



Surgical Complication Prevention Guide

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Introduction

Surgical complications take an immeasurable toll on our patients and their families. Some studies have found 3 percent to 27 percent of surgical patients suffer from a surgical adverse event. Often, we hear that these complications are inevitable—our patients are old, our patients are sick. Yet a substantial proportion (e.g., more than half in one study) are preventable.¹⁻³

Between 2009 and 2012, more than 1,000 hospitals joined a national program funded by AHRQ to eliminate central line-associated blood stream infections—a hospital-associated infection once perceived as inevitable. Their great success shows that engaged teams can transform care when they own a problem, apply proven improvement strategies, and learn from each other.⁴⁻⁷

Surgical teams at The Johns Hopkins Hospital applied these principles in their perioperative areas and reduced their surgical site infection (SSI) rates by 33 percent.⁸

The AHRQ Safety Program for Surgery incorporated these principles and was associated with a substantial reduction in surgical site infections among the approximately 200 hospitals that participated (see Final Report).

What's in This Guide?

There are two aspects to the AHRQ Safety Program for Surgery: an adaptive component and a technical component. You and your health care organization can redesign your care system through technical and adaptive work to improve patient safety and eliminate preventable harm. Technical work changes procedural aspects of care that can be explicitly defined, such as surgical skin preparation procedures. Adaptive work changes the attitudes, values, beliefs, and behaviors of the people who deliver care. This guide addresses the technical component. Please refer to the AHRQ Safety Program for Surgery guide to Applying the Comprehensive Unit-based Safety Program (CUSP) To Promote Safe Surgery for the adaptive component.

By using this guide and tools in your perioperative areas simultaneously with the guide to Applying the Comprehensive Unit-based Safety Program (CUSP) To Promote Safe Surgery, your team will become part of a national effort to reduce surgical complications. However, this guide is not a prescription for success. The authors of this guide do not work in your perioperative area. Only your team understands your specific obstacles and your opportunities for improvement. The materials presented here provide a structure for your efforts to implement evidence-based practices and protect your patients from surgical complications. Success requires creative energy, persistence, leadership, and teamwork.

Using the TRIP Model as a Framework

This guide's structure is based on the *TRAnslate evidence Into Practice* (TRIP) model, which is designed to close the gap between evidence-based guidelines and bedside practice.

Briefly, the model is composed of four phases, listed below:

- Develop an evidence-based intervention (or set of interventions).
 - Identify interventions associated with improved outcomes.
 - Wherever possible, select interventions with the largest benefit and lowest burden.
 - Operationalize your intervention bundle.
- Identify barriers to implementation and formulate plans to overcome these barriers.
- Measure baseline performance.
- Ensure all patients receive the intervention.⁹

The majority of examples in this guide address the prevention of SSI in colorectal patients as an illustrative case. This focus on colorectal SSI is used as a starting point given the relatively high rate of infections in colorectal patients and the associated increased morbidity, mortality, and costs of care.^{10,11} Your team can apply this model to other surgical complications and service lines.

Phase 1. Develop an Evidence-Based Intervention

A major success of the Surgical Care Improvement Project (SCIP), sponsored by the Centers for Medicare & Medicaid Services (CMS), was the development of process measures to improve surgical care and reduce SSI. However, some studies have found that adherence to these process measures has not resulted in reduced infection rates or improved surgical outcomes.^{12,13}

Below are a few reasons for the lack of expected improvement:

- In contrast to the mature evidence for preventing other health care-associated infections, such as central line-associated blood stream infections, evidence for SSI prevention cannot be boiled down into a simple behavioral checklist or “bundle.”
- SSIs are complex. Contributing factors in addition to SCIP processes—like appropriate antibiotic dosage by patient weight, appropriate antibiotic redosing dependent on antibiotic used, or the quality of skin preparation process—impact SSI rates.¹⁴
- For many clinicians, SCIP adherence is an exercise in documentation or “checking a box.” We must reengage clinicians with the intention of SCIP, which is to improve care for surgical patients.

Identify Interventions Associated With Improved Outcomes

Your team has likely already devoted significant energy and resources to reducing surgical complications. Don't reinvent the wheel. Build upon your work in three ways.

Start by Asking Your Frontline Staff How the Next Patient Will Be Harmed.

