Incidence of Urinary Retention in
Post-Operative Orthopedic and Trauma Patients
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Abstract
For patients in the hospital setting, the early removal of indwelling urinary catheters is an important consideration to prevent catheter-associated urinary tract infections. There is increased cost related to catheter-associated urinary tract infections evidenced in the literature which supports the rationale for early removal. The aim of this project was to assess whether early removal of indwelling urinary catheters was related to decreased or increased incidence of urinary retention in trauma and orthopedic patients using a nurse-driven protocol for catheter-associated urinary tract infection prevention. Through retrospective chart review, bladder scan volume, eight-hour voiding trials, and failed trials to void were used to assess spontaneous voiding versus urinary retention in trauma patients undergoing surgical fixation of femoral fractures in a 6-week period. Other risk factors were collected to assess for correlation between incidence of urinary retention and its potential relationship to age, sex, mobility, cognitive status, and length of stay. The results of this study suggest that the removal of indwelling urinary catheters 8 hours or at midnight post-operatively causes increased incidence of urinary retention in trauma and orthopedic patients. However, due to small sample size, these findings may not be generalizable and may require further research. Maintenance of indwelling urinary catheters for 12-48 hours post-operatively may be appropriate for this surgical population without increasing risk of urinary retention, catheter-associated urinary tract infections, or hospital length of stay.

Keywords: early removal, indwelling urinary catheter, orthopedic surgery, trauma patient, urinary retention
Incidence of Urinary Retention in Post-Operative Orthopedic and Trauma Patients

Urinary retention is the acute or chronic inability to pass urine voluntarily (Serlin et al., 2018). For orthopedic patients undergoing surgical intervention, post-operative urinary retention is a common complication that can cause urinary tract infections, sepsis, and acute or chronic renal disease (Simsek & Karaoz, 2017). Patients admitted to the trauma service arrive from the emergency department to the surgical unit with an indwelling urinary catheter inserted and it is discontinued 12–48 hours post-operatively. The rationale for insertion is the need for intraoperative monitoring of urinary output (, 2019). There is a CAUTI prevention nurse-driven protocol written to address the need for parameters of indwelling catheter insertion, maintenance, and discontinuation. The purpose of this project is to implement this protocol and document its use in the electronic healthcare record to measure whether discontinuation of an indwelling catheter at midnight or 8 hours post-operatively is related to a decreased or increased incidence of post-operative urinary retention. The results of this study will be used to validate, change, or guide future practice for orthopedic and trauma patient populations.

Background and Significance

Each year over 300,000 older people, those 65 and older, are hospitalized for hip fractures (Center for Disease Control and Prevention, 2016). As per the Agency for Healthcare Research and Quality (AHRQ) there are 300,000 total hip replacements performed every year in the United States (Foran, 2015). Up to 25% of all hospital patients undergo urinary catheterization to accurately monitor urine output following surgery and to treat urinary retention (Pamaiahgari, 2019). The current population at highest risk of urinary retention and catheter-associated urinary tract infections are post-operative orthopedic and trauma patients.
INCIDENCE OF URINARY RETENTION

(Stefanik et al., 2015). Many of these patients have known risk factors such as older age, male gender, exposure to anesthesia, opioid use for pain management, and exposure to medications with anticholinergic effects that decrease detrusor muscle contractility (Serlin et al., 2018). They are also at risk for impaired mobility. Most worrisome is that elderly patients are at highest risk of morbidity secondary to inappropriate catheter use (i.e., incontinence management or urine collection in patients that can spontaneously void) and the sequelae that result in poor prognosis (Schaeffer, 2020). Therefore, it is important to only maintain short-term indwelling catheters when all other alternatives have been dismissed (Pamaiahgari, 2019).

Halawi et al. (2019) found that the routine placement of intraoperative indwelling catheters and fluid administration of 1350 ml or greater were identified as highest risk factors for post-operative total hip arthroplasty urinary retention. More notably, indwelling urinary catheters were identified as the only risk factor for post-operative urinary retention after total knee replacements. Like the findings of other researchers, patients older than 60 years were identified as highest risk (Halawi et al., 2019). Regardless, trauma patients undergoing orthopedic surgical intervention require catheterization for accurate measurement of urinary output. Currently, the practice is to operate with the use of an indwelling catheter and maintain it post-operatively for 12-48 hours. The decision to insert, maintain, and remove indwelling catheters is managed by the surgical or trauma team, not by nursing staff. According to Pamaiahgari (2019), removing indwelling urinary catheters as soon as possible is the best approach to reduce unnecessary catheterizations and maintenance time of indwelling urinary catheters. The hospital-developed nurse-driven protocol includes specific criteria for catheter maintenance versus discontinuation. Removal is to take place at midnight or eight hours following surgery (Appendix A). The staff was educated on the standard once it was approved.
but it was not translated to practice because assessment and documentation of the standard in the patient electronic health record did not exist. Unfortunately, nurses returned to previous practice, waiting for a physician’s order to discontinue the patient’s indwelling urinary catheter.

This is relevant because nurses are not functioning at their highest level of autonomy and it may have a negative impact on patient outcomes. In a study by Stefanik et al. (2015) orthopedic patients were identified at highest risk of postoperative urinary retention. Stefanik et al. (2015) developed a new algorithm based on a literature review to standardize nursing practice, interventions, and empower nurses to identify patients at high risk. The implementation of a post-operative urinary retention algorithm decreased risk of infection, detrusor muscle damage, length of patient stays and increased patient satisfaction (Stefanik et al., 2015). The long-term results also include increased patient safety, patient and provider satisfaction, and collaboration between healthcare providers (Stefanik et al., 2015). This standard created shared governance between healthcare providers and provided clinical excellence translated from evidence.

This protocol’s implementation is also important to reduce patient length of stay. Simsek & Karaoz (2017) found that the complication of urinary retention was the most common after orthopedic surgeries requiring spinal anesthesia and caused increased length of stay and patient discomfort. Patients who develop post-operative urinary retention are at increased risk of urinary tract infection and increased length of stay (Kort et al., 2018). Patients requiring catheterization for urinary retention are at an increased risk for catheter-associated urinary tract infections. Urinary tract infections associated with catheter use increase patient length of stay (2-4 days), increase health care cost (4340-450 million/year), mortality, and decrease patient satisfaction (Agency for Healthcare Research and Quality, 2015). Because the Centers for Medicare and
Medicaid will not reimburse costs associated with hospital-acquired catheter-associated urinary tract infections, there is financial incentive to decrease catheter use because it is associated with $1,300-1,600 additional cost per patient, not adjusted for inflation (Agency for Healthcare Research and Quality, 2015). This project’s results may identify the best approach to decrease patient post-operative complications and improve patient overall outcomes.

According to Fowler et al. (2018) urinary retention in trauma patients is a problem that may be responsive to a standardized guideline which can be individualized to patient-specific factors. The literature encourages the use of a nurse-driven protocol to prevent catheter-associated urinary tract infections because nurses are at the patient bedside. A nurse-driven protocol is fitting because nurses are knowledgeable about patient risk factors and can contribute to creating guidelines and sharing feedback about their experiences with indwelling urinary catheters insertion, maintenance, and removal, intermittent catheterization, bladder scanning, medication administration, and infection rates (Fowler et al., 2018). Educating nurses, gaining their input regarding the protocol’s meaningful use, trending patient outcomes, and rewarding them for successes all help to continue the promotion of the nurse-driven protocol (Agency for Healthcare Research and Quality, 2015).

By implementing the nurse-driven protocol, a standard of care will be provided to all patients equally. This will help to determine the relationship and timing between urinary catheterization discontinuation and the occurrence of post-operative urinary retention. Through both prospective and retrospective analyses, assessment and documentation will be utilized and data will be collected for patients regarding length of indwelling catheter maintenance, 8-hour
voiding trial, bladder scan volume, and incidence of urinary retention after the nurse-driven protocol is implemented and documented within the electronic health record.

**Needs Assessment**

The hospital’s mission statement is to provide high quality, compassionate patient care and comprehensive community services (2020). To provide the best quality of care, a retrospective analysis of the CAUTI protocol implementation will aid in determining how to decrease post-operative complications for indwelling urinary catheter discontinuation and assessment of urinary retention incidence in the trauma and orthopedic surgical population. Throughout the literature there are discrepancies, with multiple researchers using varied practices for urinary retention management. In a Turkish study by Simsek & Karaoz (2017), the definition of urinary retention was the inability to void with a full bladder of >500 ml. Patients in the intervention group were asked to void pre-operatively and a bladder scan was used to assess a post-void residual of less than or greater than 300 ml. The nursing intervention was to place patients’ hands in warm water and place warm water bags on their abdomens while providing patient privacy to increase the likelihood of spontaneous voiding. Bladder scanning was used hourly until the patient voided, or catheterization was performed as a last resort, only if the patient reported pain, an inability to void, and a bladder scan volume of >500 ml (Simsek & Karaoz, 2017). Time was not accounted for in this study and a bladder volume of >999 ml for 1-2 hours was not considered to be related to harmful patient outcomes in either group. In contrast Kort et al. (2018) states that exceeding 600 ml of bladder volume is considered pathophysiological with the risk of bladder overdistension causing urological adverse events. Kort et al. (2018) found that a pre-operative bladder scanning protocol after patients voided
identified those with >200 ml urine retention at risk for post-operative urinary retention and an indwelling catheter was inserted for 24-hours. Once the indwelling catheter was removed, all patients in the study were able to void freely. Kort et al. (2018) also identified a post-operative residual of >200 ml as a risk factor for urinary retention and patients were assessed every 3-hours with a bladder scanner until they were able to void freely. The Agency for Healthcare Research and Quality (2015) states that patients should be prompted to void every 4-6 hours and mobility should be encouraged. Intermittent catheterization should be provided every 4-6 hours if post-void residual is >300 ml or a patient is unable to void spontaneously or when prompted. This variance in practice standards shows that urinary retention is acknowledged as a complication but there is no consensus for determining what retention volume or time interval requires catheterization.

