SURGICAL SITE INFECTIONS OF PATIENTS FOLLOWING AN ABDOMINAL HYSTERECTOMY: A LITERATURE REVIEW

By

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ABSTRACT

Surgical site infections (SSIs) are the most common complication resulting from surgical procedures. As they impact patient recovery, well-being, and the health care system, SSIs cost time and money. Researchers have identified a number of factors influencing the causation and prevention of SSIs. The purpose of this paper is to examine the literature in regards to factors that have an impact on the incidence of SSI. Review of the literature was guided by the following PICO question: "In women undergoing abdominal hysterectomy, what are the most effective interventions to be used in a standardized care plan, when compared to current practice with varied and undefined interventions, in reduction of surgical site infection?". Four key variables were identified that either influence the incidence of SSI, or are important in shaping policy concerns regarding SSI. The most evident interventions were prophylactic antibiotics and preoperative washing. The findings from literature regarding dressings remain inconclusive in the reduction of SSI incidence. Furthermore, the findings for obese women showing higher risk for SSI remain inconclusive, but specialized interventions can be used for this group. These findings help to bring further attention to how research in these key areas can improve future nursing practice.

Key words: surgical site infection, hysterectomy, women, prevention, prophylactic.

Surgical site infections (SSIs) complicate the care of post-operative patients who have undergone all types of surgery (Gagliardi, Fenech, Eskiciogly, Nathens, & McLeod, 2009; Löfgren, Poromaa, Stjerndahl, & Renström, 2004). At University Hospital of Northern British Columbia (UHNBC) located in Prince George- BC -, Canada, a number of cases were seen specifically in abdominal hysterectomy patients leading to the implementation of a practice improvement program to reduce this phenomenon. Surgical site infection (SSI) may be linked to many factors including diabetes, tobacco use, post-discharge surveillance, intra- and post-operative oxygenation, body temperature maintenance, laparoscopic, vaginal or abdominal hysterectomy procedures, obesity, dressings or wound care, antibiotic prophylaxis, intra- or

pre-operative skin washing, and hair removal (Kjølhede, Halili, & Löfgren, 2009; Löfgren et al., 2004). For the purposes of this paper, the latter four factors will be examined in depth. Despite numerous studies being available relating to each specific potential cause, much of the data reported was noted to contraindicate other research findings. Thus, the recommendations provided serve only as plausible options for SSIs reduction, and should not be considered the only option. It is important to consider each patient and case on an individual basis, taking into account the presence of co-morbidities and reasons why hysterectomy is indicated. This paper will apply a practice-driven PICO question to the reduction of surgical site infections and use this question to describe potential interventions, determine strengths and weaknesses, and provide recommendations for nursing practice as determined by published research articles.

PICO Question

The PICO question for this project was discussed with and approved by academic and clinical nursing experts from School of Nursing at University of Northern British Columbia (UNBC) and UHNBC. The issue to be studied was voiced as an important concern, and is the basis for an initiative to be evaluated on the surgical floor at UHNBC. The PICO question developed for and used in this paper is: "In women undergoing abdominal hysterectomy, what are the most effective interventions to be used in a standardized care plan, when compared to current practice with varied and undefined interventions, in reduction of surgical site infection?" In this case, current practice within the Northern Health region can be defined as unstandardized care, dependent on a patient's specific surgeon and care team during acute hospitalization. For example, no specific standardized procedures are used on all patients for dressing removal. One surgeon always removes the wound dressing post-operative day one, while other surgeons expect daily dressing changes. As well, nurses are expected to use their own assessment and judgment as to how to dress the incision. Some surgeons use staples to close the incision, while others suture or use butterfly stitches. Post-operative antibiotics and doses also vary depending on primary surgeon. (Personal communication with Surgical South Unit Nurses at UHNBC, November 28, 2012).

Significance for Nursing

The presence of SSIs affects health care at all levels. From an administrative standpoint, SSIs are a huge financial burden on the health care system. In fact, the cost of a single SSI can be upwards of ten thousand dollars (Kao, Meeks, Moyer, & Lally, 2009). In relation to nursing, diagnosis and treatment of SSIs requires more complicated assessments and patient-nurse time in comparison to treating post-operative patients without infection. The patient with a SSI has current issues such as higher risk for pain management and risk of infection spreading to other sites and body systems, requiring longer antibiotic therapy. This leads to prolonged hospital stays with additional nursing interventions required (Gagliardi et al., 2009). Although many studies

about this topic have been found, the existence of SSIs persists, causing concern and necessitating a further look into proper evidence-based practices to reduce these occurrences.

