

Actionable Patient Safety Solutions (APSS) #2C: **Surgical site infections (SSI)**

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for SSI. In it, you'll find:

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APSS #2C: Surgical site infections (SSI)

Executive summary checklist

A surgical site infection—or SSI, for short—is an infection that happens after surgery in the part of the body where the surgery took place. Creating evidence-based protocols and engaging staff responsible for preventing and reducing the occurrence of SSIs can greatly impact the frequency of SSIs in your organization.

Post-operative infections at the site of surgery remain a major source of perioperative morbidity and mortality. The perioperative period is the time period of a patient’s surgical procedure.

Use this checklist to help you prioritize your actions and measure your organization’s progress in each area.

Create an action plan to engage staff and use data to find areas for improvement

- Implement evaluation practices and metrics to measure patient outcomes
- Review results of all evaluation activities frequently, including at caregiver education sessions, such as at “grand rounds”
- Educate patients and families on SSI prevention
- Use patient stories - written & in video - to help teach and inspire change in your staff

Implement pre-operative measures

- Administer antimicrobial antibiotic prophylaxis in accordance with evidence-based standards and guidelines (Bratzler et al., 2013)
 - Administer within 1 hour prior to incision (2 hours for vancomycin and fluoroquinolones)
- Administer the appropriate parenteral prophylactic antimicrobial agents before skin incision in all cesarean section procedures (Berríos-Torres et al., 2017)
- Choose the appropriate agents on basis of:
 - Surgical Procedure
 - Most common SSI pathogens for the planned procedure
 - Known allergies or drug reactions of each specific patient
 - Published recommendations
- Don’t remove hair at the operative site unless it will interfere with the surgical procedure
- Use appropriate antiseptic agent and technique for skin preparation, preferably an alcohol containing preparation (Berríos-Torres et al., 2017)
- If appropriate, mechanically prepare patients for colorectal surgery by enema or cathartic agents (Ban et al., 2017)
- Tell patients to stop smoking 4 to 6 weeks before surgery (Ban et al., 2017)
- Implement perioperative glycemic control and use of blood glucose targets levels less than 200 mg/dL in patients with and without diabetes (Berríos-Torres et al., 2017)
- Tell patients to shower or bathe (full body) with soap (antimicrobial or nonantimicrobial) or an antiseptic agent on at least the night before their procedure (Berríos-Torres et al., 2017)

Implement intra-operative measures

- Maintain intra-operative and post-operative normothermia (Ban et al., 2017)
- Re-dose prophylactic antibiotics based on agent half-life or for every 1,500 mL of blood loss (Ban et al., 2017)
- Keep operating room doors closed during surgery, except as needed for passage of equipment, staff, and the patient
- Keep the interior of the operating room at “positive pressure”
- Use an impermeable plastic wound protector after open abdominal surgery, especially colorectal and biliary procedures (Ban et al., 2017)
- Ask staff to change their gloves before closure in colorectal cases (Ban et al., 2017)
- Perform topical irrigation of the incision site, especially in colorectal surgery (Mueller et al., 2015)
- In clean and clean-contaminated procedures, don't administer additional prophylactic antimicrobial agent doses after the surgical incision is closed in the operating room, even in the presence of a drain (Berríos-Torres et al., 2017)
- For patients with normal pulmonary function undergoing general anesthesia with endotracheal intubation, administer increased FIO₂ during surgery (Berríos-Torres et al., 2017)
- Perform intra-operative skin preparation with an alcohol-based antiseptic agent unless contraindicated (Berríos-Torres et al., 2017)
- Do not withhold transfusion of necessary blood products from surgical patients as a means to prevent SSI (Berríos-Torres et al., 2017)
- For prosthetic joint arthroplasty patients in clean and clean-contaminated procedures, do not administer additional antimicrobial prophylaxis doses after the surgical incision is closed in the operating room, even in the presence of a drain (Berríos-Torres et al., 2017)

Implement post-operative measures:

- Protect primary closure incisions with sterile dressing for 24-48 hours post-op
- Stop using antibiotics within 24 hours after the surgery end time–48 hours for cardiac patients–unless signs of infection are present
- Do not apply antimicrobial agents (i.e., ointments, solutions, or powders) to the surgical incision to prevent an SSI (Berríos-Torres et al., 2017)
- For patients with normal pulmonary function undergoing general anesthesia with endotracheal intubation, administer increased FIO₂ after extubating in the immediate post-operative period (Berríos-Torres et al., 2017)

What we know about SSIs

An SSI is an infection that happens after surgery in the part of the body where the surgery took place. Most patients who have surgery don't develop an infection.

