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Bordered Silver Foam Dressings for Colorectal Surgical Patients

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By

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Abstract

Although a surgical site infection (SSI) is a risk of an operative procedure, most are preventable (health Protection Agency, 2009). The Joint Commission National Patient Safety Goal 7 stipulates the implementation of evidence-based practice for SSI prevention in acute care facilities. The purpose of this pilot project was to implement a bordered silver foam dressing protocol for post-operative colorectal surgical patients. Using a pre- and post-comparison design, the new dressing protocol was implemented for a two-month pilot for colorectal surgical patients meeting the specified criteria at Cabell Huntington Hospital. SSI rate following the protocol was compared to the SSI rate for a similar pre-intervention period did not reflect success in the protocol. Anecdotal data to evaluate the process were useful in identifying some areas for improvement.

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By

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Background and Significance of Project

Problem Identification

Invasive surgical procedures include many risks, one of which is surgical site infections (SSI). An SSI is defined as infection which occurs after a surgical procedure at the site in which the surgery took place (Centers for Disease Control and Prevention (CDC, 2015a). SSIs occur in approximately one to three out of 100 surgical patients (CDC, 2015b). SSIs are the leading cause of nosocomial infections (Magill et al., 2014). SSIs increase morbidity and mortality rates, double hospital length of stay, increase cost of healthcare, and increase wound healing time (Potter, Perry, Stockert, & Hall, 2013).

Context of the Problem

SSIs can be classified as superficial, deep, or organ/space. Superficial SSIs involve the skin or subcutaneous tissue around the surgical wound. Deep incisional SSIs involve deep soft tissue; organ/space SSIs involve any part of the anatomy other than the incision near the surgical site, more specifically, organs manipulated during surgery (CDC, 2015b).

Most SSIs are preventable (Health Protection Agency, 2009). However, SSI occurrences are multifaceted. Predisposing factors of SSIs emerge during the pre-operative, peri-operative, and post-operative periods. Pre-operative risk factors for SSIs include hospital length of stay, smoking, antibiotic prophylaxis, bowel preparation, hair removal, showering, and surgical hand antisepsis. Gould (2012) identified skin disinfection, body temperature, and length of surgery, surgical technique, surgical staff attire, and surgical expertise as peri-operative factors. Factors occurring post-operatively include appropriate patient education on wound care and management, application of dressings, hand washing and keeping wounds clean and dry (Gould, 2012).

The Joint Commission National Patient Safety Goal (NPSG) 7 stipulates the implementation of evidence-based practice for SSI prevention. Simultaneously, hospitals and other health care agencies are expected to be in compliance with CDC surveillance requirements, monitoring SSI rates for the first 30 or 90 days following surgical procedures (Joint Commission Perspectives, 2013). Surveillance may be targeted to certain procedures based on the organization's risk assessment.

Scope of the Problem

Cabell Huntington Hospital (CHH) had an overall SSI rate of 1.43 per 100 patients in 2014 with colorectal surgeries having the highest SSI rates (A. Bullington, personal communication, June 3, 2014). In 2013, the American College of Surgeons National Surgical Quality Improvement Program reported a colorectal SSI rate of 9.8 per 100 patients (Cima et al., 2013). In 2014, the Joint Commission reported a colorectal SSI rate among seven selected hospitals to be 10.9% (The Joint Commission, 2014). During the 2014 reporting year, the CHH SSI rate for colorectal surgeries was 21 per 100 patients. SSIs occur in all types of surgical patients; however, colon surgical patients are identified as being the most at risk (Magill et al., 2014).

An estimated 157,500 SSIs occur annually in the United States and tie in rank as the number one health care associated infection (CDC, 2015b). Scott (2009) estimated the cost of inpatient hospital services for the treatment of SSIs ranging from $11,874 to $34,670 per patient. Berrios-Torres (2009) identified that SSIs have a health care cost of $10 billion dollars annually. Indirect costs (loss of work, mortality, income loss, family travel and living expenses) are estimated to range from $16,359 to $19,430, while intangible costs such as anxiety, depression,

pain, and suffering, as well as decreased ability to perform activities of daily living are also significant (Scott, 2009).

Consequences of the Problem

SSIs have a 3% mortality rate, increasing the chance of death by 2-11 times (Berrios-Torres, 2009). According to the CDC (2015b), when a patient has a SSI there is an increase in hospital length of stay of approximately seven to ten days. SSI can range from trivial wound drainage to life threatening conditions including sepsis. Patients suffering from a SSI can have not only physical implications, but the condition also can impact their social and emotional wellbeing. SSI patients are at greatest risk for long-term disabilities (CDC, 2015b).

Evidence-based Intervention

Multiple investigators have demonstrated the benefits of silver-based dressings for reducing SSIs (Huckfeldt et al., 2008, Krieger et al., 2011; Biffi et al., 2012; Siah & Yatim, 2011; Beele, Meuleneire, Nayuns, & Percival, 2010; Bowler et al., 2013; Galli, Protzman & Brigido, 2013; Schwarts et al., 2014). Specifically, Biffi et al. (2012) and Siah and Yatim (2011) demonstrated the effect of silver-containing dressings in inhibiting the growth of bacteria and decreasing SSI rates among colorectal cancer surgical patients. Silver-based dressings have silver ions implanted within the dressing that are released into the wound, some at a rapid rate some at a slower rate. For this project, the Mepilex Border Ag, a 7-day slow-releasing bordered silver foam dressing (Molnlycke Health Care, Norcross, GA), was used. The bordered foam dressings were available in various sizes and were selected based on the incision length. Dressing lengths range from 4 to 14 inches. Dressings were occlusive, since the use of totally occlusive ionic silver dressings have been shown to reduce bacterial colonization of post-colorectal surgical wounds (Siah & Yatim, 2011).

Purpose of the Project

The purpose of this project was to implement a bordered silver foam dressing protocol for post-operative colorectal surgical patients.

Theoretical Framework: Unpleasant Symptoms

Nurses carry much of the responsibility for managing symptoms and improving health outcomes (Lenz & Pugh, 2014). The purpose of the theory of unpleasant symptoms (TOUS) is to "improve understanding of symptom experience in various contexts and to provide information useful for designing effective interventions to prevent, ameliorate, or manage unpleasant symptoms" (Lenz & Pugh, 2014, p. 166). The TOUS has notable features making the theory applicable to multiple symptoms of varying illnesses as well as identifying multiple symptoms that often occur simultaneously.

Three key concepts have been identified by Lenz & Pugh (2014): symptom(s), influencing factors, and performance outcomes. Symptoms are subjective perceptions by the patient that are different from normal. Symptoms can occur alone or in conjunction and/or interact with other symptoms. Symptoms may precede or trigger others, and often vary in quality and intensity. Improving or worsening pathology is the typical reason for symptoms; however, the relationship is not always easily identifiable.

Influencing factors are any physiological, psychological and situational factors that affect a given symptom. Physiological factors are those that affect anatomy, physiology, genetics, and illness and treatment variables. Psychological factors represent affective and cognitive variables, such as uncertainty of the situation, level of knowledge about the symptom, cognitive development level, ability to cope, and the meaning of the symptom to the individual. Situational factors originate in the physical and social environment and can include but are not limited to financial status, marital status, and social support.

Performance outcomes determine the individual's ability to function or perform physically, cognitively, and in socially-defined roles. A given symptom may produce different performance outcomes.

The TOUS was utilized as the framework guiding this implementation of a bordered silver foam dressing protocol for colorectal surgical patients. Symptoms caused by the SSI on the patient (pain, fever, drainage, redness, swelling at the surgical site) are unpleasant symptoms, which produce undesirable outcomes for the patient. The use of a bordered silver foam dressing protocols helps prevent SSI and the associated unpleasant symptom.

Review of Relevant Literature

Silver Nylon Dressings

Huckfeldt et al. (2008) conducted a retrospective and prospective controlled trial to compare the incidence of mediastinitis in cardiac surgery patients. The intervention group had a silver nylon dressing applied postoperatively that was left in place for seven days unless the dressing became loose or saturated. If discharge occurred before the seventh postoperative day, a new silver nylon dressing was applied and the patients were instructed to leave the new dressing on for another five days. The control group had standard gauze dressing that were changed every 24 hours.

Chi-square test for independence showed that the development of mediastinitis was significantly related to the type of dressing applied to the wound ((1, N=1600) = 3.88, $p<0.05$, phi=0.049). (See Appendix A for Intervention/Outcomes Synthesis Table).

Krieger et al. (2011) conducted a randomized control trial (RCT) to evaluate the effectiveness of silver nylon dressings for prevention of SSIs in patients undergoing surgery. Sterile gauze dressings secured with paper tape were applied to participants in the control group. The study group had silver nylon dressings hydrated in sterile water. The surgical team in the

operating room applied the initial dressings. The dressings of the control group were discontinued 48 hours postoperatively. The study group had another silver nylon dressing applied either seven days post-operatively or just before discharge. The silver nylon dressing was discontinued seven to ten days post discharge. All patients had additional follow-up by telephone at 30 days post operation and completed a standardized survey.

