

SPECIAL ARTICLES

Guideline for Prevention of Surgical Site Infection, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD; The Hospital Infection Control Practices Advisory Committee

From the Hospital Infections Program
National Center for Infectious Diseases
Centers for Disease Control and Prevention
Public Health Service
U.S. Department of Health and Human Services

Hospital Infection Control Practices Advisory Committee

Membership List, January 1999

Chairman

Elaine L. Larson, RN, PhD, FAAN, CIC
Columbia University School of Nursing
New York, New York

Executive Secretary

Michele L. Pearson, MD
Centers for Disease Control and Prevention
Atlanta, Georgia

From the Hospital Infections Program, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Public Health Service, US Department of Health and Human Services, Atlanta, Georgia.

Reprint requests: SSI Guideline, Hospital Infections Program, Mailstop E-69, Center for Disease Control and Prevention, 1600 Clifton Rd, Atlanta, GA 30333. The "Guideline for Prevention of Surgical Site Infection, 1999" is available online at www.cdc.gov/ncidod/hip.

Published simultaneously in *Infection Control and Hospital Epidemiology*; *AJIC: American Journal of Infection Control* 1999;27:97-134; and the *Journal of Surgical Outcomes*.

Dr. Mangram is currently affiliated with the University of Texas Medical Center, Houston, Texas.

This document is not copyright-protected and may be photocopied.

17/52/98051

Table of Contents

EXECUTIVE SUMMARY	99
I. SURGICAL SITE INFECTION (SSI): AN OVERVIEW	100
A. Introduction	100

Surgical Site Infection Guideline Sponsor

James T. Lee, MD, PhD, FACS
University of Minnesota
Minneapolis, Minnesota

Members

Audrey B. Adams, RN, MPH
Montefiore Medical Center
Bronx, New York

Raymond Y. W. Chinn, MD
Sharp Memorial Hospital
San Diego, California

Alfred DeMaria, Jr, MD
Massachusetts Department of Public Health
Jamaica Plain, Massachusetts

Susan W. Forlenza, MD
New York City Health Department
New York, New York

Ramon E. Moncada, MD
Coronado Physician's Medical Center
Coronado, California

William E. Scheckler, MD
University of Wisconsin Medical School
Madison, Wisconsin

Jane D. Siegel, MD
University of Texas Southwestern Medical Center
Dallas, Texas

Marjorie A. Underwood, RN, BSN, CIC
Mt. Diablo Medical Center
Concord, California

Robert A. Weinstein, MD
Cook County Hospital
Chicago, Illinois

II. Recommendations for prevention of surgical site infection

A. RATIONALE

The Guideline for Prevention of Surgical Site Infection, 1999, provides recommendations concerning reduction of surgical site infection risk. Each recommendation is categorized on the basis of existing scientific data, theoretical rationale, and applicability. However, the previous CDC system for categorizing recommendations has been modified slightly.

Category I recommendations, including IA and IB, are those recommendations that are viewed as effective by HICPAC and experts in the fields of surgery, infectious diseases, and infection control. Both Category IA and IB recommendations are applicable for, and should be adopted by, all healthcare facilities; IA and IB recommendations differ only in the strength of the supporting scientific evidence.

Category II recommendations are supported by less scientific data than Category I recommendations; such recommendations may be appropriate for addressing specific nosocomial problems or specific patient populations.

No recommendation is offered for some practices, either because there is a lack of consensus regarding their efficacy or because the available scientific evidence is insufficient to support their adoption. For such unresolved issues, practitioners should use judgement to determine a policy regarding these practices within their organization. Recommendations that are based on federal regulation are denoted with an asterisk.

B. RANKINGS

Category IA. Strongly recommended for implementation and supported by well-designed experimental, clinical, or epidemiological studies.

Category IB. Strongly recommended for implementation and supported by some experimental, clinical, or epidemiological studies and strong theoretical rationale.

Category II. Suggested for implementation and supported by suggestive clinical or epidemiological studies or theoretical rationale.

No recommendation; unresolved issue. Practices for which insufficient evidence or no consensus regarding efficacy exists.

Practices required by federal regulation are denoted with an asterisk (*).

