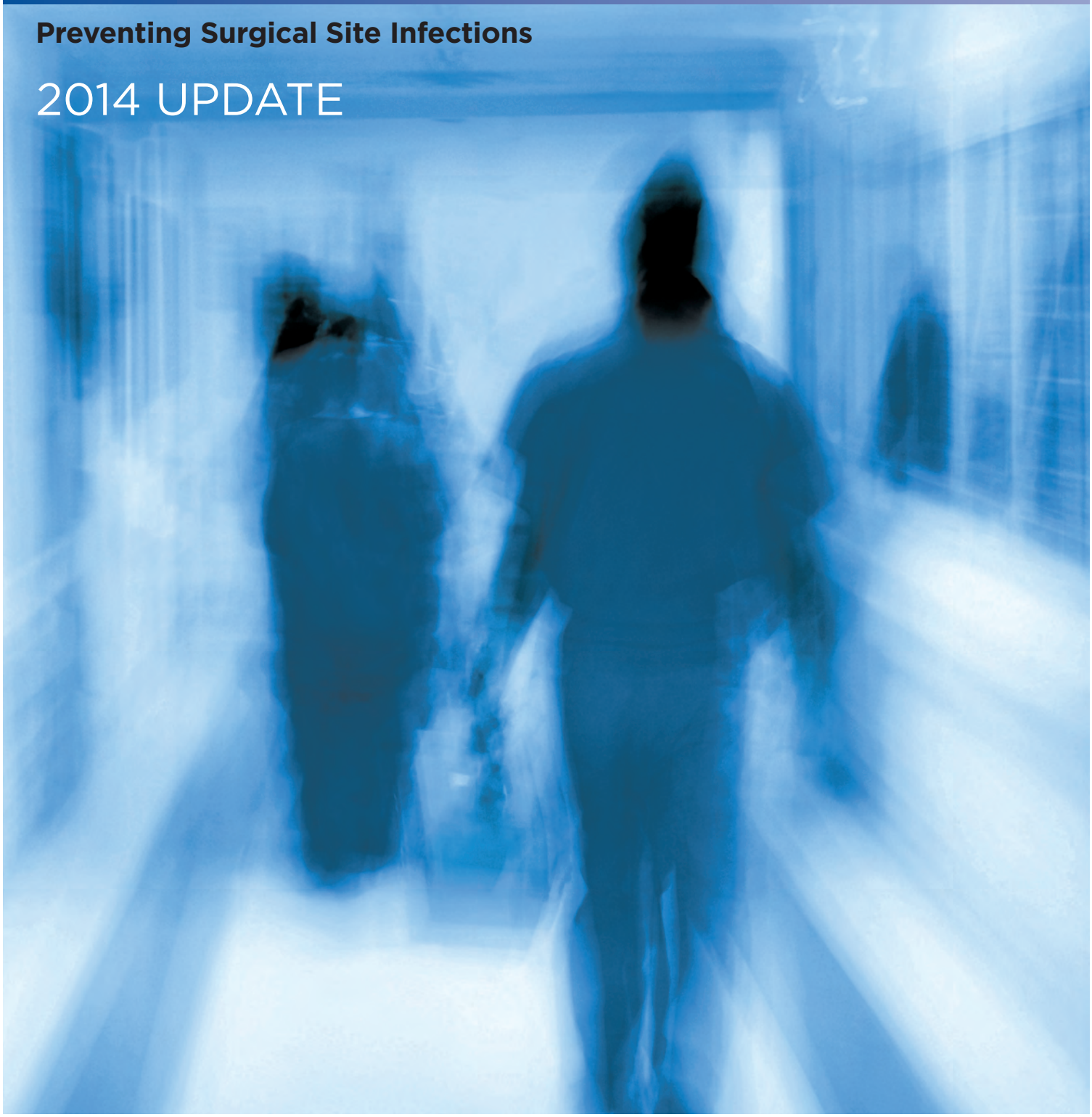
SURGICAL SITE INFECTION (SSI) CHANGE PACKAGE

Preventing Surgical Site Infections

2014 UPDATE



American Hospital Association

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
PARTNERSHIP FOR PATIENTS
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Introduction
This Guide to Surgical Site Infection and Safe Surgery is divided into two sections.

Section One: Surgical Site Infection
This section demonstrates how to implement the 'basics' and 'beyond' in efforts to reduce surgical site infection, including how to conduct a GAP analysis and how to assess the potential effectiveness of 'change ideas' being considered.

Section Two: Safe Surgery
This section provides guidelines for implementation of the WHO Surgical Safety Checklist to drive and promote a safe surgical culture.

The AHA/HRET HEN would like to acknowledge our partner, Cynosure Health, for their work in developing the Surgical Site Infection (SSI) Change Package.

Section One: Surgical Site Infection

WHAT'S NEW?

This newly revised SSI Change Package contains updated references and a focus on antimicrobial stewardship in surgical patients. Despite reports of high compliance with process improvement measures (e.g. hair removal practices, pre-operative skin antisepsis, timing of antibiotics), surgical site infections remain a significant problem. A report issued by the Centers for Disease Control (CDC) in March 2014 indicated that surgical site infections account for 22% of all healthcare associated infections.

A major enhancement of this resource is the section that outlines Antimicrobial Prophylaxis. It is estimated that 40-60 percent of SSIs may be preventable with the appropriate use of prophylactic antibiotics. We also know that in 25-50% of the time, prophylactic antibiotic use in surgical patients is not ideal.

The reference list has been extensively updated. In particular, recent papers that support the relationship of perioperative hyperglycemia for patients other than cardiac patients are worth noting. Healthy glucose levels should be a goal for all surgical patients, not just those known to be diabetic or those undergoing cardiac surgery.

SURGICAL SITE INFECTION AND SAFE SURGERY OVERVIEW

Background

- There are approximately 234 million surgeries worldwide annually, surpassing the number of births. From January 2009 through December 2010, Surgical Site Infections (SSIs) accounted for 23% of all healthcare associated infections reported to the Centers for Disease Control's National Healthcare Safety Network (NHSN) surveillance system by over 2,000 hospitals.
- In industrialized countries, 3 to 16 percent of patients undergoing surgery experience a major complication. The peri-operative inpatient surgery death rate is 0.4 to 0.8 percent.
- Nationally, the rate of surgical site infection averages between two to three percent for clean cases (Class I/Clean as defined by the CDC). An estimated 40 – 60 percent of these infections may be preventable. The number of SSIs is likely to be under-estimated since only half are likely identified after discharge.
- Actual attributable costs of SSIs are difficult to determine. Cost estimates are commonly restricted to facility charges and can vary greatly depending upon surgical procedure, severity of infection, type of facility, geographic location, study design, and study method. Estimated attributable costs of SSIs range from just over $10,000 to $25,000 per infection. Costs can exceed $90,000 when the SSI involves a prosthetic joint implant or an antimicrobial-resistant organism. Seventy-five percent of deaths among patients with surgical site infections are directly attributable to the SSIs.

Suggested AIM

- Reduce surgical site infections by 40 percent by December 8, 2014.

Potential Measures

Outcome: Surgical site infection rate (number of infections per 100 surgical procedures) will be reduced (by 40%). (EOM-SSI-88 or EOM-SSI-89)

Process: 100% of surgical patients will receive prophylactic antibiotics recommended for their specific surgery (EOM-SSI-84).

PRIMARY DRIVERS	IDEAS TO TEST
Adopt the Surgical Safety Checklist	• Conduct three pauses with the surgical team at critical points: — Before the induction of anesthesia. — Before the incision of the skin. — Before the patient leaves the operating room. • Verbally confirm all the items on the surgical checklist at each pause with the appropriate surgical team members. • Implement the use of a standard tool to check items in the surgical checklist so as not to rely on memory.
Antimicrobial Prophylaxis	• Develop standardized order sets for each procedure that include the appropriate antibiotic, the timing of administration, the appropriate dose, and the timing of discontinuation. • Develop pharmacist and nurse-driven protocols that ensure the correct antibiotic selection based on the type of surgery and the patient characteristics (age, weight, etc.). • Create a process to review all exceptions to protocols. • Ensure that antibiotics are re-dosed appropriately in surgeries longer than three hours.
Pre-operative Skin Cleansing	• Develop standardized order sets for pre-operative skin cleansing. • Develop a strategy for distribution of the skin antiseptic agent to the patients. • Educate patients on how to apply the skin antiseptic agent prior to the day of surgery.
Peri-operative Skin Antisepsis	• Develop standardized practices for application of dual-agent skin antiseptics. • Educate peri-operative personnel on the safe application of selective skin antiseptic agents.
Normothermia in the Operating Room	• Develop a standardized procedure for pre-warming for every surgical patient without a contraindication. • Develop a standardized procedure for active warming in the operating room that could include placing warming blankets under patients on the operating table. • Utilize 'low tech' warming system where warmed blanket is covered by a sheet.
Peri-operative Glucose Control	• Obtain glucometers for every anesthesia station. • Develop a peri-operative glycemic control team that includes surgeons, anesthesiologists, endocrinologists and nurses, and assign responsibility and accountability for blood glucose monitoring and control.

Key Resources

- www.safesurgery2015.org
- How-to Guide: *Prevent Surgical Site Infections.* Cambridge, MA: Institute for Healthcare Improvement; 2012: Retrieved at http://www.ihi.org/knowledge/Pages/Tools/HowtoGuidePreventSurgicalSiteInfection.aspx

SURGICAL SITE INFECTION DRIVER DIAGRAM

Suggested AIM: Reduce Surgical Site Infections by 40 percent by December 8, 2014.

PRIMARY DRIVERS	SECONDARY DRIVERS	CHANGE IDEAS
Antimicrobial Prophylaxis	• Use the appropriate prophylactic antibiotic for the surgical procedure as guided by national guidelines. • Ensure that proper antibiotic selection, timing, dosing, and duration are followed.	• Develop standardized order sets for each surgical procedure that include the antibiotic name, timing of administration, appropriate dose, and timing of discontinuation. • Educate surgeons regarding the appropriate antibiotics, the appropriate timing of administration, and the short duration (<24hr) of action of prophylactic agents. • Develop pharmacist- and nurse-driven protocols that ensure correct antibiotic selection based on the type of surgery and patient characteristics (age, weight, etc.). • Create a process to review all exceptions to protocols. • Ensure that antibiotics are re-dosed appropriately in surgeries lasting longer than 3 hours. • Establish a protocol wherein the anesthesiologist is prompted to re-dose the patient (e.g. via a timer or clock). • Report on the need for re-dosing in the 'hand-off'.
Pre-operative Skin/Oral Antisepsis	• Ensure that patients complete a regimen of pre-admission skin cleansing immediately prior to their operative procedure. • Establish and implement protocols to reduce post-operative pneumonia in patients who will receive general anesthesia.	• Develop standardized order sets for pre-operative skin cleansing. • Develop a strategy for low-cost distribution of skin antiseptic agent(s) to surgical patients prior to surgery to ensure availability and use. • Educate patients on how to appropriately apply the skin antiseptic agents prior to surgery. • Consider evidence that demonstrates that repeated use of chlorhexidine gluconate (CHG) soap for bathing or showering enhances the residual effects of CHG, resulting in progressive reductions in skin bacterial counts. • Consider evidence that demonstrates the positive impact of repeated use of CHG baths (e.g. during the 3 days prior to surgery rather than only the night before). • To confirm patients' use of pre-surgical skin cleansing prior to surgery, use a standard form for patients to fill out after they have performed skin cleansing that lists the dates and times of cleansing. Ask the patients to pull the antiseptic's sticker off and glue it on the form to demonstrate that the skin cleansing actually took place. • Educate patients about the risk of applying lotions/deodorants during the cleansing period as these agents will interfere with the benefits of the CHG protocol. • Consider a pre-operative CHG oral rinse the night before and the morning of surgery to reduce the risk of post-operative pneumonia for those who will be receiving general anesthesia.
Peri-operative Skin Antisepsis	• Select the most appropriate peri-operative skin antiseptic agent for the type of surgery being performed. • Ensure that each surgical patient receives both appropriate and correctly-administered skin antisepsis.	• Acknowledge differences in mechanisms of function between povidone iodine and chlorhexidine gluconate (CHG) as skin antiseptic agents. • Acknowledge the role that alcohol plays in creating a synergistic effect when combined with CHG or iodophor. • Acknowledge that the combination of a long-acting agent (either an iodophor or CHG) with povidone-iodine is more effective than povidone-iodine alone. • Develop standardized practices (as guided by the product inserts) for peri-operative application of skin antiseptic agents • Educate peri-operative personnel on the safe application and use of selective skin antiseptic agents. • Using an evidence-based review of the literature, educate all peri-operative personnel on the benefits of skin antisepsis to reduce the microbial burden on the skin prior to surgery. • Review the package instructions to determine the amount of skin each unit-dose container of skin antiseptic is able to cover with a therapeutic dosage.