Data were analyzed using chi-squared. Chi-squared results showed a significantly lower percentage of SSIs for the treatment group in total incidence of SSI ($p=0.01$) Data were insufficient to calculate an effect size.

Silver Hydrofiber Dressings

Storm-Versloot, Vos, Ubbink, and Vermeulen (2010) conducted a systematic review to establish the effects of silver-containing dressings and topical agents in preventing wound infection and healing of wounds. RCTs comparing silver-containing wound dressings and topical agents with silver-containing and non-silver containing comparators on uninfected wounds were selected for the systematic review. Results were grouped according to wound type and type of silver dressing. The sample included 2,066 men and women age 18 and older.

Data were analyzed with risk difference (RD) and confidence intervals. Silver sulphadiazine (SSD) cream compared to bacitracin showed no statistical difference in wound infection prevention (RD 0.07, 95% CI -0.01 to 0.14). The Neomycin group had significantly fewer patients who developed SSI when compared to SSD cream group (RD 0.08; 95% CI 0.00 to 0.15). No statistical difference was reported in silver containing dressing compared to non-silver containing dressings in SSI rates (RD -0.01; 95% CI -0.17 to 0.14). Wound healing showed no statistical difference between silver-based dressings compared to non-silver dressings (RD 0.13; 95% CI -0.04 to 0.31).

Biffi et al. (2012) conducted a prospective RCT to compare the efficacy of silver hydrofiber dressing (Aquacel Ag) to sterile gauze dressing for preventing SSIs in 112 patients undergoing elective colorectal cancer surgery. Patients were assigned to control or experimental groups using computer-generated randomization without blocking. The scrub nurse in the operating room applied dressings and the Aquacel Ag was covered with a common wound dressing to ensure blinding.

Data were analyzed using ANOVA. ANOVA showed that surgical wound length differed from one setting to the other ($p<0.0001$). Although not statistically significant, the experimental group had a 15.5% SSI rate, compared to the control group rate of 20.4%. Data were insufficient to calculate an effect size for determination of clinical significance.

Siah & Yatim (2011) conducted an RCT to compare the efficacy of a total occlusive ionic silver-containing dressing (TOISD) to conventional dressing method on bacterial colonization and risk of SSI in patients undergoing colorectal surgery. Culture swabs from both groups were obtained for culture and sensitivity analysis upon wound closure in the operating room as a baseline, and again on either the fifth, sixth, or seventh postoperative day. The TOISD dressing was applied to wounds of the experimental group patients and left in place for up to seven days, whereas the conventional dressing were removed on postoperative day one.

Data showed a statistical significant relationship between bacterial colonization and SSI rate ($p<0.001$), with no superficial SSI rates in TOISD experimental group. The data demonstrated a medium magnitude of effect (0.612). Siah & Yatim (2011) concluded that TOISD reduced bacterial consolidation within the surgical site. Although non-significant, TOISD could lead to a reduction in the risk and exacerbation of deep incisional SSI (Siah & Yatim, 2011).

Beele, Meuleneire, Nahuys, and Percival (2010) conducted a prospective randomized multicenter, multinational study to assess the signs and symptoms of infection and healing. They also report on the use of silver alginate/carboxymethyl-cellulose (SACMC) antimicrobial wound dressing for reducing wound infections in at risk patients with chronic venous stasis ulcers. Alginate fiber (non-silver) dressings were applied to participants in the control group. The study group used SACMC dressings.

The study was conducted at multiple centers in Belgium and the Netherlands between October 2005 and August 2006. The 36 adult patients had a chronic wound at risk for infection and with moderate to heavily exudate. The treatment was extended for four weeks with either dressing. The wound was inspected and a wound index score was obtained five times throughout the study, once before treatment, then at every weekly patient visit for up to four weeks (Beele Meuleneire, Nahuys, & Pervical, 2010).

Students *t*-tests results showed a statistically significant wound surface area reduction in the study group [(p=0.017); 17.7 $\pm$ 25.4 (SACMC) and 18.7 $\pm$ 44.1 (AF)]. X^2 results showed a significanctly higher percentage of prevention of wound infection with SACMC compared to non-silver alginate fiber dressings (4.3$\pm$5.5 and 5.8$\pm$4.3; *p*=.013) with a small magnitude of effect (0.029).

Bowler, Welsby, Hogarth, and Towers (2013) investigated the antimicrobial effect of silver-based gel fiber dressing against *Propionibacteriu acnes* (*P. acnes*) using stringent in-vitro models that simulated various wound conditions. A fluid model simulating heavy exudation wounds was used to quantify the antimicrobial capacity of the silver-based gel fiber dressing. A simulated colonized shallow wound model was used to investigate the dressing's antimicrobial

activity. The third model was devised to measure the effects of the dressing on embedded bacteria within a simulated colonized wound surface.

Data showed 100% of non-silver-based dressings on simulated wound fluids had complete growth of *P. acnes* across the inoculated surface are. In addition, 99% of shallow wounds were void of growth of *P. acnes*. Data supported the use of silver-based gel fiber dressings to decrease the colonization of surgical wounds and minimize the risk of infection caused by *P. acnes*.

Connery, Downs, and Young (2012) conducted a retrospective chart review to investigate whether a silver-impregnated dressing applied in the operating room reduced the need for additional post-operative wound care visits and improve SSI rates in patients undergoing cesarean delivery. The study included 72 patients; 36 had a standard gauze dressing and the remaining 36 had Silverlon dressing.

A higher percentage of patients in the Silverlon group had comorbidities, having a negative effect on SSIs (Control group = 9.4%, Silverlon group = 33.3%, $p = .002$). Additionally, the onset of prenatal care was significantly earlier for the Silverlon group receiving earlier prenatal care (8.7; p=0.02). Data showed non-significant difference between the standard dressing and Silverlon dressing groups in either the percentage of patients needing postoperative wound visits or the number of SSIs.

Silver Hydrogel Sheet Dressings

Galli, Protzman, and Brigido (2013) conducted a prospective pilot study to compare silver hydrogel dressings with petroleum-based dressings. They measured differences in the development of superficial and deep infections, epithelialization, and dehiscence. The 59 participants were divided into two groups: a forefoot and a midfoot group (n = 29) and a

hindfoot/ankle group (n = 30). Within each group participants were randomized into the silver hydrogel group or the petroleum-dressing group. During the 1-week, 2-week, 5-week, and 12-week post-operative visits, incisions were evaluated for SSIs as well as epithelialization, dehiscence, and infected or incisional complications.

The investigators found significant reduction of scar length in patients treated with silver hydrogel dressings (18%), compared to those treated with petroleum-based dressings (2%; $p < 0.001$). The magnitude of effect was medium (0.63). There was no significant difference in infection rates although the silver hydrogel group only had one superficial SSI whereas the petroleum-based dressing group had three superficial SSIs and one deep SSI ($p = .37$).

Unspecified Post-operative Silver Dressing

Schwartz et al. (2014) evaluated the effect of silver-based dressing on patients' SSI. In a prospective trial, 199 patients underwent a clean surgical procedure who were deemed at high risk for SSIs, including obesity, diabetes mellitus, long leg incisions, and surgical implants. In the first arm, conducted at a tertiary medical center, the control group had standard gauze dressing applied whereas the study group had a silver-based dressing applied immediately post-operative and left in place for up to seven days. Participants were evaluated in the hospital for up to seven days post-operatively. The second study arm, in three additional medical centers, followed the same procedure except the study period was extended to three weeks or six dressing changes, whichever came first.

The investigators found no significant difference between the percentages of patients receiving antibiotic therapy in the study group (3%) compared to the control group (6%); (95% CI 16.7 to 7.1%, $p = 0.498$). There was a trend toward a higher SSI rate in the control group.

Synthesis of Research Findings

Level of evidence was determined using the hierarchy pyramid present by Melnyk & Fineout-Overholt (2011). An illustration of the evidence hierarchy is found in Appendix B. Storm-Versloot et al. (2010) provided Level I evidence with their systematic review of RCTs comparing silver-containing wound dressings and topical agents with silver-containing and non-silver-containing comparators on uninfected wounds. The systematic review included 26 RCTs, but only two included acute surgical wounds. The other 24 RCTs focused on either burns or chronic wounds

Multiple RCTs provide Level II evidence. Beele et al. (2010) conducted a two-armed RCT in different medical centers. Despite the multiple sites, their sample was small (N=36). Krieger et al. (2011) provided evidence for reduction in total and superficial SSIs, but did not blind participating physicians. The investigators estimated rather than measured incision length before the dressing was applied, thus, missed important incisional length data. Siah & Yatim (2011) strengthened their homogenous RCT with colo-rectal surgical wounds by blinding data collectors and including wound culture data. Biffi et al. (2012) had a strong double-blinded research design, but included only a small sample size (N=112). Having the operating room nurse cover the silver dressing with a common wound dressing for blinding purposes could have inhibited the performance of the antimicrobial agents.

