

Reducing Colorectal Surgical Site Infections

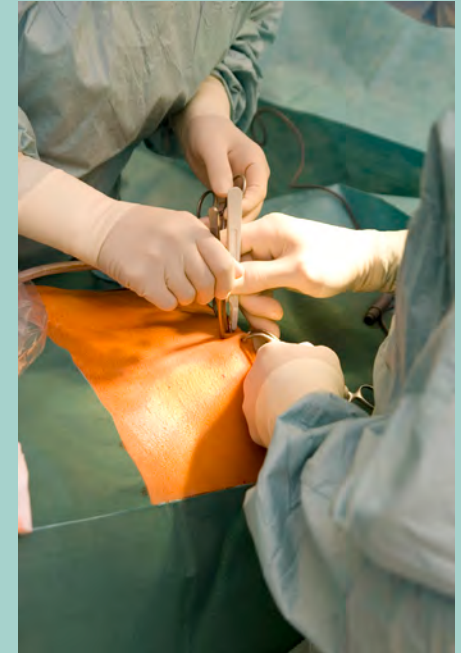
The Joint Commission's Center for Transforming Healthcare aims to solve health care's most critical safety and quality problems. Leading health care organizations partnered with the Center to use a proven, systematic approach to analyze specific breakdowns in patient care and discover their underlying causes to develop targeted solutions that solve these complex problems. In keeping with its objective to transform health care into a high reliability industry, The Joint Commission shares these proven effective solutions with the more than 20,500 programs it accredits and certifies. Also, part of the mission of the Joint Commission Center for Transforming Healthcare is to ensure the lessons learned and solutions developed can be applied to other health care organizations across the country.

This project was launched in collaboration with the **American College of Surgeons (ACS)**. The ACS is dedicated to improving the care of the surgical patient and to safeguarding standards of care in an optimal and ethical practice environment. The Reducing Colorectal Surgical Site Infections (SSI) project uses data derived from the ACS's National Surgical Quality Improvement Program (NSQIP). Hospitals that participate in the ACS NSQIP program use trained surgical clinical reviewers to collect preoperative through 30-day postoperative data on randomly assigned patients. The collected clinical data allows ACS NSQIP to provide blinded, risk-adjusted data to share with all NSQIP hospitals, allowing them to nationally benchmark their complication rates and surgical outcomes. NSQIP data on outcomes of surgery are highly regarded by physicians as clinically valid, using detailed medical information on severity of illness and comorbidity to produce data on risk-adjusted outcomes. SSI is one of the most prevalent negative outcomes reported by NSQIP hospitals.*

Colorectal Surgical Site Infections Project Participants

- Cedars-Sinai Medical Center, Los Angeles, California
- Cleveland Clinic, Cleveland, Ohio
- Mayo Clinic-Rochester Methodist Hospital, Rochester, Minnesota
- North Shore-Long Island Jewish Health System, Great Neck, New York
- Northwestern Memorial Hospital, Chicago, Illinois
- OSF Saint Francis Medical Center, Peoria, Illinois
- Stanford Hospital & Clinics, Palo Alto, California

*David B. Hoyt: "Looking Forward," *Bulletin of The American College of Surgeons*, 2010;95(11):4-5



Colorectal Surgical Site Infection Project Outline

Background

Surgical site infections (SSIs) are the second most common healthcare-associated infection (HAI). SSI rates are disproportionately higher among patients following colorectal surgeries. Resulting SSIs are known to have significant patient complications with adverse clinical and economic impact.

Quality improvement methods

In partnership with the American College of Surgeons, the Joint Commission Center for Transforming Healthcare led a multi-institutional collaboration of seven leading U.S. hospitals, established to reduce colorectal SSIs. Preventing colorectal SSIs is a complex problem with multiple variables specific to patients and patient populations, institutional factors, surgical practice and process. Recognizing this complexity, participating hospitals used Lean Six Sigma and change management methods to understand why infections were occurring at their facilities and how to prevent them. Outcome measures were the observed rate of colorectal SSIs and the ACS NSQIP observed-to-expected (O/E) ratio for colorectal SSIs. Participants focused on improving the care received by colorectal surgical patients, from preadmission to 30-days after surgery.

Results

After two-and-a-half years, there was an overall reduction in superficial incisional SSIs by 45 percent and all types of colorectal SSIs by 32 percent. Participants attained cost savings of more than \$3.7 million for the 135 estimated colorectal SSIs avoided during the project period. Applying the reduction in SSIs to the annual case load of colorectal surgeries at participating hospitals suggests that they will experience 384 fewer SSI cases and save \$10.6 million per year as the result of this work. The average length of stay for hospital patients with any type of colorectal SSI decreased from an average of 15 days to 13 days.



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* Key Terms

- **Correlating Variables** are factors or attributes that are strongly associated with an outcome. For this project, participating hospitals analyzed and validated a number of variables that significantly influence the occurrence of colorectal SSIs within their organizations.
- **Contributing Factors** are a set of actions leading to surgical process failure that increase the risk or likelihood of colorectal SSIs. Contributing factors are determined from correlating variables.
- **Targeted Solutions** are practices developed to mitigate each contributing factor. They have been thoroughly tested and proven effective.

Colorectal Surgical Site Infections: Characteristics of Project Participants

Site		# of Beds	# of Colorectal Surgeries/Month	# of Colorectal Surgeries/Year	# of Surgeons Performing Colorectal Surgeries
Cedars-Sinai Medical Center		923	45	536	46
Cleveland Clinic		1,200	237	2,854	16
Mayo Clinic-Rochester Methodist Hospital		700	208	2,500	8
North Shore-Long Island Jewish Health System		1,290	55	662	31
Northwestern Memorial Hospital		894	33	404	8
OSF Saint Francis Medical Center		616	21	250	13
Stanford Hospital & Clinics		613	32	380	47
Total:				7,586	

- The surgeons involved may be directly employed by the hospital, or be a mix of employed and private practice surgeons who perform surgeries at the participating hospitals.
- Although two of the participating hospitals do not participate in the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP), all of the project participants agreed to use a common set of metrics to measure and monitor their colorectal SSI outcomes.
- All of the project participants are academic medical centers.