C. RECOMMENDATIONS

1. Preoperative

a. Preparation of the patient

1. Whenever possible, identify and treat all infections remote to the surgical site before elective operation and postpone elective operations on patients with remote site infections until the infection has resolved. *Category IA*
2. Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation. *Category IA*
3. If hair is removed, remove immediately before the operation, preferably with electric clippers. *Category IA*
4. Adequately control serum blood glucose levels in all diabetic patients and particularly avoid hyperglycemia perioperatively. *Category IB*
5. Encourage tobacco cessation. At minimum, instruct patients to abstain for at least 30 days before elective operation from smoking cigarettes, cigars, pipes, or any other form of tobacco consumption (e.g., chewing/dipping). *Category IB*
6. Do not withhold necessary blood products from surgical patients as a means to prevent SSI. *Category IB*
7. Require patients to shower or bathe with an antiseptic agent on at least the night before the operative day. *Category IB*
8. Thoroughly wash and clean at and around the incision site to remove gross contamination before performing antiseptic skin preparation. *Category IB*
9. Use an appropriate antiseptic agent for skin preparation (Table 6). *Category IB*
10. Apply preoperative antiseptic skin preparation in concentric circles moving toward the periphery. The prepared area must be large enough to extend the incision or create new incisions or drain sites, if necessary. *Category II*
11. Keep preoperative hospital stay as short as possible while allowing for adequate preoperative preparation of the patient. *Category II*
12. No recommendation to taper or discontinue systemic steroid use (when medically permissible) before elective operation. *Unresolved issue*

13. No recommendation to enhance nutritional support for surgical patients solely as a means to prevent SSI. *Unresolved issue*
14. No recommendation to preoperatively apply mupirocin to nares to prevent SSI. *Unresolved issue*
15. No recommendation to provide measures that enhance wound space oxygenation to prevent SSI. *Unresolved issue*

b. Hand/forearm antisepsis for surgical team members

1. Keep nails short and do not wear artificial nails. *Category IB*
2. Perform a preoperative surgical scrub for at least 2 to 5 minutes using an appropriate antiseptic (Table 6). Scrub the hands and forearms up to the elbows. *Category IB*
3. After performing the surgical scrub, keep hands up and away from the body (elbows in flexed position) so that water runs from the tips of the fingers toward the elbows. Dry hands with a sterile towel and don a sterile gown and gloves. *Category IB*
4. Clean underneath each fingernail prior to performing the first surgical scrub of the day. *Category II*
5. Do not wear hand or arm jewelry. *Category II*
6. No recommendation on wearing nail polish. *Unresolved Issue*

c. Management of infected or colonized surgical personnel

1. Educate and encourage surgical personnel who have signs and symptoms of a transmissible infectious illness to report conditions promptly to their supervisory and occupational health service personnel. *Category IB*
2. Develop well-defined policies concerning patient-care responsibilities when personnel have potentially transmissible infectious conditions. These policies should govern (a) personnel responsibility in using the health service and reporting illness, (b) work restrictions, and (c) clearance to resume work after an illness that required work restriction. The policies also should identify persons who have the authority to remove personnel from duty. *Category IB*
3. Obtain appropriate cultures from, and exclude from duty, surgical personnel who have draining skin lesions until infection has been ruled out or personnel have received adequate therapy and infection has resolved. *Category IB*
4. Do not routinely exclude surgical personnel who are colonized with organisms such as *S. aureus* (nose, hands, or other body site) or group A *Streptococcus*, unless such personnel have been linked epidemiologically to dissemination of the organism in the healthcare setting. *Category IB*

