Comparison of Chlorhexidine and Triclosan Anti-Bacterial Soaps on Surgical Site Infections

Cheryl Barnes, Amanda Hanna, Vanessa Williams Suzack, Sharon Wehr,

and Michelle Wonacott

Ferris State University

Comparison of Chlorhexidine and Triclosan Anti-Bacterial Soaps on Surgical Site Infections

Nursing administration is a specialty practice role which has historical involvement in nursing research and illness prevention. Dating back to the mid 1800’s, nurses who functioned in a supervisory capacity noticed wound patterns and trends in post-operative Crimean War soldiers. These first nurse administrators identified possible causative factors, such as unsanitary conditions, for these wound trends and then enacted hygiene and cleanliness standards for the patients and those working (Lee, Clark, & Thompson, 2013). During this time great advances were made in medical and other sciences pertaining to illness and infection. Eventually the Germ Theory of Disease was developed which stated that disease and illness were caused by infectious micro-organisms called germs (Fry, 2010). Subsequently other theories were developed from the Germ Theory of Disease, notably Joseph Lister’s theory on the Antiseptic Principle of the Practice of Surgery which continues to be a basic underpinning to illness and infection prevention for today’s surgical patients (Fry, 2010).

Surgical site infections (SSIs) account for nearly 500,000 of the annual reported United States health care related infections (Wenzel, 2010, p. 75). Of these reported SSIs, an estimated 6,000 to 20,000 occur in patients whom have had either a total knee or hip arthroplasty procedure (Institute for Healthcare Improvement, 2012, p. 1). In 2011, the Musculoskeletal Infection Society (MSIS) convened to evaluate available literature and propose a universal standard definition for periprosthetic joint infections. The 21 member workshop included members of the Centers for Disease Control (CDC) and the National Institute of Health. According to Parvizi (2011), this new standard definition was adopted by the American Academy of Orthopedic Surgeons. The criteria for the approved definition will be used to define a surgical site infection in this proposed study (see Appendix A).

Nurse administrators by definition of scope of practice are leaders and managers in their field. They strive to implement best practice guidelines into clinical practice, assist in financial decisions for the betterment of their facility, develop policy and protocol for non-management personnel, and oversee policy change (American Nurses Association, 2009). According to the American Nurses Association’s (ANA) *Nursing Administrators Standards of Professional Performance*, nurse administrators will ideally be actively involved in nursing research and incorporating these research findings into practice (ANA, 2009). Since patients and health care organizations are greatly impacted by SSIs, interventions that reduce this negative outcome must be studied so nurse administrators can make evidenced based policy changes.

**Literature Review**

SSIs have presented as a post-operative complication for as long as surgical procedures have existed. Although uncountable advancements in medicine, pharmaceuticals, and science have occurred reducing the incidence of SSIs, these infections remain an area of great concern for nurse administrators. Research studies have indicated through culture results of SSI wound bed areas, the vast majority of SSIs are caused by skin flora such as Staphylococcus aureus (SA), Methicillin resistant Staphylococcus aureus (MRSA), and Enterococcus strains such as Vancomyacin resistant Enterococcus (VRE) (Ritz, Pashnik, Padula, & Simmons, 2012).

Another concern for health professions and nursing administrators is the bacteria causing SSIs, such as MRSA and VRE, are becoming increasingly virulent and drug resistant. Only a few antibiotics can combat these bacteria and the treatment often creates severe side effects such as possible liver and kidney damage. (Ritz et al., 2012). Another SSI concern for nurse administrators relates to patient mortality. Research indicates that patient demise occurs up to five times more frequently in patients that have a SSI following a surgical procedure especially total joint arthroplasties (Hemani & Lepor, 2009).

