



Getting Started Kit: Prevent Surgical Site Infections

Bibliography

100,000 Lives Campaign

We invite you to join a Campaign to make health care safer and more effective — to ensure that hospitals achieve the best possible outcomes for all patients. The Institute for Healthcare Improvement (IHI) and other organizations that share our mission are convinced that a remarkably few proven interventions, implemented on a wide enough scale, can avoid 100,000 deaths between January 2005 and July 2006, and every year thereafter. Complete details on the web at <http://www.ihl.org/IHI/Programs/Campaign/>.

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Brennan TA, Leape LL, Laird NM, et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. *N Engl J Med.* 1991;324(6):370-376.

This paper describes a retrospective medical record review of 30,121 randomly selected records from 51 randomly selected acute care non-psychiatric hospitals in New York State in 1984. The data were used to develop population estimates of adverse events and injuries. Conclusion: there is a substantial amount of injury to patients from medical management, and many injuries are the result of substandard care.

Burke JP. Maximizing appropriate antibiotic prophylaxis for surgical patients: an update from LDS Hospital, Salt Lake City. *Clin Infect Dis.* 2001;33(Suppl 2):S78-83.

This report describes one hospital's experience, over thirty years, as it developed and implemented programs to improve antimicrobial prophylaxis, decrease surgical site infection rate, and adhere to recommendations regarding prevention of antimicrobial resistance. This institution conducted multiple studies over the thirty years (1971-2001), looking at infection rates and the use of antibiotics. The researchers were also able to describe data feedback and other quality improvement techniques happening throughout the period. The results indicate that looking at processes and systems, rather than targeting individual providers, and implementing system-wide improvement programs resulted in major improvement in the appropriate use of antimicrobial prophylaxis.

Classen DC, Evans RS, Pestotnik SL, Horn SD, Menlove RL, Burke JP. The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. *N Engl J Med.* 1992;326:281-286.

This study is a retrospective medical record review of 2,847 patients having had clean or clean-contaminated inpatient elective procedures during a 12-month period in 1985-1986 at a 540-bed teaching hospital affiliated with the University of Utah. The objective of the study was to examine how variations in the timing of prophylactic antibiotics affect the occurrence of surgical wound infections in clinical practice. Results of the study showed that the initiation of prophylactic antibiotics within the two-hour period prior to initial incision was associated with the lowest rate of surgical site infection.

Dellinger EP, Gross PA, Barrett TL, et al. Quality standard for antimicrobial prophylaxis in surgical procedures. Released in 1994 (reviewed 1998). *Clin Infect Dis.* 1994 Mar;18(3):422-7. *Infect Control Hosp Epidemiol* 1994;15:3.

This is a standard developed by The Quality Standards Subcommittee of the Clinical Affairs Committee of the Infectious Diseases Society (IDSA). The standard is endorsed by IDSA, the Surgical Infection Society (SIS), and the Society for Healthcare Epidemiology of America (SHEA). The intended outcome of this standard is for "more uniform and reliable administration of prophylactic antibiotics in those circumstances where their value has been demonstrated or their use has been judged by the local practicing medical community to be desirable." Of note is the implementation portion of the standard in which the developers give examples of programs that hospitals might develop to implement and ensure compliance with the standards. *Some of the interventions* described are:

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- The use of a check-off box on the medical record forms to be completed in the preoperative area. The dose, route, and time of administration or the surgeon's specific instruction not to give antimicrobial prophylaxis would be noted.
- Preprinted standing orders from each surgical specialty for all operations within the specialty in which prophylaxis is appropriate. Because the guidelines encourage the administration of the prophylactic antibiotics for <24 hours, the standing order could specify automatic discontinuation.
- The OR should stock the usual prophylactic drugs in the standard dose.
- QA Department should monitor for prophylactic drug usage in those procedures deemed necessary, for compliance with the timing and duration of administration, and should ascertain that the data are disseminated to the appropriate personnel.

Dellinger EP. Preventing surgical-site infections: the importance of timing and glucose control. *Infect Cont Hosp Epidemiol*. 2001;22:604-606.

This editorial examines the impact of strategies developed over the years to prevent surgical wound infections. Dr. Dellinger begins with the recognition of the role of bacteria and the development of aseptic technique. He then discusses the introduction of prophylactic antibiotics in the 1960s and, more recently, changes in practice regarding hair removal, temperature control, and tissue oxygen levels. Finally, he reviews recent studies regarding the role perioperative hyperglycemia plays in the development of SSI. This editorial also serves as an introduction to the Latham article (listed below).

