PREVENTING SURGICAL SITE INFECTION: AN ANALYSIS OF COMPLIANCE WITH ANTIBIOTIC PROPHYLAXIS STANDARDS

BY

David A. Wyatt

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Chairperson

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The Thesis Committee for David A. Wyatt certifies
That this is the approved Version of the following thesis:

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Committee:

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Chairperson

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Date approved:___________________

Preventing Surgical Site Infection: An Analysis of Compliance with Antibiotic Prophylaxis Standards

Background: Surgical site infections increase patient morbidity and mortality as well as increase the consumption of resources, both human and durable. An effective strategy for prevention of surgical site infection is appropriate surgical antibiotic prophylaxis.

Methods: Data from an existing hospital performance improvement data set were analyzed for relationships between the outcome variables of antibiotic choice, administration within 60 minutes prior to incision, discontinuation in 24 hours and total compliance with all three outcomes and characteristics of cases such as location of antibiotic administration, length of procedure, and who administered antibiotic. These data were reported from August 8, 2005 – August 31, 2006. The total number of cases included in this study was 1,355.

Results: Compliance with antibiotic choice was 94.8%, administration within 60 minutes prior to incision was 91.3%, discontinuation within 24 hours (or 48 hours for Cardiac surgery) was 87.7% and total antibiotic compliance was 79.5%. Outcome Choice compliance was significantly related to procedure category ($p < .001$) with Cardiac surgery most compliant at 99.7% and Abdominal – General with only 55% compliant with choice. Outcome Administration within 60 minutes prior to incision was significantly related to location of administration with administration in the OR 95.8% compliant ($p < .001$) and administration in CV Holding compliant at 41.7% (p

$< .001$). Administration by anesthesia was also significantly related to compliance with compliance of 100% ($p < .001$). Outcome Discontinuation within 24 hours (or 48 hours for Cardiac surgery) was significantly related to procedure category ($p < .001$) with Cardiac surgery 97.7%, Abdominal – General 53.5% and Joint at 73.6% compliant. Total antibiotic compliance was significantly related to procedure category ($p < .001$) with Cardiac surgery 95.5%, Abdominal – General 36.7% and Joint 58.2% compliant. Administration in the OR 85.0% vs. 66.6% ($p < .001$) compliance and administration by anesthesia 87.1% vs. 0% ($p < .001$) compliance were both significantly related to total antibiotic compliance.

Conclusions: Hospitals and healthcare providers striving to improve compliance with antibiotic choice, administration and discontinuation should focus interventions on who is administering the antibiotic and where it is being administered. Anesthesia should be administering the antibiotic in the OR for optimal compliance with the outcomes of choice and administration timing. Additional interventions based on procedure category should focus educational strategies for these surgical services staff to promote compliance with the outcomes of choice and discontinuation.

Introduction:

Surgical procedures comprise a significant portion of the healthcare provided to patients in hospitals in the United States (1). The Centers for Disease Control (1993) estimates 27 million surgical procedures are performed annually in the United States (2). It is estimated that over two million nosocomial infections occur in the United States each year, of these surgical site infections (SSI) number over 500,000 each year representing 14%-25%. (3, 4). SSIs in most surgical patients are preventable with techniques such as antibiotic prophylaxis and strict surgical aseptic technique (5). Most focus of SSI prevention has been on the acute care hospital setting, however, it is estimated that 75% of SSI are now occurring in the outpatient setting (6). SSIs have significant impacts for patients, providers and healthcare organizations. They contribute to increased patient morbidity and mortality, increased hospital length of stay and increased consumption of resources, both human and durable. (6)

Costs associated with treatment of SSI vary considerably for a number of reasons. The type of microorganism colonized and severity of the infection will affect the treatment course of the patient. Superficial infections may respond to therapy on an outpatient basis or in the patient’s home while a deep infection may delay patient discharge and result in a lengthy and expensive inpatient admission.

The type of organism will determine the choice and course of therapy especially if the patient develops an infection with a drug resistant microorganism, resulting in a long and expensive course of treatment. Length of stay is one of the primary costs that are increased, for example, a patient undergoing cardiac surgery that results in a SSI may increase the costs of the hospitalization from $8,000 to over $42,000 (6). SSIs can result in health care costs that increase to over $1-10 billion annually (6). In addition to increased health care costs from the SSI, the patient also experiences loss of productivity and function (6). SSI increases hospital stays by an average of 7 days (7). Other health care facility resources consumed for patients who experience SSI include increased admissions to the emergency department and readmissions to surgical units, radiology services, and home health services or extended care facilities (7).

Organizations such as the Institute for Healthcare Improvement (IHI), the National Institutes of Health (NIH), the American Hospital Association (AHA), the Joint Commission on HealthCare Accreditation (JCAHO), as well as the Centers for Disease Control (CDC) and Centers for Medicare and Medicaid Services (CMS) have placed high priority on the development of SSI reduction strategies (1). Antibiotic prophylaxis is one of the interventions that is recognized as a primary strategy in prevention of SSIs.

Clinicians utilize a variety of strategies to ensure that patients undergoing surgical procedures are kept free of infection. Improvements in sterilization methods (decreasing flash sterilization), increasing the efficiency of operating room ventilation, limiting traffic control during surgical procedures, and improving surgical technique have decreased the incidence of SSI (8). Although these measures decrease the risk of infection to some extent, combining these measures with appropriate antibiotic prophylaxis provides the best assurance and protection to the patient. Kasteren, et al. identified that for prevention of SSI in total hip arthroplasty patients, timely administration of the antibiotic was the most important factor (9). This literature dates back to the development of antibiotics in the 1950s that administration prior to incision has shown to reduce SSI (8, 10).

Appropriate antibiotic prophylaxis involves more than administration prior to incision. The IHI and CMS have identified three key variables related to antibiotic prophylaxis these variables include; choice of antibiotic, timing of administration, and discontinuation (11-13). While antibiotic prophylaxis is not the only variable related to surgical site infection, clinicians who adhere to these three principles better protect their surgical patients from the development of SSI. It is important to recognize that antibiotic administration is not a substitute for poor technique and while it will reduce SSI by 40%-80%, it is most effective when used in conjunction with appropriate aseptic technique and other standards of surgical patient care (13).

Review of the Evidence: Antibiotic choice

Inappropriate antibiotic choice may foster the development of SSI. It is important to be cognizant of the type and location of the surgical procedure and the organisms that are endogenous to those tissues. Targeting the incorrect organisms will leave patients vulnerable to infection without any antibiotic protection (14 – 16). The guidelines are based upon extensive research that has shown when antibiotic prophylaxis is appropriately selected and used, there is a reduction in SSI post procedure. The IHI and CMS have developed guidelines for antibiotic choice by procedure (see Table 1).