Standard of Nurse Administration Practice 7, Quality of Practice, states nurse administrators are to enhance the quality and efficacy of nursing practice, service administration, and delivery of care systems (ANA, 2009). To meet the requirements of this standard, a nurse administrator must initiate change via incorporation of new knowledge and use results of quality improvement constructs (ANA, 2009). Standard of Nurse Administration Practice 13, Research, states nurse administrators need to integrate research findings into clinical practice (ANA, 2009). To meet the requirements of this standard, a nurse administrator must utilize research findings and best practice evidence to create policy, procedure, and guidelines after assuring the evidence aligns with their organization’s vision, mission, and strategic plans (ANA, 2009). As new bacterial strains emerge into the healthcare landscape, it is the obligation of the nurse administrator to take an active role in researching prevention and treatment of SSIs and also integrating these findings into policy and protocol to ensure the highest quality patient care.

**Medical Research**

When conducting a literature review on SSIs, there are two main groups of research: medical based research and nursing based research. Studies conducted within the medical community focus on which cleansing and antiseptic agents are most effective in eradicating bacteria on the surface of the skin, pathophysiology of SSIs, and efficacy of screening operative patients for the presence of nosocomial agents such as MRSA and VRE. Multiple articles within current research indicate that the use of chlorhexidine gluconate (CHG) impregnated pre-operative preparations is more effective than traditional povidone iodine based preparations (Anderson, Horn, Lin, Parks, & Peterson, 2010; Hemani & Lepor, 2009). Studies based on total joint arthroplasty patients indicate that CHG impregnated preparations are 2.5 to 8 times more likely to reduce the incidence of SSI (Kapadia, Johnson, Daley, Issa, & Mont , 2012, p. 493; Zywiel et al., 2011). An interesting factor in all of the medical studies is the research teams recommend the use of triclosan based over the counter soap, such as Dial Soap, for patient wound cleansing use after hospital discharge (Anderson et al., 2010; Hemani & Lepor, 2009; Kapadia et al., 2012; Zywiel et al, 2011).

Research studies based on patient screening for nosocomial infections indicates that research subjects whom test positive for SA, MRSA, and VRE either in the nasal passages, urinary tract, or lower respiratory tract, are found to have a 5-30% higher incidence of SSI (Hautemaniere, Florentin, Hunter, Bresler, & Harteman, 2012, p. 2; Rao et al., 2011, p. 1502). These studies also indicate that the patients who test positive for SA, MRSA, and VRE are also increasingly likely to expire within one to two years post-operatively (Hautemaniere et al., 2012; Rao et al., 2011). Basically stated, patients who are carriers for SA, MRSA, and VRE are more likely to have a post-operative SSI and also exponentially more likely to die from it. These medical research studies have great relevance to the nursing administration role. Since it is the responsibility of nurse administrators to implement best practice guidelines into clinical practice, these nurses need to review research findings in order to establish patient care practices designed to eradicate bacteria on the surface of the skin, prevent SSIs, and reduce patient demise.

**Nursing Research**

Published nursing based SSI research studies are limited. Since 2010 only a handful of reputable, nursing based research studies can be found. These studies are based on the same basic principles; pathophysiology of SSI and the effectiveness of pre-operative CHG impregnated wipes or CHG impregnated soap physical scrubs (Jakobsson, Perlkvist, & Wann-Hansson, 2011; Ritz et al., 2012 ). These studies, although two years apart, appear to come to the same conclusion that there are no conclusive research findings that indicate whether CHG wipes or scrubs are more effective in reducing SSI. However, both studies indicate that the use of a CHG impregnated preparation the day of surgery will decrease the incidence of SSI (Jakobsson et al., 2011; Ritz et al., 2012). These findings are again important for nurse administrators who need to take an active role in researching prevention and treatment of SSIs.

Multiple gaps have been identified within the literature focusing on nursing administration and SSI. One gap is the lack of definitive SA, MRSA, and VRE screening methods in pre-operative patients. Another literature gap is the need to test and establish which method of pre-operative CHG preparation is most effective. An additional gap is the need to compare higher concentration povidone iodine preparations to the CHG preparations currently being used.

