Surgical Infection Prevention (SIP) Collaborative

Problem Statement

Summary by Qualis Health at http://www.qualishealth.org/sip.htm

Americans rely on their healthcare system for the maintenance and improvement of health, which often involves care in the hospital setting. Although most patients believe that the American healthcare system provides the highest quality and safest care in the world, it is estimated that four out of every one hundred hospitalized patients in the United States suffers a serious adverse event, many of which are avoidable. In the Institute of Medicine report To Err is Human it is estimated that between 44,000 and 98,000 deaths per year result from adverse events.\(^2\) In comparison, there are approximately 45,000 deaths yearly from auto accidents.

Sixty-nine percent of adverse events and deaths in healthcare are due to an error in management and thus are potentially preventable. Dr. Lucian Leape and colleagues have described these types of errors, which include diagnostic failures, treatment errors, errors in prevention, and others including communication failure and equipment failure.\(^3\) Some of these errors lead to perioperative infections, a major cause of patient injury, mortality, and healthcare cost. An estimated 2.6 percent of nearly 30 million operations are complicated by surgical site infections (SSIs) each year.

Established in 1970, the CDC’s National Nosocomial Infections Surveillance (NNIS) system monitors reported trends in nosocomial infections in participating US acute-care hospitals. According to the NNIS system reports, SSIs are the third most frequently reported nosocomial infection, accounting for 14–16% of all nosocomial infections among hospitalized patients.\(^4\) Surgical site infections are a common complication of care, occurring in 2–5% of patients after clean extra-abdominal operations (e.g., thoracic and orthopedic operations) and in up to 20% of patients undergoing intra-abdominal procedures.\(^5\) Among surgical patients, SSIs were the most common nosocomial infection, accounting for 38% of all such infections. When surgical patients with nosocomial SSI died, 77% of the deaths were reported as related to the infection, and the majority (93%) were serious infections involving organs or spaces accessed during the operation.\(^11\) Cruse estimated that an SSI increased a patient’s hospital stay by approximately ten days and cost an additional $2,000 in 1980.\(^12,13\) There are more recent studies, including a 1992 analysis by Martone, which corroborate an increase in length of stay and cost (7.3 additional postoperative hospital days and $3,152 in extra charges) in patients with SSIs.\(^14\) If a hospital with an annual surgical volume of 10,000 operations could reduce their 300 SSIs by half, this would result in an average annual cost savings of approximately $450,000, based on 1992 cost estimates. Deep SSIs involving organs or spaces are associated with even greater increases in hospital stays and costs.\(^17,18\)

An estimated 40–60% of SSIs are preventable with appropriate use of prophylactic antibiotics.\(^11,19\) Overuse, under use, improper timing, and misuse of antibiotics occurs in 25–50% of operations.\(^22\) A large number of hospitalized patients develop infections caused by Clostridium difficile, and 16% of this type of infection in surgical patients can be attributed to inappropriate prophylaxis use alone.\(^27\) Inappropriate use of broad spectrum antibiotics or prolonged courses of prophylactic antibiotics puts all patients at
even greater health risks due to the development of antibiotic-resistant pathogens. In addition to the proper use of prophylactic antibiotics and good surgical technique, other factors under the control of the operative team have been demonstrated to affect significantly the risk of SSI. These other factors include preventing hypothermia during the procedure, maintaining high levels of inspired oxygen, controlling serum glucose within certain limits, avoiding shaving the operative site, and other basic prevention strategies. All of these preventive measures provide opportunities for improvement in most hospitals.

Although the primary focus of the Collaborative work is SSIs, infections in patients undergoing surgery are not limited to those that involve the surgical site. Other types of infections occurring in patients undergoing surgery include, but are not limited to, infections of centrally inserted venous access lines for perioperative monitoring, urinary tract infections, and pneumonia.

Effective surgical infection prevention and harm reduction therefore require redesigning systems with safety in mind. The fundamental law of improvement is this: every system is perfectly designed to achieve exactly the results it gets. In order to attain a new level of performance in safety, there must be a new system. This applies to all forms of performance—such as selection, timing, and duration of antimicrobial prophylaxis; thermoregulation; oxygen tension; glucose control; hair removal and other basic prevention strategies. Some healthcare organizations have succeeded in creating new and safer systems for SSIs. Major opportunities still exist to reduce the incidence of surgical infections, create safer care for patients requiring surgery and a more satisfactory work environment for healthcare workers, and reduce costs and improve efficiency.

