, the CAUTI incidence for the facility was 7 with 11.53 predicted infections compared to the NHSN baseline, for a SIR of 0.60; and CAUTI incidence in the implementation phase was 5 with 13.12 predicted infections for a SIR of 0.38. Utilization of catheters increased compared to prior, with an SUR growth from 0.69 to 0.74. The CAUTI Rate decreased from 0.82 to 0.52. The number of CAUTI events occurring in the ICU decreased from 5 events to 2 events. Of the seven CAUTI events occurring prior to implementation, five of these were due to inappropriate catheter dwell times according to the NDP, whereas in the post-implementation phase, one of them was attributed to inappropriate use. An independent samples t-test was conducted comparing the six-month control SIR values (M = .586, SD = .785) to the six-month implementation SIR values (M = .378, SD = .351) which did not necessarily demonstrate a significant difference, t(10) = .594, p = .566.
Regarding staff perception, a paired sample of 37 nurses completed both pre-test and post-test surveys with a 100% attrition rate. The sampled population was predominantly female, most were between the ages of 18-30 years old, with nursing experience between 0 to 5 years (Appendix H). A data table comparing the pre-implementation and post-implementation results can be seen in Appendix I. In an effort to compare variability of the results without compromising the ordinal nature of the data, a Chi-Square test was performed on the pre-implementation and post-implementation Likert-scale results. Ultimately, nurses were more likely to report that they were knowledgeable (M = .648, SD = 1.059) of the NDP criteria $X^2(5, N = 37) = 12.33, p = .03$, less likely to report that they were confident (M = -.027, SD = .725) in discussing NDP criteria with their peers $X^2(5, N = 37) = 4.52, p = .47$, as well as less likely to report their personal belief in the efficacy of the NDP (.351, SD = .538) to prevent infection $X^2(5, N = 37) = 6.04, p = .30$. Despite this unanticipated variation, the mode for question one increased from “Agree” to “Strongly Agree”, the mode for question two remained the same at “Agree”, and the mode for question three increased from “Agree” to “Strongly Agree”.

**Discussion**

**Team Clinical Aims:**

1. **Decrease CAUTI frequency, as measured by the CAUTI Standardized Infection Ratio (SIR), from current 98% (2020) to less than 75% within 6 months of intervention implementation.**

2. **Decrease Indwelling urinary catheter utilization, as measured by the CAUTI Standardized Utilization Ratio (SUR), at least 5% within 6 months of intervention completion.**
The Nurse-Driven Protocol was effective in minimizing CAUTI as well as maintaining the SIR below our goal of less than 0.75, per the NHSN national goal for acute care hospitals. A 22% reduction in SIR was seen between the control group and experimental group. To that end, the SIR output for the entire 2022 calendar year is 0.48. If compared to the 2020 CAUTI SIR of 0.98, which served as the initial benchmark and stimulus for change in the organization at the beginning of this project, this represents a 50% decrease in CAUTI incidence year over year. This figure was attained despite a 6-month implementation period. This outcome aligns closely with data reported in the literature. (Alexaitis & Broome, 2014; Dy, Pegues & Bradway, 2016; Gyesi-Appiah, Brown & Clifton, 2020; Johnson, Lintner & Buckner, 2016; Maxwell, Murphy & McGettigan, 2018; Mori, 2014; Teal et al. 2020; Theobald et al., 2017; Timmons, Vess & Conner, 2017; Tyson et al., 2018; Quinn, 2015; Yatim et al., 2016; Zurmehly, 2018)

An independent t-test was performed upon the data demonstrating a decreased mean and standard deviation, though with a quite elevated p value. This test is likely limited by the small sample size and would require a considerably larger data set. However, further analysis of the SIR with an expanded 18-month independent control chart indicates a process under control after the implementation period (Appendix E). In this case, a process variation of greater than 1 sigma (σ = 1.56), is considered as our upper control limit of concern, where any variation above this line even if not sustained, would not only threaten the integrity of our quarterly SIR but most importantly would indicate that multiple process failed in a system designed for a nearly zero-tolerance.

Prior to the Site Assessment with hospital administration, it can be seen that 6 out of 8 data points lie above the Control Line of 0.71, and 2 of 8 data points lie above the +1 Sigma line of 1.56, including February 2022, which prompted the initial Site Assessment. After
implementation of the NDP in July 2022 only 1 of 6 data points exceeds the Control Line. In fact, after the Site Assessment only 2 of 10 data points exceed the Control Line, likely reflecting an enhanced drive in the organization to dynamically communicate and collaborate to prevent CAUTI, with newly implemented systems shortly thereafter to maintain sustained change.

