# NURSE-DRIVEN CATHETER-ASSOCIATED URINARY TRACT INFECTION (CAUTI) PREVENTION PROJECT

by

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# ABSTRACT

An indwelling urinary catheter (IUC) is a tube that is placed into the bladder through the urinary tract, left in place and connected to a closed system drainage bag. Catheter placement in the urinary tract increases the risk of bacteria ascending the catheter and causing an infection, known as a catheter-associated urinary tract infection (CAUTI) (Center of Disease Control [CDC], 2019; Fekete, 2020). Healthcare-associated infections (HAI) are the most common complication of healthcare treatment and are a major cause of mortality and morbidity. CAUTIs are the most common and preventable HAI, making up over 30% of the HAI in the United States (Agency of Healthcare Quality and Research [AHRQ], 2015; CDC, 2019; Centers for Medicare & Medicaid Services [CMS], 2008). CAUTIs cause increase pain and discomfort, and increase patients' hospital length of stay (AHRQ, 2017; CDC, 2019). IUCs are frequently placed without appropriate indication and remain in longer than medically necessary (CDC, 2019). Problem statement: Critical care patients are most vulnerable to acquiring a CAUTI from an IUC due to their weakened immune systems and underlying co-morbidities (CDC, 2019). The intensive care unit (ICU) setting has the highest reported rates of CAUTIs (CDC, 2019). Purpose statement: The purpose of this project was to reduce CAUTIs by implementing a nurse-driven algorithm to avoid IUC insertion, decrease IUC duration, and strengthen existing CAUTI prevention measures. Methods: Kotter's change management theory combined with the Plan-Do-Study-Act (PDSA) model served as the project's framework. The project was designed to foster a collaborative approach to reduce CAUTI incidences by empowering nurses to work at the highest level of their scope of practice, standardizing care, and strengthen existing CAUTI prevention. Results: CAUTIs were measured pre/post-implementation, and an absolute reduction from 2 to 0 was observed. The standard infection ratio (SIR) decreased to 0 post-implementation and the standard utilization ratio (SUR) decreased by 2.17%. ICU nurses were very likely (92%) to implement the algorithm into practice, and 81% indicated they implemented the algorithm on 75% of their patients. Conclusion: Although many studies have looked at reducing CAUTIs and have shown the benefit of avoiding insertion and using alternatives, there are few that have examined the standardization and combination of alternative measures, appropriate indications, and acute urinary retention measures into one nurse-driven algorithm. This quality improvement project implemented evidence-based practice in a nurse-driven algorithm and observed a decrease in CAUTI incidence.

# CHAPTER ONE

# BACKGROUND

## Introduction

Healthcare-associated infections (HAI) are the most common complication of healthcare treatment and are a major cause of mortality and morbidity. It is estimated that in 2011 there were 722,000 HAI and 75,000 of those infections were fatal (AHRQ, 2015). HAI cost $40 billion annually in the United States (AHRQ, 2015). Catheter-associated urinary tract infections (CAUTI) are the most common and preventable HAI, making up over 30% of the HAI in the United States (AHRQ, 2015; CDC, 2019; CMS, 2009).

The instrumentation, or placement, of a catheter in the urinary tract increases the risk of bacteria ascending the catheter and causing an infection called a CAUTI (CDC, 2019; Fekete, 2020). An indwelling urinary catheter (IUC) is a tube that is placed into the bladder through the urinary tract, left in place, and connected to a closed system drainage bag. The placement of an IUC is performed for therapeutic treatment and convenience. In an acute care hospital, 12-25% of all patients admitted will have a short-term IUC placed during their stay (National Health Safety Network [NHSN], 2020). Each day, the IUC remains within the urinary track the risk for developing a CAUTI increases 5-7% (IHI, 2020).

CAUTIs are not a new healthcare complication. Urinary catheters have been in use since 3,000 BC and were used to treat urinary retention. Then, urinary catheters were made from rolled-up plant matter or metal made into tubes (Carithers & Palumbo, 2016). In the 11$^{th}$ century, most urinary catheters were made from silver and could be bent into different shapes. Urinary

catheters made from rubber came about in the 18th century, but they would degrade within the body and leave debris (Carithers & Palumbo, 2016). In the 1930s, latex rubber became available followed by the invention of the urinary catheter with a balloon, and, when inflated in the bladder, the balloon held the catheter in place (Carithers & Palumbo, 2016). Physicians used the aseptic techniques, from the principles of Lister of 1867, during the insertion of urinary catheters but were still concerned about infections because their patients were still developing "catheter fever," which today we refer to as CAUTIs (Carithers & Palumbo, 2016).

CAUTIs are adverse events and are categorized under the National Quality Forum (NQF) of 2002 as a device event causing serious harm or death. The NQF was asked by the Centers for Medicare and Medicaid (CMS) and the Institute of Medicine (IOM) to identify adverse healthcare events that should never occur, are preventable with proper care, and should be part of a quality measure reporting system (Kizer & Stegun, 2005). The Department of Health and Human Services (DHHS) started collecting baseline quality measures on CAUTIs in acute care hospitals in 2007. CMS incentivized mandatory reporting by implementing a 2% deduction from the reimbursement if quality measures are not reported by the acute care hospitals (CMS, 2008).

A payment reform was enacted in 2008 to promote quality healthcare by providing incentives for hospitals that engage in quality improvement initiatives (CMS, 2008). CMS moved to aggressively encourage greater patient safety by implementing several actions to reduce the number of "never events," which include CAUTIs (CMS, 2008). Subsequently, CMS no longer reimbursed the additional costs of "never events," leaving the additional costs of CAUTIs, at an average of $13,793 per event, to fall on the hospital (AHRQ, 2017).

In 2009, CMS announced a national goal to decrease CAUTIs by 25% by the year 2013. As part of that goal, the CDC rolled out its CAUTI prevention guidelines, which recommend (a) appropriate use, (b) aseptic insertion, (c) proper maintenance, (d) timely removal, and (e) surveillance (CDC, 2019). In 2013, the CDC and CMS goal to decrease CAUTIs was not met, even though the CDC's CAUTI Prevention Guidelines were implemented and CMS had provided financial incentives. Instead, the rate of CAUTIs in the United States increased by 6% (CDC, 2019). As a result, CMS implemented CAUTI National Quality Measures, another financial incentive to reach the stated goal, and failure to meet these standards resulted in a 1% deduction in a facility's annual reimbursement by CMS (CMS, 2020; CMS, 2008).

The National Health Safety Network (NHSN)/CDC defines a CAUTI, as a UTI where an IUC was in place for two consecutive days (day one being the day of insertion) and symptomatic UTI (SUTI) present the day of or day after removal of the IUC (CDC, 2019). NHSN is an HAI national tracking database that allows facilities, state, and federal agencies to identify infection prevention problems, benchmark progress, and comply with state and federal reporting mandates (NHSN, 2019). Currently, it is mandatory for acute-care facilities to report on the number of CAUTIs per 1000 catheter days, referred to as standard infection ratio (SIR), and urinary catheter days per 1000 patient days, which is referred to as catheter utilization ratio (SUR) (CDC, 2019; NHSN, 2019). Additionally, each acute care hospital is mandated to report CAUTI events and IUC days to the NHSN through the Antibiotic Resistance and Patient Safety Portal (AR&PSP) (CMS, 2020).

In 2019, the CDC reported a 12% reduction in CAUTI events but an overall 11% increase in SIR, indicating that the CAUTI infection rates were higher than expected even though the total

number of CAUTI events decreased (CDC, 2018). Every day in the United States, 1 in 31 patients acquire an HAI during their hospital stay: emphasizing the need for improvement in HAIs in acute care hospitals (CDC, 2018). Even though progress has been made in decreasing and preventing CAUTIs, additional interventions are needed to reach the CDC's new goal of eliminating CAUTIs altogether.

## Problem Statement

CAUTIs are the most common type of HAI and are associated with increased morbidity and mortality (AHQR, 2015; CDC, 2019; CDC, 2018; Fekete, 2020; NHSN, 2020). CAUTIs increase pain, discomfort, and hospital length of stay (AHRQ, 2017; CDC, 2019). IUCs are frequently placed without appropriate indication and remain in place longer than medically necessary. Providers are frequently unaware of their placement (CDC, 2019). This leads to prolonged and unnecessary use of IUCs. Each day the IUC remains in the patient, the risk of developing a CAUTI increases 5-7%, and after 30 days the risk increases to 100% (Fekete, 2020; Institute for Healthcare Improvement [IHI], 2020). The United States healthcare industry spends over $340 million annually on CAUTIs (NHSN, 2015). CAUTIs are preventable with proper, evidence-based care (AHRQ, 2015; CDC, 2019; Fekete, 2020).

The ICU setting has the highest reported rates of CAUTIs (CDC, 2019). Critical care patients are most vulnerable to acquiring a CAUTI from an IUC due to their weakened immune systems and underlying co-morbidities (CDC, 2019). They are also more vulnerable to developing multiple drug-resistant organisms (MDROs) because of their increased exposure to antibiotics (AHRQ, 2017). CAUTIs account for 23% of all HAIs in the ICU and are the second leading cause of bloodstream infections (AHRQ, 2017). A CAUTI increases the patient length of

stay by 2-4 days and results in the administration of additional antibiotics that increase microbial resistance (AHRQ, 2017).

The site of this project was a 286-bed acute care hospital. The facility is a Level II Trauma Center in Central Montana. The facility serves the local community but also pulls from surrounding Eastern Montana, northern parts of Wyoming, and South Dakota. The ICU is an adult mixed surgical, medical, and trauma unit with 24 beds. The facility is one of the largest in the state, and in 2015, the facility implemented an evidence-based CAUTI prevention program from the recommendations of the CDC Prevention Guidelines. As a result, the facility had decreased its CAUTIs, over one year, from 14 to zero. The facility continued its evidence-based CAUTI prevention bundle and surveillance. However, in 2020, the facility had acquired ten CAUTIs. In contrast to 2019's one CAUTI, the increase was significant and unacceptable.

The facility's quality department expressed concern about the increase in CAUTIs and a desire for quality improvement to decrease prevalence (K. Usuriello, personal communication, August 7, 2020). The Quality Director and Quality Officer indicated that the ICU had the highest incidence of CAUTIs in the hospital (K. Usuriello, personal communication, August 7, 2020). The ICU setting was the source of 50% of the CAUTIs reported for the facility and had a 30% higher SUR, at 1.3 SUR, than similar ICUs across the nation. The Quality Director, Quality Officer, and Nursing Shared Governance Committee indicated the need for a quality improvement project to decrease CAUTI incidence.

Socio-adaptive culture issues identified within the facility included 1.) nurse confusion due to individual physician preferences and ambiguity in orders, and 2.) beliefs that all ICU patients needed an IUC with routine placement of an IUC on admission to the ICU. The facility

was facing a 1% deduction from the total reimbursement for the following fiscal year if CAUTI quality measures were not met as well as the loss of $13,793 per CAUTI event. The facility had already lost $137,930 in 2020 for the treatment of its ten CAUTIs (AHRQ, 2017).

## Purpose Statement

The purpose of this project was to reduce CAUTIs by implementing a nurse-driven algorithm to avoid IUC insertion, decrease IUC duration, and strengthen existing CAUTI prevention measures. The prevention of CAUTIs in a mixed surgical, medical, and trauma ICU setting was difficult due to ambiguity of orders, lack of knowledge on alternative measures to IUC insertion, and inappropriate indications for insertion of IUCs. Inappropriate indications for insertion of an IUC include immobility and the monitoring of hourly urinary output that is not used for the adjustment of medical treatment and titration of drugs. A nurse-driven evidence-based algorithm was implemented to increase nurse's autonomy by encouraging them to practice at the highest level of their scope of practice. Quantitative measures to evaluate the success of this project included the number of IUC days, patient days, CAUTI events, SIR, and SUR.

# CHAPTER TWO

## REVIEW OF LITERATURE

Although national guidelines have been developed for the prevention of hospital-acquired CAUTIs and quality improvement strategies have been demonstrated to reduce infections, CAUTIs remain one of the most common HAI, costing the United States $340 to $450 million annually (AHRQ, 2015). CAUTIs are one of the most preventable HAIs, and they remain one of the most prevalent in acute care settings. Guidelines for CAUTI prevention recommend (a) appropriate use, (b) aseptic insertion, (c) proper maintenance, (d) timely removal, and (e) surveillance (AHRQ, 2015; CDC, 2019; Greene et al, 2016). The literature has shown that evidence-based practice improvement projects to reduce CAUTIs have been effective but require unit-specific assessment, design, implementation, and evaluation (AHRQ, 2015; CDC, 2019; Durant, 2017; Porche, 2019).

Evidence-based practice is a process or procedure that has been established by research and experience as a standard and is suitable for implementation on a wide scale (Merriam-Webster, n.d.). A current review of the literature was conducted to determine best practices for IUC insertion, maintenance, removal, and CAUTI prevention. Literature was searched using electronic databases that included (a) CINAHL Complete, (b) PubMed, (c) PsycInfo, (d) Lippincott Advisor, (e) Cochrane Library, (f) Joanna Briggs Institute, (g) Medline, and (h) UpToDate. A keyword search was used for each database and included *urinary catheter infections, CAUTI,* and *catheter related UTI*. The search results were filtered by the following categories: full-text articles, English language, human subjects, and published between 2015-2020. The literature was further refined to include acute care facilities, adults 18 years or older,

and acute IUC use. The literature was evaluated by using the United States Preventive Services Task Force (USPSTF) grading schema and level of certainty regarding net benefit (Grade Definitions, 2018). The evidence review table is attached as an appendix (see Appendix B).

## Appropriate Catheter Use

The unnecessary placement of IUCs is the primary risk factor for CAUTIs (AHRQ, 2015). Best practice nursing interventions can be used to avoid the insertion of IUCs. Nursing interventions include mobilizing patients, use of toileting schedules, prompted voiding at timed intervals, assuring adequate hydration, reducing caffeine intake, assessment of medications for urinary retention side effects, and maintaining adequate patient hygiene. Avoiding the insertion of an IUC by using alternative urinary collection methods is one of the top recommendations in literature to reduce and prevent CAUTIs (AHRQ, 2015; Behrend, 2020; CDC, 2019; Dehghanrad, 2019; Fekete, 2020; Fong, 2019; Gould, 2016; Greene, 2016; Gyesi-Appiah et al., 2020; Porche, 2019; Russel et al., 2019). Alternative urinary collection methods include devices that are external, noninvasive, and allow for management of incontinence and measuring of intake and output.

The alternative measures include the following:

- pads/briefs that can be weighed,
- handheld urinals,
- bedpans,
- bedside commodes,
- measuring containers in the toilet,
- female external urinary collection (FEUC) devices,

- condom catheters (AHRQ, 2015; CDC, 2019; Fekete, 2020; Fong, 2019; Greene et al, 2016).

Alternative collections methods have a significantly lower risk of infection and cause less discomfort, pain, and immobility (AHRQ, 2015). Nurses are in a unique and powerful position, at the bedside, to assess the patient for appropriate indications and to make sure alternative urinary collection methods have been exhausted before placing an IUC (Dehghanrad, 2019; CDC, 2019; Greene et al, 2016; Porche, 2019; Russel et al., 2019; Scanlon et al, 2017).