Several investigators conducted controlled trials without randomization, providing Level III evidence. Huckfeldt et al. (2008) had a large sample size (N=1600). In the prospective portion of their study, all wounds were examined at three weeks by the study coordinator and surgeon. Comparison mediastinitis data were retrospective, which relied heavily on accuracy of documentation. These investigators did not provide any demographic data for the sample. The in-vitro study by Bowler et al. (2013) was the first to report the effect of silver-based dressings

on *P. acne*, but did not provide actual patient data. Galli et al. (2013) were able to demonstrate the benefit of silver dressings over petroleum dressings in reducing SSI rates. However, the investigators who evaluated the surgical wounds were not blinded to the dressing types. Most recently, Schwartz et al. (2014) included high-risk patients in their multi-site study. Although they demonstrated a lower 30-day rate of antibiotic treatment (4.5%) when the incision was covered with a silver-based dressing, weaknesses in the design such as inconsistent antibiotic use and lack of randomization may have affected the results. Patient attrition reduced follow-up visits in which SSIs may have been missed.

Connery et al. (2012) provided Level IV evidence with their retrospective chart review. While this was one of the first studies to evaluate silver-based dressings in the obstetric patients, retrospective data are often only as reliable as the medical records documentation.

Agency Description

Setting

Cabell Huntington Hospital (CHH) a 303-bed regional facility is located in Huntington, West Virginia. CHH is a teaching hospital affiliated with Marshall University Schools of Nursing and Medicine. CHH offers many specialties, is a certified stroke center, specialized pediatric care, comprehensive cancer center, and a Level 2 trauma center (Cabell Huntington Hospital (CHH), 2014).

The project was implemented in the operating room and on 2 North Bed Towers (NBT), a 38-bed medical-surgical unit.

Target Population

The CHH patients having abdominal surgeries were documented to have the one of the highest prevalence of SSIs in the facility (A. Bullington, personal communication, June 3, 2014). As this was a pilot project, only patients having colorectal surgery performed by surgeons in a

selected surgical practice were included. Thus, the target population for this project was patients 18 and older undergoing colorectal surgery without the use of implants and with a surgical incision at least three centimeters in length. Patients with allergies to agents within the silver-based dressing or sensitivity to silver were excluded from the project.

Congruence of Capstone Project to Organization's Mission, Goals, and Strategic Plan

This project for prevention of SSIs was congruent to CHH mission and vision. The mission is "to meet your lifetime healthcare needs, to provide an atmosphere of service, quality, and efficiency, and to maintain an emphasis on healthcare education" (CHH, 2014). The vision is "to be the hospital of choice for all ages in the communities we serve" (CHH, 2014). A decrease in SSIs would assist CHH in providing safe and quality care to the patients; lower SSI rates could assist in obtaining their vision to be the hospital of choice.

The Plan-Do-Study-Act model was adopted by CHH to pilot test evidence-based practice changes. First, proposed changes to the facility are implemented in one area, for example the intensive care unit (ICU). Andrea Criss, Registered Nurse (RN) and Manager of Clinical Training and Development, leads the change by assessing the evidence, educating the staff prior to implementation, and collecting and analyzing data after the intervention has been implemented for the planned period. If the data analysis supports the piloted change, the hospital will adopt the change in practice throughout the facility (A. Criss, personal communication, June 2, 2014).

Stakeholders

Patients were significant stakeholders. Peri-operative and post-operative procedures have been demonstrated to prevent post-operative infections are the safest and highest in quality. Prevention of SSIs would prevent unnecessary direct and indirect costs for patients, including

increased hospital monetary costs, length of stay, pain, suffering, and impact on functional status and post-operative quality of life.

Administrative stakeholders for this project included Joy Pelfrey RN, MSN, FNP, NEA-BC the Vice President of Nursing and Chief Nursing Officer at Cabell Huntington hospital, Teresa Sexton RN, MSNeD, Director of Adult Nursing, Amy Bullington RN, MSN, Nurse Manager of 2NBT, Marshall University School of Medicine Department of Surgery General Surgeons, and Jenny Murray, Director of Trauma Services. Each of these individuals has a desire to reduce the SSI rate and improve the safety, quality, and satisfaction of patients' experiences at CHH. The driving force is the desire for improving patient outcomes, coupled with a mandate from The Joint Commission to implement evidence-based strategies to reduce SSIs. The Centers for Medicaid and Medicare Services (CMS) is the leading source for reimbursement at CHH. As CMS identified several hospital-acquired conditions that will cause a decrease in reimbursement, prevention of complications such as SSIs is critical for cost containment ("Hospital-Acquired Conditions", 2012).

Statement of Mutual Agreement

The Statement of Mutual Agreement is included in Appendix C.

Project Design

The project was a pre- and post-comparison of the evidence-based dressing protocol outcomes. SSI rates for similar colorectal surgical patients will be compared before and after the implementation.

In addition to the project leader, key personnel that played a role in implementing this change were:

- Amy Bullington RN, Nurse Manager of 2 NBT – key project preceptor and co-project leader for IRB – provided support for project development and implementation of dressing change protocol on unit, which she manages.
- Andrea Criss MSN, RN, Manager of Clinical Training and Development – assisted with providing education to nursing and OR staff
- Janet Cooper RN, Wound Care Specialist – assisting with selecting an appropriate bordered silver foam dressing for colorectal surgical patients
- 2 NBT and OR staff nurses and colorectal surgeons – administered protocol on a patient-by-patient basis.

Project Methods

Procedure

IRB submission process. IRB approval was obtained from Marshall University; an IRB Authorization Agreement (IAA) from Eastern Kentucky University recognized Marshall University as the student's IRB of record. See Appendix D.

Measures and instruments. CHH uses CDC guidelines for diagnosing SSIs. The Health Protection Surveillance Center (HPSC) diagram guided diagnosis procedure for SSIs. (Appendix E). Wound cultures were completed on all suspected SSIs (A. Bullington, personal communication, March 30, 2015). All cultures were reported to the CHH infection control department staff, who reported any positive cultures to the patients' surgical physician and the surgical safety team. The uses of these two diagnostic methods (HPSC criteria and cultures) were already standard of practice at CHH. Thus there was no change to the previous practice of identifying SSIs at CHH.

Implementation. The intervention protocol for the implementation of the bordered silver foam dressing protocol was divided into three phases: (a) Phase I – education; (b) Phase II – implementation; and (c) Phase III – data collection**.**

Phase I. All 2NBT nursing staff and residents of the selected colorectal surgical practice were educated about the pilot project from May 15, 2015 through July 6, 2015. Mandatory education about a change in policy was provided for nurses of 2NBT, preoperative, intraoperative and postoperative surgical areas, and the Surgical Intensive Care Unit nurses. The content was presented within the area the nurses practice because content is more likely to be learned successfully when education is presented within the area the nurse currently practices (Xiao, 2010). The project leader presented educational material of current CDC statistics of SSIs and reported the benefits of silver-based dressings in reducing SSIs based on current evidence (Huckfeldt et al., 2008; Krieger et al., 2011; Biffi et al., 2012; Siah & Yatim, 2011). Educational material was provided in the format of PowerPoint presentation during mandatory staff education sessions. These onsite presentations and training for the nursing staff and residents included information about the bordered silver foam dressing, application protocol of the dressing, and the use of the HPSC diagram.

Educational material available from the manufacturer of the bordered silver foam dressing (Molnlycke Health Care, Norcross, GA) was included in the educational sessions. In addition to onsite education, the educational content/presentation was placed on Healthstream (the CHH learning management system) for each nurse to access.

The general surgeons, Marshall University School of Medicine Department of Surgery General Surgeons, and residents worked with the operating room circulating nurse to ensure all patients that meet inclusion criteria had(a) a physician order for the silver-based dressing, (b) a

dressing change order, and (c) order for daily wound assessment. A simple checklist was developed for the operating room circulating nurse to use on each patient (Appendix F). The checklist was initiated in the pre-operative area and followed the patient through the operating room to the post anesthesia care unit.

Phase II. Phase II began on July 8, 2015 through September 4, 2015. During Phase II, Marshall University School of Medicine Department of Surgery General Surgeons implemented the use of the bordered foam silver dressing on surgical patients who met the following criteria: (a) colorectal surgical patient; (b) wound class of clean, clean-contaminated, or contaminated (See Appendix G for Classification of Surgical Procedures Policy); (c) age 18 years or older; (d) wound incision greater than 3 cm in length. The pre-operative nurse obtained allergy information on allergy or sensitivity to silver. The circulating nurse was responsible for selecting the correct size bordered silver foam dressing, to be applied to the patient. The selected physicians, resident, or operating room nurse under their direction applied the bordered silver foam dressing to the selected patients prior to patient leaving the operating room.

Throughout Phase II of the project, the nurse manager and the project leader made rounds on the nursing unit to ensure strict protocol was followed and education was reinforced with the staff when selected patients were on the unit or as needed.