Symptoms of an SSI include:

- Redness and pain around the surgical site area
- Drainage of cloudy fluid from the surgical wound
- Fever

Causes of SSIs are sometimes caused by either:

- **Endogenous factors**, such as from the patient's flora or seeding from a distant site of infection, or,
- **Exogenous factors**, such as from surgical staff, physical environment and ventilation, tools, equipment, and materials in the operating room

The problems with surgical site infections (SSIs)

There are about 300,000 SSIs each year—17% of all Healthcare Associated Infections (HAIs), just second to Urinary Tract Infections (UTI).

- SSIs happen in 2%-5% of patients getting inpatient surgery (CDC, 2010)
- The SSI mortality rate is 3 %, with a 2-11 times higher chance of death when compared to other types of infections
- Seventy-five percent of deaths among patients with SSI are directly attributable to the SSI
- SSI can cause long-lasting disabilities

SSIs can sometimes result in patients spending an additional 7-10 days in the hospital.

Healthcare costs can rise up to \$3,000-\$29,000 for each SSI, depending upon the procedure and pathogen. On a national level, direct and indirect healthcare costs combined can reach up to \$10 billion annually (Quicho, 2016). These estimated costs don't account for the additional costs of:

- Rehospitalization
- Post-discharge outpatient expenses
- The costs of care for long-lasting disabilities

Detecting SSIs is also becoming increasingly challenging due to the lack of standardized methods for post-discharge and outpatient surveillance. This is in part due to an increased number of outpatient surgeries and shorter postoperative inpatient stays. The increasing trend of resistant organisms is presenting another challenge which may threaten the effectiveness of existing recommendations for antimicrobial prophylaxis.

Preventing surgical site infections

Education and awareness of risk factors among healthcare workers, physicians, and nurses followed by the implementation of standardized guidelines can minimize the occurrence of SSIs in hospitals.

Institutions can implement preventive practices, such as:

- Antimicrobial prophylaxis
- Preoperative identification and treatment of existing infections

- Proper site preparation methods
- Maintenance of normothermia in the postoperative period
- Keeping operating room doors closed during surgical procedures

Leadership plan

To improve patient health outcomes and prevent SSIs in hospitals, leaders in your organization must take these key actions:

Show leadership's commitment to preventing and reducing SSIs

- Hospital governance and senior administrative leadership must champion efforts in raising awareness around:
 - The high incidence of SSIs
 - The importance of prevention measures

Create the infrastructure needed to make changes

- Support the implementation of standards on pre-, intra- and post-operative guidelines
- Address barriers
- Provide resources
- Keep accountability throughout the organization
- Implement evaluation practices to measure outcomes
- Use patient stories—in written and video form—to identify gaps and inspire change in your staff, such as:
 - Alicia Cole video—Patient Safety Movement Foundation youtu.be/TVtTEerE0vo

Action plan

Create protocols and ensure accountability in the following areas:

- Pre-operative skin cleansing
- Pre-operative screening for patients with a higher chance of developing an SSI
- SSI prevention education for patients and their families
- Pre-operative skin antisepsis
- Proper hair removal
- The use of prophylactic antibiotics
- Maintenance of normothermia

Pre-operative skin cleansing

- Develop a standardized process for pre-operative skin cleansing. Use the information in Appendix A to verify that the ingredients used are appropriate.
- Educate patients on how to:
 - Apply the CHG before surgery
 - Avoid lotions or deodorants after cleansing