PRIMARY DRIVERS	SECONDARY DRIVERS	CHANGE IDEAS
Normothermia in the Operating Room	• Prevent hypothermia during all phases of the surgical process: — Educate pre-operative area staff on importance of pre-warming the operating suite to prevent hypothermia during an operation. — Develop standardized procedures for active warming in the operating room.	• Develop a standardized procedure for active warming in the operating room that could include placing warming blankets under patients on the operating table. • Educate patients in the pre-operative period about the value of pre-warming and warming to improve healing and reduce infection risk. • Educate the surgical team that mild hypothermia (1-2° C) increases SSI rates. • Educate the surgical team that normothermia in the O.R. results in less blood loss, and that extra blood loss and/or transfusions increase SSI risk. • Utilize a 'low-tech' warming system wherein a warmed blanket is covered by a sheet.
Peri-operative Glucose Control	• Monitor all surgical patients for hyperglycemia both pre-operatively and post-operatively.	• Implement a glucose control protocol for surgical patients. • Obtain glucometers for every anesthesia station. • Develop a list of patients at risk for hyperglycemia in the peri-operative period. Not only diabetic patients are at risk. • Initiate a protocol for point-of-care glucose testing on every pre-surgical patient upon arrival for surgery at same time as BP, heart rate, temperature, and O2 saturation are being measured and recorded. • Develop a peri-operative glycemic control team that includes surgeons, anesthesiologists, endocrinologists, and nurses, and assign responsibility and accountability for blood glucose monitoring and control. • Obtain examples of (See Appendix II on page 40 for an example) or develop protocols and algorithms for the administration of intravenous insulin to patients with intra-operative and post-operative hyperglycemia.
***Staphylococcus aureus* (SA) Screening and Decolonization**	• Optimize the identification of patients who are colonized with SA and who could benefit from implementing a de-colonization protocol for at least the 3 days prior to surgery which includes intranasal mupirocin or povidone iodine nasal antiseptic and CHG bathing.	• Develop a protocol to conduct nasal *S.aureus* (SA) screening. • Develop a protocol to attempt to de-colonize SA carriers. • Educate surgical staff so that they are aware that patients who carry SA in their nares/skin are more likely to develop SA surgical site infections. • Recognize that decolonization efforts are not a 'cure' but only result in temporary elimination of SA from the nares and skin, the natural reservoirs where SA is most often carried. • Consider implementing a facility-wide pre-screening program to identify and de-colonize SA carriers prior to designated elective surgeries (e.g. orthopedic surgeries). • Establish clear guidelines for the screening, detection and reporting of SA (e.g. who performs the swab, who conducts the test, and to whom they report positive findings; as well as who becomes responsible for assuring that necessary treatment takes place).
Oxygen Supplementation	• Establish a protocol to guide the use of supplemental oxygen intra-operatively and immediately after surgery.	• Reinforce the fact that wound oxygen tension affects outcomes; higher oxygen levels = lower SSI risk. • Educate surgical staff that oxygenation is an extremely low-cost intervention that can improve outcomes.

SURGICAL SITE INFECTION DRIVER DIAGRAM (CONTINUED)

PRIMARY DRIVERS	SECONDARY DRIVERS	CHANGE IDEAS
Control Local Bleeding (to reduce blood loss and the need for blood transfusions)	• Develop a protocol to provide guidance on blood transfusion practices in surgical patients. • Analyze surgeon-specific packed red blood cell transfusion data and evaluate the quality of each surgeon's current practice.	• Educate surgical staff that transfusing even a single unit of packed red blood cells is a risk factor for SSI. • Reinforce the reality that blood is a costly, precious resource and that a blood transfusion is technically an organ transplant. • Focus intervention efforts on high risk/high volume surgeries such as cardiac or orthopedic surgeries. • Explore the administration of ferrous sulfate during the month prior to surgery. • Inject tranexamic acid in elective joint procedures to reduce blood loss.
Wound Management	• Establish guidelines for the management of surgical wounds intra-operatively and post-operatively. • Establish protocols to outline the utilization of wound irrigation in designated surgeries.	• Consider standardizing irrigation protocols for cases in which irrigation is indicated (e.g. ophthalmologic or prolonged intra-abdominal surgeries). • Evaluate protocols for the timely removal of drains. • Consider utilizing antiseptic dressings around drains that remain in place. • Explore the benefits of utilizing dressings impregnated with an antimicrobial agent in selected cases. • Consider wound edge protectors.
Skin Closure	• Establish protocols to optimize technique when closing a surgical site. • Develop a protocol to guide surgical closure techniques for surgical procedures at high risk for SSI (e.g. hernia repair).	• Consider opening a new, sterile, instrument set and using it to close a surgical case considered to be contaminated (e.g. colon surgery). • Consider intra-operative replacement of gloves and gowns of those directly involved in closing a case that is considered contaminated. • Irrigate selected wounds prior to closure. • Utilize antimicrobial-impregnated sutures.
Back to Basics	• Adhere to established guidelines (e.g. HICPAC, AORN) to ensure that basic aseptic technique is applied uniformly.	• Observe a sample of surgical procedures to evaluate adherence to aseptic practices (refer to an example of a checklist that can be used for this purpose in Appendix III on page 41). • Evaluate traffic control patterns to establish the rates of entry and exit in surgical suites. • Establish protocols designed to minimize/identify unnecessary entries and exits in surgical suites (e.g. red caps for vendors). • Evaluate the effectiveness of practices related to hair covering (e.g. the use of a bouffant cap vs. a skull cap as the latter has been identified as being an inferior head/hair cover). • Evaluate where hair removal is actually taking place; if hair removal is occurring in the operating room, question why this is necessary; if there is no other option, consider utilizing a device that removes and contains the hair. • Evaluate patient practices such as personal hair removal (e.g. instruct female patients not to shave their legs for one week prior to a total knee replacement). • Determine a method for cleaning/sterilizing clipper hand pieces between patients. • Scrub tops with built-in long sleeve/round neck inserts for providers with hairy chests/arms. • Evaluate practice for double gloving and glove changes between stages of surgical procedure.
Team Function, Team Training, Checklist Use	• Establish a culture of safety that promotes an environment of open and receptive communication among the surgical team. • Refer to the Safe Surgery Toolkit located in this document.	• Utilize a checklist (e.g. the WHO Surgical Safety Checklist) to guide time-outs and communication, and to promote a safe culture (e.g. speaking up).

REDUCING THE RISK OF SURGICAL SITE INFECTIONS

Facts about surgery in the U.S.

- More than 15 million surgeries are performed in the United States every year.
- Several examples of high volume surgeries that are potentially high risk are:
  - — Total hip arthroplasties account for 365,000 of these surgeries.
  - — Total knee arthroplasties account for 550,000 of these surgeries.
  - — There were 220,000 bariatric surgeries performed in the U.S. in 2009.

Additional facts:

- The year 2020 is being called the 'Silver Tsunami' because almost 25% of the working population will be age 55 or older.
- 8.3% of the U.S. population has diabetes, and there are an estimated 7 million undiagnosed diabetics in this country. ~79 million people in the U.S. are pre-diabetic (source: 2011 National Diabetes Fact Sheet).
- In 2010, 35.7% of the US population was determined to have a BMI ranging from 30-40, which is defined as obesity.

These facts underscore the potential risks of surgery complications in our aging and vulnerable population. Patients are living longer and are developing risk factors for surgical complications such as hyperglycemia and obesity. The prevention of surgical site infection (SSI) must remain a top priority in the years ahead. Currently, surgical site infections are the second most common type of healthcare-associated infection (HAI) in U.S. hospitals (290,000 per year), and cost between $3.5 and 10 billion per year. SSIs lead to significant increases in hospital readmissions, ICU admissions, long-term surgical site complications, and death. With appropriate interventions, 40-60% of surgical site infections are considered preventable.

Nationalizing Surgical Risk Reduction

The Surgical Care Improvement Project (SCIP) was implemented in 2006 in collaboration with the Centers for Medicare and Medicaid Services (CMS). SCIP was designed as an evidence-based initiative to be applied broadly across selected surgical disciplines with the stated goal of reducing surgical morbidity and mortality rates by 25% by the year 2010. The specific process measures for prevention of SSI were as follows:

- Appropriate hair removal (clipping rather than shaving)
- Appropriate antimicrobial prophylaxis involving choice of agent, timing of administration, and discontinuation of therapy within 24 hours
- Normalizing core body temperature within a defined post-operative time period in colorectal surgery patients
- Glycemic control measures in selected surgical patient populations

SCIP-Plus: Adjunctive evidence-based interventions

The SCIP initiative has been successful in focusing the attention of healthcare professionals and institutions on improving post-operative patient outcomes by shining a light on this important issue and by providing concrete evidence-based recommendations for process revisions. It is clear, however, that SCIP process measures alone are not going to reduce complications such as surgical site infection rates to the extent necessary.[1]

Facilities aiming to lower their surgical site infection rates are encouraged to consider the following 'SCIP-Plus' processes:

- Revised guidelines for antimicrobial prophylaxis: changing dosing (e.g. a repeat dose for surgical cases lasting longer than 3-4 hours, a higher dose for patients with BMI>30)
- Improved antisepsis, skin and oral: choosing the appropriate surgical skin preparation agent (e.g. chlorhexidine gluconate (CHG) oral rinse)
- Recommendation of pre-operative skin antisepsis (e.g. patient showers with chlorhexidine gluconate)
- Ensuring normothermia for every surgical patient
- Ensuring glycemic control for every surgical patient (not just those patients with diabetes)
- Appropriate use of drains, drapes, and dressings
- Non-contaminating hair removal and collection of removed hair practices
- Appropriate wound irrigation practices
- Appropriate skin closure practices (e.g. use of skin adhesive, sealant, antimicrobial-impregnated sutures)
- Monitoring and evaluation of blood transfusion practices in surgical patients
- Use of surgical safety checklists
- Implementing MRSA and MSSA screening and de-colonization
- Use of Oxygen supplementation
- Use of improved skin closure techniques (e.g. changing gloves and opening sterile instrument kits before closing patients undergoing colon surgery)
- Instituting team training and team function programs

These SCIP-Plus strategies, when combined with the WHO Safe Surgery Checklist (featured in this toolkit), will provide the foundation for a comprehensive SSI prevention program.

REFERENCES

[1] Edmiston CE, Okoli O, Graham MB, Sinski S, Seabrook GR. Improving surgical outcomes: an evidence-based argument for embracing a chlorhexidine gluconate (CHG) pre-operative shower (cleansing) strategy for elective surgical procedures. AORNJ 2010; 92:509-518.

[2] Website: http://www.cdc.gov/nhsn

[3] Edmiston CE, Spencer M, Lewis BD, Brown KR, Rossi PJ, Hennen CR, Smith HW, Seabrook GR. Reducing the risk of surgical site infections: "Did we really think that SCIP would lead us to the Promised Land?" Surgical Infection 2011; 12:169-177.

ANTIMICROBIAL PROPHYLAXIS

An estimated 40–60 percent of Surgical Site Infections (SSIs) may be preventable with the appropriate use of prophylactic antibiotics. Over-use, under-use, improper timing, and misuse of antibiotics occur in 25–50 percent of surgeries, with negative consequences. For example, 16 percent of surgical patients develop a *Clostridium difficile* infection attributable to the inappropriate use of antimicrobial prophylaxis. Additionally, overenthusiastic use of broad spectrum antibiotics or an overly prolonged course of prophylactic antibiotics increases vulnerability to infection for all patients in a healthcare facility due to the development of antibiotic-resistant pathogens.