There is also varying research to support the use of an indwelling catheter over the use of intermittent catheterization. Both are used interchangeably throughout studies and practice. Zhang et al. (2015) found that the risk of urinary tract infection was comparable between the use of indwelling catheters and intermittent catheters. Zhang et al. (2015) also found that the indwelling catheter was superior to intermittent catheter use 24-48 hours on post-operative patients undergoing total joint replacements. In a multidisciplinary project completed by Parvana & Malloy (2015) up to 21% of orthopedic patients experienced post-operative urinary retention. Once patients were identified at high risk, indwelling urinary catheters were inserted in the operating room and discontinued 24-hours post-operatively. This change resulted in a decreased incidence of post-operative urinary retention and decreased catheter-associated urinary traction infection rate from 13% to 6% (Parvana & Malloy, 2015). This contrasts Schaeffer (2020) who states that clean intermittent catheterization is safer than indwelling catheter placement and there
is no difference in catheter-associated urinary tract infection rate between clean or sterile technique for intermittent catheter insertion or single versus multi-use catheters. The Agency for Healthcare Research and Quality (2015) supports the use of intermittent catheterization for patients who have urinary retention on bladder scan and are unable to void or can void but exhibit symptoms of urinary retention. Symptoms of urinary retention may include urgency, distress, or mild incontinence (Serlin et al., 2018). Repeated bladder scanning is encouraged frequently (every 3 hours) to determine retention resolution. This is all supported through the hospital developed nurse-driven protocol. The current standard criteria for maintenance of indwelling catheters include urinary retention, urinary obstruction, impaired mobilization or prolonged immobilization, stage III or IV trunk pressure ulcers or dermatitis, and management of gross hematuria (Agency for Healthcare Research and Quality, 2015; 2019). As per the pre-existing, approved protocol established for the implementation of this project, bladder scanning will be completed after the patient’s voiding trial to determine the presence and volume of urinary retention and mobilization will be encouraged.

Research will take place at a 711-bed community hospital in Brooklyn, New York. The ability to standardize practice based on the research findings will structure our patient care and provide improved patient experience and outcomes. The nurse-driven protocol for the removal of an indwelling catheter at midnight or 8 hours following surgery has been approved by the nursing research council. Documentation of the protocol in the electronic health record will allow the organization to measure the standard’s impact on post-operative retention rates in vulnerable populations and support the need and benefits of reminder systems or stop orders which prompt nurses to consider early catheter removal (Pamaiahgari, 2019). The study results will also allow nursing leadership to measure nursing compliance with the protocol. The
anticipated resistance to change that may occur is from nursing staff and physicians. It is
difficult to implement changes in practice if there is a friction over autonomy and the decision-
making process between surgeons and nurses, if the changes are time-consuming, or if neither
group can visualize the benefits. Discussions must take place between surgical, trauma, and
nursing staff to provide education, feedback, and interval reporting of the protocol’s outcomes.
The study’s opportunities include nurse empowerment and the opportunity to enhance nursing
documentation. This protocol’s implementation will validate its use and guide future research
and practice.

SWOT Analysis

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<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
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<tr>
<td>• Nursing Research Involvement</td>
<td>• Small Sample Size</td>
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<td>• Nurse-Driven Protocol Approved by the Site</td>
<td>• Difficult Data Collection</td>
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<td>• Unit Manager Approval</td>
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<th><strong>Opportunities</strong></th>
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<tr>
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<td>• Surgeon/Healthcare Provider Resistance to Change in Practice</td>
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<tr>
<td>• EHR Use for Documentation</td>
<td>• Nurse Resistance to Change in Practice</td>
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<td>• No Pre-Implementation Control Group for Comparison</td>
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Problem Statement

There is an indeterminant relationship between time and the presence of indwelling
urinary catheters with resultant rates of urinary retention in post-operative orthopedic and trauma patients.
Clinical Question

In the inpatient adult orthopedic and trauma patient, does the early removal (at midnight or 8 hours) of an indwelling catheter increase or decrease rates of post-operative urinary retention compared to standard practice (12-48 hours of catheter maintenance)?

Aim

The overall aim of this project is to determine if the implementation of the CAUTI protocol to standardize the discontinuation of indwelling catheters post-operatively will decrease or increase the rate of urinary retention in post-operative orthopedic and trauma patients. Additional aims are to determine if an 8-hour voiding trial is an adequate time interval and to assess average bladder volume in relation to incidence of urinary retention.

Objectives

• To analyze risk factors in both patient populations
• To identify what the relationship (time and volume) is between urinary retention and length of indwelling catheter maintenance in the post-operative orthopedic and trauma patient
• To determine the percentage of compliance with the nurse-driven protocol in the electronic health record

Review of Literature

Articles were searched through PubMed, Joanna Briggs Institute, Cochrane, CINAHL, and Trip databases. Keywords used included “post operative urinary retention,” “post operative urinary retention joint replacement,” “early removal of indwelling catheter,” “post operative indwelling catheter removal,” “post operative urinary retention in orthopedic patients,” “urinary retention,” “urinary retention after surgery,” “post operative urinary retention catheter,” “urinary retention in older hip fractures”. A total of 6,561 articles were compiled from the above databases and an additional 4,681 articles were found through other search engines. See
Appendix B There were 4,458 duplicate articles excluded in the search. The inclusion criteria for article selection are adult/geriatric, male/female, patients undergoing joint replacement surgery, or surgery to fix hip fractures in the hospital setting. The exclusion criteria are pediatric/adolescent population, genitourinary, gynecological, or spinal surgeries, pre-procedure use of medication to prevent urinary retention, antibiotic use, urinary tract infection rates, clamping of catheters prior to removal, articles dated >5 years, and inability to access full text article. The evidence appraisal tools used for article selection are the Johns Hopkins Evidence Appraisal Tools Appendix E and F [Dang & Dearholt, 2018, Kindle Location 4589-4597]. See Appendices C and D.

Synthesis of Findings

Manuel (2019) states that early removal of indwelling urinary catheter leads to urinary retention. In this evidence summary, one RCT found that 6 hours was too early for indwelling urinary catheter removal, but 24 hours may be too late, and the maintenance of indwelling urinary catheter increases risk of urinary tract infection, length of stay, and decreased mobility. Hollman et al. (2016) found that males undergoing total joint replacement surgery experience urinary retention at >8 hours post with a bladder scan volume of 603 ml. If more time is given, the participants reached >700 ml without the ability to void and required catheterization. This study only included males because females were unable to prevent hip flexion while going to the bathroom post-operatively as per the study’s protocol. This evidence supports the use of an eight-hour time interval for patient voiding trial and assessment of urinary retention in the nurse-driven protocol. However, it supports the insertion and maintenance of an indwelling urinary catheter post-operatively to reduce incidence of urinary retention (Appendix E).
Further noted, Zhang et al. (2015) found that the maintenance of an indwelling urinary catheter (24-48 hours) was not related to incidence of urinary tract infection and decreased incidence of urinary retention in comparison to use of intermittent straight catheterization for the post-operative management of urinary retention in total joint replacement patients. In conjunction with that finding and in a different patient population, Kwak et al. (2019) found that elderly patients undergoing surgical intervention for hip fracture were at increased risk of urinary retention due to early catheter removal and female gender. Higashikawa et al. (2019) found that elderly female patients with low serum albumin, cognitive impairment, and decreased ADLs are at increased risk of urinary retention post-operatively. This patient population may benefit from indwelling catheter maintenance without risk of increased infection. These findings suggest that indwelling urinary catheter maintenance may be superior for treatment of urinary retention as opposed to intermittent straight catheterization (Appendix E). Indwelling urinary catheterization may also be applicable to patients undergoing joint replacement who may or may not be elderly and patients who are elderly and undergoing surgical intervention for hip fracture without increased risk of infection. As per William & Raymond (2019), a bladder scan volume of > 300 ml required insertion of indwelling urinary catheter however the risk of chronic urinary retention and potential risk of urinary tract infection and stone formation is possible with extended length of catheter maintenance (i.e., >2 weeks) and is not recommended. It is noted that several of these studies use less than or greater than 24 hours as a parameter for measuring urinary catheter maintenance and removal. However, there does not seem to be a consensus on length of post-operative indwelling catheter maintenance and discontinuation.