Why Colorectal Surgical Site Infections?

Surgical site infections (SSIs) are a major cause of patient injury and death. They increase health care costs and prolong hospitalization. In a 2002 study of U.S hospitals, the estimated number of healthcare-associated infections (HAIs) was approximately 1.7 million. SSIs were the second most common HAI, accounting for 22 percent of all HAIs among hospitalized patients. SSIs occur in 2-5 percent of patients undergoing inpatient surgery in the U.S., resulting in approximately 500,000 SSIs each year. Each SSI is associated with approximately 7-10 additional postoperative hospital days. Patients with an SSI have a 2-11 times higher risk of death, compared with operative patients without an SSI. Of SSI deaths among patients, 77 percent are directly attributable to SSI. SSIs are believed to account for up to \$10 billion annually in health care expenditures. Attributable costs of SSI vary depending on the type of operative procedure and the type of infecting pathogen. Published estimates range from \$3,000 to \$29,000.

Scope of the project

A wide range of surgeries and procedures can result in SSIs – each with its own unique complications and challenges.

To narrow the scope of the project, colorectal surgery was selected because it:

- Is common across different types of hospitals. It is estimated that there are 300,000 to 600,000 patients who undergo colorectal surgical procedures annually across the U.S.
- Has significant complications with an adverse clinical impact since the colon and rectal tracts contain more bacteria that are exposed during surgery
- Presents hospitals with significant opportunities to improve performance
- Has high variability in performance across hospitals

The SSI project:

- Includes all surgical inpatients undergoing emergency and elective colorectal surgery (following the ACS NSQIPs defined CPT codes), with the exception of trauma and transplant patients and patients under 18.
- Addressed preadmission, preoperative, intraoperative, postoperative, and post discharge follow-up processes.
- Includes all surgeons, ancillary professionals, infection prevention experts, as well as patients and their caregivers.

Sources of data: Klevens RM, Edwards JR, et al: Estimating health care-associated infections and deaths in U.S. hospitals, 2002, *Public Health Reports* 2007;122:160-166

Emori TG, Gaynes RP: An overview of nosocomial infections, including the role of the microbiology laboratory, *Clinical Microbiology Reviews*, 1993;6(4):428-42

Anderson DJ, et al: Strategies to prevent SSIs in acute care hospitals, *Infection Control Hospital Epidemiology*, 2008;29:S51-S61

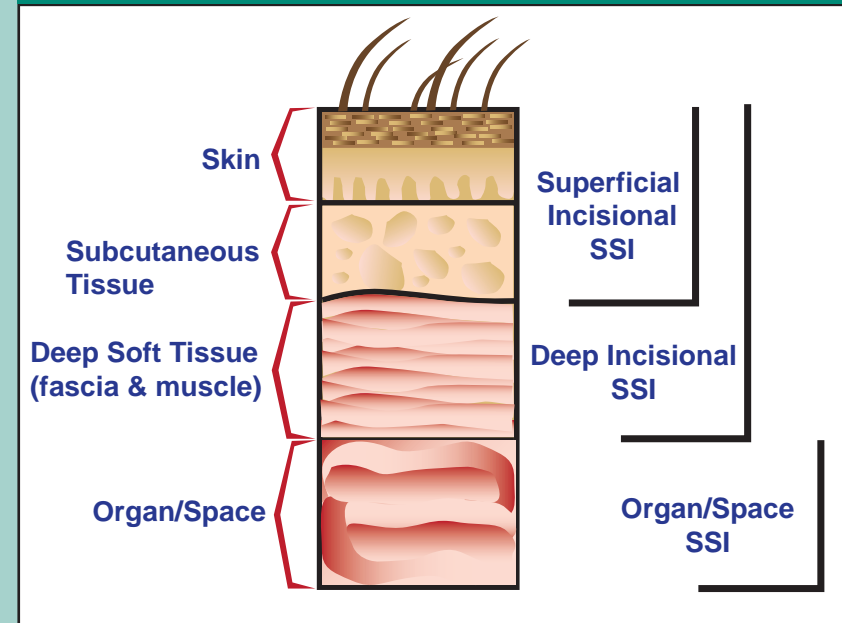
Why Colorectal Surgical Site Infections? (cont'd)

The initial scope of the project was to study the three types of colorectal SSIs – **superficial incisional, deep incisional, and organ/space SSIs** (see *graphic*). Project participants were able to identify the common set of correlating variables and contributing factors that validated the value of overall infection prevention practices to reduce some SSIs. Over the course of the project, it became apparent that the “one size fits all” approach in measuring and reducing the different types of colorectal SSIs would not achieve the same success in reducing all types of SSIs simultaneously. Organ/space SSIs were particularly challenging, requiring more in-depth investigation, especially into surgical techniques and protocols. To continue this work, pilot organizations are investigating measurement tools and improvements to reduce deep incisional and organ/space SSIs.

RPI methods:

This project addresses the problem of surgical site infections using Robust Process Improvement® (RPI®) methods. RPI® is a fact-based, systematic and data-driven problem-solving methodology. It incorporates Lean Six Sigma and change management methodologies. Using RPI®, the project participants measure the magnitude of the problem, pinpoint the contributing causes, develop specific solutions that are targeted to each cause, and thoroughly test the solutions in real life situations.

