CAUTI PREVENTION FOR LONG TERM INDWELLING BLADDER CATHETERS IN ICU PATIENTS: AN INTEGRATIVE REVIEW

A Scholarly Project

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

of Doctor of Nursing Practice

By

Joseph Chamness

Liberty University

Lynchburg, VA

March, 2021

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Scholarly Project Chair Approval:

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Abstract

This project aims to determine when a catheter should be removed in the intensive care unit to prevent premature removal. Subsequent multiple straight catheterizations may introduce bacteria into the urethra and result in hospital-acquired infections (HAI). The aim is to reduce the incidence of Catheter-Associated Urinary Tract Infection (CAUTI), a preventable HAI. A change in protocols is needed to match evidence-based research on the best practice methods. Strategies are proposed to decrease the risk of CAUTI, and limitations are discussed. Poorer strategies require more exclusions than good ones. The findings indicate more research is needed on newer strategies to determine the optimal stay-in time for foley catheters in ICU. The study focused on research articles that met ethical standards for any ages and either gender, as all are at risk of CAUTI, although women and the elderly have a higher risk. These incur increased hospital costs and extended length of time of stay. Findings also indicate that timing of catheter removal has an impact on the risk of acquiring CAUTI. The significance of these findings is they can be used as the basis for protocols, thus reducing the incidence of CAUTI, provided the guidelines are followed.

Keywords: CAUTI prevention, preventing HAIs, urinary tract infections, and catheter infection prevention, 2015-2020.

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Dedication

I would like to dedicate this project to my three daughters, Alivia, Avery, and Addilynn. This project shows that with time and dedication anything can be done. A special gratitude to my loving parents, Darel and Mary Chamness who have always encouraged me to pursue my dreams. My loving sister who is always by my side.

I would also like to dedicate this project to Kenneth Belew Jr. who has always supported me throughout this entire doctorate degree. You continue to support, encourage, and help me through every challenge I face. I love you.

Acknowledgments

A very special thank you to Dr. Cynthia Goodrich, my DNP project chair, for all the countless hours of reading, encouragement, patience, and prayers throughout the entire process. I would like to also thank all of my other DNP instructors and classmates for the words of encouragement and prayers throughout the program.

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Catheter-Associated Urinary Tract Infection (CAUTI)

Centers for Disease Control and Prevention (CDC)

Centers for Medicare and Medicaid Services (CMS)

Doctor of Nursing Practice (DNP)

Hospital-Acquired Conditions (HACs)

Hospital-Acquired Conditions Initiative (HACI)

Hospital-Acquired Infections (HAI)

Institutional Review Board (IRB)

Intensive Care Unit (ICU)

Johns Hopkins Nursing Evidence-Based Practice Evidence Appraisal Tools (JHNEBP)

Multi-Drug Resistant Organisms (MDROs)

SECTION ONE: FORMULATING THE REVIEW QUESTION

Russell (2005) states that the 5-stage integrative review process phases are: (1) problem formulation, (2) data collection or literature search, (3) evaluation of data, (4) data analysis, and (5) interpretation and presentation of results. There will be multiple phases that will be developed throughout the integrated review; in this case, step 5 of Russell's model is split into two phases.

Initially, Phase 1 will consist of developing purpose and review questions to guide the research. Phase 2 will be searching for the best evidence-based research. The researcher will use multiple databases such as UpToDate, CINAHL, Cochrane Library, and EbscoHost to perform the literature review. Subsequently, Phase 3 will select the best articles from which data is gathered for the project (Hopia et al., 2016). Phase 4 will then comprise an analysis of the populated data by using Melnyk's Level of Evidence to rate the articles and research to make sure the best research is used (Melnyk, 2016). Phase 5 will be the discussion of the results found. Lastly, Phase 6 will feature the presentation of the integrative review.

The 'Hourglass Model' has been used as the overall structure of the integrative review, as explicated by Toronto and Remington (2020). The 'Introduction' delineates the broad area the research will cover, resembling the top of the hourglass, which is wide and narrows down into the research problem and research question. The narrowest part, which is very specific, is the 'Methodology' before the hourglass base broadens. The emphasis in the 'Introduction' is to determine gaps in the literature (effective strategies and protocols for CAUTI prevention) based on key concepts such as Catheter Associated Urinary Tract Infection (CAUTI) prevention, Intensive Care Unit (ICU), and Hospital Acquired Infections (HAI), and the target population (intubated patients in ICU) relevant to the item of interest (in this case the phenomenon is the

prevention of CAUTI). From here, the inclusion and exclusion criteria are established in preparation for screening the literature (Toronto & Remington, 2020).

Catheter-Associated Urinary Tract Infection (CAUTI) is among the most prevalent and easily preventable Hospital-Acquired Infections (HAI) that plague hospitals globally (Centers for Disease Control and Prevention, 2018). The intensive care unit (ICU) habitually uses indwelling catheters for accurate intake and output monitoring. With the prevalent high rate of CAUTIs, hospitals endeavor to remove indwelling catheters as early as possible. The purpose of this project is to determine if catheters should be removed in the ICU to prevent premature removal. Doing so may introduce bacteria into the urethra with subsequent, multiple, straight catheterizations due to urinary retention once the indwelling catheter is removed (Galiczewski, 2016).

According to the Centers for Disease Control and Prevention (CDC), urinary tract infections (UTIs) are the fourth most common HAIs indicating that such infections comprise 40% of HAIs (CDC, 2018). In 2018, the CDC estimated that about 25% of the patients admitted in hospitals would receive an indwelling urinary catheter (CDC, 2018). The CDC, as reported by Scanlon (2017), estimated that annually, over 13,000 deaths in the United States' hospitals are CAUTI-related. Apart from the increased morbidity and mortality rates, CAUTI-related treatments have been expected to cost about $500 million annually, which creates an immense financial burden on the country's health care system (Scanlon, 2017).

In 2008, The Centers for Medicare and Medicaid Services (CMS) made it a requirement for hospitals to provide reports on Hospital-Acquired Conditions (HACs), including CAUTI. This was meant to provide reimbursements for the costs incurred by the hospitals in their treatment of patients (Meddys, et al., 2010). After a short reporting period, the CMS established

the no-pay rule for Hospital-Acquired Conditions Initiative (HACI). The initiative indicated that the CMS would not cover the costs related to CAUTI care, and the hospital would be responsible for the costs. The decision was based on evidence that CAUTIs were preventable, should not occur, and resulted in a significant surge in the financial costs of care, particularly in hospitals(Meddys et al., 2010). Therefore, reducing CAUTI has become an absolute necessity in health care organizations.

Urinary tract infection affects the bladder, ureter, kidney, and urethra. Most urinary tract infections today have been found to occur in hospitals when using urinary catheters. Due to these infections occurring in hospitals, they cannot be covered by Medicaid, as announced in 2008 (Underwood, 2015). Approximately 40% of the acquired diseases while in a hospital are urinary tract infections, with 80% occurring due to the use of the Foley catheter (Underwood, 2015). These infections have caused significant headaches in the nursing profession as they increase the hospital stay periods for patients, which leads to increased costs (Underwood, 2015). This increase in prevalence has also led many hospitals to complete research on the best method of using the Foley catheters to prevent infections occurring.

Defining Concepts and Variables

The key concepts have been captured in the 'Keywords,' repeated here for convenience: *Keywords*: CAUTI prevention, preventing HAIs, urinary tract infections, catheter material, and catheter infection prevention, 2015-2020.

CAUTI prevention

Taha et al. (2017) state that as much as 60% of CAUTI could have been prevented if evidence-based protocols had been followed. These include using catheters appropriately, good

hand hygiene, aseptic insertion, removal at the proper time, maintenance and the use of closed drainage systems. This integrative review will propose suitable strategies.

Preventing HAIs

According to Collins (2008) "HAIs originally referred to those infections associated with admission in an acute-care hospital (formerly called a nosocomial infection), but the term now applies to infections acquired in the continuum of settings where persons receive health care" such as in the home. This integrative review conforms to the original view, in that only infections acquired in hospital ICUs are considered relevant in this context (Saint et al., 2016).