The literature indicates that condom catheters and FEUCs have been effective in reducing the risk of CAUTIs while also providing the patient with urinary management (AHRQ, 2015; Eckert et al., 2020; CDC, 2019). In one study the implementation of FEUCs decreased the utilization of IUCs from 31.7% down to 26% and CAUTIs decreased to 0% (Eckert et al. 2020). In a randomized clinical trial of 75 males, those who received condom catheter, had a cumulative five times the reduction in risk of CAUTI and death compared to those who received an IUC, and the condom catheters were also better tolerated by the patients (AHRQ, 2015).

The literature indicates that having nursing staff who are knowledgeable about indications for external urinary collection devices, contraindications, and implementation, assists in the reduction of IUC insertion (AHRQ, 2015; CDC, 2019; Eckert, 2020; Gould, 2016; Gyesi-Appiah et al., 2020; Porche, 2019; Russel et al., 2019; Scanlon et al., 2017). One of the limitations of the alternative external urinary collection system is its inability to manage patients with acute urinary retention. The implementation of ultrasonic bladder scanning protocols combined with intermittent catheterization (IC) protocols has led to a reduction in the placement of IUCs for acute urinary retention (Barrisford & Graeme, 2020). Nurse-driven protocols for

portable bladder scanners have been shown to decrease the risk of CAUTIs (AHRQ, 2015; Barrisford & Graeme, 2020). IC is the temporary insertion of a catheter to empty the bladder, after which the catheter is immediately removed. It is considered the gold standard for acute management of medical emptying of the bladder due to idiopathic or neurogenic bladder dysfunction (Barrisford & Graeme, 2020), and it should be used in appropriate patients to reduce the risk of infection from the placement of an IUC (Barrisford & Graeme, 2020; Greene et al, 2016; Khanh-Dao Le, 2020). Acute urinary retention algorithms and protocols have been shown to reduce the insertion of IUCs, and therefore, decrease the risk of CAUTIs (Barrisford & Graeme, 2020; Fong, 2019).

The CDC (2019) and AHRQ (2015) guidelines report the high priority recommendations to only insert an IUC for appropriate indications (Behrend, 2020; Greene et al, 2016; Fekete, 2020; Fong, 2019; Gould, 2016; Gyesi-Appiah et al., 2020; Khanh-Dao Le, 2020). Nurses play a key role in reducing inappropriate IUC placement (AHRQ, 2015). The literature indicated that the implementation of a protocol, algorithm, or electronic orders that specify appropriate indications for IUC placements have led to a reduction of inappropriate placement of IUCs and reduced the risk of CAUTIs (AHRQ, 2015; Porche, 2019).

Appropriate indications for IUC placement include the following:

1. The need for accurate hourly measurement of urinary output is used to make medical treatment decisions in critically ill patients.
2. Perioperative use for selected surgical procedures, such as urological or genitourinary tract surgery, prolonged surgical duration, large volume infusions or diuretics, and intraoperative monitoring of urinary output.

3. To assist healing of open sacral and perineal pressure wounds in the presence of incontinence.
4. The management of patients with acute urinary retentions or bladder outlet obstruction.
5. To improve the comfort of patients at end of life if needed or wanted.
6. To facilitate strict immobilization following specific trauma or surgery, including unstable pelvic factures and unstable spinal fractures (AHRQ, 2015; CDC, 2019; Gould, 2016; Porche, 2019).

## Insertion and Maintenance

Once alternative urinary collection methods have been exhausted and the patient meets one of the six IUC indications above, then it iss appropriate to insert an IUC. Properly trained clinicians must adhere to the aseptic technique for placement, manipulation, and maintenance of IUC to reduce the risk of CAUTIs (AHRQ, 2015; CDC, 2019; Fekete, 2020; Fong, 2019; Gould, 2016; Greene et al, 2016; Gyesi-Appiah et al., 2020; Kranz, 2020; Olatunji, 2019).

With a catheter in place, the daily risk of developing a CAUTI ranges from 5-7% (IHI, 2020). Appropriate catheter maintenance can mitigate some of the risk of developing a CAUTI (AHRQ, 2015; CDC, 2019; Fekete, 2020; Fong, 2019).

The literature indicates that maintenance of an IUC includes the following:

- daily perineal cleansing,
- unobstructed urine flow,
- not changing catheters or drainage bags routinely,
- maintaining a closed system,

- avoiding irrigation,
- keeping drainage bag below the level of the bladder,
- disinfecting and allowing the access port to dry completely when sampling, and
- securing the catheter to the abdomen or thigh to decrease the risk of the catheter being dislodged (CDC, 2019; Fekete, 2020; Fong, 2019; Gould, 2016; Greene et al, 2016; Porche, 2019).

## Prompt Catheter Removal

It is well established that the duration of IUC increases the risk for developing a urinary tract infection (UTI) (AHRQ, 2015; Ballard, 2018; CDC, 2019; Fekete, 2020; Fong, 2019; Greene et al, 2016). As previously stated, each day an IUC remains in, the patient has a 5-7% increase risk of developing a CAUTI, and after 30 days the risk is 100% (AHRQ, 2017; CDC, 2019; IHI, 2020). Multiple studies have shown that the daily reassessment of IUC indications and prompt removal of the IUC when indications are no longer applicable decrease IUC utilization and CAUTI rates (AHRQ, 2015; Ballard, 2018; Campbell, 2020; CDC, 2019; Durant, 2017; Gould, 2016; Greene et al, 2016; Gyesi-Appiah et al., 2020; Fong, 2019; Johnson et al., 2016; Knill et al., 2018; Manuel, 2019; Porche, 2019). The use of automated reminders and stop orders has decreased the length of time IUCs are in place and decreased the rate of CAUTIs (AHRQ, 2015; CDC, 2019; Fong, 2019; Manuel, 2019). A nurse-driven removal protocol has been shown to increase the reassessment of IUC indications and lead to prompt removal of IUCs when no longer indicated, reducing catheter use and decreasing the rates of CAUTIs (AHRQ, 2015; CDC, 2019; Durant, 2017; Fekete, 2020; Fong, 2019; Gould, 2016; Greene et al., 2016;

Gyesi-Appiah et al., 2020; Knill et al., 2018; Manuel, 2019). The literature indicates that having a nurse-driven acute urinary retention protocol or algorithm to guide nurses through the decision-making process post-catheter removal has reduced reinsertion of IUCs (AHRQ, 2015; Campbell, 2020; Durant, 2017; Gould, 2016; Gyesi-Appiah et al., 2020; Knill et al., 2018). It has been shown that the implementation of a bladder scan and straight catheter algorithm or protocol to decrease reinsertion of IUCs for acute urinary retention post-catheter removal has been effective in decreasing CAUTIs (AHRQ, 2015).

## Surveillance and Reporting

NHSN is an HAI national tracking database that allows facilities, state, and federal agencies to identify infection prevention problems, benchmark progress, and comply with state and federal reporting mandates (NHSN, 2019). The NHSN implemented standardized measures, SIR and SUR for accurate reporting, data analysis, and the ability to compare current and past data. The CDC's CAUTI Prevention Guidelines (2019) recommend the use of standardized metrics for CAUTI surveillance and include number of CAUTI per 1000 catheter days (SIR), IUC days per patient days (SUR), and the number of bloodstream infections secondary to CAUTIs per 1000 catheter days. These standardized measures are essential and make it possible to compare results across a variety of CAUTI prevention projects.

## Summary and Discussion

According to the CDC (2019) and AHRQ (2015), the highest priority recommendation (from their guidelines) is to avoid the insertion of IUCs to reduce CAUTIs. This can be accomplished by using alternative measures and inserting IUCs when only appropriate

indications are met (AHRQ, 2015; CDC, 2019; Gould, 2016; Fekete, 2020; Fong, 2019; Knill et al., 2018). Nurse-driven protocols and algorithms empower nurses to problem solve and make autonomous care decisions that can facilitate alternative measures and appropriate catheter use to reduce the rate of CAUTIs (Behrend, 2020; Durant, 2017; Knill et al., 2018; Kranz, 2020; Russell et al., 2019). Although the site organization and its staff implemented the CDC's CAUTI prevention bundle in 2015 and initially had success, they were still seeing a significant increase in their CAUTI rates that was unacceptable. A root cause analysis was performed (Appendix A), and in review of the current literature, a gap in practice was identified. The gaps needing to be addressed included a lack of nurse-driven protocol/algorithm for implementation of alternative measures before insertion of an IUC and a lack of standardized protocol/algorithm for managing acute urinary retention.

In the literature, there is strong evidence to support the use of nurse-driven algorithms and protocols to decrease CAUTI rates (Campbell, 2020; Durant, 2017; Johnson et al, 2016; Porche, 2019). There is a lower level of evidence in the literature to support the use of specific algorithms and protocols for the use of IUC alternatives (Quinn, 2015; Scanlon et al., 2017). Limited studies, but of a higher level of evidence support the use of acute urinary retention protocols and algorithms in the prevention of CAUTIs (Barrisford & Graeme, 2020; Manuel, 2019; Russell et al, 2019). Although many studies look at reducing CAUTIs and have shown the benefit of avoiding insertion and using alternatives, there is a lack of studies on standardization and combination of alternative measures, appropriate indications, and acute urinary retention measures into one nurse-driven algorithm and its affect on CAUTI prevention. Therefore, this project focused on implementing an evidence-based nurse-driven urinary management algorithm

that standardized care and focused on the recommended avoidance of IUC insertion by using alternative measures and only inserting IUC if appropriate indications were met.

The high rate of CAUTIs is unacceptable for the organization and unacceptable by national standards. Addressing change and sustaining quality improvement in CAUTI prevention requires addressing not only the technical aspects but also the cultural social adaptation as well (Greene et al., 2016; Quinn, 2015; Scanlon et al., 2017). The organization is built on a culture of patient safety, improving the health of its patients, and community. Because of this commitment to patient safety, the facility was critically looking at its CAUTI prevention practices to decrease their CAUTI rates and reduce patient harm. The organization's Quality Director, Quality Officer, and Nursing Shared Governance Committee, after being introduced to the identified gap in practice, indicated the need for a quality improvement project that addressed nurses' lack of knowledge and confidence with alternative IUC measures and IUC indications for insertion. Therefore, a nurse-driven urinary management algorithm was developed and implemented.

# CHAPTER THREE

# SETTINGS AND METHODS

The literature has shown that evidence-based practice improvement projects to reduce CAUTIs have been effective but require unit-specific assessment, design, implementation, and evaluation (AHRQ, 2015; CDC, 2019; Durant, 2017; Porche, 2019). Thus, implementing an evidence-based improvement project in the organization's ICU would require an assessment of the current IUC use, design, implementation, and evaluation that is specific to the needs of the ICU to be effective in reducing CAUTIs.

## Quality Improvement Framework

The effective and sustainable implementation of change within an organization requires a systematic well-designed plan, strong leadership, and collaboration. There are multiple designs and frameworks for quality improvement projects. The difficulty lies in aligning the framework and design with the organization's values and desired outcome. Kotter's change management theory was the primary theoretical framework for this project. The theory resonates with the organization's culture of patient safety and decreasing patient harm. The theory focuses on creating a respectful, learning, and trusting organizational culture through leadership and collaboration to effect continuous change and improvement (Kotter, 2012). The change theory consists of an eight step-by-stepprocess that focuses on successful and sustainable organizational change. The steps include (a) create urgency, (b) form a powerful coalition, (c) create a vision for change, (d) communicating the vision, (e) empower action, (f) create quick wins, (g) build on the change and don't let up, and (h) make change stick.

The science of improvement involves testing the changes. The PDSA is a model for improvement that incorporates the science of improvement and tests for change (IHI, 2020). The PDSA is a model that is cyclic, not linear. The model was used to judge whether the change was effective.

The following are the key components of the PDSA cycle:

1. Plan and develop the test of change and how data will be collected.
2. Do the test, carry out the plan, and document observations and problems.
3. Study and analyze data then reflect on what was learned.
4. Act on what was learned and refine the change, and prepare, and plan for the next test.

The PDSA cycle allowed this project to implement a change on a small scale in the ICU, analyze the results, refine, and modify the change before implementing it on a larger scale throughout the organization (IHI, 2020). Combining Kotter's change management theory with the PDSA model for improvement increased the effectiveness and sustainability of the project. The change theory provided a framework for the DNP student to guide the organization's nursing leadership, collaborate with multidisciplinary teams, respond constructively to resistance to change, and meet the needs for continuous evolving quality improvement within the healthcare system. The improvement model tested the change, added value to the project, and allowed for continuous learning, and revision, to ensure effective and sustainable change.

## Agency Description

The project took place at a 286-bed acute care hospital. The facility is a Level II Trauma Center and is in a large urban setting in Central Montana. The facility serves the local

community but also pulls from its rural surroundings in Eastern Montana, northern parts of Wyoming, and South Dakota. The facility has a 24-bed ICU.

The ICU is a mixed surgical, medical, and trauma unit with 24 beds, serving patients 18 years and older. Most patients are Caucasian or American Indian. The sample population was one of convenience, made up of patients in the ICU through the six-week period of the project and who have or had placement of an IUC during their stay. The unit was staffed twenty-four hours a day and seven days a week with an intensivist and supporting nursing staff. The nursing staff was trained in critical care, and depending on the acuity level of the patient, patient to nurse ratio was 2:1 or 1:1. Full-time, part-time, and relief nurses take care of ICU patients; approximately 58 nurses took part in the nurse-driven quality improvement project.

## Description of Stakeholders

The second step of Kotter's change theory is forming a powerful coalition (Kotter, 2012). The development of a multidisciplinary CAUTI improvement team was created. The multidisciplinary team was made up of a core group of nurses, administrators, and support staff within the ICU and organization. Two ICU staff nurses were identified as champions to support the algorithm and empower their coworkers to practice to the full extent of the scope of nursing practice. The nurse-driven urinary management algorithm was distributed to the nursing staff through the organization’s email and education presentation. Unit administrators facilitated the project feedback to the nursing staff through email. The facility’s quality department collected data monthly on urinary catheter days and CAUTI incidences in the ICU throughout the project. The multidisciplinary team met at scheduled times throughout the project, where PDSA cycles were analyzed and modifications were implemented (see Appendix D).

### Facilitators and Barriers

The organization's quality department was a strong facilitator in the nurse-driven CAUTI quality improvement project. An analysis of the organization's baseline strengths, weaknesses, opportunities, and threats (SWOT) toward the implementation of the quality improvement project was completed (Appendix C). Strengths were identified as support from the organization's administrators and nursing staff, material, and products already available, education platform in place, and process/procedure of data collection already developed. Weaknesses were identified as increased IUC utilization, lack of knowledge on alternatives to IUC insertion, overworked and stressed staff in the middle of the COVID-19 pandemic, and increased financial burden on the organization. Opportunities identified for improvement included empowerment of nurses, standardization of urinary management, multidisciplinary collaboration, improved CAUTI rates, and implementation of evidence-based practice. Threats were identified as COVID-19 pandemic restrictions on in-person gatherings, supply shortages, high patient to nurse ratio, delay in delivery of alternative urinary management products, low CMS score cards due to CAUTI rates, and patients seeking another organization for care.