The causative pathogens associated with SSIs in U.S. hospitals have changed over the past two decades. The percentage of SSIs caused by gram negative bacilli decreased from 56.6% in 1986 to 33.8% in 2003. *S. aureus* was the most common pathogen, causing 22.5% of SSIs during this time period. NHSN data from 2006 to 2007 revealed that the proportion of SSIs caused by *S. aureus* increased to 30%, with MRSA comprising of nearly 50% of these isolates. In a study of patients readmitted to U.S. hospitals between 2003 and 2007 with a culture-confirmed SSI, the proportion of infections caused by MRSA increased significantly from 16.1% to 20.6% ($p<0.0.0001$). MRSA infections were associated with higher mortality rates, longer hospital stays, and higher hospital costs compared with other infections. The predominant organisms causing SSIs after clean procedures are skin flora, including *S. aureus* and coagulase-negative staphylococci (e.g. *Staphylococcus epidermidis*). In clean-contaminated procedures (e.g. abdominal procedures and heart/kidney/liver transplants), the predominant organisms include gram-negative rods and enterococci in addition to skin flora.

S. aureus nasal colonization in the general population decreased from 32.4% in 2001-02 to 28.6% in 2003-04 ($p<0.01$) whereas the prevalence of colonization with MRSA increased from 0.8% to 1/5% ($p<0.03$) during the same periods.

Colonization with *S. aureus*, primarily in the nares, occurs in roughly one in four persons and increases the risk of SSI by 2 to 14 fold. There are data that demonstrate that the use of intranasal mupirocin in nasal carriers of *S. aureus* decreases the rate of *S. aureus* infections.

Surgical antimicrobial prophylaxis can alter individual and institutional bacterial flora which can lead to changes in colonization rates and increased bacterial resistance. Surgical prophylaxis can also predispose patients to *Clostridium difficile*-associated colitis.

Risk factors for *C. difficile*-associated colitis include longer duration of prophylaxis and use of multiple antimicrobial agents. Limiting the duration of antimicrobial prophylaxis to a single preoperative dose can reduce the risk of *C. difficile* disease.

Agents that are FDA-approved for use in surgical antimicrobial prophylaxis include cefazolin, cefuroxime, cefoxitin, cefotetan, ertapenem and vancomycin.

Ideally, an antimicrobial agent for surgical prophylaxis should do the following:

1. Prevent SSI
2. Prevent SSI-related morbidity and mortality
3. Reduce the duration and cost of healthcare (when the costs associated with the management of SSI are taken into consideration, the cost-effectiveness of prophylaxis becomes evident)
4. Produce no adverse effects
5. Have no adverse consequences for the microbial flora of the patient or the healthcare setting

To achieve these goals, an antimicrobial agent should be:

1. Active against the pathogens most likely to contaminate the surgical site
2. Given in an appropriate dosage and at a time that optimizes adequate serum and tissue concentrations during the period of potential contamination
3. Safe
4. Administered for the shortest period to minimize adverse effects, the development of resistance, and costs

The selection of an appropriate antimicrobial agent for a specific patient should take the following into account:

1. Characteristics of the ideal agent
2. Comparative efficacy of the antimicrobial agent for the procedure
3. Safety profile
4. The patient's medication allergies

The American Society of Health-System Pharmacists (ASHP), the Infectious Diseases Society of America (IDSA), the Surgical Infection Society (SIS) and the Society for Healthcare Epidemiology of America (SHEA) revised clinical practice guidelines for antimicrobial prophylaxis in surgery in 2013. These guidelines

reflect substantial changes from the guidelines published in 1999. Highlights of the changes are as follows:

Pre-operative dose timing:

1. The optimal timing for administration of pre-operative doses is within 60 minutes prior to surgical incision
2. Consider establishing a goal to administer pre-operative doses 30 minutes prior to incision
3. Some agents (fluoroquinolones and vancomycin) require administration over one to two hours therefore administration of these agents should begin within 120 minutes prior to surgical incision

Selection and timing:

- Consider the need for weight-based dosing in obese patients and the need for repeat doses during prolonged procedures
- For all patients, intra-operative re-dosing is needed to ensure adequate serum and tissue concentrations of the antimicrobial if the duration of the procedure exceeds two half-lives of the drug or if there is excessive blood loss during the procedure
- Consider recommendations for the selection of antimicrobial agents for specific procedures and the use of alternative agents (e.g. for patients with allergies to beta-lactam antimicrobials)
- Avoid routine use of vancomycin prophylaxis for any procedure
- Consider vancomycin as the regimen of choice when a cluster of MRSA cases appears (e,g, a cluster of mediastinitis after cardiac surgery)
- Consider vancomycin prophylaxis for patients with known MRSA colonization in the absence of surveillance data (e.g. patients with recent hospitalization, nursing home residents, hemodialysis patients)
- Each facility should develop guidelines for the proper use of vancomycin

Duration of prophylaxis:

- Consider new recommendations for a shortened post-operative course of antimicrobials such as providing a single dose or continuing therapy for less than 24 hours
- Determine the need for continued antimicrobial treatment based on the presence of indwelling drains and intravascular catheters
- Re-dosing may be indicated if there are case factors such as extensive burns that could shorten the half-life of an antimicrobial agent
- Measure the re-dosing interval from the time of administration of the pre-operative dose, not from the start of the surgical procedure

Spectrum of Activity:

- Select the antimicrobial agent with the narrowest spectrum of activity required for efficacy
- Consider local resistance patterns and overall SSI rates when adopting recommended practices
- Resistance patterns from organisms causing SSIs should take precedence over hospital-wide antibiograms
- Treat remote infections prior to surgery

Topical Irrigation, Pastes, and Washes

- Unfortunately, limited high-quality data are available regarding the use and effectiveness of antimicrobial irrigation, pastes, and washes that are administered topically

Common Principles to Promote Reduced Numbers of SSIs:

- Consider expanded and new recommendations for plastic, urology, cardiac and thoracic procedures in addition to procedures where implantable devices are inserted
- Consider the use of mupirocin and the role of vancomycin in surgical prophylaxis
- Explore the impact of other potential factors such as
  - — Local attention to basic infection-control strategies
  - — Surgeons' experience and technique
  - — Duration of procedures
  - — Hospital and operating room environments
  - — Instrument-sterilization issues
  - — Pre-operative preparation (surgical scrub, skin antisepsis, appropriate hair removal)
  - — Peri-operative management (temperature and glycemic control)
  - — The underlying medical condition of each patient

Secondary Drivers

- Use the appropriate prophylactic antibiotic for a specific surgical procedure based on current national guidelines.
- Ensure that proper antibiotic selection, timing of administration, dosing, and duration of administration are implemented.

Change Ideas: Strategies for improving antimicrobial prophylaxis

- Develop standardized order sets for each surgical procedure that include the name of the designated antibiotic, the appropriate dose and timing of its administration, and the recommendations for its discontinuation.
- Educate surgeons regarding the appropriate antibiotics for specific surgeries, and the appropriate timing and duration (<24hr) of administration of prophylactic agents.
- Develop pharmacist- and nurse-driven protocols that promote the correct antibiotic selection and use based on the type of surgery and the specific patient characteristics (age, weight, etc.).
- Create a process to review all exceptions to the developed protocols.
- Ensure that antibiotics are re-dosed appropriately in surgeries lasting longer than 3 hours.
- Establish a protocol whereby the anesthesiologist is prompted to re-dose the patient by, for example, a timer or clock.
- Incorporate recommendations for re-dosing in the 'hand-off' during breaks and shift relief.
- Verify the antibiotic administration time during a 'time out' or pre-procedural briefing so action can be taken if the prophylaxis has not been administered.
- Guided by national guidelines, control operating room drug stocks so that they include only standard medications in standard dose packages.

Suggested Process Measures

- A monthly audit of the percentage of patients who received the appropriate weight-based antimicrobial pre-operative dose.
- A monthly audit of the percentage of patients who received an additional antimicrobial agent when appropriate because of an extended duration of a surgical procedure.

PRE-OPERATIVE SKIN ANTISEPSIS

The research evidence that pre-operative bathing or showering with CHG soap reduces SSI rates is controversial. A Cochrane Systematic Review that included data from seven randomized controlled studies concluded that there was not clear evidence that CHG bathing reduced the risk of SSI. However, most of these studies used only one or two applications of the CHG washes. (Webster J, Osborne S. Pre-operative bathing or showering with skin antiseptics to prevent surgical site infection. *Cochrane Database of Systematic Reviews.* 2007; 2.DOI:10.1002/14651858.CD004985.pub)

However, studies DO show that CHG bathing or showering substantially reduces the density of microorganisms on the skin that can lead to SSI. These data inform the rationale for the 1999 Hospital Infection Control Practices Advisory Committee (HICPAC) "Guideline for Prevention of SSI" recommendations that patients shower or bathe with an antiseptic agent at least the night before the day of their surgery (Mangram A, Horan T, Pearson M, Silver I, Jarvis W. Guideline for Prevention of Surgical Site Infection. *Infection Control and Hospital Epidemiology*. 1999:20(4):250-280.)

Studies also show that repeated use of CHG soap for bathing or showering enhances the residual antimicrobial effects of CHG (i.e., the ability of CHG to reduce bacterial counts on skin, not only during the immediate period after the shower, but for hours afterwards), resulting in progressive reductions in skin bacterial counts.

Another study evaluated the impact of CHG shower/bath applications on volunteers who performed five days of CHG shower washes. Abdominal and inguinal skin swabs for culture were performed on days one, two, and five. CHG use resulted in significant microbial reductions from baseline levels, with progressive reductions noted as the study continued. (Paulson D. Efficacy Evaluation of 4% Chlorhexidine Gluconate as a Full-body Shower Wash. *American Journal of Infection Control*. 1993;21(4):205-209.)

A different study compared patients taking three showers with CHG versus patients using a placebo cleanser. CHG use resulted in decreased bacterial counts on the skin. There was a median of five days before skin recolonization was noted. (Byrne D. Napier A, Phillips G, Cushieri A. Effects of whole body disinfection on skin flora in patients undergoing elective surgery. *The Journal of Hospital Infection*. 1991; 17(3):217-222.)

A prospective randomized study compared the effectiveness of pre-operative showers with CHG, povidone-iodine, and lotion

soap in reducing the staphylococcal skin flora of patients scheduled for elective cardiac surgery or coronary artery angioplasty. CHG was shown to be more effective than povidone-iodine or lotion soap in diminishing skin colonization with staphylococci. Repeated applications of CHG were superior to a single shower with this agent (Kaiser A, Kernodle D, Barg N, Petracek M. Influence of pre-operative showers on staphylococcal skin colonization. A comparative trial of antiseptic skin cleansers. *The Annals of Thoracic Surgery.* 1988; 45(1):35-38.)

Secondary Driver

Ensure that patients complete a regimen of pre-operative skin cleansing immediately prior to their operative procedure.

Change Ideas:

- Develop standardized order sets for pre-operative skin cleansing to reduce protocol variation.
- Develop a strategy for distribution of skin antiseptic agent(s) to patients at low cost to ensure agent availability and use.
- Educate patients on how to appropriately apply the skin antiseptic agents prior to surgery.
- Consider evidence demonstrating that repeated use of CHG soap for bathing or showering enhances the residual effects of CHG, resulting in progressive reductions in bacterial counts on the skin.
- Consider evidence that demonstrates the positive impact of repeated use of CHG baths (e.g. over the 3 days prior to surgery rather than only the night before).
- Engage patients and families by using a standard form for patients to fill out after they perform skin cleansing that lists the cleansing dates and times. Ask patients to affix the bottle label/package sticker to the form to confirm their use of pre-surgical skin cleansing prior to surgery.
- Engage patients and families by educating them about the risks of applying lotions/deodorants after cleansing, as these agents will reduce the benefits of the CHG residue.

Suggested Process Measures

- A monthly audit of the percentage of patients eligible for pre-operative skin cleansing who actually received the cleansing product.
- A monthly audit of the percentage of eligible patients who document the appropriate performance of pre-operative skin cleansing.

Suggested Balance Measure

- A monthly audit of patients who experienced a rash or other skin reaction possibly related to the pre-operative skin cleansing.

PERI-OPERATIVE SKIN ANTISEPSIS

Standardization and agreement on a peri-operative skin preparation remains an area of contention among many surgical providers. For example, there are clearly differences in mechanisms of action between povidone iodine and chlorhexidine gluconate (CHG) that may favor the selection of one or the other product in certain patients. And, when combined with either CHG or iodophor, alcohol also plays a synergistic role in enhancing skin preparation. It is important to:

- Select the most appropriate peri-operative skin antiseptic agent for the type of surgery performed.
- Ensure that each surgical patient receives both appropriate and correctly-administered skin antisepsis.