Criteria for Search

MEDLINE and Cumulative Index to Nursing and Allied Health Literature (CINAHL) were accessed through an EBSCOHost search for this paper. Four meta-analyses were obtained from the Cochrane Library which was accessed through an MEDLINE (Ovid) search. PubMed and the United States Library of Medicine also searched. Search terms included a combination of: abdominal, hysterectomy, surgery, surgical, infection, pre-operative, skin preparation, hair removal, dressing, bandage, antibiotic, prophylactic, obese, and surgical site infection (SSI).

On the recommendation of the clinical practice leader of Surgical South Unit at UHNBC, who ultimately applied this evidence into practice, the National Surgical Quality Improvement Program(NSQIP) from the American College of Surgeons (Ingraham, Shiloach, Patchen-Dellinger, & Esnaola, 2009) was used as a background resource.

Literature Synthesis, Methodology and Adequacy of Available Literature

With 38 current research articles amassed, each was categorized according to topic and examined thoroughly to evaluate the relevance to surgical site infection. Further evaluation was performed to assess the credibility and credentials of the articles' authors. Each article was then appraised for validity by examining the research method, size of sample and objective evidence. Fifteen articles were excluded as they pertained specifically to vaginal or laparoscopic hysterectomies and were not applicable to abdominal surgical site infections. A majority of the articles about dressings and bandages were left out as they related specifically to the treatment of infection, leaving only the four articles and one Cochrane Review relating to prevention of SSI's. Several more studies that appeared to be relevant were excluded as research quality became questionable upon closer analysis of sample size. The 23 research articles and four Cochrane Reviews available to complete this paper were adequate. However, it is evident that aspects of this topic, such as surgical dressings for the prevention of SSIs require further study. The majority of the 27 articles utilized were the 15 randomized control trials, followed by five literature reviews, four meta-analyses and three retrospective cohorts.

Description of the Literature Review

Obesity

Obesity can be defined as having a body mass index (BMI) greater than or equal to 30 kilograms per meter squared (Geppert, Lonnerfors, & Persson, 2011). Approximately two-thirds

of American adults are overweight or obese (Geppert et al., 2011; Harmanli et al., 2010). Within the northern interior of British Columbia, where Prince George city can be found, overweight and obesity rates of 54.9% are higher than the Canadian average of 52% (Northern Health, 2012). More specifically related to this project, 41.6% of females in the northern interior are either overweight or obese (Northern Health, 2012). Studies have discussed the effect of obesity on surgical site infections (SSIs) but whether obesity increases the risk for an SSI still remains controversial (Doyle, Lysaght, & Reynolds, 2010). Doyle et al. (2010) suggest that specific pathophysiological changes within the body related to excessive adipose tissue may complicate surgery or delay post-operative healing. The authors discussed the presence of non-vascular adipose tissue leads to tissue hypo-perfusion and decreased oxygen tension. As the body's defense system becomes compromised, the risk of infection increases. Doyle et al. (2010) insist the importance in pre-surgical weight loss for an obese patient undergoing elective surgery.

Although there are different theories to explain how obesity can affect postoperative outcomes, many of them focus on the physical deposition of adipose tissue. The accumulation of fat on the neck and diaphragm impedes normal breathing, decreasing oxygen distribution to the lungs and other areas of the body, including the surgical incision site. Since oxygen is a key component to wound healing, the decrease in oxygen weakens the wound healing process. Research has found that weight in the abdominal area could cause poor circulation leading to ischemia. Tissue hypoxia in combination with ischemia put the surgical site at an even greater risk for infection (Baugh, Zuelzer, Meador, & Blankenship, 2007; Wilson & Clark, 2004). Belda et al. (2005) conducted a study consisting of 300 participants who were randomly assigned to receive Fraction of Inspired Oxygen (FiO2) of 80% or 30% intra-operatively and for six hours post-operatively. Results showed a 39% reduction in the development of wound infections.

In obese women, the body is trying to maintain body fat stores for future energy needs and often uses lean muscle mass first (Nobbs & Crazier, 2011). The production of this energy can lead to depletion of lean body tissue, which can place the body into negative nitrogen balances, further compromising the wound healing process (Nobbs & Crazier, 2011). Geppert et al. (2011) attest that obese women display a seven-fold increase in the risk for wound complications following open hysterectomies when compared to non-obese women. Foley and Lee (1990) found a five times higher risk for a wound infection in obese women who underwent abdominal hysterectomies due to endometrial cancer. Other studies support that abdominal hysterectomies in obese women, indicated due to endometrial cancer, increase the risk for surgical site infections (Harmanli et al., 2010). Cruse and Foord (1973) reviewed approximately 23,000 surgical wounds and found a 13% incidence of wound infection in obese patients treated with abdominal surgery compared with less than 5% in women with normal weight. Obesity has also been proven to have an effect on the pathophysiology of the human body, which can increase the risk for post-surgical complications, such as diabetes.