## Project Design

The purpose of this quality improvement project was to reduce CAUTIs by implementing a nurse-driven algorithm to avoid IUC insertion. The project was designed to foster a collaborative approach to reduce CAUTI incidences by empowering nurses to work at the highest level of their scope of practice, standardizing care, and strengthening existing CAUTI prevention.

Project Goals

- Goal #1: Have 80% of ICU nurses complete the Nurse-Driven Urinary Management Algorithm education within three-weeks of implementation.
- Goal #2: Identification of two ICU nurse champions and completion of in-person Nurse-Driven Urinary Management Algorithm education within three weeks of implementation.
- Goal #3: Decrease SUR by 15% and SIR by 10% by end of project.
- Goal #4: At one year post-implementation, decrease CAUTI rate by 50%, decrease SUR by 30%, and achieve SIR equal to or less than one.

The third step in Kotter's change theory is creating a strategic vision of change (Kotter, 2012). The vision for this project was to empower nurses to use evidence-based interventions in practice, reduce patient harm, reduce CAUTIs, improve patient outcomes, and decrease cost.

## Project Methods

The guiding framework for this project was Kotter's theory on change. The framework was used to guide the project through the implementation of a nurse-driven urinary management algorithm to empower nurses to improve their CAUTI prevention practices. Through collaboration with a multidisciplinary team, the ICU nurses participated in the project to reduce the incidence of CAUTIs in the ICU. In the first four weeks of the project, the ICU nursing staff completed education on the nurse-driven urinary management algorithm and alternative urinary management products (Goal #1). Two ICU nurse champions were identified through the organization's Shared Governance-Infection Free Committee. The nurse champions were provided with in-person training and were able to lead and encourage their coworkers (Goal #2).

Nursing staff engagement and leadership in this project were essential for successful outcomes (see Appendix G).

The nurse-driven urinary management algorithm combined best practice nursing assessments with evidence-based practice. Research indicated that the use of nurse-driven algorithms and protocols reduced the insertion and duration of IUCs, decreasing CAUTI events (AHRQ, 2015; Campbell, 2020; Durant, 2017; Gould, 2016; Gyesi-Appiah et al., 2020; Knill et al., 2018). Algorithms provide clarity, decrease workload, and aid nurses in making decisions on urinary management and preventing IUC insertion.

## Implementation Plan

The fourth step of Kotter's change theory is communicating the vision and enlisting a volunteer army (Kotter, 2012). This meant communicating the vision to the collaborative team in the form of a plan. The implementation plan guided the team and helped enlist others who want to put the change into action (see Appendix E). The fifth step in Kotter's change theory is to empower others to enact action and change (Kotter, 2012). The identified and trained ICU nurse champions encouraged change among their coworkers by demonstrating knowledge, skill, behavior, and improved processes related to CAUTI prevention. The DNP student recruited the nurse champions through the organization's Shared Nursing Governance Committee and Infection Free Committee and completed their education.

The seventh step in Kotter's change theory is to build on the change and sustain acceleration (Kotter, 2012). Implementation of feedback and modification resulted from the PDSA cycles, allowed the project to build on itself, adjust to facilitators and barriers that arose, and keep the momentum moving forward.

Key aspects of the implementation plan included the following:

- Education on the nurse-driven urinary management algorithm and alternative measures were implemented as a self-directed and self-paced emailed presentation and an in-person presentation was also provided (see Appendix H).
- The education was delivered to the ICU nurses through the organization's email.
- An email was sent via the organization's email service, informing the nurses of the new education and the three-week timeframe for completion.
- Reminders to complete the assigned education were sent out via email.
- Two ICU nurse champions were identified.
- A prize was offered if the nursing staff met the goal of 80% completing the education in three weeks.
- PDSA cycles were performed every three weeks, followed by a collaborative meeting with core stakeholders the following week to analyze the PDSA cycle and make modifications.

Nurse Driven Algorithm

An algorithm was developed from the literature to guide nurses on decision-making related to use of alternative urine collection devices and indications for IUC placement (see Appendix G). The algorithm guided nurses on decision-making related to the use of alterative urine collection devices, indications for IUC insertion, urinary retention management, and nursing best practice. Organizational policies and protocols were incorporated into the algorithm to make it comprehensive, multifactorial, and to integrate it into normal nursing workflow.

Data were collected after the six-week project implementation. To determine if the evidence-based practice change was effective, SIR, SUR, and CAUTI events were collected before and after the project implementation to track progress (see Appendix I). The organization's QI officer obtained the data through the data collection process that was already in place for reporting to the NHSN data portal. The QI officer shared the data with the DNP student without PHI information attached. Two questionnaires, comprised of one question each with multiple choice answers, were distributed to the ICU nursing staff following the algorithm educations and at the end of the project.

The following outcomes were measured:

- Nurse completion of education: Number of nurses completing education divided by the number of nurses invited to complete education.
- Nursing intent to use the nurse-driven algorithm: Item on post-education question (see Appendix F).
- Nursing use of nurse-driven algorithm: Item on post-project question (see Appendix F).
- SIR and SUR: SIR and SUR data provided by the hospital.

The data analysis was conducted in the Microsoft Excel program. Analysis included a comparison of pre- and post-implementation numbers, percentages, rates, and averages. The data was then compared to the NHSN National Standard Metrics for CAUTIs.

Human Subject Protection

The project met the criteria for exemption from full review, which was obtained from the Institutional Review Board (IRB) at Montana State University (MSU) (see Appendix O). Data were collected, following procedures established by the facility's Quality Department, and all patient health information (PHI) was removed before data was acquired. The data were stored on a locked laptop that was protected by an eight-character password and accessed by one person. The two questionnaires were distributed to the ICU nurses, and they both were anonymous, voluntary, and demographic information was not obtained.

## Timeline of Project

- Late November 2020: IRB submission
- Middle of January 2021: Education distributed to ICU nurses
- Mid-January 2021 to early February 2021: Nursing staff education
- Mid-January to End of February: Algorithm implemented
- Early March 2021: Final data collected and analyzed
- Mid- April: Project presentation (see Appendix D).

Resources required for the project included the following:

- DNP student access to Lucid Chart program (supplied by organization) to create algorithm,
- materials for printing and laminating algorithm,
- organization's audio-video communication,
- organization's email for communication with stakeholders and nursing staff.

The organization’s cost for this project was from the education hours of the ICU nursing staff. Most of the other cost for this project was related to the hours that the DNP student spent working on the project and prizes, such as treats supplied to the staff during education presentation.

# CHAPTER FOUR

## RESULTS

The purpose of this quality improvement project was to reduce CAUTIs by implementing a Nurse-Driven Urinary Management Algorithm. This project implemented an evidence-based nurse-driven algorithm that standardizes care and focused on the recommended avoidance of IUC insertion by using alternative measures and only inserting IUC if an appropriate indication has been met. The project was designed to foster a collaborative approach to reduce CAUTI incidences through empowering nurses to work at the highest level of their scope of practice, standardizing care, and strengthening CAUTI prevention.

The Nurse-Driven Urinary Management Algorithm and education were distributed to the ICU nursing staff through the organization's email in mid-January. The Nurse-Driven Management Algorithm education session was completed by 57 employees in mid-February. This included 51 out of 58 (87%) nurses that work in the ICU, four CNAs, the quality improvement officer, and the ICU manager. Two questionnaires, comprised of one question each with multiple choice answers, were distributed to the ICU nursing staff following the algorithm education and at the end of the project. Two PDSA cycles were completed over the duration of this project. Data were collected at three-week intervals for six weeks following the implementation of the Nurse-Driven Urinary Management Algorithm.

Table 1. Project Data Collection, Pre- and Post-Implementation

| | October 2020 | November 2020 | December 2020 | | January 2021 | February 2021 |
|---|---|---|---|---|---|---|
| SUR | **1.474** | **1.445** | **1.374** | | **1.494** | **1.323** |
| SIR | **0.881** | **0** | **0.994** | | **0** | **0** |
| CAUTI events | **1** | **0** | **1** | | **0** | **0** |
| # IUC days | **560** | **501** | **422** | | **419** | **413** |
| #Patient days | **642** | **586** | **519** | | **474** | **526** |

**SUR=** Standard Utilization Ratio (urinary catheter (IUC) days per 10000 patient days)

**SIR=** Standard Infection Ratio (CAUTIs per 1000 catheter days)

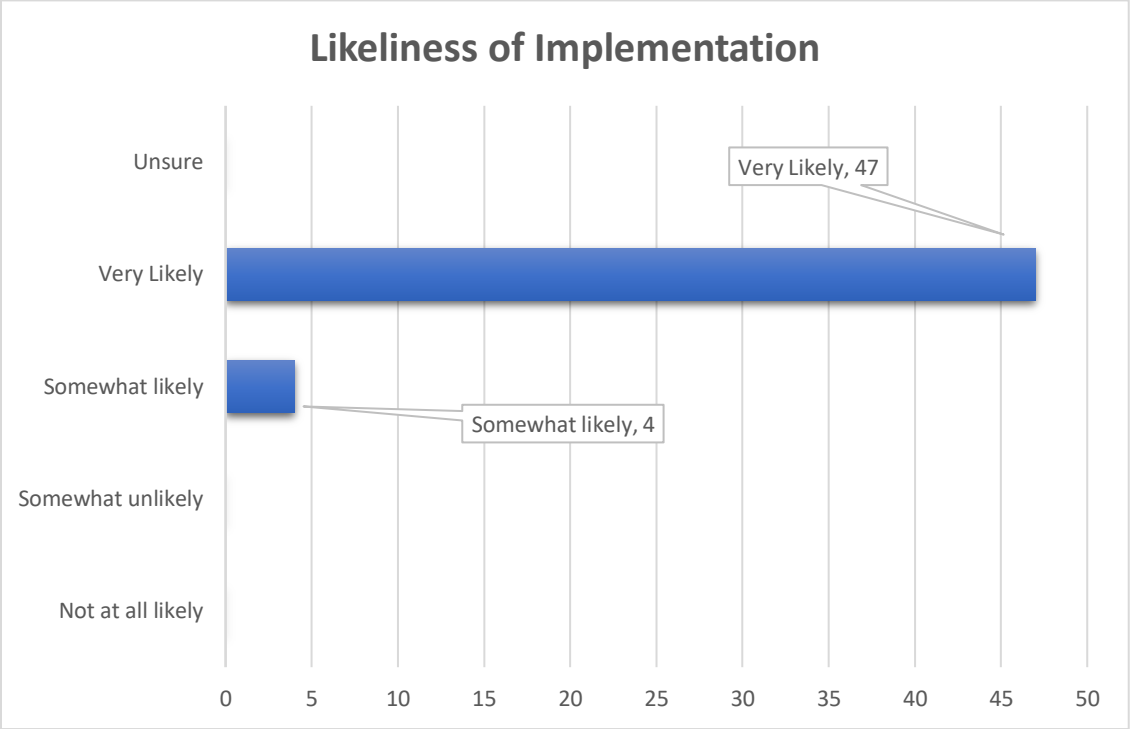
**CAUTI events=** The number CAUTIs events

**# IUC days=** The number of days an IUC remains in a patient

**# Patient days** = Number of patient days on the ICU

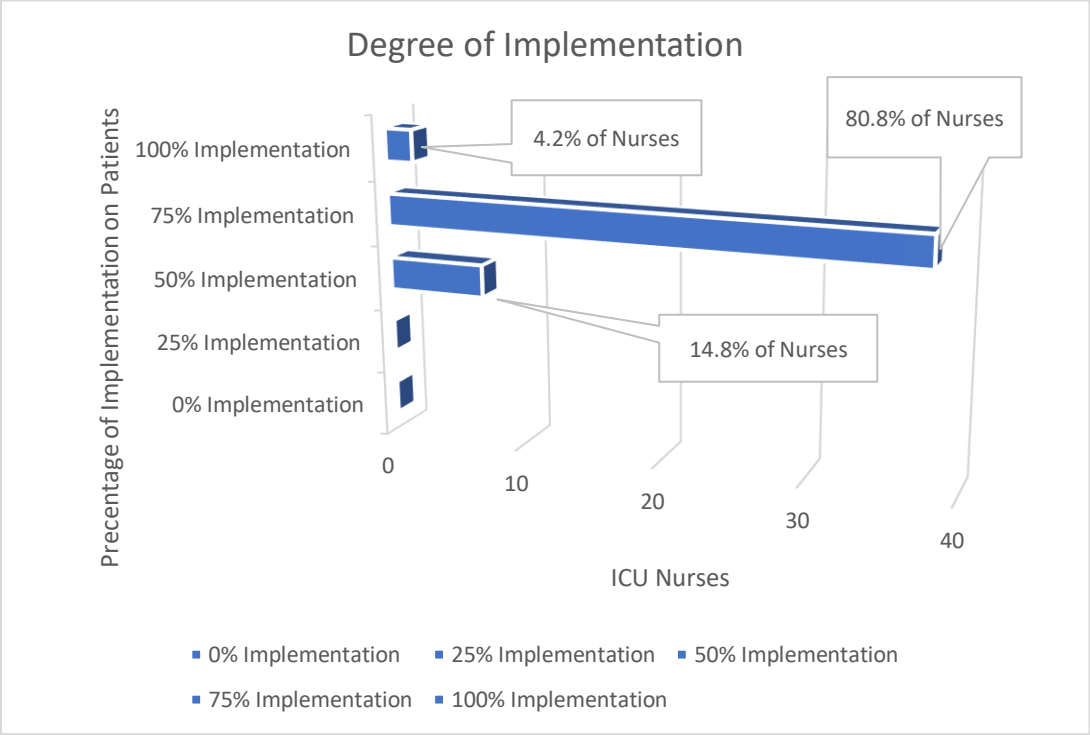
The Nurse-Driven Urinary Management Algorithm, PowerPoint education presentation, and Post-Algorithm Education question were distributed through email to the ICU nursing staff on week one in mid-January and through a paper format during the education session held mid-February. Fifty-one out of 58 (87%) were returned during the education session. None of the emailed questionnaires were returned. Of the 51 questionnaires returned, 47 (92%) indicated that they were very likely to implement the Nurse-Driven Urinary Management Algorithm into their nursing practice and 4 (8%) indicated that they were somewhat likely.