Dosage of antibiotic is also of concern. Several studies have shown the importance of adjusting the dose depending upon the size of the patient. This is done because the dose of antibiotic is dependent upon the amount of drug concentration in the tissues (17). Pediatric and morbidly obese patients should receive doses of antibiotics appropriate to their size in order to achieve the same therapeutic levels of the drug (18). For surgical procedures lasting longer than 2-3 hours, it is recommended that re-dosing the antibiotic should occur to maintain the therapeutic level of antimicrobial agent in the tissues for maximum tissue concentration of the drug during the surgical procedure.

Evidence has supported that antibiotics administered when there is little value does nothing but increase the risk of super infections, antibiotic resistance and potential harm to the patient (19). Not all surgical procedures warrant the administration of antibiotic prophylaxis. Rohrich and Rios (2003) discussed the need to re-evaluate the common overuse of antibiotic administration in clean plastic surgical procedures when there is no data to support the need for antibiotic administration (19).

Table 1 Prophylactic Antibiotic Regimen Selection by Procedure

Surgical Procedure	**Approved Antibiotics**
CABG, Other Cardiac Or Vascular	Cefazolin, Cefuroxime, or Vancomycin* If β-lactam allergy: Vancomycin** or Clindamycin**
Hip/Knee Arthroplasty	Cefazolin or Cefuroxime, or Vancomycin* If β-lactam allergy: Vancomycin** or Clindamycin**
Colon* **	Oral: Neomycin Sulfate + Erythromycin Base **OR** Neomycin Sulfate + Metronidazole (Administered for 18 hours preoperatively) Parenteral: Cefotetan, Cefoxitin, Cefazolin + Metronidazole, or Ampicillin/Sulbactam *If β-lactam allergy*: Clindamycin + Gentamicin, or Clindamycin + Quinolone, or Clindamycin + Aztreonam **OR** Metronidazole with Gentamicin, or Metronidazole + Quinolone
Hysterectomy	Cefotetan, Cefazolin, Cefoxitin, Cefuroxime, or Ampicillin/Sulbactam If β-lactam allergy: Clindamycin + Gentamicin, or Clindamycin + Quinolone, or Clindamycin + Aztreonam **OR** Metronidazole + Gentamicin, or Metronidazole + Quinolone **OR** Clindamycin monotherapy
Special Considerations	*Vancomycin is acceptable with a physician documented justification for its use in the patient's medical record **For cardiac, orthopedic, and vascular surgery, if the patient is allergic to β-lactam antibiotics, Vancomycin or Clindamycin are acceptable substitutes. ***For colorectal surgery, a case will pass the antibiotic selection indicator if the patient receives oral prophylaxis alone, parenteral prophylaxis alone, or oral prophylaxis combined with parenteral prophylaxis.

Source: http://www.jointcommission.org/NR/rdonlyres/28F37987-3CF5-467F-9607-E406B1C54EE1/0/SCIPInf2MemoCMSJCAHOFall2006.doc (1)

Review of the Evidence: Antibiotic administration within 60 minutes prior to incision

Although clinical trials have shown the efficacy of administration of prophylactic antibiotics within 1 hour prior to incision (2 hours for administration of Vancomycin) to infuse the tissues with antibiotics prior to incision, health care facilities have achieved poor compliance with this recommendation. It is estimated that at least one-third to one-half of surgical patients do not receive antibiotic prophylaxis or are delayed in receiving them so that they are inadequately protected from the risk of SSI (20). This lack of compliance with appropriate timing of antibiotic, whether greater than 60 minutes or after the incision puts patients at higher risk for development of SSI (20).

Antibiotics that are administered on time, within 30-60 minutes before the incision for broad-spectrum antibiotics, and within 2 hours for Vancomycin can decrease the risk of SSI for surgical patients (18). While the standards focus on administration within 60 minutes prior to incision, some recommendations promote narrower windows of time such as 30 minutes prior to incision (13). Proper timing is what increases the chance that the antibiotic concentration will be optimum in the tissues prior to incision. It is most important to maintain therapeutic levels of antibiotic during the surgical procedure (17). Tissue perfusion at the site of incision combined with allowing the antibiotic dose to peak will minimize the risk of SSI. Healthcare providers involved in orthopedic or limb procedures using a tourniquet cuff, should pay attention to administration of the antibiotic prior to the inflation of the tourniquet in addition to incision times. The timing issue of most concern is administration after the incision is made – this exposes the patient to the greatest risk of SSI (17). Exceptions to this have been found for surgical patients undergoing Caesarean section; antibiotic prophylaxis should be initiated immediately after the cord is clamped (18).

Review of the Evidence: Antibiotic discontinuation within 24 hours after surgery

Maintaining patients on unnecessary antibiotic therapy for long periods after surgical intervention is problematic. Increasing the timeframe that patients continue on antibiotic therapy increases the risk of microbial resistance (13). Surgeons have traditionally kept their patients on antimicrobial therapy while wound drainage devices have remained in place or until discharge from the inpatient hospital. These practices are no longer supported by research (7). Perceptions of healthcare providers that antibiotic therapy longer than 24 hours is helpful to patient care have been difficult to change. Wound drainage devices particularly have caused some concern for surgeons – providing a foreign body in the wound and the tubing providing a route into the wound for bacteria. This rationale was the basis for prolonged antibiotic coverage; historically the decision to administer antibiotics for this reason appeared to have merit. Little research has actually supported the use of maintaining antibiotic prophylaxis in patients who retain wound drainage devices (7). The Society of Thoracic Surgeons Workforce on Evidence Based Surgery developed guidelines stating antibiotic prophylaxis will not be dependent upon the use of indwelling catheters of any type. According to these guidelines, decisions regarding the continuation of antibiotics post operatively should not be guided by the presence of indwelling catheters or drains (21). The American Academy of Orthopedics Advisory Statement on use of intravenous antibiotics also identifies that continuation of antibiotic therapy post procedure longer than 24 hours is unmerited and unsupported by medical research (22)

There is little benefit from prolonged administration of prophylactic antibiotics after the surgical procedure ends. Studies have shown that the risk of antibiotic resistant microorganisms increases and medications that provide little benefit are expensive and wasteful (13). Discontinuation within 24 hours has been found to be beneficial and in most cases only a single dose of antibiotic is needed (17). Most studies have advocated either discontinuing the antibiotic immediately in the post operative period (single dose only) or when providing antibiotic coverage in contaminated wounds, discontinuing the antibiotic within 24-48 hours after surgery (23, 24). Additional unmerited antibiotic therapy is not supported by research and only serves to increase cost to patients and healthcare organizations.

Several interventions have been developed to assist with appropriate discontinuation of antibiotic therapy – some hospitals initiating automatic stop orders, or brightly colored reminders in the chart with first dose of antibiotic timing (17, 24). This intervention was found to increase discontinuation of antibiotics to 74% from 29% pre intervention (23). This is an example of a process change to affect compliance with these standards. Several strategies to affect compliance with appropriate antibiotic prophylaxis focus on process changes and provider preferences. Development of order sets, clinical pathways or pre-printed medication order sheets are examples of processes that assist providers to comply with established guidelines.