Of note, an Antimicrobial Stewardship Urine Culturing Guideline consistent with CDC guidelines was implemented at the facility two months prior to the NDP and is reflected in the process control chart. This could imply that both systems complement one another and further assisted in maintaining control of the process, though 4 out of the 5 total CAUTI that occurred during the testing period were attributed to noncompliance with the Urine Culturing guideline, indicating an inadequate implementation process by the team overseeing that intervention. The facility decided to introduce both processes during similar time periods at the recommendation of AHRQ, which heavily recommends the implementation of a Nurse-Driven removal program as well as an enhanced urine culturing guideline together, to prevent CAUTI in those with short term catheterization by ensuring prompt removal, as well as to prevent potentially inappropriate CAUTI diagnoses in those with chronic indwelling urinary catheters and asymptomatic bacteriuria associated with its use (AHRQ, 2015). Similarly, the literature supports the synergistic effect that both programs can have on CAUTI prevention when implemented in tandem (Al-Bizri et al., 2021; Mullin et al., 2017; Saint et al., 2016; Sampathkumar et al., 2016; Tyson et al., 2018). To that end, the intervention is considered successful in satisfying Project Aim #1.

While indwelling catheter utilization rates are not considered a major quality improvement measure such as that of the SIR, and hospitals are not penalized for excessive catheterization rates, it can be a helpful measure for internal process improvement strategies
seeking to reduce or avoid indwelling catheter usage. Furthermore, SUR was selected as opposed to the traditional measure of Device Utilization Rate (DUR) given that SUR inherently compensates for changes in total patient population over time, whereas DUR does not. As such, there was a hypothesis that if all indwelling urinary catheters in the hospital system were reliably being removed at the appropriate intervals, then overall utilization rates would decrease to some extent; and if catheter utilization is decreased than one could conceivably interpret that as an overall reduced risk of CAUTI for the inpatient population. However, according to the SUR, overall utilization of indwelling urinary catheters unexpectedly increased by 5% compared to previously, largely due to outlier data (Appendix G). This was an unanticipated change compared to data reported by Gyesi-Appiah, Brown & Clifton (2020), who reported that NDP CAUTI programs were able to reduce device utilization by up to 9%.

A process control chart was similarly developed to visualize this change in utilization over time (Appendix F). It can be seen that catheter utilization is grossly exhibiting a process in control save for an outlier in November 2022 where SUR increases by 13%, exceeding the upper control limit, and then immediately stabilizes back to the control line in December. A review of the clinical outcome data seen in Appendix x indicates that there is an unusual increase in Patient Days in March, October, November, and December. It can be seen in this process control chart that November is the only month in which SUR is so heavily influenced by the patient population itself, likewise Predicted CAUTI is notably higher in November than any other month. This is explained by a large event in the community that occurs annually in the area during this time period, in which the hospital saw an unusually high number of Trauma admissions to the ICU. However, despite a major 13% increase in foley catheter utilization
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during this time in which the ICU was experiencing a high number of admissions, one CAUTI occurred during this month, and did not originate or occur in an ICU patient.

This data establishes that the intervention had no meaningful impact on the SUR and did not satisfy Project Aim #2 of reducing the SUR across the included units. However, this also demonstrates that despite a considerably higher utilization of foley catheters in our high infection risk ICU patients, none of them developed CAUTI. Other supplementary measures found that Dwell Time to CAUTI decreased by 2.3 days, and CAUTI occurrence in the ICU decreased from 5 to 2 (Appendix G). This may suggest then that indwelling catheters were utilized more efficiently than before in our high-risk ICU population as a result of the Nurse-Driven Protocol.