As supported in the literature, the long-acting bordered silver foam dressing remained intact for seven days or until the day of discharge, whichever came first (Connery et al., 2012; Schwartz et al, 2014). The dressing was then changed and a new bordered silver foam dressing was applied to the surgical incision using sterile technique by the staff nurse (Siah & Yatim, 2011; Biffi et al., 2012). The primary nurse and/or resident changing the dressing on post-operative day seven or prior to discharge was responsible for evaluating the incision for signs

and symptoms of infection using the HPSC diagram (Appendix E). For any patients suspected of having a SSI, the physician was notified, and a wound culture was obtained and delivered to the microbiology lab per CHH standard practice.

Upon hospital discharge, patients were given follow-up appointments according to each surgeon's preference. Marshall University School of Medicine Department of Surgery General Surgeons typically scheduled their patients for a one- or two-week post-operative office visit as well as a one-month post-operative visit. In the event that the seventh post-operative day fell on a holiday or weekend, the patient was sent home with directions for removal of dressing on the seventh day and was scheduled for an office visit according to the each surgeon's preference. If the patient was seen in the surgeon's office, the surgeon removed the dressing at the post-operative outpatient follow-up and inspected the incision for possible signs and symptoms of infection. If an infection was suspected, the surgeon collected a wound culture with a swab of the surgical site. Wound culture specimens were sent to the CHH microbiology lab for analysis. Each physician was responsible for notifying the infection prevention specialist at CHH of the suspected SSI. In the case of a failed report by the physician all positive wound cultures of surgical sites were automatically sent to the infection prevention specialist for further investigation.

Phase III. In compliance with CDC guidelines, each patient was monitored for 30 days postoperatively via medical records review, infection prevention specialist reports, and wound culture reports. Data collection was completed on October 1, 2015.

Results

A total of 11 colorectal surgical patients met the implementation protocol criteria during the 57-day data collection period. All 11 patients were Caucasian with a mean age of 54$\pm$13.61,

a mean BMI of 31.5±8.58, and a mean length of stay of 13.36±14.71 days (See Table 1). Ten patients had multiple comorbidities; only one patient had no comorbidities (See Table 2). Among the 11 patients, three types of surgical procedures were performed (Table 3). All 11 patients had mid-abdominal incisions greater than 3 cm in length.

Table 1

Mean Age, BMI, and LOS (N=11)

	Minimum	Maximum	Mean	Std. Deviation
Age	39.0	79.0	54.5	13.6
BMI	20.0	45.0	31.5	8.6
LOS	3.0	54.0	13.4	14.7

Table 2

Comorbidities and Smoking Status (N=11)

	Frequency	Percent
DM	5	45.5
Hypertension	8	72.7
CV Disease	3	27.3
Cancer	6	54.5
Smoker	3	27.3

Table 3

Type of Colorectal Surgery (N=11)

	Frequency	Percent
Hemicolectomy/Colectomy	8	72.7
Colostomy Closure	2	18.2
Lysis of Adhesions	1	9.1

Eight of the 11 patients were included in the protocol. Three of the 11 patients were not included in the protocol related to lack of adherence to the protocol (n=2) and lack of supply coordination (n=1). The hospital staff followed the prescribed protocol exactly on five of the eight patients, applying the bordered silver foam dressing to the surgical wound in the OR. A deviation from the protocol occurred on three patients who had an initial abdominal pad with gauze surgical wound dressing applied in the OR. In each case, a member of the nursing staff recognized the deviation and applied the bordered silver foam dressing within 6 hours post-operative. None of these three patients developed SSIs

Surgical site infections occurred in both the protocol and non-protocol patients (Table 4) but at a higher rate for those who did not receive he bordered silver foam dressing. Both superficial and organ/space SSIs were observed (Table 5).

Table 4

Frequency of Surgical Site Infections (N=11)

	SSI	No SSI	Infection Rate
Protocol (n=8)	3	5	37.5%
Non-protocol (n=3)	2	1	66.7%

Table 5

SSI by Protocol Status and Infection Type

	Superficial	Deep	Organ/Space	No Infection	Infection Rate
Protocol (n=8)	1	0	2	5	37.5%
Non-protocol (n=3)	1	0	1	1	66.7%
Total Protocol & Non-protocol July/August 2015	2	0	3	6	45.5%
Total Non-protocol July/August 2014 (N=14)	1	1	1	11	21.5%

Discussion

Evidence for implementation of the bordered silver-foam dressing as the bandage of choice following colorectal surgeries has been well documented in the literature. CHH administrators, nurses, and surgeons supported the development and implementation of the

project protocol to pilot the use of these antimicrobial dressings for their colorectal surgery patients. Throughout the protocol pilot period, most remained supportive and were highly diligent in assuring that patients were treated according to the protocol. The project Phase II education sessions for physicians and nurses were highly supported by the hospital administration and were well received by participants. Staff nurses in both the OR and on 2NBT were not only receptive, but conscientious about adhering to the protocol. The culture of protocol adherence was apparent, but even more importantly, the culture of providing the safest and highest quality care was evident.

Eight of the 11 patients meeting project criteria were treated with a post-operative bordered silver foam dressing that remained in place for up to seven days. Dressings were assessed, signs and symptoms of SSIs were monitored, and wound cultures were obtained and reported when SSIs were suspected or apparent.

Despite the evidence in the literature for the benefit of the bordered silver foam dressing as an effective post-operative colorectal surgical intervention, data from this pilot project were not as encouraging. In this project, infection rates for protocol and non-protocol patients were 37.5% and 66.7% respectively. The total infection rate for this two-month period was 45.5% compared to the 21.5% infection rate during the same two-month period one year earlier. Investigators who studied the silver microbial dressings reported drops in infection rates ranging from 22% (control group) to 11% (experimental group) (Krieger et al., 2011), 20.4% (control group) to 15.5% (experimental group) (Biffi et al., 2012) and 6% (control group) to 3% (experimental group) (Schwartz et al., 2014).

The pilot sample of 11 patients did not provide enough quantitative data to determine the absolute advantage or disadvantage of the bordered silver foam dressing. Variations from the

protocol occurred: three patients missed the protocol and three patients had the dressing applied on the post-operative nursing unit. Variation from the protocol, even for up to six hours post-operatively, did not affect the infection rate, as there were no infections for the three patients that did not follow protocol.

Several benefits of the project were identified using formative evaluation. The OR and 2NBT nursing staff were updated in their education on SSIs and prevention strategies. The 2NBT nursing staff was diligent in their post-operative protocol implementation and patient education. The project helped identify the logistical issues of real-world implementation.

Currently the Surgical Safety Team (consisting of administrators, nurses, physicians, and a pharmacist) is planning an implementation of a comprehensive Colorectal Bundle with target implementation date of December 1, 2015. Based on this project's literature review, educational materials developed and administered to nurses and physicians, and the formative assessment data, the current plan is to include the bordered silver foam dressing as part of the Colorectal Bundle (A. Bullington, personal communication October 15, 2015). Exact evaluation strategies for the Colorectal Bundle implementation have not yet been determined.

Implications

There are several practice implications for the feasibility and sustainability of using bordered silver foam dressings as an SSI preventative measure in colorectal patients. First, introduction of the practice change, accompanied by education and coordination of multiple patient care services is important. The education provided in this pilot project was central for alerting nurses and physicians of the infection rate problem, providing the evidence for a simple and feasible intervention, and training them in the dressing protocol so they could carry it out

accurately. Although the implementation was not perfect, there were situations in which a deviation from protocol was noted and immediately corrected by staff nurses.

Secondly, the planned implementation of the Colorectal Bundle containing the bordered silver foam dressing is a more comprehensive approach to SSI reduction. Published literature provides evidence to support the inclusion of bordered silver foam dressings; formative evaluation from this project provides anecdotal data useful in future projects to preserve the necessary protocol adherence to evaluate SSI outcomes.

Thirdly, continued attention to the SSI rate, first and foremost for patient care quality and safety reasons, but also for reimbursement and compliance reasons, is crucial. Ongoing attention to health care delivery, implementation of evidence-based interventions, and evaluation of patient outcomes are necessary for improving and maintaining a safe surgical care environment.

Summary

SSIs are one of the leading causes of nosocomial infections (Magill et al., 2014). In support of CHH quality improvement projects to decrease the incidence of SSIs, this three-phase pilot project educated staff, implemented use of bordered silver foam dressings for colorectal surgical patients, and evaluated SSI rates.

Although, there is strong evidence in the literature to support using bordered silver foam dressings as a strategy to reduce SSIs (Krieger et al., 2011; Storm-Versloot et al., 2010; Siah et al., 2011; Huckfeldt et al., 2008), the benefit was not evident in this pilot program. Following protocol implementation on eight colorectal surgical patients, the SSI rate was 37.5% an increase from 21% during the same months one year earlier. Still, this project raised awareness among staff nurses, the OR surgical staff and services of the SSI issues and necessity of protocol adherence. The planned implementation of a Colorectal Bundle includes the use of the bordered silver foam dressings.