The purpose of this study was to analyze compliance with established guidelines for surgical antibiotic prophylaxis at the University of Kansas Hospital. The study aims were:

1. Characterize current performance to the Centers for Medicare and Medicaid Services (CMS) guidelines for surgical antibiotic prophylaxis; choice, administration within 60 minutes prior to incision, discontinuation within 24 hours post surgery (or 48 hours for Cardiac surgery) and total antibiotic compliance (all three outcomes met per case).
2. Identify potential factors associated with adherence to CMS guidelines for surgical antibiotic prophylaxis; choice, administration within 60 minutes prior to incision, discontinuation within 24 hours post surgery (or 48 hours for Cardiac surgery) and total antibiotic compliance (all three outcomes met per case).

Methods:

Study sample. The study sample was gathered from a performance improvement data set created at a large urban Midwest academic teaching hospital. This performance improvement project used the guidelines set in the IHI 100,000 Lives Campaign (see Addenda A) to determine compliance for antibiotic surgical prophylaxis. The hospital staff identified surgical procedures that were consistent with the ICD-9 coding criteria set by CMS for the surgical care improvement project as well as the IHI 100,000 Lives Campaign. Each day a report was queried by the OR information systems staff for these targeted procedures. These cases included procedures such as coronary artery bypass graft, total knee replacement, hysterectomy and colon resection. Data collection for this study was August 8, 2005 through August 31, 2006. These cases were identified via the report and reviewed for criteria to be included in the study; all patients under age 18 were excluded from the report prior to the data transfer to the study data workbook. Exclusion criteria in addition to age less than 18 years of age at time of procedure were; evidence of pre-existing infection, currently on antibiotic therapy prior to surgical procedure and a "bring-back" procedure or the second surgical procedure for a patient in a single inpatient hospitalization. See Table 2 for summary of exclusion criteria and the number and percentage of patients excluded by each criterion. The number of cases in this study sample was 1,355. Each of these cases were then coded for the outcomes of antibiotic choice and discontinuation by the OR pharmacy staff and the report then returned to the OR information systems supervisor. These codes were then transcribed into the ORSOS® system for these cases. The criteria used for compliance of antibiotic choice are outlined in Table 1. The criteria used to determine discontinuation within 24 hours of procedure (or 48 hours of procedure for Cardiac surgery) was an order placed for appropriate duration of antibiotic therapy, i.e. "Cefazolin IV every 8 hours times three doses". These cases were then categorized by the OR Information Systems supervisor by the type of procedure and surgical service such as Cardiac surgery, Orthopaedic/Joint, Abdominal – General, etc. Antibiotic administration information such as location of administration and if the antibiotic was administered by anesthesia staff was documented by the OR RN in the electronic operative nursing record at the time of the surgical procedure. This information was then queried in the study report.

Table 2 Exclusion Criteria, Frequency and Percentage of Total Sample

	N	**%**
Total Sample	1524	100%
Pre-existing Infection	93	6%
Bring Back Patient (2nd OR)	30	2%
Currently on Antibiotic Tx	46	3%
Study Sample	**1355**	**89%**

For the purposes of this study these performance improvement data were downloaded to an excel spreadsheet from ORSOS® the hospital operating room information system. Upon transfer to the study data workbook all patient identifiers were removed including surgeon name and date of procedure. See table 3 for a list of the variables collected per case and a description of the variable. The variable total antibiotic compliance was computed for each case as 1 if all three outcomes choice, administration and discontinuation were compliant and 0 if any of the outcomes of choice, administration or discontinuation were non compliant.

Table 3 Variable Name, Description and Associated Outcome to be Tested

			OUTCOMES		
Variable Name	**Variable Description**	**Choice**	**Administration**	**DC**	**Total Compliance**
TOTALINC	Total Minutes from Start to End of Procedure		X		X
TOTALRM	Total Minutes from Enter to Leave OR		X		X
ProcedureCategory	Category of Procedure	X	X	X	X
ASA	ASA Classification	X	X	X	X
SDS	Admin in SDS		X		X
OR	Admin in OR		X		X
CVHolding	Admin in CV Holding		X		X
AYES	Administration by Anesthesia	X	X		X
DESCRIPTION	Case type	X	X	X	X
Enter_Incision	Minutes from Room time to Incision		X		X

Initial compliance rates were calculated by outcome to determine overall compliance for the study sample. These data were then analyzed for bivariate relationships to identify characteristics associated with compliance with the study outcomes of; antibiotic choice, antibiotic administration within 60 minutes prior to incision and antibiotic discontinuation within 24 hours (or 48 hours) after the end of the procedure as well as total antibiotic compliance. Using the crosstabs function in SPSS® 15.0 contingency tables were created to distinguish relationships in compliance for the categorical variables of procedure category, ASA, SDS, OR, CV Holding, AYES and Case Type. Using Chi Square test for differences, p values were calculated to determine the significance of differences in these categories related to rates of compliance in the outcome variables. The variables Enter_Incision, TOTALINC and TOTALRM were analyzed for differences in the means by outcome, using the t test function to compare means, these variables were grouped by outcome to determine significant differences in the mean times of total OR Room time, total procedure time or enter to incision times. This was to determine if there were differences in the mean times in those cases that were compliant in each of the outcome variables versus those cases that were not compliant.

Results:

The study sample consisted of 1,355 cases with 658 being male, 697 female, and an average age of 60. The sample total room time mean was 231.29 minutes with a range of 829 minutes, total procedure time mean was 170.72 minutes with a range of 784 minutes, the mean length of time from enter OR to Incision was 45 minutes with a range of 129. The majority of patients in this study sample were classified by the anesthesia staff as ASA III, comprising nearly 61% of the sample (See Figure 1). 77.9% of the case types for cases was Elective (Scheduled) with Elective (Add on) adding another 17.5% (See Figure 2). The most common procedure categories for this study sample were Cardiac, Orthopedic/Joint, Vascular and Hysterectomy (See Figure 3). 1,237 cases had antibiotics administered by anesthesia comprising 91.3% of the sample.