However, the largest gap in literature is found when comparing the medical based and the nursing based studies. After an extensive review of applicable medical studies, it is derived that the use of triclosan based soap for post-operative outpatient wound cleansing is recommended rather than CHG impregnated soap. In contrast, the reviewed nursing studies indicate that pre-operative CHG preparation is recommended. As a result of these incongruent findings, a literature search was conducted in search of establishing whether triclosan based or CHG based soap would be more effective if used as a pre-operative outpatient preparation for three washings prior to procedure. No research on this topic was found. Without the studies that are identified as gaps it will be difficult for nurse administrators to make best practice policy decisions.

Problem Statement

Peri-prosthetic hip and knee joint infection is a devastating complication resulting in extreme patient morbidity and health care facility expense (Smith, Jacobs, Rodier, Taylor, & Taylor-White, 2011). The estimated economic impact of one joint space infection is $100,000 in hospital costs alone for a total hip arthroplasty and $60,000 for a total knee arthroplasty (Institute for Healthcare Improvement [IHI], 2012, p. 2). Over 1,000,000 total hip and knee arthroplasties are performed in the United States each year (IHI, 2012, p. 1). These figures are expected to increase dramatically due to an aging population seeking a better quality of life (IHI, 2012).

The overall infection rate for these two procedures ranges from .67% to 2.4% (IHI, 2012, p. 1). If these rates are applied to all hip and knee arthroplasties performed in the United States, a surgical site infection rate of 6,000 to 20,000 occur each year (IHI, 2012, p. 1). Treatment frequently includes additional surgery and hospitalization, prolonged systemic antibiotic therapy, compromised mobility, and additional costs to patients, insurers, and hospitals (IHI, 2012).

In the interest of promoting high quality, patient-centered care and accountability, the Centers for Medicaid and Medicare Services (CMS) are denying additional reimbursement for many hospital acquired conditions (IHI, 2012). The emerging consensus is that many periprosthetic joint infections are avoidable and will soon also be denied additional reimbursement (IHI, 2012). Hospitals are searching for ways to reduce these infections, not only for healthy patient outcomes but for healthier financial bottom lines.

 In today’s era of healthcare reform and increasing healthcare costs, administrative nurses must strive to reduce the financial impact, improve the outcome, and minimize adverse events in patients undergoing total hip and knee arthroplasty (Smith et al., 2011). Recent research suggests the use of CHG soap preoperatively reduces SSI in the first thirty days following these procedures (Institute for Healthcare Improvement website, 2013). However, there is a research gap as few studies have focused on recommendations for greatest benefit. Thus, further investigation regarding best practice in the use of CHG soap pre-operatively is required.

**Purpose Statement**

The purpose of this study is to test the following hypothesis: Adult patients deemed low risk by their primary care providers, including negative Staph aureus nasal cultures, undergoing total hip or knee arthroplasty in an acute care hospital, who shower with 4% chlorhexidine soap two days prior to surgery, one day prior to surgery, and the morning of surgery will have a significantly lower rate of surgical site infections as defined by the American Academy of Orthopedic Surgeons, for 30 days post-operatively compared with similar subjects who use anti-bacterial soap containing triclosan for the same series of showers.

**Theoretical Framework**

Our research on preoperative soap will be guided by Joseph Lister’s theory on the Antiseptic Principle of the Practice of Surgery. This revolutionary theory is built from Louise Pasteur’s Germ Theory of Disease which remains foundational to modern surgical practice (Pitt & Aubin, 2012).

The Germ Theory of Disease evolved in the 1860s and 1870s and has been a fundamental principle in the understanding and management of infectious disease. Pasteur conceived of the germ from his studies of fermentation and observations of infection in the silk worm. Robert Koch scientifically documented the fundamental postulates of germ theory. From Koch’s postulates it is traditionally believed that living microorganisms must be cultured from the infected individual, the pathogen should be grown in vitro, and the pathogen can then be inoculated and recovered from the susceptible host that has been challenged and developed the disease. For surgeons the germ theory was an important consideration in Lister’s clinical studies of the surgical site infection (Fry, 2010).