**Team Process Aim:**

3. *Increase the percentage of nursing staff who have received team training to at least 80% within two months of protocol implementation.*

Medical Team Training sessions were key to developing buy-in from staff and engaging a relaxed and collaborative learning environment. The facility had already recently implemented mandatory 4 to 5-hour team training sessions for all clinical nursing staff once per quarter, or four times per year in response to previous TeamSTEPPS initiatives performed in the past. The Nurse-Driven Protocol was developed and finished in March 2022 in preparation for the monthly Quarter 2 Team Training sessions to integrate the new tool into a 15-to-20-minute timeframe. Team training sessions were regularly attended by the physician champion, who is a well-known family medicine physician in the health system, and at least one member of the infection prevention team. These team members would lead the training session with a presentation and utilize a teach-the-trainer approach utilizing scenario-specific questions developed specifically for enhanced decision-making with the NDP. With a three-month lead-time before the
intervention testing phase in July 2022, we were able to easily meet and exceed our goal of at least 80% attendees before intervention testing across all of the included units. A 100% attendance rate was not feasible due to multiple factors, namely staff turnover and select PRN employees with difficulty scheduling training sessions. For this reason, new-hire training needs were considered, and newly hired nurses were required to attend a Teams Training session as soon as possible after hire, usually within 30-days. The literature supports similar successes in CAUTI reduction with NDPs when paired with high quality collaborative team training mechanisms. Gesmundo (2016), and Gyesi-Appiah, Brown & Clifton (2020) reported successful CAUTI incidence reductions with the implementation of regular live education programs with staff. Johnson et al., (2016), Maxwell et al., (2018), Teal et al., (2020), and Quinn (2015) similarly reported successful CAUTI QI programs when paired with team training with physician champions and transparent data sharing with clinical staff via process control charts to highlight progress, share wins, and otherwise empower nurses with the knowledge that their care makes a difference.

**Team Outcome Aim:**

4. *Increase ICU RNs perception of the intervention’s utility in clinical practice, as assessed by a Likert-Scale Questionnaire approved by FSU faculty, within 6-months of intervention implementation.*

There was a desire to survey the nursing staff who are expected to utilize the Nurse-Driven Protocol on a daily basis, to determine their perception of the protocol’s efficacy in clinical practice. Nurses are experts in finding the most efficient and ingenious ways to meet the rapidly changing needs of their patients. Undoubtedly, the introduction of a new practice guideline or tool however steeped in evidence as it may be, may be met with disdain by the clinical team if
the implementation of that intervention perceptibly hinders their ability to best care for their patients. We knew that we had to implement this intervention across multiple systems to promote buy-in. For that reason, it was important to the Change Team that the NDP be succinct as possible and then unobtrusively integrated into the EHR as soon as possible in an effort to automate the decision-making process on behalf of the nurse, while also potentially influencing a feeling of familiarity and ownership of the intervention. The Nurse-Driven Protocol, as the name implies, is only effective if nurses are choosing to utilize it in their assessment and decision-making.

A paired sample of thirty-seven registered nurses were surveyed via Qualtrics prior to initiation of implementation strategies, and again three months after implementation of the intervention in clinical practice. Despite some unexpected variability in answers between tests as indicated by Chi Square testing, many more nurses strongly agreed with a familiarity with the protocol’s criteria compared to prior, and more nurses agreed that the NDP is effective in preventing infection. However, there was some slight variability with a net negative change in the answers for question two, which asks nurses their confidence level in discussing the NDP with other nurses, thus implying that nurses may have been met with push-back from other nurses during the implementation period. Ultimately, despite some unanticipated variability, a net positive perception toward the NDP was fostered as indicated by Mean change between groups. However, it is clear that a more robust and validated workplace culture survey like that of the TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ) would prove more useful in the future (AHRQ, 2018).

*Sustainability Planning*
The results of this project were communicated regularly to the Chief Nursing Officer with other members of the Change Team, who have agreed that the project was successful in accomplishing and exceeding the clinical outcome goals. It was important to ensure that the successes of this QI project are fostered well into the future, as well as to ensure that any limitations or weaknesses are met with an alternative action plan. The NDP was integrated into EHR for active viewing and consideration when charting upon urinary catheter care ensuring that this pertinent protocol will be viewed by every nurse every day. In relation to the literature, Kranz et al., (2020), and Rea et al., (2018) found that integration of their NDP into the EHR was attributed to sustainable CAUTI reductions.

Charge nurses for each unit, both day shift and night shift will take over NDP compliance auditing and provide immediate feedback to nursing staff as needed for any identified gaps in knowledge during the auditing process. The Infection Prevention staff will continue to perform Root Cause Analysis via CAUTI Event Reporting and involve nursing education and nursing management in brief non-punitive Team-Based debriefing meetings when knowledge gaps with the protocol are identified. Involved staff will be surveyed regarding suggestions for improvement when such process failures occur. Quarterly team-based education including the physician champion and infection prevention team will continue to occur monthly for at least another six months. The Chief Nursing Officer will continue to hold monthly quality improvement meetings with nursing leadership and other members of the Change Team to oversee continuing process improvement. The infection prevention staff will remain responsible for ongoing implementation and oversight planning from this point forward.