Bladder scanning has been shown throughout the literature to be an effective assessment tool in each of these studies and its use in this project is supported. Bladder scanning is pertinent
especially for elderly patients who may not experience symptoms of urinary retention and require screening <24 hours post-operatively (Cialic et al., 2017). Bjerregaard et al. [2016] completed an RCT comparing patients with urinary retention volumes of 500 ml compared to 800 ml with bladder scan assessment. In the 500-ml group, 32.2% received catheterization (114 of 354) compared to 13.4% (49 of 367) in the 800-ml group (relative risk, 0.4; 95% CI, 0.3 to 0.6; \( P < 0.0001 \)). Between the two groups, there was no difference in patient outcomes and Bjerregaard et al. (2016) found that if a bladder volume of 800 ml was the precedent for catheter insertion in the presence of urinary retention, it would decrease use of catheters and not cause any urological complications. This is significant because urinary catheterization can cause patient discomfort and increase patient length of stay. An increased threshold for urinary retention management may be more cost-effective as well. Simsek & Paraoz (2017) implemented an intervention in their RCT that standardized use of warm water and compresses to stimulate spontaneous micturition. Bladder scanning was used hourly until the patient voided or catheterization was performed only if the patient reported pain, an inability to void, and a bladder scan volume of >500 ml. Similarly, Bjerregaard et al. (2016) found that a bladder volume of >999 ml for 1-2 hours was not considered to be related to harmful patient outcomes in either group. Unlike the study of Hollman et al. (2016), these two findings suggest that acute post-operative urinary retention with high bladder volumes may not require catheterization but more time in the voiding trial (>8 hours).

Research supports the use of an electronic health record system to encourage early indwelling urinary catheter removal. Porritt (2019) recommended use of reminder systems or stop orders which prompt clinicians to consider early catheter removal however it seems that
balancing the prevention of acute urinary retention and urinary tract infection simultaneously is unclear.

**Identification of Solutions/Gaps**

The bladder volume of urinary retention is not clearly defined in the literature and several new and varied risk factors have been identified among the orthopedic and trauma patient populations. The evidence suggests that indwelling catheterization may be beneficial to prevent urinary retention without increased risk of urinary tract infection for short term use, however, there is no consensus for length of indwelling catheter maintenance and appropriate time for removal.

**Theoretical Framework**

This quality improvement project is supported by the PDSA cycle (Appendix F). Throughout the planning phase, the expectation is to use documentation in the electronic health record. Educating the staff, gaining buy in, and accepting feedback from physicians, nurse practitioners, and nurses about their attitudes and roles in the implementation process should be addressed in the planning phase.

The implementation phase requires nursing staff to utilize the standard and document in the nursing data base in the electronic health record. Reminders will be provided verbally weekly to all staff.

The study phase is the summation of the data that will be collected from retrospective analysis. Determining the number of patients that experience urinary retention post-operatively after an eight-hour voiding trial, the type of surgery, patient age, sex, cognitive status, and length of stay will be collected for analysis. Catheter maintenance, bladder scan use and volume,
voiding trial assessment, and patient mobility will also be collected. Analysis will include identifying barriers to implementation and areas for improvement and feedback from nursing staff, nurse practitioners, and physicians.

The action phase is the re-evaluation of the intervention and assessment of its efficacy based on the data gathered and analyzed. The objective of the study is to determine if the intervention is best practice to reduce incidence of urinary retention in the present patient population.

Methodology

Design of Project

The study was secondary research that included prospective implementation of the CAUTI prevention protocol and a retrospective chart analysis of its adherence. Due to stakeholder pushback, a quasi-experimental design was developed with a control group for comparison. This was a quality improvement intervention. The query assessed the length of time given for a voiding trial, average urinary retention volume, and a bladder scan assessment 8-hours after indwelling catheter removal (for standard practice) or 8-post-hours post-operatively. If patients no longer met the criteria, then the indwelling catheter was discontinued, and patients were given an 8-hour voiding trial. If patients exhibited signs of urinary retention after an 8-hour voiding trial or were unable to void within the 8-hour voiding trial, a bladder scan was completed for volume assessment and the covering physician was notified. If more time was given or bladder decompression with straight catheterization or re-insertion of an indwelling urinary catheter was implemented, this data was also collected.
Setting

The study took place in a large community teaching hospital. The 711-bed hospital is in a densely populated and diverse, urban area of Brooklyn, New York. Access to electronic health records was approved by the site IRB and Rutgers IRB.

Study Population

The study included men and women 18 years or older who had undergone orthopedic surgery for fixation of a femoral fracture in a 6-week period. Exclusion criteria included subjects with incomplete documentation of urinary output management. Using G*Power 3 version 1.9.7 for a priori power analysis to calculate sample size, the number of subjects per group (control versus intervention) was 10. The study aimed to gather data on 20 subjects.

Subject Recruitment

Because this study was a normal hospital operations quality improvement process involving the prospective implementation of the CAUTI protocol and a retrospective chart review, recruitment was not necessary.

Consent Procedure

Consent for chart review was not necessary given that this analysis is retrospective, and all subjects had received care previously. The intervention implemented in this project was an internal quality improvement measure and a consent waiver was requested and approved through the IRB application process.

Risks/Harms/Ethics

There is risk associated with accessing patient information through the electronic health record. However, all information gathered in the data collection was de-identified and secured, minimizing risk.
Subjects Costs and Compensation

There was no cost or compensation to the subjects included in the study.

Study Intervention

The intervention was the implementation and documentation of the CAUTI protocol to standardize the discontinuation of indwelling urinary catheters for surgical patients at midnight or 8-hours after surgery. The surgical population included in this study were orthopedic and trauma patients who had undergone surgical fixation of a femoral fracture.

Outcomes to be Measured

The outcomes measured were the patients’ type of surgery, length of stay, discontinuation of indwelling urinary catheter, reinsertion of urinary catheter (straight vs. indwelling), bladder scan volume, and voiding trial time. Data regarding age, sex, mobility, and cognitive status were also collected and measured.

Project Timeline

Site IRB approval was received December 14, 2020 and Rutgers IRB approval was received January 19, 2021. The study was initiated January 20th, 2021 and data collection was completed by March 3rd, 2021. Data analysis and synthesis of findings were completed by March 12th, 2021. Final dissemination of study results will take place by April 16th, 2021.

Resources Needed/Economic Considerations (Project Budget)

Microsoft Excel and IBM SPSS version 27 were required for data input and analysis. IBM SPSS Version 27 was downloaded and paid for 6-months by the project coordinator.
Evaluation Plan

Data Analysis

Microsoft Excel was used for data collection and IBM SPSS software version 27 was used to analyze data. Coding was applied for all data input. Descriptive comparative statistics were used for mean, median, and mode to determine central tendency of data. The data was organized in quartiles and standard deviation was used to measure the dispersion of data. Inferential statistics were applied between groups with an alpha level of 95% and p-value of 0.05. Independent samples t-test was used as the testing family. Pearson’s Correlation was used to assess the relationship between scale variables. The independent samples Kruskal-Wallis test was used as nonparametric analysis of bladder scan volume and voiding trial hours between groups.

Data Maintenance/Security

Data Storage

All data was coded, de-identified, and stored within the hospital’s SharePoint infrastructure.

Data Access

The project coordinator had access to participant PHI but complied with hospital policies regarding HIPAA. Only the project coordinator had subsequent access to de-identified data collected.

Privacy and Confidentiality of PHI

Participants included in the study were de-identified and given a case number.
Once data was collected, there was no PHI to link to the data. The case numbers assigned to each patient were randomized. At the project’s completion, all de-identified data collected will be stored in the hospital’s electronic infrastructure for 3 years as per the hospital’s policy and transferred for storage to the Stanley Bergen Building, 11th Floor Room 27, Newark, NJ 07107 as per Rutgers University policy.

Results

The study collected data on 21 participants between an intervention group of 3 participants and a control group of 18 participants. The study adopted a quasi-experimental design due to barriers mentioned later in this discussion. Participants were mainly female (85.7%) with a mean age of 80.6 years old and mode of 89 years or older (Appendix G & H).

The most frequent type of surgery across both groups was the IM Nailing/Pinning for surgical fixation, with 17 participants having undergone this procedure. The 4 remaining participants underwent hip hemiarthroplasty surgeries (Appendix G). This finding may represent the general population that is treated under both trauma and orthopedic services and this study’s results may not represent participants who undergo elective joint replacements solely by the orthopedic service.

The average for mobility was post-op day 1 which may represent the general findings for this population. Thirteen of 21 participants across both groups were alert and oriented to person, place, and time with the second largest concentration of participants being alert and oriented to person (Appendix G & H).

The average bladder scan assessment was >400 ml in the intervention group for participants who failed the 8-hour voiding trial. Kort et al. (2018) identified a post-operative
residual of >200 ml as a risk factor for urinary retention, which is observed in this study. The AHRQ (2015) recommends that intermittent straight catheterization be provided every 4-6 hours if a patient has a post-void residual >300 ml, is unable to void spontaneously, or when prompted. However, insertion of indwelling catheter was the intervention of choice within the study for participants who failed the trial to void or were given more time and failed the trial to void. This creates an opportunity among medical and nursing providers to discuss the risks and benefits of implementing a straight catheterization protocol for patients who fail trials to void once an indwelling urinary catheter is removed (if standard practice is used-after 12-48 hours) versus indwelling catheter reinsertion.