Change Ideas: Strategies for improving peri-operative skin antisepsis

- Understand the differences in the mechanisms of action between povidone iodine and chlorhexidine gluconate (CHG) as skin antiseptic agents.
- Understand the synergistic effect of alcohol when combined with CHG or iodophor
- Understand that using the combination of a long-acting agent (either an iodophor or CHG) with povidone-iodine is more effective than using povidone-iodine alone.
- Guided by the product insert, develop standardized practices for the peri-operative application of skin antiseptic agents.
- Educate peri-operative personnel on the safe application and use of selected skin antiseptic agents.
- Using evidence-based results from the literature, educate all peri-operative personnel on the benefits of skin antisepsis to reduce the microbial burden on the skin prior to surgery.
- Review package instructions to determine the amount of skin surface each unit-dose container of skin antisepsis is able to cover and maintain a therapeutic dose particularly when preparing a patient scheduled for bariatric surgery.

Suggested Process Measures

- A monthly audit of the percentage of patients whose skin was prepared with the standardized skin preparation protocol.
- A monthly audit of the percentage of bariatric patients who were prepped with the appropriate dose of a skin cleansing agent as calculated based upon skin surface measurements.

NORMOTHERMIA IN THE OPERATING ROOM

The medical literature demonstrates that patients undergoing colorectal surgery have a decreased risk of SSIs if they are not allowed to become hypothermic during the peri-operative period (Melling. *Lancet*. 2001; 358:876). Anesthesia, anxiety, cold or wet skin preparations, and skin exposure in cold operative rooms can cause patients to become clinically hypothermic during surgery. Though the SCIP directive focused only on colorectal patients, there is evidence to show that preventing hypothermia is beneficial in reducing complications in other patients, and contributes to patient comfort. (Kurz A, Sessler DI, Lenhardt R. Peri-operative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Eng J Med* 1996;334: 1209-1214; Mahoney C B, Odom J. Maintaining intraoperative normothermia: A meta-analysis of outcomes with costs. AANA J 1999;67:155-163. Doufas AG. Consequence of inadvertent pre-operative hypothermia. *Best Pract Res Clin Anaesthesiol* 2003; 17:535-549. Melling AC, et al. Effects of pre-operative warming on the incidence of wound infection after clean surgery: A randomized controlled trial. *Lancet*. 2001;358: 876-880. Sessler KI, Akea O. Non-pharmacological prevention of surgical wound infections. *Clin Infect Dis* 2002;35:1397-1404.

Secondary Drivers

To prevent hypothermia during all phases of a surgical process:

- Educate pre-operative area staff on the importance of pre-warming to prevent hypothermia during an operation.
- Develop a standardized procedure for active warming of patients in the operating room.

Change Ideas: Strategies for promoting normothermia in the surgical setting

- Develop a standardized procedure for active warming of patients that could include using warming blankets under patients on the operating table.
- Engage patients and families by teaching patients in the pre-operative period about the value of pre-warming and warming to improve healing and reduce infection risk post-surgery.
- Educate the surgical team that even mild hypothermia (as little as 1-2° C) increases SSI rates.
- Educate the surgical team that normothermia in the O.R. results in less blood loss, and that excessive blood loss and/or blood transfusions increase SSI risk.
- Use hats and booties on patients peri-operatively.
- Adjust engineering controls so that operating rooms and patient areas are not permitted to become excessively cold overnight, when many rooms are empty.
- Use warmed fluids for IV's and for flushes into surgical sites and orifices.
- Measure temperature with an accurate thermometer at appropriate intervals.

Suggested Process Measures

- A monthly audit for the percentage of patients whose temperature remained within the normal range peri-operatively.
- A monthly audit for the percentage of patients who received warmed fluids for IV's and flushes.

PERI-OPERATIVE GLUCOSE CONTROL

The medical literature indicates that the degree of hyperglycemia in the post-operative period is correlated with the rate of SSI in patients undergoing major cardiac surgery (Latham. *Inf Contr Hosp Epidemiol* 2001;22:607/Dellinger *Inf Contr Hosp Epidemiol* 2001:22:604). The study of glucose control post-operatively has been largely focused on the cardiac surgical population. There have been recent publications that support the value of controlling peri-operative glucose levels in general surgery patients. A Washington State quality improvement initiative evaluated the relationship of perioperative hyperglycemia (>180 mg/dL) and insulin administration on infections for patients undergoing elective colorectal and bariatric surgery. After controlling for clinical factors, patients with hyperglycemia had a significantly increased risk of infection. Those with hyperglycemia on the day of surgery who received insulin had no significant increase in infections. (Kwon S, Thompson, R, Dellinger P, Yanez D, Farrohki E, Flum D. *Ann Surg* 2013 Jan;257(1);8-14).

Secondary Drivers

Monitor all surgical patients for hyperglycemia pre-operatively, peri-operatively, and post-operatively.

Change Ideas: Strategies for improving glucose control in surgical patients

- Implement a glucose control protocol for surgical patients.
- Obtain glucometers for every anesthesia station.
- Develop lists of patients at risk for hyperglycemia in the peri-operative period. This list should **NOT** only include diabetic patients.

- Develop a protocol to require that every surgical patient is glucose tested on arrival in the operating room. Perform glucose testing when BP, heart rate, temperature, and O2 saturation are being recorded.
- Develop a peri-operative glycemic control team that includes surgeons, anesthesiologists, endocrinologists, and nurses who are assigned the responsibility for blood glucose monitoring and control.
- Develop or obtain examples of protocols and algorithms for the appropriate administration of intravenous insulin to patients with intra-operative and post-operative hyperglycemia.
- Minimize extremes of glucose during peri-operative care.

Suggested Process Measures

- A monthly audit for the percentage of patients who had their blood sugar checked intra-operatively.
- A monthly audit for the percentage of anesthesia stations that have a functioning glucometer present.

STAPHYLOCOCCUS AUREUS (SA) SCREENING AND DECOLONIZATION

Patients who carry *Staphylococcus aureus* (SA) – both methicillin-sensitive and methicillin-resistant – in their nares or on their skin are more likely to develop *Staphyloccus aureus* surgical site infections. (Kluytmans J, Mouton J, Ijzerman E, Vandenbroucke-Grauls C, Maat A, Wagenvoort J, et al. Nasal carriage of *Staphylococcus aureus* as a major risk factor for wound infections after cardiac surgery. *The Journal of Infectious Diseases.* 1995;171(1):216-219. Huang S, Platt R. Risk of methicillin-resistant *Staphylococcus aureus* infection after previous infection or colonization. *Clinical Infectious Diseases* 2003;36(3):281-285. Rao N, Cannella B, Crossett L, Yates A, McGough R, Hamilton C. Pre-operative screening/decolonization for *Staphylococcus aureus* to prevent orthopedic surgical site infection: Prospective cohort study with 2-year cohort study with 2-year follow-up. *The Journal of Arthroplasty* 2011;25(8):1501-1507).

The combination of intranasal mupirocin and CHG bathing or showering eliminates SA, at least temporarily, from the nares and skin; the natural reservoirs in which SA is most often carried. The results of several studies have suggested that pre-operative intranasal mupirocin reduces the risk of SSI for SA carriers (van Rijen M, Bonten M, Wemnzel R, Kuytmans J. Intranasal mupirocin for reduction of *Staphylococcus aureus* infections in surgical patients with nasal carriage: A systematic review. *Journal of Antimicrobial Chemotherapy.* 2008;61:254-261.)

A recent randomized, double-blinded, placebo-controlled trial showed that SA carriers treated with five days of intranasal mupirocin and CHG washes before surgery had a 60% lower SSI rate with *Staphylococcus aureus* than did the placebo group (Bode L, Kluytomans J, Wertheim H, Bogaers D, VAndenbroucke-Grauls C, ORoosendaal R, et al. Preventing surgical site infections in nasal carriers of *Staphylococcus aureus*. *New England Journal of Medicine.* 2010;362(1);9-17.)

Implementing a hospital-wide pre-screening program to identify and decolonize SA carriers prior to elective orthopedic surgery is feasible and can lead to significant reductions in SSI rates (van Rijen M, Bonten M, Wenzel R, Kluytmans J. Intranasal mupirocin for reduction of *Staphylococcus aureus* infections in surgical patients with nasal carriage. A systematic review. *Journal of Antimicrobial Chemotherapy.* 2008;61:254-261).

Secondary Drivers

Optimize the identification of patients who are colonized with SA and who may benefit from a decolonization protocol which includes the use of intranasal mupirocin or povidone iodine nasal antiseptic and a CHG bath in the 3 days prior to surgery.

Change Ideas: Strategies for improving SA screening and decolonization for surgical patients

- Develop a protocol to conduct nasal *Staphylococcus aureus* (SA) screening.
- Develop a protocol to attempt to decolonize SA carriers (with either mupirocin or povidone iodine).
- Educate the surgical staff to be aware that patients who carry SA in their nares/skin are more likely to develop SA surgical site infections.
- Recognize that decolonization efforts are not a 'cure', but only a temporary elimination of SA from the nares and skin, the natural reservoirs where SA is most often carried.
- Consider implementing a facility-wide pre-screening program to identify and decolonize SA carriers prior to designated elective surgeries (e.g. orthopedic or coronary artery bypass surgery).
- Establish clear protocols for the screening, detection and reporting of SA. Address who performs the diagnostic swab, who processes the swab to identify SA, who receives the notification of SA presence, who coordinates and implements treatment of identified SA.

Suggested Process Measures

- A monthly audit of the percentage of patients who have a pre-operative nasal SA screening performed.
- A monthly audit of the percentage of patients with a positive SA screen who also receive mupirocin, povidone iodine cleaning, and CHG decolonization interventions.

OXYGEN SUPPLEMENTATION

The role that oxygen supplementation plays in preventing surgical site infections has not been conclusively established. (Reference: *Anesth Analg* 2012 Feb;114(2):334-42. doi: 10.1213/ANE.0b013e31823fada8. Epub 2011 Dec 9).

Randomized controlled trials on this topic have reported disparate results. It is believed, however, that oxygenated tissue is healthier and more likely to heal, therefore oxygenation supplementation may be considered as an inexpensive, benign, and potentially beneficial surgical site infection prevention intervention.

Secondary Drivers

Establish a protocol to guide the use of supplemental oxygen intra-operatively and immediately after surgery.

Change Ideas: Strategies for improving the oxygenation of surgical patients

- Reinforce the notion that wound oxygen tension has an impact on healing; higher oxygen = lower SSI risk.
- Educate surgical staff that oxygenation is a low-cost intervention with minimal risks and possible benefits.

Suggested Process Measures

A monthly audit of the percentage of patients who received supplemental oxygen therapy immediately after surgery.

CONTROL LOCAL BLEEDING TO PREVENT BLOOD LOSS AND NEED FOR BLOOD TRANSFUSION

Even a single unit of packed red blood cells should be considered an organ transplant with the potential to be an immune modulator. Blood transfusions must be considered a risk factor for surgical site infections. Blood transfusion options are commonly guided by provider judgment and community practice standards; however, it is critical to consider that these prescribing practices can be potential drivers for SSIs.

Secondary Drivers

- Develop a protocol to provide guidance on appropriate blood transfusion practices for surgical patients.
- Evaluate and analyze surgeon-specific packed red blood cell transfusion practice data.

Change Ideas: Strategies for improving blood transfusion practices for surgical patients

- Educate surgical staff that transfusing even a single unit of packed red blood cells must be considered a risk factor for SSIs.
- Reinforce the fact that a blood transfusion is costly and is technically an organ transplant.
- Focus attention on high risk/high volume surgical areas such as cardiovascular or orthopedic surgery to minimize bleeding.
- Explore the provision of ferrous sulfate to patients one month prior to surgery to build up red blood cell levels as medically appropriate.
- Inject tranexamic acid in elective joint procedures to reduce blood loss.
- Utilize "blood saver technology."

Suggested Process Measures

- A monthly audit of the percentage of surgical patients who received one or more units of packed red blood cells peri-operatively.
- A monthly audit of the percentage of cardiac/orthopedic patients who received one of more units of packed red blood cells peri-operatively.

BACK TO BASICS

The fundamental basics of aseptic technique and sound practices can be ignored when the focus is solely on 'above and beyond' practices. It cannot be over-emphasized that the basics of aseptic techniques should be employed in **every** surgical case.

