



How-to Guide: Prevent Surgical Site Infections

Prevent surgical site infections (SSI) by implementing the four components of care recommended in this guide.*

*This guide also addresses the additional changes in care recommended by the Surgical Care Improvement Project (SCIP): beta blockers for patients on beta blockers prior to admission, venous thromboembolism prophylaxis, and ventilator-associated pneumonia prevention.

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Introduction

What is the Institute for Healthcare Improvement (IHI)?

The Institute for Healthcare Improvement (IHI) is a not-for-profit organization leading the improvement of health care throughout the world. IHI helps accelerate change by cultivating promising concepts for improving patient care and turning those ideas into action. Thousands of health care providers participate in IHI's groundbreaking work.

What is a How-to Guide?

IHI's How-to Guides address specific health care interventions that hospitals and/or entire health systems can pursue to improve the quality of health care while reducing unnecessary deaths, medical errors, and costs. These interventions align with several national initiatives of the Institute of Medicine (IOM), Agency for Healthcare Research and Quality (AHRQ), Centers for Medicare & Medicaid Services (CMS), the Joint Commission (JC), and the Centers for Disease Control (CDC), as well as the Department of Health and Human Services (HHS) "Partnership for Patients" initiative.

This material was first developed for IHI's 5 Million Lives Campaign, a voluntary initiative to protect patients from five million incidents of medical harm from December 2006-December 2008. The 5 Million Lives Campaign was built on the 2004-2006 IHI 100,000 Lives Campaign. Both Campaigns involved thousands of hospitals and communities from around the United States in specific interventions. "Mentor Hospitals" showed marked improvement in one or more of the Campaign interventions and volunteered to teach other hospitals. Many of their successful implementation stories and data have been included in this How-to Guide.

5 Million Lives Campaign Donors

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The Case for Preventing Surgical Site Infections

Surgical site infections are a frequent cause of morbidity following surgical procedures.¹ Surgical site infections have also been shown to increase mortality, readmission rates, length of stay, and costs for patients who incur them.² While nationally the rate of surgical site infection averages between two and three percent for clean cases (Class I/Clean as defined by CDC), an estimated 40 to 60 percent of these infections are preventable.

A review of the medical literature shows that the following care components reduce the incidence of surgical site infection: appropriate use of prophylactic antibiotics; appropriate hair removal; controlled postoperative serum glucose for cardiac surgery patients; and immediate postoperative normothermia for colorectal surgery patients. These components, if implemented reliably, can drastically reduce the incidence of surgical site infection, resulting in the nearly complete elimination of preventable surgical site infection in many cases.

Where Are We Now?

A medical record review of 34,133 charts performed under the auspices of CMS demonstrated significant opportunity for improvement in surgical site prevention.³ In the area of appropriate antibiotic use, the medical record review found the following:

- Appropriate antibiotic selection occurred in 92.6% of cases;
- Antibiotics were given within one hour of incision time to 55.7% of patients; and
- Prophylactic antibiotics were discontinued within 24 hours of surgery end time for only 40.7% of patients.

These performance levels existed even after these three measures had been generally accepted for several years and had been the focus of many improvement collaboratives, nationally and at the state level.

Recent data from the Surgical Care Improvement Project (SCIP) (September 2010) indicate that performance has improved considerably and, for some measures, has reached or exceeded the 2013 proposed target of 95% adherence to process measures to prevent SSI. Continued focus on these measures will be necessary and important in sustaining this improvement over time.

¹ Kirby JP, Mazuski JE. *Surg Clin North Am.* April 2009;89(2):365-389.

² Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, et al. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization and extra costs. *Infect Control Hosp Epidemiology.* 1999;20:725.

³ Bratzler DW, Houck PM, et al. *Arch Surg.* 2005;140:174-182.

SCIP Data⁴

	FY06	FY07	FY08	FY09
Antibiotic 1 hour prior to incision	83%	87%	91%	96%
Appropriate antibiotic administered	n/a	92%	95%	98%
Antibiotic discontinued	74%	80%	87%	92%
Glucose control for cardiac surgery	n/a	n/a	89%	92%
Appropriate hair removal	n/a	n/a	97%	99%

A major national effort has been made to further improve compliance with SSI prevention measures through their inclusion in SCIP. The 5 Million Lives Campaign intervention was aligned with this initiative.

A recent Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals published by SHEA-IDS⁵ (in partnership with the Joint Commission, the Association for Professionals in Infection Control and Epidemiology (APIC), and the American Hospital Association (AHA)) emphasizes the importance of reducing these infections and includes guidelines of practice recommendations to address them.⁶

General Considerations for Improvement in SSI

Any improvement process should be driven by leadership, with a commitment to providing adequate resources and attention to the initiative. It is also imperative to involve a multidisciplinary team in the surgical site infection improvement process. Successful teams set clear aims for their work, establish baseline measurements of performance, regularly measure and study the results of their work, and test various process and systems changes over a variety of conditions in order to find the ones that lead to improvement in their particular setting.