Figure 1. Post-Algorithm Education Likeliness of Implementation



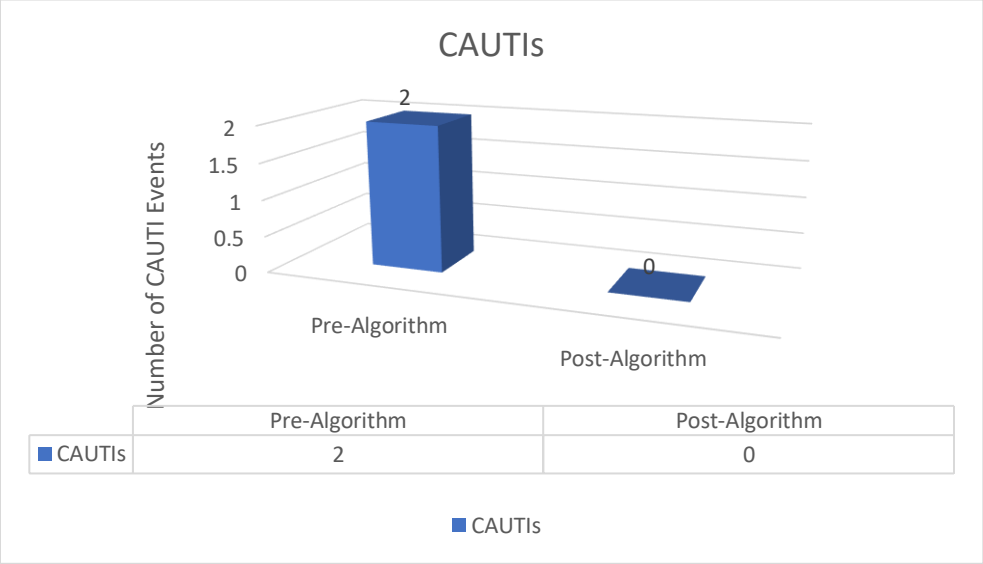

The Post-Project Questionnaire was distributed in late February through paper form, and 48 out of 58 (82%) of the paper questionnaires were returned in early March. Of the 48 questionnaires returned, 38 (81%) indicated implementation of the Nurse-Driven Urinary Management Algorithm on 75% of their patients, 7 (15%) indicated its use on 50% of their patients, and 2 (4%) indicated its use on 100% of their patients.

Figure 2. Post-Project Evaluation, Degree of Implementation



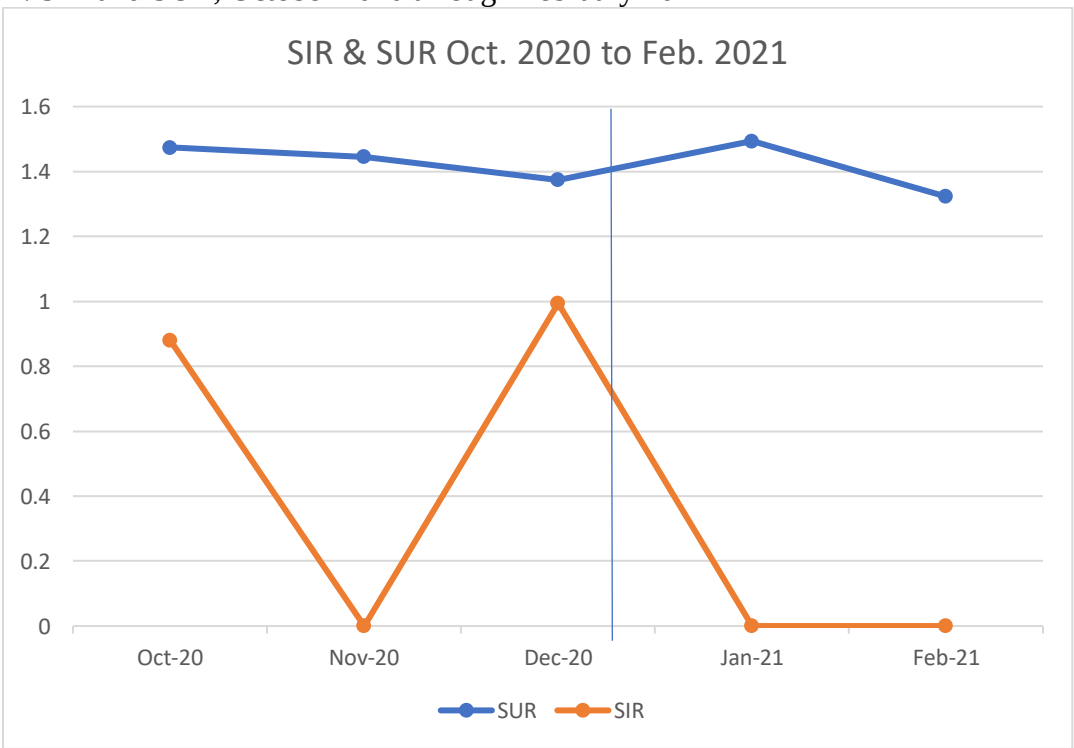

CAUTIs were measured pre/post-implementation, and an absolute reduction from 2 to 0 was observed.

Figure 3. CAUTI Events Pre- and Post-Implementation of the Nurse-Driven Urinary Management Algorithm



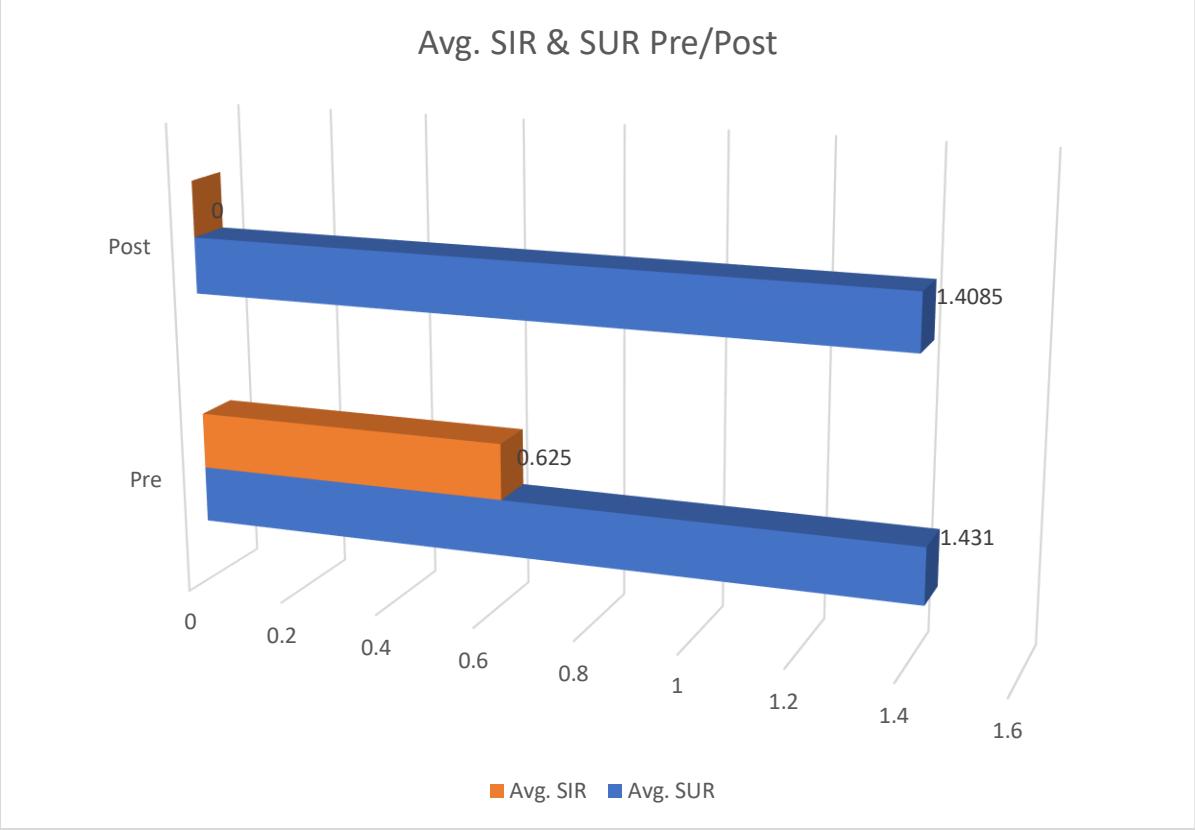

The SIR decreased to 0 post-implementation and the SUR decreased by 2.17%.

Figure 4. SIR and SUR, October 2020 through February 2021




Note: Vertical line indicates the implementation of the Nurse-Driven Urinary Management Algorithm.

Figure 5. Average SIR and SUR Pre and Post Nurse-Driven Urinary Management Algorithm




## Summary of Project Goals

The implementation of this project was significantly impacted by the COVID pandemic which impacted the agency directly and the plans for this project implementation. Subsequently, goal achievement was variable.

- Project Goal # 1: Have 80% of ICU nurses complete the Nurse-Driven Urinary Management Algorithm education within three-weeks of implementation.

  Outcome: 87% of the ICU nurses completed the training within four weeks.

- Project Goal #2: Identification of two ICU nurse champions and completion of in-person Nurse-Driven Urinary Management Algorithm education within three-weeks of implementation.

  Outcome: Two ICU nurse champions were identified and provided in-person education in mid-February, four weeks post-implementation, not meeting the project goals timeframe.

- Project Goal #3: Decrease SUR by 15% and SIR by 10% by end of project.

  Outcomes: At the end of the project, pre- and post-implementation the SUR average change was 2.17%, not meeting the project goal. The SIR decreased from 0.625 to zero, meeting and exceeding the project goal (see Appendix N). The Standard Infection Rate (SIR) post-implementation was zero.

- Project Goal #4: At one year post-implementation, decrease CAUTI rate by 50%, decrease SUR by 30%, and achieve SIR equal to or less than one.

  Outcome: Projected at the rate of change the CAUTI rate and SIR will reach the goal by one year. The SUR, at the current rate of change, will not meet the goal at one year.

# CHAPTER FIVE

## DISCUSSION

CAUTIs are the most common type of HAI and are associated with increased morbidity and mortality (AHQR, 2015; CDC, 2019; CDC, 2018; Fekete, 2020; NHSN, 2020). CAUTIs cause increased pain, discomfort, and increase patients' hospital length of stay (AHRQ, 2017; CDC, 2019). IUCs are frequently placed before alternative measures are implemented, without appropriate indication, and remain in longer than medically necessary (CDC, 2019). This leads to prolonged and unnecessary use of IUCs. Each day the IUC remains in the patient, an increased risk of developing a CAUTI 5-7%, and after 30 days the risk increases to 100% (Fekete, 2020; IHI, 2020). CAUTIs are preventable with proper care and with the implementation of evidence-based practice (AHRQ, 2015; CDC, 2019; Fekete, 2020).

The goal of this quality improvement project was to decrease CAUTIs by implementing a Nurse-Driven Urinary Management Algorithm. To accomplish that goal, the DNP student implemented an evidence-based nurse-driven algorithm that focused on the recommended avoidance of IUC insertion by using alternative measures and appropriate indications for inserting an IUC. The project was designed to foster a collaborative approach to reduce CAUTI incidence by empowering nurses to work at the highest level of their scope of practice, standardizing care, and strengthening existing CAUTI prevention measures. The implementation of the Nurse-Driven Urinary Management Algorithm in this quality improvement project met its goal by decreasing CAUTIs, empowering nurses to practice at the highest level of their scope of practice and implementing evidence-based practice.

## Discussion of Results

The rate of CAUTI events was higher during the pre-intervention phase (October 2020-December 2020) than the post-intervention phase (January 2021-February 2021). During the project implementation, there were a total of six weeks without a CAUTI event. The SIR was higher pre-intervention than post-intervention, indicating a decrease in infection rate. The SIR decreased from 0.625 to zero post-intervention. The SUR was higher during the pre-intervention phase than the six-weeks post-intervention. The SUR change post-intervention was 2.17%; the SUR decreased from 1.421 to 1.409, indicating a decrease in IUC insertion or duration post-intervention. CAUTI events, SIR, and SUR were all higher pre-intervention than post-intervention, indicating a decrease in IUC insertion or IUC duration and a decrease in CAUTIs post-intervention. Since IUC insertion and duration are directly linked to CAUTIs, the post-intervention SIR and CAUTIs were significantly decreased; this relationship has been seen in other studies (Fekete, 2020; IHI, 2020). The goal of this quality improvement project was to decrease CAUTI events and that goal was achieved.

This quality improvement project had four goals. One goal was to have 80% of ICU nurses complete the education on the Nurse-Driven Urinary Management Algorithm within three weeks of implementation. This goal was not achieved within the allotted timeframe. On the other hand, 87% of the ICU nurses completed the education by week four post-implementation. Goal number two was to identify two ICU nurse champions and provide further education on the algorithm within three-weeks post-implementation, which was not achieved within the designated timeframe. Two ICU nurse champions were identified and provided in-person education at week four. The end-of-project goal was to decrease the SUR by 15% and the SIR by

10%. The SUR decreased by an average of 2.17% and the SIR by 100%. The SUR did not meet the end-of-project goal, but the resulting decrease in the SIR was greater than expected and sets the organization on target for meeting national benchmarks for SIR for this reporting year. Last year, the organization had 10 CAUTIs, and the potential cost saving from avoidance of CAUTI treatment alone this year will be $137,930 (AHRQ, 2017). CAUTIs increase the length of stay on average by four days costing on average $40,000 per four days of in-hospital stay. If the current post-intervention SIR is maintained, the organization is projected to see additional cost savings of $400,000 resulting from CAUTI prevention in comparison to 2020 (Healthcare, n.d.).

There were several long-term goals for this project which included decreasing the CAUTI rate by 50% in one year, decreasing SUR by 30% in one year, and decreasing the SIR to 1.0 or below at one year post-implementation. Based on the rate of change in the SIR and CAUTIs during this project, if maintained, the long-term goals will be achieved at one year post-implementation. The SUR, at the current rate of change, will not meet the 30% decrease at one year. Even though the SUR decrease did not meet the project's goal, a decrease did occur with a resulting decrease in related CAUTI infections.

This project lends additional support to the literature:

- Nurses trained on appropriate indication for IUC insertion and implementing best practice interventions decrease the risk of CAUTIs (Kranz et al., 2020).
- Avoiding the insertion of an IUC by using alternative urinary collection methods is one of the top recommendations in literature to reduce and prevent CAUTIs (AHRQ, 2015; Behrend, 2020; CDC, 2019; Dehghanrad, 2019; Fekete, 2020;

Fong, 2019; Gould, 2016; Greene, 2016; Gyesi-Appiah et al., 2020; Porche, 2019; Russel et al., 2019).

- Having knowledgeable nursing staff on external urinary collection device indications, contraindications, and implementation assists in the reduction of IUC insertion (AHRQ, 2015; CDC, 2019; Eckert, 2020; Gould, 2016; Gyesi-Appiah, 2020; Porche, 2019; Russel et al., 2019; Scanlon et al., 2017).
- Nurse-driven protocols and algorithms empower nurses to make autonomous care decisions that can facilitate appropriate catheter use and alternatives to reduce the rate of CAUTIs (Behrend, 2020; Durant, 2017; Knill et al., 2018; Kranz, 2020; Russell et al., 2019).
- Implementation of protocols, algorithms, or electronic orders that specify appropriate indications for IUC placements have led to a reduction of inappropriate placement of IUC's and reduced the risk of CAUTIs (AHRQ, 2015; Porche, 2019).
- Nurses play a key role in reducing inappropriate IUC placement and the importance that nurses at the bedside have on quality outcomes, such as decreasing CAUTI rates (AHRQ, 2015).
- Decreasing patient harm and improving patient outcomes is one goal of Healthy People 2030, and this project addresses that goal by decreasing CAUTIs that cause direct patients harm and results in increased cost (Health People 2030, 2021).