Pre-operative screening for patients at risk for SSI

- Create a protocol to conduct nasal *Staphylococcus aureus* (SA) screening in patients

who will have cardiac and elective orthopedic surgery

- Create a protocol to decolonize SA carriers that includes intranasal Mupirocin

Educate patients and families on SSI prevention

Talk to your patients and their families about:

- The negative effects of tobacco use
 - Tell them to stop using tobacco 1 month before and after surgery
- The importance of eating healthy before and after surgery
- In patients with diabetes, the importance of making sure their blood sugar levels are well controlled
- Pre-operative bathing and skin cleansing
- How to identify skin irritation, hypersensitivity, or any skin condition before surgery
- Post-operative wound handling techniques
- Hand hygiene
- The early warning signs of sepsis

Peri-operative skin antisepsis

- Use pre-operative skin antiseptic agents—FDA approved or cleared—and approved by your organization’s infection control staff:
 - The purpose of skin antiseptic agents is to significantly lower microorganisms on intact skin
 - Skin antiseptic agents should be used for all pre-operative skin preparation
 - Skin antiseptic agents must contain a non-irritating antimicrobial preparation, be broad spectrum, fast acting, and have a long-lasting effect
- Develop standardized practices—guided by the product insert—for the peri-operative application of skin antiseptic agents
 - These practices ensure that an appropriate therapeutic dose covers and is maintained across the entirety of the skin surface
- Educate peri-operative staff on:
 - The safe application and use of skin antiseptic agents
 - The benefits of skin antiseptics—to reduce the microbial burden on the skin before surgery

Proper hair removal

- Remove only hair that interferes with the surgical procedure
- Clip hair at the surgical site using:
 - A single-use hair clipper
 - A clipper with removable head that can be disinfected between patients
- Don’t use razors

Appropriate timing, selection, and duration of prophylactic antibiotics

- Create protocols about the appropriate use of prophylactic antibiotics to prevent and reduce infection complications

Maintenance of normothermia

- Use warmed forced-air blankets:

1. Preoperatively
 2. During surgery
 3. In PACU
- Use warmed fluids for IVs and flushes in surgical sites and openings

Technology plan

Technology can help you successfully implement your plan and track outcomes. This section lists technologies that have evidence-based safety benefits. In some cases, it lists the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider:

patientsafetymovement.org/actionable-solutions/apss-workgroups/technology-vetting/

System or Practice	
<p>The Office of the National Coordinator for Health Information Technology (ONC) Meaningful Use Certified EHR system</p> <p>Electronic Health Record (EHR) System with the following capabilities:</p> <ul style="list-style-type: none"> • Computerized Provider Order Entry (CPOE) • Drug-drug interaction check • Drug-allergy interaction check • Clinical Decision Support tools (CDS) 	
Skin antiseptic activity	
Supportive intra-operative wound protection	
Actively clean and remove infectious contamination from the surgical incision	

Measuring outcomes

Topic 1

Colon Surgical Site Infection Rate (Colo SSI):

Rate of patients with a Colon Surgical Site Infection per 100 NHSN colon operative procedures

Outcome Measure Formula:

Numerator: Colon surgical site infections based on CDC NHSN definitions (CDC, 2019)

Denominator: Total number of colon operative procedures based on CDC NHSN definitions

** Rate is typically displayed as SSI/100 Operative Procedures*

Metric recommendations

Indirect Impact:

All patients requiring a colon operative procedure

Direct Impact:

All patients requiring a National Healthcare Safety Network (NHSN) colon operative procedure

Lives Spared Harm:

Lives Spared Harm = (SSI Rate_{baseline} - SSI Rate_{measurement}) X Operative Procedures_{baseline}

Lives Saved:

Lives Saved = Spared Harm X Mortality Rate

Notes:

To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards.

Data Collection

All NHSN colon operative procedures require infection surveillance for 30 days following the procedure date. Operative procedures are defined by ICD and CPT codes.