DiPiro JT, Cheung RP, Bowden TA Jr, Mansberger JA. Single dose systemic antibiotic prophylaxis of surgical wound infections. *Am J Surg*. 1986;152:552-559.

This paper examines over 40 published studies in which single doses of parenteral antimicrobials were given for the purpose of preventing surgical infection. The studies involve the comparison of single-dose antibiotic versus multiple-dose, single-dose versus placebo, single-dose of one drug versus multiple doses of another drug, or comparisons of single-dose regimens of various antibiotics. The surgical types examined in the review of literature include hysterectomies and cesarean sections, colorectal operations, gastric, biliary, and transurethral operations, and open heart operations. None of the trials examined showed a multiple-dose regimen to be more effective than a single-dose of antibiotic given immediately preoperatively.

Khuri SF, Daley J, Henderson WG. The comparative assessment and improvement of quality of surgical care in the Department of Veterans Affairs. *Arch Surg*. 2002;37:20-27.

The VA National Surgical Quality Improvement Program (NSQIP) is the focus of this article, in which the authors describe the evolution, methods, and future plans of the NSQIP. The program uses 52 preoperative data variables, 15 intraoperative variables, and postoperative laboratory variables, as well as morbidity and mortality data to comparatively assess the quality of surgical care in VA hospitals. The primary focus of the program is to provide reliable information, benchmarks, and consultative advice that will guide the surgeons and facility managers to continually improve their local processes

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and structures of care. The quality improvement function of the NSQIP also allows for identification and dissemination of best practices.

Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. *Infect Control Hosp Epidemiol.* 1999;20:725-730.

This paper describes a prospective, case-controlled study of 22,742 patients undergoing inpatient surgical procedures between June 1, 1991, and July 31, 1995. The procedures were all performed at a 415-bed teaching hospital. The objective of the study was to examine the mortality, need for intensive care admission, need for readmission to the hospital within 30 days of discharge, length of stay, and cost attributable to surgical site infection. The results of the study indicate that patients with surgical site infection (in this case defined using CDC NNIS criteria) had longer and costlier hospitalizations, were twice as likely to die, 60% more likely to spend time in an intensive care unit, and more than five times as likely to be readmitted to the hospital within 30 days of discharge.

Ko W, Lazenby WD, Zelano JA, Isom OW, Krieger KH. Effects of shaving methods and intraoperative irrigation on suppurative mediastinitis after bypass operations. *Ann Thorac Surg.* 1992;53:301-305.

This paper describes a prospective randomized trial examining two variables—hair removal by shaving (razor) vs. clipping and use of povidone-iodine vs saline for intraoperative irrigation—to determine the effects of these variables on the occurrence of postoperative suppurative mediastinitis. The study included 1980 consecutive patients undergoing surgical procedures requiring bypass between July 1987 and June 1989. Prophylactic antibiotic therapy was standardized for all patients. Results indicated that although intraoperative irrigation with povidone was not more effective than irrigation with saline, the surgical site infection rate for those patients undergoing hair removal via shaving (razor) was more than twice that of those undergoing hair removal via clipping.

Krinsley JS. Effect of an intensive glucose management protocol on the mortality of critically ill adult patients. *Mayo Clin Proc.* 2004;79(8):992-1000.

A glucose management protocol was adopted by a university-affiliated community teaching hospital in a 14-bed medical-surgical intensive care unit. It involved using intensive monitoring and treatment to maintain plasma glucose levels lower than 140mg/dL. When glucose values exceeded 200mg/dL for two successive tests, continuous intravenous insulin was initiated. The use of the protocol resulted in significant improvement in glucose control and was associated with decreased length of stay, organ dysfunction, and mortality.

Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. *N Engl J Med.* 1996;334:1209-1216.

This paper describes a randomized, double-blind study to test the hypothesis that mild core hypothermia increases the incidence of surgical wound infection and lengthens hospital stay in patients undergoing colorectal surgery. All pre-, peri-, and postoperative care was standardized between the two groups of patients with the exception of use of warmed IV fluids and warmed air delivered into a forced-air cover in the normothermia

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group. The study was stopped after the initial 200 patients due to the fact that the surgical site infection rates between the normothermia and control groups was found to be statistically significant ($P < 0.01$) at that point. The conclusions of the study indicate that in patients undergoing elective colorectal surgery, maintaining intraoperative normothermia is likely to decrease surgical wound infections and to decrease lengths of hospital stay.

Latham R, Lancaster AD, Covington JF, Pirolo JS, Thomas CS. The association of diabetes and glucose control with surgical-site infections among cardiothoracic surgery patients. *Infect Control Hosp Epidemiol.* 2001;22:607-612.