It has been reported that an obese woman is 13 times more likely to develop type II diabetes than a woman who is not obese (Nobbs & Crazier, 2011). According to Kao et al. (2009), perioperative hyperglycemia has been associated with increased surgical site infections. Peppa, Stavroulakis, and Raptis (2009) found that when diabetes is present, the inflammation phase becomes disorganized causing a delay in the wound healing process. Hyperglycemia stimulates the release of pro-inflammatory mediators and depressed the immune system, which then increases the body's susceptibility to bacterial infections (Kao et al., 2009). It is known and accepted that control over blood glucose impacts the healing process (Kao et al., 2009). These authors conducted a literature review of five studies to examine if strict glycemic control would have positive effects on post-surgical outcomes. The five studies were not conclusive in reaching a definitive conclusion due to the difference in target ranges, measurement techniques, and other factors. Kao et al. (2009) concluded that further research is required in this area in order to make further recommendations regarding strict glucose control in regards to the prevention of SSIs. Although research exists confirming that obesity carries an inherent risk for surgical site infections, other studies support the idea that the evidence collected about diabetes as a factor of post-surgical complications is not strong enough to draw conclusions from. Jeon, Furuya, Berman, and Larson (2012) conducted a general study of 13,800 patients who underwent surgery. Glucose levels were monitored 72 hours pre- and post-operatively and results showed that SSI risk did not vary significantly with glucose levels (Jeon et al., 2012). However, further research is needed to better understand the relationship between blood sugar levels and infection risk, and therefore, it cannot be concluded that diabetes is or is not related to risk of infection.

Not only has there been evidence that opposes the idea that obesity-caused diabetes can increase the risk for SSIs, but there has also been research to suggest that obesity in general does not increase the risk for post-operative SSIs. Doyle et al. (2009) showed that BMI as a measure of obesity is a convenient tool; however, it does not distinguish lean tissue mass from adipose tissue mass and does not reflect adipose tissue distribution. Thus, if a woman is obese, it cannot be assumed that the distribution of the excess adipose tissue is located within the abdominal region of the body. Therefore, it cannot be generalized that women with a high BMI are at an increased risk for infection following an abdominal hysterectomy. In order to examine the relationship between obesity and SSI risk, Harmanli et al.'s (2010) study was selected because it was a retrospective review with purposive sampling of women who underwent abdominal hysterectomies that compared outcomes specifically between obese and non-obese women. Women who underwent procedures that contributed to their reason for hysterectomy were excluded from the study to ensure internal validity. The study involved women subjects undergoing surgery, and included 172 obese and 185 non-obese women. The research found that obesity does not have a significant effect on short-term outcomes of total abdominal hysterectomies, such as SSIs.

Dindo, Muller, Weber, and Clavien (2003) conducted a cohort study of 6336 patients undergoing general elective surgery to assess the effects of obesity. Results showed that the

sample of obese patients undergoing open surgery had a 4% rate of wound infection while non-obese women had a 3% rate, showing little variance. Two different samples of obese and non-obese women undergoing laparoscopic surgery each showed a 2% rate of surgical site infections. These results show that obese patients did not face a higher risk for postoperative complications in general elective surgery. Rasmussen et al. (2004) conducted a study to investigate the association between obesity and perioperative complications post-hysterectomy. They found that obese patients did not experience an increased risk of morbidity when compared to women of normal weight.

Due to contradicting results found in the previous studies and explanations in literature, further research is needed to confirm whether or not obesity increases the risk for postoperative surgical site infections. Despite this, recommendations can be made prophylactically for pre-surgical weight loss to overweight and obese patients considering abdominal hysterectomy, in an attempt to reduce the risk of surgical site infection.

Dressings and surgical site infections

The use of dressings following open surgeries, including abdominal hysterectomies, is common within the hospital setting. Dressings are often viewed as an effective intervention to decrease the risk of SSI for patients, serving as an artificial barrier between the skin and outside environment to decrease the risk of harmful microbes being introduced into patient surgical incision sites following surgery. A study performed by Gillespie, Chaboyer, Nieuwenhoven, and Rickard (2012) to assess the potential obstacles present within the health-care setting and the clinicians' ability to deal effectively in wound management. This study was included within this project because of its validity and the fact that it addressed key areas pertinent to patient outcomes, looking at ways to improve current clinical practice amongst health-care professionals through the use of an environmental scan. An environmental scan is an evaluation of evidence-based best practice compared to current practice (Gillespie et al., 2012). This environmental scan helps one to understand both the external and internal factors which influence present barriers in improving patient outcomes, and is seen as a "well-established quality improvement activity with clearly defined elements" (Gillespie et al., 2012, p. 92). The authors aimed to identify the major concepts related to factors influencing hospitals' ability to deal efficiently and effectively in wound management, including cost restraints, practitioner experience and knowledge, and collaboration between health-care workers. Limitations within Gillespie et al.'s study including a small sample size and lack of randomization hinder generalizability of these findings into a wide variety of health-care settings. However, the authors insist the importance of identifying barriers and strengths regarding wound management within hospitals, and draws attention to key areas requiring further research to improve clinical practice (Gillespie et al., 2012).