⁴ Hospital Compare Hospital Quality Initiatives. http://www.cms.gov/HospitalQualityInits/11_HospitalCompare.asp. Updated August 8, 2011. Accessed November 7, 2011.

⁵ Compendium of Strategies to Prevent HAIs. <http://www.shea-online.org/about/compendium.cfm>. Accessed November 7, 2011.

⁶ Yokoe DS, Mermel LA, Classen, D, et al. A compendium of strategies to prevent healthcare-associated infections in acute care hospitals. *Infect Control Hosp Epidemiol*. 2008;29:S12-S21.

SSI Prevention: Four Components of Care

1. Appropriate Use of Prophylactic Antibiotics

For the purposes of the 5 Million Lives Campaign, the antibiotic process measures are these:

- Prophylactic antibiotic received within 1 hour prior to surgical incision*
- Prophylactic antibiotic selection for surgical patients consistent with national guidelines (as defined in JC/CMS Specification Manual and SCIP for Measure SCIP-Inf-2)
- Prophylactic antibiotics discontinued within 24 hours after surgery end time (48 hours for cardiac patients)

It is worth noting that these measures apply to antibiotics administered for SSI prophylaxis only. The definition of the measures in SCIP excludes patients who are already receiving antibiotics for other reasons. It often is not necessary to administer an additional antibiotic or dose in such cases, as this only leads to unnecessary administrations which should be avoided.

**Due to the longer infusion time required for Vancomycin, it is acceptable to start this antibiotic (e.g., when indicated because of beta-lactam allergy or high prevalence of MRSA) within 2 hours prior to incision.*

What changes can we make that will result in improvement?

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the antibiotic use measures. Some of these changes are:

- Use preprinted or computerized standing orders specifying antibiotic, timing, dose, and discontinuation.
- Develop pharmacist- and nurse-driven protocols that include preoperative antibiotic selection and dosing based on surgical type and patient-specific criteria (age, weight, allergies, renal clearance, etc.).
- Change operating room drug stocks to include only standard doses and standard drugs, reflecting national guidelines.
- Assign dosing responsibilities to anesthesia or designated nurse (e.g., pre-op holding or circulator) to improve timeliness.
- Involve pharmacy, infection control, and infectious disease staff to ensure appropriate timing, selection, and duration.
- Verify administration time during “time-out” or pre-procedural briefing so action can be taken if not administered.

2. Appropriate Hair Removal

For many years, it has been known that the use of razors prior to surgery increases the incidence of wound infection when compared to clipping, depilatory use, or no hair removal at all.⁷ Razors can cause small cuts and nicks to skin, many of which may be microscopic and not visible to the human eye. However, many teams working on this measure find that the use of razors in their own institutions can range from zero to nearly 100 percent.

Hair removal may not be necessary for many procedures, yet has been “carried over” from years ago when surgical patients commonly received extensive pre-op shaving.

When hair must be removed to safely perform the procedure, it should never occur with a razor. It is preferable to use clippers rather than shaving with a razor as this results in fewer surgical site infections.⁸

The use of clippers has been found to be the best method in many hospitals, as depilatory creams can cause skin reactions. Staff must be trained in the proper use of clippers because an untrained user can damage the skin. If hair must be removed preoperatively, it is generally recommended that this not occur in the operating room itself, as loose hairs are difficult to control.

What changes can we make that will result in improvement?

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the appropriate hair removal measure. Some of these changes are:

- Ensure adequate supply of clippers and train staff in proper use.
- Use reminders (signs, posters).
- Educate patients not to self-shave preoperatively.
- Remove all razors from the entire hospital.
- Work with the purchasing department so that razors are no longer purchased by the hospital.

⁷ Seropian. *Am J Surg.* 1971;121:251.

⁸ Tanner J, Woodings D, Moncaster K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database of Systematic Reviews* 2006, Issue 3. Art. No.: CD004122. DOI: 10.1002/14651858.CD004122.pub3

3. Controlled Postoperative Serum Glucose in Cardiac Surgery **,*

Review of medical literature shows that the degree of hyperglycemia in the postoperative period was correlated with the rate of SSI in patients undergoing major cardiac surgery.⁹ Glucose control postoperatively was focused on the cardiac surgical population during the Campaign, based on the literature and alignment with SCIP. Future studies of the effectiveness of glucose control in other surgical populations may be forthcoming; however, literature to date links this measure with SSI prevention only in the cardiac surgical population. Other articles have demonstrated that stringent glucose control in surgical intensive care unit patients reduces mortality.¹⁰

**NOTE that, for this effort, “glucose control” is defined as serum glucose levels below 200 mg/dl, collected at or closest to 6:00 AM on each of the first two postoperative days.*

***NOTE that tight glycemic control (e.g., using an insulin drip) is often performed in an intensive care setting or equivalent for safety.*

What changes can we make that will result in improvement?