Urinary Tract Infections

Flores-Mireles et al. (2015) describe the steps that lead to UTIs in uncomplicated then complicated UTIs. This is significant, as the most common reason for complications is catheterization, which is necessitated in intubated patients in ICU. In step 1, the periurethral area is contaminated by uropathogens in the gut. Having colonized the urethra, in step 2 they move to the bladder; in step 3 they move to the umbrella cells; in step 4, the immune response kicks in, followed by step 5 when those pathogens that have evaded the immune system multiply. Step 6 involves biofilm formation, and in step 7, host cell damage occurs. Step 8 is an upwards move to the kidneys, which are colonized in step 9 and host tissue damage takes place in step 10. Step 11 is the progression to bacteremia when UTIs are left untreated.

Complicated UTIs progress in the same fashion but must involve compromising of the bladder after step 2. The primary reason this occurs is a catheterization. In step 4 when the immune system is activated, which is encouraged by catheterization, fibrinogen accrues on the catheter. This is a conducive environment as the uropathogens collect and adhere as fibrinogen-binding proteins. This difference is an important point because it indicates what stage catheterization may become problematic.

Catheter Infection Prevention

Catheter infections can be caused endogenously by bacteria on the perineum, or exogenously from health care practitioners' hands or drug-resistant hospital pathogens (Assadi, 2018). Thus, prevention strategies are essential. Assadi provides further support for preventative measures: (1) 80% of ICU patients with an indwelling urinary tract catheter develop CAUTIs; (2) the rate of development of CAUTIs is 3-10% for every day the catheter remains in place, reaching up to 100% in thirty days; (3) the danger of bacteremia as the main cause of mortality and morbidity of hospitalized patients. These outcomes can be avoided by proper preventive strategies (Wild, et al., 2017).

Catheter Material

The catheter is made of either latex, Teflon or silicon, and is flexible to allow insertion into a patient. They can also be made of polyvinyl chloride (PVC) that is translucent, enables the medical practitioners to see the color of the patient's urine, and can be used by patients with latex allergies. However, the durability of silicon catheters is lower than latex, and is more porous, although it is preferred in some cases as it is considered to have reduced risk of injury to patients (SAI Infusion Technologies, 2019).

Rationale for Conducting the Review

The integrative review used a unique methodology with a view to obtain the key learnings from previous empirical and/or theoretical sources and synthesize these into a new meaning that will highlight an aspect of healthcare. This will form the basis of nursing science, outlining policies, developing protocols, and providing impetus for future research (Whittemore & Knafl, 2005). According to Whittemore and Knafl, integrative reviews will be just one type of literature reviews that will become increasingly sought due to the focus on evidence-based

interventions. This will lead to greater systemization and more stringent methodologies. The rationale, in this case, will be to contribute a new synthesis of the existing and recent studies on CAUTIs to add to the body of knowledge in the field and to bring this latest data into the scientific field in a unified and expanded form.

Purpose and/or Review Question(s)

The purpose of this project is to determine when a catheter should be removed in the ICU setting, to prevent premature removal which provides for the introduction of bacteria into the urethra with multiple straight catheterizations due to urinary retention once the indwelling catheter is removed (Locke et al., 2017). The project leader will take the integrative review research and develop a protocol to reduce CAUTIs in the ICU setting on patients requiring prolonged catheterization.

Numerous hospitals have implemented indwelling catheter care bundles. However, based on HAI reports provided by these organizations, they are still experiencing difficulties in reducing the incidence rates of different UTIs, including CAUTI. As highlighted above, CAUTI is the most common and most expensive UTI that occurs in hospital settings, and it increases the length of patients' stay in different care facilities. Notably, CAUTI is also among the conditions for which the CMS does not provide reimbursements for the additional treatment costs incurred by hospitals if the condition develops while the patient is admitted.

Despite the efforts of numerous organizations to reduce the incidents of CAUTIs, the U.S. Department of Health and Human Services reported a 9% increase in CAUTIs between 2010 and 2013. As part of its efforts to reduce the incidence of UTIs, including CAUTIs, the CMS introduced penalties imposed on hospitals. Regardless of this, the rates of Foley catheter use and CAUTIs are still increasing. Part of the problem is that healthcare facilities are not

strictly adhering to the policies and procedures established to ensure the prevention, hence the need for improvements. Besides that, the policies and procedures themselves require alterations to address the CAUTIs problem in healthcare facilities comprehensively. Among the primary goals of the Joint Commission is reducing the incidence rates of CAUTIs in healthcare organizations. The evidence-based proposal arose from the clinical question tied to the early removal of the catheters in ICU patients, which in turn leads to multiple straight catheterizations due to urinary retention, compared to retaining the catheters for an extended period to reduce the risk of bacterial colonization in the external catheters, hence reducing the incidents of CAUTIs (Young et al., 2018).

The purpose of the project is to increase the level of awareness about the devastating CAUTI-related health consequences and complications. Furthermore, the project aims to reduce the incidents of CAUTIs in health care organizations, considering the entire process that begins during admission with orders for insertion of a urinary catheter to the point where catheter use is discontinued. By considering the entire process of catheter use, the project will ensure the prevention and reduction of CAUTIs incidents, including lessening the days of indwelling catheters and, consequently, the length of stay in hospitals while minimizing chances of readmissions (Clark & Wright, 2019).

Carrying out this project would facilitate improvements in the safety and quality of care provided, resulting in better treatment outcomes. It will also, consequently, reduce the occurrence of multi-drug resistant organisms (MDROs) that are due to the use of different antibiotic therapy. Overall, this will ensure the necessary efficiency ideal for reducing the costs of care and improve patient satisfaction with the care provided. It is critical to note that CAUTIs are not benign; therefore, the project also aims to provide an evidence-based treatment approach.

As evidenced in the literature review, the timing of catheter removals determined the rates of CAUTI occurrence. Therefore, the introduction of a study-based practice would provide guidelines, the adherence to which would improve treatment outcomes (Billod, 2019).

To prevent or reduce the rates of CAUTIs, multiple review and purpose questions were developed. In this regard, the main question driving this review is: Among admitted ICU patients with indwelling urinary catheters receiving proper catheter care, does early catheter removal with multiple straight catheterizations due to urinary retention, compared to prolonged catheter retention, reduce the incidents of CAUTIs during the admission period.

My review and purpose questions include the following

- Does urinary bladder catheter insertion technique help to prevent infection rates?
- How does the dwell time of urinary bladder catheters impact infection rates?
- What are the best cleansing techniques to prevent catheter-associated infections in patients who require longer dwell times while in the intensive care unit?
- Does the type of material the urinary catheter is constructed to make a difference in the infection rates?

The research was completed using the CINAHL, EBSCO Host, Cochrane Library, CDSR, and Medline databases. Other articles used in search of this evidence were found from the use of various keywords: urinary tract infections, urinary catheterization, and prevention and control strategies for urinary area infections caused by catheters. All the articles used in my research were written in the past five years.

Formulate Inclusion and Exclusion Criteria

Table 1 illustrates the inclusion and exclusion data that were determined for this integrative review. There are more exclusion criteria (see ‘Quality’ under ‘Excluded’) as the

research undertaken in this integrative review suggests that there needs to be more research done on new strategies to help improve outcomes in patients whose catheters need to stay in longer for medical treatment purposes.

Table 1: Inclusion and Exclusion Criteria

Included	**Data**	**Reason**
Topic area	ICU, intubated, all / any patients	Such studies are relevant to the research question and delineate the search area.
Publication type	Scholarly, peer-reviewed	To ascertain legitimate evidence of published studies for accuracy
Publication date	Within last 5 years	To maintain up to date information linked with current treatment protocols

Excluded	**Data**	**Reason**
Topic area	Non-ICU	Studies in the hospital setting provide a confined clinical area with good records.
Publication type	Letters, blogs	To remain unbiased to the study
Publication date	Before 2015	Information is too old to align to current requirements
Quality	Poor quality	Data that is inferior has a badly designed study, or that lacks internal validity would skew the picture and provide an inaccurate synthesis.

