Use of Silver Coated Catheters to Prevent Urinary Tract Infections:

An Evidenced Based Project

Team Purple

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Evidenced Based Project Identification of Clinical Question

The purpose of this paper is to identify the significance of catheter associated urinary tract infections in relation to urinary catheter use. The use of urinary catheters remains prevalent in healthcare facilities today. Each year approximately four million Americans undergo urinary catheterization, approximately 500,000 remain indwelling for a period of time, and 25% of hospitalized patients have an indwelling catheter (Parker et al., 2009). The urinary system is the most common site for hospital-acquired infections and catheter-associated urinary tract infections (CAUTIs) account for almost 40% of all nosocomial infections (Parker et al., 2009). CAUTIs increase the length of stay, hospital costs, morbidity, and mortality (Williams & Haas, 2007). CAUTIs can add as much as $500 million in healthcare costs to the United States each year (Srinivasan, Karchmer, Richards, Song, & Perl, 2006).

Several suggestions related to catheter care and types of catheters have been recommended to decrease CAUTIs. Recent speculation has alluded to the fact that although more expensive, silver-alloy coated urinary catheters may decrease the occurrence of CAUTIs. As CAUTIs remain such a prevalent issue related to healthcare costs and patient outcomes, additional information is required to determine the difference in CAUTI rates in the traditional non silver-alloy urinary catheter versus the silver-alloy coated catheters.

Clinical Foreground Question

In hospitalized patients with urinary catheters, what is the effect of silver-coated alloy catheters compared to the traditional non silver-alloy urinary catheter on decreasing catheter related urinary tract infections?

Appraisal of the Evidence

Introduction

Urinary tract infection (UTI) is the most common hospital acquired infection today. Use of urinary catheters increases the risk of UTI development in patients. According to the Compendium of Strategies to Prevent Catheter Associated Urinary Tract Infections in Acute Care Hospitals, "Twelve to sixteen percent of hospital inpatients will have a urinary catheter at some time during their hospital stay" (SHEA & IDSA, 2008, p S41). Furthermore, on July 31, 2008, Centers for Medicare & Medicaid Services (CMS) identified catheter associated urinary tract infections (CAUTIs) as one of ten health care acquired conditions that would be subject to changes in reimbursements (CMS, 2010). Subsequently, hospitals around the United States are diligently working to implement evidence based practice protocols to decrease the incidence of CAUTIs.

One potential intervention under consideration by many facilities, is use of silver coated urinary catheters as a risk reduction and best practice strategy. Evaluation of use of these catheters versus standard silicone or latex catheters has been the subject of health related research. The medical uses of silver include its use as an antiseptic and disinfectant. "Among inorganic antibacterial agents, silver has been employed most extensively since ancient times to fight infections and control spoilage" (Sukdeb Pal, 2007, p 1). Today, silver impregnated products are utilized extensively in health care. Examples include silver dressings for wounds and central lines, silver coated intravenous catheters, and silver alloy urinary catheters. The rise in antibiotic resistent bacteria, has increased the need for alternative measures to prevent infections with use of medical applications. The purpose of this literature review is to evaluate

current data related to use of silver alloy catheters in decreasing CAUTIs (refer to Appendix A, Tables A1 and A2 for summary and analysis of literature).

Substantive Themes

The pattern of evidence in the literature review points to a consistent decrease in CAUTIs with the use of a silver-coated urinary catheter. While some findings were not considered statistically significant, the findings still resulted in a decrease in CAUTIs with the use of silver-coated catheters in all studies. The evidence reviewed consisted of a sample size of thousands of patients and catheter days. The evidence also demonstrated a decrease in CAUTI rates that ranged from 32%-72%. One study stated a 100% decrease, but that was an isolated study. The decrease in CAUTI rates per 1000 catheter days ranged from 16.2 in the non-silver catheter population, down to 2.37 in the silver-coated catheter population.

One gap in the body of evidence is the inconsistent definition of a CAUTI. While most studies utilized the Center for Disease Control (CDC) definition, this was not true of all studies. Another short-coming is the measurement used to determine CAUTI. Some studies only included symptomatic CAUTIs, while others based the results solely on the culture reports. The differences in the reporting measures also allows for gaps in the evidence. While some studies reported rates for CAUTIs as infections/1000 catheter days, others used infection/100 catheters and others utilized infection/patient days. One final gap that was addressed in some of the studies is that other practice changes cannot be ruled out as a contributing factor to the decrease in CAUTIs. Examples included focus on hand hygiene, catheter monitoring changes, early removal of catheter, and antibiotic usage.

Theoretical Themes

In many nursing studies, the framework is not an explicit theory or conceptual model, and often the underlying theoretical rationale for the inquiry is not explained (Polit & Beck, 2008). The research evidence reviewed was mainly all quantitative research, without any references to theoretical frameworks being utilized to address the research question. However, "even in the absence of a formal theory, quantitative research can inductively weave together the findings from prior studies into a conceptual scheme that provides methodologic and conceptual direction to the inquiry" (Polit & Beck, 2008, p. 164).