Secondary Driver

Adhere to established guidelines (e.g. HICPAC, AORN) to assure that basic aseptic technique is applied consistently and uniformly.

Change Ideas: Strategies for improving 'The Basics'

- Conduct direct observational studies of a sampling of surgical procedures to evaluate adherence to aseptic practices.
- Evaluate traffic control patterns to establish the rate of entry and exit in the surgical suite.
- Establish protocols designed to identify and minimize unnecessary entries and exits in the surgical suite (e.g. using red caps for vendors).
- Evaluate practices related to hair-covering (e.g. using bouffant caps instead of skull caps as the latter have been identified as being inferior head/hair covers).

- Evaluate where hair removal is actually taking place. If it is occurring in the operating room, question why this is necessary. If there is no other option, consider utilizing a device that removes and also contains the hair.
- Engage patients and families by advising them about appropriate personal hair removal practices (e.g. instruct female patients not to shave their legs in the week prior to a total knee replacement and advise female patients not to shave their perineal area prior to a scheduled C-section).
- Determine the method used to clean/sterilize clipper hand pieces between patients.
- Utilize double gloving and glove changes.
- Consider the use of a new 'closing set' for 'contaminated cases' such as colon surgery.

Suggested Process Measures

- A monthly audit of the percentage of patients who have hair removed in the O.R., creating or promoting a non-sterile environment.
- A weekly audit of the number of times the door in an operative suite opens during a surgical procedure.
- A weekly audit of the staff who have their hair 100% covered while in the surgical suite.

POTENTIAL BARRIERS

Many of these change ideas will require that surgeons, nurses and other clinical staff will have to modify their day-to-day routines. Because habits are ingrained in the operative world, change may be perceived as challenging. Resistance to change is common, particularly when proposing modifications in surgical procedures such as peri-operative skin preparation. Therefore, when suggesting changes, introduce the research and literature that highlight the evidence of benefits from these changes. Additionally, enlist champions to advocate for these changes. A champion may be a surgeon, a surgical nurse, an anesthesiologist, a perfusionist, or a pre-operative nurse. An effective champion is interested in and supportive of the quality improvement program, and is open to change ideas which attempt to improve services. Progress requires continuous improvement efforts; leaders and champions can help an organization adopt advances in knowledge and practice that may enhance patient outcomes.

THE MODEL FOR IMPROVEMENT

Tips on How to Use the Model for Improvement

What to test

Review the change package in this guide and select a process that you haven't yet implemented or tested accurately and reliably.

Where do you think your efforts might have the greatest impact?

- By focusing on pre-surgical skin cleansing?
- By enhancing antimicrobial therapy practices?
- By improving traffic control during your joint procedures?
- By keeping your patients warm during and after surgery?

The key to a successful Model for Improvement is to include the following elements:

AIM: The goal or objective that your team would like to achieve.

Example: We will reduce surgical site infections by 40% by December 8, 2014.

MEASURES:

Assess whether you have reached your goal by measuring the processes (what was done), the outcomes (the results), and the balance measures (potential pitfalls or undesirable consequences).

CHANGE:

Select a new process, such as:

- Ask one nurse on one day to ask one patient whether s/he used the CHG bathing cloths that were provided during the pre-operative visit. Determine if the use was appropriate and user-friendly.
- Ask one nurse to instruct her next female patient seen in pre-op to not shave her legs one week prior to her hip replacement. Determine compliance.

Plan-Do-Study-Act (PDSA)

The key to determining successful change is to "test small." Small and local tests of change are an optimal way to find out if a change process is effective.

To implement a small test of change

Example:

AIM: To find out if anesthesiologists will agree to administer a designated antibiotic as per protocol and document its administration.

PLAN:

Select a volunteer anesthesiologist to administer and document one antibiotic dose for the first case of the day.

Example: What do we have to collect?

- the O.R. nurse will record the observation of administration and document any secondary issues that may arise.
- the anesthesiologist will document the time and dose of antibiotic administration on the pre-operative checklist.
- the process will be reviewed with the anesthesiologist and the nurse in a debriefing after the surgery is complete.

DO:

Carry out the change and test. Collect information and data about the test and begin your analysis. For example:

- A test was conducted on the first surgery case on Tuesday morning.
- The anesthesiologist was not happy; he did not have the pre-operative checklist in his hands at the scheduled time of antibiotic administration because the circulating nurse was carrying it.

STUDY:

Debrief and conduct an analysis of the findings. How did or didn't the results of this cycle agree with your initial predictions?

- Summarize the new knowledge that was gained from this PDSA cycle. In this example:
  - —The checklist currently in use was not ideal for use by anesthesiologists who need to record dose administration.
  - —Discuss whether the time of antibiotic administration can be documented on the anesthesia record instead of the checklist.
  - —Revise the checklist and anesthesia record as needed to ensure that the documentation of administration time is consistent.

ACT:

List new actions that will be implemented as a result of the analysis of this cycle. In this example:

- The anesthesiologist is willing to try the test again.
- Repeat this test the next day after drafting a revision to the anesthesia record.
- Plan for the next cycle (implement change, perform another test, analyze, and revise).
- Run a second PDSA cycle the next day for two or three scheduled surgeries.

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SAFE SURGERY TOOLKIT

Please contact the Safe Surgery 2015 Team for help or if you have any questions:

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Surgical care is responsible for a major portion of hospital admissions and expenditures. More than 64 million surgeries are performed every year in the United States.[1] Improving surgical care is vital and can have a significant positive impact on our patients' lives. Over the last century, there have been major advances in improving surgical safety, especially in the areas of anesthesia and infection control. Unfortunately, fewer efforts have focused on improving communication and teamwork in the operating room. Failures in communication and teamwork negatively impact infection control practices and can increase risks of patient injury, especially when unexpected circumstances arise in the operating room. This Safe Surgery Program focuses on both reducing infection and improving teamwork and communication in the operating room.

The WHO Surgical Safety Checklist is a simple tool that promotes communication and teamwork in the operating room. The checklist requires surgical team members to stop at three critical points during each operation to discuss patient care as a team. Effective use of the checklist has been shown to reduce avoidable surgical complications and death globally. The checklist was originally studied in an eight-center multi-country pilot study and the results were published in the January, 2009 New England Journal of Medicine article, *"A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population."* Use of the checklist reduced the rate of deaths and complications by more than one third. After implementation of the checklist, the rate of major inpatient complications dropped from 11 percent to 7 percent, and the inpatient death rate following major operations also fell from 1.5 percent to 0.8 percent.[2] Similar results have been demonstrated in operating rooms in the United States and The Netherlands when operating room teams utilized a surgical checklist.[3,4] Today, the WHO Surgical Safety Checklist (or a modified version of this tool) is used in thousands of operating rooms in the United States and throughout the world. When the checklist is used effectively, it improves communication and teamwork, strengthens the partnership between physicians and the hospital, increases staff retention, improves staff satisfaction, and benefits patients. Proper use of the checklist has also been shown to decrease the rate of surgical site infections.

Although the checklist is a simple tool, its implementation requires cultural and behavioral changes. The checklist is not simply a piece of paper, but a mechanism to improve teamwork. If the checklist is used correctly it can help to create an environment where all team members feel safe to voice concerns and contribute to patient care quality. Input and involvement from every member of the surgical team is critical.

This toolkit includes materials that are used as part of the Safe Surgery 2015 Initiative. The Safe Surgery 2015 initiative is coordinated by the Harvard School of Public Health and was developed to reduce surgical infections, major complications, and death through effective population-wide implementation of the WHO Surgical Safety Checklist Program. Its goal is to implement the checklist in every hospital in the United States by 2015. To learn more about the Safe Surgery 2015 Initiative please visit www.safesurgery2015.org.

We invite you to join us on this journey to improve surgical outcomes for our patients. This toolkit walks you through the essential steps of implementing the checklist and how to overcome barriers that you may face with this change idea. Implementing the checklist will take time, but when performed correctly, can change the way team members interact with one another and ensure that our patients receive the best care possible.

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Step 1 — Checklist Background

Before you start to work on the checklist it is important to understand the checklist's background and history and the evidence that supports this tool. These materials will prepare you to start working on this project.

VIDEO OVERVIEWS	**Core Principles Behind This Work** This three-minute video clip summarizes the overarching principles of this project and how the checklist differs from other quality improvement efforts.	**To view a short overview:** http://youtu.be/KaCfzQh042M **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Checklist Development This 24-minute video describes the development and evolution of the checklist. Topics that are covered include: checklist creation, testing, impact of the checklist, dissemination of the checklist, and the background of the South Carolina Checklist template.	**To view a short overview:** http://youtu.be/rqHsFo3CoCk **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Safe Surgery 2015: Checklist Videos Demonstration videos and testimonials about the checklist that were created by hospitals across the world.	**Videos may be found here:** http://www.safesurgery2015.org/checklist-videos.html
DOCUMENTS	**Checklist Bibliography** A comprehensive bibliography that includes the research and articles that supported the development of the checklist.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/10908835/checklist_references_4-12-12.doc
	HRET Surgical Safety Checklist Template Use this checklist template as a starting point for this initiative. This template has been modified specifically to meet the needs of hospitals in the United States. This checklist was developed by hospitals that participated in the Safe Surgery 2015: South Carolina initiative.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/10908835/checklist_template_hret_3-30-12.doc

Step 1 — Action Items

After reviewing the videos and documents in this section please complete the following action items.

1. Review the evidence that led to the development of the WHO Surgical Safety Checklist.
2. Review the HRET Surgical Safety Checklist Template.

Step 2 – Critical Preparation

Before you start disseminating the checklist in your operating rooms, think about issues that you might face when you start the checklist implementation. The following materials will walk you through the process of building an implementation team to lead this project, assessing current safety practices in your operating rooms, using the checklist as a documentation tool, measuring checklist impact, engaging executive leadership in this work, and addressing malpractice concerns.

VIDEO OVERVIEWS	**Building an Implementation Team** This eight-minute video discusses the first — and one of the most important — steps in this initiative. This clip also discusses how to identify clinical champions.	**To view a short overview:** http://youtu.be/GRa5EOwMhp4 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	We're Already Doing All of This This two-minute clip discusses one of the most common objections to using the checklist.	**To view a short overview:** http://youtu.be/gwCHpUryM80 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	The Checklist as a Documentation Tool This four-minute clip discusses how the checklist can be used as a documentation tool and included in the medical record.	**To view a short overview:** http://youtu.be/8b27Sfl3RXs **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Understanding Checklist Impact and its Measurement This eight-minute clip discusses the best ways to measure the impact of the checklist. This clip also discusses barriers to measuring the checklist in your hospital.	**To view a short overview:** http://youtu.be/e6SzD6I5tik **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Malpractice Issues Related to the Checklist This five-minute clip discusses frequently asked questions about checklist use and malpractice issues.	**To view a short overview:** http://youtu.be/eP_zpdxaLy8 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	What the Checklist Is and Isn't This three-minute clip provides a brief overview of how to properly use the checklist.	**To view a short overview:** http://youtu.be/hRtcYlHeFs8 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html

DOCUMENTS	**Are We a Safe Surgery 2015 Hospital?** If you think that your hospital optimally uses the checklist and has achieved an effective and full implementation we encourage you to use this document to assess if you meet the standards of Safe Surgery 2015.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/are_we_a_safe_surgery_2015_4-10-12.doc
	CEO One Page Summary Engaging executive leadership is key. This document explains the basics of the project in a one-page summary designed specifically for distribution to hospital CEO's.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/ceo_one_pager_4-10-12.doc

Step 2 — Action Items

After reviewing the videos and documents in this section, please complete the following action items.

1. Build an implementation team that consists of at least one administrator, anesthesia provider, circulating nurse, scrub tech, and surgeon.
2. Schedule regular meetings with your checklist implementation team (once every week or every two weeks).
3. With your team, think about and discuss how the checklist fits in with your current O.R. processes. Compare what happens in your O.R.s with the items that are outlined in the "Are We a Safe Surgery 2015 Hospital" document.
4. Schedule a time and venue for an implementation meeting (or repurpose existing departmental meetings) wherein the implementation team will be able to talk to O.R. personnel including anesthesia providers, nurses, surgeons, and techs about using the checklist at your hospital. These meetings should be scheduled about six to 10 weeks after you begin the initiative and should precede your checklist launch/roll-out.
5. Identify which members of the hospital leadership should be engaged in this project. It is helpful to have the CEO, CMO, board members, and the chiefs of surgery, anesthesia, nursing, and other medical and administrative leadership be aware of and support this project. These individuals do not need to be part of your checklist implementation team, but should be updated on the progress that you are making as well as the barriers that you are facing. The most successful hospitals have enlisted support for this project at ALL levels.