Conceptual Framework

This integrative literature review utilized the integrative conceptual approach, as discussed by Whitmore & Knafl (2005). An integrative model is a reputable framework in nursing research and evidence-based practice due to its holistic and multidisciplinary nature. This model guides researchers towards adopting evidence-based initiatives to extrapolate all kinds of literature reviews to achieve a well-informed nursing decision. The primary assumption

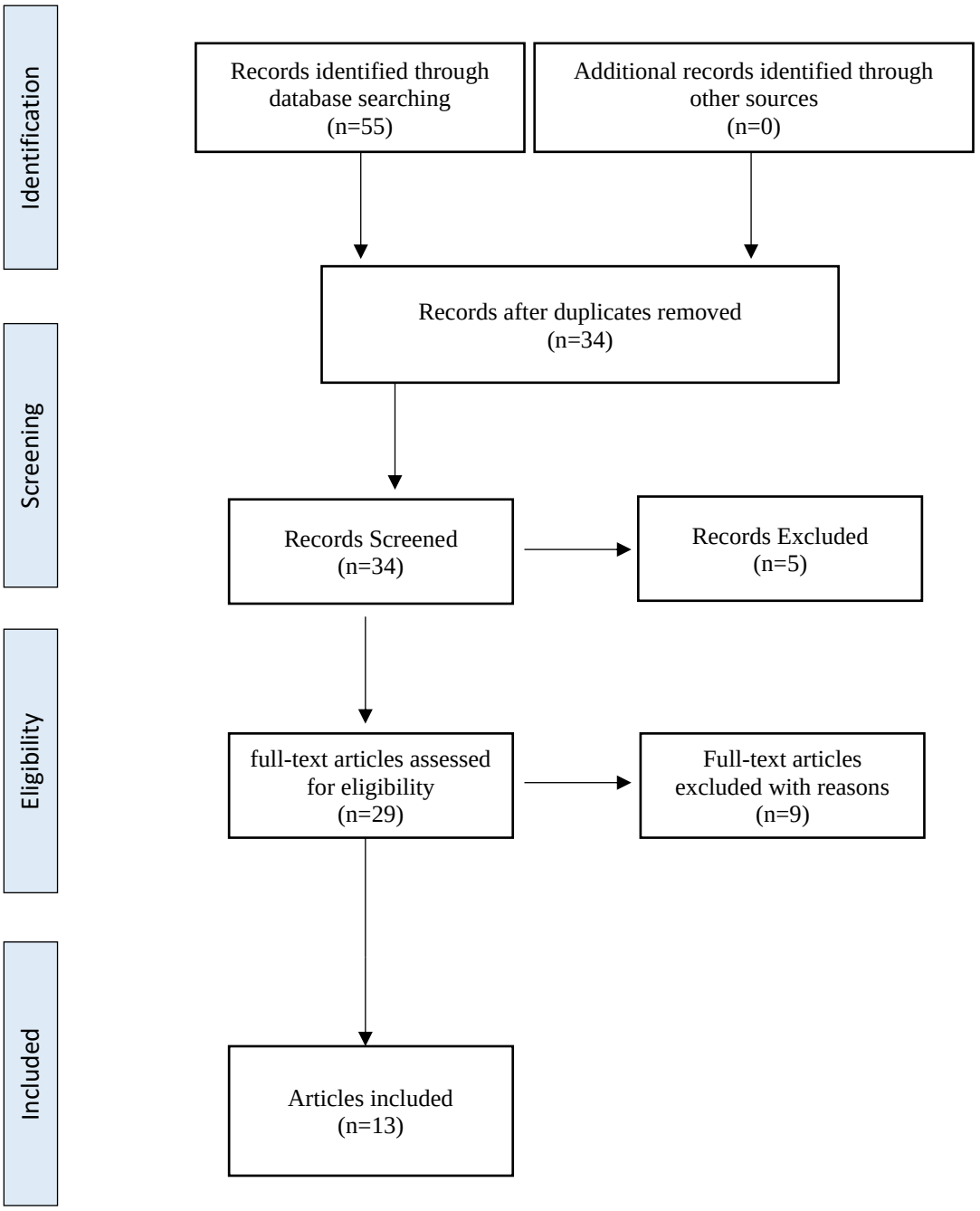
made by Whitmore & Knafl (2005) in their model, is that an integrative literature review is the only suited approach that combines diverse review methodologies (including experimental and non-experimental), which plays a potential role in fostering evidence-based nursing intervention for health quality promotion. An integrative review framework will promote enhanced data collection and extraction made possible by combining a variety of methodologies which are both empirical and theoretical sources. The integrative approach will provide the essential rigor which will bridge the knowledge gap and allow for the identification of the nursing problem in such a systematic manner. The model will, therefore, remain relevant in dissecting the mechanism of CAUTIs and for designing knowledge to prevent its consequences. The first decision-making point of the model will be the documentation of CAUTI prevalence and the imposed consequences. The integrative review model allowed the project leader to look at multiple methodologies and research, such as systematic reviews, meta-analysis, and qualitative reviews. As mentioned earlier, an integrative theoretical model of research will be capable of yielding a wide range of evidence-based data for building robust prevention measures for CAUTIs for patients under ventilation.

Significant evidence shows that CAUTIs and other nosocomial infections impose a significant burden for the healthcare system. Despite preventive efforts, the rate of CAUTIs remains high. This observation showed if an evidence-based care approach is not designed, then the problem will persist, perhaps beyond control. Therefore, an integrative review model developed by Whitmore & Knafl (2005), provides a robust approach for building evidence-based preventive strategies for clinical practice. If integrative measures are adopted at the early stages, then the occurrence of CAUTIs will be highly reduced, maximizing treatment outcomes. The

PRISMA Diagram in Figure 1 below shows how an integrative review model was used to collect and sort studies that resulted from the search process.

Figure 1:

PRISMA Diagram



Moher, D., Liberati, A., Tetzlaff, J., Altman, D. The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA statement. PLoS Med 6(6): e1000097. Doi: 10.1371/journal.pmed.1000097

SECTION TWO: COMPREHENSIVE AND SYSTEMATIC SEARCH

According to Toronto and Remington (2020), the integrative review requires data collection at various stages. This section reports on the process of information gathering to answer the research question.

Search Organization and Reporting Strategies

Data gathering involved a literature review process. The evidence was gathered from different databases relevant to nursing, inclusive of CINHL, Scopus, Ovid, and PubMed, and other credited journals in nursing. In addition, the process included considering the existing treatment guidelines. Filters were also used to ensure the most relevant and recent studies were central to the sources. Specific search terms included CAUTI prevention, preventing HAIs, urinary tract infections, and catheter infection prevention. To ensure the use of the most recent research findings, the studies considered were those conducted in the last five years (2015-2020) and published in English. A literature review table was used to analyze the evidence, which allowed for making comparisons, evaluating, and differentiating the various methodologies, settings, and sample sizes used in these studies.

The initial review examined 55 studies that were appraised for the investigation of the variables, including catheter management, outcome measures, conceptual frameworks, and nurses' perception. The review employed the Rapid Critical Appraisal of Evidence-based Practice Implementation or Quality Improvement Projects developed by Melnyk and Fineout-Overholt (2011). The tool evaluated and assessed the level of evidence. In addition, Melnyk’s Level of Evidence was used to analyze the populated data to rate the articles (Melnyk, 2016).

Terminology

When identifying the specific concepts and search terms of an integrative review they must be clearly defined to have an effective search (Toronto & Remington, 2020). Since integrative review can have such complicated theories the following concepts and terms were identified during the search process:

- CAUTI - A catheter-associated urinary tract infection; where the count for bacteriuria or funguria exceeds 10^3 CFUs/ml (Labib & Spasojevic, 2013).
- HAI - A hospital-acquired infection
- UTI - A urinary tract infection
- Complicated UTIs - Urinary tract infections caused most commonly by catheterization
- Types of Foley Catheter – Latex and Silicone are the most common.
- Coated catheters – Usually made of Latex then coated with Teflon, Silicone, or Silver.

SECTION THREE: MANAGING THE COLLECTED DATA

There is a danger that poor quality sources will slant the synthesis stage of the integrative review, although inclusion may increase the diversity of the study. It is important, whatever the decision, to keep the research question in mind (Toronto & Remington, 2020). In this integrative review, poor quality sources have been excluded. This is felt to be a more valuable strategy for answering the research questions. Reliable studies enabled the project leader conducting an integrative review to base their synthesis and contributions on accurate results.