Methodologic Themes

Research methods can be defined as the "steps, procedures, and the strategies for gathering and analyzing data in a study" (Polit & Beck, 2008, p. 758). The design and methods of a research study are dependent upon the subject matter under review. Qualitative designs are utilized to explore and explain human experiences and perceptions. Quantitative designs utilize numbers to explain and predict phenomena. A quantitative research study that involves manipulation of variables or initiation of interventions is called a clinical trial. Blinded randomized clinical trials are the strongest, most reliable form of research studies.

As noted above, the articles in this literature review concerning use of silver alloy catheters were mainly quantitative in nature. Over half of the articles utilized quasi-experimental or experimental designs. In these quantitative studies, the dependent variable was almost uniformly CAUTI rates. The independent variables included the catheter types included in each research project. Sample size varied and sampling methods included mostly convenience sampling. There was little blinding and most randomization was done based on unit type or

defined study time periods. There was one qualitative study that assessed nurse's perceptions of policies, knowledge and attitudes about UTI prevention methods (Drekonja et al, 2010).

Generalizability/Transferability Themes

The sample population in the reviewed studies consisted of patients with urinary catheters in an in-patient setting. All studies were conducted in a hospital setting on multiple different care units, with the exception of one that was performed in an in-patient rehabilitation facility. The care units included but were not limited to burn unit, medical intensive care, surgical intensive care, general medical, and surgical care units. Most studies did not isolate data to certain units of the hospital, but rather compared silver-coated and non-silver catheters. All studies were performed in-patient, and therefore assessed short-term catheter use only. The findings support the ability to generalize the data to hospitalized patients with short-term catheter use. No data was obtained for out-patients and therefore cannot be generalized to the out-patient setting, where catheter use may be long-term.

Historical Themes

The Center for Disease Control and Prevention (CDC) published guidelines for prevention of catheter associated urinary tract disease in 1981 (Parker et al, 2009) and more recently in 2009. However, recent literature shows that indwelling urinary catheters and their associated urinary tract infections continues to be problematic.

There are substantive trends over time that suggests that the use of silver alloy catheters resulted in marked reduction in the number of CAUTIs versus standard latex catheters. Evidence is getting better in establishing validity and reliability. Studies using different populations and sample sizes consistently show that silver alloy catheters reduce CAUTIs. Research as recent as 2010 has been conducted, and is still yet ongoing, as hospitals and healthcare facilities explore

what will economically reduce hospital cost, patients stays, catheter days and treatment of CAUTIs. Studies also support that the reduction in CAUTIs reduces the risk that facilities encounter in acquiring reimbursement and provides best medical care to patients. Cost of the silver alloy catheters has been compared to standard latex catheters, and studies suggest that the reduction in nosocomial infections from CAUTIs provide a cost benefit to facilities. However, it has been suggested by researchers that urinary catheter use needs to be examined more carefully. Guidelines regarding who should receive indwelling catheters, when these catheters are clinically indicated, who is at risk for CAUTIs, and what the best practices are for insertion, care technique, and discontinuation should be established in every healthcare facility.

Researcher Themes

The majority of the researchers of the literature review were professionals in the healthcare arena such as nurses, advanced practice nurses, nurse specialists and medical doctors. Many of the nurses participated in programs for quality improvement, infection prevention, and /or infection control in their facilities. Large numbers of nurses are in some type of advanced practice role with advanced degrees such as leadership, nurse directors, researchers, professors and educators, nurse managers, clinical consultants and administrators, with either Master's or Doctorate degrees. Most studies were done in the United States. There has been an explosive interest in CAUTIs as the CMS declared that reimbursements would not be made for catheter related UTI's, if acquired during a stay in the hospital. Focus from the CMS has been put on not only the reduction of CAUTIs overall, but also on the prevention of CAUTIs .This idea has not been expressed from other countries in reviewing the literature. Researchers appeared to be specialists in their field and knowledgeable about the research process. In most studies, extensive literature reviews were performed, and multiple study designs were investigated.

Conclusion

A thorough review of the literature was performed on the use of silver coated urinary catheters and their impact on CAUTI rates. While most of the studies reviewed were not randomized, double-blinded controlled studies, the results of all the studies demonstrated a decrease in CAUTI rates when a silver coated urinary catheter was used compared to a non-silver urinary catheter. Although, most of these differences in CAUTI rates were not statistically significant, there is much indication for further research on the use of silver coated catheters. Research on cost savings, short and long term catheter use, long term effects of silver, and the impact of implementing practice guidelines in regards to catheter techniques in care, insertion, and duration all need to be explored more in depth. With the recent changes in the CMS no longer reimbursing for hospital acquired CAUTI, preventing and reducing the incidence of CAUTI is a priority initiative for many healthcare facilities. Exploring the use of silver coated urinary catheters has demonstrated some promising results over the past decade and continues to be researched for the best evidence today.

Implementation Plan

Based on the literature reviewed on the use silver coated urinary catheters, an evidenced based protocol was developed (Refer to Appendix B for protocol). The potential to implement the protocol was verified and steps to pilot test and evaluate the protocol were identified.