The use of Kotter's change theory enabled the design of a quality improvement project that was respectful, encouraged learning, and created a trustful culture through leadership and collaboration to affect change and improvement (Kotter, 2012). The use of PDSA cycles allowed implementation of change on a small scale in the ICU, refinement and modification of the project, and analysis of the results before implementing the project on a larger scale throughout the organization (IHI, 2020). Combining Kotter's change management theory with the PDSA model for improvement increased the effectiveness and sustainability of this project. The change theory provided a framework for the DNP student to guide the organization's nursing leadership, collaborate with multidisciplinary teams, respond constructively to resistance to change, and meet the needs for continuous evolving quality improvement within the healthcare system. The improvement model tested the change, adding value to the project, and allowed for continuous learning and revision to ensure effective change.

## Challenges Encountered

The project experienced an unanticipated delay by the organization's IRB process, which set the project timeline back four weeks. Due to this unforeseen change in the timeline, the project was adjusted from an eight-week duration down to six-weeks to meet the constraints of the academic calendar. The PDSA cycles and data collection timeframes were adjusted to accommodate the new schedule. Additionally, due to the changes in the timeframe, the use of the organization's electronic education platform was no longer an option, as this would have added two to four weeks to the implementation of the algorithm and education. This problem was addressed by using the organization's email and sending out the algorithm, education on the algorithm (virtual and in-person PowerPoint presentation), and questionnaires to the ICU nursing

staff. Finally, the delay also resulted in the loss of the originally identified nurse champions, who were no longer available for the position due to earlier than expected maternity leave and planned vacation. Two new ICU nurse champions were identified in week two of the project, and their in-person education was carried out in week four of the project, one week behind the projected timeline. These challenges were addressed as they were encountered to keep the project moving forward.

Another challenge faced was the lack of returned questionnaires at week three. This challenge was addressed in week four, following the first PDSA cycle, by changing the questionnaire to a printed version and scheduling three days of on-site, in-person educational presentation on the algorithm (in compliance with COVID-19 restriction five nurses per session), administration of questionnaires, and followed by a question and answer period. These measures resulted in 87% of ICU nurses completing the education on the algorithm and 92% indicating that they were very likely to implement the evidence-based algorithm in the care of their patients.

One of the greatest challenges this project faced was the implementation of a quality improvement project in an ICU during the COVID-19 pandemic. The pandemic resulted in an ongoing change in the ICU that included the addition of traveling nurses, traveling providers, changing infection control measures, no visitation policies, increases in workload, and increases in nursing shifts to cover the surge in ICU patients. The increase in QI officer's workload extended CAUTI-related data collection to monthly rather than weekly. The in-person staff meetings and change of shift meetings were canceled in the ICU, requiring changes in strategies to keep the nurses informed on the project's progress, maintain buy-in, and receive feedback. Video conferences and email were relied upon heavily. During project implementation, the ICU

nursing staff were responding to a global pandemic, and even though they were being bombarded by change, increasing stress, and increasing work load, they showed their dedication to patient safety and preventing patient harm throughout this project.

## Limitations

Limitations of this quality improvement project were related to the patient sample size that was small due to the decrease in sampling time. The reduction of the sampling time post-implementation was decreased from eight weeks to six weeks, decreasing the sample size in the ICU. Also, this project was carried out in a single agency, and it is difficult to know if the outcomes would be the same elsewhere. The design of the project, as a pilot project, in a 25-bed ICU also lent to a smaller sample size.

## Recommendations for Future Work

The standard CAUTI-related measurements should be implemented to allow for comparison across QI projects. These standardized measures, SIR, SUR, and CAUTI rate, are essential and make it possible to compare results across a variety of CAUTI prevention projects. One of the strengths of this project was the combination of education with the algorithm to help guide clinical decisions. The education provided the nurse with the knowledge of the recommendations and interventions to prevent CAUTIs. This new knowledge allowed them to apply the “why” and “how” to the algorithm and critically think through the urinary management of their patients to prevent CAUTIs. And so, future work might expand the use of the algorithm to other units, agencies, or look at the ease of its general use. The timeframe of this project was shortened due to academic calendar restraints, but future work should evaluate the use of the

algorithm over a greater time period. The reevaluation of the project, through PDSA cycles, allowed the project to adjust to change and meet the stakeholder and participants' needs, suggestions, and feedback to foster a more collaborative atmosphere and maintain buy-in from the organization. Recommendations derived from this project include driving CAUTI prevention from the bedside, starting with the nursing staff, and then working to adjust policies and regulations. The nurses were the driving force behind the success of this quality improvement project.

## Project Work as Related to DNP Essentials

The DNP Essentials articulate the competencies of the doctorly prepared NPs who are prepared at the highest level in leadership, scientific inquiry, and practice experts (American Association of College of Nursing [AACN], 2006). DNP Essential I is the scientific underpinnings for practice and include nursing science, conceptual foundation of nursing, principles of law for the sick and well, nursing process, and theoretical underpinning of the nursing profession. This quality improvement project was built on the theoretical underpinnings of change theory, nursing process, and the principle of doing no harm. DNP Essential II is the Organizational and Systems Leadership for Quality Improvement and Systems Thinking. Through this DNP project, I was able to implement transformational leadership skills to facilitated strategic thinking and planning, innovation, and engagement of multidisciplinary stakeholders to affect meaningful and sustainable system change (Falk, 2015). The DNP Essential III is Clinical Scholarship and Analytical Methods for Evidence-Based Practice (EBP) (AACN, 2006). The application of EBP to solve practice problems in an increasingly complex system is difficult. Currently, there is an increasing amount of scientific knowledge and the

length of time for the new knowledge to be implemented at the bedside is too long (Melnyk, et al., 2016; Ost, et al., 2020). This is unacceptable, and through this project, I was able to disseminate new knowledge, and integrate it into practice. I have developed the knowledge and skills to analyze, evaluate, and create program planning to integrate EBP into the current healthcare system. The application of evidence into practice is difficult; however by aligning the organizational culture and infrastructure to support the translation and integration of EBP, this quality improvement project demonstrated how effective it can be (Ost et al., 2020).

DNP Essential IV consists of information systems/technologies and patient care technology for the improvement and transformation of healthcare. The use of SIR and SUR that was extracted from the electronic health record by the QI officer allowed the analysis and synthesis of significant amounts of data and protect patient's health information. The use of standard measures enables comparison of these project results to other healthcare systems at the local and national level to improve the healthcare system. DNP Essential V consists of Healthcare Policy for Advocacy in Healthcare, and through this project, I was able to critically analyze practice, and demonstrate leadership in development and implementation of organizational health policy related to CAUTI prevention (AACN, 2006). DNP Essential VI, Interprofessional Collaboration for Improving Patient and Population health outcomes, was met through the development of an effective interprofessional collaborative team, leadership, and adaptation of the team to change. The DNP Essential VII consists of Clinical Prevention and Population Health for improving the nation's health. Through this project, I was able to analyze the clinical data to determine a need for health promotion and risk reduction related to CAUTIs.

With the development, implementation, and evaluation of the CAUTI prevention project, I was able to address gaps in care and improve the care of individuals.

Finally, DNP Essential VIII, Advanced Nursing Practice, sets the foundational competencies that are required by all DNPs (AACN, 2006). Through this project, I was able to promote a new model of CAUTI prevention in health care through the integration of EBP and patient-centered care. Through the development of this quality improvement project, I have been able to apply my leadership skills, plan for system change, lead clinical innovation, perform health policy analysis and integrate EBP into a complex clinical specialty to affect change. Dissemination of this project will take place in April 2021 with a poster presentation, then it will be implemented throughout the hospital with plans of implementation throughout the organization in multiple states across the Northwest.

## Feasibility and Plan for Sustainability

The eighth and last step in Kotter's change theory is to make the changes stick by incorporating the changes into the culture. This step lends itself to the project's feasibility and plan for sustainability. The implementation of a change theory and quality improvement design framework strengthens the project to sustain change (Kotter, 2012). Addressing the complexity and lack of clarity in the decision-making process to place an IUC and incorporating the change into a normal nursing workflow will help sustain the change past the project's implementation period (Murphy et al. 2015). Surveillance of CAUTI quality measures will continue to assess the change and determine if or when further improvements are needed. The algorithm is a tool that can be used to educate, teach, and sustain the change past the implementation of this project. Surveillance of CAUTI quality measures will continue to be assessed and used to determine if or

when further improvements are needed. Continuing education can be implemented on a routine annual basis through the organization's online education portal and practical skills check-offs can be completed on the units by CAUTI champions to minimize deterioration in process, performance, and knowledge overtime. This QI project is planned to undergo organization review and then be implemented hospital-wide and through frequent PDSA cycles adjusted to each hospital unit to meet their individual needs. The use of standardized measures, SIR, SUR, and CAUTI rate are essential and make it possible to compare results across a variety of CAUTI prevention projects.

The benefit of this quality improvement project significantly outweighs the cost. Financial implications to the facility were cost avoidance related to prevention of CAUTIs and improved reimbursement from CMS for meeting national safety benchmark measures for CAUTIs in 2021. The organization's mission "is to improve the health of the people and community it serves through caring spirit, excellence, good humor, integrity, stewardship, and safety", and this project directly aligned with the mission, vision, and values by aiming to eliminate CAUTIs and deliver quality care that seeks to eliminate harm to the patient (St. Vincent Healthcare, 2017).

The DNP student's time and resources were donated and did not cost the organization. Other infrastructural costs were reduced by using existing organizational resources with no additional cost. The organization had a reduction in the cost of treatment of CAUTIs and is now on target for meeting the national benchmark for CAUTIs, resulting in full reimbursement from CMS for services rendered.

## Conclusion

Although the organization and its staff implemented the CDC's CAUTI prevention bundle in 2015 and initially had success, they were more recently seeing a significant increase in their CAUTI rates that was unacceptable. Studies have shown the benefit of avoiding catheter insertion by using alternatives urine collection devices. This quality improvement project implemented evidence-based nurse-driven algorithm to reduce the use of indwelling urinary catheters with the goal to decrease CAUTI incidence. The ICU nursing staff was provided with the Nurse-Driven Urinary Management Algorithm and education on its use. The nurses' self-reported post-algorithm education a high rate of "likely to use" within their daily care of patients, and at the end of the project a majority of nurses reported using the algorithm on 75% or greater of their patients. This indicates that the nurses developed greater autonomy in making clinical decisions regarding urinary management, allowing them to work at the highest level of their scope of practice, decreasing CAUTI events, decreasing preventable patient harm, and decreasing the cost of healthcare.

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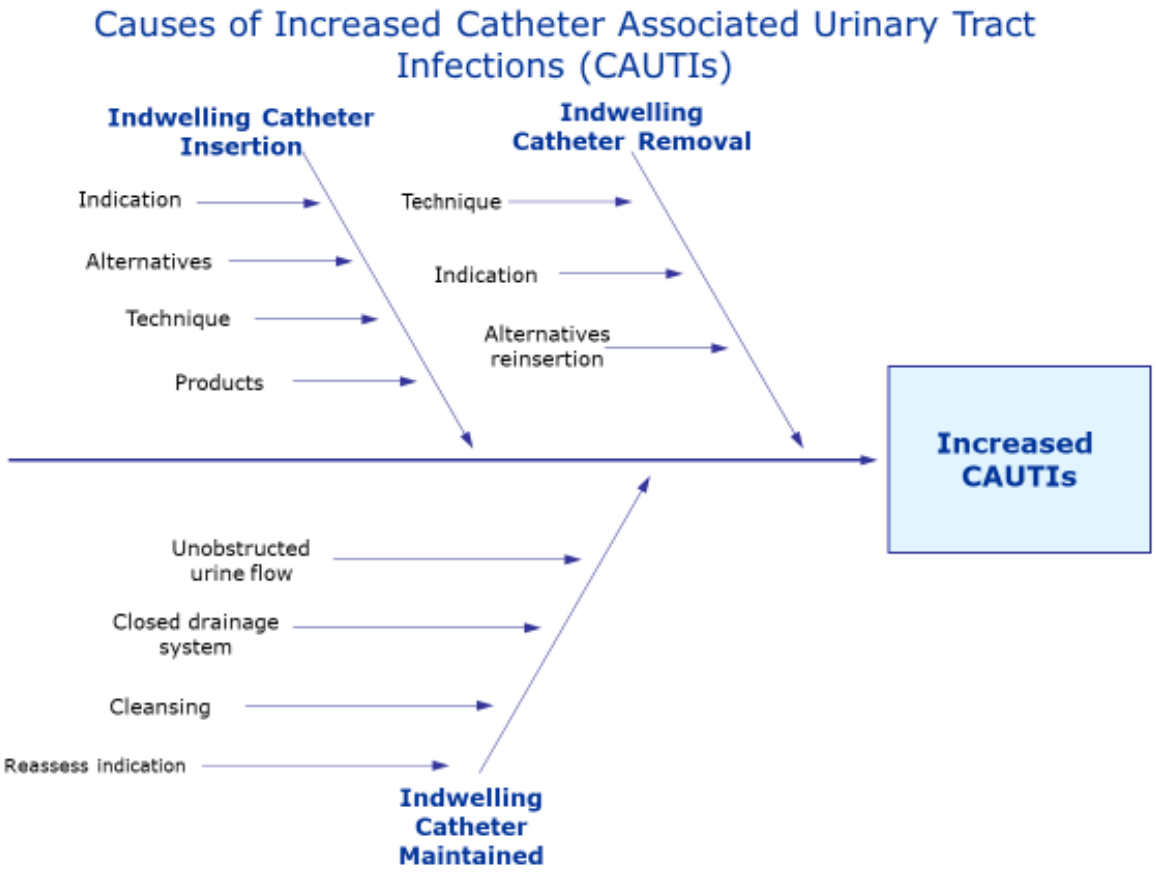
# APPENDICES

# APPENDIX A

## CAUSES OF INCREASED CAUTIS


Causes of Increased Catheter Associated Urinary Tract Infections (CAUTIs)
Indwelling Catheter Insertion
Indwelling Catheter Removal
Indication
Alternatives
Technique
Products
Technique
Indication
Alternatives reinsertion
Increased CAUTIs
Unobstructed urine flow
Closed drainage system
Cleansing
Reassess indication
Indwelling Catheter Maintained