Step 3 — Checklist Modification and Customization

Modifying the checklist is essential to ensuring that the checklist meets the needs of each individual hospital. We recommend that hospitals modify the checklist to reflect their institution, even by simply adding the local hospital logo. The following documents will guide you through this process and provide you with the information that you will need to modify the checklist to meet your unique needs.

VIDEO OVERVIEWS	**Modification 101** We recommend that every hospital modify the checklist in some capacity. This 10-minute clip discusses how to do so, and how to ensure that your modified checklist retains the critical elements of the WHO and South Carolina checklists.	**To view a short overview:** http://youtu.be/soT899yyL5A **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Process to Follow When Modifying the Checklist This four-minute clip describes the process that you and your implementation team should follow when modifying the checklist for your hospital's needs.	**To view a short overview:** http://youtu.be/QF9lXXPy6vw **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
DOCUMENTS	**Checklist Modification Guide** This document outlines the considerations one must keep in mind while customizing the checklist in order to ensure that the utility of the tool is not compromised.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/modification_document_4-10-12.doc
	HRET Surgical Safety Checklist Template This checklist template includes the items from The Joint Commission, the SCIP, as well as items to enhance communication and teamwork.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/checklist_template_hret_3-30-12.doc
	Does Our Checklist Contain the Critical Elements? This document will help ensure that your customized checklist contains the items that are essential to enhancing teamwork and communication in the operating room.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/does_our_checklist_contain_the_critical_elements_4.10.12.docx
	Checklist Templates for Rapid Turnover and Cardiac Surgery Cases Some of the videos on modification briefly highlight checklist templates that have been designed and tested for rapid turnover and cardiac surgery cases. We believe that these two areas may need specialized checklists to best suit their unique environments.	Please send us an email at: safesurgery2015@hsph.harvard.edu to obtain copies of these two checklist templates.

Step 3 — Action Items

After reviewing the videos and documents in this section please complete the following action items.

1. Work with your implementation team to modify the checklist. Ensure that a representative from every discipline has an opportunity to participate in this process.
2. Ensure that your checklist retains the elements that are outlined in the document, "Does Our Checklist Contain the Critical Elements" document.

Step 4 — Testing the Checklist

We recommend pilot testing the checklist before you use it in the operating room with a patient. The following materials will walk you through the essential steps of pilot testing. Options include performing a "table-top simulation" and using the checklist in the O.R. under observation.

VIDEO OVERVIEWS	**Pilot Testing the Checklist:** A Demonstration of a Table-Top Simulation This 14-minute clip explains the importance of testing the checklist outside of the O.R. and includes a demonstration of how to test the checklist via a table-top simulation.	**To view a short overview:** http://youtu.be/MAjRH3TGyAU **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Taking the Checklist into the Operating Room for the First Time How to display the checklist in the O.R. during testing after you expand the use of the checklist to the entire O.R. suite.	**To view a short overview:** http://youtu.be/sb9BBnlIPO4 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Safe Surgery 2015: Checklist Videos Checklist demonstration videos and testimonials created in hospitals around the world.	**Videos may be found here:** http://www.safesurgery2015.org/videos.html

Step 4 — Action Items

1. Test your checklist in a "table-top simulation" with members of the checklist implementation team. Collect feedback from this test and incorporate it into the next version of your checklist.
2. Have one surgical team use the checklist for one case. If this team includes staff who are not on the checklist implementation team, remember to brief the staff in advance about the checklist and enlist buy-in. Collect feedback after this test run and incorporate this input into your checklist revisions.
3. After the surgical team has completed the first test run, ask the team use the revised checklist for every case for a full day and continue to modify the checklist as necessary.

Step 5 — Engaging Surgical Team Members in Checklist Adoption

In order to achieve effective checklist implementation it is essential to brief everyone who will be involved with the checklist. This briefing should include: the purpose of the checklist, its form and presentation, the value of its use, and the methods of its use. We encourage checklist implementation teams to engage in one-on-one conversations with all the individuals on the surgical teams in advance of checklist launch and to provide education about the checklist and address questions and concerns. This is a critical step for a successful implementation.

VIDEO OVERVIEWS	**Engaging Surgical Team Members** This 18-minute clip provides an overview of the importance of engaging everyone who will be affected by this project. This is one of the most important things that you can do to make the checklist implementation successful in your operating rooms.	**To view a short overview:** http://youtu.be/CLN9fU342os **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	How To Engage Everyone with an Effective One-on-One Conversation This two-minute clip talks about how to conduct effective one-on-one conversations.	**To view a short overview:** http://youtu.be/fXUHDm7y9l8 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Engaging Your Colleagues By Holding or Repurposing Meetings This nine-minute clip discusses the importance of presenting the checklist at general meetings and provides tips on how to best introduce the checklist.	**To view a short overview:** http://youtu.be/IF9yJhgg2UQ **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Presentations for Surgeons This 11-minute presentation demonstrates how to present the checklist to surgeons. We suggest that you review this clip before speaking to surgeons about this project.	**To view a short overview:** http://youtu.be/F_ym0FMkxwI **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html

DOCUMENTS	**Operating Room Personnel Spreadsheet** This spreadsheet was designed to track which surgical team members have been briefed in one-on-one conversations.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/contact_information_template.xlsx
	One-on-One Conversation Guide This conversation guide is designed to offer discussion points for talking with colleagues.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/one-on-one_conversation_guide_4.10.12.doc
	Large Group Multi-Disciplinary Meeting Presentation Template This presentation template is designed for the large group meetings that should be held in your hospital to inform colleagues about details of this project.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/large_meeting_presentation_4-10-12ppt.ppt
	Anesthesia Providers Presentation Template This presentation template is designed specifically for use in discussions with anesthesia providers about the checklist.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/anesthesiologist_template_4-10-12ppt.ppt
	Nursing and Surgical Tech Colleagues Presentation Template This presentation template is designed specifically for discussions with nursing and surgical tech colleagues about the checklist.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/nurse_and_scrub_tech_4-10-12ppt.ppt
	Surgeons Presentation Template This presentation template is designed specifically for use in speaking with surgeons about the checklist.	**To download this document:** http://www.safesurgery2015.org/uploads/1/0/9/0/1090835/surgeon_template_4-10-12ppt.ppt

Step 5 — Action Items

After reviewing the videos and documents in this section, please complete the following action items.

1. Complete the operating room personnel spreadsheet by listing the names of everyone who will be affected by or involved with the checklist. Identify staff that may have questions or concerns and allow for extra one-on-one discussion time to address their issues.
2. Use the O.R. personnel list that you created and assign members of the implementation team to speak with each staff member individually prior to the checklist launch.
3. Begin presenting the checklist information to your colleagues via one-on-one conversations. Try to speak with skeptics one-on-one before holding large group presentations.

Step 6 — Implementation Planning

Planning for the dissemination and broader utilization of the checklist is critical. We recommend that you and your checklist implementation team discuss how best to expand the use of the checklist. It is best to begin in units where there is the most buy-in. The following materials will assist you with planning the checklist roll-out and marketing in your institution.

VIDEO OVERVIEWS	**Implementation Planning Basics** This seven-minute clip discusses planning for checklist expansion. Picking the most receptive and enthusiastic teams to initially implement checklist use can promote successful checklist adoption.	**To view a short overview:** http://youtu.be/DAGxWE0a7BQ **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Accommodating Feedback This six-minute clip discusses the importance of being available to address questions and concerns when expanding the use of the checklist and how to use short surveys to collect feedback on the implementation process. This clip also discusses the critical importance of addressing and solving problems that are identified during debriefing sessions.	**To view a short overview:** http://youtu.be/ZEd7iGWtBmY **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Planning Checklist Expansion in Small Hospitals This video clip explains how to plan checklist implementation in a small-sized hospital.	**To view a short overview:** http://youtu.be/I3Z0MGcqyu4 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Planning Checklist Expansion in Medium to Large Hospitals This video clip explains how to plan an effective implementation in a medium-to-large-sized hospital.	**To view a short overview:** http://youtu.be/H0tNTQsU8us **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Getting Your Checklist Ready for its Roll-Out This short video provides some tips for printing checklists and preparing for their roll-out.	**To view a short overview:** http://youtu.be/8eYLDx8WdfA **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html

Step 6 — Action Items

After reviewing the videos and documents in this section, please complete the following action items.

1. Finalize your hospital's checklist.
2. Decide if the checklist will be displayed as a poster or distributed in paper form in your O.R.s. If your hospital will be using posters, arrange for their printing.
3. Market the checklist project in your hospital and inform staff about its benefits.
4. Consider creating a video that stars the surgical teams at your hospital who are using the checklist. The video can be used to teach peers how to use the checklist.
5. Hold the large group meetings that you scheduled at the beginning of this project.
6. Prioritize surgical specialties for the roll-out as guided by your assessment of which surgical teams will be most receptive to using the checklist. Create a timeline for the broader expansion of checklist use at your institution.
7. Begin implementing the checklist over the course of a week with the receptive surgical team.
8. Set up a system to collect feedback from the surgical team about the checklist and how the implementation is proceeding.
9. Decide how the impact and effectiveness of the checklist will be monitored.
10. Work with your checklist implementation team to develop a way to inform patients and staff about the checklist items that are being monitored. Consider letting patients know about the checklist and advertising the checklist in patient waiting rooms, to advise patients and families that patient safety is a priority. (the intent is to let the patient/family know that safety is a priority and the checklist is a tool to assure this)

Step 7 — Sustaining Checklist Use

Congratulations, you have successfully implemented the checklist in your operating rooms. Ensuring that the checklist continues to be used appropriately over time can be challenging. The following materials will provide you with an overview of some ways to ensure that effective checklist use is sustained in your operating rooms.

VIDEO OVERVIEWS	**Revisiting Checklist Impact and Measurement** This is a seven-minute review of the best way to measure the impact that the checklist has on your patient outcomes.	**To view a short overview:** http://youtu.be/e6SzD6I5tik **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Becoming a Checklist Coach This 10-minute clip is an overview of how to improve staff performance in using the checklist by coaching in the operating room.	**To view a short overview:** http://youtu.be/yfCayGUDzYE **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	Tips for Sustaining Checklist Use This six-minute clip shares tips for successfully sustaining the use of the checklist in your operating rooms.	**To view a short overview:** http://youtu.be/WBPbbwiYV90 **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html
	A Look Into The Future This clip discusses barriers that hospitals face after they launch checklist implementation and how to overcome them.	**To view a short overview:** http://youtu.be/l-ia40tuhDI **Refer to the Safe Surgery 2015 home page** http://www.safesurgery2015.org/index.html

Step 7 — Action Items

After reviewing the videos and documents in this section, please complete the following action items.

1. Identify individuals in your hospital who can serve as coaches in the operating room. Ask them to observe and coach teams using the checklist.
2. Continue to observe and assess how teams are using the checklist. Continue to monitor checklist use and collecting feedback from surgical teams about how it is going and what could be improved.
3. Meet with front-line staff, including physicians, and obtain input and feedback about the checklist and its utilization.
4. Continue to update hospital leadership on checklist use.

SAFE SURGERY DRIVER DIAGRAM 2013-2014

AIM: Reduce Surgical Site Infections by 40 percent by December 8, 2014.