Clinician experience is seen as a factor in the ability to treat post-surgical wounds effectively. Downie, Egdell, Bielby, and Searle (2010) acknowledge the importance of clinician experience in wound management; stating proper dressing choice is reliant "on the clinician's expert assessment of the individual clinical circumstances" (p. S46). Aindow and Butcher (2005) state nurses must "have an understanding of what they want the dressing to achieve and what products are available to them" (p. S15) in order to improve patient outcomes and decrease the likelihood of wound contamination. If knowledge is lacking for nurses, they will be unable to determine the most effective intervention relating to wound management for each particular patient. Choosing dressings not only depends on patient preference and clinician experience, but also validated study findings to guide the nurse in clinical decisions that would be most beneficial to the patient.

A randomized control trial [RCT] conducted by Ubbink et al. (2008) to examine the difference in healing rate, cost and surgical site infections between the traditional gauze dressing and newer hydrocolloid dressings in 285 patients. Seen as the pinnacle in developing evidence-based practice, RCTs help to decrease extraneous variables and potential biases, as well as increase internal validity and reliability (Loiselle, Profetto-McGrath, Polit, & Beck, 2011). Using a RCT design gives credit to this study. However, the size of the study's sample is a limitation that could reduce the study's generalizability. Ubbink et al. (2008) noted that a majority of incisions dressed with gauze, heal in slightly less time though no significant difference in the rate of surgical site infections between the two groups was evident. In contrast, Gregson (2011) conducted a retrospective cohort study involving caesarean section patients and "results suggest that the hydro fiber and hydrocolloid combination dressing assists in the reduction of SSI rates" (p. 35). One of the strengths of this study is the large sample size; however the use of questionnaires 30 days after the surgery may contribute to recall bias (Gregson, 2011). Furthermore, diagnosis of infection is made by midwives with various levels of training could make results inconsistent and less unreliable (Gregson, 2011). Aindow and Butcher (2005) also note within their report the use of semi-permeable bandages such as hydrocolloids improves the skin's ability to breathe, heal and control moisture; furthermore, hydrocolloids have been shown to help with decreasing bacterial counts, including the antibiotic resistant organism Methicillin-Resistant Staphylococcus Aureus (MRSA).

A Cochrane Review performed by Dumville, Walter, Sharp and Page (2011) was included as part of this project, as it seeks to determine the effectiveness in the use of dressings to decrease the risk of SSIs through the analysis of several randomized control trials (RCTs). The authors of this review followed stringent criteria in analyzing each study, helped to establish increased confidence within the findings.

The Cochrane Review is not only extensive and incorporates a large amount of knowledge, but also its ability to establish conclusive evidence in relation to the necessity of

dressings in decreasing SSIs amongst this cohort is undeniable. Dumville et al. (2011) clearly define SSIs within this review, including measurable and objective characteristics beneficial to the clinician when assessing post-operative wounds. At the beginning, the authors hypothesized that "the risk of SSIs may be reduced by providing a barrier to environmental contamination" (p. 4).

In relation to significant differences between the uses of basic dressings versus wound exposure to air, Dumville et al. (2011) found:

> There is insufficient evidence regarding whether wound coverage with basic wound contact dressings…affects the rate of SSIs surgical wounds…what evidence there is indicates no effect. The use of dressings incurs additional costs, but there are no cost-effectiveness data available from these studies to facilitate informed decision-making (p. 13).

Regarding the use of complex dressings versus wound exposure to air, Dumville et al. (2011) conclude there is no direct evidence showing a relationship in decreasing SSI rates with the use of any type of dressings post-surgery in comparison to leaving the wound open to air.

The importance in these findings influences current practice within the hospital setting following surgery, and impacts how health-care providers must approach wound management, and dressing use. Again, costs incurred by organizations in the utilization of dressings, and the various types of dressings, are a major issue pertinent to the delivery of patient care, as the findings of the Cochrane Review, subsequent research and literature demonstrate. Through the literature review, significance in improving patient outcomes through the use dressings to reduce SSIs is inconclusive and lacks evidence. Dumville et al. (2011) conclude it is would seem most beneficial for researchers to consider patient outcomes in the decision-making process relating to bandage use and type, and developing firm guidelines to improve clinical practice in the future for patients.

Preoperative Skin Preparation

Preoperative skin preparation is an important process in the reduction of bacterial growth from a surgical incision (Centers for Disease Control, 2009). Hair removal from the operative site, when appropriate, is another technique to reduce bacterial growth (Centers for Disease Control, 2009). A common preoperative procedure is the removal of hair from surgical sites and surrounding areas. Hair can potentially interfere with the wound and dressing application. The most common methods for hair removal include: razor, fine teeth clippers and depilatory creams. Razors can leave microscopic cuts and abrasions, acting as gateways for microorganisms to enter and colonize and may leak exudate that provides a culture medium for microorganisms to grow (Centers for Disease Control, 2009).

