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Infectious Risk Factors Related to Operating Rooms

Didier Pittet, MD, MS; Georges Ducel, MD

ABSTRACT

Risk factors related to operating rooms include patient-associated risks, the operating room environment, ventilation systems, cleansing and sterilization, and operating room personnel. Although constantly debated, surgical wound infection surveillance with appropriate feedback to surgeons is one of the few effective measures that helps reduce surgical infection rates, and we strongly recommend its use. We also recommend the further study of other potential components of effective infection control programs for surgical patients (*Infect Control Hosp Epidemiol* 1994;15:456-462).

INTRODUCTION

Wound infections accounted for approximately 24% of the total number of nosocomial infections identified in the Study of the Efficacy of Nosocomial Infection Control (SENIC) project.[1] Despite the high standards set for surgical performance and equipment, the controlled environment of the operating room remains potentially dangerous for the patient. Many physical and biological hazards are present in the modern operating room.

Most surgical infections originate from bacteria that enter the operating room at the time of operation. The causative pathogens originate from the patient's endogenous microflora, from the operating room environment, or from organisms shed by the operating room team.

This review reports the incidence of wound infections in large series published in the literature, and discuss the risk factors for infection related to underlying patient conditions and type of surgical procedure, as well as those specifically related to the operating environment.

INCIDENCE

According to national statistical reports, 47% of all patients admitted to hospitals in the United States in 1987 had inpatient surgery.[2] This represented nearly 16 million patients. It is estimated that 325,000 postoperative wound infections occur each year in the United States.[3] The risk of acquiring a nosocomial infection varies according to type of procedure.[4-7] Data were reported recently from a total of 106 U.S. hospitals that followed standard National Nosocomial Infections Surveillance protocols (NNIS System).[7] Surveillance of surgical patients from January 1986 through June 1992 reported 59,351 nosocomial infections among 48,168 patients, an average of 1.23 infections per patient. Overall, 17% of the infected patients had more than one nosocomial infection. Surgical site was the most common infection site (37%). Urinary tract infections represented 27% of infections complicating surgical procedures, pneumonia 15%, and primary bloodstream infection 7%. However, infections elsewhere than the surgical site were most frequent following certain operations; eg, urinary tract infection was the leading infection site (52%) after joint prosthesis surgery. Overall nosocomial infection rates were reported by type of operation; patients undergoing gastric surgery had the highest rate of infection (21%) and those recovering from hemiorrhaphy the lowest (2%).

Surgical wound infections are classified as incisional surgical site infection and organ/space surgical site infection, the former usually being more frequent than the latter.

From the Infection Control Program (Dr. Pittet) and Hospital Hygiene (Dr. Ducel), Division of Infectious Diseases, Department of Medicine, University Hospital of Geneva, Switzerland.

Address reprint requests to Didier Pittet, MD, MS, Infection Control Program, Division of Infectious Diseases, Department of Medicine, University Hospital of Geneva, 24 rue Michelidu-Crest, 1211 Geneva 14, Switzerland.

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In the report by Horan et al,[7] incisional surgical site infection represented on average 24% of all infections, whereas organ/space surgical site infection represented only 11%.

Reporting of surgical wound infection rates must take into account the severity of the patient's underlying illness, as well as the type of operation and wound class. The type of operative procedure to be performed traditionally has been accepted as the most critical factor in predicting postoperative wound infection rate.[8] The classification of surgical wounds as clean, clean-contaminated, contaminated, and dirty or infected is widely accepted. In clean operative procedures, the wound infection usually is due to exogenous microorganisms such as staphylococci. Pathogens complicating other categories of surgery usually originate from the aerobic-anaerobic endogenous flora. Infection rates traditionally accepted for the different types of operations are as follows: clean, 1% to 5%; clean-contaminated, 3% to 11%; contaminated, 10% to 17%; and dirty, more than 17%.[9] Although such wound classification remains effective for predicting surgical wound infection, recent investigation suggested that, to refine the prediction, risk factors for the development of postoperative infections have to be considered. In particular, factors associated with the patients themselves have to be taken into account.[3,10-13]