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Appendix A

Intervention/Outcomes Synthesis Table

Outcomes	Krieger et al.	Huckfeldt et al.	Storm-Versloot et al.	Biffi et al.	Siah et al.	Beele et al.	Bowler et al.	Connery, Downes, & Young	Galli, Protzman, & Brigido	Schwarts et al.
	2012	2008	2010	2012	2011	2010	2013	2012	2013	2014
Interventions	Silver Nylon		Silver Hydrofiber						Silver Hydrogel Sheet	POSD (not specified)
Total SSI rate	↓	↓	–	↓*	↓*	↓	↓	=	↓*	↓*
Superficial SSI rate	↓			↓*	↓*				↓*	
Deep SSI rate	↓ (ns)			↓*	↓*				↓*	
Organ/Space SSI rate					–				↓	
Bacterial Colonization					↓		↓			

*NSS= not statistically significant, but possibly clinically significant.

Appendix B

Level of Evidence Synthesis Table

Level of Evidence		Storm-Versloot et al. (2010)	Beele et al. (2010)	Krieger et al. (2011)	Siah & Yatim (2011)	Biffi et al. (2010)	Huckfeldt et al (2008)	Bowler et al. (2013)	Galli et al. (2013)	Schwartz et al. (2014)	Connery et al. (2012)
I	Systematic Reviews Meta-analyses	X									
II	RCT		X	X	X	X					
III	Controlled trial without randomization						X	X	X	X	
IV	Case control Cohort Studies										X
V	Systematic Review of Qualitative or Descriptive Studies										
VI	Qualitative or Descriptive Studies EBP Implementation Projects										
VII	Expert Opinion										

Appendix C

Statement of Mutual Agreement for Capstone Project

Eastern Kentucky University
Department of Baccalaureate and Graduate Nursing
Doctor of Nursing Practice Program

Statement of Mutual Agreement for Capstone Project

The purpose of a Statement of Mutual Agreement is to describe the agreement between a designated clinical agency and the DNP student regarding the student's Capstone Project. The guide provides a format and an outline of components that should be included in the statement.

I. General Information

Student Name:	Jessica Maynard
Project Title:	Bordered Silver Foam Dressings for Colorectal Surgical Patients
Agency:	Cabell Huntington Hospital
Agency Contact:	Amy Bullington MSN, RN

II. Brief description of the project

- Expected project outcomes (products, documents, etc.)
- On-site Activities (DNP student role, required meetings, access to agency records, non-disclosure expectations)
- Products resulting from DNP Capstone Project with potential market value.
  Any products produced from collaboration with the agency must be discussed with the student, Capstone Advisor, and appropriate agency representative. The ownership of intellectual property rights must be determined prior to the implementation of the project.

Purpose of the Project

The purpose of this project will be to implement a silver-based dressing protocol for post-operative colorectal surgical patients. The proposed change project is the implementation of bordered silver foam dressings for colo-rectal surgical patients who are not allergic to silver products and are not having surgical implants. The design will be a pre- and post- comparison of the evidence-based practice. SSI rates for similar colo-rectal surgical patients and costs will be compared for a matching 30-day period before and after the implementation.

Expected Project Outcomes

Reduce surgical site infections

Eastern Kentucky University
Department of Baccalaureate and Graduate Nursing
Doctor of Nursing Practice Program

Onsite Activities

During the three phases of the project the DNP student (J. Maynard) will provide educational materials via PowerPoint presentations, one on one education sessions with the nursing staff and residents, and a healthstream module. The DNP student will attend Surgical Safety Team Meetings throughout the capstone project to discuss root cause analysis of SSI patients. The DNP student will also participate in chart reviews for completion of RCA's of suspected SSIs.

Needed Resources

The following resources for this project will be provided by CHH: (a) education specialist time for training staff nurses; (b) staff nurse time for learning new colo-rectal surgical wound and dressing protocol; (c) cost of wound culture supplies and laboratory culture development as already previously billed for surgical site infections; (d) bordered silver-foam dressings supplied by Cabell.

Eastern Kentucky University
Department of Baccalaureate and Graduate Nursing
Doctor of Nursing Practice Program

Student Name: Jessica Maynard

Project Title: Bordered Silver Foam Dressings for Colorectal Surgical Patients

III. Agreement of written and oral communication

- Reference to clinical agency in student's academic work, publications, and presentations
- Restrictions on discussion of any project or agency details
- Formal agency approval needed for any publicly shared findings

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IV. Required Signatures:

Jessica Maynard — Student — 3/25/2015 — Date

_____ Capstone Advisor — _____ Date

Amy Bullington BN, MSN — Agency Representative — 3/30/2015 — Date

Approved ___(Date)_____

Appendix D

IRB Approval and IRB Authorization Agreement

w w w . m a r s h a l l . e d u

Office of Research Integrity
Institutional Review Board
One John Marshall Drive
Huntington, WV 25755

FWA
00002704

IRB1
#00002205
IRB2
#00003206

June 22, 2015

Amy Bullington, MSN
Cabell Huntington Hospital, Nursing Post-Surgical

RE: IRBNet ID# 760259-1
At: Marshall University Institutional Review Board #1 (Medical)

Dear Dr. Bullington:

Protocol Title: [760259-1] Bordered Silver Foam Dressings for Colorectal Surgical Patients

Expiration Date: June 22, 2016
Site Location: CHH
Submission Type: New Project APPROVED
Review Type: Expedited Review

In accordance with 45CFR46.110(a)(5), the above study was granted Expedited approval today by the Marshall University Institutional Review Board #1 (Medical) Chair for the period of 12 months. The approval will expire June 22, 2016. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date. The approval also includes the Waiver of Informed Consent.

If you have any questions, please contact the Marshall University Institutional Review Board #1 (Medical) Coordinator Trula Stanley,MA, CIC at (304) 696-7320 or stanley@marshall.edu. Please include your study title and reference number in all correspondence with this office.

Institutional Review Board (IRB) Authorization Agreement

Name of Institution or Organization Providing IRB Review (Institution/Organization A):
Marshall University

IRB Registration #: IRB 0000 Federalwide Assurance (FWA) #, if any: 0000 704

Name of Institution Relying on the Designated IRB (Institution B):
Eastern Kentucky University

IRB Registration #: IRB00002836 Federalwide Assurance (FWA) #, if any: FWA00003332

The Officials signing below agree that Eastern Kentucky University may rely on the designated IRB for review and continuing oversight of its human subjects research described below: (*check one*)

(___) This agreement applies to all human subjects research covered by Institution B's FWA.

(x) This agreement is limited to the following specific protocol(s):

Name of Research Project: Bordered Silver Foam Dressings for Colorectal Surgical Patients
Name of Principal Investigator: Amy Bullington
Protocol Number: 760259-1

(___) Other (*describe*):_____

The review performed by the designated IRB will meet the human subject protection requirements of Institution B's OHRP-approved FWA. The IRB at Institution/Organization A will follow written procedures for reporting its findings and actions to appropriate officials at Institution B. Relevant minutes of IRB meetings will be made available to Institution B upon request. Institution B remains responsible for ensuring compliance with the IRB's determinations and with the Terms of its OHRP-approved FWA. This document must be kept on file by both parties and provided to OHRP upon request.

Signature of Signatory Official (Institution/Organization A): _____ Date: 7/8/15

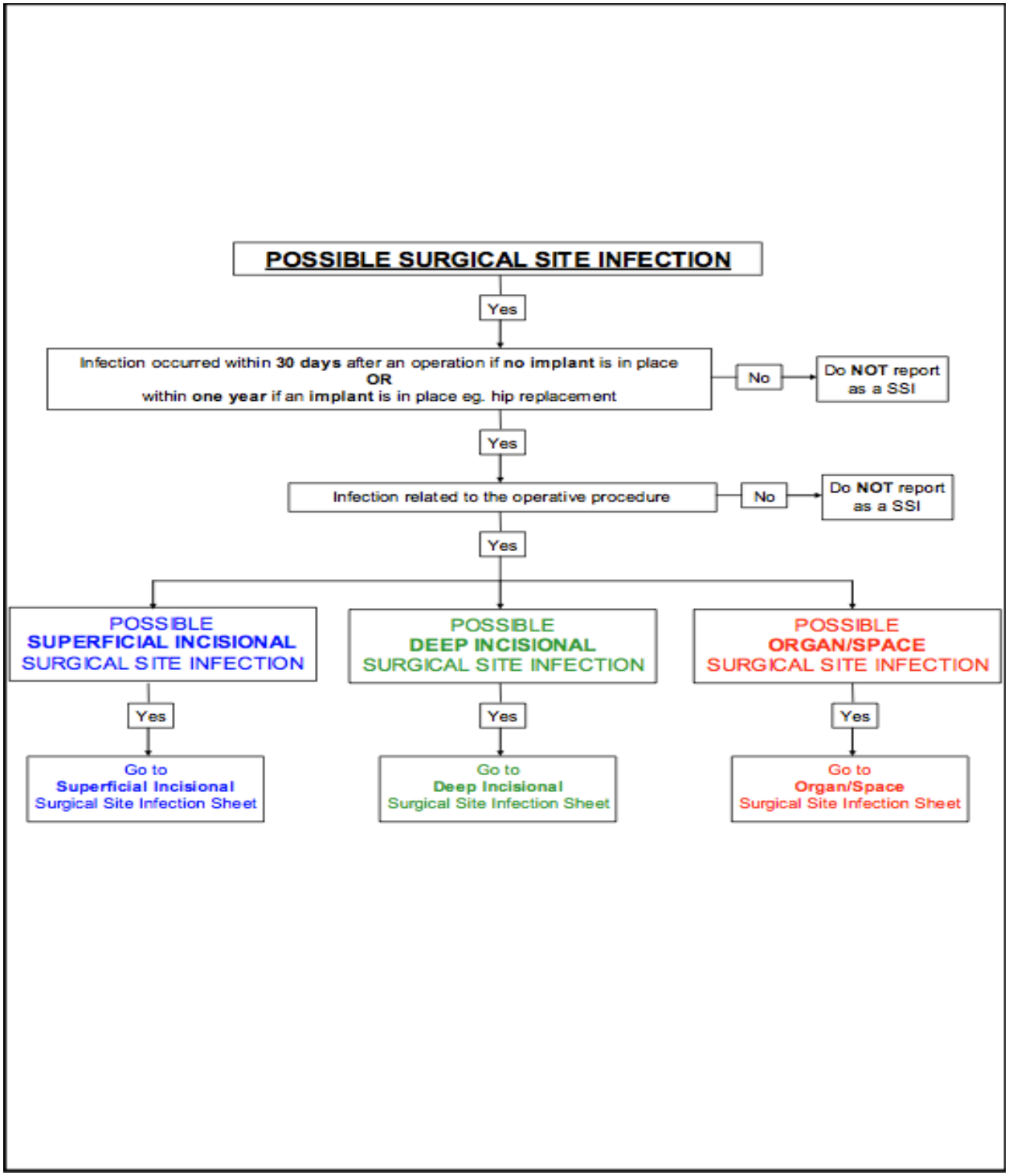
Print Full Name: JOHN M. MAHER, PHD Institutional Title: VICE IDENT. RESEARC