d. Antimicrobial prophylaxis

1. Administer a prophylactic antimicrobial agent only when indicated, and select it based on its efficacy against the most common pathogens causing SSI for a specific operation (Table 4) and published recommendations.^{266,268,269,282-284} *Category IA*
 2. Administer by the intravenous route the initial dose of prophylactic antimicrobial agent, timed such that a bactericidal concentration of the drug is established in serum and tissues when the incision is made. Maintain therapeutic levels of the agent in serum and tissues throughout the operation and until, at most, a few hours after the incision is closed in the operating room. *Category IA*
 3. Before elective colorectal operations in addition to d2 above, mechanically prepare the colon by use of enemas and cathartic agents. Administer non-absorbable oral antimicrobial agents in divided doses on the day before the operation. *Category IA*
 4. For high-risk cesarean section, administer the prophylactic antimicrobial agent immediately after the umbilical cord is clamped. *Category IA*
 5. Do not routinely use vancomycin for antimicrobial prophylaxis. *Category IB*
2. Intraoperative
- a. Ventilation**
1. Maintain positive-pressure ventilation in the operating room with respect to the corridors and adjacent areas. *Category IB*
 2. Maintain a minimum of 15 air changes per hour, of which at least 3 should be fresh air. *Category IB*
 3. Filter all air, recirculated and fresh, through the appropriate filters per the American Institute of Architects' recommendations.²⁹⁹ *Category IB*
 4. Introduce all air at the ceiling, and exhaust near the floor. *Category IB*
 5. Do not use UV radiation in the operating room to prevent SSI. *Category IB*
 6. Keep operating room doors closed except as needed for passage of equipment, personnel, and the patient. *Category IB*
 7. Consider performing orthopedic implant operations in operating rooms supplied with ultraclean air. *Category II*
 8. Limit the number of personnel entering the operating room to necessary personnel. *Category II*
- b. Cleaning and disinfection of environmental surfaces**
1. When visible soiling or contamination with blood or other body fluids of surfaces or equipment occurs during an operation, use an EPA-approved hospital disinfectant to clean the affected areas before the next operation. *Category IB**

2. Do not perform special cleaning or closing of operating rooms after contaminated or dirty operations. *Category IB*
3. Do not use tacky mats at the entrance to the operating room suite or individual operating rooms for infection control. *Category IB*
4. Wet vacuum the operating room floor after the last operation of the day or night with an EPA-approved hospital disinfectant. *Category II*
5. No recommendation on disinfecting environmental surfaces or equipment used in operating rooms between operations in the absence of visible soiling. *Unresolved issue*

c. Microbiologic sampling

1. Do not perform routine environmental sampling of the operating room. Perform microbiologic sampling of operating room environmental surfaces or air only as part of an epidemiologic investigation. *Category IB*

d. Sterilization of surgical instruments

1. Sterilize all surgical instruments according to published guidelines.^{212,299,314,321} *Category IB*
2. Perform flash sterilization only for patient care items that will be used immediately (e.g., to reprocess an inadvertently dropped instrument). Do not use flash sterilization for reasons of convenience, as an alternative to purchasing additional instrument sets, or to save time. *Category IB*

e. Surgical attire and drapes

1. Wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation. *Category IB**
2. Wear a cap or hood to fully cover hair on the head and face when entering the operating room. *Category IB**
3. Do not wear shoe covers for the prevention of SSI. *Category IB**
4. Wear sterile gloves if a scrubbed surgical team member. Put on gloves after donning a sterile gown. *Category IB**
5. Use surgical gowns and drapes that are effective barriers when wet (i.e., materials that resist liquid penetration). *Category IB*
6. Change scrub suits that are visibly soiled, contaminated, and/or penetrated by blood or other potentially infectious materials. *Category IB**
7. No recommendations on how or where to launder scrub suits, on restricting use of scrub suits to the operating suite, or for covering scrub suits when out of the operating suite. *Unresolved issue*