The eight-hour voiding trial was normally distributed and had the highest frequency (8 participants=38.1%) between both groups. While some research in the literature review recommends use of longer voiding trials, this interval may be acceptable as standard practice. Two participants in the intervention group failed the 8-hour voiding trial with a bladder scan volume >400 ml and received re-insertion of indwelling catheters. One of these participants was given 13 hours to void but failed. Of the 18 control group participants, 5 failed the 8-hour voiding trial but more time was given to 3 participants who eventually voided, one of whom was given a 16-hour voiding trial. The remaining 2 required catheter reinsertion after 11- and 16-hour failed voiding trials. Bladder scan volume was not assessed for participants in the control group, except for 1 participant. This finding suggests variance in clinical judgment and practice.

In the future, it may be beneficial to reinforce the standard for bladder scan assessment in patients who fail trials to void. However, data was not collected specific to the participants and other interventions implemented in place of catheterization, such as IV hydration.
An independent-samples t-test was conducted to compare the bladder scan volume and hours given for voiding trial between the intervention and control groups. The Levene’s test for equality of variance was used and showed that equal variance could not be assumed between groups. There was a significant difference ($t(2.028) = 1.910, p = <0.01$ in the scores with the mean score for the intervention group ($M=1.33, SD=1.155$) being higher than the control group ($M=0.06, SD=.236$). The magnitude of differences in the means (mean difference = 1.278, 95% CI: 1.563 to 4.119) was significant. This finding is clinically and statistically significant because it may suggest that the intervention group experienced higher incidence of urinary retention due to the early removal of indwelling catheters. However, this finding may not be generalized due to the small sample size and inconsistent use of bladder scan assessment in the control group. This finding may require further research to be validated or refuted and can be visualized between Table 1A and Table 1B.

**Table 1A**

*Statistics for Bladder Scan Volume and Hours Given for Voiding Trial Between Groups*

<table>
<thead>
<tr>
<th></th>
<th>N (total number of participants)</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error Mean</th>
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<tbody>
<tr>
<td>Bladder Scan Volume</td>
<td>Intervention</td>
<td>3</td>
<td>1.33</td>
<td>0.667</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>18</td>
<td>0.06</td>
<td>0.056</td>
</tr>
</tbody>
</table>
### Table 1B

*Independent Samples t-test for Equality of Means of Bladder Scan Volume and Voiding Trial Between Groups Including Levene’s Test for Equality of Variances*

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>Sig.</th>
<th>Mean</th>
<th>Standard Error</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
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<tr>
<td>BSV</td>
<td>EVA</td>
<td>28.802</td>
<td>&lt;.001</td>
<td>4.700</td>
<td>19</td>
<td>&lt;.001</td>
<td>1.278</td>
<td>.272</td>
<td>.709</td>
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<tr>
<td>BSV</td>
<td>EV</td>
<td>1.910</td>
<td>.778</td>
<td>.408</td>
<td>19</td>
<td>.688</td>
<td>.944</td>
<td>2.317</td>
<td>-3.905</td>
</tr>
<tr>
<td>VT</td>
<td>EV</td>
<td>0.082</td>
<td>.778</td>
<td>.408</td>
<td>19</td>
<td>.688</td>
<td>.944</td>
<td>2.317</td>
<td>-3.905</td>
</tr>
<tr>
<td>BT</td>
<td>EV</td>
<td>.379</td>
<td>.778</td>
<td>.408</td>
<td>19</td>
<td>.688</td>
<td>.944</td>
<td>2.317</td>
<td>-3.905</td>
</tr>
</tbody>
</table>

*Note.* BSV= Bladder Scan Volume; VT=Hours Given for Voiding Trial; EVA=Equal Variances Assumed; EVNA= Equal Variances Not Assumed

*p <0.05, two-tailed.

The Kruskal-Wallis Test between Independent Samples (Appendix I) was also used for nonparametric analysis to support the above finding. With this specific test, there was a 0.004 statistically significant difference between bladder scan volume (>400 ml versus >200 ml) in the
intervention group versus the control group. This finding may also suggest that the early discontinuation of indwelling urinary catheters in post-operative patients may be related to an increased incidence of urinary retention. However, this finding may similarly not be substantial due to small samples sizes between groups.

A correlations tabulation was used to determine the relationship between scale variables including age, hours given for voiding trial, bladder scan volume, length of stay, mobility, and cognitive status (Table 2). There was a significant relationship between age and mobility with a Pearson Correlation of .440, 2-tailed significance \( p = .046 \), 95% CI: .000 to .728. While the direction is unclear, this may be interpreted as an inverse relationship of increased age versus decreased mobility. This result may be supported by the participants’ mean age but is not necessarily supported by the frequency of mobility. It is standard practice to move patients out of bed post-op day 1 excluding complications such as mechanical ventilation or anemia requiring blood transfusion. The Pearson Correlation for bladder scan volume and hours given for voiding trial was .412, \( p = .064 \). This is not statistically significant however this finding may be undermined by inconsistent use of bladder scan assessment in the control group. If more participants in the control group had documented bladder scan volumes, this may have altered the intervention for participants who failed the trial to void. There were no other significant correlations between age, hours given for voiding trial, bladder scan volume, length, mobility, or cognitive status.

Table 2

Correlations Between Scale Variables


## INCIDENCE OF URINARY RETENTION

|                          | Age in Years | Pearson Correlation | Sig. (2-tailed) | N  | Voiding Trial | Pearson Correlation | Sig. (2-tailed) | N  | Bladder Scan Volume | Pearson Correlation | Sig. (2-tailed) | N  | Cognitive Status | Pearson Correlation | Sig. (2-tailed) | N  | Mobility |  |  |  |  |
|--------------------------|--------------|---------------------|-----------------|----|---------------|---------------------|-----------------|----|---------------------|---------------------|-----------------|----|------------------|-------------------|-----------------|----|-----------| | | | | |
| Age                      | 1.327        | .271                | .125            | .440* | -.298        |                      |                 |    |                      |                      |                 |    |                  |                    |                 |    |          | | | | | |
| Voiding                  | .327         | 1                   | .412            | -.163 | -.054        |                      |                 |    |                      |                      |                 |    |                  |                    |                 |    |          | | | | | |
| Bladder Scan Volume      | .271         | .412                | 1               | .058  | -.029        |                      |                 |    |                      |                      |                 |    |                  |                    |                 |    |          | | | | | |
| Cognitive Status         | .125         | .271                | .058            | 1     | -.276        |                      |                 |    |                      |                      |                 |    |                  |                    |                 |    |          | | | | | |

The table above presents the Pearson correlation coefficients and their significance levels for the variables related to patient characteristics and outcomes. Each variable is paired with others to assess their relationship, with the significance level (Sig.) indicating whether the correlation is statistically significant. The "N" column denotes the number of observations for each correlation.
The average length of stay was 5.52 days between both groups with a frequency of 4 days (Appendix G). This finding suggests that the use of indwelling catheters for urinary assessment and management does not significantly increase patient length of stay. The length of stay was significantly increased for 2 participants in the control group for reasons unrelated to this study.

Originally, the goal sample size for this study was 168 participants. There were several barriers that reduced the sample size to a new estimated goal of 20-44 participants (with the anticipated use of t-testing). Limitations to the study included a 7-month wait time for site and institutional IRB approval. The COVID-19 pandemic also impacted the sample size and length of data collection time. Nursing compliance was difficult and resulted in 14.3% implementation of the protocol. This finding may be related to several factors including stakeholder pushback.
with protocol use and patient location (transfers between units). In the future, if used, it may be beneficial for all stakeholders to discuss shared goals and expectations for successful implementation. Nursing leadership must also be involved in reinforcing the protocol’s use daily and super users may be beneficial to encourage other nurses to remain consistent in their assessment, use, and documentation.

Discussion

Implications on:

Practice

The findings in this study suggest that current practice may be more appropriate compared to early removal of indwelling catheters in the post-operative orthopedic and trauma patient. There was no statistical significance for age, sex, type of surgery, mobility, or cognitive status and incidence of urinary retention. There was a statistically significant inverse correlation found between age and mobility. This finding may substantiate general knowledge that with increased age, there is decreased mobility.

Policy Implications

While the CAUTI protocol is evidenced-based practice, it may not be applicable to this patient population in the time established. The protocol may additionally require amendments that consider other risk factors for urinary retention not included in this study (i.e., history of urinary retention, urinary tract infection on admission, benign prostatic hyperplasia, neurological disease, anesthesia, genitourinary consultation for indwelling catheter insertion, hypovolemia, worsening labs [i.e., anemia, impaired renal function], and serum albumin). There is opportunity for discussion of implementation of nurse-driven straight catheter protocol for failed trials to void as this is supported as evidence-based practice and was not used in the study. Lastly, it may
be beneficial to reinforce the standard for bladder scan assessment in patients who fail trials to void after 8 hours. Kort et al. (2018) specified that post-void residual bladder scan volume of >200 ml and post-operative bladder scan volume >200 ml increased risk for urinary retention with bladder scanning every 3 hours. The AHRQ (2015) specified that bladder scan assessment should be performed every 4-6 hours with a post-void bladder scan volume >300ml as an indication for intervention. More frequent bladder scan assessment (every 3-6 hours versus every 4-6 hours) may be applicable in future application of the bladder scan assessment standard.

