National Association of Orthopaedic Nurses

Advancing the Art and Science of Orthopaedic Care

Clinical Practice Guideline
Surgical Site Infection Prevention

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Disclaimer

This clinical guideline was developed by the NAON Evidence-Based Practice and Research Committee (NEBPRC) and is provided as an educational tool based on an assessment of current scientific and clinical research information. The tool is not intended to replace a clinician's independent judgment and critical thinking, but to enhance the clinician's knowledge base regarding the prevention of surgical site infections (SSIs).

Levels of Evidence

The evidence within this clinical practice guideline is rated to differentiate evidence of varying strengths and quality. "The underlying assumption is that recommendations from strong evidence of high quality would be more likely to represent best practices than evidence of lower strength and less quality" (Newhouse, 2007 , p. 90). Refer to the Appendix for an explanation of the levels of evidence contained within this guideline.

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Introduction

A surgical site infection is defined by the Center for Disease Control's (CDC) National Healthcare Safety Network (NHSN) as an infection of the surgical site following a surgical procedure. The surgical procedure must involve an incision through skin or mucous membrane. Surgical site infections following surgical procedures are classified as superficial incisional, deep incisional, or organ/space depending upon the tissue or body part involved (Association for Professionals in Infection Control and Epidemiology [APIC], 2010, page 17) (Level II).

Surgical Site Infection is recognized as one of the most prevalent healthcare associated infections (Mangrum et al., Horan, T., Pearson, M., Silver, L., & Jarvis, W., 1999) (Level I). Up to 355,500 surgical patients develop SSI after orthopaedic surgery each year (Eislet, 2009) (Level I). Surgical site infections play a major role in increasing morbidity and mortality, prolonging hospitalizations, and increasing hospital readmissions, in addition to contributing to rising healthcare costs (Bachoura, 2011) (Level II).

To reduce the risk of SSI, a systematic but realistic approach must be applied with the awareness that this risk is influenced by the presence of modifiable and non-modifiable factors (Reyes, 2011) (Level I). Modifiable risk factors include surgical technique and the measures of infection prevention that are utilized. Non-modifiable risk factors are the presence of patient co-morbidities, the type of procedure performed (emergent vs. non-emergent), and the presence of wound contamination prior to surgery (Mu, 2011) (Level IV). Other non-modifiable risk factors that highly influence the development of SSI following skeletal trauma include the site of injury, number of operations required to effectively address the injury, the utilization of a drain, and the patient being a methicillin-resistant staphylococcus aureus (MRSA) carrier (Bachoura, 2011) (Level II).

Purpose

The purpose for the Surgical Site Infection Prevention Clinical Practice Guideline is to educate staff in promoting a multi-faceted approach to prevent all orthopaedic surgery related infections. A consistent implementation of practices related to preoperative surgical site preparation, intra-operative as well as postoperative care would serve to improve outcomes.

Rationale for Guideline

Due to increasing prevalence, extent of injury, rising healthcare costs pertaining to SSIs, and the increasing incidence of MRSA-related SSIs, prophylaxis pertaining to SSIs has become a national priority (Evans, 2009) (Level I). The incidence of SSIs may be decreased and the extent of injury minimized by utilizing evidence-based SSI prophylaxis measures (Hall, 2007) (Level I).

The Surgical Care Improvement Project (SCIP) is a national partnership that was developed in 2003 by the Centers for Medicare and Medicaid Services (CMS), the Centers for Disease Control and Prevention (CDC), and various organizations committed to improving the safety of surgical care through the reduction of postoperative complications by utilizing evidence-based core measures. The SCIP was developed as a result of core measures pertaining to the prevention of surgical infections in the hospital setting that were introduced by Joint Commission (JC) in 2003. SCIP Infection (INF) milestones for infection prevention include:

- SCIP INF 1a: Prophylactic antibiotic received within 1-hour prior to surgical incision (Evans, 2009) (Level I);
- SCIP INF 2a: Prophylactic antibiotic selection for surgical patients (Evans, 2009) (Level I);
- SCIP INF 3a: Prophylactic antibiotics discontinued within 24 h after surgical end time (Evans, 2009) (Level I);