Hospital teams across the United States are developing and testing process and systems changes to improve performance on the postoperative glucose control measure. Some of these changes are:

- Implement one standard glucose control protocol for cardiac surgery.
- Regularly check preoperative blood glucose levels on all patients to identify hyperglycemia; this is best done early enough that assessment of risk can be completed and treatment initiated if appropriate.
- Assign responsibility and accountability for blood glucose monitoring and control.

⁹ Latham. *Inf Contr Hosp Epidemiol*. 2001;22:607; Dellinger. *Inf Contr Hosp Epidemiol*. 2001;22:604.

¹⁰ Van den Berghe. *NEJM*. 2001;345:1359.

4. Immediate Postoperative Normothermia in Colorectal Surgery*

The medical literature indicates that patients undergoing colorectal surgery have a decreased risk of SSI if they are not allowed to become hypothermic during the perioperative period.¹¹

Anesthesia, anxiety, wet skin preparations, and skin exposure in cold operating rooms can cause patients to become clinically hypothermic during surgery. In the Campaigns and SCIP, focus was directed at colorectal surgery patients based on literature linking them to risk for SSI. However, there is evidence to show that preventing hypothermia is beneficial in reducing other complications, and it clearly is more comfortable for patients.^{12,13,14,15,16}

**NOTE that this component of care does not pertain to those patients for whom therapeutic hypothermia is being used (e.g., hypothermic cardioplegia).*

What changes can we make that will result in improvement?

Hundreds of hospital teams across the United States have developed and tested process and systems changes that allowed them to improve performance on the normothermia measure. Some of these changes are:

- Prevent hypothermia at all phases of the surgical process.
- Use warmed forced-air blankets preoperatively, during surgery, and in PACU.
- Use warmed fluids for IVs and flushes in surgical sites and openings.
- Use warming blankets under patients on the operating table.
- Use hats and booties on patients perioperatively.
- Adjust engineering controls so that operating rooms and patient areas are not permitted to become excessively cold overnight, when many rooms are closed.
- Measure temperature with a standard type of thermometer.

¹¹ Melling. *Lancet*. 2001;358:876.

¹² Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med*. 1996;334:1209-1215.

¹³ Mahoney CB, Odom J. Maintaining intraoperative normothermia: A meta-analysis of outcomes with costs. *AANA J*. 1999;67:155-163.

¹⁴ Doufas AG. Consequences of inadvertent perioperative hypothermia. *Best Pract Res Clin Anaesthesiol*. 2003;17:535-549.

¹⁵ Melling AC, et al. Effects of preoperative warming on the incidence of wound infection after clean surgery: A randomized controlled trial. *Lancet*. 2001;358:876-880.

¹⁶ Sessler DI, Akca O. Nonpharmacological prevention of surgical wound infections. *Clin Infect Dis*. 2002;35:1397-1404.

Additional SCIP Changes in Care

Beta Blockers for Patients on Beta Blockers Prior to Admission

Much has been written about the use of beta blockers and beta blockade in surgical patients, including non-cardiac surgery, as prevention for intra-operative and postoperative cardiac events. Published studies show conflicting results, and there is lack of consensus about the appropriateness of beta blockers for some types of patients. A trial presented at the American Heart Association Annual Meeting (POISE Trial) suggested that acute administration of beta blockers beginning the morning of surgery and continued postoperatively in beta-blocker-naive patients was associated with a reduction in non-fatal myocardial infarction but at an increased risk of stroke and all-cause mortality.¹⁷

However, these results do not apply to the current SCIP measure of continuation of beta blockers in those patients already taking these agents. One thing remains universally agreed upon: **patients on beta blockers preoperatively should be continued on beta blockers postoperatively.**

The American College of Cardiology/American Heart Association Task Force on Practice Guidelines notes, “Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers to treat angina, symptomatic arrhythmias, hypertension, or other ACC/AHA Class I guideline indications.”¹⁸ Reliable systems should be established to ensure that these patients have their beta blockers continued during the transition from preoperative to postoperative care.