Prior to Louise Pasteur’s work most people did not believe that germs were the cause of infected wounds since germs could be found in healthy areas of the human body, such as the mouth, as well as in infected wounds (Alexander, 1985). Alexander (1985) also explains that Joseph Lister was brilliant in his realization that there was a correlation between the process of wound infections and Pasteur’s process of fermentation which lead Lister to the belief that “invisible living particles were the cause of infection” (p. 427).

The Antiseptic Principle of Surgery is a medically based theory which has relevance to this research and to the practice of nursing. The purpose of this study is not to test the Antiseptic Principle of the Practice of Surgery, but rather to use this theory to guide the proposed research and provide organization to the study. Researchers often use a theory framework or model to guide research and provide organizational structure. In addition, previous research studies provide excellent reference information and data for which new research can be built upon and new research can add to the validity of theory (Polit & Beck, 2012).

Joseph Lister developed his Antiseptic Principle of the Practice of Surgery based on the recognition that if microbes (or germs) are not controlled or prevented from invading a wound they will cause complications of infection and death. According to Herr (2007), “Joseph Lister’s discoveries were fundamental to medicine when he proposed his principles of antiseptic surgery: that to destroy germs on a wound or to prevent their entrance into an injury would lessen the chance of infection” (p. 457). As part of his research Joseph Lister instituted techniques that would prevent contamination and infection during surgery. He prepared antiseptic solutions from strong chemicals of that time period and would cleanse surgical wounds with the solution either by spraying it over the wound or by applying it with a dressing. Lister believed that destroying germs and preventing them from entering into a wound would decrease the chance of infection and also emphasized the importance of antiseptic principles include the cleansing of instruments, hands, and wounds (Herr, 2007).

**Theory Congruency**

The antiseptic principles, however primitive, remain as guiding standards for surgical practice in today’s highly advanced practice of medicine and nursing. The principles are applicable as guides for our research in that: they identify germs in our environment as causes of infections; they identify that germs must be prevented from the opportunity to infect a surgical wound through a number of interventions such as antiseptic solutions; their purpose is to prevent post-surgical wound decomposition as well as patient complications. Today, Lister’s antiseptic techniques have been expanded to include other methods of preventing SSIs. However the ideology remains the same and is included in the CDC recommendations for antiseptic pre-surgical showers (Strelczyk, 2008). Lister’s (1867) Principles of Antiseptic Practice state that:

• the essential cause of suppuration in wounds is decomposition brought about by the influence of the atmosphere;

• to prevent the occurrence of suppuration with all its attendant risks was an object manifestly desirable;

• decomposition may be avoided by applying as a dressing some material capable of destroying the life of floating particles;

• in conducting treatment, the first object must be the destruction of any septic germs which may have been introduced into the wounds either at the moment of the accident, or during the time which has lapsed….guard effectively against the spreading of decomposition into the wound;

• all that is requisite is to guard against the introduction of living atmospheric germs from without, at the same time that free opportunity is afforded for the escape of discharge from within;

• a solution of carbolic acid in twenty parts of water, while a mild and cleanly application, may be relied on for destroying any septic germs that may fall upon the wound during the performance of an operation; and also that for preventing the subsequent introduction of others.

From Joseph Lister’s perspective, one can begin to understand how preoperative soap can impact SSIs. However, when examining the connection between nursing administration and the antiseptic principles within the Antiseptic Principle of the Practice of Surgery theory a question comes to mind: What considerations must a nurse administrator make when establishing best practice for reducing SSI through preoperative skin cleansing? Further research will help to clarify and answer this question (See Appendix B).

**Research Questions**

Based on a review of the literature and theoretical framework, the purpose of this research is to conduct a quantitative study that will determine if there is decrease in the number of surgical site infections within thirty days of surgery when patients use 4% chlorhexidine soap for three serial washings are compared to patients using antibacterial soap containing triclosan for three serial washings. Further sub-questions were generated to aid in the research design: (1) Is there a variance in the criteria physicians use when deeming patients low risk? (2) Is there a greater prevalence of one joint having a surgical site infection compared to the other?