A research article by Taylor and Tanner (2006) compared three methods of hair removal on reducing postoperative infections. This research article was chosen because it is a randomized control trial, which minimizes selection and allocation bias (Loiselle et al., 2011). The study found that postoperative infection rates decreased with clipping and depilatory creams in comparison to the use of razors (Taylor & Tanner, 2006). The results however have to be applied with caution due to the small sample size and the short length of the study (Loiselle et al.; Taylor & Tanner, 2006). Dizer et al. (2009) conducted a study to determine the effects of nurses performing preoperative skin preparation on surgical site infections in abdominal surgeries. This study was selected for its relevance to the nursing practice as nurses prepare patients for surgery. The study involved 39 patients in the control group and 43 patients in the study group. This study is reliable and valid, as it was a randomized control trial, with a sufficient number of patients involved (Dizer et al., 2009). Regarding hair removal, the authors emphasized the importance of using clippers compared to razors when preparing a surgical site. It is suggested hair is only to be removed if it interferes with the surgical area; the study found hair removal via clippers is the least invasive technique (Dizer et al., 2009). Tanner, Norrie and Melen (2011) conducted a literature review for 14 randomized controlled trials comparing razors and clippers and the incidence of surgical site infections. The authors were unable to find conclusive evidence between rates of surgical site infections with hair removal via clippers or razors.

Antiseptic compounds applied at different intervals preoperatively have various levels of bacterial growth reduction (Maiwald, Chan, & Khan, 2012). Cleansing skin with appropriate antiseptic compounds is another vital step in preventing surgical site infections. Cleansing the skin removes oil and transient microorganisms for a short period of time with the least amount of skin irritation and inhibits rebound growth of microorganisms (Maiwald et al., 2012). Murkin (2009) supported the use of antiseptic skin cleansers as they are broad spectrum, rapid in bactericidal activity, maintain persistent or residual properties on skin, effective in the presence of organic matter, non-irritating and have no or little systemic absorption. Murkin's article was selected because it reviewed several studies comparing chlorhexidine gluconate and povidone-iodine, which are considered the 'gold standards' of antiseptic skin cleansers. The author classified alcohol as an exceptional antiseptic agent but with limited use because of no residual properties whereas chlorhexidine gluconate as the superior antiseptic skin cleanser because of its residual activities. The review of six randomized controlled trials presents information that is useful in this paper. Jakobsson, Perlkvist and Wann-Hansson (2011) conducted a comprehensive review of 10 studies comparing disinfection showers using chlorhexidine gluconate and povidone-iodine and the reduction of normal skin flora. The findings from this review corresponded with Murkin's findings in that chlorhexidine gluconate was the clear choice for preoperative preparation due to decreased skin flora following application. Jakobsson et al. (2011) discussed how limitations of findings were due to the different studies' designs and interventions allowing results only to be interpreted by narration. Preoperative skin preparation is

one of the first steps in preventing surgical site infections; therefore, more research needs to be done to find more conclusive results (Jakobsson et al., 2011).

Kjølhede et al. (2009) performed a retrospective cohort study in Sweden using Gothe Swedish National Register for Gynecological Surgery to determine whether vaginal cleansing, which is not consistently used, is effective in preventing infection in abdominal hysterectomies. The study concluded that chlorhexidine usage preoperatively did not reduce risk of postoperative infection. A Cochrane systematic review conducted by Webster and Osborne (2012) assessed if bathing or showering with antiseptics lowered rates of surgical site infections. The review concluded that there is no clear evidence for preoperative chlorhexidine usage over other products to lower incidence of surgical site infections (Webster & Osborne, 2012). Webster and Osborne discussed that many of the studies were of poor quality and may have been influenced by haphazard antibiotic prophylaxis usage. Studies most susceptible to bias were excluded from their systematic review. The seven trials included in the review contained a sample population of 10, 0157. The Cochrane review identified three studies that found a significant minimization of surgical site infections with chlorhexidine bathing (Webster & Osborne, 2012). Preoperative skin preparations with antiseptic solutions in conjunction with antibiotic prophylaxis are an important regime in reducing bacterial infections.