Frontline providers understand patient safety risks in their perioperative area. They develop tactics to safeguard their patients against them in their everyday work. We need to seek frontline providers' knowledge and use it to guide our safety improvement efforts. Many of your interventions will be derived from their wisdom. Your team can use the Perioperative Staff Safety Assessment (PSSA) to gather their thoughts. The PSSA asks staff how their next patient will be harmed, how their next patient will develop an SSI, and how these complications can be prevented. For more information about the PSSA, please see the guide to Applying the Comprehensive Unit-based Safety Program (CUSP) To Promote Safe Surgery on the Web site of the Toolkit To Promote Safe Surgery.

Dig Deeper Into SCIP Processes To Identify Opportunities for Improvement.

Many organizations have achieved near perfect compliance with the SCIP process measures, yet additional opportunities to improve exist. For example, the majority of patients may receive the right antibiotic at the right time, but may not receive the right dose of antibiotic or the right frequency of antibiotic redosing. Other problems, or defects, may exist, such as maintaining normothermia or consistent skin preparation practices. These defects lead to SSIs. Your safety team can better understand these defects by auditing your clinical practice. Facilitate these audits with the audit tools contained in [Appendix A](#).

Consider Emerging Evidence for SSI Reduction.

In 2013, several leading professional societies jointly released SSI prevention guidelines: the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Society for Healthcare Epidemiology of America, and the Surgical Infection Society.¹⁵ These guidelines include recommendations on antibiotic dosing, redosing, weight-based dosing, and the use of mechanical bowel preparation with oral antibiotics for colon surgery. The Centers for Disease Control and Prevention published guidelines for the prevention of surgical site infection in 2017.¹⁶ Evaluate whether your surgical practice is aligned with current evidence-based recommendations.

Select Interventions With the Largest Benefit and Lowest Burden

After your team identifies defects that may contribute to SSIs, select the interventions to address these defects. Then, prioritize the interventions for implementation. While there is no formula for where to start, your team will want to consider a few factors:

- How much effort is required to build buy-in for your intervention?
- How many resources are required to change local practice?
- How strong is the evidence supporting the intervention?

Consider opportunities for fast and visible “early wins” to build momentum before focusing on more challenging interventions.



Surgical Safety Work in Practice

When we started to address defects in our practice, we started simple by looking at the right antibiotic at the right time. We got some pushback at first. Some clinicians felt that they had “already done SCIP.” But our antibiotic audit data clearly showed that a fair amount of our penicillin-allergic patients weren’t receiving appropriate antibiotic prophylaxis. In the end, it was a good place to start. No one could deny the evidence that patients should receive appropriate antibiotics for SSI prophylaxis, so everyone was motivated to improve once they realized we had a problem.

—Safety Team Surgeon Champion

Operationalize Your Intervention

Evidence-based guidelines can be complex. Whenever possible, simplify guidelines into specific behaviors. Develop protocols that clarify inevitable questions about who does what, where, when, and how. While there is no single checklist for SSI prevention, your team will need to make your interventions actionable, so that clinicians understand how to change their practice.



Surgical Safety Work in Practice

Our infection control group recommends dosing clindamycin with gentamicin 5 mg/kg for colorectal surgery patients who are penicillin-allergic. This is nearly double the usual dose of gentamicin used on the wards. Clinicians were concerned that this high dose of gentamicin might be harmful, so frequently they either gave a lower dose or just clindamycin. We decided to operationalize our intervention by focusing on appropriate gentamicin dosing for penicillin-allergic patients.

—Certified Registered Nurse Anesthetist, Safety Team Member

Phase 2. Identify Barriers to Implementation


Clinicians want to achieve the best possible outcomes for their patients. If patients are not receiving the evidence-based interventions, identify the barriers to compliance and the underlying reasons for processes that work around the barriers.¹⁷

Common barriers to reliable use of evidence-based interventions include—

- Clinicians aren't aware of the evidence-based intervention.
- Clinicians don't agree with the intervention.
- Clinicians don't have convenient access to equipment or supplies needed to implement the intervention.

Barrier Identification and Mitigation Tool

Your team can use the Barrier Identification and Mitigation (BIM) tool to identify and address the barriers identified in this phase [Appendix B](#).¹⁷ The tool includes a brief user's guide to orient you to its five-step process:

 STEPS	APPROACH
Assemble a subset of the safety team to form the BIM Team	Compose an interdisciplinary team to examine an intervention compliance problem.
Identify the barriers	BIM team members work independently to identify compliance barriers in three ways: <ul style="list-style-type: none">• Observe the process—passively observe clinicians providing care.• Discuss the process—ask clinicians about the intervention.• Walk the process—using either simulation or under real circumstances, try to implement the intervention.
Compile and summarize the barrier data	Organize all the information you got in the previous step.
Review and prioritize the barriers	Systematically prioritize barriers to determine which one should be tackled first.
Develop an action plan for each targeted barrier	Once the team identifies the barriers to target, take action to eliminate them.