PRIMARY DRIVERS	SECONDARY DRIVERS	TERTIARY DRIVERS (Refer to the companion guide, the 'Safe Surgery Toolkit', for each step. It contains helpful templates, educational videos, presentations, and slide sets)
STEP 1: Understand the background of and the evidence basis behind the WHO Surgical Safety Checklist	• Learn about the evidence that led to the development of the WHO Surgical Checklist. • Learn the history of the development of the checklist and its evolution. • See a video demonstration of the checklist. • Review the HRET Surgical Safety Checklist template.	• Review the core principles behind this initiative. • Review the topics of checklist creation, pilot testing, effectiveness, and dissemination. • View the checklist demonstration video and the testimonials from hospitals using it around the world. • Download the HRET Surgical Safety Checklist as a template to be customized for your facility. • Recognize that the checklist is a 'working document' and will need ongoing revisions as the Safe Surgery team identifies its strengths and limitations.
STEP 2: Engage in critical preparation before implementing the checklist	• Build a checklist implementation team • Identify, enlist, and nurture clinical champions. • Schedule regular meetings with your checklist implementation team. • Ask the implementation team to address O.R. personnel about using the checklist. • Engage hospital leadership in this effort.	• The team should consist of at least one administrator, an anesthesia provider, a circulating nurse, a scrub tech, and a surgeon. • Choose clinical champions that are well respected and known for their ability to influence their colleagues. • Hold implementation team meetings at least once every other week. Schedule a time for a new meeting or repurpose an existing meeting. Choose a venue where the implementation team can address as many O.R. personnel as possible. • Think about which members of the hospital leadership to engage; the most successful hospitals enlist support from **all** levels in the organization.
STEP 3: Modify and customize the checklist to address the issues in your facility	• Each facility should modify or customize the relevant sections of the checklist. • Understand which criteria are critical for an effective customized checklist. • Ensure that your modifications do not compromise the utility and effectiveness of the checklist. • Ensure that your checklist contains the necessary elements. • Review the checklist templates for cases involving rapid turnover and cardiac surgery.	• Learn the basic guidelines of checklist modification to ensure that your modified checklist retains the critical elements of the WHO and South Carolina Checklists. • Understand the steps that your implementation team should follow when modifying the checklist for your hospital. • Determine which sections of the checklist can be modified and which sections should not be changed. • Two areas within the safe surgery initiative may require the development of unique checklists: rapid turnover and cardiac surgery. To obtain copies of templates for these checklists please e-mail safesurgery2015@hsph.harvard.edu.
STEP 4: Test the checklist	• Test your checklist in a "table-top simulation" with the implementation team. • Have a designated surgical team use the checklist for one case. • If one surgical team has used the checklist once successfully, have the team then use the checklist for every case in one full day.	• Collect feedback from the table-top simulation and use the feedback to revise your checklist. • Have one surgical team use the checklist for one case. Ensure that the team has been briefed in advance about the checklist and is enthusiastic about the test. Collect feedback from the test case use the feedback to revise your checklist. • After one surgical team has used the checklist for every case in one full day, modify the checklist as needed.

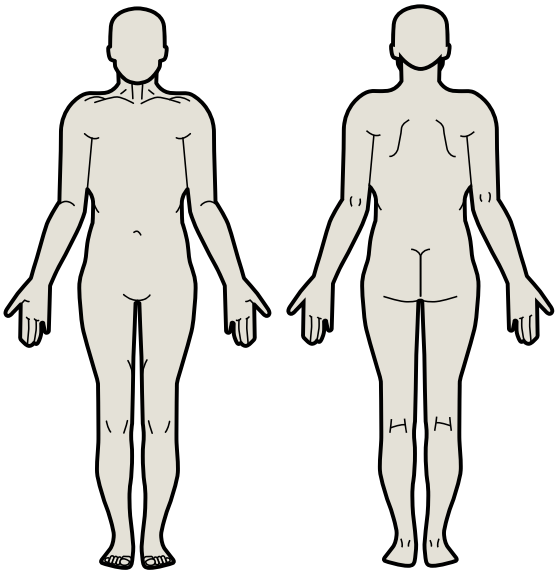
SAFE SURGERY DRIVER DIAGRAM 2013-2014 (CONTINUED)

PRIMARY DRIVERS	SECONDARY DRIVERS	TERTIARY DRIVERS (Refer to the companion guide, the 'Safe Surgery Toolkit', for each step. It contains helpful templates, educational videos, presentations, and slide sets)
STEP 5: **Engage surgical team members in this initiative**	• Engage surgical team members in one-on-one conversations to provide input. • Engage your colleagues by setting up or repurposing meetings. • Provide presentations on the initiative to all surgeons.	• Enter the names of all O.R. personnel who will address checklist items on the spreadsheet. • Assign implementation team members to speak to everyone on the O.R. personnel spreadsheet individually, before a group meeting. Try to address the concerns of skeptics. • Hold group meetings regarding the checklist and continue one-on-one conversations, especially with skeptics.
STEP 6: **Plan the implementation**	• Finalize your hospital's checklist. • Decide if the checklist will be mounted as a poster or distributed on paper in your O.R.s. • Advertise and market the checklist project in your hospital. • Consider creating your own video showing surgical teams in your hospital using the checklist.	• Review the Toolkit Implementation Planning Basics, which include: — How to accommodate feedback. — Issues to keep in mind when planning checklist dissemination in small hospitals. — Issues to keep in mind when planning checklist dissemination in medium-to-large hospitals. — How to prepare your checklist ready for its rollout hospital-wide.

Appendix I: Preparing the Skin Before Surgery

PREPARING THE SKIN BEFORE SURGERY

Preparing or "prepping" skin before surgery can reduce the risks of infection at the surgical site. To make the 'prep' process easier, this facility has chosen disposable cloths moistened with a no-rinse, 2 percent Chlorhexidine Gluconate (CHG) antiseptic solution. The steps below outline the prepping process and should be carefully followed.



Night Before Surgery:

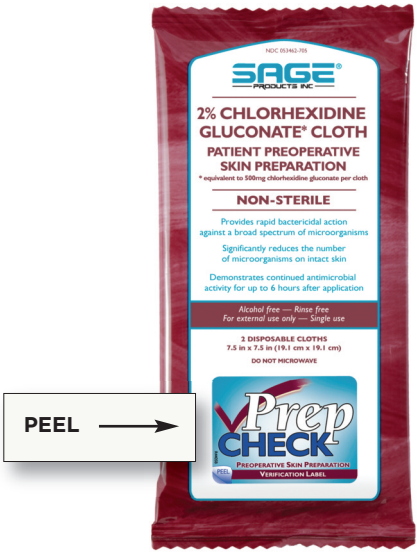
- Shower the night before surgery at least one hour **before** you prep your skin for the first time.
- **Do not** allow this product to get into your eyes, ears, and mouth.
- Prep the skin as directed using the first package of cloths.
- Stop use if redness or irritation occurs.
- **Do not** apply lotions, moisturizers, deodorant, or makeup after prepping.
- Dress in clean clothes/sleepwear.
- Remove the sticker from the used package and apply it to this form.

Morning of Surgery:

- You may shower, then wait one hour to prep the skin.
- Prep the skin as directed using the second package of cloths.
- Do not apply lotions, moisturizers, deodorant, or makeup after prepping.
- Dress in clean clothes/sleepwear.
- Remove the sticker from the used package and apply it to this form.
- Bring this form with you to your surgery.

How to Use Cloths:

1. Prep only the circled areas above
2. Scrub the skin back and forth for 3 minutes with 1 cloth
3. Do not rinse
4. Allow to air dry
5. Discard each cloth after a single use
6. **Repeat** the process with the second cloth



SERVICE	ATTENDING	RESIDENT	SEE FOR ALLERGIES

OPERATING ROOM AND PRE-OP HOLDING INSULIN INFUSION PROTOCOL ORDERS
Goal BG Range = 100-140 mg/dL

- ☑ Discontinue All Previous Subcutaneous Insulin Orders
- ☑ Standard insulin infusion: 100 units/100 mL 0.9% Sodium chloride via an infusion device
- ☑ Confirm piggyback of 5% Dextrose at 100mL/hr is infusing
- ☑ Check blood glucose (BG) hourly

Treatment of Hypoglycemia (BG <70 mg/dL) or symptoms of hypoglycemia

- ☑ **Turn off** insulin infusion for any BG below goal **AND**
- ☑ Give 25 mL (1/2 amp) of 50% dextrose IV if BG 50-69 mg/dL **OR**
- ☑ Give 50 mL (1 amp) of 50% dextrose IV if BG < 50 mg/dL.
- ☑ Recheck BG every 20 minutes until BG ≥100 mg/dL
  - → IF BG is <70 mg/dL repeat 25 mL (1/2 amp) 50% dextrose
  - → WHEN BG is ≥100 mg/dL, restart the insulin infusion at a lower dose by using one algorithm **LEFT** from previous algorithm (see "Evaluating Trends & Using Algorithms" section).

Algorithm 1 **Start here for Type 1 DM**		**Algorithm 2** **Start here for Type 2 DM**		**Algorithm 3** **Do NOT Start here**		**Algorithm 4** **Do not start here**	
BG	**Units/hr**	BG	**Units/hr**	BG	**Units/hr**	BG	**Units/hr**
<70 = Hypoglycemia (See page 1 for treatment)							
70-99: Off x 20 minutes & recheck BG							
100-120	**0.5**	100-120	**1**	100-120	**2**	100-120	**3**
121-140	**0.8**	121-140	**1.5**	121-140	**2.5**	121-140	**4**
141-160	**1.2**	141-160	**2**	141-160	**3**	141-160	**5.5**
161-180	**1.5**	161-180	**2.5**	161-180	**4**	161-180	**7**
181-210	**2**	181-210	**3**	181-210	**5**	181-210	**9**
211-240	**2.5**	211-240	**4**	211-240	**6**	211-240	**12**
241-270	**3**	241-270	**5**	241-270	**8**	241-270	**16**
271-300	**3.5**	271-300	**6**	271-300	**10**	271-300	**20**
301-330	**4**	301-330	**7**	301-330	**12**	301-330	**24**
331-360	**4.5**	331-360	**8**	331-360	**14**	>330	**28**
>360	**6**	>360	**12**	>360	**16**		

Evaluating Trends & Using Algorithms:

Move right or left only one algorithm per BG check. Subtract current BG reading from previous BG reading for the change in BG.

- ☑ BG **in** goal range:
  - If BG has decreased ≥100 mg/dL in one hour, move **LEFT** one algorithm and use appropriate rate from table
  - If BG has decreased <100 mg/dL in one hour, maintain patient within current algorithm and adjust rate until patient is in goal range for 4 hours
  - Once patient is within goal range for 4 hours, do NOT adjust rate unless BG exits goal range
- ☑ BG **above** goal range:
  - If BG has not decreased by at least 60 mg/dL, move **RIGHT** one algorithm and use appropriate rate from table
  - If BG has decreased by 60-100 mg/dL, stay within current algorithm and use appropriate rate from table
  - If BG has decreased ≥100 mg/dL in one hour, move **LEFT** one algorithm and use appropriate rate from table
- ☑ Hypoglycemic event OR BG below goal range
  - Turn off insulin infusion. Treat hypoglycemia if BG<70mg/dL Recheck BG in 20 minutes.

Move **LEFT** one algorithm and use appropriate rate from table when BG returns to goal range.

PHYSICIAN SIGNATURE	PRINT NAME	PAGER	UPIN/NPI	DATE	TIME

Appendix III: O.R. Observation Checklist

CHECKLIST — Intra-operative IP&C (infection prevention and control)

Note: this is the personal checklist developed by Sue Barnes, RN, CIC, National Leader Infection Prevention and Control Quality and Safety Department, Program Office Kaiser Permanente — it is not intended to suggest or mandate a product preference or endorsement.

PRE-OPERATIVE

ASK

- Has patient/family teaching been performed and understood? Has Teach-back been used?
- Has pre-op antiseptic bathing been advised — e.g. chlorhexidine cloths or liquid night before and morning of surgery
- Has active surveillance testing for MRSA and decolonization been done by the MD or Nurse?
- Has a pre-op oral rinse with chlorhexidine been performed?
- Has glucose testing been performed and is glucose controlled?

OBSERVE

- Hair removal — by clipper or not at all (not using razor)? If in O.R. is a ClipVac used?
- Pre-op antibiotic given at dose adjusted for weight within one hour prior to incision— re-dosed if length of case is > 2 hours?
- Skin prep with a dual agent — Chloraprep or Duraprep — applied correctly; Sterile PVI 0.25% for ophthalmology cases with a single prep stick for lids (PVI)?
- OB/GYN: vagina and belly button cleansed with ½ strength H2O2 prior to povidone-iodine to remove blood and bioburden?
- Normothermia — use of electric warmed air blanket or warmed blanket covered by warmed sheet tucked around patient?
- Disposable B/P cuff, pulse ox, EKG leads used?
- Sterile trays opened no more than 60 min prior to the case — and monitored after opening?
- Does the team discuss: if a Foley catheter is needed? Aseptic insertion? Time of removal?