The objective of this prospective study was to assess the relative importance of chronic glycemic control, perioperative glucose management, and previously undiagnosed diabetes in the development of postoperative infection. The study included all patients admitted to a 540-bed tertiary care university-affiliated hospital for CABG or cardiac valve procedures between November 1998 and September 1999. The study found that the rate of surgical site infections correlated with the degree of hyperglycemia during the postoperative period (O/R 2.54 for glucose 200-249; 2.97 for glucose 250-300 and 3.32 for glucose levels >300). The authors conclude that early identification of those likely to develop postoperative hyperglycemia would be worthwhile in the prevention of surgical site infection.

Mangram AJ, Horan TC, Pearson ML, et al.; the Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection, 1999. *Infect Control Hosp Epidemiol.* 1999;20:247-278.

This is the most current evidence-based guideline for prevention of SSI issued by CDC. The recommendations reflect studies published through 1998.

Melling AC, Ali B, Scott EM, Leaper DJ. Effects of preoperative warming on the incidence of wound infection after clean surgery: a randomised controlled trial. *Lancet.* 2001;358:876-880.

This is a report of a randomized controlled trial assessing the efficacy of local or systemic warming of patients prior to clean operations in reducing the incidence of surgical site infections. For this study, 421 patients undergoing scheduled elective hernia repair, varicose vein surgery, or breast surgery were randomized into three groups: control; preoperative systemic warming with a warming blanket; and 30 minutes of local (to the planned operative site) warming preoperatively. This study found an overall infection rate of eight percent; the combined warming group's infection rate was five percent while the control group's rate was 14 percent.

Pestotnik SL, Classen DC, Evans RS, Burke JP. Implementing antibiotic practice guidelines through computer-assisted decision support: clinical and financial outcomes. *Ann Intern Med.* 1996;124:884-890.

This study reports on the outcomes and effects of a hospital-wide computer-assisted decision support program for antimicrobial usage. The study looked at data from all patients in the hospital during the period between January 1988 and December 1994 who received antimicrobials for prophylactic (specifically, surgical prophylaxis), empiric, or therapeutic reasons. The report details findings about each of these categories of

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antimicrobial use. For the surgical prophylaxis group, the study found that the implementation of the program increased the timeliness of administration of antibiotics, reduced the rates of antibiotic-associated adverse drug events and mortality, and stabilized the emergence of antibiotic-resistant pathogens.

Seropian R, Reynolds BM. Wound infections after preoperative depilatory versus razor preparation. *Am J Surg.* 1971;121(3):251-254.

No abstract available for this article regarding a controlled clinical trial; no annotation included.

van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in the critically ill patients. *N Engl J Med.* 2001;345(19):1359-1367.

This is a report from a prospective, randomized controlled study involving adults admitted to the surgical intensive care unit on mechanical ventilation. This study examined whether normalization of blood glucose levels with insulin therapy would improve prognosis for critically ill patients with or without diabetes. Results indicated that intensive insulin therapy to maintain blood glucose at or below 110 mg/dl reduces morbidity and mortality among critically ill patients in the surgical intensive care unit.

Zanetti G, Giardina R, Platt R. Intraoperative redosing of cefazolin and risk for surgical site infection in cardiac surgery. *Emer Infect Dis.* 2001;7:828-831.

This is a retrospective cohort study done to assess the effect of intraoperative redosing of antimicrobial prophylaxis on the occurrence of surgical site infection following prolonged cardiac procedures. The study population included 1,548 patients who had cardiac surgeries at Brigham and Women's Hospital between April 1, 1998, and September 30, 1999. Surgical site infections were prospectively identified using modified NNIS criteria. Following multivariate analysis, the authors concluded that a strategy of redosing for all procedures longer than 240 minutes would result in a 16 percent reduction in surgical site infection rates.

Zerr KJ, Furnary AP, Grunkemeier GL, Bookin S, Kanhere, V, Starr A. Glucose control lowers the risk of wound infection in diabetics after open-heart operations. *Ann Thorac Surg.* 1997;63:356-361.

This paper reports on a retrospective chart review study of diabetic patients who underwent cardiac surgery between 1987 and 1993, before and after a glucose-control protocol was implemented. Its objective was to assess the effect of a glucose-control protocol on the risk of deep wound infection. The results indicate that elevated blood glucose levels at 48 hours postoperatively was significantly associated with an increased risk of deep wound infection ($p < 0.002$). The article concludes that the implementation of a protocol to maintain mean blood glucose levels at or below 200 mg/dl in diabetic patients undergoing cardiac surgery significantly decreased the deep wound infection rate in these patients.