Cross section of abdominal wall showing the levels and types of SSIs



Superficial incisional SSI: infection involves only skin or subcutaneous tissue of the incision

Deep incisional SSI: infection appears to be related to the operation and involves deep soft tissues (ex: fascial and muscle layers) of the incision

Organ/space SSI: infection appears to be related to the operation and involves any part of the anatomy other than the incision (ex: organs or spaces), which was opened or manipulated during an operation

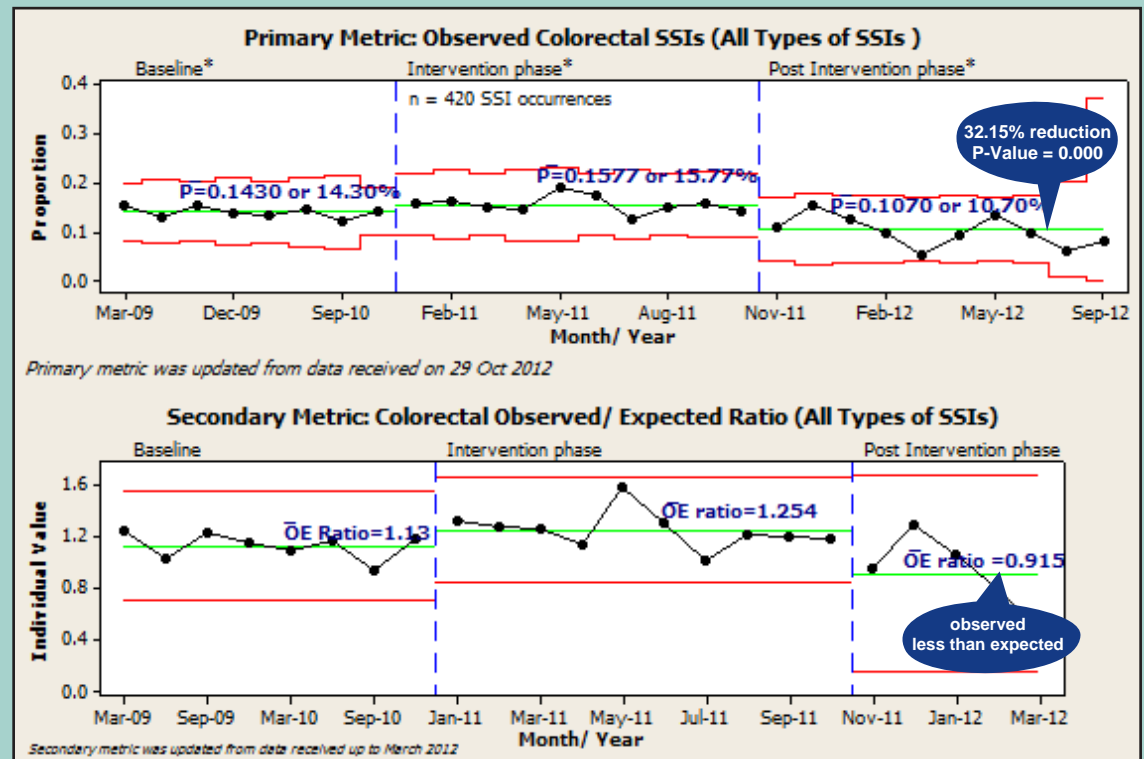
Colorectal Surgical Site Infection Project Results

The project launched in August 2010.

- Figure 1** shows aggregate performance over the course of the project. The overall SSI rate from colorectal surgical procedures at the 7 participating hospitals was at 15.77 percent of patients during a 10-month intervention phase when hospitals started adopting changes. During the post intervention phase, once all changes were completed, the infection rate dropped to 10.70 percent. Participating hospitals reduced all types of SSIs by 32 percent (135 SSIs) after all solutions were implemented.
- Correspondingly, the ACS NSQIP observed-to-expected (O/E) ratio declined from 1.25 in the intervention phase to 0.92 in the post intervention phase showing there were less colorectal SSIs in the study population than expected after adjusting for age, sex, body mass index, and other factors. This shows that the SSI decrease was not due to changes in the types of patients undergoing surgery. Decreases in SSIs validated the principal outcome of this project—that the interventions developed and deployed by these 7 hospitals substantially reduced their rates of SSIs following colorectal surgery.
- Cost savings of \$3.7 million were estimated for the 135 SSIs avoided during the post intervention phase. Applying the reduction in SSIs achieved in this project to the annual case load of colorectal surgeries at the 7 participating hospitals (7,586) suggests that they will experience 384 fewer SSI cases and save \$10.6 million per year as the result of this work. The ACS NSQIP Return on Investment calculator was used to estimate savings.
- Overall, the average length of stay (ALOS) decreased from an average of 15 days to 13 days for hospital patients with any type of colorectal SSI. In comparison, ALOS is 8 days for patients with no SSIs. The ALOS excluded patients who were readmitted.

* Source: <http://site.acsnsqip.org/wp-content/themes/nsqip/extras/flex2/ROI Calc.html>

Figure 1



Baseline = January 2009 to October 2010. The period when no changes were made. Data collected reflect the SSI rate before any improvement interventions took place. Project participants used this baseline data to establish a target rate for reducing SSIs.

Intervention phase = January 2011 to October 2011. Period when multiple improvement activities were in progress and pilot testing occurred.

Post intervention phase = After October 2011. Period when all the improvement solutions were implemented and data reflected decreasing rates of SSIs.