Reducing surgical infections while minimizing antibiotic resistance remains a challenge to many healthcare institutions. Healthcare providers are faced with the additional challenge of trying to integrate new evidence-based infection prevention strategies, such as perioperative glycemic control, into practice. Enlightened management teams, regulatory agencies, health plan providers and purchasers, and medical associations need to provide the support required to create a culture of patient safety in our healthcare systems. With this support, informed, activated hospital teams can be empowered to make key changes to their subsystems (e.g., surgical units) and to incorporate safety considerations into their everyday work.
References


26. Houck PM, Bratzler DW. Personal communication.


Recommended Reading


Change Package

The change package is a collection of ideas for changing processes of care. The following figure and table present ideas for preventing surgical infection.

Surgical Infection Prevention

Use Antibiotics Appropriately
Maintain Normal Body Temperature
Maintain Normal Blood Glucose
Optimize Oxygen Tension
Avoid Shaving Site
Other Basic Prevention

Surgical Infection Prevention Strategies
Informed, Activated Surgical Team Working in a Safety Culture
<table>
<thead>
<tr>
<th><strong>Prevention Strategies</strong></th>
<th><strong>Key Changes for Surgical Infection Prevention</strong></th>
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</table>
| Use prophylactic antibiotics appropriately | • Designate responsibility and accountability for preoperative prophylactic antibiotic administration (e.g., preoperative nurse, circulating nurse, anesthesiologist) connected to key point in process  
• Standardize administration process to occur with commonly performed activity within one hour prior to incision  
• Through the use of antibiotic standing orders specific to surgical site, administer prophylactic antibiotics according to guidelines based on local consensus  
• Make agreed upon antibiotics available in the operating room (OR)  
• Standardize delivery process to ensure timely delivery of preoperative antibiotics to the holding area  
• Provide visible reminder or checklist to give antibiotics on each case (e.g., brightly colored sticker)  
• Ensure systematic documentation of antibiotic administration on every patient chart (paper or electronic)  
• Develop system where antibiotic is hanging at head of patient’s bed ready for administration  
• Design protocols to deliver antibiotic to OR with patient  
• Educate OR staff regarding the importance and reasoning of antibiotic timing, selection, and duration  
• Provide feedback on prophylaxis compliance and infection data monthly  
• Involve pharmacy staff to ensure timing, selection, and duration are maintained |
| Maintain normothermia perioperatively | • Limit heat loss in patients prior to operative procedure  
• Standardize use of warming devices (warming blankets, hot air blankets, IV fluid heaters, filter heater hydrator for laparoscopic procedures) to ensure patient temperature >36°C perioperatively  
• Provide devices and protocol for consistent measurement of patient temperature  
• Designate responsibility and accountability for thermoregulation  
• Assure engineering controls allow surgical staff to control room temperature  
• Provide surgical staff with cooling gear/devices |
| Maintain glucose control | • Design standardized protocol for intraoperative and postoperative glucose monitoring  
• Use standardized treatment protocol to maintain serum glucose ≤200 mg/dL |
### Prevention Strategies | Key Changes for Surgical Infection Prevention
---|---
**Optimize oxygen tension** | • Design protocols to administer supplemental O₂, which is defined as (a) intraoperative FIO₂ >80% in the intubated patient or a non-rebreathing face mask at >12 L/min fresh gas flow in the non-intubated patient and (b) postoperative FIO₂ >80% in the intubated patient or a non-rebreathing face mask at >12 L/min fresh gas flow in the non-intubated patient for 2 hours  
• Design educational training programs for postoperative staff

**Avoid shaving operative site** | • Remove all razors from operating room  
• Perform hair removal when necessary with clippers right before surgery  
• Establish protocol for when and how to remove hair in affected areas  
• Provide patient education and materials on appropriate hair removal techniques to prevent shaving at home