The plan was to do an integrative review to find the best and most practical research to implement (Hopia et al., 2016). The results obtained from this project helped the project leader to determine the right time and moment to remove the catheters to prevent the risk of contracting CAUTI or spreading the disease in the Intensive Care Unit (ICU) (Locke et al., 2017).

The primary outcome of the project is to raise the level of awareness among care providers regarding the severe consequences of CAUTI. Based on the existing literature on the subject, CAUTI is one of the most common hospital-acquired infections, which hinders patients from attaining optimal health (Rahimi et al., 2019). In addition, it prolongs their time in the hospital, which not only increases the costs associated with the treatment of the infections but also reduces the revenue and reputation of hospitals. The project focuses on strategies for reducing the incidents of CAUTI by educating the care providers about the best time to remove the catheters during the admission period (Rahimi et al., 2019). The project aims to attain this objective within three months after the completion. This allowed the project leader to gather enough practical evidence, aligned with the research, for the care providers to improve their awareness, skills, and knowledge in dealing with this problem.

The integrative review of literature focused on articles based on patients needing an indwelling catheter in the ICU setting. The integrative review was conducted to establish multiple different approaches to the reduction of CAUTIs in intubated patients who need prolonged catheterization. The project plan was to find enough evidence-based research to develop a new protocol for healthcare providers to apply a catheter for intake and output measurements in the ICU setting without having to insert a straight catheter intermittently multiple times due to urinary retention (Wyndaele, 2002). The current protocol is to remove the indwelling catheter as early as possible, and if the patient is unable to urinate, it is recommended to perform straight catheterization three times before replacing the foley catheter. This process has multiple problems, such as potentially introducing bacteria multiple times, which could be prevented if the indwelling catheter is left in place, and given proper care (Mitchell et al., 2017).

The integrative review of the literature focused on evidence-based research conducted and published within the last five years. The use of research material that has been published within the last five years provides the project leader with access to current information that has been established from recent research perspectives. The limitation to the literature of not more than five years old allows the project leader to be comprehensive in the research. More so, the limited pool of literature is focused on recent developments in the proposed area of research, and how such developments may facilitate the successful identification of better ways to prevent and reduce the risk of contracting CAUTI in patients who are in the ICU practice environment (Gray et al., 2016).

SECTION FOUR: QUALITY APPRAISAL

Sources of Bias

The minimization of bias in the research design, conduct and analysis determines the quality of studies (Toronto & Remington, 2020). Bias "distorts the results of a study in a way that is different from the truth" (Toronto & Remington, 2020, p. 46). Because bias can occur during any phase of the research process for the integrative review, it is necessary to interrogate every phase.

Internal Validity

Internal validity is the absence of bias, or as explicated by Toronto and Remington (2020) the believability that can be attributed to the findings of a study. They list the four common bias types as "selection, measurement, attrition and performance bias" (Toronto & Remington, 2020, p. 46). "Understanding Internal and External Validity" (2020) notes that internal validity is measured by how well a study demonstrates a reliable cause-and-effect relationship between treatments and outcomes. Further, the findings should rule out alternative possibilities to the

extent that the study is internally valid (Toronto & Remington, 2020). In this integrative review, only studies that showcase treatments related to catheterization and their outcomes were included.

Confounding happens when other aspects muddle the outcomes of a study so that it is perceived as having a lower internal validity (Toronto & Remington, 2020). For example, to include a study on the use of catheters in home care would be confusing to the reader when the study has already defined its scope as only involving intubated ICU patients. Another aspect of being aware of when assessing studies for inclusion or exclusion is how participants were selected and assigned to control or treatment groups – preferably via randomization, whether blinding was used, experimental manipulation of an independent variable such as also introducing an intervention, and following study protocols to avoid introducing unwanted elements that skew outcomes such as unplanned differences between treatment groups (Toronto & Remington, 2020).

Appraisal Tools (Literature Matrix)

Catheter-associated urinary tract infections (CAUTI) are a prevalent problem among the adult population across various health facilities in the United States (Lee et al., 2016; Septimus & Moody, 2016). According to Kim et al. (2017), CAUTI is the most prevalent nosocomial infection within healthcare facilities. The presence of a urinary catheter exposes a patient to a risk factor of urinary tract infection (UTI), where the risk is directly proportional to the number of days the catheter remains in place. This results in a high number of healthcare-associated infections, which highlights the importance of addressing the issue at the level of healthcare practice (Fasugba et al., 2017). Lee et al. (2016) note longer durations of catheter use pose a greater risk of urinary infection among pediatric patients, which may be symptomatic or

asymptomatic (Fasugba et al., 2017). According to Lee et al. (2016), the use of initiatives that target quality improvement is essential to reducing CAUTI rates. Moreover, the authors highlight that it is also important to discern the individual effectiveness of various approaches to prioritize their implementation in healthcare.

One of the methods of intervention is the reduction of the amount of time the catheter remains in the urinary tract (Lee et al., 2016). This entails cultural interventions addressing urinary catheter usage, such as the use of appropriate toilet schedules as a non-invasive catheter alternative. The method is the most effective means of reducing CAUTI, as it targets the use of catheters, which act as the instigating factor (Fasugba et al., 2017). This not only lowers occurrence of CAUTI incidences but also reduces possible physical injury on the patient. Another method of reducing the time of catheter insertion is the maintenance of patient logs, detailing the schedule of insertion and removal, which reduces cases of forgetfulness on the side of the nurse. On the other hand, Akbari, Firouzi, and Akbarzadeh-Pasha (2017) note there is no agreeable optimal time to remove the catheter from patients. Moreover, the authors note that earlier than the optimal time of removal may cause urinary tract infection, especially in men.

Another intervention method used to reduce CAUTI is the use of proper techniques during insertion and removal of catheters (Löcherbach et al., 2018; Fasugba et al., 2017). According to Löcherbach et al. (2018), the catheterization process is common globally, with minimal documented complications. However, they also highlight improper insertion or removal of the Foley-Catheter can result in complications such as intubation of the ureter. Such complications cause extensive patient discomfort while exposing him or her to the risk of infection. Thus, to avoid such occurrences, the standard technique should be upheld, with sonographic confirmation checks where possible. The proper technique can be reinforced using a

checklist of processes, to ensure compliance with standard technique (Septimus & Moody, 2016). Kim et al. (2017) notes keeping a sterile insertion technique is a useful method of reducing CAUTI incidences. If misplacement is detected, replacement, stenting of the ureter and antibiotic therapy should commence immediately to curb any risk on the patient's wellbeing.

Another method that can be used to reduce CAUTI is the proper cleaning of the urinary tract. Fasugba et al. (2017) note that catheter use is unavoidable in some patients, hence the need for methods for reducing the risk of infection, apart from minimizing catheter use. One such method to be used as a strategy for reducing CAUTI risk is the cleaning of urethral meatus using chlorhexidine solution before insertion of the catheter. This approach applies to patients whose catheter should remain in place for a period of longer than five days (Septimus & Moody, 2016). This decreases the bacterial colonization around the region, limiting the likelihood of introduction of opportunistic bacteria to the urinary tract during catheterization. Moreover, the use of chlorhexidine as a preventive strategy is important and effective due to the prevalent increase of drug-resistant urinary pathogens, that would otherwise thrive despite antimicrobial use. The authors note the procedure requires further research as current data and prevalent research findings are limited (Yu et al., 2017).

The cleaning procedures are not restricted to the urethral meatus, as they can also be applied to the catheter equipment, such as catheter hubs and connectors (Septimus & Moody, 2016). Good hygiene can also be used as a method of complementing the cleaning method outlined above. This entails observance of good personal hygiene prior to and after the insertion of the catheter. For instance, performance of hand hygiene before and after catheter insertion can reduce CAUTI from 4.08 to 0.42 per 1000 catheter line days (Septimus & Moody, 2016). This should be accompanied by maximum sterile barrier precaution, particularly during catheter

insertion. Additionally, the catheter should be properly maintained while in use, to replace broken or leaking devices, which would otherwise pose a risk of infection to the patient. The use of records such as logs would also help improve daily catheter maintenance, by enforcing accountability (Kim et al., 2017). This also enhances the monitoring schedule of the patient by medical staff alongside adherence to guidelines.