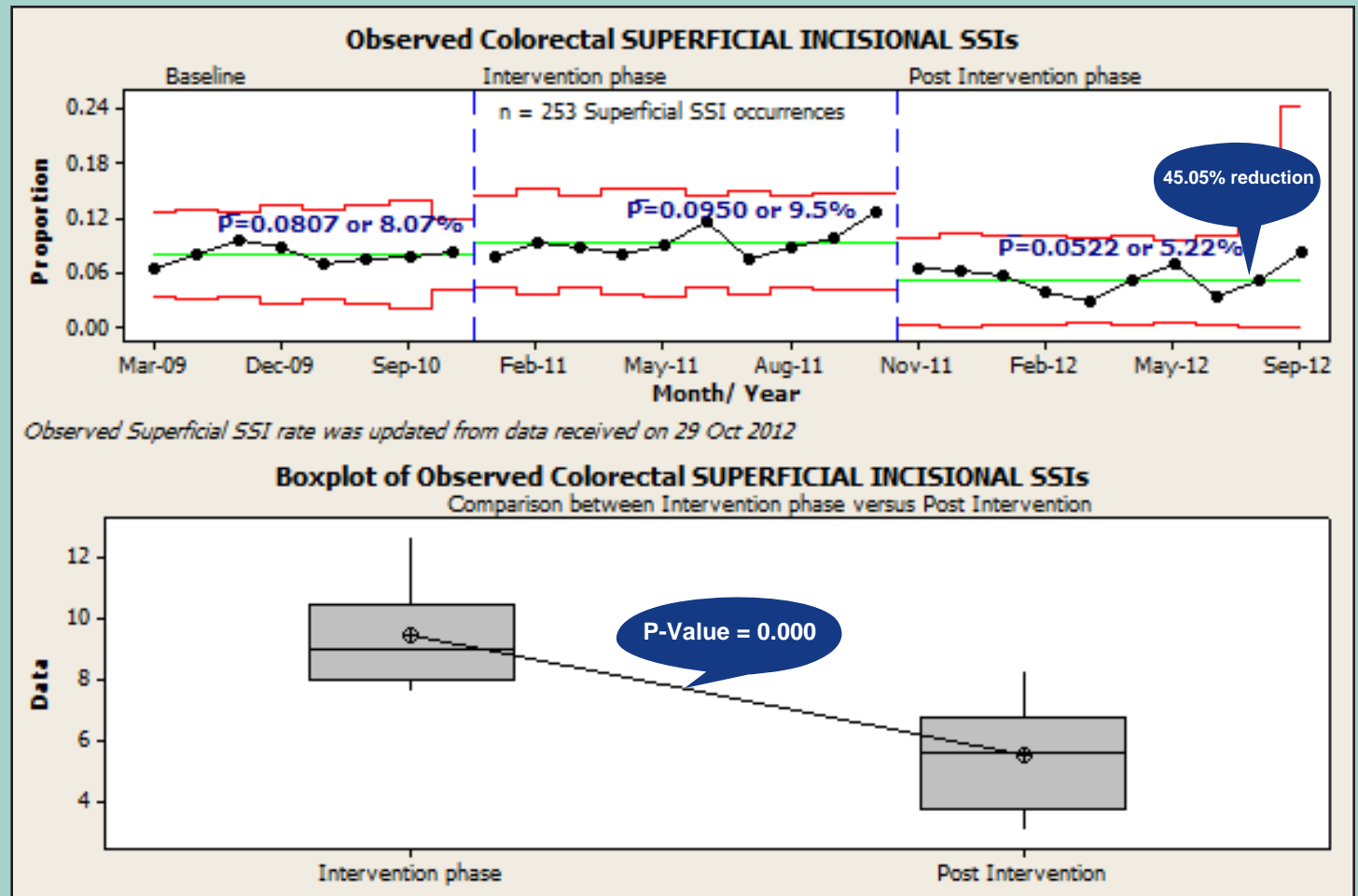
Colorectal Surgical Site Infection Project Results (cont'd)

When project participants stratified improvement results by types of colorectal SSI, the most significant impact was the reduction of superficial incisional SSIs.

Figure 2 shows that superficial incisional SSIs decreased by 45 percent, and 114 infections were avoided after all solutions were implemented.

To reach these results, participating hospitals followed a systematic, data-driven process that led to a deeper understanding of why colorectal SSIs were happening at each of their facilities. The strategies to prevent SSIs were developed by identifying and studying the variables most strongly associated with the occurrence of SSIs. These solutions are detailed in pages 9-11.

Figure 2



Baseline = January 2009 to October 2010. The period when no changes were made. Data collected reflect the SSI rate before any improvement interventions took place. Project participants used this baseline data to establish a target rate for reducing SSIs.
 Intervention phase = January 2011 to October 2011. Period when multiple improvement activities were in progress and pilot testing occurred.
 Post intervention phase = After October 2011. Period when all the improvement solutions were implemented and data reflected decreasing rates of SSIs.

Colorectal Surgical Site Infection Project Results: National Impact

Each year, more than 600,000 surgical procedures are performed in the United States to treat a number of colon diseases. (Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), 2013: at: <http://www.sages.org/publication/id/PI09/>)

Applying results to the national estimate show that, by using the methods, solutions and lessons learned through the SSI project, approximately 30,420 infections from colorectal surgeries can be prevented with an annual savings of up to \$834 million.



Contributing Factors and Targeted Solutions to Reduce Colorectal SSIs

Contributing factors are a set of actions leading to surgical process failure that increase the risk or likelihood of colorectal SSIs. Targeted solutions are practices developed to mitigate each contributing factor. They have been thoroughly tested and proven effective. The table below links solutions to the factors they were designed to solve.