# APPENDIX B

## EVIDENCE TABLE

Evidence Table also included as a supplemental file to the main document

| Citations | Conceptual Framework | Design/Method | Sample/Setting | Majior Variables Studied and Their Definitions | Measurement of Major Variables | Data Analysis | Study Findings | Strength of the Evidence (Level of evidence quality [strenghts and weaknesses]) | IUC= Indwelling Urinary Catheter |
|---|---|---|---|---|---|---|---|---|---|
| Agency of Healthcare Quality and Rese | n.d. | Summary of meta-analysis of additional cost estimates | Average of 6.5 studies per HAI, CAUTI 4 studies, Adults, greater than 18 years old; 105,113(10yr pool) surgical oncology. | mortality, additional cost, adverse drug events, per HAI, EMRs and nationlly representative samples. | Cost per incidence, Excess mortality, adverse drug event | pooled meta-analysis based estimates, 95% confidence intervals, mean, median. | CAUTI $13,793 (95% CI: $5,019 to $22,568), excess mortality 0.036 (95% CI: 0.004 to 0.079). 36/1000 CAUTI excess death | Large variation in sample, individual estimates. Moderate level of certainty, large range of variation, GRADE C, specifice to populations, no harm, small benefit of complications from HAI | HICPAC- Healthcare Infection Control Practices Advisory Committee categorization scheme for recommendations |
| AHRQ. (2015). Toolkit for Reducing Cat | CUSP Framwork, Stop CAUTI tool kit | CUSP, Learn from defects tool, HICPAC guidelines, Ann Arbor Criteria, RAND/UCLA Appropriates Method. 15 member expert panel, systematic revied of lit. with expert panel assess potentia of harm vs | 2015 review of lit. refined guidelines, expert panel on HICPAC guidelines and Ann Arbor Criteria | Appropiate indication, Inappropiate indication, Alternatives to IUC, Insertion, Maintenance, Prompt removal, Reminders and stop orders | Level of certainty, GRADE system, | Systematic review of litrature, guidelines. GRADE system, peer reviewed | Avoidance of unnecessary catheterization, use of sterile technique for insertion, maintance of closed system and removal as soon as possible are essential to the prevention of catheter-associated UTI. | High level of certaintiy, strong evidence, grade A Additonal tools for QI projects. | CAUTI= Catherter Associated Urinary Tract Infection |
| Ballard, P. (2018) HOUDINI Impacts on | CUSP Framework, 4 "E" model | Retrospective Quality Improvement Initiative, Impact nurse-drivien removal checklist, data compared pre/post intervention, comphrensive training, | Medical/surgical unit, implementation of NDRP | Patient care days, catheter days, catheter utilization ratios, # CAUTIs (NHSN definition) | not listed | pre n=3565 post=3 | not statistical change, potential clinical meaningful redu | GRADE C, moderate level of certinaty, quality improvement, good quality, level V, statistical unachanged, specific sample size, moderatly feesable, ? Sustainable, USPSTF C | PRISMA= Perferred Reporting Items for Systematic Review |
| Barrisford, G. W., Graeme, S. S. (2020). . | n.a. | Systematic review of current and new evidence, peer review process. | Review of guidelines and recommendations, 57 studies reviewed | Review of issues related to evaaluation and management of acute urinary retention. | No stats, USPSTF GRADE system and level of certainty to determine level of recommendations | n.a. | Bladder scan, A bladder volume on ultrasound ≥300 cc suggests urinary retention warranting decompression.Bladder decompression can be accomplished with urethral or suprapubic catheterization. Contraindicated-recent urologic surgery (eg, radical prostatectomy or urethral | In patients with AUR, compared with indwelling catheters, CIC is associated with an increased rate of spontaneous voiding and reduction in urinary tract infections. GRADE A, High level of certainty, structured systematic review of high level of evidence. procedure can be performed relatively quickly, a bladder ultrasound is a good first choice for patients who are not in | 4"E" model- engagement, education, execution, and evaluation |
| Behrend, L. (2020). Revisiting CAUTI Pre | Kotters change Management Theory, Kaizen Blitz, PRISMA flow diagram, Lean Six Sigma, DMAIC | Quantitative method, Quasi-experimental design. | Primary acute care hospital setting, 400 bed, 18 age or older, 4 weeks pre and post | VI- Nurse driven removal protocal, education, DI, SIR, improve knowledge gap pre-post survey, use of nurse-driven protocal, CAUTI , catheter utilization days | SIR-Gold standard from CDC guidelines, CAUTI per 1,000 catheter days; survey IBM PCSS statistical | pre CAUTI 15, post | Survey of knowledge, post significantly higher mean the | Low level of Certainty, moderate evidence, GRADE C Significantly improved knowledge gap in nursing group, decreased CAUTIa; Lack of time to determine sustainability, no buy in from physicians, no visual aids with education, decrease in SIR. Small sample, site specific, | CUSP- Comprehensive unit-based safety program |
| Campbell, B. J. (2020) Improving Patien | Lewins Change Theory, Tanners Model of Clinical Judgment | Quantitative method, Quasi-experimental design. | Pre 4wks and post 4wks intervention, Medical surgical small rural hospital with IUC, Adults (18 and older), convience, | IV NDRP-HAUDI, DV IUC device days | IUC device days from EHR | t-test, two tailed a | 337 IUC days, pre IUC days 173, post IUC days 164. not s | GRADE C, moderate level of certainty. Sustainable- low cost, easy to implement, evidence-based, reliable tool, measure-already documented and easy extraction from EHR Limitations, small sample size, rural facility, length of study, not statisticaly significant. | NHSN- National Healthcare Saftey Network |
| Centers for Disease Control (CDC). (201 | n.d. | Targeted systematic review of evidence, GRADE system, HICPAC, | Literature search, scan electronic databases - OVID, MEDLINE, EMBASE, CINAHL, Wolters, Cochrane, english, 8065 (7005 | IUC appropiate, best practice-risk/benefit, preventing best practice obstruction, | Strength of evidence, GRADE work group | Finalized recomme | Guidelines on appropiate use, insertion, maintaince, an | Strong evidence, High level of certainty, grade A, wide systematic search of evidence, limited by current research avaliable, updated in 2017-not much change, | NDRP- Nurse driven removal protocal |
| Dehghanrad, F., Nobakht-e-Ghalati, Z., . | n.d. | Before-after quasi-experimental study. Effect of instruction and implementation of a preventive urinary tract infection bundle on the incidence of CAUTI. | two adult ICU-330 patients were included (185 patients in before and 145 in after the intervention) | CAUTI incidences, CAUTI was identified based on the Center for Disease Control and Prevention/ National Healthcare Safety Network (CDC/NHSN) criteria. urinary catheter utilization, indication for | observed compliance, unobserved compliance, physician opinion on indication, nurse | Not indicated, report rates and incidneces and compare | 3.2 v/s 1.36 in 1000 catheter-day, p<0.388. most frequent indication-critical monitoring of I&O. CAUTI reducation was not significant. Need larger sample size, longer periods of sampling. CAUTI incidence higher in longer utilization day | CAUTI bundle, appropriate utilization, appropriate insertion, appropriate maintenance techniques and improving infrastructure. Not statisticaly significant, decrease utilization. GRADE C low benefit, moderate certainty, select sample size. Need increase in sample size, | DMAIC- define, measure, analyze, improve, control |
| Durant, D. J. (2017). Nurse-driven proto | n.a. | Systematic review of liturature | Since 2006 following guidelines from Instiute of Medicine. From CINAHL, Medline, professional agencies and expert consults. 29 | IUC utilization, CAUTI rates, CAUTI incidence, | formal quality metric, Institiue of Medicines quidlines for systematic review, quality, grading, and | synthesized qualitative, heterogeneity of outcomes unable to make statistical meta-analysis. | decreased IUC utilization and clinical predictors, and CAUTI rates. Some studies did not affect the CAUTI rates. Quality assessmnet reveiled high level of bias, only met 4.9 out of 11 quality indicators. Many do not use standardized measures. Showed need for improving study design. | GRADE B, with high level of certainty, systematic review of liturature, showed positive impact of clinical predictors and prevalence of CAUTIs. Indicated need for standardized measures and improvement of study design. Limited to studies from 2006-2017. | SIR-standerdized infections rate. National guidelines for success below 1.0 |
| Eckert, L. Mattia, L., Patel, S., Okumura, | n.a. | PDCA (Plan, DO, Check, Act) Comprehensive CAUTI prevention program based on US CDC prevention recommendations. | Female pateints admitted to 386-bed community hospital in S. California, requiring urinary management. Pilot study on | CAUTI rate for females, catheterization utilization | CDC NHSN statistical calculator that uses SAS Macros, monthly reports ran from manditory reporting to the | discriptive stats. Statistically signifigant decreae p value less than 0.05 | FEUC device, in 2015, the baseline female IDC utilization rate was 31.7% (7181 IDC device-days/22,656 patient-days) and the female CAUTI rate was 1.11 (8 cases/7181 IDC device-days) per 1000 days. 2016 IDC utilization was 29.7%, CAUTI 0%. 2017 26% utilization and CAUTI 0.90. FEUC device reduced risk of | Prioritize the use of external device for urinary management to reduce risk of CAUTI. No provider order needed because it is considered noninvasive and similar to the use of a condom catheters used in male patients. Limitation-unknow length of time used, only colletion from supplier, increase purchased device suggest increase use but no data colected to confirm. | Kaizen- methodology of determineing areas of waste, performance gaps, safe practice, satisfation of nursing and patients, interprofessional team approach |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fekete, T. (2020) Catheter-associated U | na | comprehensive review of peer-reviewed journals (420) and clinical databases (Medline, Cochrane, BMJ, reviewed by group of peers. Hierarchy of evidence, Recommendations sturtured from | comprehensive review of peer-reviewed journals (420) and clinical databases (Medline, Cochrane, BMJ, reviewed by | UTI, CAUTI, CAUTI prevention, CAUTI Guidlines HAI, HAC, | GRADE system level of recommendation PICOT | Recommendations | Recommendations: Avoidance of unnecessary catheteri | Strong evidence, high level of certainty, grade A, review of current liturature, evidence based, and guidelines. Limited risk of harm, greater benefit. Feasability-decrease CAUTI | GRADE= Grading of Recommendations Assessment, Development, and Evaluation system |
| Fong, E. (2019). Evidence Summary; Ure | n.a. | Systematic review of liturature, summary of recommendations. Best available evidence related to prevention of CAUTI in adults with short-term cath (1-14 days)? | Two part review of liturature to identify nursing interventions, Systematice review of 23 RCTs, clinical guidline, 30 studies, & | Benefit vs harm, decreading SIR, SUD, cath days, CAUTIs | Level of evidence to rank litiurature, GRADE system for recommendations from the USPSTF | n.a | Catheters should only be inserted when clinically indicated and promptly removed. Urinary catheter reminders and stop orders appeared to reduce rates of CAUTI and should be strongly considered to enhance the safety of hospitalized patients.Staff education about catheter management and monitoring CAUTI | GRADE B, with high level of certainty, Indicated need for standardized measures. Evaluation of current recommendations and reporting measures by reglitory organizations. Level of recommendations throught the Stanford grading of evidence and recommendations. Limited-did not refrence specific liturature, personal summary. | CAUTI acronym- C cause or indication, A assess for necessity, U utilize infection prevention measures, T teach patient and family, I informatics |
| Gould, C. (2016). Catheter-associated u | n.a. | Prevention collaberation, CDC, DHQP (Division of Healthcare Quality Promotion), Toolkit-summary or recommndations | Review of guidelines and recommendations | SIR, CAUTI, Indication, cath days, closed system | NHSN SIR- # symptomatic CAUTI/ 1000 cath days, asymptomatic vs. symptomatic UTI NHSN clasification, | no states, HICPAC guidelines | Implement quality improvement programs to enhance appropriate use of indwelling catheters and reduce risk of CAUTI 1. Insert catheters only for appropriate indications. 2. Leave catheters in place only as long as needed. 3. Properly trained personell insert and maintain. 4. aseptic insertion. 5. Maintain closed | GRADE B, with high level of certainty, Indicated need for standardized measures. Evaluation of current recommendations and reporting measures by reglitory organizations. Level of recommendations throught the Stanford grading of evidence and recommendations. Limited-did not refrence specific liturature, personal summary. | ICARE- Identify, Clarify, Analysis, Revision, Evaluate/Educate |
| Greene, T. M., Krein, S. L., Rogers, M. A | n.a. | AHRQs- National Comprehensive Unit-based Program, Multilevel negative binomial models, CUSP model | 926 units (59.7% non-ICU, 40.3% ICU) 603 hospitals in 32 states | CAUTI rates, saftey culture, units provided the total numbers of catheter-associated UTIs, catheter-days, and patient-days for each month of data collection | AHRQ tools for CAUTI prevetion, checklists, cusp-tool, data colletion sheets. | Descriptive statistics. Multilevel mixed-effects negative binomial regression, alpha | CAUTI rate unadjusted 2.82 pre intervention to 2.19 post intervention per 1000 cath days (incidence rate ratio, 0.86; 95% confidence intervalAHRQ national prevention program, reduce catheter use and catheter-associated UTI rates in non-ICUs. (Funded by the Agency for Healthcare Research and Quality). No | GRADE B, high level of certinaty- implementation of best evidence, with little to no harm to patients. Benefit of technical and cuture intervetions. Collaborative effort. Non-Icu decreased by 14% and ICU only by 9% in line with CDC's surveillance dataprovoding training to address any identified gaps in knowledge about urinary management processes. Both technical and socioadaptive | FEUC- Female external urinary collection devices |
| Gyesi-Appiah, E., Brown, J., & Clifton, A | n.d. | Intergrated Systematic Review, PRISMA, Examine the risks associated short-term urinary catheters (UC) | Identified n=536, duplicates n=536, Screened n=133, Full text n=14 | Presence or Absence of UC, un-aseptic, | # days in situ, # infections, | | UC lead to infection, increased length of stay and motbi | Higher level of evidence, small sample size, retrospectivley, quantitative, evidence from medical records, cheap, sustainable, perninent, can recheck for validation, moderate level of certinty, GRADE B/C | |
| Institute for Healthcare Improvement. ( | na | How to guide-recommnedations from review of the evidence by national clinical experts in infection control and prevention. | IOM, AHRQ, CMS, Joint Commission, CDC, as well as the Department of Health and Human Services' —Partnership for | CAUTI reducation, avoid, insert, maintain, review | Insetion with aseptic technique, IUC not meeting indication criteria, maintained according to | CAUTI-rate, cath days, unnessary cath days | na | How to guide based on recommendation from CDC, IHI, AHRQ, and CMS. High level of certainty, Grade B- moderate benefit, no harm. Question outcome measures with lack of standardization seen currently in manditory reporting | |
| Jain M, Dogra V, Mishra B, Thakur A, Lo | NA | Qualatative, prospective questionnaire-based survey. Assess the knowledge and attitude of the health care providers regarding the indications for catheterization and methods of CAUTI prevention. | Questionnair comprised of 41 items some demographic, 54 doctors and 105 nurses. | Years of experince and meausres of prevention of CAUTI. Indications for IUC use | na | response was evaluated for statistical correlation. Numbers, means, and precentages. | The knowledge regarding indication and preventive measures was suboptimal in our study group. 53% of respondants could identily all measures of prevention of CAUTI. Knowledge of indications was signifcantly low and providers did beter than nurses in knowing indications. | Moderate certainty. GRADE C. Small benefit, small sample, select area, difficulty generalizing to general public. Indicates a lack of knowledge and understanding in prevention measures and indications. Points to the need for improvement projects that focus on prevention measures and indications for IUC insertion. | |
| Johnson, P., Gilman, A., Lintner, A., & B | Springers 6 characteristics of collarboration, academic-practice partnership, ICARE-performance improvement method | Pre and post intervention study, small pilot study, adult ICU sample | Acute care hospital, level 1 trauma, burn center, ICU, adult, over 8 months, pateint with IUC, | Nurse-driven removal protocol, education on IUC care, implement silver-cleaning products | CAUTI rates per 1000 cath days, number of CAUTIS, number of catheter days, | quantative data, cath days, CAUTI per 1000 cath days, avarage day of CAUTI infection | Post implementation 25% reducation in CAUTI rate over 8months, 11% reducation in catheter days, later average day of CAUTI pre 8.9 and post 16.5 | Limitations in small study, undefined population base, number, and critera. Unknown participation or utilization or compliance with implementation. Improve CAUTI rate, decrease utilization, increased avearge days of CAUTI, moderate benefit, no harm-best practice interventions. GRADE C, Moderate level of certainty. Individual base, small benefit, need more information, better | |
| Khanh-Dao Le, L. (2020). Evidence Sumr | n.a | Systematic review of evidence and recommendations. Best avaliable evidence for the safe and effective management of intermittent urinary catheters? | 3 Evidence-based guidelines, systematic review 14 RTCs, 42 systematic review quasi-randomized studies, 2 Expert | Education, training, maintaince, insetion, and management | JBI structured ssytematic review of liturature, GRADE from USPSTF and level of evidence | n.a. | Intermittent self-catheterization may be used in preference to indwelling catheterization, as there is a lower rate of infection associated. (Grade B) Health care professionals should be constantly aware of their hand hygiene practices to minimize the risk of cross contamination. (Grade B) Urinary | GRADE B, with high level of certianty. Systematic review of evidence with a summary of recommendations. Intermittent cath should be used in appropiate patients to decrease the risk of UTI from IUC. Also, education/training on management and trained proffectionsals. | |
| Knill, L., Maduro, R., Payne, J.( 2018) Ta | na | retrospective study, Urinary catheter insertion decision tree | Hospital, patient with IUC, | IUC, IUC utilization ratio | CAUTIs, IUC utilization ratio | pre - IUC utilization | Statistically significant decrease in IUC utilization ratio, | Moderate certainty, strong evidence, grade B, Use of catheteres and CAUTIs decreased after algorithm, avoiding catheters unless medical nessisary, use of altrnatives, EBP maintance and management, nurse empowerment and autonomy. Limitations- CAUTI decrease not statisticaly significant. Unknown sampling information, statistics, design, | |
| Kranz, J., Schmidt, S., Wagenlehner, F., | n.d. | systematic meta review of liturature from Medline of randomized clinical trials and systematic review. Two author review, independently. Adult patients with CAUTIs | 508 studies, 69 selected for analysis | indication for IUC, duration, type, infection prevention, education, multiple interventions | evidence table, eBOX= serach strategy within study | none | Duration of IUC determinative risk for CAUTI. Indication for ICU considered per case, duration shortes time possible, training personel= decrease CAUTI | Unable to recommendations, but eous of study- decrease duration, careful consideration of indications, training of personel. High level of evidence. Differentiation between asymptomatic and symptomatic catheter-associated urinary tract infection, consideration for antibiotic stewardship. | |
| Manuel, B. (2019). Evidence Summaries | n.a | Systematice review of Literature, What is the best available evidence regarding safe removal of urinary catheters? | 26 systematic review trials with total 2,933 participants, RCT prostpective include 60 participants, 6 RCT-1 non-RCT meta-analysis, | Harm vs benefit, re-catheterization, clamping before removal vs no clamping, use of pre-medication for retention, reminders and stop orders | JBI structured ssytematic review of liturature, GRADE from USPSTF and level of evidence | n.a. | Reminders or stop order systems should be considered where feasible to prompt timely catheter removal. (Grade A) It is recommended that short-term indwelling urinary catheters be removed as soon as possible to minimize the risk of urinary tract infection. (Grade B) | GRADE B on most recommendatiosn but a GRADE A on reminders and stop orders to remove IUC as soon as possible. High level of certainty due to high level of evidence. Review found that stop orders or reminders reduced UTI, and the amount of days patients were catheterized. (Level 1) | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Maxwell, M., Murphy, K., & McGettigan | Plan-Do-Study-Act quality improment model, CUSP: STOP CAUTI | Pre and Post implementation. Step by step implementation of each intervention over one year. Plan-Do-Study-Act quality improment model, CUSP: STOP CAUTI | Acute care hospital, ICU/IMCU mixed neurosurgical, trauma, pulmonary, medical, 24 bed unit, level II trauma center | Urinary catheter utilizations, CAUTI event | Part of HAI survelance and reported to NHSN per month, Urinary catheter utilizations, CAUTI event | qualitative and quantitative statistical deviations | Pre intervention utilizations ratio 57%, post 48%. Decrease by 9% and relative change of 15.78%, one year later abslute hcange of 17% and relative 29.82%. One standard deviation below NHSN mean. Overall decreae in IUC and increase in utilizationn of alternative devices. | Moderate Certainty, GRADE B, evidence-based intervention, little to no harm to patient, moederate benefit, no statistical anylysis , pre and post intervention. SIR and SUR used from NHSN standardization. Question on measuring cultural change with reporting before asked? not the best measurement of cultural change for all intervetions. decreased utilization, decrease CAUTI | |
| Murphy C, Prieto J, Fader M"It's easier t | NA | Qualitative study, High levels of inappropiate use of IUC's, difficult practice to change, better understand factors infuencing clinicians' decisions. | Acute medical ward and emrgency department, 1200+ bed hospital. 30 retrospective think aloud and 20 | Opinions on when an IUC was warranted varied considerably | Interview and think outloud | no stats, just discussion of findings | Inconsistency in decision-making was caused by differing beliefs on when an IUC was appropriate for each clinical indication. Numerous patient and non-patient factors, including clinical setting, resources, patient age and gender and staff workload, also impacted on each decision. Assessing when the benefit | Moderate Certainty. GRADE C. Selectivly offering, small benefit. Small sample size, qualitative opinion of selected nurses and physicisans in one facility, unable to generalize to population. | |
| National Healthcare Saftey Network (NI | n.d. | Data collection from healthcare faclilities on HAI and outcomes | United States internet-based surveillance system. Each state specific reporting indicated by legislation | HAI including CAUTI, CLABSI, VAP, VAE vaccinations, transfusion-related events, | SIR-Gold standard from CDC guidelines, CAUTI per 1,000 catheter days; SUD | SIR, SUD, statistical reports, montior and compare to baseline 2015 to trend progress | CAUTI complications,CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality, prevaliance, cost ,9.5% of infections reported by acute care hospitals,13,000 deaths are associated with | High level of certainty, strong evidence, Grade B, lacks a systematic reviwe of liturature. Great source for statistics and reference data for specific HAI, trend data over time, national progress towards goals, areas of need or improvement, compare to other facilities, natinal standards and benchmarks | |
| Olatunji, O. (2019). Education program | Knowles's adult learning theory | qualitative and quantitaive quasi experimental convience sample. | CAUTI incidence 1 month pre and post education implementation with teach back method. | Pres and post test of education provided, | 32 CCU nurses participated, including age, race, sex, years of experince; CAUTI audit bundle tool | 1-sample t test, pa | Increase knowledge of CAUTI, knowledge of clinical indi | Low level ofCertainty, GRADE C or D, no harm to nurses or patinets, but little to no benefit on desired outcome, increased education but did not effect the CAUTI rates. Increased knowledge through pr and post tes, small select sample size, increase cost and time with unknown benefit. | |
| Porche, D. J. (2019). Urinary Tract Infect | n.a. | Systematice review of literature, Evaluating interventions related to prevetions of infections associated with the ise of short-term IUC in adult patients. | Systematic review, 30 controlled trials, quasi-experimental study 24 months of base line data, review of 5 systematic reviews. | CAUTI, CAUTI rates per 1000days, cost benefit, length of time IUC in place | na | Level of evidence to rank litiuratue, GRADE system for recommendations from the USPSTF | Reductions in UTI rates were more effective with multifaceted interventions such as patient education and audit or catheter removal protocols. (Level 1) Nurse driven protocols consisted of a medical necessity rubric to guide nursing decisions for appropriate catheter insertion and | Grade A, moderate level of certainty for nurse-driven protocols combined with nursing education and with mutlidisiplinary team colaberation can decrease CAUTIs. | |
| Prevention of Catheter-Associated Urin | n.a. | Double blind peer review, Expert Peer Review, Editorial Board review. | na | Risk factors for CAUTI, IUC, length of use | na | none | Action for nurses: Assess the patient for accepted indications and alternatives before placing any indwelling urinary catheter. Adhere to aseptic technique for placement, manipulation, and maintenance of indwelling urinary catheters. Document all instances of indwelling urinary catheters, | Low level of certainty, low evidence, grade C , low to no risk of harm, suggestions agree with CDC Guidelines, recommneded resources, lack methods, list of studies, evidence to support | |
| Quinn, P. (2015). Chasing Zero: A Nurse | n. d. EBP Question the Foley framework from an Illinois long-term care facility | qualitative, quasi-experimental, Implementation of EBP nurse driven protocol decrease CAUTIs by 1/2 in 1yr. | 301bed non-academic community hospital in suburbs of NY. Education 400 nurses (75%) education on protocol, | CAUTI incedences per 1,000 catheter days, # days IUC remained in (dwell time), pre and post cost of treatment of CAUTI | Electronic health record, Quality officer quartley report CAUTI incidence, finacial officer-cost of | Speacilized reports from EHR by informatics speacialist, campare pre and post | decreased CAUTI rates from 4.9/1000 to 3.9/1000, decreased utilization use from the start 5.6 days aerage of the study through the end 3.6 day average | Baseline dwell time or length of time IUC in place not known. Single study quisiexpermental, conveince sample. Lack of measurements and statistics. Did see a clinical decrease in CAUTIs and IUC urilization. Contribute success to colaberate effors of mutidisiplinary team and finacial benefit. GRADE C level of certainty of moderate. not a well designed study, possiblility of | |
| Russell, J. A., Leming-Lee, T, & Watters, | Kanters theory of organizational empowerment | Lean process improvement model, Model for Improvement (MFI) -2 parts, thinking and doing (PDSA cycles). | 42 bed cardiovascular thoracic tertiary facilitty, pateints from heart, lung, 38 nurses, implementation over 6weeks, RN to 3-4 | Data tools, individual audits, review of EHR documentation | cath days (days of IUC/days in hospital), indications, algorithm applicable, CAUTI | Quantitative, simple rate (numerator/dino minator) | CAUTI rate decrease by 37% not 50% as the goal from 4.80 to 3.05 per 1000 cath days, %7% compliance rate-Goal 80% | Indicated need for voiding trial and retention education and algorithms, finding indicates the use of other methods to calculate urine output, such as metered urinals and urine catch devices placed in patient bathrooms. Nurse algorithm not implemented into practice due to issues with md ordersets-limitation-not sustainable- low use of IUCs in population base for implementation | |
| Scanlon, K. A., Wells, C. M., Woolforde, | Lean, Acute Cause Analysis (ACA), Plan-Do-Study-act | quantittaive quasi experiment, implementation of nurse-driven algorithm/protocol, rounds, ambassaadors,CAUTI acronym-CAUTI SIR and Cost- | two hospital facilities, non-ICU and ICU, point system for population at risk-ED, ICU, OR, PACU. (188-nurse education) | SIR, incidence, IUC days,finances, nurse-driven algorithm, dry bag concept, perineal care practices, maintenance and insertion techniques, two RN mandate, development of CAUTI ambassadors, | CAUTI ACA, rounds, ambassadors, prevention bundle, education, cost, catheter days | HAI data analysis, SIR compared, actual and predicted on reference points | ICU SIR of 32% and in 18 months expressed a 73% reduction. ICU CAUTI incidence decreased by 46% and 89%. catheter days decreased by 22% and 58% respectively.purchase of additional bladder scanners and education to non-ICU units that lagged behind ICU. Non-ICU SIR declined by 10% | Structured, unified process, hospital-based scorecard,unit level combined to make hospital score.autonomy of frontline staff to elevate practice providing safe quality care, momentum, passion. Changing culture through interprofessional collaboration and team development. small change in practice with large impact. GRADE C, moderate certinty small benifit possible, not harmfull, but might | |