f. Asepsis and surgical technique

*Federal regulation: OSHA

1. Adhere to principles of asepsis when placing intravascular devices (e.g., central venous catheters), spinal or epidural anesthesia catheters, or when dispensing and administering intravenous drugs. *Category IA*
 2. Assemble sterile equipment and solutions immediately prior to use. *Category II*
 3. Handle tissue gently, maintain effective hemostasis, minimize devitalized tissue and foreign bodies (i.e., sutures, charred tissues, necrotic debris), and eradicate dead space at the surgical site. *Category IB*
 4. Use delayed primary skin closure or leave an incision open to heal by second intention if the surgeon considers the surgical site to be heavily contaminated (e.g., Class III and Class IV). *Category IB*
 5. If drainage is necessary, use a closed suction drain. Place a drain through a separate incision distant from the operative incision. Remove the drain as soon as possible. *Category IB*
3. Postoperative incision care
 - a. Protect with a sterile dressing for 24 to 48 hours postoperatively an incision that has been closed primarily. *Category IB*
 - b. Wash hands before and after dressing changes and any contact with the surgical site. *Category IB*
 - c. When an incision dressing must be changed, use sterile technique. *Category II*
 - d. Educate the patient and family regarding proper incision care, symptoms of SSI, and the need to report such symptoms. *Category II*
 - e. No recommendation to cover an incision closed primarily beyond 48 hours, nor on the appropriate time to shower or bathe with an uncovered incision. *Unresolved Issue*
4. Surveillance
 - a. Use CDC definitions of SSI (Table 1) without modification for identifying SSI among surgical inpatients and outpatients. *Category IB*
 - b. For inpatient case-finding (including readmissions), use direct prospective observation, indirect prospective detection, or a combination of both direct and indirect methods for the duration of the patient's hospitalization. *Category IB*
 - c. When postdischarge surveillance is performed for detecting SSI following certain operations (e.g., coronary artery bypass graft), use a method that accommodates available resources and data needs. *Category II*
 - d. For outpatient case-finding, use a method that accommodates available resources and data needs. *Category IB*
 - e. Assign the surgical wound classification upon

- completion of an operation. A surgical team member should make the assignment. *Category II*
- f. For each patient undergoing an operation chosen for surveillance, record those variables shown to be associated with increased SSI risk (e.g., surgical wound class, ASA class, and duration of operation). *Category IB*
- g. Periodically calculate operation-specific SSI rates stratified by variables shown to be associated with increased SSI risk (e.g., NNIS risk index). *Category IB*
- h. Report appropriately stratified, operation-specific SSI rates to surgical team members. The optimum frequency and format for such rate computations will be determined by stratified case-load sizes (denominators) and the objectives of local, continuous quality improvement initiatives. *Category IB*
- i. No recommendation to make available to the infection control committee coded surgeon-specific data. *Unresolved issue*

The Hospital Infection Control Practices Committee thanks the following subject-matter experts for reviewing a preliminary draft of this guideline: Carol Applegett, RN, MSN, CNOR, CNA, FAAN; Ona Baker, RN, MSHA; Philip Barie, MD, FACS; Arnold Berry, MD; Col. Nancy Bjerke, BSN, MPH, CIC; John Bohnen, MD, FRCSC, FACS; Robert Condon, MS, MD, FACS; E. Patchen Dellinger, MD, FACS; Terrie Lee, RN, MS, MPH, CIC; Judith Mathias, RN; Anne Matlow, MD, MS, FRCPC; C. Glen Mayhall, MD; Rita McCormick, RN, CIC; Ronald Nichols, MD, FACS; Barbara Pankratz, RN; William Rutala, PhD, MPH, CIC; Julie Wagner, RN; Samuel Wilson, MD, FACS. The opinions of all the reviewers might not be reflected in all the recommendations contained in this document.

The authors thank Connie Alfred, Estella Cormier, Karen Friend, Charlene Gibson, and Geraldine Jones for providing invaluable assistance.