The catheter should be kept as clean as possible while in use by the patient, to minimize the risk of infection of the urinary tract. However, this poses a challenge due to their in-dwelling nature. One possible solution is cleaning the catheter's insertion area alongside the perineal area to minimize the risk of bacterial infection. This can be achieved using a spongy, absorbent body with fingerlings that extend externally from the front side to release a cleansing agent into the catheter insertion and perineal areas of the patient. Allen et al. (2016) note meatal cleansing and cleaning of the catheter should be distinct from other cleaning routines such as bathing and incontinence cleanup, to avoid the unintended introduction of dirt or bacteria. Moreover, the catheter should be treated with a washcloth infused with cleaning solution at least four times a day. The cleaning solution should be compatible with the catheter, to avoid corrosion or damage that affects the catheter's performance. The catheter should then be allowed to air dry in between the treatments. This high frequency of cleaning and treatment reduces the accumulation of infection-causing bacteria (Mandakhalikar et al., 2016).

The methods discussed addressing CAUTIs can be used collectively as preventive measures, as opposed to the adoption of a single method or approach. This entails the use of a multifaceted intervention approaches to reduce the occurrence of CAUTIs (Mullin et al., 2017). Evaluation guidelines can also assess fevers in critically ill patients, as fever may indicate

urinary tract infection or secondary bloodstream infection, and would necessitate the removal of the catheter to avoid infection of the urinary tract or its spread.

Reporting Guidelines

Whitmore & Knafl (2005) describe the primary tenets of the integrative review framework. The project leader noted that a well-sculptured integrative framework for research review should be presented in such a manner that it addresses concerns specific to the purpose, literature search, primary source data evaluation, data analysis, and the presentation of the results. As for a qualitative review, data analysis is presented as proposed strategies that enhance rigor in combining both empirical and theoretical sources of the review (Toronto & Remington, 2020). The integrative review approach has the potential to combine diverse primary research methods so they become a significant part of the evidence-based practice.

This integrative review followed the reporting guidelines provided by the institution and guided by the literature on integrative reviews. Reporting includes tables and diagrams to render the data more meaningful and visually accessible (Ellis, 1991).

SECTION FIVE: DATA ANALYSIS AND SYNTHESIS

The goal of data analysis is to achieve synthesis. In other words, the studies that are included in the integrative review shed light on the research question. But more than that, it helps the researcher “to recast, combine, reorganize, and integrate” the materials chosen by first deconstructing them, using a review matrix (Toronto & Remington, 2020). The review matrix and deconstruction took place in the previous section. In Section Five, the reconstruction takes place. According to Torraco (2016), analysis precedes synthesis with the latter producing something new.

Data Analysis Methods a Thematic Analysis

Descriptive Results

The project leader used the literature review as the basis for developing a new protocol to reduce the number of CAUTIs in the ICU setting. The trends from evidence-based research instrumentally inform the identification of a possible intervention that can reduce the risk of developing CAUTIs for ICU patients. The nature of the research is an integrative review, which required a qualitative method to analyse the data collected from the literature and subsequent review (Gaur and Kumar, 2018). The qualitative data analysis method that was employed for the data analysis phase was a thematic analysis.

A thematic analysis involved applying a class of methods that accommodated the objective, quantitative, and systematic description of the evidence manifested in the selected literature that has undergone the review process. This gave the project leader the recurrent themes and concepts across multiple sources of literature. The research of the thematic analysis process enabled the evaluation of evidence therein to ascertain which themes had recurrently come to the surface with the most significant level of success compared to others in the prevention and reduction of the risk of contracting CAUTIs in patents within the ICU setting.

Data Collection

The project leader engaged in a thorough literature review to find the best evidence-based articles to reduce CAUTIs in ventilated patients in the ICU setting. The data collection process was mostly determined by the ideal framework of the research undertaking. The use of the integrative review approach is accommodative of both quantitative and qualitative methods (Christmals & Gross, 2017). The qualitative nature of the data collection process is based on the activities the researcher undertook in reviewing the evidence provided in the selected body of

evidence-based research studies relevant to the topic of research. As such, the data collection in the context of the integrative review focused upon the collection of evidence provided by the selected literature after the completion of the literature search. The qualitative collection of data consisted of going through the selected research studies and noting down the evidence provided in each of the research studies.

Synthesis

Some of the common symptoms of CAUTI include blood in the urine, urgency for urination, spasms in the lower abdomen, along with chills and fever. In order to check for these kinds of infections, the doctor would prescribe a urinalysis test, which detects white and red blood cells, along with a urine culture. Furthermore, an ultrasound or a C.T. exam of the pelvis may also be advised. However, after being diagnosed, the doctor will take measures to prevent CAUTI as the catheter, and its removal is not always an option. Hence, in these circumstances, there are several strategies which can be used (C, 2018).

According to the 2009 HICPAC guidelines, urinary catheters are indicated perioperatively for selected surgical procedures. Catheters are indicated when surgery is expected to be prolonged when a patient will require large-volume infusions or diuretics during surgery, or when there is a need for strict urinary output monitoring such as in the ICU setting ("CDC - MMWR - MMWR Publications - Recommendations and Reports: Past Volumes (1997)", 1997).

A specially coated catheter will be able to minimize the risks of infections related to catheters. (Wyndaele, 2002) A systematic antimicrobial therapy is a useful strategy for the prevention of catheter-related infections. This preventive strategy has received high recognition in various studies, including a review by Johnson et al. (2006)**.** This method can be adopted in

patients with short-term indwelling urethral catherization. Antimicrobial coated catheters are also referred to as silver or antibiotic coated urinary catheters and can be a useful strategy for the elimination of the minimization of CA-bacteriuria (B-II). Nevertheless, there is a need for additional data for its effectiveness on patients with short-term indwelling urethral catheterization.

Prophylaxis with Methenamine Salts can also be adopted as it is studied to minimize infections after a gynecologic surgery or in patients who have been inserted with a catheter for less than a week. (Hooton, 2010) Similarly, surgical procedures would also call for this measure. However, Methenamine Salts are not advised for use in indwelling urethral and suprapubic catherization, and there is insufficient data proving the effectiveness of one methenamine salt over another. Moreover, the urinary pH needs to be properly maintained and kept at a level below 6.0 to reduce infections. Nevertheless, processes to achieve a low urinary pH still have sufficient scope for data evaluation and analysis. Proper meatal care, including cleaning procedures with silver sulfadiazine or povidone-iodine solutions, are not advised for regular use in patients with indwelling urethral catheters as there are few data and research on the effectiveness of using meatal cleansing procedures for the minimization and elimination for catheter-related infections (Huang et al., 2020).

Furthermore, antibiotic lock therapy can also be used for the prevention of the infections related to foley catheter. Catheters with multiple uses, rather than single uses can be adopted. However, there is insufficient data proving which cleaning method for multiple use catheters is a better and risk-free option (Ghuman, 2017).

According to research, using catheters in hospitals or in nursing homes increases the chance of acquiring UTI which directly increases the mortality rate. (Catheter associated UTI,

2015). In the current scenario where many studies have also been conducted on preventive strategies, the researcher has found that the use of closed drainage systems may help in preventing UTI and they have recommended basic research is needed to find out new strategies for preventing the infections (Ha & Cho, 2006). Also known as a closed catheter drainage system, this method includes the use of needle aspiration of the urine with the help of ports in the distal catheter. This method is capable of minimizing the catheter-associated bacteria (A-II) along with CA-UTI (A-III), for the treatment of short and long-term indwelling urethral or suprapubic catheters. However, this method is not suggested for the minimization of CA-bacteriuria (A-I). Nevertheless, overall data regarding its effectiveness is yet to be properly studied to understand the topic. UTI is the most common infection and unavoidable but with the help of precautionary measures the risk of developing it can be reduced in clinical settings.

The research was conducted by the project leader to find out the awareness between doctors and paramedical staff about catheter insertion and its associated infections. According to the study, UTI infection is the most common and is preventable by taking proper measures for catheter insertion and by using appropriate methods. (What is a Catheter, 2020).