Table 4 Total Sample Characteristics

Gender	**N**	**% of Sample**		
Male	658	48.56%		
Female	697	51.44%		
	1355			
	Mean	**Median**	**Mode**	**Range**
Age	60	61	58	77
Total Room Time (Minutes)	231.29	214	159	829
Total Procedure Time (Minutes)	170.72	153	106	784
In Room - Incision (Minutes)	45	43	43	129
ASA Class	**N**	**% of Sample**		
ASA I	18	1.33%		
ASA II	277	20.44%		
ASA III	823	60.74%		
ASA IV	227	16.75%		
ASA V	5	0.37%		
Undocumented	5	0.37%		
	1355	100.00%		
Case Type	**N**	**% of Sample**		
Elective (Scheduled)	1056	77.90%		
Elective (Add on)	237	17.50%		
Emergency	42	3.10%		
Trauma	5	0.40%		
Urgent	15	1.10%		
	1355	100.00%		

Table 4 continued

Procedure Category	**N**	**%**		
Vascular	158	11.6%		
Cardiac	575	42.4%		
Ortho/Joint	299	22.0%		
Hysterectomy	213	15.7%		
Other GYN	13	0.9%		
Abdominal – General	60	4.4%		
Neuro	34	2.5%		
GU	3	0.2%		
Administration Location	**N**	**% of Sample**		
SDS	300	22.10%		
OR	951	70.20%		
CV Holding	12	0.01%		
Undocumented	92	7.69%		
	1355	100.00%		
Administration by Anesthesia	**N**	**% of Sample**		
Yes	1237	91.30%		
No	118	8.70%		
	1355	100.00%		

Figure 1 ASA Classification

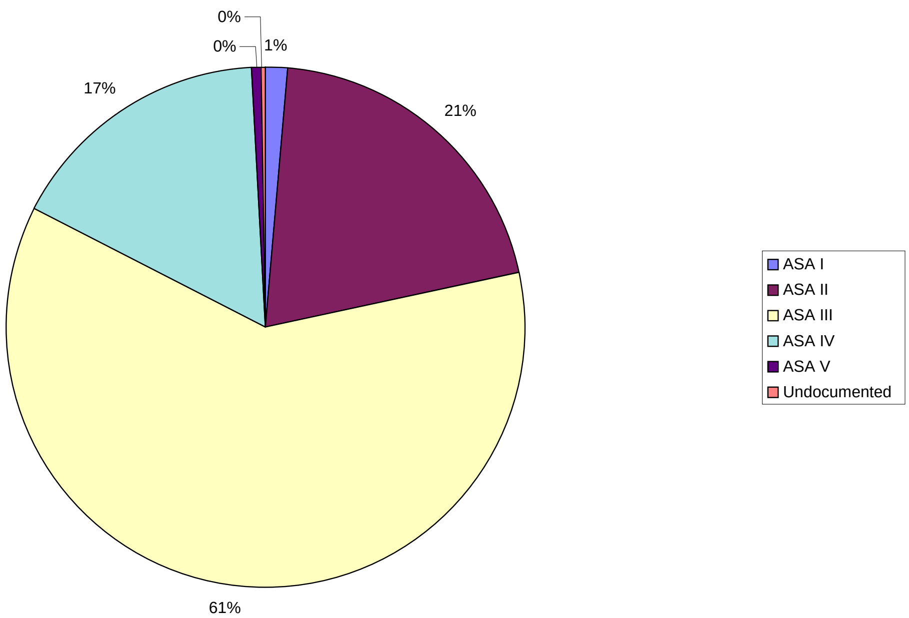


Figure 2 Case Type

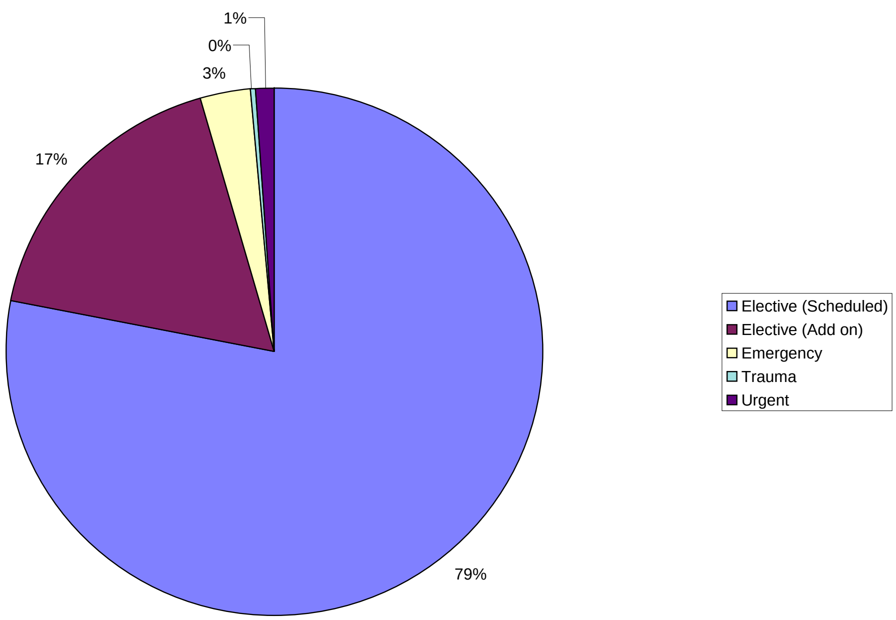
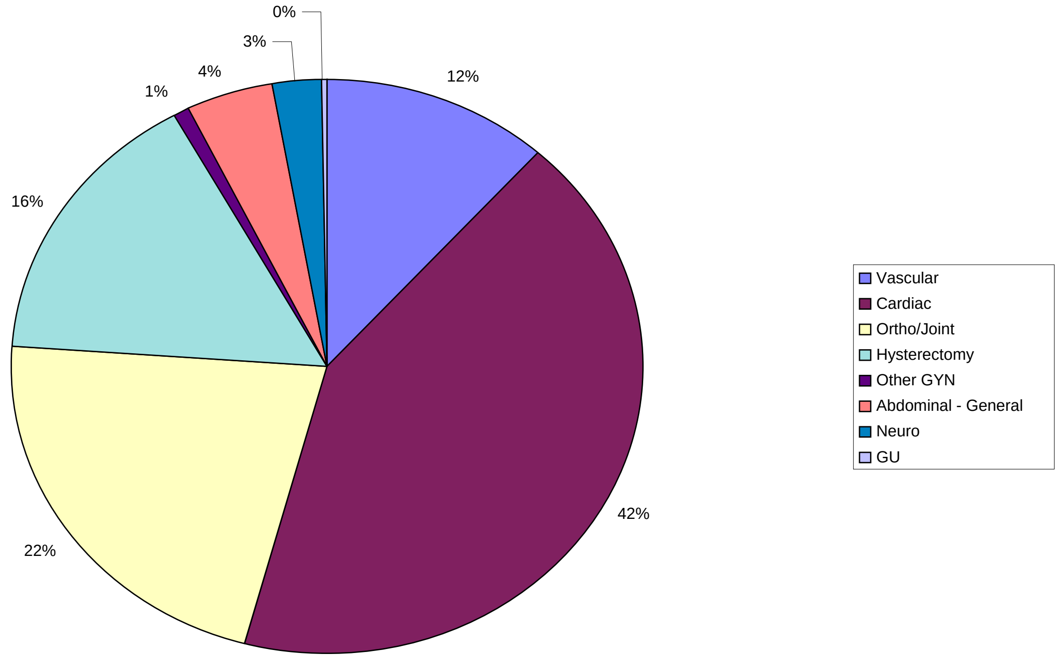


Figure 3 Procedure Category



This study sample was compliant with antibiotic choice n = 1284 (94.76%), administration n = 1237 (91.29%) and Discontinuation n = 1188 (87.68%), with Total Antibiotic Compliance n = 1077 (79.48%) (See Figure 3 and 4).