Transition points always carry the risk of inadvertent error. In the postoperative setting, it is not always clear who will be responsible for ordering preoperative medications: surgeons may prefer that a primary care physician (PCP) or internist address these medications, but the PCP may not see the patient in the hospital, especially if the surgical case is uncomplicated and length of stay is short; anesthesiologists may not be writing any postoperative orders at all; hospitalists may not exist in the organization or may not see surgical patients. These types of circumstances may lead to patients not receiving their beta blockers postoperatively and then experiencing withdrawal, which can result in harm. In a study of 140 patients who received beta blockers preoperatively, eight patients had their beta blockers discontinued postoperatively and mortality was 50%, compared to mortality of 1.5% in the other 132 patients who had beta blockers continued (odds ratio 65.0, $P < .001$).¹⁹ Hoeks and colleagues²⁰ studied 711 consecutive peripheral vascular surgery

¹⁷ <http://www.americanheart.org/presenter.jhtml?identifier=3051716>. Accessed February 18, 2008.

¹⁸ ACC/AHA Practice Guidelines. *JACC*. 2006;47:11;2342-2355.

¹⁹ Shammash JB, Trost JC, et al. *Am Heart J*. 2001;141(1):148-153.

²⁰ Hoeks SE, Scholte Op Reimer WJ, van Urk H, et al. *Eur J Vasc Endovasc Surg*. 2006.

patients, and beta blocker withdrawal was associated with an increased risk of one-year mortality compared to non-users (HR=2.7; 95% CI=1.2-5.9).

A patient on beta blockers prior to admission is defined as one receiving beta blockers for 24 hours prior to incision.

What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process and systems changes that have allowed them to improve performance on beta blocker measures. Some of these changes are:

- Identify patients preoperatively who are on beta blockers to ensure that they are continued postoperatively.
- Develop standard postoperative order sets or automatic protocols that include provision of beta blockers for patients receiving beta blockers preoperatively.
- Designate responsibility for postoperative ordering of preoperative medications.
- Implement medication reconciliation.

Educate patients preoperatively about the importance of continuing beta blockers postoperatively and informing the surgeon and anesthesiologist that they take these medications.

Venous Thromboembolism (VTE) Prophylaxis

Deep vein thrombosis (DVT) is estimated to occur in 10% to 40% of general surgical patients when prophylaxis is not provided. Surgical patients are at increased risk due to stasis in the operating room and postoperatively due to difficulty ambulating from pain, effects of anesthesia, and pain-relieving agents. This can result in a pulmonary embolism (PE) in some cases and can be fatal, sometimes instantly. In a study cited by the American College of Chest Physicians (ACCP), autopsies of surgical patients who died within 30 days postoperatively revealed that 32% had a PE and that it was the cause of death for most.²¹

ACCP has published guidelines for VTE prophylaxis in surgical patients, based on surgery type. ACCP recommends routine prophylaxis for all patients in the target group; signs and symptoms of DVT in early stages are unreliable for preventing significant events. Adherence to these guidelines is the basis of the SCIP measures in this area.

²¹ Lindblad B, Eriksson A, Bergqvist D. *Br J Surg*. 1991;78:849-852.

What changes can we make that will result in improvement?

Hospital teams across the United States have developed and tested process and systems changes that have allowed them to improve performance on the VTE prophylaxis measure. Some of these changes are:

- Develop standard order sets for prophylaxis.
- Develop protocols for providing prophylaxis automatically, based on surgical procedure.
- Provide education and training for staff on the importance of VTE prophylaxis.
- Educate patients preoperatively about the prophylaxis they will receive and steps they can take to reduce risk.

Ventilator-Associated Pneumonia Prevention

According to SCIP, “postoperative pneumonia occurs in 9% to 40% of surgical patients and has an associated mortality of 30% to 45%.”^{22,23} While not all surgical patients receive postoperative mechanical ventilation, those who do are at risk for one of the most serious types of pneumonia: ventilator-associated pneumonia (VAP).

What changes can we make that will result in improvement?

Hospitals seeking to aggressively reduce surgical complications should consider using the Ventilator Bundle for all surgical patients receiving postoperative mechanical ventilation, particularly those ventilated for more than 24 hours. A complete [How-to Guide: Prevent Ventilator-Associated Pneumonia](#) is available.

²² Brooks-Brunn JA. Predictors of postoperative pulmonary complications following abdominal surgery. *Chest*. 1997;111:564-71.

²³ Brooks-Brunn JA. Postoperative atelectasis and pneumonia. *Heart Lung*. 1995;24:94-115.

Using the Model for Improvement

In order to move this work forward, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.
- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, for an entire pilot population or on an entire unit.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement at www.ihl.org.

PDSA Worksheet

CYCLE: 1 DATE: 11/07/11



Project: SSI - Prophylactic Antibiotic within One Hour before Incision

Objective for this PDSA Cycle: Test administration of antibiotic by anesthesiologists.