**Basic prevention strategies**  
*(Based on organizational self-assessment of adherence to practice)*  
*Category IA CDC Recommendations*  
• Exclude patients with prior infections  
• Stop patient tobacco use prior to surgery  
• Apply sterile dressing for 24–48 hr  
• Shower with antiseptic soap  
• Provide positive pressure ventilation in OR with at least 15 air changes/hr  
• Keep OR doors closed  
• Use sterile instruments  
• Wear a mask  
• Cover hair  
• Prepare skin with appropriate agent  
• Wear sterile gloves; double-glove  
• Maintain short nails; remove artificial nails  
• Handle tissue gently  
• Ensure that surgeons/staff clean hands with appropriate agents and methods  
• Delay primary closure for heavily contaminated wounds  
• Exclude infected surgeons  
• Use closed suction drains (when used)
# Measurement Strategy

The following table lists required and optional measures that teams can select or adapt. Teams can also develop new measures based on the issues that are of most interest and importance to their hospital. There are three types of measures: outcome measures, process measures, and balancing measures. The table below provides definitions of each type of measure. Also provided on page 43 is a sample data collection tool. This tool will also be available electronically on the e-mail list.

<table>
<thead>
<tr>
<th>Measure</th>
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<th>Appropriate Collaborative Goals</th>
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</table>
| **Outcome Measures** (Measures of change [or lack of change] in the well-being of a defined population related to an intervention. Improvement in outcome measures reflects the health status of the patient, whereas process measures reflect the care delivery to the patient. Improvement in outcome measures has a direct effect on mortality and morbidity.) | O1. Number of surgical cases between surgical site infections (SSIs) | Number of surgical cases between each SSI | Infections acquired in the hospital by a surgical patient at the surgical site. SSI may be of three types:  
• superficial incisional  
• deep incisional  
• organ or space infection | Create system to capture data prospectively on 100% of patients in the pilot population | Double number of surgical cases between SSIs |
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<tr>
<td>P1. Percent of surgical cases with on-time prophylactic antibiotic administration (Required)</td>
<td>• N = number of patients with prophylactic antibiotics within one hour prior to surgical incision (see “Exceptions” to the right) • D = number of surgical cases with documented antibiotic administration time and time of surgical incision</td>
<td>• Antibiotic started means administration has begun but is not necessarily completed • Cases in which time of antibiotic administration or time of surgical incision is not documented should be excluded from the numerator and denominator • Exceptions: (1) within two hours if patient receiving vancomycin due to beta-lactam allergy, (2) patients with tourniquets need to have all antibiotic administration completed before the tourniquet is inflated and within one hour prior to surgical incision and (3) patients undergoing C-section should receive the antibiotic as soon as the umbilical cord is clamped</td>
<td>Create system to capture data prospectively on 100% of patients</td>
<td>100% beginning within one hour prior to surgical incision (see “Exceptions” to the left)</td>
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| P1-2. Percent of surgical cases with timing documented *(Optional)* | • N = number of patients with times documented  
• D = number of surgical cases receiving prophylactic antibiotics | Proportion of patients receiving a prophylactic antibiotic who have antibiotic administration time and time of surgical incision documented | Create system to capture data prospectively on 100% of patients | 100% of patients receiving prophylactic antibiotics |
| P2. Percent of surgical cases with appropriate selection of prophylactic antibiotic *(Required)* | • N = number of patients receiving antibiotic consistent with adopted guidelines  
• D = number of surgical cases | • Proportion of patients given right antibiotic as determined by published guidelines  
• Organizations will adopt a published guideline (CMS or other) or adapt a published guideline to local circumstances and use this to determine if the correct antibiotic was given to the patient  
• Note: See back pocket of handbook for CMS recommended guidelines | • Create system to capture data prospectively on 100% of patients  
• If events very rare, may use the number of cases between inappropriate selection | Achieve 100% compliance with appropriate selection of prophylactic antibiotics |
| P3. Percent of patients with perioperative glucose control *(Optional)* | • N = number of surgical patients whose serum glucose was controlled  
• D = number of surgical patients | Alternate proposed definition is percent of patients with serum glucose ≤200 mg/dL intraoperatively and during the first 48 hours postoperatively | Create system to capture data prospectively on 100% of patients | Achieve 100% compliance with perioperative glucose control (alternatively, ≤200 mg/dL) during the first 48 hours after an operation for the pilot population |
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<tr>
<td>P4. Percent of surgical patients with perioperative normothermia (Optional)</td>
<td>( N ) = number of surgical patients with temperature ( &gt;36 ) °C ( D ) = number of patients not excluded from normothermic maintenance</td>