Transferability of the Findings

The proposed setting for implementation of this practice guideline is the inpatient hospital setting. The inpatient units that will pilot this implementation are general med-surgical and intensive care. The target populations utilized in the research included inpatient hospital

units, with the exception of one inpatient rehabilitation facility. This pilot will utilize similar units, such as medical-surgical and intensive care units.

The change in practice requires a different type of indwelling urinary catheter for patients that require short-term catheter use. Short-term use is defined as up to two weeks duration of the indwelling catheter. The current philosophy of urinary catheter use is not different for this protocol, as the catheter type itself is the only change.

Each year approximately four million Americans undergo urinary catheterization, approximately 500,000 remain indwelling for a period of time, and twenty-five percent of hospitalized patients have an indwelling catheter (Parker et al., 2009). The urinary system is the most common site for hospital-acquired infections and catheter-associated urinary tract infections (CAUTIs) account for almost forty percent of all nosocomial infections (Parker et al., 2009). CAUTIs increase the length of stay, hospital costs, morbidity, and mortality (Williams & Haas, 2007). Based on this information, there are a large number of patients that can benefit from this practice change. This change can be easily implemented by changing the urinary catheter type to a silver-coated catheter, versus the use of the non-silver catheter.

Feasibility

This practice change is easily accomplished by the nursing staff. In the event that there is the need to stop the use of the silver-coated catheter for any reason, this can be done by the nursing staff and the catheter can be removed and replaced with the previous non-silver catheters. This practice change does not interfere with current practice as guidelines for catheter care and implementation will be the same except with a different product.

Administrative support is obtained by providing information regarding the potential of improved quality outcomes in decreasing CAUTIs. The silver-coated catheters are more costly

and therefore details related to the return on investment are provided. Antibiotic usage to treat CAUTIs and increased hospital length of stay information are compared to the additional cost of these catheters. These items will be further discussed under the cost/benefit ratio information.

Silver-coated medical devices are common and have proven to prevent infection in medical uses such as dressings and endotracheal tubes. Consensus of the physicians, nursing staff, infection control practitioners and infectious disease physicians is required in the success of this protocol. This group is necessary in driving the understanding and support to improve quality measures through this intervention.

The skill requirement of the nursing staff is unchanged with this protocol. Education regarding the device change and supportive reasons will be communicated to appropriate staff. The staff members that will receive training are the direct care-givers on the assigned nursing units, unit managers, infection control nurses, and clinical educators. Training hours related to the new product have been calculated and it is determined that a thirty minute classroom in-service is necessary. Those who are absent from the in-service will review educational handouts and follow up with the unit educator. These hours have been compared to the training budget hours and should not exceed the budgeted hours for the time period. These hours have been approved by Nursing Leadership and administration (refer to the training curriculum in Appendix C).

The catheter systems are ordered through the purchasing department. The silver-coated catheters are available on contract and therefore will not require rate negotiation through the finance department. The amount of supply required for a six month pilot is approximately 240 catheter systems (20 cases). Existing supply of urinary catheters on the designated unit supply carts will be removed and replaced with the silver coated catheters.

Measuring tools for this practice change do not differ than current tools used for measuring CAUTI rates. Urine culture review by the Infection Control Practitioner and infectious disease physician will continue to determine whether or not a CAUTI has occurred. This information will follow the normal reporting mechanisms for the organization up through the Infection Control Committee, the Medical Executive Committee and the Quality Council. (See definitions for symptomatic CAUTIs in the protocol)

Cost/Benefit Ratio of the Innovation

The risks to the patients related to this practice change are minimal. Silver allergies must be noted on admission and these patients will not be enrolled in the pilot program. One study tested antimicrobial resistance to silver, and determined that this did not occur during the study, although further research is required. Silver sensitivity must be monitored and the catheter discontinued if this occurs. Other risks to the patient are the current risks associated with urinary catheters; the development of a urinary tract infection.

The potential benefits for this practice change include decreased CAUTIs. This benefit affects both the patient and the organization. The patient may experience discomfort related to a CAUTI as well as side effects of the antibiotics used to treat the infection. The patient may also be required to stay in the hospital longer if a CAUTI occurs. A prolonged length of stay may occur depending on the organism and the treatment regimen required for the infection. A decrease in CAUTIs will provide benefit to those patients that do not acquire an infection.

The organizational benefits include positive quality outcomes, and potential financial benefits. Some organizations are required to report quality outcomes. CAUTIs are considered a preventable infection. Organizations with high nosocomial infection rates may be viewed poorly by the public in overall quality of care. The financial benefits to the organization include

decreased avoidable patient days and decreased cost of antibiotic use. While some CAUTIs are less costly to treat, other antibiotic resistant organisms may require costly medication regimens. The risk of not implementing this practice change would be continued CAUTIs.

The material costs to the organization associated with this practice change include the catheter cost and training hours for staff. The typical cost of each non-silver urinary catheter system (ordered by the case) is approximately $2.00, versus the typical cost of a silver-coated urinary catheter system which is approximately $8.00. The number of staff that requires training is approximately eighty (Registered Nurses, Licensed Practical Nurses, and Patient Care Technicians). Forty training hours of non-exempt employees is required.