**Impact on Healthcare Quality/Safety**

Using the PDSA cycle, there is an opportunity for discussion among medical and nursing providers regarding this protocol’s use in this surgical population. While the exact time period remains unclear, the results of this study may suggest that the early removal (8 hours or at midnight) of indwelling catheters post-operatively increases the incidence of urinary retention. The findings may also support the maintenance of indwelling urinary catheters for 12-48 hours without increasing the incidence of urinary retention in post-operative orthopedic and trauma patients. These findings are also supported in some studies cited in the literature review. However, due to the small sample size, these findings may not be generalizable. Further research may be necessary.

**Economic/Cost Benefits of Project**

There is some financial gain associated with not using additional indwelling urinary catheter kits or straight catheterization equipment for patients who fail trials to void by determining what is best practice. Standard practice may be more appropriate for management of urinary output without causing increased risk of urinary retention, catheter-associated urinary tract infections, or hospital length of stay.
Plans for Sustainability and Translation (to broader group)

This study’s findings may be applicable to the prevention of urinary retention in other surgical groups, such as neurosurgical or gastrointestinal surgical patients, in which the occurrence rate may be similar.

Plans for Dissemination and Reporting

The results of this study are summarized in the final version of this paper and will be presented before the DNP project team on April 16, 2021 and the project coordinator’s peers and colleagues on Poster Day, April 19, 2021. The results will be reported to the hospital administration as a support of collaborative practice, nursing education, and leadership protocols. Results may also be presented to the orthopedic and trauma specialties to encourage interdisciplinary discussion. The results will also be stored in the Rutgers University Library Repository. If appropriate, this review will be submitted for publishing to a professional nursing journal.

Conclusion

The aim of this study was to determine whether the early removal of indwelling urinary catheters is related to increased or decreased incidence of urinary retention following orthopedic surgery. The bladder scan volume >400 ml is an acceptable standard for intervention with an 8-hour voiding trial. It is still unclear what amount of time is appropriate for catheter removal given the voiding trials of 11-, 13-, and 16- hours occurred between groups, but maintenance of urinary catheters for 12-48 hours may be more appropriate. The results of this study suggest that the early removal of indwelling urinary catheters causes increased incidence of urinary retention. Collaborative discussions are encouraged between administrators, physicians, nurse
practitioners, and nursing staff to consider amendments and establish shared standards and goals, effective communication, and daily protocol reinforcement for successful implementation if used in the future.
References


INCIDENCE OF URINARY RETENTION

https://doi.org/10.1097/JTN.0000000000000400

https://doi.org/10.1016/j.arth.2018.08.042

https://doi.org/10.3928.01477447-20150603-59

https://doi.org/10.1097/MD.0000000000016023


INCIDENCE OF URINARY RETENTION

https://doi.org/10.1186/s13018-019-1360-1

https://www.maimonidesmed.org/avid-test/test-content-page


https://doi.org/10.1016/j.jopan.2015.05.023


SUBJECT: Standard of Nursing Practice for Insertion, Maintenance, and Discontinuation of an Indwelling Urinary Catheter

I. POLICY

This policy outlines the standard of nursing practice for the insertion, maintenance, and discontinuation of an indwelling urinary catheter to:

• provide a uniform standard of nursing practice for patients with an indwelling urinary catheter; and
• reduce indwelling urinary catheter use and dwell time.

II. RESPONSIBILITY

Nursing staff is responsible to comply with the standard of nursing practice outlined in this

III. INDICATIONS FOR INDWELLING URINARY CATHETER

A. Critically ill patients with the following elements of care:
   a. Sedated and mechanically ventilated, and
   b. Receiving vasopressors, and
   c. Requiring strict intake & output
B. Acute urinary retention or bladder outlet obstruction
C. Perioperative use for selected surgical procedures
   a. Patients undergoing urologic procedures or other surgery of genitourinary tract
   b. Anticipated prolonged duration of surgery
   c. Patients who receive large-volume infusions or diuretics during surgery
   d. Need for intraoperative monitoring of urinary output
O. Patients who require prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fractures)
E. Incontinent patients with stage III or IV pressure injuries or perineal wounds/severe incontinent dermatitis
F. To improve comfort in palliative care and/or end of life care
IV. STANDARDS OF NURSING PRACTICE

Standard 1: Nursing Assessment

A. Assess the patient as per Assessment Policy utilizing the Nursing Data Base.
B. Assess for previous history of dysuria, such as enlarged prostate or bladder distention.
C. Assess for past history or problems with insertion of urinary catheter.
D. Assess for Latex Allergy. (If present, use silicone catheter)
E. Assess for risk factors of CAUTI
   a. Female
   b. Age (older patients may exhibit change in mental status)
   c. Prolonged catheterization
   d. Impaired immunity
   e. Lack of antimicrobial exposure
F. Monitor for signs and symptoms of CAUTI
   a. Urgency, frequency, dysuria, or other suprapubic tenderness
   b. Fever
   c. Hemodynamic instability
   d. Color or character changes in the urine indicative of infection, hematuria or positive urine culture
   e. Mental status changes especially in older adults
   f. Report any signs or symptoms of infection or changes in behavior to LIP

If silicone catheter is needed, call Warehouse.

Standard II: Nursing Measures

A. Insertion of Indwelling Urinary Catheter
   1. Confirm indications for insertion
   2. Consider alternatives
   3. Obtain a current LIP order
   4. Gather necessary equipment, including a closed system with metered drainage bag
   5. Provide for patient privacy
   6. Explain procedure to patient
   7. Perform hand hygiene
   8. LIP and/or RN insert urinary catheter using aseptic techniques and sterile equipment.
   9. For catheterization:
      i. Use a 16 or 18 French catheter
      ii. Place a liberal amount of surgi-lube on the catheter for ease of insertion
   10. Check balloon prior to insertion by inflating balloon using prefilled 10 mL syringe

Note: RN should make 2-3 attempts at catheterization. If unable to pass catheter, notify the LIP.

   11. Secure catheter to patient’s leg with catheter holder
INCIDENCE OF URINARY RETENTION

12. Document insertion date/time on the orange label found in the kit and place label on the side of the urimeter.

13. Always place drainage bag below the level of the bladder to allow urine to drain via gravity.

Note: Routine urinalysis and urine cultures are not recommended for patients without local genitourinary symptoms or other systemic signs of infection except pregnant women and patients undergoing urologic surgical procedures. 

B. Maintenance of the Indwelling Catheter
   1. Implement the catheter maintenance bundle:
      a. Perform daily assessment with indication and review the need for urinary catheter.
      b. Check the catheter tubing for kinks and maintain a closed drainage system at all times.
      c. Maintain the drainage bag below the level of the bladder.
      d. Provide catheter-care using cleanser and water every shi2, when patient has a bowel movement, and pm. For uncircumcised males, the foreskin must be pulled down after cleaning.
      e. A labeled individual container is used to empty the urinary bag.
   2. Ensure indwelling catheter indication is included in shift to shift handoff.
      a. Include anticipated date/time to discontinue the indwelling urine catheter based on criteria/indications.
   3. Notify LIP for changes in color, consistency, odor of the urine or S & S of infection.
      a. If indicated, obtain specimen using the designated po%.
      b. Cleanse port with alcohol or chlorhexidine (CHG) prior to obtaining specimen.
   4. Only change indwelling catheter or drainage bags based on clinical indications such as infection, obstruction, or when the closed system is compromised.
      a. LIP order is needed.
   5. If urine output stops/changes, the following steps should be done:
      a. Reposition patient.
      b. Check for bladder distention.
      c. Notify LIP for abnormal Endings.

C. Discontinuation of the Indwelling Urinary Catheter
   1. If the patient does not have or no longer has an indication for the indwelling urinary catheter, the RN will discontinue without the need for an LIP order. For po!-op patients, an assessment for discontinuation will be made at midnight or within eight hours following surgery (excluding urologic and gynecological surgery).
   2. Explain the procedure to the patient.
   3. Deflate the balloon.
   4. Instruct patient to deep breath and gently remove catheter.
   5. Examine catheter tip for integrity.
6. Assess for discomfort, burning when voiding, bleeding, and changes to vital signs.
7. Monitor for post removal voiding within 8 hours
8. Implement additional plans if needed (i.e., noninvasive urine collection devices, ensure commode is available at bedside, frequent rounding)
9. If patient does not void within 8 hours:
   a. Assess for bladder distention or pain
   b. Perform bladder scan to check for residual (refer to bladder scanner guidelines)
   c. Notify LIP

Note: Indications and anticipated discontinuation of indwelling catheters will be discussed during daily Interdisciplinary Team Rounds. If an indwelling urinary catheter is discontinued notify the LIP and document as per policy.

Standard III: Patient Education
A. Educate patient/family:
   1. Indication and need for indwelling urinary catheter
   2. Signs and symptoms of infection
   3. Report any discomfort or changes immediately to the RN
   4. Do not pull catheter or disconnect the tubing

Standard IV: Documentation
A. Electronic Medical Record (EMR)
   1. Nursing worklist
   2. Flowsheet
   3. Interdisciplinary Education
B. Focus Note
C. Nursing Data Base

Standard V: Patient Outcomes
A. Patient will return to normal voiding patterns without complications after removal of indwelling urine catheter
B. Patient will not develop any catheter related complications

IV. CONTROLS
The Chief Nursing Officer and Leadership will ensure training and compliance with this policy by all nursing staff.