Surgical Safety Work in Practice

Before rolling out our intervention, we used the BIM tool to uncover barriers that might undermine our work. When we “walked the process,” we found that there was not enough gentamicin in the operating room to routinely administer 5 mg/kg for an average 70 kg patient. How can we expect our clinicians to give a medication that is not available in adequate quantities? We took this information to our pharmacy, and they increased the number of gentamicin vials in our operating room stock.

—Safety Team Surgery Nursing Champion

Phase 3. Measure Baseline Performance

Your team needs to collect baseline process and outcome data to assess current performance and progress towards improving patient care.

Process Measures

Your team will select its own process measures depending on the intervention being developed. For example, if your team focuses on appropriate antibiotic prophylaxis in penicillin-allergic patients, your numerator may be the number of penicillin-allergic patients receiving 5 mg/kg of gentamicin, and your denominator may be the number of penicillin-allergic patients.

It may be helpful to use auditing tools to periodically evaluate performance. You may find this method simpler than developing a formal data collection strategy that often requires modifications to existing information technology infrastructure.

Outcome Measures

At the start of your intervention, collect SSI data as your outcome measure. As you become more comfortable with these improvement methods, you can spread your technical work to address other surgical complications such as deep vein thromboembolism or postoperative pneumonia.

Since January 2012, CMS has required hospitals that perform colon surgery and abdominal hysterectomies to report related SSI rates to the National Healthcare Safety Network. Additionally, your hospital may elect to submit SSI data to the American College of Surgeons National Surgical Quality Improvement Project.

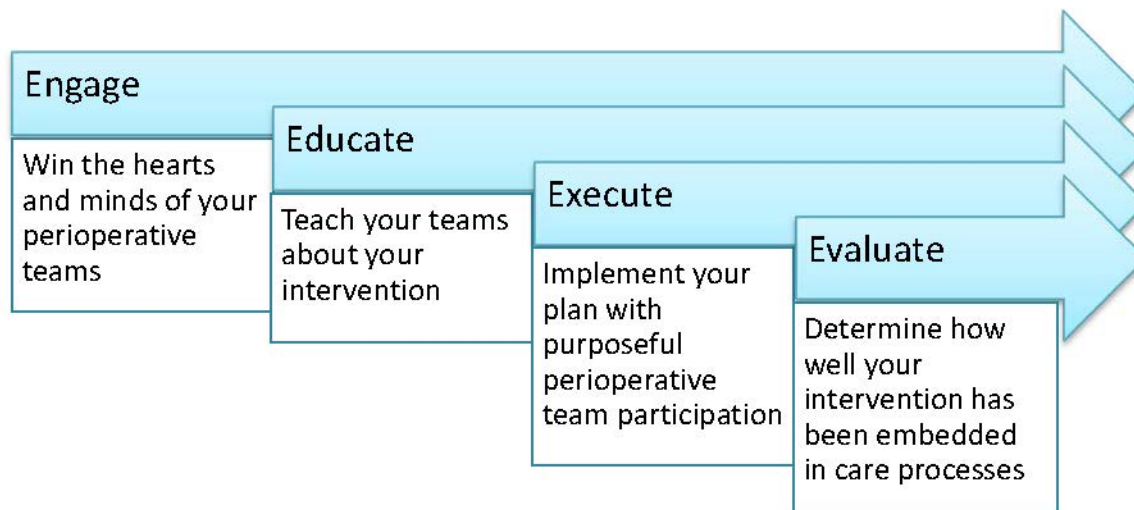
Phase 4. Ensure All Patients Receive the Intervention

Finally, reliably deliver evidence-based care to 100 percent of your patients. Ensure that your evidence-based intervention becomes “the way things are done around here.” This phase poses the biggest challenge. So far, your safety team has been implementing phases 1 through 3. Phase 4 will require buy-in and involvement from the entire perioperative team and stakeholders implementing your intervention. Successful interventions must be tailored to address each perioperative team’s current system, culture, resources, and commitment.¹⁸

The Four Es

Drawing from evidence and experience, clinicians at The Johns Hopkins Hospital developed a “Four Es” model to ensure that patients receive the targeted interventions.¹⁸ The model prompts your team to consider staff engagement, local culture, and contextual factors in a phased plan to embed your intervention in existing care processes.