Plan:

Questions: Will anesthesiologists agree to administer the antibiotic and document the time?

Predictions: The anesthesiologists will agree. Documentation location may need to be clarified for consistent practice.

Plan for change or test – who, what, when, where:

Get an anesthesiologist to volunteer to administer and document one antibiotic dose for first case on Tuesday.

Plan for collection of data – who, what, when, where:

- Nurse will record observations and any issues that arise.
- Anesthesiologist will document administration time on preoperative checklist.
- Debrief with anesthesiologist after the surgery is complete.

Do:

Carry out the change or test. Collect data and begin analysis.

- Conducted the test on the first surgery on Tuesday morning.
- The anesthesiologist became frustrated because she did not have the pre-op checklist at administration time because the circulating nurse was using it.

Study:

Complete analysis of data.

- Debrief: Discuss whether the administration time can be documented on the anesthesia record instead of on the checklist. The anesthesiologist is willing to try the test again tomorrow.

How did or didn't the results of this cycle agree with the predictions that we made earlier?

Documentation form currently in use is not ideal for use by anesthesiologists if they administer the dose.

- Summarize the new knowledge we gained by this cycle: May need to revise checklist and anesthesia record if tests are successful, so that documentation of administration time is always in the same place.

Act:

List actions we will take as a result of this cycle: Repeat this test tomorrow after drafting a sample revision to anesthesia record. Plan for the next cycle (adapt change, another test, implementation cycle): Run a second PDSA cycle tomorrow for three scheduled surgeries.

Forming the Team

No single person can create system-level improvements alone. First, it is crucial to have the active support of leadership in this work. The leadership must make patient safety and quality of care strategic priorities in order for any surgical care improvement team to be successful.

Once leadership has publicly given recognition and support (dollars, person-time) to the program, the improvement team can be quite small. Successful teams include a physician (either a surgeon, anesthesiologist, or both), an operating room nurse, and someone from the quality department. Each hospital will have its own methods for selecting a core team. The team should use the Model for Improvement to conduct small-scale, rapid tests of the ideas for improvement over various conditions in a pilot surgical population. The team should also track performance on a set of measures designed to help them see if the changes they are making are leading to improvement, and regularly report these measures back to leadership.

Measurement

See Appendix A for specific information regarding the recommended process and outcomes measures for surgical site infection prevention.

The recommended outcome measure is “Percent of Clean Surgery Patients with Surgical Infection” (i.e., surgical site infections within 30 days of surgery for patients with Class I / Clean wounds, as defined by CDC and NSQIP for wound classification). If you are just starting this work, this may be a good measure to begin tracking. We are not distinguishing as to whether this is superficial infections only, or also includes deep incision and organ space infections; this should be decided locally for your organization. As your work progresses and you are ready for advanced measures on this topic, consider measures that address the different types of SSIs as well as the other classes of wounds, similar to the data being collected in the [National Surgical Quality Improvement Program at the American College of Surgeons](#).

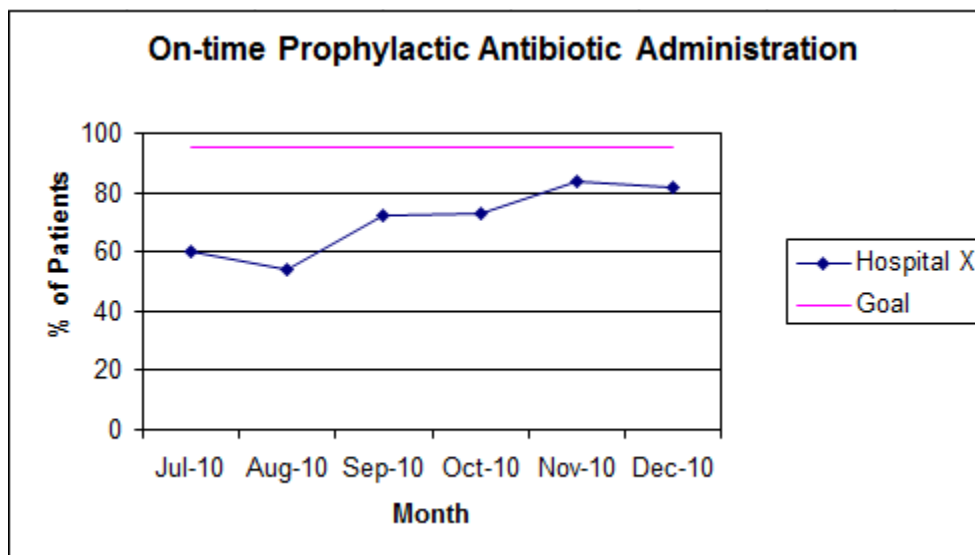
For each process measure, obtain the data via medical record review. (Follow the links in Appendix A for details about data collection.) The process measures recommended by the Campaigns are identical to those being used in CMS’s current Surgical Infection Prevention program, the Joint Commission’s current core measure set, and SCIP. Using run charts helps make change over time visible to the team and to the leadership.