It was found in the study doctors were much more aware than the other paramedical staff about UTI and preventive measures. Researchers have recommended all paramedical staff including doctors be required to have proper education and training about UTIs and prevention, and the authorities should include the preventive strategies in their priority list (Thakur et al., 2015).

Other strategies for the prevention of catheter-related infections include catheter irrigation for patients who have undergone surgical procedures and are being treated with short term catherization. (Cravens, 2000) Furthermore, a urine culture before initiating antimicrobial

therapies is also linked to the prevention of the infections due to the presence of potential infecting organisms.

There are several strategies which can assist in the prevention of catheter-related infections. However, further research on such measures needs to be conducted to fill in the significant gaps in knowledge of their effectiveness. An increment in the number of experiments will assist in understanding the methods properly. Aged people, who are at risk of acquiring such infections because of the need of surgeries and bladder problems, would be required to be treated with the catheter intact as removing it, would not be an option for them. Therefore, for a better future and to minimize complications arising from the catheters, it is vital to have a better understanding of this field.

After the review of the literature, several themes emerged regarding the prevention of CAUTIs among patients. Among the themes were aseptic/ hygienic insertion that was considered a component of the recommended catheter insertion bundle. There were minor variations regarding the insertion, but the suggestion was the bundles included the proper indication, hand hygiene, and sterile equipment and lubricants. As well as, and most importantly, the necessity for early catheter removal emerged as a theme, since the risk of CAUTIs onset increases will result in a prolonged time of catheter indwelling. Several articles exhibit that early removal has the impact of reducing the rates of CAUTIs (Halperin et al., 2016; Meddings et al., 2014; Parker et al., 2017; Richards et al., 2017). Mechanisms that promoted discontinuation were suggested and these included placing a label with the date of placement, using condom catheters, using “electronic hard-stop queries” software and providing education (Kachare et al., 2014; Richards et al., 2017). Various researches supported the early removal of catheters as being an effective

preventive measure. However, hand hygiene was considered to be the most inexpensive and practical approach. The thematic analysis and data synthesis are indicated in Figure 2 below.

Figure 2: thematic analysis/ data synthesis showing themes and sub-themes

Early removal of the catheters	Regular use of checklists for indwelling catheters	Appropriate use and maintenance of catheters	Training of healthcare workers	Hygienic insertion catheters
Short catheterization durations reduce incidence of CAUTIs	Indication of appropriateness	Use of appropriate cleaning agents	Increase skills and expertise in catheter insertion	Cleaning of hubs & connectors
Daily regular monitoring of patients to determine their appropriateness	Reduced use of catheters when not required	Maintenance of sterile environment	Highlight causes and prevention of CAUTIs	Cleaning of urinary tract
	Regular monitoring of patients for symptoms of infection	Connection of drainage system	Educate on need of hygienic catheterization practices	Use of appropriate cleaning agents
		Placement of drainage bags in lower level	Indication of conditions when patients require catheterization	
		Cleaning of catheters in a downward manner from point of insertion		

Ethical Considerations

The project leader submitted the project to the Liberty University Institutional Review Board (IRB). The IRB responded with an email stating the project is exempt. The project leader archived the email from the IRB and is attached (see Appendix B).

The existing literature indicates five major ethical issues have to be considered when dealing with human research participants. These ethical issues were instrumental in providing assurances by addressing voluntary participation, not harming the research participants, providing full anonymity to their involvement, and establishing the study's objective. The study's primary ethical consideration included the confidentiality of the research respondents, their health, welfare and well-being, deception and exaggerations, misleading information, biases, and miscommunication (Ives, 2017). Similarly, the researcher would have undertaken to provide ethical assurances and implement safety measures for the research participants while encouraging them to participate freely; the project leader ensured that the sampled literature for the integrative review met the ethical criteria.

The nature of the research in question being the review of literature, the selection process of literature needed to focus upon research that indicated the use of ethical research principles. As such, it was categorically important for the selected evidence-based research to be vetted on the level of adherence to existing ethical principles of research that involved the participation of human subjects (Ives, 2017).

SECTION SIX: DISCUSSION

It is helpful in starting the Discussion Section to look back at the importance of doing an integrative review. This is captured by Crawford and Rondinelli (2013) in their statement that integrative reviews are the “Cornerstone of Evidence-Based (E.B.) Practice” (slide 6). Other

reasons for doing an integrative review are: (1) ensuring that evidence is brought into practice; (2) providing insight into current practices; and (3) using evidence-based practice as the basis of guidelines (Crawford & Rondinelli, 2013).

Where new findings are discussed in the Findings Section, an explanation of the synthesis that was formed from those findings is provided in the Discussion Section (Toronto & Remington, 2020). An integrative review is a specialized form of research with the objective of providing new knowledge (Toronto & Remington, 2020; Torraco, 2016). Torraco further notes when the methodology and purpose result in an integrative review that has cohesion, it is unified. One of the reasons integrative reviews are used, according to Torraco, is that they "often are conducted on dynamic topics that experience rapid growth in literature and that have not benefited from a comprehensive review and update during an extended period" (2016; p. 63). This is a worthy aim which this integrative review has aspired to.

Thematic analysis was used to indicate the themes that were relevant to the study, in indicating when a catheter should be removed in the ICU settings, and how they should be maintained. The thematic analysis identifies, analyzes, and reports codes in data and indicates the relationship between them. These data codes are then developed into themes. The themes identified in this integrative literature review were: hygienic catheter insertion, appropriate catheter use and maintenance, regular use of catheter checklists for the indwelling urinary catheter indications, early removal of indwelling catheters, and training of healthcare workers on their insertion and use.

Hygienic Catheter Insertion

The subthemes identified were: cleaning of the hubs, connectors and proper cleaning of the urinary tract, using appropriate agents such as chlorhexidine solution before their insertion, to

minimize the risks of infections. Cleaning reduces the bacterial colonization around the urinary tract, thereby reducing the likelihood of introducing opportunistic bacteria to the tract during insertion. Besides, the healthcare workers should wash their hands with soap and water before and after catheterization, and use sterile gloves.

Appropriate Catheter Maintenance and Use

After insertion of the catheters, a sterile environment should be maintained to prevent the transmission of bacteria from the catheter to the urinary tract, particularly, the bladder, to prevent extraluminal CAUTIs (Löcherbach et al., 2018; Fasugba et al., 2019). Regular hand hygiene should be observed during check-up or maintenance, and catheters should be cleaned in a downward manner from the point of insertion. Assadi (2018) notes that the drainage system of the catheter should be connected, as keeping it disconnected or open is a risk of bacterial entry, colonization and transmission. The drainage bags should be placed on a lower level than the patient, prevent the backward flow of urine into the bladder, and be emptied regularly, as this presents a major risk for CAUTIs. Besides, keeping the indwelling catheters securely in place after insertion prevents injuries to the patients' urethral meatus.

Regular Use of Catheter checklists for the Indwelling Urinary Catheter Indications

The catheters should be used only when appropriate, to reduce the risk of patient infections. For instance, the catheterization should only be conducted in patients with inadequate bladder emptying due to urine retention problems or obstruction. The patients should be monitored regularly, and when there is no need of the indwelling catheters, they should be removed. Also, regular surveillance for infection symptoms such as fever should be carried out, to implement treatment with the recommended antibiotics or replace the catheters. Besides, redundant procedures that do not benefit the patients should be avoided, including regular

spraying of antibiotics or saline on the urethral region, as this has been shown only to promote antibiotic resistance (Hooton, 2015). Also, regular cleaning of the region with soap and water may not always benefit the patients, as this causes mucosal irritation and breakdown, thereby increasing the risks of patient infection (Assadi, 2018).

Early Removal of Indwelling Catheters

Daily monitoring of patients with indwelling catheters enables medical practitioners to determine their appropriateness, and when they are considered inappropriate, they should be removed. Short durations of catheterizations have reduced risks of the development of CAUTI when compared to long durations of catheterization. For instance, patients who have obstructions should not be catheterized after they have a normal flow.

Training of Healthcare Workers on Catheter Insertion and Use

Healthcare workers are significant in the control of CAUTIs, as they are involved in the catheterization and monitoring of patients. Therefore, their training to have the expertise in the catheterization of the patients and to meet the healthcare goals is important. They should also be trained in the appropriate cases, and indications for patient catheterization, as not all critically ill patients require indwelling catheters. Training programs for healthcare workers should also highlight the causes and prevention measures for CAUTIs, and the hygienic practices/ techniques for their insertion and documentation of the procedures.