The Four Es represent the four phases of this model:



Put The Four Es to Work

Safety efforts succeed through the investment of key stakeholders, including senior leaders, project team leaders, and frontline staff. Though stakeholders have different perspectives, hopes, and concerns, they often have the same questions about their involvement in the quality improvement process.

Put the Four Es model to work by explicitly addressing the questions that your key stakeholders are sure to have:

1. **Engage:** How will SSI reduction make the world a better place?
2. **Educate:** What do we need to do to reduce SSI?
3. **Execute:** How will we reduce SSI in our hospital given local culture and resources?
4. **Evaluate:** How will we know we made a difference?

Engage: How Will SSI Reduction Make the World a Better Place?

Your staff may be overwhelmed by the amount of quality improvement initiatives going on in your hospital. You will need to convince them that this work is not just a “flavor of the month,” but a national fight against surgical complications.

Share Real Patient Stories

Sharing real stories of patient tragedies and triumphs can unify your organization around efforts to improve patient care. With the exception of the surgeon, surgical staff rarely has the opportunity to interact with patients outside of the operating room. They may feel detached from their patients’ outcomes. Patient stories provide a powerfully effective way to connect staff with their patients and the impact of the care they provide. Your team must consider privacy and other restrictions when sharing patient stories. Contact your privacy officer, legal department, or risk management group to align efforts.

Make Performance More Meaningful

Typically, improvement teams report performance data as “percent compliance,” and report complication data as a “rate per 100 cases.” However, converting traditional data into estimates of preventable deaths, excess costs, and excess hospital days makes the impact of performance more meaningful to stakeholders. The [opportunity estimator](#) used in a previous AHRQ project is an example of this type of data conversion and feedback.

Make Performance More Visible

Often, safety teams share process and outcome measures with select individuals or improvement groups. Key stakeholders, including frontline staff and senior leadership, are often unaware of local performance. If you were to ask frontline staff and senior leadership what your SSI rate is, would they know the answer? In most cases, they would not.

Give your invested stakeholders feedback by sharing performance on process measures and SSI rates in the following ways:

- Post a graph of your SSI rates in your perioperative, intensive care, and inpatient units so that all providers can see how SSI rates are changing over time.
- Post the number of days (weeks or months) since your last SSI. Be sure to update it regularly.
- Review data at key meetings or morning reports.

Feedback will only be meaningful if your clinicians believe in the validity of the measures. Be transparent about your data collection methods and any efforts your team has made to address possible biases.

Recognize Staff Efforts

Financial incentives to engage staff and leaders, while attractive, are often not feasible or sustainable. Staff recognition including nonfinancial strategies can engage your colleagues.

Some examples include the following:

- Assign a title for key participants, such as the physician or nurse project leader. A good title confers empowerment and acknowledges effort.
- Encourage team members to present their efforts at committee or board meetings within your organization. Regional and national surgical conferences also provide an opportunity to share your quality improvement initiatives.
- Highlight staff efforts in local newsletters, bulletins, or publications.



Surgical Safety Work in Practice

We went to our inpatient surgery floor and asked the nurse manager if she knew of any patients who had suffered a difficult hospital course due to SSI. She remembered a colorectal surgery patient who had colon cancer. The patient could not resume chemotherapy for months until his infected abdominal wound healed sufficiently. The delay was extremely hard on both him and his family. When we took this patient's story back to our perioperative staff, they were moved. We reinforced that his outcome was the result of system-level problems that could be fixed with their help. People got on board.

–Surgical Technician, Safety Team Member

Educate: What Is the Evidence for SSI Reduction?

Your team will need to educate your frontline staff about the evidence behind your intervention. Conduct staff inservices to introduce the intervention and answer any questions. Continue to provide education until the staff is comfortable with the new information. Your team can use factsheets such as the example in [Appendix C](#) and slide sets posted to the Web site of the [Toolkit To Promote Safe Surgery](#) as educational aids.

Education sessions should be interdisciplinary, allowing each discipline to discuss local practices, barriers, and plans. However, surgeons may be most receptive to other surgeons. The surgeon champion on your safety program team should lead, model, and reinforce surgeon education efforts.

Several education strategies described in the literature focus on changing physician behavior:

- Provide surgeons with educational information packets consisting of research literature, evidence-based reviews, hospital-specific data, and national guidelines.
- Introduce educational information at surgical staff meetings or grand rounds.
- Utilize informal educational meetings and networks to disseminate information.
- Conduct educational outreach visits involving content experts, such as pharmacists, or infection preventionists. Consider engaging a respected surgeon leader at your hospital to help champion the effort even if he or she works in a different service line.