Run Charts

Improvement takes place over time. Determining if improvement has really happened and if it is lasting requires observing patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement.

Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- As you work on improvement, they provide information about the value of particular changes.
- Run chart example – first test of change:



Teams may elect to work on any or all of the four care components: antibiotic use, hair removal, glucose control, and normothermia. A first test of change should involve a very small sample size (typically one patient) and should be described ahead of time in a Plan-Do-Study-Act format so that the team can easily predict what they think will happen, observe the results, learn from them, and continue to the next test.

Example: Administration of preoperative dose of antibiotic

- The team decides to test having the anesthesiologist administer the pre-operative dose of prophylactic antibiotic and document the administration time. They identify an anesthesiologist who supports the idea, and let the anesthesiologist know that they will test this with one case. On their PDSA form, they predict that the surgeon will agree to administer the dose but that documentation may need to be clarified. They then conduct the test. They note that the anesthesiologist becomes frustrated because s/he cannot access the preoperative checklist used for documentation of administration time because it is in use by the circulating nurse. The team's study of the data indicates that they should repeat this test, after first developing an alternative documentation location that will be accessible to the anesthesiologist at the time of administration.

Ideally, teams will conduct multiple small tests of change simultaneously across all four components of care. This simultaneous testing usually begins after the first few tests are completed and the team feels comfortable and confident in the process.

Implementation and Spread

For surgical site infection, teams will usually choose to begin their improvement process by working with a “pilot” population. This pilot population may be the hip- and knee-replacement patients, for example, or cardiac operations, or gynecologic procedures, etc. It is possible to include the universe of surgical patients in the pilot population, if that number is small (fewer than 50 cases per month). We recommend including at least 50 cases per month in the pilot population in order to increase the ability to measure and detect improvement.

In order to maximize the reduction in overall hospital mortality related to surgical site infections, however, hospitals must spread improvements begun in a pilot population to the universe of surgical populations. Organizations that successfully spread improvements use an organized, structured method in planning and implementing spread across populations, units, or facilities. You can find information about planning, tracking, and optimizing spread at www.ihl.org. (See IHI's Innovation Series white paper, “[A Framework for Spread: From Local Improvements to System-Wide Change.](#)”)

Barriers

Teams working on preventing surgical site infection have learned a great deal about barriers to improvement and how to overcome them. Some common challenges and solutions are:

- Lack of support from leadership

Solution: Use opinion leaders (physicians) and data and if possible; a business case for the project may help to win leadership support.

- Uneven physician acceptance of new practices

Solution: Use physician opinion leaders, review the medical literature, and feed back data on a surgeon-specific level. Remember that physicians may fall anywhere on the “Adoption of Innovations” curve; work first with your early adopters and use their stories to convince the majority.

Tips and Tricks

More than 3,000 hospitals across the US have been working hard to implement the Campaign interventions. Here are some of the “tips and tricks” for successful testing and implementing of each intervention that we have gathered from our site visits to Campaign hospitals, our Campaign calls, and our Discussion Groups at www.ihi.org.

- Set a narrower range internally for timing of the preoperative antibiotic dose, e.g., 5 to 50 minutes prior to incision. This helps account for clocks not in synchrony and allows a small buffer.
- Use 36.5 degrees Celsius as the intervention point for temperature; waiting until 36 degrees is usually too late to prevent hypothermia below that level.
- Measure pre-op blood glucose early enough so that if it is unexpectedly high, a plan of action can be initiated.
- Schedule the times for post-op doses of prophylactic antibiotics in the OR, based on the time incision is closed, to ensure completion within 24 hours (don’t use standard dosing times).
- Measure the SSI interventions as an all-or-nothing measure for each patient.
- Approach the SSI interventions like “mini-bundles” for each phase: pre-op, intra-op, and post-op. Hold each area accountable for their bundle.

- Maintain a reasonable temperature in the OR – not too cold for patients, but not too warm for staff. High 60s Fahrenheit seems to be ideal.
- Don't allow operating rooms to get excessively cold overnight when closed.

Frequently Asked Questions

Surgical Site Infections

Our surgeons are asking, “If there is no data that what I am doing—e.g., shaving just before surgery—is dangerous, why should I change?” I have no evidence-based medicine with which to answer them.