President & CEO
REFERENCE:

- (CAUTI) National Patient Safety Goal for Hospitals (2017)
- Requirements for the Catheter-Associated Urinary Tract Infections
Appendix B

## Appendix C

Johns Hopkins Nursing Evidence-Based Practice
Appendix E: Research Evidence Appraisal Tool

<table>
<thead>
<tr>
<th>Article Title:</th>
<th>Number:</th>
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<tbody>
<tr>
<td>Author(s):</td>
<td>Publication Date:</td>
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<td>Journal:</td>
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<th>Setting:</th>
<th>Sample (Composition &amp; size):</th>
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</table>

<table>
<thead>
<tr>
<th>Does this evidence address my EBP question?</th>
<th>☐ Yes</th>
<th>☐ No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do not proceed with appraisal of this evidence</td>
</tr>
</tbody>
</table>

**Level of Evidence (Study Design)**
A. Is this a report of a single research study?  **If No, go to B.**

1. Was there manipulation of an independent variable?
2. Was there a control group?
3. Were study participants randomly assigned to the intervention and control groups?

If Yes to all three, this is a Randomized Controlled Trial (RCT) or Experimental Study  ➔

If Yes to #1 and #2 and No to #3, OR Yes to #1 and No to #2 and #3, this is Quasi Experimental (some degree of investigator control, some manipulation of an independent variable, lacks random assignment to groups, may have a control group)  ➔

If No to #1, #2, and #3, this is Non-Experimental (no manipulation of independent variable, can be descriptive, comparative, or correlational, often uses secondary data) or Qualitative (exploratory in nature such as interviews or focus groups, a starting point for studies for which little research currently exists, has small sample sizes, may use results to design empirical studies)  ➔

NEXT, COMPLETE THE BOTTOM SECTION ON THE FOLLOWING PAGE, “STUDY FINDINGS THAT HELP YOU ANSWER THE EBP QUESTION”
B. Is this a summary of multiple research studies? *If No, go to Non-Research Evidence Appraisal Form.*

1. Does it employ a comprehensive search strategy and rigorous appraisal method (*Systematic Review*)? *If No, use Non-Research Evidence Appraisal Tool; if Yes:*
   a. Does it combine and analyze results from the studies to generate a new statistic (effect size)? (*Systematic review with meta-analysis*)
   b. Does it analyze and synthesize concepts from qualitative studies? (*Systematic review with meta-synthesis*)

   *If Yes to either a or b, go to #2B below.*

2. For Systematic Reviews and Systematic Reviews with meta-analysis or metasynthesis:
   a. Are all studies included RCTs? →
   b. Are the studies a combination of RCTs and quasi-experimental or quasi-experimental only? →
   c. Are the studies a combination of RCTs, quasi-experimental and non-experimental or non-experimental only? →
   d. Are any or all of the included studies qualitative? →

   □ LEVEL I
   □ LEVEL II

COMPLETE THE NEXT SECTION, “STUDY FINDINGS THAT HELP YOU ANSWER THE EBP QUESTION”

□ LEVEL III
□ LEVEL III
STUDY FINDINGS THAT HELP YOU ANSWER THE EBP QUESTION:

Quality Appraisal of Research Studies
Does the researcher identify what is known and not known about the problem and how the study will address any gaps in knowledge?

Was the purpose of the study clearly presented?

Was the literature review current (most sources within last 5 years or classic)? □ Was sample size sufficient based on study design and rationale?

If there is a control group:
  o Were the characteristics and/or demographics similar in both the control and intervention groups?
  o If multiple settings were used, were the settings similar?
  o Were all groups equally treated except for the intervention group(s)?

Are data collection methods described clearly?

Were the instruments reliable (Cronbach's α [alpha] > 0.70)?

Was instrument validity discussed?

If surveys/questionnaires were used, was the response rate > 25%?

Were the results presented clearly?

If tables were presented, was the narrative consistent with the table content?

Were study limitations identified and addressed?

Were conclusions based on results?

| Quality Appraisal of Systematic Review with or without Meta-Analysis or Meta-Synthesis |
|---------------------------------|-----------------|----------------|
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
| Yes | No | NA |
### Incidence of Urinary Retention

- Was the purpose of the systematic review clearly stated? □
  - Were reports comprehensive, with reproducible search strategy?
    - Key search terms stated
    - Multiple databases searched and identified
    - Inclusion and exclusion criteria stated
- Was there a flow diagram showing the number of studies eliminated at each level of review?
- Were details of included studies presented (design, sample, methods, results, outcomes, strengths and limitations)?
- Were methods for appraising the strength of evidence (level and quality) described?
  - Results were interpreted
  - Conclusions flowed logically from the interpretation and systematic review question
- Did the systematic review include both a section addressing limitations and how they were addressed?

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<tr>
<td>A High quality: consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence</td>
</tr>
<tr>
<td>B Good quality: reasonably consistent results; sufficient sample size for the study design; some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence</td>
</tr>
<tr>
<td>C Low quality or major flaws: little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn</td>
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</tbody>
</table>
**Appendix D**

**Johns Hopkins Nursing Evidence-Based Practice Appendix F: Non-Research Evidence Appraisal Tool**

<table>
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<tr>
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<td>Publication Date:</td>
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<td>Journal:</td>
<td></td>
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**Does this evidence address the EBP question?**

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<th>□Yes</th>
<th>□No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do not proceed with appraisal of this evidence</td>
</tr>
</tbody>
</table>

**Clinical Practice Guidelines:** Systematically developed recommendations from nationally recognized experts based on research evidence or expert consensus panel. **LEVEL IV**

**Consensus or Position Statement:** Systematically developed recommendations based on research and nationally recognized expert opinion that guides members of a professional organization in decision-making for an issue of concern. **LEVEL IV**

- Are the types of evidence included identified?  □Yes □No
- Were appropriate stakeholders involved in the development of recommendations?  □Yes □No
- Are groups to which recommendations apply and do not apply clearly stated?  □Yes □No
- Have potential biases been eliminated?  □Yes □No
- Were recommendations valid (reproducible search, expert consensus, independent review, current, and level of supporting evidence identified for each recommendation)?  □Yes □No
- Were the recommendations supported by evidence?  □Yes □No
- Are recommendations clear?  □Yes □No
**INCIDENCE OF URINARY RETENTION**

<table>
<thead>
<tr>
<th><strong>Literature Review:</strong> Summary of published literature without systematic appraisal of evidence quality or strength. <strong>LEVEL V</strong></th>
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</thead>
<tbody>
<tr>
<td>• Is subject matter to be reviewed clearly stated?</td>
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<tr>
<td>• Is relevant, up-to-date literature included in the review (most sources within last 5 years or classic)?</td>
</tr>
<tr>
<td>• Is there a meaningful analysis of the conclusions in the literature?</td>
</tr>
<tr>
<td>• Are gaps in the literature identified?</td>
</tr>
<tr>
<td>• Are recommendations made for future practice or study?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Expert Opinion:</strong> Opinion of one or more individuals based on clinical expertise. <strong>LEVEL V</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Has the individual published or presented on the topic?</td>
</tr>
<tr>
<td>• Is author’s opinion based on scientific evidence?</td>
</tr>
<tr>
<td>• Is the author’s opinion clearly stated?</td>
</tr>
<tr>
<td>• Are potential biases acknowledged?</td>
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</tbody>
</table>

**Organizational Experience:**

**Quality Improvement:** Cyclical method to examine organization-specific processes at the local level. **LEVEL V**

**Financial Evaluation:** Economic evaluation that applies analytic techniques to identify, measure, and compare the cost and outcomes of two or more alternative programs or interventions. **LEVEL V**
**Program Evaluation:** Systematic assessment of the processes and/or outcomes of a program and can involve both quantitative and qualitative methods. LEVEL V

<table>
<thead>
<tr>
<th>Setting:</th>
<th>Sample (composition/size):</th>
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<tr>
<td>- Was the aim of the project clearly stated?</td>
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</tr>
<tr>
<td>- Was the method adequately described?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>- Were process or outcome measures identified?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>- Were results adequately described?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>- Was interpretation clear and appropriate?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>- Are components of cost/benefit analysis described?</td>
<td>□ Yes □ No □ N/A</td>
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**Case Report:** In-depth look at a person, group, or other social unit. LEVEL V

<table>
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<tr>
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<tr>
<td>- Is the case report clearly presented?</td>
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<tr>
<td>- Are the findings of the case report supported by relevant theory or research?</td>
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</tr>
<tr>
<td>- Are the recommendations clearly stated and linked to the findings?</td>
<td>□ Yes □ No</td>
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</table>
### Community Standard, Clinician Experience, or Consumer Preference

**Community Standard**: Current practice for comparable settings in the community **LEVEL V**

**Clinician Experience**: Knowledge gained through practice experience **LEVEL V**

**Consumer Preference**: Knowledge gained through life experience **LEVEL V**

<table>
<thead>
<tr>
<th>Information Source(s):</th>
<th>Number of Sources:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Source of information has credible experience.</td>
<td>□ Yes □ No □ N/A</td>
</tr>
<tr>
<td>• Opinions are clearly stated.</td>
<td>□ Yes □ No □ N/A</td>
</tr>
<tr>
<td>• Identified practices are consistent.</td>
<td>□ Yes □ No □ N/A</td>
</tr>
</tbody>
</table>

**Findings that help you answer the EBP question:**
**QUALITY RATING FOR CLINICAL PRACTICE GUIDELINES, CONSENSUS OR POSITION STATEMENTS (LEVEL IV)**

**A High quality:** Material officially sponsored by a professional, public, private organization, or government agency; documentation of a systematic literature search strategy; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years.