PATIENT-ASSOCIATED RISK

In 1985, Haley et al first reported the importance of identifying patients at higher risk for surgical infection in each category of operative procedure.[14] Based on data collected on 58,498 patients undergoing surgery in 1970, these authors developed a multivariate risk index with 10 possible risk factors for infection. By logistic regression procedures, four variables independently predicted infection and were contained in their model. These were: 1) recovery from abdominal operation; 2) contaminated or dirty wound by traditional wound classification; 3) operation lasting longer than 2 hours; and 4) patient having three or more different diagnoses at the time of discharge from the hospital. The predictive model developed was validated subsequently on another group of 59,352 surgical patients admitted in 1975 through 1976.

The simplified index they developed proposes three risk levels (low, medium, and high) of developing wound infection and predicts surgical wound infection risk nearly twice as well as the traditional wound classification. Among patients within each category, risk for infection varies over a wide range: eg, in clean operations, 1.1% in low-risk operations to almost 16% in high-risk operations (Table).

More recently, Culver et al at the Centers for Disease Control and Prevention (CDC) developed another risk index to predict risk of acquiring surgical wound infection.[11] Data were collected from a total of 84,691 operations performed from January 1987 through December 1990 at 44 NNIS hospitals. Patients developed a total of 2,376 surgical wound infections, giving a rate of 2.8 per 100 operations. This new risk index ranges from 0 to 3 and corresponds to the number of risk factors present among the following: a) the American Society of Anesthesiologists (ASA) preoperative assessment score (3, 4, or 5); b) an operation classified as either contaminated or dirty-infected; and c) an operation with duration of surgery longer than a procedure-related cutoff point.

TABLE
TRENDS IN SURGICAL WOUND INFECTION RATES

	1970	1975 to 1976	1967 to 1990
Clean	1 to 5"	2.9 (1.1 to 15.8)	2.1 (1.0 to 5.4)
Clean-contaminated	3 to 11	3.9 (0.6 to 17.7)	3.3 (2.1 to 9.5)
Contaminated	10 to 17	8.5 (4.5 to 23.9)	6.4 (3.4 to 13.2)
Dirty-infected	≥17	12.6 (6.7 to 27.4)	7.1 (3.1 to 12.8)

* Number of surgical wound infections per 100 operations.
Adapted from surgical wound infection rates of the SENIC project and NNIS system reports.[9,11,14]

The distribution of duration of surgery for the different operative procedures was determined. The cutoff point, defined as the 75th percentile of each distribution, ranges from 1 hour for appendectomy or cesarean section to 5 hours for coronary artery bypass graft. This procedure-related duration-of-surgery cutoff point enhances the discriminatory power of this composite risk index.

In the results reported by the CDC investigators," the ASA score was a better single predictor of surgical wound infection risk than the traditional surgical wound classification system. Taking into account the three risk factors, combined into the composite index, considerably increases predictive power. Surgical wound infection rates ranged from 1.5 episodes per 100 operations for patients with none of the factors to 13 episodes per 100 operations for patients with all three factors. The presence of each additional risk factor nearly doubles the risk index. Importantly, in almost all different operative procedure categories, surgical wound infection rates increase significantly ($P<0.05$) with the number of risk factors present. For example, rates of surgical wound infection complicating coronary artery bypass graft increased from 1.05 episodes per 100 procedures in patients with no risk factor to 3.49, 6.67, and 33.3 episodes per 100 procedures in patients with 1, 2, and 3 risk factors for infection, respectively.

The ASA score is a critical component of the risk index and attempts to account for underlying host conditions that may increase infection risk. It is readily available at the time of surgery, in contrast to the previously chosen analog-the number of discharge diagnoses-in the SENIC index.[15] In almost all of the operative procedure categories, surgical wound infection rates increase significantly with the number of risk factors present.[11] Interestingly, the risk index also predicted reasonably well the risk of infections at sites other than surgical wounds, ie, bloodstream, urinary, and respiratory tract infections.[11] Better prediction, however, certainly would result from including factors more specifically associated with those infections, particularly the use of specific devices.