The outcome variable of choice showed significant associations in compliance to procedure category ($p < .001$), with Cardiac surgery compliant at 99.7% and Joint surgery at 97.3% and Abdominal – General at 55.0% and Neurosurgery at 85.3%. As well, Administration by anesthesia showed significant associations with compliance, those administered by anesthesia were 95.3% compliant versus those not administered by anesthesia at 89.0% ($p = .003$). ASA and Case Type did not show significant associations with choice compliance, $p = .664$ and $p = .334$ respectively.

Figure 4 Frequency Study Outcomes Compliance

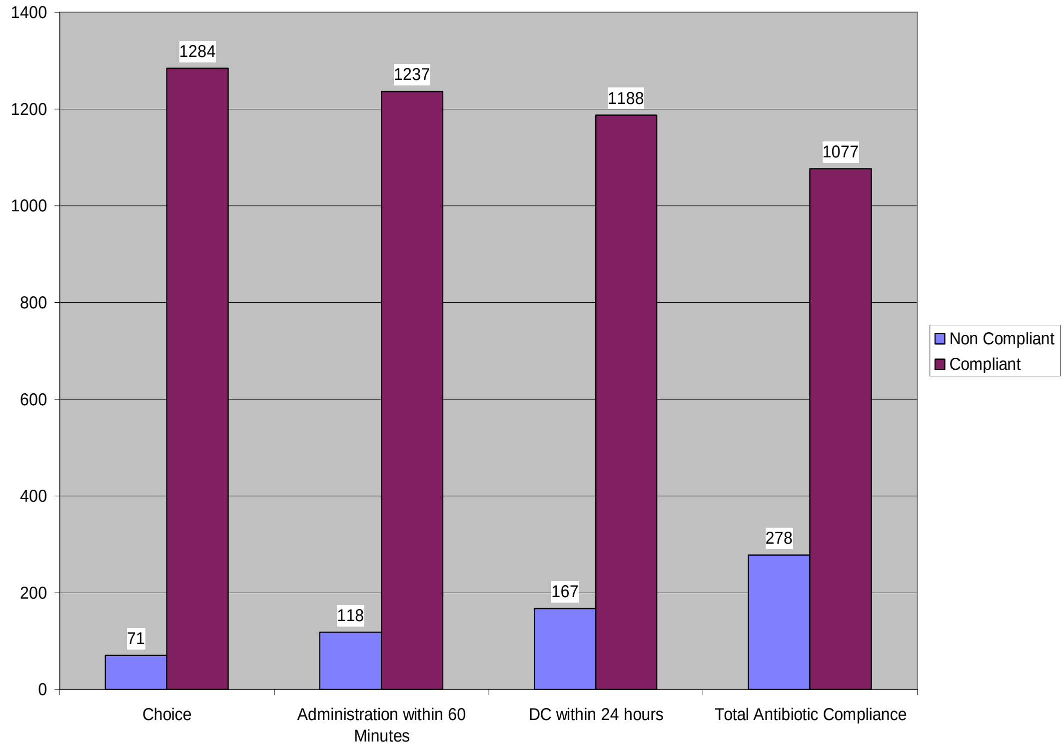


Figure 5 Percentage Study Outcome Compliance

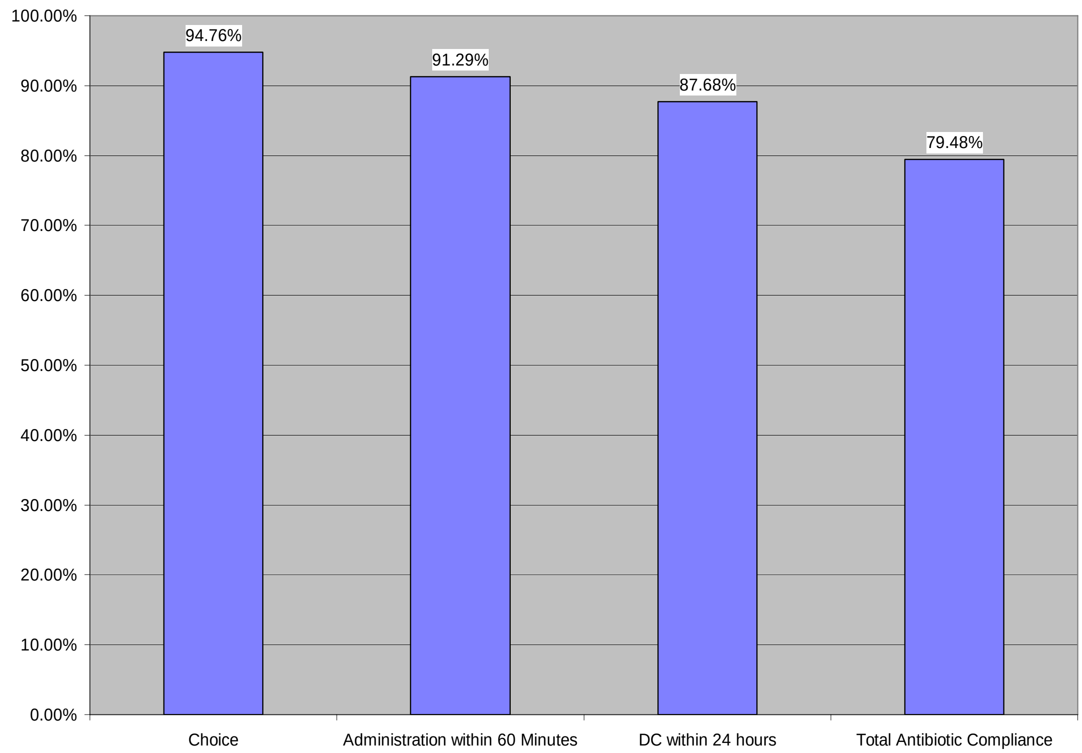


Table 5 Bivariate Analyses - Outcome Antibiotic Choice

Variable	**Compliant**	**%**
Procedure Category		
Vascular	148	93.7%
Cardiac	573	99.7%
Joint	291	97.3%
Hysterectomy	197	92.5%
Other GYN	12	92.3%
Abdominal - General	33	55.0%
Neurosurgery	29	85.3%
Urology	1	33.5%
Total	1284	94.8%
Chi Square	254.387	
Df	7	
p value	**< .001**	
ASA		
ASA I	17	94.4%
ASA II	264	95.3%
ASA III	775	94.2%
ASA IV	219	96.5%
ASA V	0	0.0%
Chi Square	2.390	
Df	4	
p value	**0.664**	
Administration by Anesthesia		
No	105	89.0%
Yes	1179	95.3%
Chi Square	8.688	
Df	1	
p value	**0.003**	
Case Type		
Elective (Scheduled)	997	94.4%
Elective Add on	229	96.6%
Emergency	38	90.5%
Trauma	5	100.0%
Urgent	15	100.0%
Chi Square	4.574	
df	4	
p value	**0.334**	