**B Good quality:** Material officially sponsored by a professional, public, private organization, or government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results, sufficient numbers of well-designed studies; evaluation of strengths and limitations of included studies with fairly definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years.

**C Low quality or major flaws:** Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no evaluation of strengths and limitations of included studies, insufficient evidence with inconsistent results, conclusions cannot be drawn; not revised within the last 5 years.

**QUALITY RATING FOR ORGANIZATIONAL EXPERIENCE (LEVEL V)**

**A High quality:** Clear aims and objectives; consistent results across multiple settings; formal quality improvement or financial evaluation methods used; definitive conclusions; consistent recommendations with thorough reference to scientific evidence

**B Good quality:** Clear aims and objectives; formal quality improvement or financial evaluation methods used; consistent results in a single setting; reasonably consistent recommendations with some reference to scientific evidence

**C Low quality or major flaws:** Unclear or missing aims and objectives; inconsistent results; poorly defined quality improvement/financial analysis method; recommendations cannot be made
<table>
<thead>
<tr>
<th>Quality Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A High quality</td>
<td>Expertise is clearly evident; draws definitive conclusions; provides scientific rationale; thought leader in the field</td>
</tr>
<tr>
<td>B Good quality</td>
<td>Expertise appears to be credible; draws fairly definitive conclusions; provides logical argument for opinions</td>
</tr>
<tr>
<td>C Low quality or major flaws</td>
<td>Expertise is not discernable or is dubious; conclusions cannot be drawn</td>
</tr>
</tbody>
</table>
## Appendix E

### Table of Evidence

<table>
<thead>
<tr>
<th>Article #</th>
<th>Author &amp; Date</th>
<th>Evidence Type</th>
<th>Sample, Sample Size, Sample Setting</th>
<th>Study findings that help answer the EBP Question</th>
<th>Limitations</th>
<th>Evidence Level &amp; Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Porritt, K. (2019)</td>
<td>Evidence Summary</td>
<td>A systematic review including 21 studies (four randomized controlled trials (RCTs), seven prospective cohort and 10 case-control studies, 1 expert opinion paper, a systematic review of 48 RCTs, and a systematic review of 15 RCTs including 1732 participants.</td>
<td>Recommended use of reminder systems or stop orders which prompt clinicians to consider early catheter removal; this supports the use of the intervention to decrease length and use of indwelling urinary catheters; each evidence component was graded</td>
<td>Expert Opinion and Quasi-Experimental Results weaken evidence</td>
<td>Level IV, A</td>
</tr>
<tr>
<td>2</td>
<td>Manuel, B. (2019)</td>
<td>Evidence Summary</td>
<td>A systematic review that included 26 trials with a total of 2,933 participants, a prospective randomized controlled trial that included 60 participants, a systematic review and meta-analysis that included seven studies (six RCTs), a Cochrane systematic</td>
<td>Assess for risk factors of POUR and mobilize patients early to decrease POUR; immediate removal of indwelling urinary catheters causes greater risk of post-op urinary retention, however 24- hour maintenance is greater risk for</td>
<td>Quasi-experimental results weaken evidence</td>
<td>Level IV, A</td>
</tr>
<tr>
<td></td>
<td>Author(s) (Year)</td>
<td>Study Design</td>
<td>Study Details</td>
<td>Findings</td>
<td>Study Quality</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------</td>
<td>--------------</td>
<td>---------------</td>
<td>----------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Zhang, et al. (2019)</td>
<td>Systematic Review and Meta-Analysis</td>
<td>9 RCTs with 1771 participants</td>
<td>Indwelling catheterization with removal 24–48 hours postoperatively decreased the rate of post-operative urinary retention and did not increase the risk of UTI</td>
<td>No time restriction for RCT study inclusion; exclusion criteria not identified; setting for all RCTs unknown</td>
<td>Level I, A</td>
</tr>
<tr>
<td>4</td>
<td>Kwak et al. (2019)</td>
<td>1 Retrospective Cohort Study</td>
<td>Elderly patients &gt;70 years old admitted with hip fractures S/P intramedullary nailing or arthroplasty surgeries; 214 participants in the hospital setting</td>
<td>Elderly patients are at increased risk for post-operative urinary retention with gender and early removal of indwelling urinary catheter as significant risk factors; impaired mobility, pain, comorbidities, and medications were analyzed</td>
<td>It is a retrospective cohort study with no control group for comparison; PCA was used as pain management analgesia which is not generally used, and participants had a 24.1-day length of hospital stay which does not align with the current study’s tentative LOS</td>
<td>Level III, B</td>
</tr>
<tr>
<td>Study ID</td>
<td>Authors (Year)</td>
<td>Study Design</td>
<td>Sample Description</td>
<td>Risk Factors</td>
<td>Risk of Urinary Retention</td>
<td>Risk Level</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>5</td>
<td>Cialic et al. (2017)</td>
<td>Prospective Cohort Study</td>
<td>88 Participants in a single-center tertiary hospital</td>
<td>Identified as non-significant risk factors; occurrence of post-operative urinary retention in this study was 31.8%; this population may benefit from maintenance of an indwelling urinary catheter &gt;3 days without increased risk of infection; mobility is mentioned as an indicator of decreased risk for post-operative urinary retention</td>
<td>Small sample size and it is unclear if these participants had indwelling catheters during surgery; all participants were female</td>
<td>Level II, C</td>
</tr>
<tr>
<td>6</td>
<td>Higashikawa et al. (2019)</td>
<td>Retrospective Cohort Study</td>
<td>221 female participants undergoing surgery for a hip fracture in a hospital setting</td>
<td>Elderly (&gt;65 years old) female patients with low serum albumin, cognitive impairment and decreased ADLs are at increased risk of urinary retention</td>
<td>All participants are female and indwelling urinary catheter maintenance versus removal time was not defined</td>
<td>Level III, B</td>
</tr>
<tr>
<td></td>
<td>Simsek &amp; Karaoz (2017)</td>
<td>1 Randomized Control Trial</td>
<td>132 participants &gt;18 years old, undergoing orthopedic surgery and spinal anesthesia in an orthopedic/trauma hospital</td>
<td>Rate of post-operative urinary retention in the control group was 97%, with 31.3% requiring catheterization; In the Intervention group, 77.3% experiencing post-operative urinary retention with 3.9% requiring catheterization. All participants completed a pre-operative urinary retention assessment of risk factors; the intervention group was prompted to urinate pre-operatively and bladder scanned for post-residual void &gt;300ml; all patients Length of post-operative voiding trial was not documented; patients were not encouraged to move OOB to urinate spontaneously due to safety risk in the immediate post-operative phase</td>
<td>Level I, B</td>
<td></td>
</tr>
</tbody>
</table>
were bladder scanned to assess for presence of urine volume in bladder pre-operatively; the intervention group placed their hands in warm water and warm water bags were placed on their abdomens to increase the likelihood of spontaneous voiding. Bladder scanning was used hourly until the patient voided or catheterization was performed as a last resort, only if the patient reported pain, an inability to void, and a bladder scan volume of >500ml; a bladder volume of >999ml for 1-2 hours was not considered to be related to harmful patient outcomes in either group
| 8 | Bjerregaard et al. (2016) | 1 Randomized Open-Label Control Trial | 800 Participants greater than or equal to 18 years old who underwent THA or TKA in three Danish, fast-track, orthopedic departments; 721 participants included in final analysis (20 did not complete the study and 59 were excluded from the analysis). | If a bladder scan result was greater than 500 or 800 ml (depending on group assignment), the patient was encouraged to void but was catheterized if not successful. In case a patient was intermittently catheterized twice and still incapable of voluntary micturition, an indwelling catheter was inserted and left in place for 24 h. Any patient incapable of voluntary micturition, who had abdominal pain/discomfort and/or an urge to void, was catheterized. | The study was not single/double blinded due to the need for expertise with bladder scanner use from healthcare workers. Another limitation was the relatively large amount of protocol violations resulting in exclusion of 59 patients (7.4%) from analysis. However, the results of our post hoc analysis did not suggest that the excluded patients had higher incidences of urological complications than those included in the per-protocol analysis. Anesthetic | Level I, A |
Despite the bladder scan results; patients were assessed with bladder scan every 2 hours for urinary retention until first void; in the 500-ml group, 32.2% received catheterization (114 of 354) compared to 13.4% (49 of 367) in the 800-ml group (relative risk, 0.4; 95% CI, 0.3 to 0.6; \( P < 0.0001 \)). The authors found no difference between groups in any secondary outcome; a catheterization threshold of 800 ml significantly reduced the need for postoperative urinary catheterization, technique and intraoperative fluids administered were not standardized, but were well balanced between groups; participants were not registered for catheterization between their first voluntary micturition and the 30-day follow-up making a possible relation between catheterization and UTI inconclusive; possible type 2 errors due to insignificant finding of UTI post-op.
### INCIDENCE OF URINARY RETENTION