The cost of the silver-coated catheter will increase the unit's supply costs during the course of this pilot. Catheters will be ordered by the case and according to the past six month usage. It has been determined that twenty cases will be required for the pilot time period. The cost for long term change includes the comparative pricing of the silver-coated catheters versus the non-silver. The cost of the silver-coated catheters is $1440 more than non-silver catheters over a 6 month timeframe. This cost difference is based on amount of supply needed for the pilot units. However, future cost of this product must also be compared to antibiotic usage and patient days based on the decrease in CAUTIs.

Most urinary tract infections are treated with antibiotics such as Bactrim, Levaquin, Ciprofloxacin, or Zyvox. The cost of a full treatment regimen (7-10 days) with these antibiotics ranges from as little as $3.00 to as much as $1950 per infection. This price range includes both oral and intravenous forms of these antibiotics. These prices are cost to the hospital and not the charge to the patient, as the charge to the patient is much higher. Other costs associated with the treatment of a CAUTI include nursing labor, pharmacy equipment and labor, equipment for

intravenous administration, and avoidable patient days. Therefore, based on this information, the difference of $6.00 per catheter is relatively small compared to the potential cost of treating a CAUTI.

Potential barriers to implementation may include staff and physician resistance in accepting use of a silver coated urinary catheter. Literature supporting the use of silver catheters should be readily accessible for the clinicians to review on each pilot unit, in addition to the silver coated catheter protocol. Unit managers, educators, or infection control practitioners should be available to address any questions or concerns they may have.

Evaluating Outcomes

The units performing the pilot protocol are a 50-bed medical surgical unit and an 8-bed intensive care unit. The current CAUTI rate for the past six months is 3.05. The desired outcome for this pilot is a decrease in CAUTI rates related to the use of silver-coated catheters. No other changes to practice will be implemented during this pilot period except for the change in catheter type. Upon completion of the six month pilot period, a full program evaluation will be completed to evaluate the effectiveness of the Silver Coated Catheter Use Protocol in reducing CAUTI rates. Rates pre-protocol and post-protocol will be analyzed. Other areas to be explored will include staff feedback regarding protocol implementation and the educational process. Barriers to implementation or continuation of the protocol will be assessed, in addition to the financial implications based on patient outcomes in the pilot units. Opportunities for improvement and options for further spread of the protocol to neighboring units within the facility will be identified.

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Appendix A

Summary and Analysis of Literature

Table A1 – Research Methods

Authors	Publication Year	Country	Theory	Dependent variables	Independent variables	Study Design	Sample size	Sampling Method	How Data Collected
Lai, K.K., Fontecchio, S.A.	2002	USA	N/A	CAUTI rate	Silver-hydrogel urinary catheters	Quasi-experimental	Average of 9109 patient days and 25 CAUTIs per month	Convenience sampling. Reviewed all patients at 375 bed hospital positive for CAUTI over 5 non consecutive months	Urine cultures and urinalysis positive for UTI per CDC criteria were reviewed over 5 months. Compared to baseline historical rate of UTI prior to silver catheter use.
Kerridge, J., Chou, T., Kulkarni, M., Malow, J.	2009	USA	N/A	CAUTI rate	Silver-impregnated urinary catheters	Quasi-experimental	6096 catheter days over a 5 month period at a 551 bed urban community hospital	Convenience sampling. Patients with urinary catheters admitted to the MICU and SICU during a 5 month period.	Urine cultures reviewed daily by infection preventionists and evaluated for CAUTI per CDC NHSN definitions
Hill, J., Jenkins, W., Boykin, D.	2007	USA	N/A	CAUTI rate	Urinary catheters- a) latex, b) all silicone, and c) silver coated, all silicone	Process improvement project	Sample size not given. Each surveillance period over 5 months at 261 bed community hospital	Convenience sampling	Chart reviews on all positive urine cultures and urinalysis reviewed during each 5 month surveillance period.
Drekonja,D. M., Kuskowski, M.A., Johnson, J.R.	2010	USA	N/A	None	None	Qualitative	10,000 Minnesota nurses	Minnesota Board of nurses provided e-mails for 10,000 randomly selected nurses. Invitation to participate was sent to these RNs who self selected for the study	Surveymonkey.com 17 question survey to assess nurses perception of policies, knowledge, &attitudes about UTI prevention methods

Table A1 – Research Methods (continued)