# APPENDIX C

## SWOT ANALYSIS


Strengths
• Orginizational Support
• Products and Material Avaliable
• Established Education Platform
• Established Data Collection
Weakness
• Lack of Knowlege and Buy In on IUC Alternatives
• Overworked and Stressed Staff during COVID-19
• Increase Finacial Burden for Organization
ease IUC Utilization
SWOT
Opportunities
• Empower Nurses
• Increase Multidisciplinary Collaboration
• Decrease CAUTI rate
• Implement Evidence-Based Practice
Threats
• Supply shortages
• Delay in Product Distribution
• COVID-19 Restrictions
• CMS Score Card
• Patient Seeking Treatment Elsewhere

# APPENDIX D

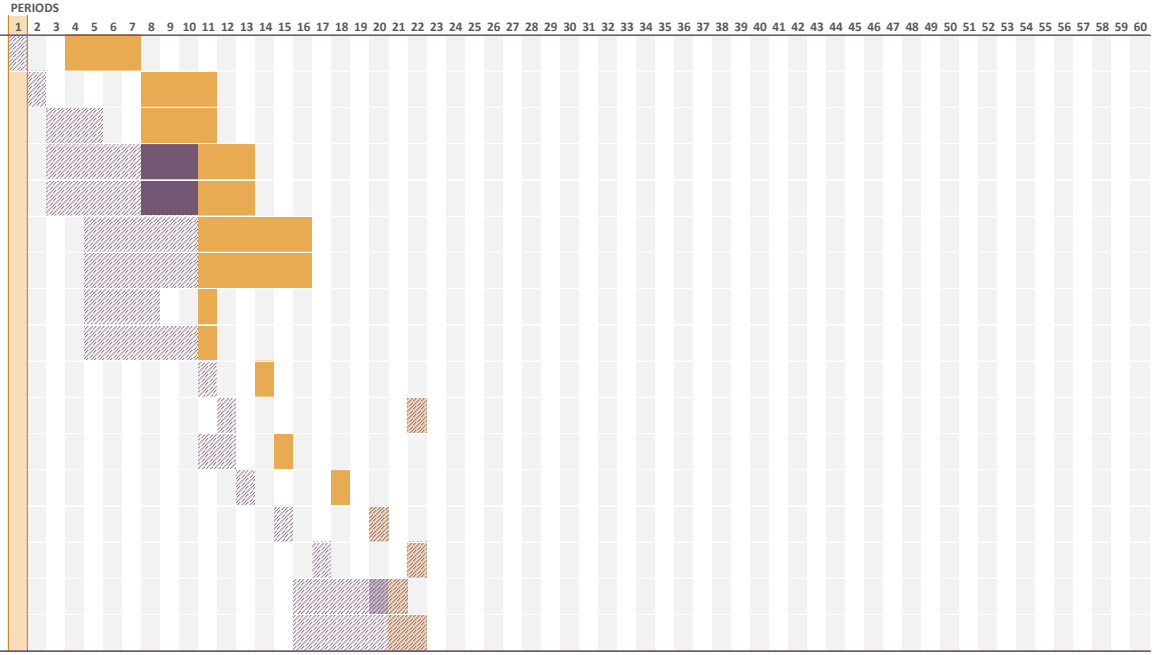
GANTT CHART

# Nurse-Driven CAUTI Prevention Project

*Periods are in one week increments.*

Period Highlight: 1 | Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan

| ACTIVITY | PLAN START | PLAN DURATION | ACTUAL START | ACTUAL DURATION | PERCENT COMPLETE |
|---|---|---|---|---|---|
| Submitting to IRB | 1 | 1 | 4 | 4 | 100% |
| Loading Algorithm and | 2 | 1 | 8 | 4 | 100% |
| Education on Algorithim and | 3 | 3 | 8 | 4 | 100% |
| Implementatio n of Algorithm | 3 | 8 | 8 | 6 | 100% |
| Collecting data | 3 | 8 | 8 | 6 | 100% |
| PDSA Cycle | 5 | 6 | 11 | 6 | 100% |
| Meeting with Stakholders | 5 | 6 | 11 | 6 | 100% |
| Modification from | 5 | 4 | 11 | 1 | 100% |
| Share Progress with Unit | 5 | 6 | 11 | 1 | 100% |
| Conclusion of Project | 11 | 1 | 14 | 1 | 100% |
| Share result of Project with | 12 | 1 | 22 | 1 | 0% |
| Anyalizing Results | 11 | 2 | 15 | 1 | 100% |
| Project Conclusion and | 13 | 1 | 18 | 1 | 100% |
| Final Project Defense | 15 | 1 | 20 | 1 | 0% |
| Submit to Graduate | 17 | 1 | 22 | 1 | 0% |
| Present to Organization | 16 | 5 | 21 | 0 | 0% |
| Dissemination of Project | 16 | 5 | 22 | 0 | 0% |



# APPENDIX E

## POST-ALGORITHM EDUCATION AND POST-PROJECT IMPLEMENTATION QUESTIONS

## Post-Algorithm Education and Post-Project Implementation Questions

### Post-Algorithm Education

Participation is voluntary.