- SCIP INF 6: Surgery patients with appropriate hair removal (Evans, 2009) (Level I);
- SCIP INF 10: Surgery patients with perioperative temperature management (Bergstrom, 2010) (Level I)

Goal of Clinical Practice Guideline

Identification of evidence-based prevention measures pertaining to SSIs will provide orthopaedic nurses with the knowledge base needed to effectively deliver high quality, continuity of care among patients undergoing surgery of the musculoskeletal system.

Assessment of Scientific Evidence

Centers for Disease Control and Prevention guidelines for reducing the transmission of SSIs include utilizing contact precautions for patients with known or suspected infections, employing appropriate hand hygiene measures, performing effective environmental cleaning, and following the SCIP measures (Hall, 2007) (Level I). Studies have also been conducted regarding the utilization of patient-centered modalities to decrease the incidence of SSIs. These modalities include, but are not limited to nasal swabbing, preoperative skin cleansing, preoperative hair removal, perioperative antibiotic timing and specific post-operative care measures (Standiford & Aziz, 2005) (Level I).

Nursing Diagnosis

Deficient knowledge

Risk for infection

Risk for impaired skin/tissue integrity

Risk for imbalanced nutrition

Risk for ineffective tissue perfusion

Risk for hypothermia

Risk for injury

Potential for ineffective thermoregulation

Risk for fluid imbalance

Risk of impaired self-image

Description

Identifying characteristics that may influence risk of SSI development are:

- patient being an MRSA carrier;
- preoperative skin prep;
- duration of surgical scrub;
- preoperative shaving;

- duration of surgery;
- antimicrobial prophylaxis;
- inadequate operating room ventilation;
- inadequate sterilization of instruments;
- foreign material in the surgical site;
- surgical drains;
- surgical technique with poor hemostasis;
- presence of fluid imbalance;
- failure to obliterate dead space;
- tissue trauma; and
- post-operative wound care (Mangram et al., 1999) (Level I).

A variety of patient or host and procedure-associated factors also appear to be related to an increased risk of infection following orthopaedic surgery. Host specific SSI risk factors include:

1. obesity;
2. current smoking;
3. hematocrit <36;
4. elevated pre-operative or post-operative serum glucose;
5. diabetes;
6. chronic steroid use
7. advanced age
8. renal failure
9. low serum albumin level
10. patient being a carrier of MRSA;
11. male gender;
12. rheumatoid arthritis;
13. The American Society of Anesthesiologists (ASA) Score of 3 or greater;
14. disseminated cancer; and
15. admission from a healthcare facility.

Procedure specific SSI risk factors include:

- estimated blood loss of greater than 1 liter;
- longer procedure time;
- suboptimal timing of prophylactic antibiotic;
- two or more residents participating in the procedure;
- prolonged wound drainage;
- spinal procedure via the posterior or the anterior/posterior approach;
- previous infection at the site; and
- low volume of procedures performed by the surgeon or low volume performed at the hospital (APIC, 2010 p. 12) (Level II).

Definition of the Problem

SSIs can lead to compromised wound healing, failure of components and hardware, in addition to increased medical costs, morbidity, and mortality (Evans, 2009) (Level I).

Pathophysiology

- Methicillin sensitive Staphylococcus aureus (MSSA), and drug-resistant organisms including MRSA and vancomycin-resistant enterococci (VRE) colonize on the skin and are spread by contact (Evans, 2009) (Level I).
- MSSA and MRSA bacteria can live with other bacteria on a person's skin, such as on the hands or in a person's nose. Whenever a person touches people or things, he or she can pass on the bacteria (Evans, 2009) (Level I).
- Every surgical wound is able to tolerate some degree of host damage locally and a certain amount of bacterial flora; however, the condition of the wound and the bacterial flora are interrelated. If either of these exceeds a tolerable threshold, infection may develop. The threshold may be determined by host factors such as the presence of co-morbid conditions (diabetes, autoimmune disorders), age, and nutritional status. (Evans, 2009) (Level I).