The NNIS surgical wound infection risk index[11] was not developed by a multivariate modeling approach with more of the potential risk factors for infection included. Garibaldi et al conducted a 4-year prospective study involving 1,852 general (79%) and gynecology (19%) surgical patients to identify other risk factors for infection.[12] Although various variables, such as length of hospital stay prior to surgery or surgical factors such as the occurrence of glove puncture, hair removal technique, or primary or secondary closure were included in the analysis, only documented intraoperative bacterial contamination constituted an independent risk factor for infection in addition to surgical wound class, duration of surgery, and the ASA group.[12] However, the positive predictive value of microbiologically documented intraoperative cultures was low (32%), making its clinical value doubtful. Importantly, a preoperative stay greater than 3 days increased the predicted probability of infection for patients undergoing clean procedures.

It certainly would be useful to develop more specific risk indices within the respective categories of surgical operative procedures. Richet et al conducted a prospective, multicenter study of all 561 vascular surgery patients at four French hospitals between December 1987 and June 1989.[13] A total of 23 patients (4.1%) developed surgical wound infections. Half of these infections (48%) were superficial, while the other half were deep wound infections. More than 20 variables were collected. Independent predictors for infection included surgery on lower extremities (estimated relative risk [RR] = 231), delayed surgery (RR = 2.0), the presence of insulin-dependent diabetes (RR= 2.9), a past history of vascular surgery (RR= 1.7), and short-course antimicrobial prophylaxis (RR= 1.6). The latter was defined as three doses of a second-generation cephalosporin, whereas long-course antimicrobial prophylaxis referred to regimens where the same drug was given for at least 48 hours.

To assess the exact role of antimicrobial prophylaxis on the risk of surgical wound infection, Richet et al provided stratified analysis according to the type of antimicrobial prophylaxis.[13] It is important to note that the presence of diabetes, delayed surgery, and past history of vascular surgery were significant risk factors for surgical wound infection only in patients who had received a short-course antimicrobial prophylaxis. Using the five independent risk factors for infection identified by logistic regression analysis, the authors developed a risk index (0 to 5) and found that the rates of wound infection increased in parallel with the increasing index: index of 0, rate = 0%; 1, 2.5%; 2, 3.4%; 3, 7.2%; ≥4, 54%. As a practical conclusion of their study, the authors recommend a 48-hour prophylaxis when surgery on a lower extremity is performed in a patient with any of the other four risk factors for infection.[13]

Other risk indices have been and will be developed. Work by Christou[16] suggests that nutritional status should be included in some indices. Measuring the intrinsic risk of wound infection and expressing it in a simple, easy-to-compute, practical risk index available at the bedside at the time of surgery is a critical tool for making the feedback of wound infection rates useful to surgeons and hospitals.[3,10,15] The newly developed indices should be used and further studies carried out to refine procedure-specific risk indices in order to optimally predict surgical infection rates as well as other outcomes.

Trends in surgical wound infection rates according to the traditional wound classification and reported in large national series are summarized in the Table; infection rates according to patient risk indices used in the respective studies[11,14] are indicated in parentheses. As shown, surgical wound infection rates have decreased with time according to these data.

The purpose of the present review is not to discuss the validity of the previously presented risk indices.[3] Risk factors other than those used in the proposed indices have been shown to be significantly associated with an increased risk for surgical wound infection.[3,10] Among factors intrinsic to the patient, older age, diabetes, obesity, and possibly malnutrition are important. Furthermore, remote infection, duration of preoperative hospitalization, preoperative hair removal and skin preparation, as well as various aspects of the surgical technique and the urgency of the operation, strongly influence rates of postoperative wound infections. Appropriateness of antimicrobial prophylaxis is of critical importance. In the study by Classen et al[17] the timing of antibiotic administration significantly affected the risk of surgical wound infection.