Contributing Factors	Targeted Solutions
Preadmission and preoperative evaluation processes	
<p>All types of SSIs</p> <ul style="list-style-type: none"> • Failure of preoperative testing and health screening to detect active medical conditions that increase the risk of SSIs. • Inadequate management of active medical conditions preoperatively led to patients being operated on under suboptimal conditions. This compromises patients' immune functions, increases the risk of SSIs, and affects patients' ability to recover. 	<p>Establish a protocol for colorectal-specific preoperative testing and evaluation, to be implemented at preadmission and preoperative inpatient units.</p> <ul style="list-style-type: none"> • Provide nutritional counseling and intervention before surgery, if the patient's condition indicates this need. • Refer the patient to a smoking cessation program. • Screen for infections during preadmission testing. • Build alerts into existing computer system to identify high-risk patients so additional precautions can be taken in preparing these patients for surgery. • Reconcile medications and appropriately adjust dosing of high risk medications prior to surgery (if not contraindicated for the patient's conditions).
<p>Incisional SSIs</p> <p>Inconsistent preoperative orders and preparation to reduce SSI risks.</p>	<ul style="list-style-type: none"> • Standardize preoperative physician order sets for all colorectal surgical patients. • Program procedure listing software to automatically prompt an order for skin cleansing in pre-op/holding for patients who are at high risk for SSI or who have a body mass index (BMI) higher than 30.
<p>Inconsistent and incomplete application of required preoperative skin cleaning product by patients and caregivers.</p>	<ul style="list-style-type: none"> • Standardize preoperative educational materials for surgery preparation and SSI prevention. Provide these materials to physician clinics, preadmission testing and preoperative areas. • Staff in the physician office or preadmission testing area provide instruction to patients and caregivers for applying the preoperative skin cleaning product.

Contributing Factors and Targeted Solutions to Reduce Colorectal SSIs (cont'd)

Contributing factors are a set of actions leading to surgical process failure that increase the risk or likelihood of colorectal SSIs. Targeted solutions are practices developed to mitigate each contributing factor. They have been thoroughly tested and proven effective. The table below links solutions to the factors they were designed to solve.

Contributing Factors	Targeted Solutions
Preadmission, preoperative to intraoperative care processes	
<p>All types of SSIs</p> <p>Inconsistent infection prevention practices (based on protocol or best practices) for surgery preparation.</p>	<ul style="list-style-type: none"> Standardize the preoperative skin cleansing orders for all colorectal patients. Establish policy and protocol to standardize surgical preparation practices for use of the skin disinfection agent and who can perform the skin prep. Hair removal takes place in the preoperative holding area (instead of in the OR).
Preoperative to intraoperative care processes	
<p>All types of SSIs</p> <p>Inadequate administration of antibiotic(s) to patient.</p>	<ul style="list-style-type: none"> Establish weight-based antibiotic(s) dosing protocol for colorectal surgeries. Program documentation software to automatically prompt intraoperative re-dosing of antibiotic(s) if surgery is longer than 3 or 4 hours (timing determined by the hospital). Build a real-time prompt into anesthesia's documentation system to ensure compliance, to indicate the time that the first dose was administered, and to remind staff about re-dosing at the 3rd or 4th hour from incision time.
Preoperative, intraoperative to postoperative care processes	
All types of SSIs	
<p>Patient's core temperature was not consistently maintained at the recommended range for optimal wound healing and infection prevention.</p>	<ul style="list-style-type: none"> Initiate preoperative warming interventions. Establish protocol to standardize warming interventions in the OR.
Intraoperative care processes	
All types of SSIs	
<p>Uncoordinated surgical team activities and breaks in the sterile fields increased the risk of wound contamination and patient susceptibility to infection. The risk of wound contamination was most often identified with bowel anastomosis, digital rectal examination (DRE), and the closing process.</p>	<ul style="list-style-type: none"> Establish standardized closing process. Standardize the set up of instruments and the instrumentation set used for clean versus "dirty" parts of the surgical procedure.

Contributing Factors and Targeted Solutions to Reduce Colorectal SSIs (cont'd)

Contributing factors are a set of actions leading to surgical process failure that increase the risk or likelihood of colorectal SSIs. Targeted solutions are practices developed to mitigate each contributing factor. They have been thoroughly tested and proven effective. The table below links solutions to the factors they were designed to solve.

Contributing Factors	Targeted Solutions
Postoperative to post-discharge care processes	
<p>Incisional SSIs Inconsistent wound management increased risks of SSIs and delayed wound healing.</p>	<ul style="list-style-type: none"> Standardize intraoperative application of wound dressing to minimize opportunities for wound contamination and maximize wound healing. Standardize orders for postoperative wound dressing, such as: continuation of OR wound dressing for 48 hours and dressing removal postoperative day (POD) 2. To ensure consistent wound management, assign ownership to a specific discipline. For example, the first dressing is removed by the primary service providers to ensure the first critical assessment of wound healing is done by the correct person. Consult a wound ostomy nurse for complicated wound management, such as use of vacuum dressing. Establish specific criteria for the correct management of specific types of wounds. For example, wound probing for some types of contaminated colorectal wounds.
Preadmission, preoperative and postoperative care processes	
<p>Incisional SSIs Failure to perform hand hygiene by staff and patient or caregiver increased opportunities for surgical wound contamination and the risk of developing SSIs.</p>	<ul style="list-style-type: none"> At preadmission and postoperatively, provide patient and caregiver with education about personal hand hygiene (for example, a "Reducing Your Risk of SSI" pamphlet). Provide hand sanitizing wipes and personal-size hand sanitizing foam at bedside for patient. Post signs reinforcing critical moments of hand hygiene. Make hand cleansing agent readily available for staff (for example, attach hand sanitizer to bed poles).
Postoperative to post-discharge care processes	
<p>Incisional SSIs Inconsistent understanding among patients, caregivers and health care professionals of wound care management in decreasing risk of and preventing SSIs.</p>	<ul style="list-style-type: none"> At discharge, provide patient education on wound care and how to recognize the symptoms of infection. Have nurses make a follow-up phone call to patients within one week after discharge from the hospital.