Authors	Publication Year	Country	Theory	Dependent variables	Independent variables	Study Design	Sample size	Sampling Method	How Data Collected
Seymour, Coral	2006	Whales	N/A	Urinary Tract Infection (UTI)	Silver Alloy coated Foley catheter use	Quasi-experimental – descriptive, pre- and post-intervention design	117 patients	Adult patients hospitalized at Royal Gwent Hospital who required a urinary catheter for >48 hours were included in the sample. Study unit used standard non coated catheters for 10 weeks followed by use of Silver Alloy – coated Foley catheters for a period of 10 weeks	Observation of patients for signs and symptoms of infection CAUTI (catheter associated urinary tract infection rates) per intervention period were calculated by study staff.
Karchmer,T. B., Giannetta,E.T., Muto, C.A., Strain, B.A., Farr,B.M.	2000	USA	N/A	Urinary Tract Infection	Silver coated catheter use	Experimental Randomized Crossover Trial	27,878 patients 114,367 patient days	Randomization by hospital unit not individual patients. Adult ICU and step-down units were involved, each using different catheters, one silver coated and the other a standard non coated product for 6 months. After a 1 month wash out with the standard catheter, the two units switched products for an additional 6 months.	Microbiology data and patient record review for UTI diagnosis
Saint,S., Veenstra,D.C., Sullivan, S.D.,Chenoweth, C., Fredrick, M.	2000	USA	N/A	Symptomatic UTI, bacteremia, medical costs	Silver Alloy coated catheter use	Non-experimental	1000 acute care patients in need of short term catheters.	Simulated cohort consisting of patients admitted to hospitals for general medical, surgical, urologic, and intensive care services.	Hypothetical cohort in the decision analytic model utilizing Decision analytic software (DATA 3.5)

Table A1 – Research Methods (continued)

Authors	Publication Year	Country	Theory	Dependent variables	Independent variables	Study Design	Sample size	Sampling Method	How Data Collected
Gentry, H., Cope, S.	2005	UK	N/A	CAUTI rate	Silver alloy hydrogel coated Foley catheter	Experimental. Quality improvement study	133 during 2003 & 2004	340 bed acute general hospital in Worcestshire, from medical and surgical patients.	A baseline population before insertion of silver coated catheter established. Each patient meeting criteria for an indwelling catheter for longer than 24 hours, compared to the baseline population.
Newton, T., Still, J., Law, E.	2002	USA	N/A	CAUTI rate	Silver alloy impregnated Foley catheters	Quasi-experimental. Retrospective/ Comparative	1757	All patients admitted from referrals with catheters were included in the study.	Patients were referred to burn center from other facilities already having standard Foley catheters inserted.
Parker, D., Callan, L., Harwood, J., Thompson, D., Wilde, M., Gray, M.	2009	USA	CMS: major paradigm shift in reimbursement practice	CAUTI rate	Silver coated antimicrobial catheter	Meta-analysis, Non-experimental	13546; 13 trials	Individual studies from other researchers. Mixture of randomized clinical trials.	Extensive literature review
Kassler, J., Barnett, J.	2008	USA	N/A	CAUTI rate	Ionic silver coated catheters	Experimental	Not given. 6 month trial period.	42 bed rehabilitation (LTC) facility in North Arkansas. 95% of patients from acute care settings. Average length of stay is 13 days.	5% to 10% of patient populations have catheters. Patients transferring in with CAUTI were identified. The facility made a decision to change out catheters with 100% silicon, ionic silver coated catheters.

Table A1 – Research Methods (continued)

Authors	Publication Year	Country	Theory	Dependent variables	Independent variables	Study Design	Sample size	Sampling Method	How Data Collected
Johnson, J.R., Kuskowski,M., A., and Wilt, T., J.	2006	USA	N/A			Randomized or quasi-randomized trials			Systematic review of literature of other clinical trials
Srinivasan, A., Karchmer, T., Richards, A., Song, X., Perl, T. M.	2006	USA	N/A	CAUTI rates	Silver alloy catheters	Experimental. Prospective crossover study	3,036 patients	Convenience – 1 hospital setting. Used either silver-coated silicone catheter or non silver silicone catheter.	Obtained urine cultures based on MD orders. Participants had a catheter for greater than 48 hours and cultures could be obtained 7 days post catheter removal.
Rupp, M. E., Fitzgerald, T., Marion, N., Helget, V., Puumala, S., Anderson, J. R., Fey, P. D.	2004	USA	N/A	CAUTI rates	Silver coated urinary catheters	Prospective surveillance, experimental	NUTI rates over 4 year period in 600 bed tertiary care hospital, 10 patient units	NUTI rates (NUTI/1000 Foley catheter days)	2 year prospective surveillance study in 10 pt care units. Historical data used as control.