Utilization of Clinical Quality Indicators

- Clinical quality indicators (CQIs) allow for the identification of areas that need improvement and serve as evidence-based guides that assist with the measurement of the quality and safety of patient care (Smith, 2011) (Level II).
- CQIs specific to infection prophylaxis include intravenous antibiotic administration, adherence to perioperative skin preparation, systematic assessment of postsurgical incision, proper technique with post-surgical dressing changes, and compliance with facility-specific perioperative and post-operative protocols (Smith, 2011) (Level II).

Nursing Interventions and Expected Outcomes

The spread of infectious disease can be prevented by maintaining contact precautions for patients with an infection that is present or suspected. This includes, but is not limited to, good hand-washing practices, utilizing private patient rooms along with contact precautions, using Personal Protective Equipment (PPE), and maintaining sterility when performing all sterile and aseptic procedures. Soap and water are the most effective means of removing infectious organisms from hands/fingers. Hand antiseptics should be used as directed (Standiford & Aziz, 2005) (Level I).

Prior to entering the operating room, traditional or dry scrubbing of hands must take place to help prevent the development of SSI. There is no increased risk for SSI with the use of dry scrubbing vs. traditional scrubbing (Parienti, 2002) (Level I)

Nursing Assessment Pertaining to Patient Care

- Inspect wounds for redness, tenderness, warmth, drainage, drainage that has an odor, or if patient if febrile (Horan, 1992) (Level III).
- Determine wound classification to predict the risk for SSI development (AORN, 2011) (Level II)
- Determine the presence of co-morbid conditions that may increase incidence of SSI (Bosco, Slover, & Haas, 2010) (Level I).
- Determine presence of modifiable and non-modifiable risk factors (Bachoura, 2011) (Level II).
- Review with patient their previous history of infections. (Bachoura, 2011) (Level II).

- Ask the patient to describe his or her living environment. (Bachoura, 2011) (Level II).
- Observe very closely those patients with non-modifiable risk factors that may be at increased risk for SSI post-operatively (Prokuski, 2008) (Level I).

Patient Care Management

Determine Wound Classification

Centers for Disease Control recommend assessing surgical wounds and determining the probability of SSI by utilizing a classification that consists of four types of surgical wounds (AORN, 2011).

Clean Wounds (Class I): uninfected operative wounds where no inflammation is present and no signs of infection. These wounds are primarily closed and are able to be drained with a closed wound drainage system. An example of a clean wound is a total joint replacement.

Clean Contaminated Wounds (Class II): operative wounds that involve entering the respiratory, alimentary, or genitourinary tracts. There are no signs of infection present. Examples are hysterectomy, non-perforated appendectomy, or lobectomy.

Contaminated Wounds (Class III): open, fresh, accidental wounds. This is any type of penetrating trauma or open fractures.

Dirty-Infected Wounds (Class IV): wounds that involve an existing clinical infection. Examples are incision and drainage of an infected wound or delayed primary closure of a contaminated wound.

Preoperative Care

Nasal Swabbing

- Preoperative nasal swabbing may be utilized to screen for patients who are carriers of MRSA or MSSA. Initiating treatment for those patients who test positive preoperatively may decrease the SSI rate as much as 82% among patients undergoing total joint arthroplasty (Sporer, 2011) (Level II).
- If preoperative nasal swab screening is done, it should be done at least 14 days prior to the surgical procedure. If a culture is positive, decolonization with 2% mupirocin intranasally twice a day is recommended until day of surgery (Sporer, 2011) (Level II).

Pre-op Patient Skin Cleansing

- Chlorhexidine gluconate-containing products require several applications to attain maximum antimicrobial benefit; so repeated antiseptic showers are usually indicated preoperatively (preferably the evening before surgery and the morning of surgery). If advanced notice prior to surgery, cleansing can be recommended each day up to approximately 5 days before surgery (Mangram et al., 1999) (Level I).