Antibiotic Prophylaxis

Antibiotic prophylaxis is a practice noted as an evident intervention in many studies. These studies look at the benefits of prophylactic antibiotic usage in abdominal hysterectomy and issues pertinent to this topic. Löfgren et al. (2004) conducted a retrospective cohort study involving approximately half of all hysterectomies performed in Sweden. The study aimed to determine usage of antibiotic prophylaxis, rates of post-operative infections, and risk factors for post-operative infections (Löfgren et al., 2004). This study found infection rates to be almost half as frequent when antibiotic prophylaxis was administered. The authors identify a few limitations in the study including: the small number of people undergoing abdominal hysterectomy without antibiotic prophylaxis, lack of randomization, and diagnosis of post-operative infection based on doctor diagnosis (Löfgren et al., 2004). However, the findings are still valuable because of the broad range of clinics involved and various levels of prophylaxis implementation compared between clinics (Löfgren et al., 2004). While the study was not specific to abdominal hysterectomies, more than half of the 3267-sample population had abdominal hysterectomies (Löfgren et al., 2004).

Van Eyk and van Schalkwyk (2012) involved with the Infectious Disease Committee, researched numerous systematic reviews, randomized control trials, and observational studies to develop the Society of Obstetricians and Gynaecologists of Canada Clinical Practice Guidelines. The guideline recommends prophylactic antibiotics for all women undergoing abdominal

hysterectomies, which should be administered 15-60 minutes prior to surgery, and as a single dose except for in abnormal circumstances (Henry, Muriel, & Hirway, 2007; Van Eyk, & van Schalkwyk, 2012). Abnormal circumstances would include surgery taking longer than three hours or a blood loss of greater than 1500 ml (Van Eyk & van Schalkwyk, 2012). Twenty five randomized control trials on the specific topic of efficacy of antibiotic prophylaxis in abdominal hysterectomies were reviewed to create these guidelines all showing significantly lower incidences of infections amongst those treated with prophylactic antibiotics (Van Eyk & van Schalkwyk, 2012).

Gagliardi et al. (2009) conducted a scoping review examining the differences between evidence supporting antibiotic prophylaxis and integration into practice. The review advocated for multidisciplinary pathways, written or computerized orders, and individualized performance data as measures to improve prophylactic antibiotic usage. Gagliardi et al. (2009) were quite critical in the articles that were included in their review, paring down the original 192 studies to 19. Despite the strict criteria, article choices had limitations in that not all relevant articles on the subject may have been found, and many were uncontrolled and not randomized (Gagliardi et al., 2009). The purpose of a scoping review is to provide recommendations for further research, which this study does adequately.

Trends within the Literature

Obesity

The majority of the available research regarding the effect of obesity increasing the risk of surgical site infections remains controversial, due to inconclusive research and lack of generalizability among studies. Important risk factors related to SSIs and wound healing within the literature include diabetes, excess adipose tissue, and poor oxygen status (Doyle et al., 2009; Geppert et al., 2011; Harmanli et al., 2010; Nobbs & Crazier, 2011). While some studies have shown a higher incidence of SSIs post-operatively in obese women when compared to non-obese women (Harmanli et al., 2010; Kao et al., 2009; Rasmussen et al., 2004; Quinn et al., 2009), most research could not prove the hypothesis that obesity increases the risk of infection with statistical significance (Doyle et al., 2009; Rasmussen et al., 2004). Many reviewed studies showed no relationship between infection rates and obesity in women (Harmanli et al., 2010; Jeon et al., 2012; Rasmussen et al., 2004). The majority of articles confer there is evidence to suggest SSI rates increase in obese patients. However, due to inconclusive data with the studies, it cannot be inferred women with an excess amount of adipose tissue undergoing total abdominal hysterectomies, are at a higher risk for surgical site infection. All reviewed studies recommend further research is required.

Dressings and surgical site infections

According to Gillespie et al. (2012), SSIs are prevalent in approximately 30% of surgical procedures, and account for a large number of nosocomial infections. The rates of mortality and morbidity in relation to SSIs developing once surgery is complete, is a major issue in regards to time spent in the hospital, and increased costs that hospitals must account for (Gillespie et al., 2012). The costs associated with dressing use, in attempts to improve outcomes associated with SSIs, appears to be an ongoing trend within the literature, as several authors discuss how this impacts patient outcomes (Aindow & Butcher, 2005; Downie et al., 2010; Dumville et al., 2011). Downie et al. (2010), along with Gillespie et al. (2012), discuss the complexities in managing post-surgical infections with dressings in order decrease the risk of acquiring SSIs. Downie et al. (2010) continue with the need for health-care facilities to realize the importance of well-established protocols regarding proper dressing use in managing the rates of post-surgical SSIs. Downie et al. (2010) refer to a "comprehensive strategy for the management and control of SSIs" (p. S43) that should be adhered to by those within health-care administration, to help guide practice and decrease infection rates.