Table A2 – Strengths, Weaknesses, & Key Findings

Authors	Year of Publication	Major Strengths	Major Weaknesses	Key Findings
Lai, K.K., Fontecchio, S.A.	2002	Utilized CDC defined criteria for UTIs	• Not a randomized, double-blind, controlled study. • Utilized patient hospital days instead of catheter device days as denominator for UTI rates. • Baseline historical rates of UTI measured over 2 months, study period over 5 months	• Baseline CAUTI rate was 4.9/1000 pt days; CAUTI rate for study period with silver urinary catheters 2.7/1000 pt days. Results in 45% decrease (P=.1), but not statistically significant. • Averages to 516 CAUTIs per year in baseline year compared to 216 CAUTIs/yr with silver catheter use. • Estimated yearly cost of savings from using silver catheters based on *average cost* of UTI is $142,000, but only savings of only $12,500 when based on the *median cost* of UTI.
Kerridge, J., Chou, T., Kulkarni, M., Malow, J.	2009	Large number of catheter days in study	• Not a double-blinded case control study. • Cultures obtained only from pts with suspected UTIs and not all pts. • Different individuals collected the data	• The CAUTI rates with the silver-coated catheters were 3.05 infections/1000 urinary catheter days in the MICU compared to the non-silver silicone catheter rate of 5.57; The SICU rate was 4.64 with silver-coated catheters compared to 5.45 with non-silver catheters. • No statistical differences in CAUTI rates between groups • Use of non-silver catheters and staff education on CAUTI prevention as effective as using silver coated catheters.
Hill, J., Jenkins, W., Boykin, D.	2007	Measured CAUTI rates with 3 different types to evaluate differences between groups- latex, silicone, silver-coated silicone	• Sample size of groups not given • Not a randomized study • No definition given for criteria to diagnose CAUTI	• No statistical difference in CAUTI rate comparing latex catheters to all-silicone catheters • Statistically significant decrease in CAUTI rate between latex and silver-coated silicone catheters by 40% (p=0.0223) • Statistically significant decrease in rates by more than 34% between all-silicone and sliver-coated silicone (p=0.0483) • Estimated cost of annual savings based on decrease of 27 CAUTIs when using silver silicone Foley catheters= $186,000. • Decrease in CAUTI decreases morbidity, antibiotic usages, length of stay, and is cost-effective

Table A2 – Strengths, Weaknesses, & Key Findings (continued)				
Authors	**Year of Publication**	**Major Strengths**	**Major Weaknesses**	**Key Findings**
Drekonja,D.M., Kuskowski, M.A., Johnson, J.R.	2010	Diverse sample population from multiple areas of nursing specialty	• Low response rate – 4% lends to possible response bias	• ICU RNs rated antimicrobial coated catheters more highly for preventative efficacy than did other RNS (3.2 vs. 3.0 respectively; P=.007) • Significant room exists for improving the catheter related knowledge of Minnesota RNS. • System based practices to standardize ordering and monitoring of catheters appear to be underused. • Respondents related the practice of early removal as the most effective prevention measure (4.5 out of 5)
Seymour, C.	2006	Clear inclusion and exclusion criteria	• Randomization by nursing unit rather than participant • No standardized definition for UTI (e.g. CDC Definitions) reported	• When Silver Alloy catheters were used there was a reduction in risk rate of 71.2% exceeding the audit's aim of 20%
Karchmer,T.B., Giannetta,E.T., Muto, C.A., Strain, B.A., Farr,B.M.	2000	Utilized Center for Disease Control definitions for standardization, consistency, and comparability. High power with large sample size	• Participants were not randomized as individuals, rather by nursing units – one unit may have received more education or be more proficient at asepsis with insertion or care of catheters – potential for detection or misclassification bias	• Overall rate of infection in patients with catheters inserted on study was 2.64 infections/100 catheters used. • For infections in the silver alloy population, the rate was 2.13 infections/100, compared with 3.12 infections per hundred • There was a 32% reduction of CAUTIs with use of silver coated catheters. (RR 0.68, 95% CI, P=.001)

Table A2 – Strengths, Weakness, & Key Findings (continued)				
Authors	**Year of Publication**	**Major Strengths**	**Major Weaknesses**	**Key Findings**
Saint,S., Veenstra,D.C., Sullivan, S.D., Chenoweth, C., Fredrick, M.	2000	Performed with multivariant sensitivity analysis	• This was an estimate of symptomatic UTI based on 2 previous prospective studies • Hypothetical cohort design	• Use of Silver Alloy catheters in patient requiring short term catheterization reduces the incidence of symptomatic UTI and bacteremia • There is likely a cost savings with using Silver Alloy catheters compared to standard catheters.
Gentry, H., Cope, S.	2005	Authors were the primary source. Authors were infection prevention and control nurses. Easy access to participants.	• Small sample. Not enough sample meeting criteria for catheterization. Were monitored during hospital stay and 7 to days after catheter removed or discharge, whichever came sooner. • More research studies need to be performed.	• Comparison of treated to baseline historical data. Drop in CAUTI rate, from 7.7% in the baseline to 5.1% in the evaluation sample, represented an overall reduction rate of 33.5%. Reduced clinical risk to the patients. • Overall decrease in cost due to less being treated for CAUTI's and less hospital stays.
Newton, T., Still, J., Law, E.	2002	Authors were the primary source and conducted the study.	• Not a doubled blinded case control study.	Study consisted of two time periods, with two treatments. In 1988 (time period 1) patients that were referred with a catheter kept that catheter inserted unless a problem existed, and then it was replaced with a silver alloy coated catheter. In 1999(time period 2), all patients referred who already had a catheter, had their catheter immediately changed to a silver alloy catheter. • In time period 1, the rate of symptomatic UTI was 7.2/1000 catheter days. • In time period 2, the rate decreased to 4.4/1000 catheter days. • Results compared using Fisher exact test with a P value of 0.029 • The use of silver impregnated catheters significantly reduced infection rate