The outcome variable of administration within 60 minutes prior to incision showed significant associations with procedure category (p < .001), with Cardiac surgery compliant 97.0%, Other GYN 100.0%, Hysterectomy 93.4%. While compliance rates for other categories such as Vascular, Joint, Abdominal – General and Neurosurgery were lower at 91.8%, 78.3%, 88.3% and 79.4% respectively. ASA score showed a significance of p = .01, with differences in compliance ranging from 92% - 100% for ASA I, III, IV and IV, and compliance for ASA II at 86.3%. Administration of antibiotic in SDS showed no significance (p = .794), while administration in OR was significantly associated with compliance (p<.001) and administration in CV Holding was not associated with compliance (41.7% compliant, p <.001) although the number of cases with antibiotic administered in CV Holding was n = 12, less than 1% of the study sample. Administration by anesthesia showed a significant association to compliance with 100% of those cases administered by anesthesia as compliant for administration within 60 minutes prior to incision and 0.0% of those not administered by anesthesia compliant (p < .001). Case type showed no significant relationship to administration (p = .177). The means of OR Room Time, Procedure Time and Enter to Incision Time for compliant cases versus non compliant cases of the outcome Administration within 60 minutes were; 231.7 minutes versus 227.2 minutes, 171.2 minutes versus 165.2 minutes and 45.0 minutes versus 46 minutes respectively. No significant differences in means were evident with OR Room Time (p = .577), Procedure Time (p = .418) or Enter to Incision Time (.658) (See Table 6 and 7 for summary of relationships).

Table 6 Bivariate Analyses - Outcome Administration within 60 minutes prior to incision

Variable	Compliant	%
Procedure Category		
Vascular	145	91.8%
Cardiac	563	97.9%
Joint	234	78.3%
Hysterectomy	199	93.4%
Other GYN	13	100.0%
Abdominal - General	53	88.3%
Neurosurgery	27	79.4%
Urology	3	100.0%
Total	1237	91.3%
Chi Square	105.062	
df	7	
p value	**< .001**	
ASA		
ASA I	17	94.4%
ASA II	239	86.3%
ASA III	757	92.0%
ASA IV	215	94.7%
ASA V	5	100.0%
Chi Square	13.338	
df	4	
p value	**0.01**	
Administration in SDS		
No	962	91.2%
Yes	275	91.7%
Chi Square	0.068	
df	1	
p value	**0.794**	
Administration in OR		
No	326	80.7%
Yes	911	95.8%
Chi Square	81.33	
df	1	
p value	**< .001**	

Table 6 continued

Administration in CV Holding		
No	1232	91.7%
Yes	5	41.7%
Chi Square	37.503	
df	1	
p value	**< .001**	
Procedure Category	**Compliant**	**%**
Administration by Anesthesia		
No	0	0.0%
Yes	1237	100.0%
Chi Square	1355.000	
df	1	
p value	**< .001**	
Case Type		
Elective (Scheduled)	955	90.4%
Elective Add on	223	94.1%
Emergency	41	97.6%
Trauma	4	80.0%
Urgent	14	93.3%
Chi Square	6.308	
df	4	
p value	**0.177**	

Table 7 Bivariate Analysis – Outcome Administration within 60 minutes prior to incision comparison of means

Variable	**Compliant Mean in minutes**	**Non-compliant Mean in minutes**	**p value (t test)**
Total Room Time	231.68	227.2	0.577
Total Procedure Time	171.24	165.28	0.418
In Room to Incision Time	45.0	46.0	0.658

The outcome variable of discontinuation within 24 hours (48 hours for Cardiac surgery) showed significant associations with procedure category ($p < .001$), with Cardiac surgery compliant 97.7%, Hysterectomy 96.7% and other GYN 92.3%. While compliance rates for other categories such as Vascular, Joint, Abdominal – General and Neurosurgery were lower at 84.2%, 73.6%, 53.3% and 67.3% respectively. ASA score and case type showed no significant relationship to discontinuation with $p = .771$ and .072 respectively. (See Table 8 for summary of relationships).

Table 8 Bivariate Analyses - Outcome Discontinuation within 24 hours (48 hours for Cardiac surgery) of procedure

Variable	**Compliant**	**%**
Procedure Category		
Vascular	133	84.2%
Cardiac	562	97.7%
Joint	220	73.6%
Hysterectomy	206	96.7%
Other GYN	12	92.3%
Abdominal - General	32	53.3%
Neurosurgery	23	67.3%
Urology	0	0.0%
Total	1188	87.7%
Chi Square	226.479	
df	7	
p value	**< .001**	
ASA		
ASA I	15	83.3%
ASA II	239	86.3%
ASA III	725	88.1%
ASA IV	201	88.5%
ASA V	5	100.0%
Total	1185	87.8%
Chi Square	1.806	
df	4	
p value	**0.771**	
Case Type		
Elective (Scheduled)	921	87.2%
Elective Add on	217	91.6%
Emergency	35	83.3%
Trauma	3	60.0%
Urgent	12	80.0%
Chi Square	8.613	
df	4	
p value	**0.072**	

The outcome variable of total compliance showed significant associations with procedure category ($p < .001$), with Cardiac surgery compliant 95.5%, Other GYN 92.3% and Hysterectomy 84.5%. While compliance rates for other categories such as Vascular, Joint, Abdominal – General and Neurosurgery were lower at

77.2%, 58.2%, 36.7% and 52.9% respectively. ASA score and case type showed a significant relationship to total compliance with p = .004, compliance rates increased as ASA score increased ranging from 72.2% to 100%. Administration in SDS showed no significant relationship to total compliance (p = .171), while administration in the OR showed a significant relationship with p <.001 and compliance at 85%. Not administering antibiotic in CV Holding showed a relationship to compliance at 80.1% being compliant (p <.001). Administration by anesthesia showed a significant relationship to total compliance at 87.1% of those administered having total compliance, while 0.0% of those not administered by anesthesia having total compliance (p < .001). Case type showed a significant relationship to total compliance (p = .006) with Elective (Scheduled) and Elective Add on having 78.0% and 86.9% compliance respectively while Trauma cases had 40.0% compliance. The means of OR Room Time, Procedure Time and Enter to Incision Time for compliant cases versus non compliant cases of the outcome Total Compliance were; 232.5 minutes versus 226.5 minutes, 171.8 minutes versus 166.4 minutes and 45.0 minutes versus 45.0 minutes respectively. No significant differences in means were evident with OR Room Time (p = .366), Procedure Time (p = .384) or Enter to Incision Time (.826) (See Tables 9 and 10 for summary of relationships).