The necessity to possess the right tools and knowledge within the clinical setting in choosing the most effective dressing materials to prevent infection is present within most of the literature (Aindow & Butcher, 2005; Downie et al., 2010; Gillespie et al., 2012). Analyzing individual patient needs, along with acquiring the necessary knowledge related to the variety of dressing materials available within the hospital, remains a key factor in overall patient outcomes (Ubbink et al., 2008). Gillespie et al. (2012) refer to the importance of establishing effective communication patterns amongst health-care professionals within the wound care management field, as well as the need to update all team members on a regular basis in order to ensure the patients' surgical site remains free from infection. Aindow and Butcher (2005) also discuss the role of hospitals on the ability to identify deficits in knowledge relating to wound care management and dressing use, as well as incorporate and better facilitate changes to better serve patients in the future. Furthermore, Gillespie et al. (2012) insist that educators within the clinical setting have a great impact on improving wound assessment via establishing guidelines and protocols in relation to dressing use. The authors noted a "lack of educational resources and opportunities to guide their decision-making" (p. 96) negatively impacts the nurses' ability to provide optimal care.

There appear to be gaps in the literature regarding dressing selection and well-established patient outcomes once patients are discharged. While research suggests most post-surgical wounds require dressings to help protect the site and thus helps to serve as an additional barrier against infection, further inquiry into the role dressings play in length of hospital stays, and rates of nosocomial infections, would appear necessary to improve patient outcomes (Aindow & Butcher, 2005; Downie et al., 2010). The limited evidence supporting the use of hydrocolloid

dressings post-surgery to decrease SSIs (Aindow & Butcher, 2005; Gregson, 2011) hinders the ability to assess whether its use outweighs overall costs.

There has been a shift in priorities within hospitals regarding dressings; patient needs and preferences appear to be affected by a growing concern regarding costs related to the wide array of dressings available (Aindow & Butcher, 2005; Ubbink et al., 2008). Thus, it would seem important to investigate the role dressing selection has on patient progress and improvement in order to help hospitals be cost-effective long-term in managing surgical incisions post-surgery.

Preoperative Skin Preparation

There is a lack of research about the least irritating method of hair removal preoperatively regarding surgical site infections (Tanner, Norrie, & Melen, 2011; Taylor & Tanner, 2006). Therefore, there is insufficient evidence to support which hair removal method is best. The Centers for Disease Control (2009) and Dizer et al. (2009) recommend hair removal with clippers only when necessary. Several of the articles referred to pilot studies' results that conferred clippers were best for hair removal.

Using an antiseptic cleansing agent reduces the skin's normal flora, thus minimizing the risk of surgical site infections. Jakobsson et al. (2011), Maiwald et al., 2012 (2012) and Murkin (2009) identify chlorhexidine gluconate as the most effective solution for preoperative skin cleansing for its ability to reduce the skin's normal flora by nine times in comparison to povidone iodine, as well as its residual antimicrobial properties. There is conflict to whether 2% chlorhexidine gluconate or 4% chlorhexidine gluconate is optimal. Jakobsson et al., 2011; Maiwald et al., 2012; and Murkin (2009) also identify alcohol as the most efficient antimicrobial agent but show limited use in preoperative skin preparation due to the absence of residual effects. However, the literature does mention alcohol combined with chlorhexidine gluconate as a possible superior choice for skin cleansing (Jakobsson et al.; Maiwald et al., 2012; Murkin, 2009). Further research is needed to determine if alcohol combined with chlorhexidine gluconate is a more effective antimicrobial than chlorhexidine gluconate alone.

Antibiotic Prophylaxis

Prophylactic antibiotic use is meant to prevent infection caused by the introduction of microorganisms at the time of surgery (Van Eyk & van Schalkwyk, 2012). The authors use the information gathered from three meta-analyses that all had concluded significant decrease in rates of postoperative surgical site infections occur with prophylactic antibiotic use. These results are supported by a Swedish study involving nearly half of all hysterectomies in the country between July 2000 and January 2003 (Löfgren et al., 2004). The rates of post-operative infections following abdominal total hysterectomies were found in 10% of cases with antibiotic

prophylaxis in comparison to more than 14% when it was not given. Similarly, post-operative infection rates for abdominal subtotal hysterectomies when antibiotic prophylaxis was administered are approximately 6.3% as compared with nearly 11% when it was not administered (Löfgren et al., 2004).

In their investigation into poor adherence to prophylactic antibiotics despite the overwhelming evidence supporting its use, Gagliardi et al. (2009) sought to supply decision makers with knowledge on factors or interventions influencing this practice. The greatest results of antibiotic administration were found in hospitals that administered the antibiotic directly in the operating room or had specific written orders dictating the appropriate timing of administration (Gagliardi et al., 2009).