Table A2 – Strengths, Weaknesses, & Key Findings (continued)				
Authors	**Year of Publication**	**Major Strengths**	**Major Weaknesses**	**Key Findings**
Parker, D., Callan, L., Harwood, J., Thompson, D., Wilde, M., Gray, M.	2009	Large sample size.	• Authors were not the primary source, but secondary. Non-experimental but data collected from other studies.	Evidence based study of prevention of CAUTI's Initial questions answered: • Does insertion of an antimicrobial catheter influence the risk of catheter-associated UTI's? • Does catheter size influence the risk of CAUTI? • Does silver alloy coated catheter reduce the rate of infection of CAUTI? Strong evidence was found supporting insertion of a silver alloy coated catheter reduce the risk of CAUTI's for up to two weeks by patients with indwelling catheters.
Kassler, J., Barnett, J.	2008	Large number of catheter days in the study. Authors are the primary source who conducted the study.	• Not enough information about the sample size of the study. • Not a double blinded case control study. Cannot determine study contains adequate sample size. • More studies need to be conducted.	• 100% drop in CAUTI in a rehabilitation facility, during the six month trial period. Prior to changing to ionic silver coated catheters, facility had 10 nosocomial CAUTI in 4 months.
Johnson, J.R., Kuskowski,M., A., and Wilt, T., J.	2006	Reviews many studies of different catheters marketed in the US	• This is a review of literature and not one particular study. It involves 12 different studies.	• Antimicrobial catheters can prevent bacteriuria depending on the coating and several other variables. • Cost implications and effect on infectious complications remain undefined.
Srinivasan, A., Karchmer, T., Richards, A., Song, X., Perl, T. M	2006	Measured actual UTIs versus doing daily collection of cultures. Utilized the Center for Disease Control criteria.	• Sample group was disproportionate. Participant characteristics included more men than women. • Statistical difference was not significant for either group.	• 334 CAUTIs were detected. 116 in silver group (rate based on 1000 catheter days was 14.3). 218 in nonsilver group (rate based on 1000 catheter days was 16.2). Although silver group rate was lower, this was deemed to not be statistically significant. • There were no significant differences between silver and nonsilver groups with respect to the types of organisms that grew in cultures.

Table A2 – Strengths, Weaknesses, & Key Findings (continued)				
Authors	**Year of Publication**	**Major Strengths**	**Major Weaknesses**	**Key Findings**

Rupp, M. E., Fitzgerald, T., Marion, N., Helget, V., Puumala, S., Anderson, J. R., Fey, P. D.	2004	Length of time of surveillance is total of 4 years. Authors note that this could decrease Hawthorne Effect and limited practice changes.	• Was not a prospective, randomized, controlled trial.
			• Confounding variables cannot be excluded such as hand hygiene, antibiotic usage, case mix and severity of illness.
				• Compared to 1999, the NUTI rate decreased by 62% in 2001 and 52% in 2002.
				  ○ 1999: NUTI rate 6.3/1000 catheter days
				  ○ 2000: NUTI rate 6.01/1000 catheter days
				  ○ 2001: NUTI rate 2.37/1000 catheter days
				  ○ 2002: NUTI rate 2.84/1000 catheter days
				• Cost savings with silver alloy ranged from $5811-$535,000 in 2001-2002
				• No resistance to silver was noted

Appendix B

Use of Silver Coated Catheters to Prevent Catheter Associated Urinary Tract Infections (CAUTI) in Acute Care Patients

DEFINITIONS:

CAUTI is a urinary tract infection that developed as a result of urinary catheterization. Urinary tract infections are defined as catheter associated if the patient had an indwelling urinary catheter at the time of or within 48 hours before onset of the infection (NHSN, 2010). For purposes of this protocol, only Symptomatic CAUTIs will be included in the CAUTI rates.

The following are guidelines for determining a Symptomatic CAUTI:

Symptomatic CAUTI: Criterion 1A Patient had a urinary catheter in place at the time of the specimen collection **AND** At least 1 of the following signs and symptoms with no other recognized cause: fever (>38 C or 100.4 F), suprapubic tenderness, or costovertebral angle pain or tenderness **AND** A positive urine culture with 100,000 colony forming units (CFU)/ml with no more than 2 species of microorganisms
Symptomatic CAUTI: Criterion 1B Patient had a urinary catheter removed within the 48 hours prior to specimen collection **AND** At least 1 of the following signs and symptoms with no other recognized cause: fever (>38 C or 100.4 F), urgency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness **AND** A positive urine culture with 100,000 colony forming units (CFU)/ml with no more than 2 species of microorganisms
Symptomatic CAUTI: Criterion 2A Patient had a urinary catheter in place at the time of the specimen collection **AND** At least 1 of the following signs and symptoms with no other recognized cause: fever (>38 C or 100.4 F), suprapubic tenderness, or costovertebral angle pain or tenderness **AND** A positive urinalysis demonstrated by at least 1 of the following findings: a. Positive leukocyte esterase and/or nitrite b. Pyuria (specimen with ≥ 10 white blood cells or ≥ 3 WBC/high power field of unspun urine) c. Microorganisms seen on Gram stain of unspun urine **AND** A positive urine culture of ≥ 1,000 and < 100,000 CFU/mL with no more than 2 species of uropathogen microorganisms
Symptomatic CAUTI: Criterion 2B Patient had a urinary catheter removed within the 48 hours prior to specimen collection **AND** At least 1 of the following signs and symptoms with no other recognized cause: fever (>38 C or 100.4 F), suprapubic tenderness, or costovertebral angle pain or tenderness