References

- Garner JS. CDC guideline for prevention of surgical wound infections, 1985. Supercedes guideline for prevention of surgical wound infections published in 1982. (Originally published in 1995). Revised. *Infect Control* 1986;7(3):193-200.
- Simmons BP. Guideline for prevention of surgical wound infections. *Infect Control* 1982;3:185-196.
- Garner JS. The CDC Hospital Infection Control Practices Advisory Committee. *Am J Infect Control* 1993;21:160-2.
- Hecht AD. Creating greater efficiency in ambulatory surgery. *J Clin Anesth* 1995;7:581-4.
- Horwitz JR, Chwals WJ, Doski JJ, Suescun EA, Cheu HW, Lally KP. Pediatric wound infections: a prospective multicenter study. *Ann Surg* 1998;227:553-8.
- Golub R, Siddiqui F, Pohl D. Laparoscopic versus open appendectomy: a metaanalysis. *J Am Coll Surg* 1998;186:545-53.
- Mayol J, Garcia-Aguilar J, Ortiz-Oshiro E, De-Diego Carmona JA, Ferdandez-Represa JA. Risks of the minimal access approach for laparoscopic surgery: multivariate analysis of morbidity related to umbilical trocar insertion. *World J Surg* 1997;21:529-33.
- Lacy AM, Garcia-Valdecasas JC, Delgado S, Grande L, Fuster J, Tabet J, et al. Postoperative complications of laparoscopic-assisted colectomy. *Surg Endosc* 1997;11:119-22.
- Pagni S, Salloum EJ, Tobin GR, VanHimbergen DJ, Spence PA. Serious wound infections after minimally invasive coronary bypass procedures. *Ann Thorac Surg* 1998;66:92-4.
- The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. *N Engl J Med* 1991;324:1073-8.
- Centers for Disease Control and Prevention. National Nosocomial Infections Surveillance (NNIS) report, data summary from October 1986-April 1997, issued May 1997. *Am J Infect Control* 1997;25:477-87.
- Food and Drug Administration. Topical antimicrobial drug products for over-the-counter human use: tentative final monograph for health-care antiseptic drug products—proposed rule (21 CFR Parts 333 and 369). *Federal Register* 1994; 59:31441-52.
- Centers for Disease Control and Prevention, National Center for Health Statistics. Vital and Health Statistics, Detailed Diagnoses and Procedures, National Hospital Discharge Survey, 1994. Vol 127. Hyattsville, Maryland: DHHS Publication; 1997.
- Emori TG, Gaynes RP. An overview of nosocomial infections, including the role of the microbiology laboratory. *Clin Microbiol Rev* 1993;6(4):428-42.
- Cruse P. Wound infection surveillance. *Rev Infect Dis* 1981;4(3):734-7.
- Cruse PJ, Foord R. The epidemiology of wound infection: a 10-year prospective study of 62,939 wounds. *Surg Clin North Am* 1980;60(1):27-40.
- Martone WJ, Jarvis WR, Culver DH, Haley RW. Incidence and nature of endemic and epidemic nosocomial infections. In: Bennett JV, Brachman PS, eds. *Hospital Infections*. 3rd ed. Boston: Little, Brown and Co; 1992. p. 577-96.
- Boyce JM, Potter-Bynoe G, Dziobek L. Hospital reimbursement patterns among patients with surgical wound infections following open heart surgery. *Infect Control Hosp Epidemiol* 1990;11(2):89-93.
- Poulsen KB, Bremmelgaard A, Sorensen AI, Raahave D, Petersen JV. Estimated costs of postoperative wound infections. A case-control study of marginal hospital and social security costs. *Epidemiol Infect* 1994;113(2):283-95.
- Vegas AA, Jodra VM, Garcia ML. Nosocomial infection in surgery wards: a controlled study of increased duration of hospital stays and direct cost of hospitalization. *Eur J Epidemiol* 1993;9(5):504-10.
- Albers BA, Patka P, Haarman HJ, Kostense PJ. Cost effectiveness of preventive antibiotic administration for lowering risk of infection by 0.25%. [German]. *Unfallchirurg* 1994;97(12):625-8.
- Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;13(10):606-8.
- Ehrenkranz NJ, Richter EI, Phillips PM, Shultz JM. An apparent excess of operative site infections: analyses to evaluate false-positive diagnoses. *Infect Control Hosp Epidemiol* 1995;16(12):712-6.
- Taylor G, McKenzie M, Kirkland T, Wiens R. Effect of surgeon's diagnosis on surgical wound infection rates. *Am J Infect Control* 1990;18(5):295-9.
- SHEA, APIC, CDC, SIS. Consensus paper on the surveillance of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;13(10):599-605.
- Nooyen SM, Overbeek BP, Brutel de la Riviere A, Storm AJ, Langemeyer JM. Prospective randomised comparison of single-dose versus multiple-dose cefuroxime for prophylaxis in coronary artery bypass grafting. *Eur J Clin Microbiol Infect Dis* 1994;13:1033-7.
- Centers for Disease Control and Prevention. National Nosocomial Infections Surveillance (NNIS) report, data summary from October 1986-April 1996, issued May 1996. A report from the National Nosocomial Infections Surveillance (NNIS) System. *Am J Infect Control* 1996;24:380-8.