The data collection process will remain the same but with some minor changes. The infection prevention staff will continue to monitor and track SIR and SUR as usual and maintain
CAUTI Event Reporting, in addition to this, catheter dwell time for all patients will be collected daily as well. The Information Technology team has made accessible a printable list report of each patient in the health system who has an indwelling catheter and how many days have elapsed since insertion as read by the EHR. These reports will be printed and audited daily by the charge nurse of each unit to assist in streamlining the catheter necessity auditing process. The ability to more easily monitor and record dwell time for every catheter in the system will provide a more accurate process measure for monitoring the NDP’s effectiveness over time in ensuring prompt catheter removal. Nursing education will provide more robust staff perceptions testing utilizing the T-TPQ from this point moving forward to assess staff teamwork perceptions more accurately on a more global scale. Ultimately, the QI project was successful in meeting and exceeding the primary goal of preventing CAUTI and the facility was provided with a sustainability plan developed in response to the analysis of trends seen in the testing phase as outlined here.

**Significance/Implications of Results**

A Nurse-Driven Protocol for catheter removal driven by specific clinical indicators promotes enhanced device necessity surveillance and removes any potential communication barriers for prompt catheter removal. This QI project was successful in both preventing CAUTI and maintaining sustained change and adds to the literature supporting the use of NDPs in the prevention of CAUTI. A robust implementation framework like that of TeamSTEPPS and CUSP are crucial systematic tools specific to the implementation of new clinical interventions in large-scale healthcare systems, where planned communication and collaboration between departments and teams will determine the success of the proposed intervention (AHRQ, 2012). Without a
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departmentally diverse and fiercely collaborative change team focused on patient safety and systems optimization, this project may not have exhibited the same level of success.

Limitations and Suggestions for Improvement

The project was inherently limited being a feasibility study, thereby utilizing a retrospective control group, which also influenced the use of a repeated measures design when surveying staff. Without the utilization of a Randomized Control Study, I therefore could not determine cause and effect. A non-random voluntary sample of nurses was utilized, which affected the overall homogeneity of the sampled group of nurses. While nurses were surveyed anonymously via Qualtrics, though members of the Change Team were present at various times in which nurses completed their surveys, which could have influenced an observation bias in the data. The project was conducted at a single facility in a single geographical area, which does not provide for proper randomization.

Suggestions for Future Clinical Research

Standardized decision-making tools tailored to the needs of nurses can alleviate the burden of process failures that occur as a result of miscommunication. Electronic Health Systems can influence the standardization of healthcare and the continued development and validation of other Nurse-Driven Protocols should be considered in preparation for a future where standardization will influence automation. This project provided research regarding successful HAI prevention by nurses with the assistance of a standardized protocol, and this data lends itself to the hypothesis that a similarly constructed Nurse-Driven Protocol regarding Central Line-Acquired Blood Stream Infection may prevent bacteremia and mortality in hospitalized patients in relation to yet another device that is managed by nurses every day. Additional research
regarding a Nurse-Driven Protocol for Central Line catheter removal could empower nurses to eliminate the risk of bacteremia in the hospital’s most sick patients.

**Conclusion**

In a growing effort to standardize many aspects of healthcare, Nurse-Driven Protocols based on established evidence-based practice can be effective clinical decision-making tools that promote uniform care and bypass traditional communication gaps. When applied to CAUTI prevention, NDPs empower nurses to independently remove these devices that nurses routinely insert, manage and monitor. This project reports a successful nurse-driven Quality Improvement study to prevent hospital-acquired infection in the acute care hospital setting.
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*Diseases, 73(9), e2690-e2696. Available from: https://academic.oup.com/cid/article/73/9/e2690/5890408?login=true*


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Reducing Inpatient CAUTI through a bundled 6-C approach. The Joint Commission Journal on Quality and Patient Safety, 42(6), 254-AP4.