Signature of Signatory Official (Institution B): _____ _____

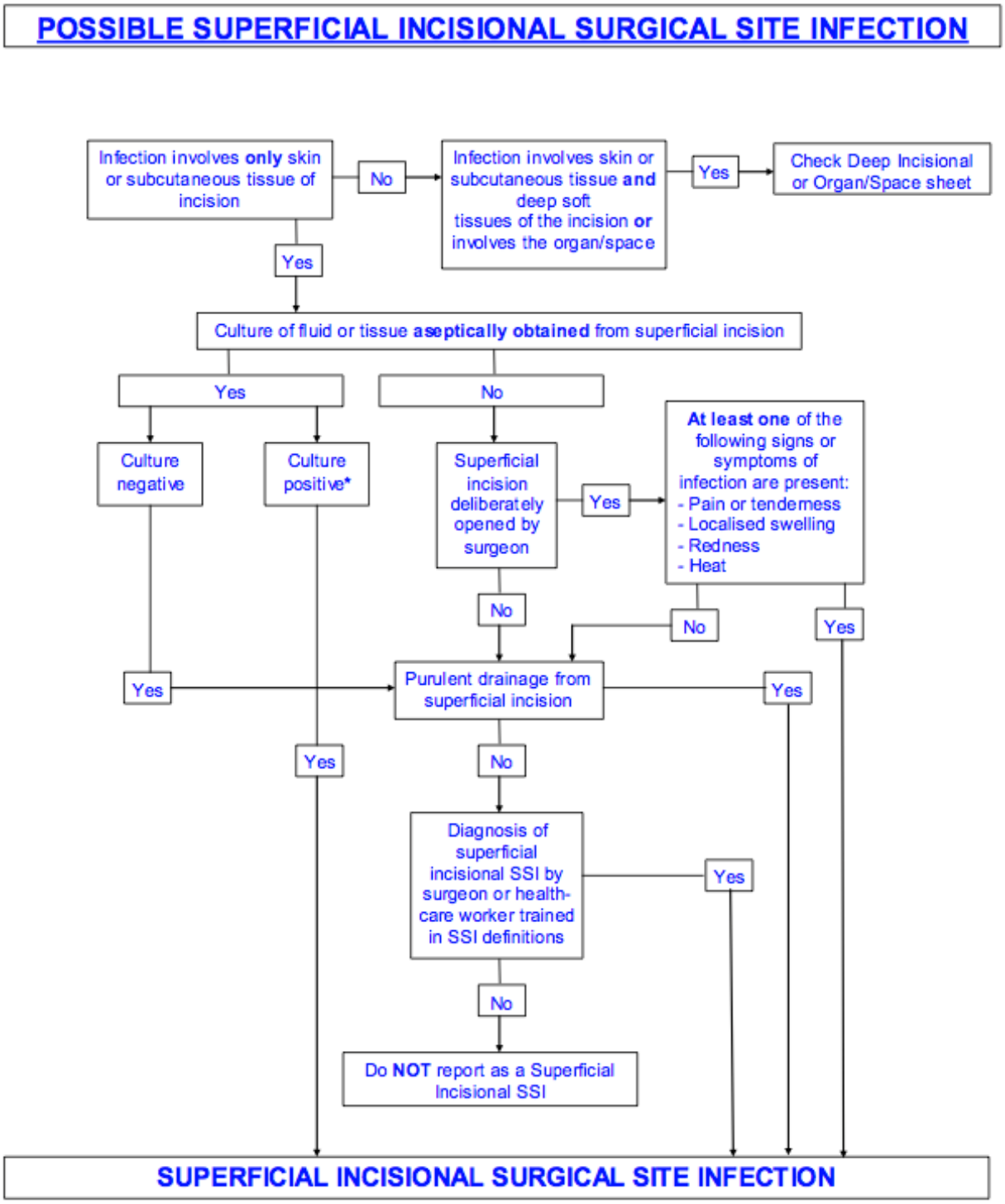
Print Full Name: *Dr. Gerald J. Pogatshink* Institutional Title: *Associate Vice President for Research*

Appendix E

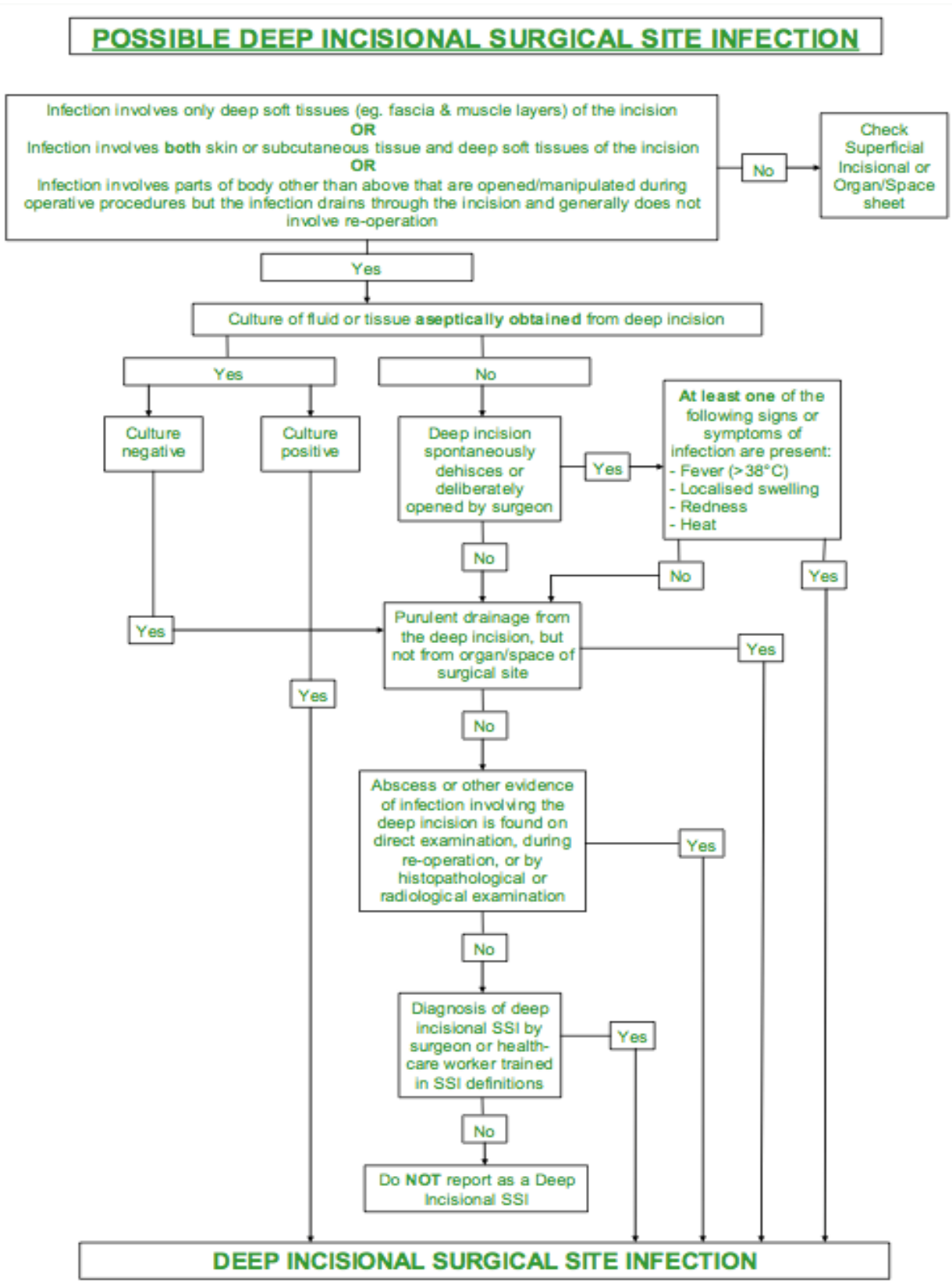
Schematic of Diagnosing Surgical Site Infections