A catheter is a thin or hollow metal tube used to drain urine by passing it into the bladder. An indwelling catheter, referred to as the catheter that stays for an extended period, is more likely to cause a urinary tract infection in the kidney or the bladder. Moreover, it is essential for people who have common bladder issues, including difficulties in emptying the bladder. Hence, urinary tract infection (UTI) is the most common infection associated with the catheter, and it

can affect any part of the urinary system, including kidneys, bladder, ureters etc. However, it is not always possible to remove the catheter due to its vitality in the functioning of many critical patients' bodies. The primary purpose of this project is to get an understanding of the strategies to prevent the infections arising from catheters without the removal of the Foley catheter. Hence, this project gives an insight into the strategies for preventing infections related to the catheter, without removing the tube from the body.

CAUTI is the most common nosocomial infection, as high as 35% in hospitals around the world. This is not surprising with catheterization an essential and much-used item: in the USA there are more than a million incidences of CAUTI annually (Labib & Spasojevic, 2013). For this reason, up-to-date treatment and usage protocols are required to minimize infections.

The source mentioned here was not included in the search, however, it paints an interesting picture – what it described in 2013 is still relevant today. An integrative review such as this is of great significance to the field, in its own right, as a consolidation of more recent literature in the past five years, as well as its new insights. The latter is the focus of this section, the findings of this integrative literature indicated the need for the implementation of multifactorial/ multifaceted measures that prevent CAUTIs among catheterized patients. These bundles of prevention care should include; early removal of catheters, regular use of catheter checklists for the indications of use of the indwelling catheters, appropriate catheter use and maintenance, training of healthcare workers on the appropriate use of catheters and hygienic insertion of the catheters. However, the studies included in the integrative literature review were not explicitly carried out in patients in the ICU settings who may require prolonged use of the catheter. Therefore, there is a need for more studies that evaluate when the catheters should be

removed from the patients, to prevent premature removal or prolonged and unnecessary use increases the susceptibility of the patients to develop CAUTIs.

Implications for Practice/ Future Work

Lee et al. in their paper, "*Risk Factors for Catheter-Associated Urinary Tract Infections in a Pediatric Institution*" discovered the two risks to infants are a long period of an indwelling catheter and contact (2016). This study compared patients with UTIs and those with catheters. It is suggested that such a study be done with adults. This will enable guidelines to be written up for all ages. Proposed guidelines are an excellent way to get evidence-based knowledge into nursing practice (Schiessler et al., 2019).

"*Changing ICU Culture to Reduce Catheter-Associated Urinary Tract Infections"* had a good result using cultural catheter alternatives (only one case over two years) (Maxwell, 2018). In cases where toilet schedules can be used is fine, where the client can be assisted to move or using a bedpan if the measurement of urine volumes is required. This can avoid the use of a catheter altogether. It makes sense to do so as the evidence shows catheters increase the incidences of CAUTI, even though not all patients can benefit from this intervention. Another nice aspect of the work is the proposal of a catheter log, which would record when the catheter is inserted (date and time). This provides a suitable way to measure rates of CAUTI compared to the length of time (hours) retained. Such would form the basis of a study to determine how long an indwelling catheter can remain, as well as the risk per period. For a truly robust study, this should be combined with tests of different methods of keeping the area clean to determine best practices and whether this is consistent for all patients (for example, high-risk groups such as the elderly). This could be supplemented by temperature readings to monitor for fever and potential infection (Maxwell, 2018).

"*Ureteral Rupture Caused by Accidental Intubation of the Ureter with a Foley-Catheter during Ureterorenoscopy*" described a single incidence (Löcherbach et al., 2018). This is generalizable to other populations because the risk of trauma exists and could conceivably affect any patient. This implies that protocols need to be checked to ensure they are standardized, best practice, and taught and monitored. While ruptures do occur, they should not if the correct procedures are followed. Studies such as these are useful teaching materials for students.

"*Chlorhexidine for Meatal Cleaning in Reducing Catheter-Associated Urinary Tract Infections: A Multicentre Stepped-Wedge Randomized Controlled Trial"* focused on advantages but not the disadvantages of 0.1 percent of Chlorhexidine solution for cleaning prior to catheterization (Fasuga et al., 2017). As masks must be worn, what is the risk to the patient? Is it suitable for pediatric patients and the elderly?

"*Prevention of Device-Related Healthcare-Associated Infections*" provided commonsense advice: remove the catheter when it is no longer required, use good personal hygiene at all stages while the catheter is in situ, replace broken or leaking devices (Septimus & Moody, 2016). The extent to which this applies in other countries may depend on the standards of health care in general, quality of training, the sufficiency of staff and other factors that may vary between countries. What factors detract from the successful implementation of these measures? What is required in hospital ICUs globally for these measures to work and what is their success rate across countries with different practices? Is there a global forum for CAUTI that shares best evidence-based practices ?

"Scrub for Inhibiting Catheter-Associated Urinary Tract Infections" provides a workable and generalizable method of reducing CAUTIs using a spongy body with fingerlings as already

described (US 9259285B2, 2016). This is useful for indwelling catheters only. This should be boosted by some of the hygiene suggestions mentioned by other studies.

"*Washcloth for Meatal Area Cleaning of an Indwelling Urinary Catheterized Patient*" has a simpler solution, a facecloth, cleaning solution and air-drying (Allen et al., 2016). Such simple measures could make a difference in countries with poor healthcare facilities at a lower cost than the previous study's proposal.

"*A Multifaceted Approach to Reduction of Catheter-Associated Urinary Tract Infections in the Intensive Care Unit with an Emphasis on Stewardship of Culturing*" suggests monitoring for fever and recommended replacement, maintenance, and removal of catheters (Mullin et al., 2017). What is needed is a comprehensive manual that proposes guidelines based on all the available evidence. This will increase the likelihood of the guidelines being translated into protocols for CAUTI prevention.

"Old Habits Die Hard; Does Early Urinary Catheter Removal Affect Kidney Size, Bacteriuria and UTI After Renal Transplantation?" focused entirely on kidney transplant patients (Akbari et al., 2017). Protocols for this special group of patients should form part of a comprehensive manual. The study needs to be replicated with female patients.

At this stage, it is useful to recall the main question and its sub-questions. The answers to these questions are that retaining an indwelling catheter (longer than five days in one study) increased the chances of CAUTI. However, multiple straight catheterizations provide an opportunity for pathogens to be introduced. Studies are needed on the risks of multiple straight catheterizations as well. Various methods were proposed but not compared, another avenue of future research.

All in all, this integrative review was a useful project in bringing together the latest research, answering the research questions, and defining areas for future studies. A recommendation for comprehensive guidelines would add value to the field.

Dissemination

To get the information out to other healthcare providers, the plan is to submit poster presentation at Huntsville Hospital during Evidence Based Practice week for all workers at the hospital to see the project. The 2021 Fourteenth National Doctors of Nursing Practice Conference that will be held in Chicago, IL August 11-13, an abstract submission will be made for a poster presentation that will hopefully be accepted. If accepted this will give the project leader a chance to present the information at a national level to healthcare providers.