Surgical Safety Work in Practice

When we informed our clinical staff that we were focusing on antibiotic prophylaxis, starting with appropriate gentamicin dosing for penicillin-allergic patients, many of our providers raised the concern again that the dose was too high. They thought the correct gentamicin dose would be nephrotoxic. I led inservices, organized by the safety program team, and showed our surgeons, nurses, and anesthesiologists the evidence. Eventually, this education resolved their concerns.

—Hospital Infection Preventionist, Safety Team Member

Execute: What Do I Need To Do?

Frame Your Intervention in the Science of Safety

Without a doubt, clinicians care deeply about their patients. Yet, we are all fallible. No matter how hard we try, we will forget to order an important medication, or we will make other mistakes. Patient safety research has demonstrated that blaming individual doctors or nurses does not prevent patient harm. Organizational-level factors, functional work area-related factors, team-related factors, task-related factors, and patient-related factors all have a role in patient outcomes.

Apply Principles of Safe System Design

Every system is perfectly designed to produce the results it delivers. If we want to achieve substantive and sustainable improvements in patient outcomes, we have to change the systems in which clinicians work. We must redesign systems to produce wellness instead of harm.

Other industries teach us that there are clear principles of safe system design, including the following:

- Standardize care and reduce complexity.
- Create independent checks along the continuum of care.
- Learn from mistakes when they happen.

Consider using briefings and debriefings to incorporate principles of safe design into your intervention. Briefings and debriefings have been associated with reductions in operating delays, procedure and miscommunication-related disruptions, and nursing time spent away from the patient bedside in order to get equipment and supplies. For more information about briefings and debriefings, please refer to the guide to Applying the Comprehensive Unit-based Safety Program (CUSP) To Promote Safe Surgery and related tools.



Surgical Safety Work in Practice

Our anesthesia providers are in charge of administering the right gentamicin dose. To reduce complexity around gentamicin dosing, we installed a weight-based dosing calculator in their electronic ordering system. To create redundancy, our nurses double-check, review and document the dosage as part of the operating room briefing.

—AHRQ Safety Program for Surgery Anesthesia Champion

Account for Local Culture and Resources

Adapt your intervention to the local cultural context. An intervention's success is dependent on the local organizational culture. Unfortunately, your intervention will fail if staff do not trust one another and cannot work together. Refer to the guide to Applying the Comprehensive Unit-based Safety Program (CUSP) To Promote Safe Surgery for materials to help your team improve safety culture.



Surgical Safety Work in Practice

We were very careful and methodical in designing our gentamicin intervention. We got input from our frontline and buy-in from the right people. Even after all of this preparation and hard work, there were some clinicians who refused to give the right gentamicin dose to patients. We expected pushback, but had to get creative with our resources to make sure the intervention succeeded within our perioperative culture. A surgeon that everyone liked and respected helped—she offered to personally call and speak with providers anytime they interfered with appropriate prophylaxis. Funny thing, after everyone found out about her offer, no one refused the appropriate dose of gentamicin again.

—Safety Team Surgeon Champion

Evaluate: How Will We Know That We Added Value?

The final step in the Four Es model is to evaluate the impact of your interventions. You need to assess whether additional effort and resources are adding value for your staff, your patients, and their families.

Evaluation methods can be formal or informal. As a formal evaluation, recollect process and outcome measures. Then compare your findings with baseline performance. First, ask staff members informally what they think about the new intervention and if it works. Ask them to identify additional improvement opportunities. Once the intervention is in place, conduct a formal evaluation. Informal evaluations cannot replace formal evaluations.

Quality improvement work is difficult and never ending. Celebrate your successes. Your team has not failed if your evaluation does not demonstrate improvement, but you may need to consider a new strategy or intervention. Through innovation and dedication, you can protect your patients from surgical complications.

For More Information

There are two aspects to this intervention program: an adaptive component (pertaining to safety culture, teamwork, and communication) and a technical component. This guide addresses the technical component. Please refer to the [guide to Applying the Comprehensive Unit-based Safety Program \(CUSP\) To Promote Safe Surgery](#) for the adaptive component.

You can access more learning materials on the Web site of the [Toolkit To Promote Safe Surgery](#).

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Appendixes

[Appendix A](#)

Critically assess your perioperative processes. Select the link for a collection of audit tools.

[Appendix B](#)

Barrier Identification and Mitigation tool.
Know where the hurdles are *before* you start the race.

[Appendix C](#)

Get the word out. Select the link for an example of factsheets you can use to educate stakeholders about your new intervention.

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