Table 9 Bivariate Analyses - Outcome Total Antibiotic Compliance

Variable	Compliant	%
Procedure Category		
Vascular	122	77.2%
Cardiac	549	95.5%
Joint	174	58.2%
Hysterectomy	180	84.5%
Other GYN	12	92.3%
Abdominal - General	22	36.7%
Neurosurgery	18	52.9%
Urology	0	0.0%
Chi Square	272.18	
df	7	
p value	**< .001**	
ASA		
ASA I	13	72.2%
ASA II	200	72.2%
ASA III	664	80.7%
ASA IV	192	84.6%
ASA V	5	100.0%
Chi Square	15.255	
df	4	
p value	**0.004**	
Administration in SDS		
No	847	80.3%
Yes	230	76.7%
Chi Square	1.875	
df	1	
p value	**0.171**	
Administration in OR		
No	269	66.6%
Yes	808	85.0%
Chi Square	58.734	
df	1	
p value	**< .001**	
Administration in CV Holding		
No	1076	80.1%
Yes	1	8.3%
Chi Square	37.585	
df	1	
p value	**< .001**	

Table 9 continued

Variable	**Compliant**	**%**
Administration by Anesthesia		
No	0	0.0%
Yes	1077	87.1%
Chi Square	500.752	
df	1	
p value	**< .001**	
Case Type		
Elective (Scheduled)	824	78.0%
Elective Add on	206	86.9%
Emergency	34	81.0%
Trauma	2	40.0%
Urgent	11	73.3%
Chi Square	14.588	
df	4	
p value	**0.006**	

Table 10 Bivariate Analysis – Outcome Total Compliance comparison of means

Variable	**Compliant Mean in minutes**	**Non-compliant Mean in minutes**	**p value (t test)**
Total Room Time	232.53	226.48	0.366
Total Procedure Time	171.83	166.42	0.384
In Room to Incision Time	45.0	45.0	0.826

Discussion

SSIs continue to contribute to patient mortality and increased cost in the United States. Hospitals, healthcare providers and organizations are strategically focusing on prevention of SSIs through initiatives such as the IHI 5 million lives campaign and the CMS Surgical Care Improvement Project. These initiatives use surgical antibiotic prophylaxis as a core intervention for prevention of SSIs (25, 26). Identification of how to improve compliance with antibiotic choice, administration within 60 minutes prior to incision and discontinuation within 24 hours (or 48 hours for Cardiac surgery) of end of procedure is key to improving care for surgical patients.

This study sample identifies that administration by anesthesia is significantly related to compliance the outcomes of administration within 60 minutes prior to incision and total compliance. This finding is consistent with the recommendations of the IHI and SCIP sponsors – engage anesthesia staff to participate in antibiotic prophylaxis. The relationship to administration within 60 minutes prior to incision is obvious; the relationship to total compliance bears further exploration. This study sample analysis shows the most significant relationship with anesthesia administration and compliance in administration within 60 minutes prior to incision, the 118 cases that were not administered by anesthesia were all non compliant in at least one outcome variable. However, not all cases that were administered by anesthesia were compliant; this may indicate that administration by anesthesia is necessary for administration compliance, but not sufficient for total compliance. A larger, multi-site study would be useful to explore the relationship of anesthesia administration and the study outcomes of choice and discontinuation as a part of total compliance. The effect of administration by anesthesia on practice patterns of surgeons related to choice and discontinuation could show trends that are useful in management of surgical patients for hospitals in other initiatives in addition to antibiotic prophylaxis.

A second focus of intervention for compliance, as indicated by this study sample is location of administration. The administration of antibiotics in the OR was associated with better performance in administration within 60 minutes prior to incision and total compliance. Administration in SDS showed no relationship to any study outcome; CV Holding showed a relationship that not administering in CV Holding was related to compliance in both administration within 60 minutes and total compliance. The mutual exclusivity of location of administration implies that since administration in the OR was significantly related to compliance in these outcomes, this should be the interventional strategy of this hospital to increase compliance rates. These relationships indicate that not only "who" is administering the antibiotic is important, but "where" it is administered is also important. Many operating rooms have conducted data analyses to establish average times for induction of anesthesia to assist with understanding how much time should be allocated for administration of antibiotics. Contrary to this conventional thinking, this time variable showed no relationship to compliance with any outcome variable. This indicates that while this variable may have some impact on compliance with administration, other variables have stronger relationships to compliance like anesthesia's involvement in administration. The attention of the anesthesia staff to timing of incision may decrease the effect of this timing variable. Further analysis on timing of dose in relation to incision may indicate other characteristics that affect compliance.

A final area of focus is related to physician practices. While the data of physician name was not collected in this study sample, another variable procedure category cans proxy to physician. This did show significant relationships to all four study outcome variables. This may indicate that some outcomes such as discontinuation and choice within this study sample are associated more with practice preferences than hospital processes. Further interventional studies should focus on strategies to develop processes to promote compliance, particularly with antibiotic choice and discontinuation. Some outcomes associated with practice preferences appear to be more difficult to affect.

When focusing on improving compliance to perfect care, the difficulty remains to be in developing processes that assist healthcare providers to order, administer and discontinue antibiotics according to established best practice guidelines. This study sample showed overall compliance in these outcomes as relatively high, choice (94.8%), administration (91.3%), discontinuation (87.7%) and total compliance (79.5%). Bratzler and Hunt (27) report national compliance rates in 4^{th} quarter 2004 for antibiotic choice, antibiotic administration within 60 minutes, and discontinuation at 92.2%, 69.7% and 52.9% respectively. This study sample showed better than 2004 national performance levels. Although these rates are high, hospitals continue to focus on improving performance. Further interventional studies should focus on identifying processes to assist ordering, administration and discontinuation as well as identifying who administers the antibiotic and where it is expected to be administered to continue to improve performance.

Limitations of this study include the absence of surgeon identifiers and dates. These data could be used to inform healthcare organizations on practices related to specific surgeon characteristics. This information may lead to how specific surgeon preferences affect compliance particularly with antibiotic choice and discontinuation. This information is valuable to healthcare organizations in establishing care based on evidence. In addition, the absence of date of surgical procedure leaves this study unable to analyze changes in compliance over time. Further research should be conducted assessing specific surgeon characteristics and changes in compliance over time.