There is ample evidence that shaving prior to a surgical procedure is associated with more wound infections than removing hair with clippers or not removing hair at all. The papers that support this conclusion are sound. You can challenge the studies as not specifically looking at shaving immediately prior to surgery because that study has not yet been done, as most patients are not prepared for surgery that way. There is nearly always a time gap between the shave prep and the incision; this likely varies greatly from institution to institution. It can be inferred from the literature that the time interval between the shaving and the incision is likely related to the wound infection rate. That interval in many cases is not absolutely controllable; cases get delayed or cancelled, putting those patients into a time range (from prep to incision) that we know scientifically is associated with more wound infections.

Further, there is no evidence that shaving immediately prior to surgery is a safe thing to do. There is no evidence that shaving with a razor at any time prior to surgery is ever associated with a lower rate of any type of complication. Why would you take a chance, in this unstudied area, with the patient's outcome?

Questions have come up in our organization regarding serum glucose. Can you help clarify?

In the glucose control measure for cardiac surgery patients, the goal is to include the “serum” glucose level as measured at 6 AM (or as close as possible to this time) on post-op days 1 and 2.

The word “serum” has caused some confusion; it has been interpreted as serum analyzed by the lab only (not finger sticks). We have clarified the definition with colleagues at SCIP.

Glucose values for this measure may be obtained from the following:

- Blood sugar
- Fasting glucose
- Finger stick glucose
- Glucometer results
- Glucose
- Non-fasting glucose
- Random glucose
- Serum glucose

What is the time frame for defining post-op wound infections for this measure? Is it infections documented while in the hospital, or does it extend post-discharge?

Most places are measuring SSI within 30 days and, in general, that has been our recommendation. Most inpatient stays are so short that we must consider the time after discharge, although surveillance is a real challenge.

The interventions we used in the 5 Million Lives Campaign contribute mostly to preventing infections within 30 days.

Is anyone looking at communication and handoffs relative to SSI prevention, specifically at incorporating Team Resource Management constructs such as briefings/debriefings and handoff tools in helping to ensure that all interventions have been completed?

A number of hospitals have built the SSI prevention items into their pre-procedural briefing. For example, during the briefing one of the items verified is whether the prophylactic antibiotic has been administered. If it has not, this step provides an opportunity to mitigate.

A Fact Sheet for Patients and Their Family Members

Most patients who have surgery do well, but sometimes patients get infections. This happens to about 3 out of 100 patients who have surgery. Infections after surgery can lead to other problems. Sometimes, patients have to stay longer in the hospital. Rarely, patients die from infections. Patients and their family members can help lower the risk of infection after surgery. Here are some ways:

Days or weeks before surgery:

Meet with your surgeon.

- Bring an up-to-date list of all the medications you take. Talk with your surgeon about why you take each medication and how it helps.
- Let the surgeon know if you are allergic to any medication and what happens when you take it.
- Tell the surgeon if you have diabetes or high blood sugar, or if family members do.

Talk about ways to lower your risk of getting an infection. This may include taking antibiotic medicines.

The day or night before surgery:

Take extra good care of your body.

- Do not shave near where you will have surgery. Shaving can irritate your skin, which may lead to infection. If you are a man who shaves your face every day, ask your surgeon if it is okay to do so.
- Keep warm. This means wearing warm clothes or wrapping up in blankets when you go to the hospital. In cold weather, it also means heating up the car before you get in. Keeping warm before surgery lowers your chance of getting an infection.

At the time of surgery:

- Tell the anesthesiologist (doctor or nurse who puts you to sleep for surgery) about all the medications you take. A good way to do this is to bring a written, up-to-date medication list with you.
- Let the anesthesiologist know if you have diabetes or high blood sugar, or if family members do. People with high blood sugar have a greater chance of getting infections after surgery.
- Speak up if someone tries to shave you with a razor before surgery. Ask why you need to be shaved and talk with your surgeon if you have any concerns.

- Ask for blankets or other ways to stay warm while you wait for surgery. Find out how you will be kept warm during and after surgery. Ask for extra blankets if you feel cold.
- Ask if you will get antibiotic medicine. If so, find out how many doses you will get. Most people receive only one dose before surgery and are on antibiotics for just one day after surgery, as taking too much can lead to other problems.

Appendix A: Recommended Intervention-Level Measures

The following measures are relevant for this intervention. We recommend that you use some or all of them, as appropriate, to track the progress of your work in this area. In selecting your measures, we offer the following advice:

- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the results they provide and the resources required to obtain those results; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use measures not listed here, and, similarly, you may modify the measures described below to make them more appropriate and/or useful to your particular setting; however, be aware that modifying measures may limit the comparability of your results to others'. (Note that hospitals using different or modified measures should not submit those measure data to IHI.)
- Remember that posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful, and that they would be excited to see.