| 62 | Hollman et al. (2015) | 1 Prospective Cohort Study | 376 Male Participants undergoing Total Hip Arthroplasty in the hospital setting; no indwelling catheter was inserted pre-/intra-operatively | 150 men (39.9%) had urinary retention. Straight catheterization was performed in 14 participants, and 136 participants received an indwelling catheter. Among these 150 men, urinary retention recurred in 10 (6.7%) after removal of the catheter, and all participants were re-catheterized (indwelling). Of these 10 patients, 7 had undergone single catheterization at first, accounting for 50% of all participants undergoing | 282 of the 376 participants were included in the multivariate analysis. An additional multivariate regression analysis was performed only for age and type of anesthesia due to missing variable-post-operative analgesia not being used. Another limitation was that information on perioperative and postoperative fluid balance indicating intravenous fluid infusion was not recorded. The amount of fluid intake and output | Level III, B |
primary single catheterization; the other 3 participants received a second indwelling catheter, accounting for 1% of all patients with indwelling catheters. Urinary retention was diagnosed an average of 8.4 hours after surgery, with a mean bladder volume of 603 mL; after 8.4 hours, 77 men (22%) had bladder volume of 700 mL or greater. Urinary tract infection occurred in 2 of the 150 patients with urinary retention (1.3%) who had a catheter inserted may or may not have affected the incidence and time of onset of urinary retention
and in none of the participants without urinary retention. No participants had acute prosthetic infection which was included as a possible complication; A significant difference between patients who had urinary retention and those who did not was seen in postoperative morphine intake ($P=.014$), type of anesthesia ($P=.010$), and age 70 years or older.

| 10 | William & Raymond (2016) | 1 Retrospective Cohort Study | N=250 participants 65 years or older undergoing surgical intervention for hip fractures; 40 out of 1349 participants experienced acute retention of urine and were managed with a protocol. The protocol was able to maintain an indwelling catheter for >48 hours (bi-weekly catheter exchanges, up to 4 months), which is not current. | Level III, B |
between December 2012 and September 2014 formed the intervention group and were treated with a unified protocol; 110 out of 1193 participants between July 2006 and December 2008 were the control group with the previous standard of practice included the use of a bladder scan when participants became symptomatic of urinary retention any time after catheter removal and/or pt. voided with greater than >300ml in bladder; F/U scan completed in intervention group up to 2x.; 16 participants failed voiding trial and were given a permanent indwelling catheter, UA/culture and KUB completed to r/o kidney stone formation. After sixteenth week, all the male participants in successful or failed would be referred to a practice; 16 participants in intervention group maintained indwelling urinary catheters chronically as opposed to 8 in the control group; the results are statistically significant but also highlight that despite the screening use of bladder scanning to assess for presence of urinary retention, prolonged use in indwelling urinary catheterizations will cause chronic urinary retention and may place patient at increased risk of UTI and kidney stone formation
urology specialist to rule out the possibility of prostatic or other urological pathology. Female participants would be referred only to a specialist clinic when protocol was ineffective.
### Appendix G

#### Table 3A

*Frequency of All Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention Group</td>
<td>3 (14.3)</td>
</tr>
<tr>
<td>Control Group</td>
<td>18 (85.7)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>18 (85.7)</td>
</tr>
<tr>
<td>Male</td>
<td>3 (14.3)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>1 (5.0)</td>
</tr>
<tr>
<td>61-70</td>
<td>4 (20.0)</td>
</tr>
<tr>
<td>71-80</td>
<td>3 (15.0)</td>
</tr>
<tr>
<td>81-89</td>
<td>4 (20.0)</td>
</tr>
<tr>
<td>&gt;89</td>
<td>8 (40.0)</td>
</tr>
<tr>
<td><strong>Type of Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>Total Joint Replacement</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hip Hemiarthroplasty</td>
<td>4 (19.0)</td>
</tr>
<tr>
<td>Hip IM Nailing/Pinning</td>
<td>17 (81.0)</td>
</tr>
<tr>
<td><strong>Hours Given for Voiding Trial</strong></td>
<td></td>
</tr>
<tr>
<td>1 Hour</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>2 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>3 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Time</td>
<td>Incidence</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>4 Hours</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>5 Hours</td>
<td>2 (9.5)</td>
</tr>
<tr>
<td>6 Hours</td>
<td>5 (23.8)</td>
</tr>
<tr>
<td>7 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>8 Hours</td>
<td>8 (38)</td>
</tr>
<tr>
<td>9 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>10 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>11 Hours</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>12 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>13 Hours</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>14 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>15 Hours</td>
<td>0 (0)</td>
</tr>
<tr>
<td>16 Hours</td>
<td>2 (9.5)</td>
</tr>
</tbody>
</table>

**Bladder Scan Volume**

- 0 (no bladder scan performed): 18 (85.7)
- >200 ml: 1 (4.8)
- >400 ml: 2 (9.5)
- >600 ml: 0 (0)
- >800 ml: 0 (0)
- >1000 ml: 0 (0)

**Straight Catheterization**

- Yes: 0 (0)
- No: 21 (100)

**Failed Trials to Void**

- 0: 16 (76.2)
- 1: 4 (19.0)
<table>
<thead>
<tr>
<th>Indwelling Catheter Inserted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of Stay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>4 days</td>
<td>11 (52.3)</td>
</tr>
<tr>
<td>5 days</td>
<td>4 (19.0)</td>
</tr>
<tr>
<td>6 days</td>
<td>3 (14.3)</td>
</tr>
<tr>
<td>7 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>8 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>9 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>10 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>11 days</td>
<td>1 (4.8)</td>
</tr>
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<td>12 days</td>
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<td>13 days</td>
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<tr>
<td>14 days</td>
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<tr>
<td>15 days</td>
<td>0 (0)</td>
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<tr>
<td>16 days</td>
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<tr>
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<tr>
<td>18 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>19 days</td>
<td>0 (0)</td>
</tr>
<tr>
<td>20 days</td>
<td>1 (4.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobility</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Mobile</td>
<td>1 (4.8)</td>
</tr>
</tbody>
</table>
INCIDENCE OF URINARY RETENTION

| Post-Op Day 0 | 4 (19.0) |
| Post-Op Day 1 | 14 (66.6) |
| Post-Op Day 2 | 1 (4.8) |
| Post-Op Day 3 | 1 (4.8) |

Cognitive Status
- Awake, Alert, and Oriented to Person, Place, and Time
  - Awake, Alert, and Oriented to Person
    - 13 (61.9)
  - Awake, Alert, and Oriented to Person
    - 2 (9.5)
  - Awake, Alert, and Oriented to Person
    - 6 (28.6)

Note. N=21; All participant data was collected from chart review. There is was no missing data.
Appendix H

Table 3B

*Descriptive Statistics of Scale Variables*

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Hours Given for Voiding Trial</th>
<th>Length of Stay</th>
<th>Mobility</th>
<th>Cognitive Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>6.71</td>
<td>7.86</td>
<td>5.52</td>
<td>1.86</td>
<td>1.67</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>7.0</td>
<td>8.00</td>
<td>4.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>1.34</td>
<td>3.637</td>
<td>3.696</td>
<td>.793</td>
<td>.913</td>
</tr>
<tr>
<td><strong>Variance</strong></td>
<td>1.80</td>
<td>13.229</td>
<td>13.662</td>
<td>.629</td>
<td>.833</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>4</td>
<td>15</td>
<td>17</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>8</td>
<td>16</td>
<td>20</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Percentiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>5.25</td>
<td>6.0</td>
<td>4.00</td>
<td>1.50</td>
<td>1.00</td>
</tr>
<tr>
<td>50%</td>
<td>7.99</td>
<td>8.0</td>
<td>4.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>75%</td>
<td>8.00</td>
<td>8.0</td>
<td>5.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
## Appendix I

### Table 4

*The Kruskal-Wallis Test for Scale Variables*

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Test</th>
<th>Significance</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>The distribution of Age in years is the same across categories of Intervention versus Control Group</td>
<td>Independent-Samples Kruskal-Wallis Test</td>
<td>.497</td>
<td>Retain the null hypothesis</td>
</tr>
<tr>
<td>The distribution of Orientation to person, place, and time/situation is the same across categories of Intervention versus Control Group</td>
<td>Independent-Samples Kruskal-Wallis Test</td>
<td>.599</td>
<td>Retain the null hypothesis</td>
</tr>
<tr>
<td>The distribution of Participants moved OOB to chair/walk is the same across categories of Intervention versus</td>
<td>Independent-Samples Kruskal-Wallis Test</td>
<td>.149</td>
<td>Retain the null hypothesis</td>
</tr>
</tbody>
</table>
INCIDENCE OF URINARY RETENTION

Control Group

The distribution of Length of Patient Stay is the same across categories of Intervention versus Control Group

The distribution of Bladder Scan Volume is the same across categories of Intervention Versus Control Group

The distribution of Hours given for Voiding trial is the same across categories of Intervention Versus Control Group

Independent-Samples Kruskal-Wallis Test

.913 Retain the null hypothesis

.004 Reject the null hypothesis

.755 Retain the null hypothesis

*\( p < .05 \).