Recommendation for Practice

A thorough review of the literature allows for inferences and recommendations to be made in each of the pertinent sections (see Table 1). The suggestions for dressings and wound care to be considered will serve as guidelines, since research in this area is inconclusive and inconsistent. In support of dressings, it may be useful to use a wound covering to manage drainage immediately post-operatively (Aindow & Butcher, 2005). It would appear from the limited research available regarding dressings, the use of hydrocolloids is most effective in controlling SSIs (Aindow & Butcher; Ubbink et al., 2008). When an incision is no longer weeping, leaving the site open to air will serve to promote healing through oxygenation exposure (Downie et al., 2010). There is no indication that wound coverings and SSIs are correlated (Dumville et al., 2011). Furthermore, nurses involved in post-operative care require better training and education surrounding independent choices in wound care (Gillespie et al., 2012). Options for training would include training courses, electronic learning, and hospital in servicing.

In regard to prophylactic antibiotic use, recommendations include standardized integration and implementation of pre-operative dosing (Gagliardi et al., 2009). UHNBC may find it worthwhile to monitor this by addition of an antibiotic reminder to the Surgical Safety Checklist to be monitored in the surgical suite by the operation room nurse. Important to note is that a single dose prior to surgery is effective in normal surgical conditions and no post-operative antibiotics are required (Van Eyk, & van Schalkwyk, 2012).

Surgical washes should be completed in the surgical suite prior to starting surgery (Dizer et al., 2009 ; Tanner et al., 2011). The superior wash of choice is chlorhexidine gluconate, applied directly as a scrub (Dizer et al., 2009; Tanner et al., 2011; Taylor & Tanner, 2006). Hair removal is indicated only if the presence of hair interferes with the surgical site, and the removal should be performed using clippers (Centers for Disease Control, 2009; Taylor & Tanner, 2006)

because a razor is not a recommended tool for pre-operative hair removal (Tanner et al.; Taylor & Tanner, 2006).

Specialized interventions to reduce SSI in overweight or obese women are inclusive of the following list: increased intra-operative oxygenation to be continued for six hours post-operatively, maintenance and control of perioperative glucose levels, and improved post-operative nutrition with healthy options (Doyle et al., 2009; Nobbs & Crazier, 2011; Belda et al., 2005). The proposed interventions are considerate of cost-benefit concerns, and require careful collaboration with interdisciplinary professionals. Nurses should follow-up with comprehensive communication from the operating room, to the recovery room, and through to admission on the surgical unit.

Table 1: RECOMMENDATIONS FOR PRACTICE

Dressings and Wound Care (Guidelines)	• Use wound covering to manage drainage immediately post-operatively (Aindow & Butcher, 2005) • When incision no longer weeping, leave site open to air (Ubbink et al., 2008) • Some research suggests hydrocolloids as the most effective in controlling SSIs (Gregson, 2011) • No indication of correlation between wound coverings and SSI (Dumville, Walter, Sharp & Page, 2011) • Better training and education for nurses regarding independent choices in wound care (Downie et al., 2010)
Antibiotic Prophylaxis	• Addition of antibiotic reminder to Surgical Safety Checklist (Gagliardi et al., 2009) • Under normal conditions a single dose is just as effective as multiple doses, no post-operative antibiotics required (Van Eyk & van Schalkwyk, 2012)
Surgical Scrub	• Completed in the surgical suite prior to starting surgery (Dizer et al., 2009, 2009; Tanner et al., 2011) • Superior wash is Chlorhexidine Gluconate applied directly as a scrub (Dizer et al., 2009; Tanner et al.; Taylor & Tanner, 2006)
Hair Removal	• Indicated only if the presence of hair interferes with the

	surgical site (Centers for Disease Control, 2009; Taylor & Tanner, 2006) • Hair removal should be performed with clippers (Tanner et al., 2011; Taylor & Tanner, 2006) • Razor is not a recommended hair removal tool (Tanner et al., 2011; Taylor & Tanner, 2006)
Interventions for Obese Women	• Increased intra-operative oxygenation to be continued for six hours post-operatively (Belda et al., 2005) • Maintenance and control of perioperative glucose levels (Nobbs & Crazier, 2011; Peppa, Stavroulakis & Raptis, 2009) • Improved post-operative nutrition with healthy options (Nobbs & Crazier, 2011)

Conclusion

The purpose of this paper was to answer a PICO question regarding what are the most effective interventions to be used in a standardized care plan, when compared to current practice with varied and undefined interventions, in reduction of SSI in women undergoing abdominal hysterectomy. SSI's are a huge concern for post-operative patients, and a reduction in number of cases means the health care industry sees gains in both financial and scientific aspects. This paper achieved its goal by presenting four of the key modifiable influences and describing in depth recommendations for practice, based on data collected through the analysis of existing literature. These perceived gaps in care could be utilized by researchers in the development and implementation of tools to be used peri-operatively to standardize high levels of care for future abdominal hysterectomy patients. As well as recommendations, the paper points out areas where future research could be done to improve the overall quality of care provided, thereby further decreasing the incidence and occurrence of SSI's. While SSI's cannot be completely eliminated, it is the hope that with increased knowledge about its existence and triggers, numbers of diagnosed infections can be greatly reduced.

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