AND
A positive urinalysis demonstrated by at least 1 of the following findings:

a. Positive leukocyte esterase and/or nitrite
b. Pyuria (specimen with ≥ 10 white blood cells or ≥ 3 WBC/high power field of unspun urine)
c. Microorganisms seen on Gram stain of unspun urine **AND**

A positive urine culture of ≥ 1,000 and < 100,000 CFU/mL with no more than 2 species of uropathogen microorganisms

Asymptomatic Bacteriuria: for purposes of this protocol will not be included in the CAUTI rates. Guidelines are as follows:

1. Patient has or has had a urinary catheter within the 48 hours prior to the specimen collection,
2. **and** as a positive urine culture (≥ 100,000 cfu/ml) with no more than two organisms,
3. **and** pt has had **NO** fever, dysuria, or suprapubic tenderness.

CAUTI rate calculation: the rate for CAUTIs is calculated as follows:

$$\frac{\text{\# of confirmed symptomatic CAUTIs}}{\text{Total patient urinary catheter days}} \times 1000$$

Short term catheterization is defined as use of a urinary catheter for a period of 2 – 14 days consecutively.

Silver Coated Catheters have a coating of Silver Alloy formulated to inhibit bacteria and biofilm growth, thus reducing the incidence of CAUTI.

ETIOLOGY
Between 15% and 25% of hospitalized patients may receive short-term indwelling urinary catheters during their hospital stay (CDC, 2009). Urinary tract infections are the most frequently occurring healthcare associated infection. Catheter associated urinary tract infections are associated with increases in morbidity, mortality, hospital cost, and length of stay (CDC, 2009).

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SUBJECTIVE
Patients with a symptomatic urinary tract infection may report urgency, frequency, and lower abdominal pain or tenderness. Some patients with a UTI will be asymptomatic.

OBJECTIVE
Urine specimens provide objective criteria for diagnosis of a UTI. These include the presence of bacteria, white blood cells, blood, leukocyte esterase, and nitrates. Urine with 100,000 per ml bacteria per high-power field is significant for a urinary tract infection.

ASSESSMENT
Literature supports the use of silver coated catheters for CAUTI prevention in patients requiring short term catheterization.

PROTOCOL

1. Patients admitted to inpatient status with orders for urinary catheterization, will be assessed for silver coated catheter use.
2. Patients admitted with a urinary catheter will be changed to a silver-coated urinary catheter on admission.
3. Criteria for utilization of silver catheter include:
   - Adult patients who will require indwelling urinary catheterization for between 2 – 14 days.
   - ICU patients
   - Medical-surgical patients

4. Patients not considered candidates for use of silver coated catheters will utilize standard non-silver urinary catheters. The following will be excluded from the silver-coated urinary catheter protocol:
   - Pediatric patients
   - Pregnant patients
   - Outpatient or observation status patients
   - Patients undergoing elective surgical procedures (total joint arthroplasty, hysterectomy, mastectomy, etc.) in which catheterization is not required post-operatively
5. Catheter type, size, balloon volume, insertion date, and time are to be documented in the electronic medical record.
6. All catheters (silver or standard Foley) are to be inserted with aseptic technique and properly secured with an approved device holder.

REFERENCES

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Appendix C

Use of Silver Coated Catheters
Protocol Education Plan

Training Requirements:

Each member of the nursing staff on pilot units will attend a mandatory 30 minute educational session prior to implementation of the new protocol. Training will be scheduled at 0730 and 1930 for a total of 6 training sessions.

Training Objectives:

- Nursing staff will list signs and symptoms of symptomatic urinary tract infections.
- Nursing staff will describe the potential benefits of using Silver Coated Catheters.
- Nursing staff will identify the population of patients that are candidates for the Silver Coated Catheters per the protocol.

Evaluation of the Learners Level of Understanding:

A written case scenario with questions directed at the training objectives and the protocol specifics will be completed at the end of the training session by participants to evaluate understanding.

Training Format:

- Clinical educator of ICU unit will present a PowerPoint presentation describing the impact of CAUTI, signs and symptoms of UTI, benefits of Silver Coated Catheters based on literature review, and the protocol specifics in this group setting. (15 minutes)
- Handouts with CAUTI definitions and the protocol will be provided for each participant.
- Written case scenarios to assess understanding (5 minutes)
- Review of case scenarios with large group & questions time (10 minutes)