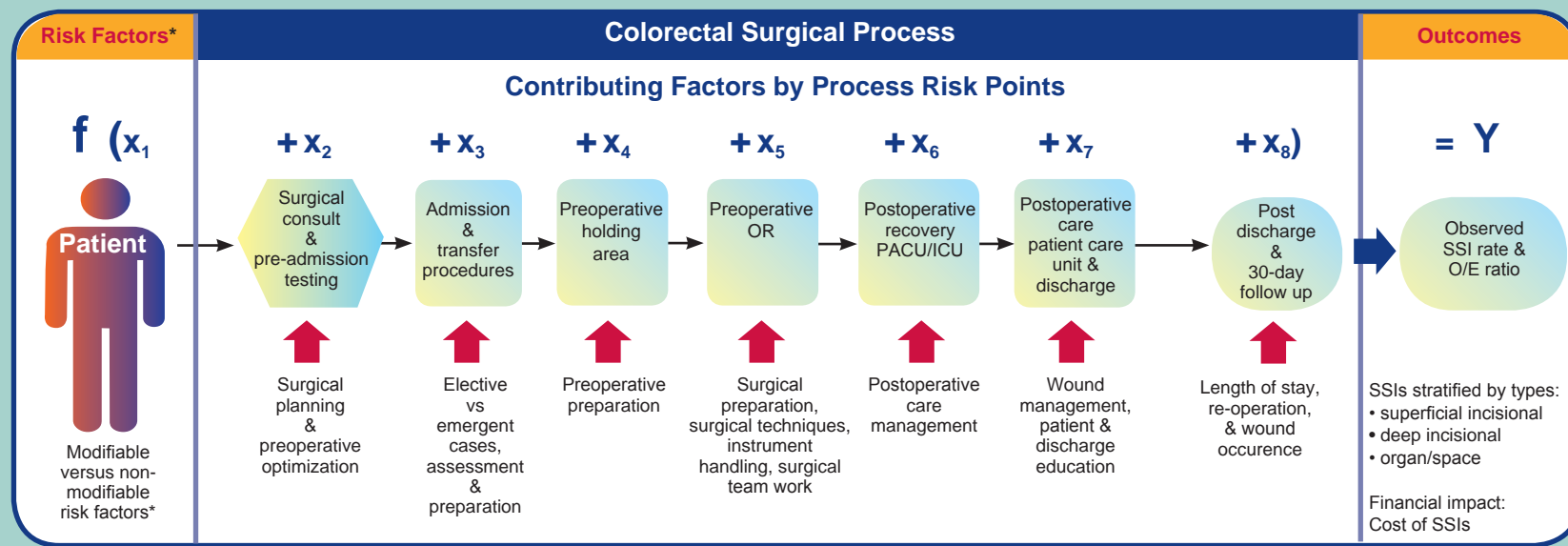
Measuring Colorectal Surgical Site Infections

The graphic below shows the types of data collection conducted throughout the colorectal surgical care continuum. The data collection effort did not follow the usual infection surveillance retrospective approach of collecting data only on colorectal patients who developed SSIs.

Project participants used a proactive measurement strategy to detect significant risk points and identify if the care provided to patients:

- Deviated from the intended practice, which was defined by the organization's policy, protocol or evidence-based recommendations
- Indicated the absence of a process step considered to be critical in delivering the intended care
- Showed significant variation in the care delivery process and inconsistency in the care approach by different care providers

The surgical process data collected was used to analyze its relationship to the SSI outcomes. This allowed project participants to detect the process risk points (x) and draw conclusions on the effect of contributing factors to the occurrence of SSIs (Y). This analysis was validated by the project participants and is simplified in the following formula: **Y is the function of (x₁ + x₂ + x₃ + x₄ + x₅ + x₆ + x₇ + x₈)**



* Modifiable versus non-modifiable factors: For colorectal surgeries, certain patient characteristics are associated with an increased risk of an SSI. Some of these factors are non-modifiable and include age, gender, and pre-existing conditions (such as cancer) that the patient brings to the clinical encounter and over which neither the provider nor the provider organization has any control. Other risk factors are modifiable, which means they can be treated, controlled, or improved upon to optimize the patient's condition and prevent the risk of developing SSIs.

Measuring Colorectal Surgical Site Infections (cont'd)

Project Goal

Achieve a **50 percent reduction** in colorectal surgical site infections using two outcome measures: a primary metric and a secondary metric.

$$\text{Primary metric: Observed rate of colorectal SSI (\%)} = \frac{\text{Observed number of colorectal SSIs (numerator)}}{\text{Colorectal surgical cases per month (denominator)}} \times 100$$

The primary metric was established by counting the occurrence of any type of colorectal SSI (following the CDC definitions of colorectal SSIs) from the colorectal surgeries performed at the participating hospital each month. The project team further stratified the overall count of colorectal SSIs and tracked the occurrence of SSIs by types: superficial incisional, deep incisional and organ/space SSIs.

Although this SSI rate does not take into account the expected risks of the colorectal surgical population, project participants did not want to lose any opportunity to analyze and learn from every SSI occurrence. Each SSI occurrence provided insight into potential contributing factors that could be prevented. This measurement can be easily adopted by any health care organization for SSI performance monitoring and quality improvement.



Measuring Colorectal Surgical Site Infections (cont'd)

$$\text{Secondary metric: ACS NSQIP observed-to-expected (O/E) ratio for colorectal SSI} = \frac{\text{Observed number of colorectal SSIs (numerator)}}{\text{Expected number of colorectal SSIs is the sum of the probabilities for SSI across all patients* (denominator)}}$$

* Variables used to calculate the expected risks of a colorectal surgical patient to develop an SSI: principal operative procedural code (CPT), surgical wound classification, the American Society of Anesthesiologists (ASA) classification of patient's physical condition before surgery, body mass index (BMI), age, diabetes mellitus, and current smoker.