Pre-op Hair Removal

- If hair removal is required in the perioperative setting, it should be removed just prior to the surgical procedure. It is recommended that hair removal take place with electric clippers (Hall, 2007) (Level I).

Blood Transfusions

- Autologous and allogeneic blood transfusions intra-operatively and post-operatively may slightly increase the risk for SSI. The risk is greater with allogeneic than autologous (Kendall, 2000) (Level III).

IV Antibiotic timing: (Hall, 2007) (Level I)

- Initiate up to 60 minutes before incision: cefazolin, cefuroxime, clindamycin.
- Initiate up to 120 minutes before incision: vancomycin.
- Infusion completed a minimum of 10 minutes prior to tourniquet inflation.

Duration of Antimicrobial Use

- Single preoperative dose (Hall, 2007) (Level I).
- Redose antimicrobial intraoperatively when procedure exceeds one to two times the antibiotic's half-life or when there is significant blood loss (Prokuski, 2008) (Level I).
- When using postoperative doses, discontinue within 24 hours after closure of the incision (Hall, 2007) (Level I).
- Patients with a higher than normal BMI may require higher dosages of antimicrobial therapy.

Preoperative Issues

- Whenever possible, identify and treat all infections remote to the surgical site before elective surgery and postpone elective surgery on patients with remote site infections until infection has resolved (Mangram et al., 1999) (Level I).
- Consider checking hemoglobin A1C levels in patients with diabetes. Adequately control serum blood glucose levels in patients with diabetes and particularly avoid hyperglycemia during perioperative phase (Mangram et al., 1999) (Level I).
- Adequately control serum blood glucose levels of less than 180 Mg/dl in all diabetic patients and particularly avoid hyperglycemia perioperatively. Hyperglycemia reduces the body's natural resistance to infection. "Diabetes has been associated with an increased risk of surgical site infections in several orthopaedic disciplines. While this so-called diabetic disadvantage may be due, in part, to the impact of the disease on a patient's biology and physiology, it is more likely that the acute effects of perioperative hyperglycemia are even more detrimental" (Evans, 2009, p. 4) (Level I).
- Pre-operative dental screenings to evaluate for the presence of tooth decay, inflammatory gum disease-gingivitis, periodontitis, or dental abscesses that may lead to seeding of bacteria and a deep joint infection (Kaar et al., 2000) (Level II).
- Determine the use of chronic medications such as steroids and immunosuppressives. These medications have been shown to increase SSI rates and negatively affect wound healing (McPhee, 1998) (Level II).
- Patients with a history of renal failure should have their renal function evaluated and optimized (Bosco, Slover, & Haas, 2010) (Level 1).
- Assess patients for evidence of malnourishment. Patients who are malnourished and have low albumin levels, are more likely to develop SSIs (Cierny, 2009) (Level I)
- Keep preoperative hospital stay as short as possible while allowing for adequate preoperative preparation of the patient (Mangram et al., 1999) (Level I).

Intraoperative Care

Surgical Hand Antisepsis

Surgical hand antisepsis is a crucial factor in preventing SSIs. It is performed before donning sterile gloves. The purpose of a surgical hand antisepsis is to reduce transient and resident microorganisms on the hands and maintain the bacterial level below baseline, as this may reduce hospital acquired infections. (APIC, 2010) (Level II). In the U.S., a standardized surgical hand scrub or rub should be performed, using either an antimicrobial surgical agent or an alcohol-based

antiseptic surgical hand rub with documented persistent and cumulative activity that has met the U.S. FDA regulatory requirements for surgical hand antisepsis.

Skin Antisepsis

The selection of the preoperative skin antiseptic agent should be based on patient assessment for any allergy or sensitivity to skin preparation agents. Qualities the preoperative antiseptic agent should possess are (APIC, 2011) (Level II)

- significantly reduce microorganisms on intact skin;
- contain a non-irritating antimicrobial preparation;
- be broad spectrum and fast acting; and
- have a persistent effect.