As highlighted by Mayhall[3] and supported by epidemiologic study findings, seven measures have proven to be effective in preventing postoperative wound infections: 1) minimizing the duration of preoperative hospitalization; 2) weight reduction for obese patients; 3) eradication of remote infections; 4) hair removal just before the operation; 5) minimizing the duration of surgery; 6) appropriate use of antimicrobial prophylaxis; and 7) feedback of surgical infection rates to the surgeons. Because not all of these measures are part of the currently proposed risk indices, one may postulate that some might be included in another variable used as a proxy (eg, ASA may well account for several of these factors) or that the currently proposed indices still might be refined. Procedure-specific indices certainly will provide part of the answer to this fascinating question.

OPERATING ROOM ENVIRONMENT

It is believed that most surgical wound infections originate from exogenous microorganisms that enter the operative wound at the time of surgery. The causative pathogens, however, may originate from the operating room environment, from shedding by the operating room personnel, or from the patient's endogenous flora. The role of the patient's intrinsic risk factors for infection of endogenous origin was discussed in the previous section. Absolute prevention of infections arising from either the operating room environment or personnel would require excluding the surgeon and the operating team from the operating room environment and providing sterile operating room air. Such an approach has been used already for orthopedic implant surgery.[18]

VENTILATION SYSTEMS

Modern standard operating rooms are virtually free of particles (including bacteria) larger than 0.5 μm when there are no people in attendance. The activity of the operating room personnel is the principal source of airborne bacteria,

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which originate mainly from the skin of the people present in the room.[19] The number of airborne bacteria depends on the number of people present, their level of activity, and compliance with infection control practices.[20] Limitation of the number of people in attendance, excessive conversation, and number of times the doors were opened was associated with a decrease in postoperative wound infection rate in orthopedic prosthesis surgery.[21] Despite our current knowledge, the safe level of airborne bacteria for different surgical procedures has not yet been determined.

Most conventional operating rooms are ventilated with 20 to 25 changes per hour of high-efficiency filtered air delivered in a vertical flow. High-efficiency particulate air (HEPA) systems removing bacteria that measure 0.5 to 5 μm are used to obtain downstream bacteria-free air. The operating room is under positive pressure in relation to the surrounding corridors to minimize inflow of air into the room.

Laminar flow systems deliver HEPA-filtered unidirectional airflow at a uniform velocity (0.3 to 0.5 μm/sec) to prevent retrograde air movements and obtain a dilution effect.[19,22] In the earliest testing of a prototype filtered-air enclosure constructed to contain half of the patient's body and three surgeons, Charnley reported a reduction of wound infection following hip prosthetic implantation from 9.5% to 1.1%.[23] Most of the patients did not receive systemic prophylaxis.

Lindwell et al reported the results of multicenter studies,[24,25] including about 8,000 total hip or knee replacement surgeries, with the aim of observing the effect of ultraclean (laminar flow) operating room air on the infection rate. A clear reduction in the rate of deep wound infections after surgery in the ultraclean-air operating room was observed. The design of the studies did not control for the effects of antibiotic prophylaxis; the latter, however, was associated with a lower incidence of infection. The authors suggested that ultraclean air and antibiotic prophylaxis have independent and cumulative effects on prevention of wound infection, but recognized that the study was not designed to examine such a hypothesis. This area is still controversial and the subject of much debate, with large prospective inconclusive studies.[26] We recently summarized data on more than 14,000 total hip replacements. Our analysis suggests that both measures (antibiotic prophylaxis and the use of ultraclean air) effectively prevent surgical wound infection and also suggests a possible independent, cumulative effect.[27] Importantly, laminar flow is sensitive to the position of operating room equipment and personnel, with unsuitable positioning associated with an increased risk of infection, in particular with horizontal laminar flow.[28,29]

CLEANSING AND STERILIZATION

Operating room cleansing can be summarized by wet mopping of the hard-surfaced floors with an appropriate disinfectant solution after each case; wet vacuuming at the end of the day or at night; and wiping down of all equipment surfaces with specific disinfectant (eg, 70% alcohol + active substance). Cleansing of the walls should by done if direct contamination has occurred, as well as once a week on a routine basis.