How the secondary metric (O/E ratio) was used for the project

- Takes into account the differences in the case mix at each of the participating hospitals
- Defines the expected SSI risk of the organization's colorectal surgical population
- Sets practical goals for a target reduction rate
- Aligns all key stakeholders to accept the scope of the SSI project
- Obtains buy-in and commitment from all parties to be accountable for further improvement in order to achieve better outcomes for colorectal surgical patients
- Validates improvement impact is significant because it takes into account the patient mix at each organization before and after improvement



Throughout the course of the project, the analysis using the O/E ratio (the secondary metric) did not yield any findings that were different from the observed rate or primary metric. Both metrics gave consistent results. Project teams from all sites were able to use the observed SSI rate in analyzing the correlating variables that contribute to the occurrence of colorectal SSIs. The primary metric proved to be a reliable measure for detecting changes in the SSI rate after implementing improvements. The evidence of trends and changes in SSI performance using both metrics were correlated for all seven sites and as an aggregate throughout the project.

Additional outcome measures: Most of the project participants monitored the impact of the SSI project on other important performance indicators within their hospitals. These included financial impact from average length of stay (ALOS) differences, the cost of implementing the solutions versus the cost avoidance from the number of SSIs prevented, as well as other post-surgical outcomes including wound occurrence (such as deep wound disruption), reoperation within 30 days, postoperative catheter-associated urinary track infections (CAUTI), and sepsis.

Measuring Colorectal Surgical Site Infections (cont'd)

Challenges in measurement

This project presented a number of challenges for the participating hospitals, especially with regard to determining SSI occurrence.

Barriers to meaningful and accessible data to guide improvement efforts: Every hospital collects multiple levels of surgical care process and outcome data to meet different requirements and expectations. These include state and federal reporting requirements for preventable hospital acquired conditions; the Surgical Care Improvement Program (SCIP) core measures; health care accreditation requirements; and for benchmarking purposes. The various reporting requirements do not have consistent rules for inclusion and exclusion criteria or for case capturing and sampling methodology, which may result in different conclusions about SSI rates. This inconsistency makes it difficult for any health care organization to have a clear systematic view of its surgical performance.

Communication barriers: Some organizations struggled to coordinate data collection and sharing, which made it difficult to provide meaningful and real-time feedback to organization leadership and front-line staff. Even when collecting similar data elements for the same surgical case, there was limited communication among staff about the data. This led to confusion in both the interpretation and use of data to guide improvement efforts.

No standardized “best practices”: Lack of strong evidence in colorectal surgical care resulted in inconsistent care being delivered to patients.

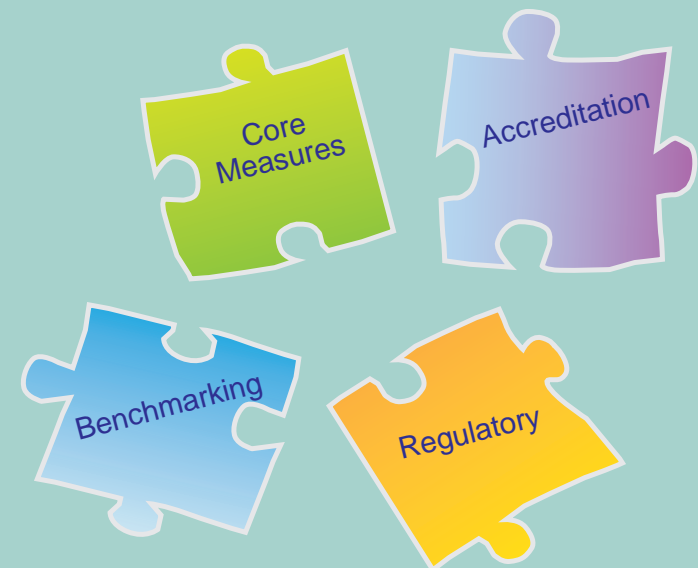
Limited available SSI data: Available hospital surveillance data only provide insight to the care received by surgical patients who develop a SSI. There is no available data to provide any insight into the surgical care, whether optimal or sub-optimal, provided to other colorectal surgical patients.

Challenges in achieving meaningful data analysis: Significant lag time in the availability of SSI data and variation in case volumes with small sample sizes resulted in project participant’s inability to identify meaningful trends or conclusive analysis findings.

Overcoming the measurement challenges

The participating hospitals took the following actions to overcome these challenges and successfully identify the contributing factors that could be improved upon to reduce colorectal SSIs.

- Coordinated data collection and SSI monitoring across silos within organizations.
- Used the RPI® Lean methodology to remove unnecessary waste in the data process flow and change management strategy to create a loop-back system with data communication.
- Went beyond the regular data collection requirements to compile data — whether the colorectal surgical patient had an infection or not.



Variables Correlated with Surgical Site Infections

This table shows the variables most strongly associated with the occurrence of colorectal SSIs. Not all correlating variables appear in each hospital, nor can every variable be modified or improved upon, such as a number of the patient characteristics. This underscores the importance of understanding the specific variables affecting SSIs that are unique to each hospital's surgical population and processes so that solutions can be targeted accordingly. The 'X' indicates a correlating variable.