<td>Normothermia occurs when temperature ( &gt;36 ) °C Exclusion: patients for whom hypothermia is deliberately sought for therapeutic reasons (e.g., hypothermic total circulatory arrest)</td>
<td>Record last intraoperative temperature (alternatively, record temperature upon arrival to PACU) Create system to capture data prospectively on 100% of patients</td>
<td>100% for those not excluded from normothermic maintenance</td>
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<tr>
<td>P5. Percent of surgical patients provided supplemental ( \text{O}_2 ) perioperatively (Optional)</td>
<td>( N ) = number of patients receiving supplemental ( \text{O}_2 ) perioperatively ( D ) = number of patients meeting inclusion criteria</td>
<td>Supplemental ( \text{O}_2 ) is defined as (a) intraoperative ( \text{FiO}_2 ) ( &gt;80% ) in the intubated patient or a non-rebreathing face mask at ( &gt;12 ) L/min fresh gas flow in the non-intubated patient and (b) postoperative ( \text{FiO}_2 ) ( &gt;80% ) in the intubated patient or a non-rebreathing face mask at ( &gt;12 ) L/min fresh gas flow in the non-intubated patient for 2 hours</td>
<td>Create system to capture data prospectively on 100% of patients Teams might want to start with high-risk population</td>
<td>100% surgical patients not excluded</td>
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Exclusions: (1) ambulatory patients (not admitted as inpatients) and (2) patients with COPD and evidence for CO\(_2\) retention
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| P6. Percent of surgical staff who are knowledgeable in surgical infection prevention (Optional) | • N = number of staff who obtain a score of 100% on post-test  
• D = number of staff surveyed | Resembles a spread measure in that it may be cumulative by month | Use survey after education detailing surgical infection prevention practices | 100% of surgical staff knowledgeable in surgical infection prevention |
| P7. Percent of patients with appropriate hair removal (Optional)         | • N = number of surgical patients with hair removed appropriately  
• D = number of patients requiring hair removal | • Exclusion: patients for whom hair removal is not necessary  
• Create system to capture data prospectively on 100% of patients  
• Define appropriate hair removal for each type of surgery in pilot population (e.g., depilatory may be appropriate, clipping may be appropriate, usually shaving is not appropriate) | Achieve 100% compliance with appropriate hair removal |
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<tr>
<td><strong>Balancing Measures</strong> (Measures that together with the selected process and outcome measures describe a great system of care. These measures may be process or outcome measures, and usually measure some aspect of the system that may inadvertently be affected by changes in specific areas of the model.)</td>
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<td><strong>B1. Percent of surgical patients who received prophylactic antibiotics whose antibiotics were discontinued within 24 hours after surgery</strong></td>
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<td>- N = number of patients receiving prophylactic antibiotics who had them discontinued within 24 hours</td>
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<td>- D = number of patients who received prophylactic antibiotics</td>
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<td>Discontinued is defined as discontinued within 24 hours of the surgery end time</td>
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<td>Create system to capture data prospectively on 100% of patients</td>
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<td>100% of surgical patients with prophylactic antibiotics discontinued within 24 hours of the surgery end time</td>
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<td>Note: this measure linked to cost and to prevention of resistant strains of bacteria</td>
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<td><em>(Required)</em></td>
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<td><strong>B2. Cost per surgery</strong> <em>(Optional)</em></td>
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<td>- N = dollars allocated to surgical accounting codes per month</td>
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<td>- D = number of surgical cases</td>
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<td>No increase in direct costs, or increase in direct cost is less than the cost of SSIs prevented</td>
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<td><strong>B3. Volume of surgical workload per month</strong> <em>(Optional)</em></td>
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<td>Number of surgical cases per month</td>
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<td>Surgery defined as involving an incision and occurring in an operating room</td>
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<td>B4. Incidence of resistant bacterial strains</td>
<td>1. N = number of different resistant strains. If the same strain is isolated several times from the same patient, it should only be reported once. If the apparently same strain is isolated from several patients, it should be reported for each patient. D = number of surgical ICU patient days/1000 days</td>
<td>1. Number of resistant strains per 1000 patient days; use laboratory determination of resistant strain 2. Defined daily dose of antibiotics per 1000 patient days</td>
<td>Laboratory data</td>
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