Steam sterilization of manually cleaned instruments, when performed at correct pressure and temperature, is the least expensive and time consuming technique. Ethylene oxide sterilization must be performed only on clean instruments sensitive to steam sterilization; gas penetration into tunnelized devices is limited and the efficacy of the sterilization process for such devices must be controlled. Ethylene oxide sterilization can be hazardous for the personnel handling it.

Inappropriate cleansing or sterilization procedures occasionally have been responsible for postoperative infections, and prevention depends on a suitable quality control process. A cluster of postoperative *Clostridium perfringens* infections occurred because of failure to sterilize the instruments contaminated by an index case.[30] The risk of environmentally spread infection is low in the modem, well-managed operating suite; however, it depends strongly on the degree of the appropriateness of instrument and device sterilization, the efficiency of the ventilation systems, and the adequacy of cleansing of the operating theater between cases. Practices such as scheduling "dirty" operative procedures for the end of the day are no longer necessary,[3,10] in particular when laminar airflow is used in the operative theater.[29]

The usual inanimate reservoirs of organisms that infect surgical wounds are contaminated antiseptics or contaminated dressings. Several outbreaks caused by *Pseudomonas multivorans, Rhizopus* species, or *C perfringens* have been reported.[31-36]

OPERATING ROOM PERSONNEL

Critical factors to prevent infection spread by operating room personnel are personal integrity and work ethics. The entire surgical team-from cleaning personnel to staff surgeons-should adhere to standardized, though not always scientifically proven, guidelines for infection prevention in the operating room.

Although the optimal duration of the first daily surgical scrub is not known, a scrub of a duration as short as 5 minutes appears to be safe.[9,37] Between consecutive surgical procedures, the surgical scrub duration can be reduced to between 2 and 5 minutes.

Reported prevalence of glove puncturing ranges from 11.5% to 53% of procedures.[3,10,38,39] Careful inspection reveals different types of glove punctures (pinhole, hole, tear) occurring with various frequencies.[40] Bacterial transfer through punctured gloves has been demonstrated.[41] Although conflicting observations have been made concerning the relationship of glove puncture and postoperative wound infection,[12,38] we strongly recommend changing gloves rapidly after accidental puncture. In the study by Garibaldi et al,[12] glove puncture was associated with an increased risk for postoperative wound infection (odds ratio = 3.1; 95% confidence interval, 2.1 to 4.6). Double-gloving is recommended during total joint arthroplasty as well as for performing surgeries in human immunodeficiency virus (HIV)- or hepatitis B virus-positive patients. Based on studies that showed that gloves could be perforated during more than 30% of operative procedures,[42] some authorities[43] recommend that gloves be changed after each hour of operating time to prevent the transmission of bloodborne disease to healthcare workers, until industry develops puncture-resistant gloves. However, such a practice needs to be studied in prospective controlled trials.

Full coverage of the mouth and nose area with a high-efficiency mask for everyone entering the operating suite proved to be associated with a reduced bacterial contamination rate.[44] The benefit in terms of reducing postoperative wound infection rates, however, has never been demonstrated and was questioned in the study by Orr. Turnevall conducted a randomized, controlled study including more than 3,000 operations and observed the surgical wound infection rate to be the same whether or not the surgical team wore masks during the operation.[45] We nevertheless recommend using a surgical mask until other well-designed and well-conducted studies demonstrate the irrrelevance of this practice.

Protecting operating room personnel from acquiring infectious diseases from infected patients is a constant challenge, in particular regarding bloodborne diseases. Sharps injuries, needlesticks, and blood splashes are regular occurences for operating personnel. The predicted risk of acquiring HIV infection appears to be associated primarily with the local prevalence of the infection, the type of surgical procedure performed, and the time spent in the operating room.[46,47] In the study by Gerberding et al at the San Francisco General Hospital, accidental exposure to patients' blood occurred in 84 of 1,300 consecutive surgical procedure[48] Importantly, preoperative testing of the patient population and the surgical team's knowledge of the HIV status did not reduce the frequency of accidental exposure to blood. Appropriate precautions against such exposure must become routine.[48-50]

ENVIRONMENTAL RISK FACTORS

Infections are usually multifactorial. The importance of environmental factors in the origin of postoperative surgical infection is difficult to assess in prospective, well-designed studies. Patient-associated risk factors for infection certainly remain predominant in the infectious process. Thus, the relative importance of patient-associated, environment-associated, and procedure-associated factors may be difficult to assess apart from certain clean surgeries associated with low rates of surgical wound infection.