**Summary**

SSIs are a complication of surgical care. Unfortunately this complication increases morbidity for patients and creates a significant economic burden for health care organizations in terms of extended length of stay and increased cost of treatment. As a result, nurse administrators need to be concerned with finding research that supports preventing these devastating and costly infections. Since bacterial skin flora can be killed with the use of antimicrobial soaps including those containing CHG and triclosan it is important to study the soap’s impact on SSI (Anderson et al., 2010). The proposed research questions seek to help the nurse administrator better understand the role of pre-operative soaps in influencing the reduction of surgical site infections.

Joseph Lister’s theory on the Antiseptic Principle of the Practice of Surgery focuses on the belief that destroying germs on a wound or preventing their entrance into an injury will lessen the chance of infection (Herr, 2007). In reviewing literature, there are conflicting findings on which pre-operative soap is most effective in reducing the entry of pathogens. In addition, there are research gaps in pre-operative screening methods and comparing the concentration of pre-operative soap preparations.

Since nurse administrators are responsible to incorporate research findings into facility policy and procedure to ensure high quality care, it is evident that more research on the role of pre-operative soap in SSIs is necessary. Chapter II of this proposal will provide literature support for use of the Antiseptic Principle of the Practice of Surgery to frame the study. In addition, a comprehensive literature review will be presented in order to provide background and context for the study. This thorough literature review will also facilitate the identification of research gaps and provide clarity on how the study contributes to the existing literature.

References

Alexander, J. W. (1985). The contributions of infection control to a century of surgical progress.

 *Annals of Surgery, 201*(4), 423-428.

American Nurses Association. (2009). *Nursing administration: Scope and standards of practice.*

 Silver Spring, MD: Nurse Books.

Anderson, M.J., Horn, M.E., Lin, Y.C., Parks, P.J., & Peterson, M.L. (2010). Efficacy

 of concurrent application of chlorhexidine gluconate and povidone iodine against six

 nosocomial infections. *American Journal of Infection Control, 38*(10), 826-831.

Centers for Disease Control. (2013). CDC/NHSN surveillance definition of healthcare-

 associated infection and criteria for specific types of infections in the acute care setting.

 Retrieved from CDC website:

 http://www.cdc.gov/nhsn/PDFs/pscManual/17pscNosInfDef\_current.pdf

Fry, D. (2010). Prions: Reassessment of the germ theory of disease. *Journal of the American College of Surgeons, 211*(4), 546-552. doi:10.1016/j.jamcollsurg2010.06.389

Hatuemaniere, A., Florentin, A., Hunter, P.R., Bresler, L., & Hartemann, P. (2012).

 Screening for surgical nosocomial infections by crossing databases. *Journal of Infection*

 *and Public Health.* Advance online publication. doi:10.1016.j.jiph.2012.08.002

Hemani, M.L., & Lepor, H. (2009). Skin preparation for the prevention of surgical site

 infection: Which preparation is best? *Reviews in Urology, 11*(4), 190-195.

Herr, H.W. (2007). Ignorance is bliss: The Listerian revolution and education of American

 surgeons. *The Journal of Urology, 177*(2), 457-460. doi:10.1016/juro.2006.09.066

Institute for Healthcare Improvement. (2012). *A brief for hospital administrators* [Issue brief].

 Retrieved from Institute for Healthcare Improvement website: http://www.ihi.org

Jakobsson, J., Perlvist, A., & Wann-Hansson, C. (2011). Searching for evidence

 regarding using preoperative disinfection showers to prevent surgical site infection.

 *Worldviews on Evidence-Based Nursing, 8*(3), 143-152.

 doi: 10.1111/j.1741-6787.2010.00201

Kapadia, B.H., Johnson, A.J., Daley, J.A., Issa, K., & Mont, M.A. (2012). Pre-admission

cutaneous chlorhexidine preparation reduces surgical site infections in total hip arthroplasty. *The Journal of Arthroplasty*. Advance online publication.

doi: 10.1016/j.arth.2012.07.015.