After a patient has been placed on the operating room table, the surgical site should be prepped by painting it with a povidone-iodine, iodine with alcohol base, or chlorhexidine solution. Chlorhexidine has been proven to be more effective in preventing SSIs when compared to iodine based solutions (Digison, 2007) (Level II).

Antibiotic Prophylaxis

- Many facilities include antibiotic prophylaxis as a routine part of the surgical time-out. An important consideration in total knee replacements is the infusion of the antibiotic prior to inflation of the tourniquet (APIC, 2011) (Level II).

Air Quality

- The quality of air entering the OR should be carefully controlled by keeping operating room doors closed except as needed for passage of equipment, personnel, and the patient (AORN, 2010) (Level II).

Traffic Patterns

- Limit number of personnel entering operating room to necessary personnel only (AORN, 2010) (Level II).

Maintain Normothermia to Avoid Hypothermia

- Hypothermia is defined as a core temperature less than 96.8°F (AORN, 2011) (Level II).

Sterilization of Surgical Instruments

- Sterilize all surgical instruments according to institutional guidelines.
- Perform flash sterilization only in emergent situations when instruments will be used immediately. Do not use flash sterilization for reasons of convenience, as an alternative to purchasing additional instrument sets, or to save time (AORN, 2010) (Level II).

Postoperative Care

Postoperative Incisional Care

- Protect an incision that has been closed primarily with a sterile dressing for 24-48 hours postoperatively (Mangram et al., 1999) (Level I).
- Perform hand hygiene before and after dressing changes and any contact with the surgical site (Mangram et al., 1999) (Level I).
- When an incision dressing must be changed, use sterile technique (Mangram et al., 1999) (Level I).

- Educate the patient and family regarding proper incision care, symptoms of SSI, and the need to report such symptoms (Mangram et a.l, 1999) (Level I).

Postoperative Skeletal Pin Care

- Be aware that pins located in soft tissue area are at greater risk for infection (Holmes & Brown, 2005) (Level II).
- After the first 48 to 72 hours following skeletal pin placement, pin site care should be done daily or weekly (Holmes & Brown, 2005) (Level II).
- Chlorhexidine 2mg/mL solution is considered to be the most effective cleansing solution for skeletal pin site care (Holmes & Brown, 2005) (Level II). Saline should be used if chlorhexidine solution is contraindicated according to the Royal College of Nursing (2011). (Level V).
- Strict hand washing before and after skeletal pin site care should always take place.

Note: Follow your facility's specific policy and procedure pertaining to skeletal pin care.

Postoperative Care of Negative Pressure Wound Therapy

- Postoperative care should be carried out per negative pressure wound therapy manufacturer's recommendations or per physician's orders.
- Strict hand washing before and after negative pressure wound therapy care should always take place
- Sterile technique should always take place when conducting dressing change.

Disinfection of Non-Critical Items

- Non-critical items include items that come in contact with intact skin. Examples of these items would include CPM machines, ice therapy packs, blood pressure cuffs, etc. (AORN, 2010) (Level II).
- These non-critical items should be cleaned at the point of use with an immediate-level or low-level disinfectant such as alcohols, sodium, hypochlorite, phenolic solutions, or ammonium solutions. (AORN, 2010) (Level II).

Nursing Responsibilities with Prophylaxis Antibacterial Therapy

- Assess the patient's allergy history before beginning IV antibacterial therapy or applying topical antiseptic agents (AORN, 2011) (Level II).
- Practice strict hand washing and contamination precautions before handling each patient's IV site (Bosco, Slover, & Haas, 2010) (Level I).
- Monitor infusion/injection site for signs of extravasation—pain, edema, and drainage (AORN, 2011) (Level II).
- Ensure IV antibiotics are given on time as ordered if the patient is receiving post-operative inpatient antibiotic IV therapy (AORN, 2011) (Level II).
- Monitor closely for hypersensitivity reaction during and after each dose (AORN, 2011) (Level II).
- Monitor for and instruct the patient to report severe diarrhea (Standiford & Aziz, 2005) (Level I).
- Monitor for and instruct the patient to report signs of renal impairment— blood urea nitrogen and creatinine intake and output and urine color (Horan, 1992) (Level III).
- Monitor and instruct the patient to report any side effects specific to particular antibacterial agent (Horan, 1992) (Level III).
- Ensure IV antibiotics are discontinued within 24 hours of after surgical end time (Evans, 2009) (Level I)