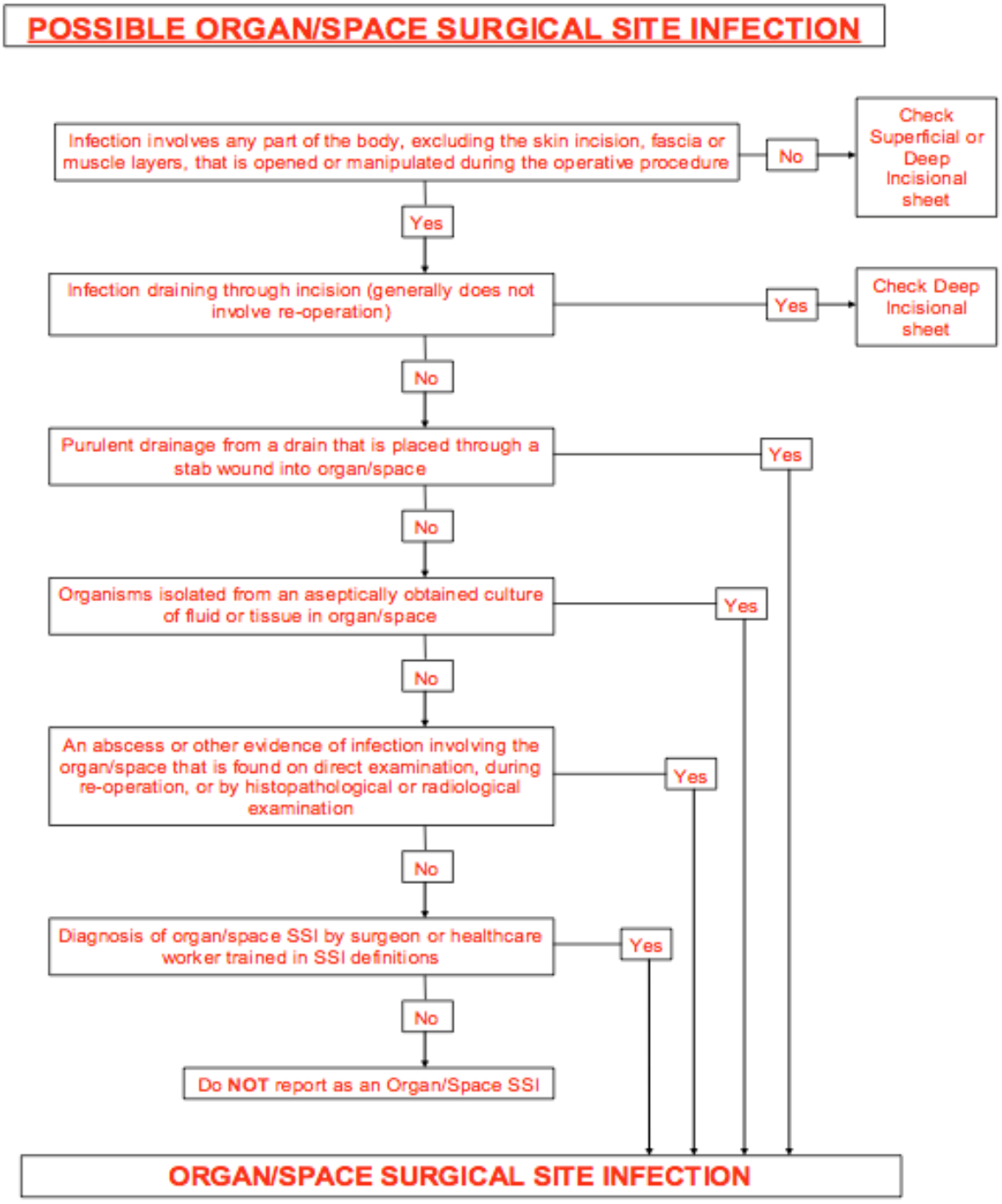
(HPSC, 2008)


POSSIBLE SUPERFICIAL INCISIONAL SURGICAL SITE INFECTION
Infection involves only skin or subcutaneous tissue of incision
No
Infection involves skin or subcutaneous tissue and deep soft tissues of the incision or involves the organ/space
Yes
Check Deep Incisional or Organ/Space sheet
Yes
Culture of fluid or tissue aseptically obtained from superficial incision
Yes
No
Culture negative
Culture positive*
Superficial incision deliberately opened by surgeon
Yes
At least one of the following signs or symptoms of infection are present:
- Pain or tenderness
- Localised swelling
- Redness
- Heat
No
No
Yes
Yes
Purulent drainage from superficial incision
Yes
Yes
No
Diagnosis of superficial incisional SSI by surgeon or health-care worker trained in SSI definitions
Yes
No
Do NOT report as a Superficial Incisional SSI
SUPERFICIAL INCISIONAL SURGICAL SITE INFECTION

(HPSC, 2008)


POSSIBLE DEEP INCISIONAL SURGICAL SITE INFECTION
Infection involves only deep soft tissues (eg. fascia & muscle layers) of the incision
OR
Infection involves both skin or subcutaneous tissue and deep soft tissues of the incision
OR
Infection involves parts of body other than above that are opened/manipulated during operative procedures but the infection drains through the incision and generally does not involve re-operation
No
Check Superficial Incisional or Organ/Space sheet
Yes
Culture of fluid or tissue aseptically obtained from deep incision
Yes
No
Culture negative
Culture positive
Deep incision spontaneously dehisces or deliberately opened by surgeon
Yes
At least one of the following signs or symptoms of infection are present:
- Fever (>38°C)
- Localised swelling
- Redness
- Heat
No
No
Yes
Yes
Purulent drainage from the deep incision, but not from organ/space of surgical site
Yes
Yes
No
Abscess or other evidence of infection involving the deep incision is found on direct examination, during re-operation, or by histopathological or radiological examination
Yes
No
Diagnosis of deep incisional SSI by surgeon or health-care worker trained in SSI definitions
Yes
No
Do NOT report as a Deep Incisional SSI
DEEP INCISIONAL SURGICAL SITE INFECTION

(HPSC, 2008)


POSSIBLE ORGAN/SPACE SURGICAL SITE INFECTION
Infection involves any part of the body, excluding the skin incision, fascia or muscle layers, that is opened or manipulated during the operative procedure
No
Check Superficial or Deep Incisional sheet
Yes
Infection draining through incision (generally does not involve re-operation)
Yes
Check Deep Incisional sheet
No
Purulent drainage from a drain that is placed through a stab wound into organ/space
Yes
No
Organisms isolated from an aseptically obtained culture of fluid or tissue in organ/space
Yes
No
An abscess or other evidence of infection involving the organ/space that is found on direct examination, during re-operation, or by histopathological or radiological examination
Yes
No
Diagnosis of organ/space SSI by surgeon or healthcare worker trained in SSI definitions
Yes
No
Do NOT report as an Organ/Space SSI
ORGAN/SPACE SURGICAL SITE INFECTION

(HPSC, 2008)

Appendix F

OR Checklist for Bordered-Silver Foam Dressings

Pre-operative

1. Allergy to silver? ___ yes ___ no (if yes, DO NOT apply silver dressing)
2. Colorectal Surgical Patient? ___ yes ___ no (if no, DO NOT apply silver dressing)
3. Laproscopic Surgery? ___ yes ___ no (if yes, DO NOT apply silver dressing)
4. 18 years and older? ___ yes ___ no (if no, DO NOT apply silver dressing)

Intra-operative

1. Wound incision(s) greater than 3 cm? ___ yes ___ no (if no, DO NOT apply silver dressing)
2. Surgical Implant? ___ yes ___ no (if yes, DO NOT apply silver dressing)
3. Bordered silver-foam dressing time, date, and initialed?

   ___yes ___no (if no, insure dressing is timed, dated and initialed immediately)

Post-operative

1. Physician order for silver-based dressing? ___yes ___no (if no, obtain order ASAP)
2. Dressing change order per protocol? ___yes ___no (if no, obtain order ASAP)
3. Order for daily wound assessment? ___yes ___no (if no, obtain order ASAP)

Appendix G

Classification of Surgical Procedures

Cabell Huntington Surgery Center		**Policy No. OR 41.0**
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Policy:
Operative wound classification; Contamination-Infection Risk.