Appendix A

Nurse-Driven Protocol: Foley Catheter Necessity Checklist and Removal Decision Tree

**Foley Catheter Necessity Checklist**

Is there an order for the Catheter? **YES** → **NO**

Does your patient meet one or more listed below? **YES** → **NO**

If at least one of the criteria listed below is not met; and the nurse driven protocol has been ordered: **REMOVE FOLEY CATHETER**

- [ ] End of Life
- [ ] Renal/Urology Surgery
- [ ] Colorectal/ Pelvic Surgery (Review 48-hour Postop)
- [ ] Hourly I&O (Urometer or Temp Sensing)
- [ ] Chronic Urinary Retention (>72 Hours)/Inability to Void (Bladder scan and review Foley necessity)
- [ ] Acute Urinary Retention (<72 hours)
- [ ] Urology Consultation
- [ ] Epidural Catheter (OB Patients)
- [ ] Stage III or IV pressure ulcers that cannot be kept clear despite other external collection devices
- [ ] Management of gross hematuria with blood clots in urine
Appendix B

NDP Protocol in Electronic Health Record

“PROTOCOL” Addition to Insert Manage Urinary Cath
Go Live: June 21, 2022

Objective: To assist with the timely removal of the Urinary Catheter per Protocol (if ordered)

✓ Note the “O” on the Worklist and view Order Detail

✓ NEW: Note the “P” on the Worklist and Documentation

✓ Select the “P” for quick view of reminders of "Foley Catheter Necessity Checklist" and "Urinary Catheter Removal/Bladder Training"

**Please contact Infection Control with any Questions**
Appendix C

NDP Staff Perception Survey

Assessing the Impact of an Educational Intervention on Nurses' Knowledge of the Nurse-Driven Urinary Catheter Removal Protocol

1.) What is your gender?
   [ ] Male
   [ ] Female
   [ ] Other
   [ ] Do not wish to disclose

2.) What is your age?
   [ ] 18-30  [ ] 31-40
   [ ] 41-50  [ ] 51-60
   [ ] 61-70  [ ] >71

3.) What is your highest attained education level?
   [ ] ASN
   [ ] BSN
   [ ] MSN/Masters
   [ ] Doctorate

4.) How many years have you been a nurse?
   [ ] 0-5  [ ] 6-10
   [ ] 11-15  [ ] 16-25
   [ ] 26-30  [ ] >30

1. I can assess a patient with an indwelling urinary catheter and identify the indications for removal of the catheter.
   a. Strongly disagree
   b. Disagree
   c. Slightly disagree
   d. Slightly agree
   e. Agree
   f. Strongly agree

2. I can discuss with other clinical staff the indications for removal of urinary catheters.
   a. Strongly disagree
   b. Disagree
   c. Slightly disagree
   d. Slightly agree
   e. Agree
   f. Strongly agree

   a. Strongly disagree
   b. Disagree
   c. Slightly disagree
   d. Slightly agree
   e. Agree
   f. Strongly agree
1. The Nurse should continuously assess the patient’s urinary catheter necessity according to the Foley Catheter Necessity Checklist at least three times per shift, and the urinary catheter should be removed as soon as it no longer meets criteria.
   a. True
   b. False

2. It is the Nurse’s responsibility to remove the indwelling urinary catheter if the order states that it may be removed under the Nurse-Driven removal Protocol.
   a. True
   b. False

3. The nurse knows that the only way to find out if the Nurse-Driven Foley Catheter Removal Protocol applies to their patient is:
   a. If it is written in the physician’s progress note.
   b. By navigating to the order details for the “Insert/Manage Indwelling Urinary Catheter” intervention in the EMR.

4. A 67-year-old male is admitted to the hospital after a fall and sustained a fractured proximal femur. He received a hip arthroplasty and a foley catheter was placed perioperatively. In reviewing the order in the EMR, the section “Remove via Nurse-Driven Protocol” is checked “Yes”. It is now postoperative day #3. The nurse understands that:
   a. The urinary catheter should have been removed immediately after surgery.
   b. The catheter must be promptly removed if the patient does not meet any other criteria on the Foley Catheter Necessity Checklist.
   c. The nurse should call the attending provider for permission to remove the catheter.
   d. It is the Orthopedic Surgeon’s responsibility to determine when the foley catheter should be removed, and he will communicate to the nurse when the catheter should be removed.