Variables	Participating Hospitals						
	A	B	C	D	E	F	G
Patient characteristics							
Younger than 44 or older than 60	X	X					
Body mass index (BMI) is lower than 20 or higher than 30	X	X	X	X	X	X	X
Diagnosed with disease or condition, such as inflammatory bowel disease, Crohn's disease, diverticular disease	X	X					
Taking insulin or non-insulin medication for diabetes	X		X		X	X	X
Taking steroids for a chronic condition	X	X					
Diagnosed with sepsis within 48 hours before surgery	X				X	X	
High blood pressure or takes medication for high blood pressure					X		
Slightly malnourished, reflected by low level of albumin		X					
Smoker or smoked within one year before being admitted for surgery			X			X	X
Requires assistance for activities of daily living before surgery							X
Surgical procedure							
Variation in surgical wound classification	X	X			X		
American Society of Anesthesiologists (ASA) physical status classification system: class 2 or above					X	X	
Laparoscopic surgery (versus open surgery)	X				X	X	X
Surgery longer than 3 or 4 hours (timing determined by hospital)	X	X	X		X	X	X
Variation in type of SSI by surgeon		X		X			

Variables Correlated with Surgical Site Infections (cont'd)

This table shows the variables most strongly associated with the occurrence of colorectal SSIs. Not all correlating variables appear in each hospital, nor can every variable be modified or improved upon, such as a number of the patient characteristics. This underscores the importance of understanding the specific variables affecting SSIs that are unique to each hospital's surgical population and processes so that solutions can be targeted accordingly. The 'X' indicates a correlating variable.

Variables	Participating Hospitals						
	A	B	C	D	E	F	G
Antibiotic(s)							
Inconsistent or ineffective use of antibiotic(s) prophylaxis	X	X	X	X			X
o No standard process for giving oral antibiotic(s) with mechanical bowel preparation before surgery			X				X
o Correct antibiotic(s) and right dose are not given before surgery	X	X		X			X
o First dose of IV antibiotic(s) was given too soon or too late; timing did not meet guidelines		X		X			X
o The protocol for antibiotic(s) re-dosing was not followed in surgeries longer than 3 or 4 hours (timing determined by hospital)	X			X			X
o Antibiotic(s) were discontinued within 24 hours after surgery							
Preoperative and intraoperative process							
No standard process for cleaning skin before being admitted to the hospital	X		X				X
Insufficient education provided to patients about how to prepare for surgery and prevent SSI	X						
Patient arrived for surgery with potential infection			X				
Hair was not clipped (when possible) before entering the OR	X						X
No standard process for managing serum glucose levels during surgery	X		X				X
Inconsistent and incorrect skin preparation for surgery	X		X	X			
Lack of hand hygiene in the OR area			X				X
Patient's temperature is not maintained within the normal range (36 to 38 Celsius)	X					X	
o Patient arrived in OR with core temperature less than 36 Celsius						X	
o No lock on thermostat in the OR; temperature in OR is adjusted to comfort level of staff						X	
o Patient's core temperature during surgery was less than 36 Celsius						X	
Inconsistent use of draping and devices to protect the surgical site from contamination							X

Variables Correlated with Surgical Site Infections (cont'd)

This table shows the variables most strongly associated with the occurrence of colorectal SSIs. Not all correlating variables appear in each hospital, nor can every variable be modified or improved upon, such as a number of the patient characteristics. This underscores the importance of understanding the specific variables affecting SSIs that are unique to each hospital's surgical population and processes so that solutions can be targeted accordingly. The 'X' indicates a correlating variable.

Variables	Participating Hospitals						
	A	B	C	D	E	F	G
Preoperative and intraoperative process (cont'd)							
Inconsistent surgical site closing process	X	X	X	X	X	X	X
o Closing tray or closing instruments not available at closing	X	X	X				X
o Closing steps not followed (surgical team is distracted or forgets to complete the steps)			X				
o No standardized closing process across all surgeons and surgical teams	X	X					X
o Surgeon does not announce "time to close"			X			X	
o Use of dirty instruments, contaminated gloves and gowns at the time of wound closure	X	X	X	X	X	X	X
Postoperative							
Patient's temperature is less than 36 Celsius		X					
Inconsistent understanding of postoperative and discharge education about hand hygiene and SSI prevention among health care professionals, patients and family	X					X	
Inconsistent wound management and lack of evidence-based practices for managing different types of surgical wounds	X	X	X		X	X	X
Inadequate skin cleaning after surgery	X					X	
Increased total average length of stay (ALOS) in the hospital	X					X	X
Wound is disrupted after surgery			X				X
Measurement challenges							
Incomplete data; not every colorectal surgical case has complete process and outcomes data		X		X			
Inaccurate and incomplete documentation of critical information (for example, wound class, operative details, and 30-day follow-up results)		X		X			
Lack of communication about SSI data: surgeons were not notified of confirmed SSI for their patient, or the physician's office failed to communicate to the hospital about a patient being treated for an SSI		X		X		X	X

Sustaining Success of a Colorectal Surgical Site Infection Project

Participating hospitals used various strategies to implement their improvement solutions. This resulted in varying degrees of success toward the goal of achieving sustainable SSI reductions. Some organizations implemented solutions all at once; others implemented solutions one at a time due to resource constraints. Despite these different approaches, project participants with the most success shared the following attributes:

- Emphasis on the use of data to guide and drive improvement decisions and implementations
- Sharing real-time data with all staff who care for colorectal surgical patients
- A committed colorectal surgeon champion who led the project
- A dedicated core team that included front-line staff from each process area and subject matter experts
- Continuous engagement of the core team throughout the project
- Leadership ensured that surgeons and other staff who worked on the project received needed support, including dedicating a certain amount of time to the project
- Engagement of staff and patient/caregivers, giving a voice to both internal and external customers
- An organizational culture that held everyone accountable for preventing the occurrence of SSIs. This sense of accountability was pervasive, reaching every touch point in every surgical patient's journey – from pre-admission, to preoperative, to the OR and PACU, through to the patient care unit and post discharge care.