How likely are you to implement the Nurse-Driven Urinary Management Algorithm into your nursing practice?

A) Not at all likely

B) Somewhat unlikely

C) Somewhat likely

D) Very likely

E) Unsure

### Post-Project Implementation

Participation is voluntary.

With what percentage of your patients did you implement the Nurse-Driven Urinary Management Algorithm?

A) 0%

B) 25%

C) 50%

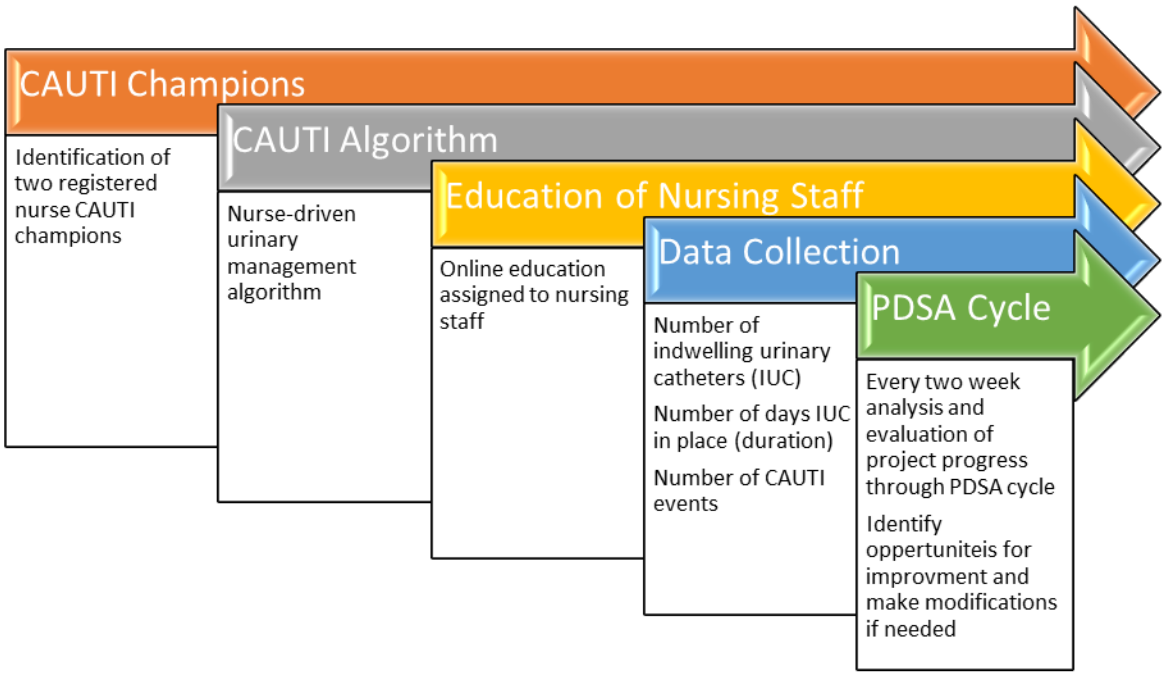
D) 75%

E) 100%

# APPENDIX F

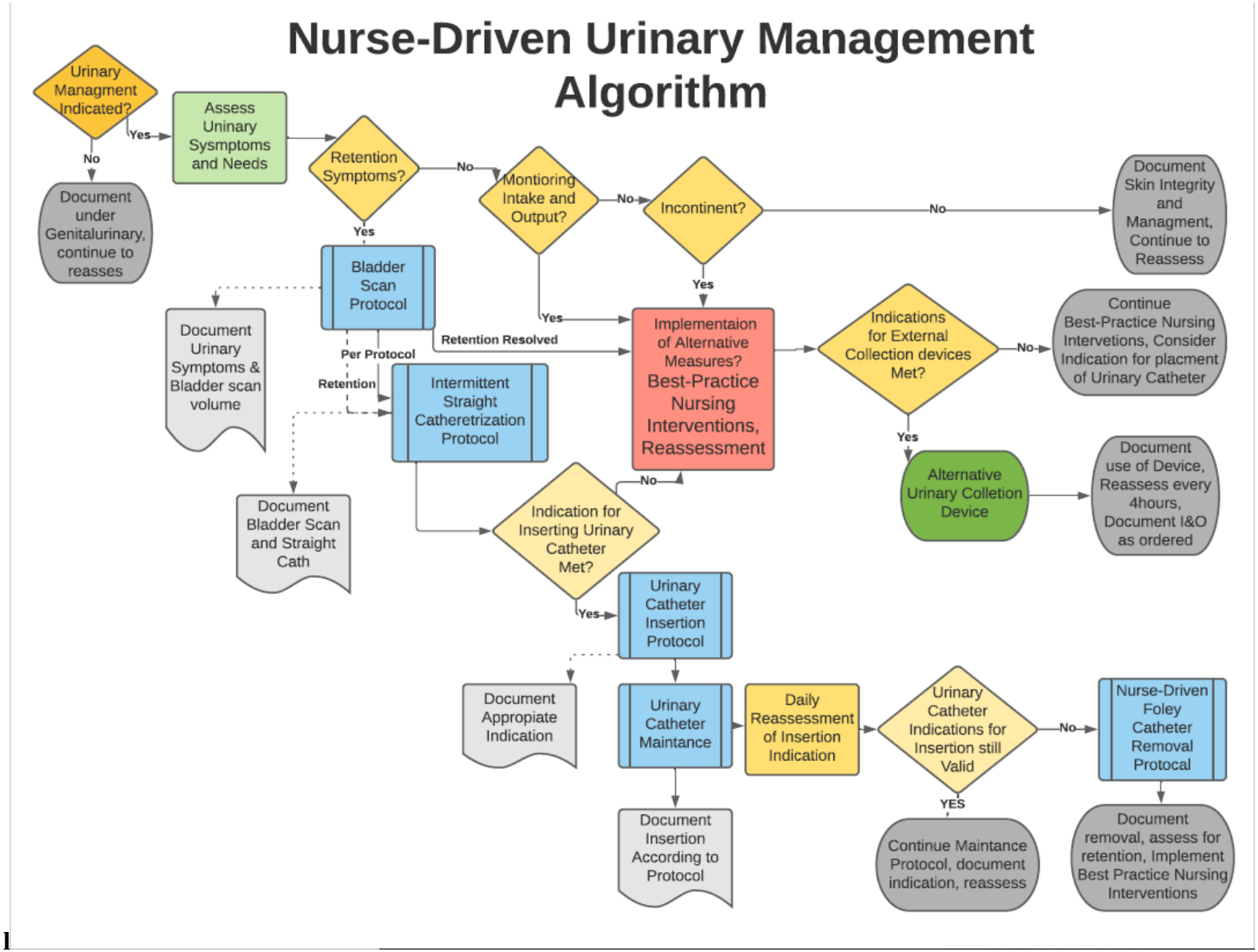
## PROJECT PROCESS

**Project Process**

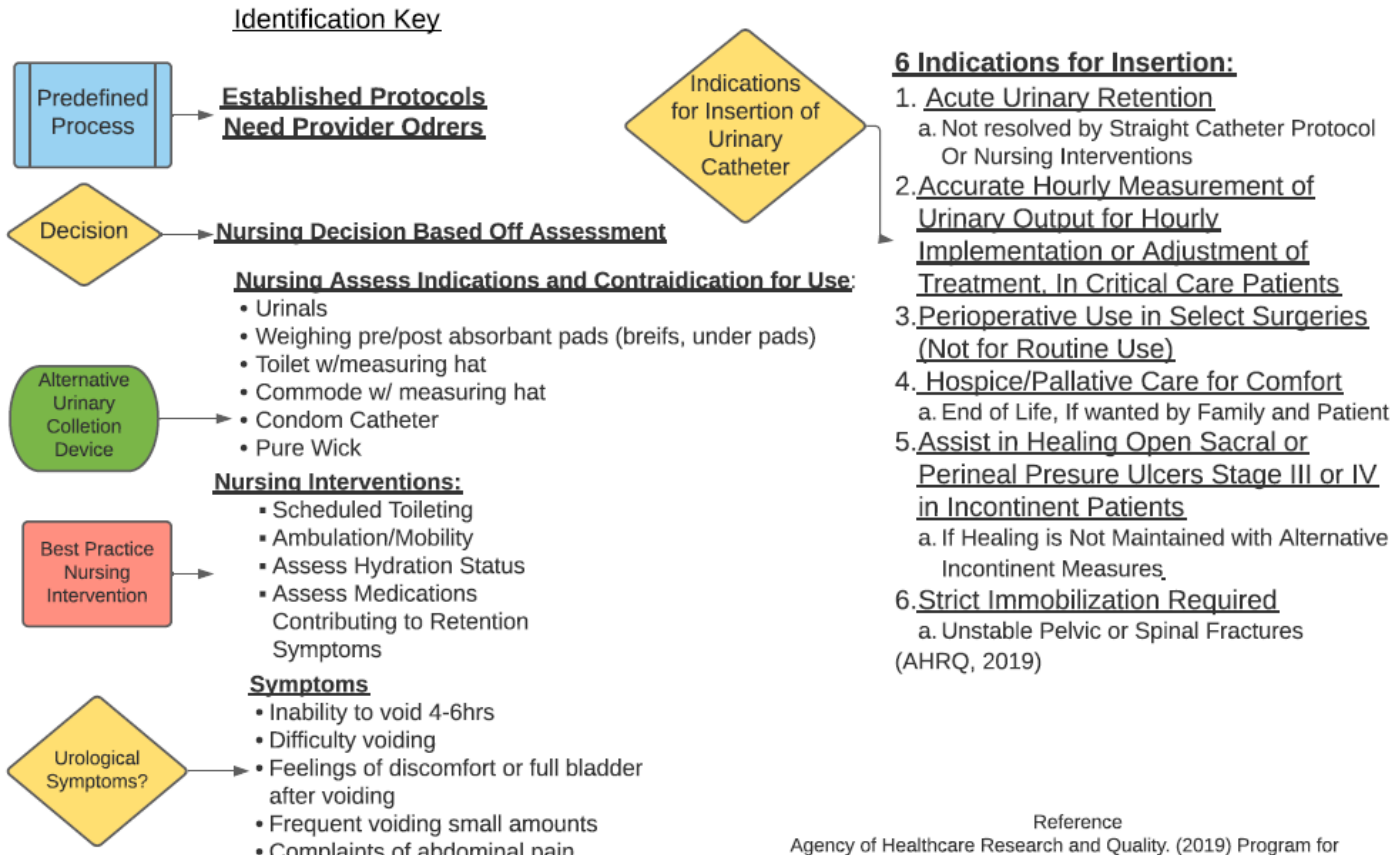


# APPENDIX G

## ALGORITHM


Nurse-Driven Urinary Management Algorithm
Urinary Managment Indicated?
Yes
No
Document under Genitalurinary, continue to reasses
Assess Uninary Sysmptoms and Needs
Retention Symptoms?
No
Yes
Montioring Intake and Output?
No
Incontinent?
No
Document Skin Integrity and Managment, Continue to Reassess
Yes
Bladder Scan Protocol
Document Urinary Symptoms & Bladder scan volume
Per Protocol
Retention
Retention Resolved
Yes
Implementaion of Alternative Measures? Best-Practice Nursing Interventions, Reassessment
Indications for External Collection devices Met?
No
Continue Best-Practice Nursing Intervetions, Consider Indication for placment of Urinary Catheter
Yes
Intermittent Straight Catheretrization Protocol
Document Bladder Scan and Straight Cath
Alternative Urinary Colletion Device
Document use of Device, Reassess every 4hours, Document I&O as ordered
No
Indication for Inserting Urinary Catheter Met?
Yes
Urinary Catheter Insertion Protocol
Document Appropiate Indication
Urinary Catheter Maintance
Daily Reassessment of Insertion Indication
Urinary Catheter Indications for Insertion still Valid
No
Nurse-Driven Foley Catheter Removal Protocal
YES
Document Insertion According to Protocol
Continue Maintance Protocol, document indication, reassess
Document removal, assess for retention, Implement Best Practice Nursing Interventions

# Nurse-Driven Urinary Management Algorithm





Reference

Agency of Healthcare Research and Quality. (2019) Program for Intensive Care Units: Preventing CAUTIs. https://www.ahrq.gov/hai/tools/preventing/index.htmlP

# APPENDIX H

## IRB APPROVAL

INSTITUTIONAL REVIEW BOARD
**For the Protection of Human Subjects**
**FWA 00000165**

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**MEMORANDUM**

**TO:** Katelyn Gaskin and Susan Luparell

**FROM:** Mark Quinn Mark Quinn CJ
Chair, Institutional Review Board for the Protection of Human Subjects

**DATE:** November 13, 2020

**RE:** *"Nurse-Driven Catheter Associated Urinary Tract Infection (CAUTI) Prevention Project" [KG111320-EX]*

The above research, described in your submission of November 13, 2020, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

____ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

__X__ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.