Purpose:
To provide a method of classifying surgical wounds for appropriate infection control measure. A wound classification based on a clinical estimation of bacterial density, contamination, and risk of subsequent infection is contained in the following outline which is now widely accepted as a standard classification of operative wounds. It is recommended for use in collating information concerning infections and relating them to sources of contamination and degree of risk to infection.

Procedure:
Classification of Operative Wounds In Relation To Contamination and Increasing Risk of Infection

1. CLEAN:
- Non traumatic
- No inflammation encountered
- No break in technique
- Respiratory, alimentary, genitourinary tracts not entered.

2. CLEAN – CONTAMINATED:
- Gastrointestinal or respiratory tracts entered, without significant spillage
- Appendectomy
- Oropharynx entered
- Vagina entered
- Genitourinary tract entered, in absence of infected urine
- Biliary tract entered, in absence of infected bile
- Minor break in technique
- Amputations and arterial grafts, in presence of distal dry gangrene or “clean” ulcer
- Operation at one site, with infection elsewhere in body.

3. CONTAMINATED:
- Major break in technique
- Traumatic wound, fresh
- Gross spillage from gastrointestinal tract
- Amputations and arterial grafts at clean area with distal infected limb, cellulites or wet gangrene.
- Entrance of genitourinary or biliary tracts with presence of infected urine or bile.

4. DIRTY AND INFECTED:

- Acute bacterial inflammation encountered, without pus
- Transection of "clean" tissue for the purpose of Traumatic wound with Retained devitalized tissue, foreign bodies, fecal contamination and/or delayed treatment, or from dirty source.

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I. A clean wound is a non-traumatic, uninfected operative wound in which neither the respiratory, alimentary or genitourinary tracts nor the oropharyngeal cavities are entered. Clean wounds are elective, primarily closed, and undrained wounds.

II. Clean-contaminated wounds are operative wounds in which the respiratory, alimentary or genitourinary tracts are entered, without unusual contamination, or wounds which are mechanically drained. Includes amputations or arterial grafts, where distal limb has dry gangrene or a "clean" ulcer. Also includes operation at a clean site, with sepsis elsewhere in the body.

III. Contaminated wounds include open, fresh traumatic wounds, operations with a major break in sterile techniques (e.g., open cardiac massage), and incisions encountering acute, nonpurulent inflammation; amputations, and arterial grafts where distal limbs are infected (e.g. with cellulites or moist gangrene.).

IV. Dirty and infected wounds include old traumatic wounds and those involving clinical infection or perforated viscera. May include amputations or vascular grafts, in presence of severe limb infection, depending on site and severity. The very definition of this classification suggests that the organisms causing postoperative infection are present in the operative field before operation.

Each surgeon is responsible for stating the class, which the nurse will document.

CLASS I: CLEAN (C) WOUNDS

1. Operation and operative field:
   - Respiratory, alimentary, genital, or urinary tracts are not entered.
   - No inflammation, cellulites, or infection in the operative field.
2. Condition of patient:
   - No infection or inflammation in other organs or sites.
3. Operating Room:
   - No break in aseptic technique.

Narrative: Clean wounds are those in which the operation does not enter a contaminated or potentially contaminated viscous or area. There is no local or distant infection, inflammation, or cellulites. Aseptic technique is adhered to without any possibility of contamination of instruments or the operative field. All clean wounds are closed primarily, and selected ones can have a closed drainage system. Wounds that follow penetrating (blunt) trauma can be listed as a clean wound if all of the other criteria are met. Almost all clean wounds occur in elective cases, but not all elective cases have a clean wound.

Examples:

Adrenalectomy
Abdominal Aortic Aneurysm
Aortic-Bifemoral Bypass
Arthroplasty
Elective Eye/Muscle Surgery
Exploratory Laparotomy
Hydrocelectomy
Heart Valve Repair/Replacement

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Examples Continued:

Aortic Coronary Bypass
Amputations
AV Fistula
Carotid Endarterectomy
Cataract Surgery
Mastectomy
Orchiectomy / Orchiopexy
Ovarian Cystectomy
Parotidectomy
Portacaval Shunt
Pacemaker Placement
Tubal Ligation
Radical Neck (w/ outside incision)
Herniorrhaphy
Hip pinnings (other pinnings)
Femoral-Popliteal Bypass
Laminectomy
Neurosurgery (craniotomy/spinal fusion)
Salpingo-Oophorectomy
Skin Grafts
Splenectomy
Sympathectomy
Thyroidectomy / Parathyroidectomy
Vein Stripping
Total Joint Replacement / Joint Prosthesis

CLASS II: CLEAN-CONTAMINATED (CC)

1. **Operation and operative field:**
   (A) The respiratory, alimentary, genital, and urinary tracts are entered under very controlled circumstances without any significant contamination of the operative field or surrounding area. [negative urine culture]
   (B) The biliary tract (in absence of infected bile), oropharynx, or vagina are entered.
   (C) Although some evidence of minimal inflammation may be present, there is no cellulites or infection in the operative field.

2. Condition of patient: Although there may be evidence of minimal inflammation in another organ or site, there is no established infection, cellulitis, or infection in the operative field.

3. Operating Room: A minor break in aseptic technique is encountered but no major break or contamination occurs.

Narrative: Clean-contaminated wounds are generally those in which the operation enters a viscous which may have minimal inflammation but no infection. There may be minimal local or distant inflammation but no infection or active cellulites. Aseptic technique may have a minor break such as contamination of the gown, but an observer with recognition of the contamination may cover the area with a sleeve or change the gown. Another common example is a break in the glove which is recognized by fluid under the glove but no large tear or exposed hand or finger exist. Most clean-contaminated wounds can be closed primarily; however, many of them will have some form of mechanical drainage.

Examples, only if uninfected:

Abdominal Hysterectomy
Abdominal perineal Resection (prepped)
Appendectomy
Bowel Resection (prepped)
Cesarean Section
Cholecystectomy (negative cultures)/ Biliary tree procedures)
Colostomy Closure
Scopes – cysto, sigmoid, procto, broncho laryngo, esophago, etc.
Oral/dental Surgery
Open Fractures < 10 hours old
Paranasal Sinus Surgery
Pilonidal cyst/ sinus surgery
Pneumonectomy/Lobectomy
Polypectomy
Radical Neck (if mouth/trachea involved

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Examples continued:

Cystoscopy (negative culture)
Rectal/Vaginal Surgery (Cone biopsy, Uterine

Esophagectomy
Hemorrhoidectomy
Intranasal Surgery
Laceration < 8 hours old
Laryngectomy
Vaginal Hysterectomy
&/or cervical biopsy, D&C)
Gastrectomy (vagotomy; antrectomy)
Small Bowel Surgery (no inflammation)
Laparoscopy
Nephrectomy (if urine is sterile)

Class III: Contaminated

1. Operation and operative field:
   (a.) The respiratory, genital, urinary, and alimentary tracts are not only inflamed, but also infected. The infection is generally contained and not throughout the entire area.
   (b.) There is gross inflammation, active infection, or cellulites in the operative field.

2. Condition of patient: There is established infection or inflammation in another organ or site.

3. Operating Room: There is a major break in technique.

Narrative: Contaminated wounds are those in which the operation enters an infected viscus or area. There is local or distant infection. A major break in aseptic technique occurs such as contamination of an instrument which is then used in the operative field or direct contamination in the body falling into the operative field. Gross spillage of visceral contents, even if not infected, is generally considered contamination of the area and placed in Class III. Most contaminated wounds are not closed or may be partially closed with external drainage of the wound.

Examples:

Appendectomy (with Perforation/ peritonitis)
Bowel Resection (with Peritonitis/perforation)
Burns (debridement)
Cholecystectomy (Positive culture)
Diverticulectomy
Fistulectomy
Intranasal Surgery
Lacerations > 8 hours
Myringotomy
Nephrectomy (Bacteruria)
Open fractures > 10 hours
Tonsillectomy & Adenoidectomy
Traumatic wounds >10 hours
TURP

CLASS IV: DIRTY

1. Operation and operative field:
   (a) There is gross contamination in the abdomen with infected material or spillage from a viscous in an inflamed or infected area.
   (b) There is active infection such as an abscess, devitalized tissue with infection or a foreign body with infection (even if “clean” tissue is transected to reach a collection of pus.)

2. Condition of patient: The patient has current septicemia or bacteremia.

3. Operating room: There is a major break in aseptic technique with a grossly infected foreign body.

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Narrative: Dirty wounds are those in which the operation drains an abscess or significantly infected area. There is local or systemic infection. The break in aseptic technique involves contamination of the operative field from an infected source. This factor rarely occurs and an example would be placement of non-sterilized prostheses. No dirty wounds are closed primarily.

ADDENDUM

Factors That Increase Class of Operative Wound:

* Major breaks in technique
* Significant acute, non-purulent inflammation
* Presence of pus
* Delayed treatment of traumatic wounds/lacerations/fractures

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