Colon SSIs can be displayed as a Standardized Infection Ratios (SIR) using the following formula:

SIR = Observed SSI / Expected SSI

Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):

The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient's grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. "At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP. In conjunction with CMS's overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national

measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2015). *Based on these data, the estimated additional inpatient mortality for Colo SSI is 0.026 (26 per 1000 events).*

Topic 2

Abdominal Hysterectomy Surgical Site Infection Rate (Hyst SSI)

Rate of patients with an abdominal hysterectomy surgical site infection per 100 NHSN abdominal hysterectomy operative procedures.

Outcome Measure Formula:

Numerator: Abdominal hysterectomy surgical site infections based on CDC NHSN definitions

Denominator: Total number of abdominal hysterectomy operative procedures based on CDC NHSN definitions

** Rate is typically displayed as SSI/100 Operative Procedures*

Metric recommendations

Direct Impact:

All patients requiring a NHSN abdominal hysterectomy operative procedure

Lives Spared Harm:

$Lives = (SSI\ Rate_{baseline} - SSI\ Rate_{measurement}) \times Operative\ Procedures_{baseline}$

Lives Saved:

$Lives\ Saved = Spared\ Harm \times Mortality\ Rate$

Notes:

To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2017).

Data Collection

All NHSN abdominal hysterectomy operative procedures require infection surveillance for 30 days following the procedure date. Operative procedures are defined by ICD and CPT codes.

Colon SSIs can be displayed as a Standardized Infection Ratios (SIR) using the following formula:

$SIR = Observed\ SSI / Expected\ SSI$

Expected infections are calculated by NHSN and available by location (unit type) from the baseline period.

Mortality (will be calculated by the Patient Safety Movement Foundation):

The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP. In conjunction with CMS’s overall leadership of the PfP, AHRQ has helped coordinate

development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the "AHRQ National Scorecard," which provides summary data on the national HAC rate (AHRQ, 2015).

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSSs recommend technologies that are offered by companies involved in the Patient Safety Movement Foundation. The workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

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Appendix A: Active Ingredients in Antiseptic Skin Preparations

In Table 3 below the antiseptic ingredients that are recommended by the Department of Health and Human Services (HHS) and Food and Drug Administration (FDA) are described (Jackson, 2018).

Table 3 lists the health care antiseptic active ingredients that have been considered under this rulemaking and shows whether each ingredient is eligible or ineligible for evaluation under the OTC Drug Review for use in health care antiseptics for each of the five specified uses: Patient antiseptic skin preparation, health care personnel hand wash, health care personnel hand rub, surgical hand scrub, and surgical hand rub.

Table 3.--Eligibility of Antiseptic Active Ingredients for Health Care Antiseptic Uses¹

Active Ingredient	Patient Antiseptic Skin Preparation	Health Care Personnel Hand Wash	Health Care Personnel Hand Rub	Surgical Hand Scrub	Surgical Hand Rub
Alcohol 60 to 95 percent	Y ²	N ³	Y	N	Y
Benzalkonium chloride	Y	Y	Y	Y	N
Benzethonium chloride	Y	Y	N	Y	N
Chlorhexidine gluconate	N	N	N	N	N
Chloroxylenol	Y	Y	N	Y	N
Cloflucarban	Y	Y	N	Y	N
Fluorosalan	Y	Y	N	Y	N
Hexylresorcinol	Y	Y	N	Y	N
Iodine complex (ammonium ether sulfate and polyoxyethylene sorbitan monolaurate)	N	Y	N	Y	N
Iodine complex (phosphate ester of alkylaryloxy polyethylene glycol)	Y	Y	N	Y	N
Iodine tincture United States Pharmacopeia (USP)	Y	N	N	N	N
Iodine topical solution USP	Y	N	N	N	N
Nonylphenoxypoly (ethyleneoxy) ethanoliiodine	Y	Y	N	Y	N
Poloxamer-iodine complex	Y	Y	N	Y	N
Povidone-iodine 5 to 10 percent	Y	Y	N	Y	N
Undecoylium chloride iodine complex	Y	Y	N	Y	N
Isopropyl alcohol 70-91.3 percent	Y	N	Y	N	Y
Mercufenol chloride	Y	N	N	N	N