Patient Education

Preoperative

- Encourage tobacco cessation. At a minimum, instruct patients to abstain from smoking cigarettes, cigars, pipes, or any other form of tobacco consumption for at least 30 days before an elective operation. The nicotine in tobacco products results in microvascular vasoconstriction, in addition to tissue hypoxia that can contribute to the development of SSI (Lindstrom, 2008) (Level II).
- Review pre-operative bathing and skin preparation instructions. Give the patient written instructions if possible (Eislet, 2009) (Level I).

Postoperative patient and/or family education pertaining to

- Signs and symptoms of infection (Mangramet al., 1999) (Level I).
- Hand washing (Bosco, Slover, & Haas, 2010) (Level I).
- Appropriate wound care (Bosco, Slover, & Haas, 2010) (Level I).
- Antibiotics (if prescribed after hospital discharge): emphasizing the importance of taking all medication until finished and the potential side effects (Evans, 2009) (Level I).

Discharge Destination

The discharge destination for the patient is based on the level of care required and the support system available to the patient. The goal would be to return to pre-hospital environment, but special consideration is required based on the need for oral or intravenous antibiotics and/or wound care. Assistance with placement for follow-up care may be needed.

Trends and Controversies

No recommendation to taper or discontinue systemic steroid use (when medically permissible) before elective surgery.

No recommendation to enhance nutritional support for surgical patients solely as a means to prevent SSI.

No recommendation to provide measures that enhance wound space oxygenation to prevent SSI.

No recommendations to use a dressing to cover an incision closed primarily beyond 48 hours, or an appropriate time to shower or bathe with an uncovered incision.

No recommendation on the use of Novel 2% Chlorhexidine Gluconate Cloths.

Controversy exists on skeletal pin care.

Web Sites

Professionals:

www.cdc.gov/ncidod/dhqp/

www.gao.gov/new.items/d08808.pdf

www.cdc.gov/drugresistance

www.ahrq.gov/qual/ssi

Patient and Family:

http://www.cdc.gov/getsmart/

http://www.cdc.gov/GetSmart/antibiotic-use/know-and-do.html

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Appendix: System for Rating the Strength of Evidence

System for Rating the Strength of Evidence	
Level I	High-quality randomized controlled trial with large sample and statistically significant difference or no statistically significant difference but narrow confidence intervals Evidence from a systematic review, a meta-analysis, or an evidence-based clinical practice guideline where only results from randomized controlled clinical trials were used.
Level II	Evidence from at least one well-designed randomized prospective comparative clinical trial. Systematic review of primarily Level II studies.
Level III	Evidence from well-designed case controlled trials without randomization, comparative studies and evidence from a systematic review, a meta-analysis, or an evidence-based clinical practice guideline where results from randomized clinical trials and controlled clinical trials were used. Systematic review of primarily Level III studies.
Level IV	Evidence from case series and cohort studies. Evidence from well-designed descriptive, qualitative, or psychometric studies. Evidence from a systematic review, a meta-analysis, or meta-synthesis of descriptive or qualitative studies.
Level V	Evidence from the opinion of authorities or experts.
Level VI	Common practice, as documented in clinical articles or nursing textbooks.

Modified from the Rating System for the Hierarchy of Evidence by Melnyk, B.M., & Fineout-Overholt, E. (2005). Evidence-based practice in nursing & healthcare: A guide to best practice (p.10). Philadelphia: Lippincott, Williams & Wilkins.

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