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Appendix A: Evidence Table

Name: Joseph Chamness

Clinical Question: *Among admitted intubated patients with indwelling urinary catheters does early catheter removal with multiple straight catheterizations due to urinary retention, compared to prolonged catheter retention, reduce the incidents of CAUTIs during the admission period?*

Author (year)	**Study Purpose/ Objective(s)**	**Design, Sampling Method, and Subjects**	**LOE***	**Intervention and Outcomes**	**Results**	**Study Strengths and Limitations**
"*Risk factors for catheter-associated urinary tract infections in a pediatric institution*." Lee, N. G., Marchalik, D., Lipsky, A., Rushton, H. G., Pohl, H. G., and Song, X. (2016).	Evaluation of UTIs in pediatric patients from 2010 to 2014.	Fifty patients with UTIs compared to 100 patients with urinary catheters. conditional multivariate regression mode	I	N/A	Longer durations of using the catheter and certain contact precautions posed a greater risk of UTIs for the pediatric patients at the hospitals.	Strong design. Only applies to pediatrics.
"*Changing ICU culture to reduce catheter-associated urinary tract infections.*" Maxwell (2018). Changing ICU culture to reduce catheter-associated urinary tract infections.	Focuses on reducing the time the catheter was still in the patient by focusing on cultural interventions in the usage of the urinary catheters. Quality improvement project with the ICU of a Level II Trauma Center.	N/A	III	Other cultural catheter alternatives e.g. appropriate toilet schedules. Log of patient's data on the date of insertion, and plan for removal, to counter forgetfulness.	Only one case of CAUTI in 2015 and 2016	Single interventions were layered to embed them.
"Ureteral Rupture Caused by Accidental Intubation of the Ureter with a Foley-Catheter during	Involves a woman who underwent an iatrogenic ureteral lesion because of an unintentional	Case study. One participant.	V	The article advocates for the precise handling of the Foley catheter while following the standard insertion	Should be detected quickly to prevent additional problems like hydronephrosis.	N/A

Ureterorenoscopy." Löcherbach, F., Grimsehl, P., Sauer, A., Wyler, S., and Kwiatkowski, M. (2018).	intubation of the left ureter with a Foley Catheter			technique. The article then goes further to state that the catheter should be removed carefully by pulling it back on to the bladder neck, which should be done with minimal resistance. The removal can also be monitored using a sonographic control as proof of adequate renal drainage.		
"*Chlorhexidine for meatal cleaning in reducing catheter-associated urinary tract infections: a multicentre stepped-wedge randomized controlled trial.*"	Advantages of using antibacterial metal cleaning to reduce CAUTIs	Three hospitals with 164 patients.	V	0.1 percent of Chlorhexidine solution for cleaning prior to catheterization.	Reduced the incidence of CAUTIs	Required the wearing of a mask during the procedure.
"*Prevention of device-related Healthcare-Associated Infections.*" Septimus, E. J., and Moody, J. (2016).	To prevent HAIs	N/A	III	Good personal hygiene prior to and after insertion of the catheter; disinfection of the catheter hubs and connectors before accessing the catheter; use of antiseptics or antimicrobials for in situ for more than five days; replacement of broken or leaking devices;	Remove the catheter when it is no longer needed by the patient; removal in patients who do not require them depending on their level of care.	Provides basic practices only
"*Current status of indwelling urinary catheter utilization and catheter-associated urinary*	To avoid urinary infections	cohort study 14.9/100 hospitalized patients (1Q 14, 3Q 16) across the six hospitals.	II	Duration of catheterization must be minimized, and a sterile insertion technique used; sealed drainage	CAUTI varies between hospitals	Good design

tract infection throughout hospital wards in Korea: A multicenter prospective observational study." Kim, B., Pai, H., Choi, W. S., Kim, Y., Kweon, K. T., Kim, H. A., ... and Kim, J. (2017).				method to reduce the chances of UTI; records for daily catheter maintenance.		
"Scrub for inhibiting catheter-associated urinary tract infections." *US9259285B2 (2016)*	To decrease the probability of getting urinary infections from in-dwelling Foley catheters	N/A	V	A spongy body with a number of fingerlings, which extends externally from the forward-facing side, liquid comprising of frangible vials deposited into the first two wings which upon squeezing causes the vials to break, releasing liquid into the spongy body.	Reduces CAUTIs	Patent
"*Washcloth for meatal area cleaning of an indwelling urinary catheterized patient*." Allen, J. M., Davis, G. T., Farrell, J. A., Green, W. E., and Hollabaugh, C. L. (2016).	To keep the Foley catheter clean	N/A	V	Treat with a washcloth infused with cleaning solution at least four times daily; air dry for approximately fifteen minutes in between the treatments.	Helps reduce bacteria and UTIs.	Patent
A Multifaceted Approach to Reduction of Catheter-Associated Urinary Tract Infections in the Intensive Care Unit	To reduce the CAUTI rates in the ICU's.	N/A	III	CDC Protocols: Recommendations: replacement, maintenance, and removal of catheters; guidelines to evaluate fever in critically ill	CAUTI rate decreased from 3.0 per 1,000 catheter days in 2013 to 1.9 in 2014	Good design

with an Emphasis on Stewardship of Culturing." Mullin, K. M., Kovacs, C. S., Fatica, C., Einloth, C., Neuner, E. A., Guzman, J. A., ... and Manno, E. M. (2017).				patients and removal of the catheter to avoid UTI.		
Old habits die hard; does early urinary catheter removal affect kidney size, bacteriuria and UTI after renal transplantation? Akb ari, R., Firouzi, S. R., and Akbarzadeh-Pasha, A. (2017).	to determine the effect of early catheter removal and its relation to causing UTIs. Focus: kidney transplant patients based on the time the Foley catheter was removed.	retrospective cohort study 74 males (67.9%) and 35 females (32.1%)	II	Removal of the catheter five days after the transplant increased the probability of contracting urinary infections in men	T-he time of catheter removal after kidney transplantation does not affect incidence of UTI but increases the probability of bacteria in men whose catheter was removed within 5 days	

Appendix B: IRB Approval Documentation (email)

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

January 6, 2021

Joseph Chamness
Cynthia Goodrich

Re: IRB Application - IRB-FY20-21-499 CAUTI PREVENTION FOR LONGTERM FOLEY CATHETERS IN ICU PATIENTS: AN INTEGRATIVE REVIEW

Dear Joseph Chamness and Cynthia Goodrich,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

(1) It will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

Also, although you are welcome to use our recruitment and consent templates, you are not required to do so. If you choose to use our documents, please replace the word *research* with the word *project* throughout both documents.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

Appendix C: CITI Certificate

Completion Date 18-May-2020
Expiration Date 18-May-2023
Record ID 36668634

This is to certify that:

Joseph Chamness

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Biomedical Research - Basic/Refresher (Curriculum Group)
Biomedical & Health Science Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Liberty University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?we74e6ea0-741d-431b-917c-7cae860d5526-36668634

Appendix D: Project Timeline

Course	Project Milestones	Hard STOP** (Check when completed)	Completion Date
NURS 836	• Project forms completed and approved by Liberty University o Liberty University assigns project chair.	Must have to be registered for NURS 839: ▪ DNP chair assigned.	**5/8/2020**

NURS 839	• DNP Chair and student meet for a discussion about project
	• Introduction
	  o Problem statements/Questions formed
	• Background
	• Evidence Table/ Review of literature
	  o Synthesis of evidence for problem
	  o Study flow diagram
		Must have to be registered for NURS 840
		▪ Project Status Report(s)
		▪ Study Flow Diagram
		▪ Evidence Table
			7/3/2020

NURS 840	• Explore Options for Theoretical framework
	  • List and define proposed frameworks
	• Draft of Scholarly Project Proposal
	  o Synthesize review of literature
	• CITI Training completed
		Must have to be registered for NURS 841:
		• Draft of Proposal
		• CITI training certificate
			8/21/2020

NURS 841	• Complete workplan	Must have to be registered for NURS 842: ▪ Successfully defend proposal ▪ Submit proposal to IRB ▪ Workplan Completed	**10/16/2020**

NURS 842	• Defend proposal
	  ○ Students defend to DNP chair faculty.
	• Submit proposal to IRB
	• Continue to work with project chair to improve project.
		Must have to be registered for NURS 843:
		▪ Project Status Report(s)
		  ✓
			12/18/2020

NURS 843	• Evaluation- Finalize Results
	  ○ Analysis/Synthesis
	  ○ Reflection on DNP Essential and Program Outcomes
	• Manuscript (Final revision due)
	  ○ Revise all sections of project
	  ○ Draft and finalize Abstract
	  ○ Schedule Final Defense
	• Have Final Defense of project.
		Must have to be registered for NURS 844:
		▪ Project Status Report(s)
		▪ Final revision
		▪ Final Defense
			3/12/2021

NURS 844	• Final written report received from final defense • Once final copy is approved by chair/committee, submit to Liberty University Scholar's Crossing. • Extend gratitude to the agencies and persons whom have supported the project.	Must have to GRADUATE: • Submit final report • Submit to Liberty University Scholar's Crossing.	**5/14/2021**