Process Measures

Note that all of the process measures are the same as those used in the 100,000 Lives Campaign; we have simply changed our policy of creating Measure Information Forms (MIFs) for measures which have already been defined by others, and instead now link directly to the “owner’s” measure definition.

Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision
Owner: SCIP
Owner Measure ID: SCIP-Inf-1a
<u>Measure Information</u>
From the link above, scroll down to find the link for SCIP-Inf-1; SCIP-Inf-1a is defined within.

Prophylactic Antibiotic Selection for Surgical Patients

Owner: SCIP

Owner Measure ID: SCIP-Inf-2a

Measure Information

From the link above, scroll down to find the link for SCIP-Inf-2; SCIP-Inf-2a is defined within.

Prophylactic Antibiotics Discontinued Within 24 Hours after Surgery End Time (48 Hours for Cardiac Patients)

Owner: SCIP

Owner Measure ID: SCIP-Inf-3a

Measure Information

From the link above, scroll down to find the link for SCIP-Inf-3; SCIP-Inf-3a is defined within.

Cardiac Surgery Patients with Controlled 6 AM Postoperative Serum Glucose

Owner: SCIP

Owner Measure ID: SCIP-Inf-4

Measure Information

From the link above, scroll down to find the link for SCIP-Inf-4.

Surgery Patients with Appropriate Hair Removal

Owner: SCIP

Owner Measure ID: SCIP-Inf-6

Measure Information

From the link above, scroll down to find the link for SCIP-Inf-6.

Colorectal Surgery Patients with Immediate Postoperative Normothermia*
Owner: SCIP Owner Measure ID: SCIP-Inf-7 <u>Measure Information</u> From the link above, scroll down to find the link for SCIP-Inf-7.

**Note: This measure is now optional in SCIP.*

Surgery Patients on Beta Blocker Therapy Prior to Admission Who Received a Beta Blocker During the Perioperative Period
Owner: SCIP Owner Measure ID: SCIP-Card-2 <u>Measure Information</u> From the link above, scroll down to find the link for SCIP-Card-2.

Surgery Patients with Recommended Venous Thromboembolism Prophylaxis Ordered
Owner: SCIP Owner Measure ID: SCIP-VTE-1 <u>Measure Information</u> From the link above, scroll down to find the link for SCIP-VTE-1.

Surgery Patients Who Received Appropriate Venous Thromboembolism Prophylaxis Within 24 Hours Prior to Surgery to 24 Hours After Surgery
Owner: SCIP Owner Measure ID: SCIP-VTE-2 <u>Measure Information</u> From the link above, scroll down to find the link for SCIP-VTE-2.

Outcome Measure

Percent of Clean Surgery Patients with Surgical Infection
Owner: IHI
Owner Measure ID: N/A
<u>Measure Information</u>

Alignment with Other Measure Sets

Measure Name	JC	CMS	SCIP	NQF	CDC
Percent of Surgical Patients with Prophylactic Antibiotic Received within One Hour Prior to Surgical Incision – Overall Rate	√1	√2	√3	√4	
Percent of Surgical Patients with Appropriate Selection of Prophylactic Antibiotic – Overall Rate	√1	√2	√3	√4	
Percent of Surgical Patients with Appropriate Prophylactic Antibiotic Discontinuation – Overall Rate	√1	√2	√3	√4	
Percent of Major Cardiac Surgical Patients with Controlled Post Operative Serum Glucose	√1	√2	√3		
Percent of Surgical Patients with Appropriate Hair Removal	√1	√2	√3		
Percent of Colorectal Surgical Patients with Normothermia in PACU	√1	√2	√3		
Percent of Clean Surgery Patients with Surgical Infection					√5
Surgery Patients on Beta Blocker Therapy Prior to Admission Who Received a Beta Blocker During the Perioperative Period	√1	√2	√3		
Surgery Patients with Recommended Venous Thromboembolism Prophylaxis Ordered	√1	√2	√3		
Surgery Patients Who Received Appropriate Venous Thromboembolism Prophylaxis Within 24 Hours Prior to Surgery to 24 Hours After Surgery	√1	√2	√3		

¹ Matches a measure in the Joint Commission (JC) National Hospital Quality Measures SCIP Core Measure Set

² Matches a measure in the CMS SCIP measure set

³ Matches a measure in the SCIP measure set

⁴ This measure is endorsed by the NQF

⁵ The definitions of “clean surgery patient” and “surgical infection” used in this measure are the same as the [CDC’s National Healthcare Safety Network \(NHSN\) Surgical Site Infection Event definitions](#), which can be found here.