Whyte et al conducted a prospective study to determine the relative importance of rates and sources of wound contamination in the pathogenesis of infection during 188 consecutive biliary tract operations.[40,51] Systematic quantitative microbiological samplings were performed of the skin incision site prior to skin disinfection and prior to stitching, as well as of the gall bladder by puncturing before its removal. Gloves used by surgeons and their assistants were turned inside out and processed according to standard microbiological techniques and inspected for glove punctures. Cultures of postoperative wounds were processed using semiquantitative culture techniques. The independent variables predicting surgical wound infection were the presence of bacteria in the bile at the time of surgery, and the number of bacteria at the skin incision site in conditions where the bile was sterile. Half of the patients were infected by bacteria from the bile. A colonized bile tract at the time of surgery was associated with wound infection with the same pathogen. larger amounts of bacteria in the bile were associated with subsequent wound infections and, when the bile was infected, the bacteria from the bile accounted for more than 99% of the bacteria recovered in the wound. Not surprisingly, infecting organisms were *Escherichia coli, Klebsiella* species, enterococci, C *perfringens,* and *Staphylococus aureus.* However, when the bile was sterile, high amounts of skin bacteria were associated with high wound counts and causative pathogens were typical skin organisms.

Whyte et al also studied the importance of airborne bacteria on wound colonization in their population.[51] The effect of airborne contamination was only observed in the absence of infection arising from the bile or the patient's skin pathogens. Airborne microbiological sampling was carried out within 30 cm downstream of the surgical wound exposed to a unidirectional laminar airflow set at a velocity of 0.5 m/sec (usual recommended velocity). Bacterial sampling of the patient's drapes and adequacy of the draping method were assessed. Skin samplings were as described above. By means of logistic regression techniques, the rate of patient's skin counts, glove puncturing, use and type of impervious gowns, use of incision drapes, and the airborne concentration of bacteria were analyzed. The results of the investigation demonstrated that the effect of airborne bacteria on wound contamination could not be detected in the presence of wound infection or when wound counts of bacteria were higher than 100 organisms per cm^2. However, when the wound counts were less than 100, the presence of airborne bacteria on the visceral surface of the liver was highly significant. Air contamination was never responsible for wound surface colonization or infection in this study. Additional information from this investigation is that air was the only variable that influenced drape contamination in areas not in contact with the wound.

It seems extremely difficult, based on the data available, to determine the importance of possible airborne contamination as a source of infection in operations other than clean procedures. In contrast to studies carried out on total joint replacements, where a significant number of infections might be associated with airborne transmission, the latter does not seem to have a significant importance in other types of surgery. No data are available regarding other prosthetic implant surgery. Efforts aimed at preventing surgical wound infection should concentrate on the importance of other nonairborne risk factors for infectious complications.

LESSONS TO BE LEARNED

Reports of outbreaks of infections occurring during the peri- and early postoperative phase help us to understand infections that subsequently may be prevented. Outbreaks of wound infections caused by rapidly growing mycobacteria have been documented following cardiac surgery and augmentation mammoplasty.[10] Air and water were suspected as the environmental source of infection, because these organisms commonly are recovered from hospital dust and can survive in soil and water. However, *Serratia marcescens* surgical wound infections complicating breast reconstruction procedures (implantation of expandable mammary implants) were reported recently[52]; infection was associated with saline expansion of the implants performed in the surgeon's office. Multiple use of contaminated saline bags and poor aseptic techniques were responsible for this outbreak.