INTRA-OPERATIVE

- Anesthesia:
  - Is the Foley off the floor?
  - Has a hub scrub been done prior to IV injections or are IV injection port protectors/hub disinfectors used?
  - Is Duraprep or Chloraprep used prior to epidural or spinal anesthesia instead of povidone-iodine?
- If hair removal in O.R.: Is a ClipVac used for clipping and containment of clipped hair (if the hair cannot be removed in the pre-op area): http://www.surgicalsitesolutions.com/?
- Do the doors remain closed and the environment remains clean and uncluttered?
- No fleece, no brief cases, no jewelry?
- Is traffic in and out of the O.R. minimized during the case?
- Is there full skin (long sleeves) and hair coverage for all O.R. staff and surgeons? Are masks tied and covering the nose and mouth?
- Is all non-sterile equipment covered by a clean barrier such as a C-arm?
- Aseptic technique
  - Staff do not turn their backs to the sterile field?
  - Scrubbed personnel pass front-to-front or back-to-back?
  - Sterile fields are not at disparate heights? Is drape length on surfaces adequate?
  - Unscrubbed maintain a 1 foot distance from sterile fields?
  - Sterile fields are protected and monitored?
  - Separation of sterile team from non-sterile team is maintained?
  - Unscrubbed personnel do not pass between two sterile fields?
  - Hands remain above the waist for scrubbed personnel?
- Glucose testing and control?
- Normothermia — is an electric warmed air blanket used or is a warmed blanket covered by warmed sheet tucked around patient?

Operative technique and intra-operative prevention of infection:

- During the operation…
  - Is the smallest incision possible made (but large enough to avoid stretching skin)?
  - Is dead space minimized? (e.g. minimal blunt dissection)
  - Is adipose tissue kept moist via irrigation or soaked gauze — e.g. in open bariatric, abdominal and breast cases?
  - If used, is wound protector applied BEFORE incising bowel to reduce wound edge contamination?
  - Do certain cutting devices — ask for the surgeon's opinion — affect SSI risk?
  - Is a wound edge protector used for abdominal cases involving entry into the bowel to prevent contamination of wound edges with visceral contents?

BEFORE INCISING BOWEL

- Have implants for ortho and plastics been soaked in an IrriSept, bacitracin, or neomycin solution?
- Irrigation:
  - Is pulsatile lavage irrigation used after prolonged intra-abdominal procedures?
  - Is Chlorhexidine 0.05% (IrriSept) added to cases currently using Neomycin/Polymixin?
  - In case of a ruptured appendix, is pus aspirated and no irrigation done?
- Wound closure and care
  - Wound closure — what is the best? Suture plus surgical adhesive, staples plus surgical adhesive, antimicrobial impregnated suture, mesh tape plus surgical adhesive? A new skin closure system, Prineo by Ethicon, is a two-step skin closure system: the mesh is dispensed like scotch tape on approximated skin edges, followed by application of adhesive over the mesh.
  - Sutures not pulled too tight on skin or subcutaneous tissue/fascia to avoid reducing vascular flow?
  - Subcutaneous sutures placed in addition to skin suture for C sections?
  - Antiseptic dressings placed around drains and pins and external fixators?
  - Antiseptic post-op dressings used?

(continued on following page)

POST OPERATIVE

- Wound closure — in order of infection prevention effectiveness: mesh tape plus surgical adhesive, suture plus surgical adhesive, staples plus surgical adhesive, antimicrobial impregnated suture?
- Early removal of drains?
- Hand piece for hair clipper sterilized? Head of clipper disposed?
- Antiseptic dressings around drain remaining in place?
- Antiseptic post-op dressings placed?
- Glucose testing and control continued?
- Normothermia — electric warmed air blanket used or is a warmed blanket covered by warmed sheet tucked around the patient?
- Patient/family teaching performed?
- Pain control provided?

OTHER

- Kaiser Permanente Plus measures for SSI prevention with an evidence summary for each measure, Page 13 of the SSI Prevention Chapter. Retrieved at: http://nursingpathways.kp.org/national/quality/infectioncontrol/toolkit/index.html,

STERILE PROCESSING DISTRIBUTION (SPD)

- Best practice: surgeon visits SPD to better understand the challenges when trays are received with a lot of bio-burden
- Best practice: SP techs observe O.R. cases to understand the importance of their role in patient safety
- Ask: how are suction cannulas and other small-lumen instruments cleaned? Is there any double-check of cleanliness such as Clean Trace 3M?
- Ask: are scissors and clamps open during decontamination and sterilization?
- Ask: how are lead aprons cleaned/disinfected between cases?
- Ask: how are pneumatic tourniquets cleaned/disinfected?

Surgical Safety Checklist

World Health Organization | Patient Safety
A World Alliance for Safer Health Care

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- ☐ Yes

Is the site marked?
- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?
- ☐ Yes

Is the pulse oximeter on the patient and functioning?
- ☐ Yes

Does the patient have a:

Known allergy?
- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?
- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?
- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

- ☐ **Confirm all team members have introduced themselves by name and role.**
- ☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?
- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:
- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:
- ☐ Are there any patient-specific concerns?

To Nursing Team:
- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?
- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:
- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- ☐ What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool

On the following page, you will find a sample gap analysis tool that will assist your team in identifying potential opportunities for improvement. Your observations via the tool can guide your efforts to improve the reliability of certain practices and suggest new change ideas for potential implementation.

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
SURGICAL SAFETY CHECKLIST				
Is there a customized Surgical Safety Checklist review at the following points: • Before induction of anesthesia • Before skin incision • Before patient leaves O.R. Does the team verbally confirm with the appropriate team members all items on the surgical checklist at each pause point? Is a debriefing incorporated into the checklist which includes: • Equipment problems that need to be addressed • Key concerns for patient recovery and management • Improvements that could have made the case safer or more efficient Is clarification and documentation of the surgical wound class included in the debriefing?				
ANTIMICROBIAL PROPHYLAXIS				
Is there a standardized order set for each surgical procedure that includes use of antibiotics, dosage and timing, and discontinuation or repeated dosage? Are there pharmacist- and nurse-driven protocols that promote ideal antibiotic selection and dose based on the type of surgery and the patient characteristics (age, weight, BMI)? Is specific 'antibiotic-in to cut-time' measured? i.e. the precise interval between the provision of the pre-op antibiotic and the placement of the incision or the application of a tourniquet?				

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
PERI-OPERATIVE SKIN ANTISEPSIS				
Are there standardized practices for the choice of and application of skin antiseptic agents? Are the peri-operative staff educated on the safe application of selected skin antiseptic agents?				
PRE-OPERATIVE SKIN CLEANSING				
Are there standardized order sets for pre-admission skin cleansing? Is there a standardized protocol for frequency and duration of pre-operative skin cleansing (e.g. for 3-5 days prior to surgery)? Is there a strategy for distribution of skin antiseptic agents/products to patients? Are patients/families educated on how to apply the skin antiseptic agent prior to admission? Is there a system in place to verify that the patient applied the antiseptic appropriately?				
***S. AUREUS*/MRSA SCREENING**				
Is there a protocol in place to conduct nasal *S. aureus*/MRSA screening? Is there a protocol in place to manage colonized patients with Mupirocin and CHG wash or Povidone Iodine nasal antiseptic and CHG wash?				

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
PERI-OPERATIVE TEMPERATURE MANAGEMENT				
Is there a standardized procedure for pre-warming every surgical patient who has no contraindications? Is there a standardized practice in place to provide active warming for patients during a surgical procedure?				
GLUCOSE CONTROL				
Is there a peri-operative glycemic control team that is assigned responsibility and accountability for blood glucose monitoring and control? Are there glucometers located at every anesthesia station? Is there a system in place to assure glucose levels are not too high and not too low and to minimize extreme values?				
OXYGEN SUPPLEMENTATION				
Is there a protocol in place to guide the use of supplemental oxygen at a FiO_2 of 80% intra-operatively and immediately after surgery for all surgeries?				

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
MINIMIZING BLOOD TRANSFUSIONS				
Have steps been taken to study blood transfusion practices in the surgical setting? Is your facility tracking and trending PRBC transfusion rates in surgical patients? Have you implemented a 'hard stop' or 'best practice alert' for PRBC transfusion orders? Do you include 'history of PRBC transfusion' in the root-cause analyses of SSI investigations?				
WOUND IRRIGATION				
Is there a protocol in place to address the utilization of wound irrigation in specific surgeries including: • Ortho/spine/colon: Chlorhexidine 0.5% sterile irrigation solution for cases currently using Neomycin/Bacitracin • Colon: Pulsatile lavage irrigation after prolonged intra-abdominal procedures • All types of surgery: normal saline copious irrigation >2000ml/hour of saline • Eye: sterile PVI 0.25% irrigation				

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
SKIN CLOSURE				
To reduce SSI, have you considered using products other than sutures or implementing different procedures such as: • Clean procedures: using skin glue instead of, or in addition to, tape or suture for high-risk cases until skin starts to heal • Contaminated procedures: using staples instead of sutures • Using skin sealant prior to incision after skin prep (e.g. Integuseal) • Cases requiring suturing: using antimicrobial-impregnated suture • All cases: are sterile gloves and instruments replaced before closing?				
DRAINS, DRAPES, DRESSINGS				
Are there protocols in place to promote the timely removal of drains and the use of antiseptic dressings around drains that remain in place? Are antimicrobial impregnated surgical drapes being used for selected cases if appropriate? (this is just a suggestion; we are not going to direct them to which cases might be considered) Are antiseptic dressings (e.g. PHMB, a derivative of chlorhexidine) being used if appropriate? ?				
TRAFFIC CONTROL				
Do you have systems in place to monitor traffic control in surgical settings? Are you correlating this measure with SSI data, and, if so, do you report your analyses to the surgical team?				

Appendix V: Identifying and Closing the Gaps/Gap Analysis Tool (continued)

PROCESS QUESTIONS	POLICIES & PROCEDURES List and review all associated policies and procedures. Are any changes needed?	TRAINING MATERIALS List and review all associated training materials. Are any changes needed?	ACTUAL PRACTICE Observe through chart reviews, staff interviews, or unit observation. Does practice match policy?	MONITORING List the measures collected and the frequency of collection. Who collects/aggregates data? Where are the findings analyzed and reported?
HAIR REMOVAL				
Is hair removal done with clippers rather than razors? Is hair removal done in a contained manner and outside of the sterile environment?				
TEAM TRAINING AND TEAMWORK				
Have you utilized a validated Safety Attitudes Questionnaire to better understand behavior in the surgical setting? If yes, how have you used the results to direct positive change and improve teamwork? Have you launched a Team Training program designed to improve teamwork in the peri-operative setting?				
IMPROVING THE ACCURACY OF SURGICAL WOUND CLASSIFICATION				
Have you validated the accuracy of the surgical wound classification? If so, what steps have you taken to improve the accuracy? Is 'surgical wound classification' a component of your surgical safety checklist?				

Surgical Site Infections (SSI) Top Ten Checklist

TOP TEN EVIDENCE BASED INTERVENTIONS				
PROCESS CHANGE	**IN PLACE**	**NOT DONE**	**WILL ADOPT**	**NOTES (RESPONSIBLE AND BY WHEN?)**
Develop and follow standardized order sets for each surgical procedure to include antibiotic name, timing of administration, weight-based dose, re-dosing (for longer procedures), and discontinuation.	☐	☐	☐	
Ensure pre-operative skin antisepsis (basic soap and water shower; chlorhexidine (CHG) showers).	☐	☐	☐	
Develop standardized peri-operative skin antiseptic practices utilizing the most appropriate skin antiseptic for the type of surgery performed.	☐	☐	☐	
Develop a standardized procedure to assure normothermia by warming ALL surgical patients.	☐	☐	☐	
Develop and implement protocol to optimize glucose control in ALL surgical patients.	☐	☐	☐	
Develop protocol to screen and/or decolonize selected patients with *Staphylococcus aureus.*	☐	☐	☐	
Adhere to established guidelines (e.g. HICPAC, AORN) to assure basic aseptic technique (e.g. traffic control, attire) is adhered to uniformly.	☐	☐	☐	
Establish a culture of safety that provides an environment of open and safe communication among the surgical team.	☐	☐	☐	
Establish system where surgical site infection data is analyzed and shared.	☐	☐	☐	
Develop a protocol to provide guidance on blood transfusion practices as a unit of packed red blood cells should be considered a transplant/immune modulator and has been linked to a higher risk of SSI's.	☐	☐	☐	