5. A 75-year-old male is admitted for shortness of breath and CHF exacerbation. A foley catheter was placed for Hourly Intake & Output while in the ICU and the order dictates that is expected to be removed per the Nurse-Driven removal protocol. Three days later, the patient’s condition is much improved, and no longer has an order for strict I&O recording. The nurse should:
   a. Promptly remove the foley catheter.
   b. Call the attending provider to clarify if the foley should be removed.
   c. Leave the catheter in place, as the foley catheter’s necessity is likely being monitored by someone else apart of the patient’s clinical care team.
   d. Leave the catheter in place, because the provider’s original order states that the catheter was placed for Hourly I&O.

6. A 55-year-old male is admitted to the hospital after sustaining a thromboembolic stroke and receives IVA. An indwelling urinary catheter was placed in the ED and the order dictates that it is expected to be removed per the Nurse-Driven removal Protocol. The patient was incidentally found to have a Stage II pressure ulcer to the sacrum. The following day, the patient’s foley catheter necessity is assessed at shift change. His urine is clear. The oncoming nurse should:
   a. Leave the Foley catheter in place due to the presence of a Stage II sacral pressure ulcer
   b. Promptly remove the Foley catheter and place an external urinary collection device.
   c. Leave the Foley catheter in place for the patient’s comfort/immobility
   d. Remove the Foley catheter before the end of the shift and place an external urinary collection device
7. A 75-year-old female was admitted to the hospital for treatment of lower extremity cellulitis. After a few days the patient developed acute urinary retention. The bladder training protocol was attempted but with no progress. The attending provider ordered a urinary catheter to manage the acute urinary retention, and it specifies removal via the Nurse-Driven removal Protocol. Three days pass and the Foley catheter has now been in place for >72 hours. The nurse understands that:
   a. The catheter should be left in place, the attending provider will communicate when they would like the catheter removed.
   b. The catheter should be left in place for at least 1-2 weeks
   c. The catheter should be left in place for now, but the attending provider should be asked at some point during the shift if they would like the catheter removed.
   d. The catheter should promptly be removed by the nurse, and the bladder training protocol should be reattempted if the patient does not void for greater than 6 hours.

8. An 82-year-old female is admitted to the hospital for treatment of COPD exacerbation. During handoff report, the receiving nurse finds that the patient has an indwelling urinary catheter that was originally placed for acute urinary retention and the order dictates that it is expected to be removed per Nurse-Driven Protocol. It has been in place for 3 days. The nurse understands that they should:
   a. Promptly remove the Foley catheter immediately and initiate the bladder training protocol with bladder scanning every six hours.
   b. Leave the Foley catheter in place, the attending provider will place an order for removal when they want the catheter removed.
   c. Leave the Foley catheter in place, it continues to meet criteria for acute urinary retention
   d. Remove the Foley catheter before the end of the shift

9. A 45-year-old female is admitted to the ICU after receiving a planned Left Femoral-Popliteal bypass. A Foley catheter was placed peripherally and the order dictates that it is expected to be removed per the Nurse-Driven Protocol. In the absence of other continuation criteria, the Foley catheter should be removed before 6:00am by the night shift nurse.
   a. True
   b. False

10. An 86-year-old male is admitted to the hospital for management of acute decompensated heart failure. A urinary catheter is initially placed in the ED for the purpose of Hourly Intake & Output, and “nurse-driven removal” is checked “Yes” within the urinary catheter order in the EMR. Four days pass, and the oncoming nurse is assessing the patient’s Foley catheter necessity at shift change. He notes that Hourly I&O has since been discontinued, and I&O is now being documented every 12 hours. The nurse understands that:
    a. The Foley catheter should remain in place for the patient’s comfort
    b. The Foley catheter should be removed before the end of his shift
    c. The Foley catheter should be removed immediately
    d. The Foley catheter should remain in place so that accurate I&O can continue to be recorded
Appendix E

CAUTI SIR Control Chart

A: Site Assessment with Quality Improvement Change Team, February 2022

B: Antimicrobial Stewardship Urine Culture Guideline is implemented, April 2022

C: Nurse-Driven Protocol for Urinary Catheter Removal is implemented, July 2022
Appendix F

CAUTI SUR Control Chart

[Chart showing CAUTI SUR control chart with control limits (CL, UCL, LCL), patient days, and data points for each month from January 2022 to December 2022.]
## Appendix G

### CAUTI Data Table

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<th>Catheter Days</th>
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## Appendix H

### Staff Demographics

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## Appendix I

### NDP Perception Survey Results

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