Several outbreaks of group A beta-hemolytic streptococcal infections with airborne transmission in the operating room have been reported.3 Mayhall reviews evidence supporting the proposition that these infections were acquired by the airborne route. Members of the operating room team were found to be colonized at anal, vaginal, or pharyngeal sites. In some cases, carriers had no close contact with the patients who later developed the infection. The epidemic strains were recovered from the carrier's colonization sites, from the air of the operating room, and from sampling plates in a room where the carrier worked during most of these outbreaks. These results reinforce the hypothesis that the sources of organisms subsequently responsible for surgical wound infections are people in the operating room.

Bloodstream infections complicating the administration of contaminated intravenous solutions have been reported and may occur in the operating room or in any other hospital ward. Epidemics of nosocomial bloodstream infections have been reviewed recently.[53] Although three quarters of these outbreaks occurred in intensive care units, some have their origin in the operating room. Medical devices, and pressure monitoring systems in particular, were responsible for 25% of all episodes of bloodstream infections reported between 1980 and 1990. New equipment and new technical procedures frequently are responsible for clusters of infection, as has been the use of multidose vials of medication; the latter should be discouraged strongly in the operating room. New equipment should be used according to edited guidelines for cleansing and sterilization (if necessary).

Single-source outbreaks of surgical wound infections have been reported following open-heart surgery.[54,55] In these two outbreaks, involving eight and seven patients, sternal wound infections were caused by *Rhodococcus bronchialis*[55] or *Candida tropicalis*,[54] respectively. In both situations, either a circulating nurse or a scrub nurse harbored the causative pathogen on the fingertips. Exclusion of the nurse from the operating team resulted in the termination of the clusters of infection at both institutions.

All epidemics or clusters of infections following surgical procedures should be investigated and described; reported experience from a specific center is helpful to prevent infection both at this center and at other institutions.

REPORTING INFECTION RATES

The earliest report of the utility of reporting wound infection rates to surgeons was published in the *Journal of the American Medical Association* in 1965. Since then, regular feedback of infection rates to surgeons has been performed and reported from several hospitals.[4,6,38,56-59] The assumption was that informing a surgeon about high or rising postoperative wound infection rates would lead to an improvement in aseptic or operative techniques, thus decreasing the rates of infection. The effectiveness of control programs based on surveillance with feedback of surgical infection rates to surgeons has been demonstrated in several studies.[4,6,38,56,58,59] Haley et al[59] in particular identified the establishment of a powerful surveillance system with feedback of infection rates to surgeons and the presence of an effective hospital epidemiologist as key components of effective infection control programs.[59] The presence of both elements contributed to a decrease of 41% in wound infection rates when applied to low-risk patients.[59] The scientific validity of the previously cited studies has been discussed by Scheckler.[60]

Despite its proven efficacy, surgical wound surveillance and feedback to surgeons has not been accepted widely by U.S. hospitals.[3,61] Mayhall recently put forward several reasons underlying the lack of enthusiasm for surgical wound surveillance programs.[3] Reporting of surgeon-specific infection rates, adjusted according to appropriate patient risk indices, constitutes a further improvement that needs to be evaluated independently regarding its efficacy as a surgical wound infection control procedure. Identification of surgical wound infections becoming manifest after discharge from the hospital constitute a major challenge in surgical wound surveillance. Studies have suggested that 20% to 60% of surgical wound infections might be diagnosed after patients have left the hospital. Given the absence of definitive studies on the effect of reporting surgeon-specific surgical wound infection rates in ambulatory surgery, and the low wound infection rates in this setting, surgeon-specific wound infection rate feedback cannot be recommended as a strategy for infection control in ambulatory surgery.

A consensus paper recently recommended a uniform approach to the definitions of surgical wound infections, and to the collection, analysis, and reporting of surgeon-specific infection rates.[62] Precautions to be taken in making such reports have been summarized by Mayhall.[3]

Although constantly debated, surgical wound infection surveillance with appropriate feedback to surgeons is one of the few effective measures that helps reduce surgical infection rates, and we strongly recommend its use. We also recommend the further study of other potential components of effective infection control programs for surgical patients.

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