Lee, G., Clark, A.M., & Thompson, D.R. (2013). Florence Nightingale- never more

 relevant than today. *Journal of Advanced Nursing, 69*(2), 245-246. doi:10.1111/jan.12021

Lister, J. (1867). On the antiseptic principle of the practice of surgery. *The Harvard Classics,*

 Bartleby Books.

Parvizi, J. (2011). A new definition for periprosthetic joint infection. American Academy of

 Orthopedic Surgeons. Retrieved from http://www.aaos.org/news/aaosnow/nov1

Pitt, D. & Aubin, J.M. (2012). Joseph Lister: Father of modern surgery. *Canadian Journal of*

 *Surgery, 55*(5), 8-9. doi: 10.1053/cjs.007112

Polit, D. & Beck, C. (2012). *Nursing Research: Generating and assessing evidence for nursing*

 practice. Philadelphia, PA: Lippincott Williams & Wilkins.

Rao, N., Cannella, B.A., Crossett, L.S., Yates, A.J., McGough, R.L., & Hamilton, C.W.

 (2011). Preoperative screening / decolonization for staphylococcus aureus to

 prevent orthopedic surgical site infection. *The Journal of Arthroplasty, 26*(8), 1501-1507.

Ritz, J., Pashnik, B., Padula, C., & Simmons, K. (2012). Effectiveness of 2 methods of

 Chlorhexidine bathing. *Journal of Nursing Care Quality, 27*(2), 171-175.

Smith, M. A., Jacobs, L., Rodier, L., Taylor, A., & Taylor-White, C. (2011). Clinical quality

 indicators: Infection prophylaxis for total knee arthroplasty. *Orthopedic Nursing, 30*(5).

 Retrieved from http://www.nursingcenter.com

Strelczyk, K. (2008). SSIs: What are the host factors? *OR Nurse 2*(8), 10-13.

 doi:10.1097/01.ORN.0000335516.58646.d2

Wenzel, R.P. (2010). Minimizing surgical site infections. *The New England Journal of*

 *Medicine, 362*(1), 75-77.

Zywiel, M.G., Daley, J.A., Delanois, R.E., Naziri, O., Johnson, A.J.., & Mont, M.A. (2011). Advance pre-operative chlorhexidine reduces the incidence of surgical site infections in knee arthroplasty. *International Orthopedics, 35*(7), 1001-1006.

Appendix A

Surgical Site Infection Definition

According to Parvizi (2011) the following definition of a surgical site infection has been adopted by the American Academy of Orthopedic Surgeons:

1. A sinus tract communicating with the prosthesis; or

2. A pathogen is isolated by culture from two separate tissue or fluid samples obtained from the affected prosthetic joint; or

3. Four of the following six criteria exist:

 a. Elevated serum erythrocyte sedimentation rate (ESR) or serum

 C-reactiveprotein (CRP) concentration

 b. Elevated synovial white blood cell (SBC) count

 c. Elevated synovial neutrophil percentage (PMN%)

 d. Presence of purulence in the affected joint

 e. Isolation of a microorganism in one culture of periprosthetic tissue or fluid

 f. Greater than five neutrophils per high-power field in five high-power fields observed from histologic analysis of periprosthetic tissue at 400 times magnification

Appendix B

Concept Map

# Lister’s Theory on the Antiseptic Principle of the Practice of Surgery

Destroy Germs

Prevent Wound Entrance

Antiseptic Solutions

Showering with 4% chlorhexidine soap two days prior to surgery, one day prior to surgery, and the morning of surgery.

Showering with anti-bacterial soap containing triclosan two days prior to surgery, one day prior to surgery, and the morning of surgery.

Surgical Site Infections as defined by the American Academy of Orthopedic Surgeons, for 30 days

post-operatively

Concept Map: Understanding the role of Lister’s Theory on Antiseptic Principle of the Practice of Surgery on pre-operative skin cleansing and its impact on surgical site infections.