The importance of SSI prevention will remain high priority for patients, physicians and healthcare organizations. As healthcare organizations continue to increase compliance in these outcomes, analysis can increase in complexity and difficulty. Trend analysis will remain important to clinicians and hospital performance improvement leaders to drive compliance even higher in these outcomes to near perfect or perfect levels. It will remain important to focus intervention strategies based on evidence rather than provider preference (28-30). Developing processes based on such things as electronic health records or computerized charting will assist in prompting real time compliance with these important outcomes (31). These strategies and additional research will continue to inform the healthcare field on prevention of SSIs and thus improve the surgical care of patients.

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Addenda A: IHI 100,000 Lives Campaign How-to Guide: Prevent Surgical Site Infection

Getting Started Kit:
Prevent Surgical Site Infections

How-to Guide

100,000 Lives Campaign
We invite you to join a Campaign to make health care safer and more effective — to ensure that hospitals achieve the best possible outcomes for all patients. The Institute for Healthcare Improvement (IHI) and other organizations that share our mission are convinced that a remarkably few proven interventions, implemented on a wide enough scale, can avoid 100,000 deaths between January 2005 and July 2006, and every year thereafter. Complete details, including materials, contact information for experts, and web discussions, are available on the web at http://www.ihi.org/IHI/Programs/Campaign/.

Goal:

Prevent surgical site infections (SSI) by implementing four components of care:

1. Appropriate use of antibiotics;
2. Appropriate hair removal;
3. Maintenance of postoperative glucose control* for major cardiac surgery patients; and
4. Establishment of postoperative normothermia* for colorectal surgery patients.

* These components of care are supported by clinical trials and experimental evidence in the specified populations; they may prove valuable for other surgical patients as well.

The Case for Preventing Surgical Site Infections

Surgical site infections are the second most common type of adverse events occurring in hospitalized patients (Brennan. *N Engl J Med*. 1991;324:370-376). Surgical site infections have been shown to increase mortality, readmission rate, length of stay, and cost for patients who incur them. (Kirkland. *Infect Control Hosp Epidemiol.* 1999;20:725). While nationally the rate of surgical site infection averages between two and three percent for clean cases, an estimated 40 to 60 percent of these infections are preventable.

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

Where Are We Now?

A medical record review of 34,133 charts performed under the auspices of the Centers for Medicare & Medicaid Services (CMS) demonstrated that there is significant opportunity for improvement in surgical site prevention. (Bratzler. *Arch Surg*. 2005;140:174-182.) In the area of appropriate antibiotic use, the medical record review found the following:

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

General Considerations for Improvement in SSI

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

Preventing Surgical Site Infection: Four Components of Care

1. Appropriate Use of Prophylactic Antibiotics

For the purposes of the 100,000 Lives Campaign, the antibiotic process measures are these:

1. Antibiotics within 1 hour before surgical incision*
2. Prophylactic antibiotic consistent with national guidelines (e.g., CDC)
3. Discontinuation of prophylactic antibiotics within 24 hours after surgery

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

» What changes can we make that will result in improvement?

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

- Use preprinted or computerized standing orders specifying antibiotic, timing, dose, and discontinuation.
- Change operating room drug stocks to include only standard doses and standard drugs, reflecting national guidelines.
- Reassign dosing responsibilities to anesthesia or holding area nurse to improve timeliness.
- Use visible reminders/checklists/stickers.
- Involve pharmacy, infection control, and infectious disease staff to ensure appropriate timing, selection, and duration.

Preventing Surgical Site Infection: Four Components of Care

2. Appropriate Hair Removal

For many years, it has been known that the use of razors (shaving) prior to surgery increases the incidence of wound infection when compared to clipping, depilatory use, or no hair removal at all (Seropian. *Am J Surg*. 1971;121:251). However, many teams working on this measure find that the use of razors in their own institutions can range from zero to nearly one hundred percent. We recommend collecting baseline information on this measure in order to determine current practice (see the Measure Information Forms in Appendix A).

» What changes can we make that will result in improvement?

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

- Remove all razors from the entire hospital.
- Work with the purchasing department so that razors are no longer purchased by the hospital.
- Use reminders (signs, posters).
- Educate patients not to self-shave preoperatively.

Preventing Surgical Site Infection: Four Components of Care

3. Maintenance of Postoperative Glucose Control* **

Review of medical literature shows that the degree of hyperglycemia in the postoperative period was correlated with the rate of SSI in patients undergoing major cardiac surgery (Latham. *Inf Contr Hosp Epidemiol*. 2001;22:607; Dellinger. *Inf Contr Hosp Epidemiol*. 2001;22:604). Other articles have demonstrated that stringent glucose control in surgical intensive care unit patients reduces mortality (Van den Berghe. *NEJM*. 2001;345:1359).

*NOTE that, for this effort, "glucose control" is defined as serum glucose levels below 200 mg/dl, collected once on each of the first two postoperative days.
**NOTE that tight glycemic control (e.g., using an insulin drip) generally should be performed in an intensive care setting or equivalent.

» What changes can we make that will result in improvement?

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

- Implement a glucose control protocol (sliding scale or insulin drip).
- Regularly check preoperative blood glucose levels on all patients.
- Assign responsibility and accountability for blood glucose monitoring and control.

Since the best evidence for glucose control is in the cardiovascular surgery population, it is sensible to focus on this high-risk population first. Tight glucose control is easier and safer to implement and monitor in an ICU setting.

Preventing Surgical Site Infection: Four Components of Care

4. Establishment of postoperative Normothermia*

The medical literature indicates that patients undergoing surgery have a decreased risk of surgical site infection if they are not allowed to become hypothermic during the perioperative period (Melling. *Lancet*. 2001;358:876). Anesthesia, anxiety, wet skin preparations, and skin exposure in cold operating rooms can cause patients to become clinically hypothermic during surgery. The relatively limited clinical data are supported by strong theoretical rationale and experimental data. Some experts believe that initial efforts should be directed at colorectal surgery patients until additional clinical studies are performed.
*NOTE that this component of care does not pertain to those patients for whom therapeutic hypothermia is being used (e.g., hypothermic cardioplegia).

» What changes can we make that will result in improvement?

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

- Use warmed forced-air blankets preoperatively, during surgery and in PACU.
- Use warmed IV fluids.
- Increase the ambient temperature in the operating room.
- Use warming blankets under patients on the operating table.
- Use hats and booties on patients perioperatively.

Using the Model for Improvement

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

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.

- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

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

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

You can learn more about the Model for Improvement on www.IHI.org

Forming a Team

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

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

Measurement

See Measure Information Forms for specific information regarding the recommended process and outcomes measures for surgical site infection prevention (Appendix A).

For each process measure, obtain the data via medical record review. We recommend using the sampling schemes described in the Measurement Information Forms. For the antibiotic measures, the measurement scheme for the Campaign is identical to that being used in CMS's current Surgical Infection Prevention program and in JCAHO's current core measure set. Using run charts help make change over time visible to the team and to the leadership.

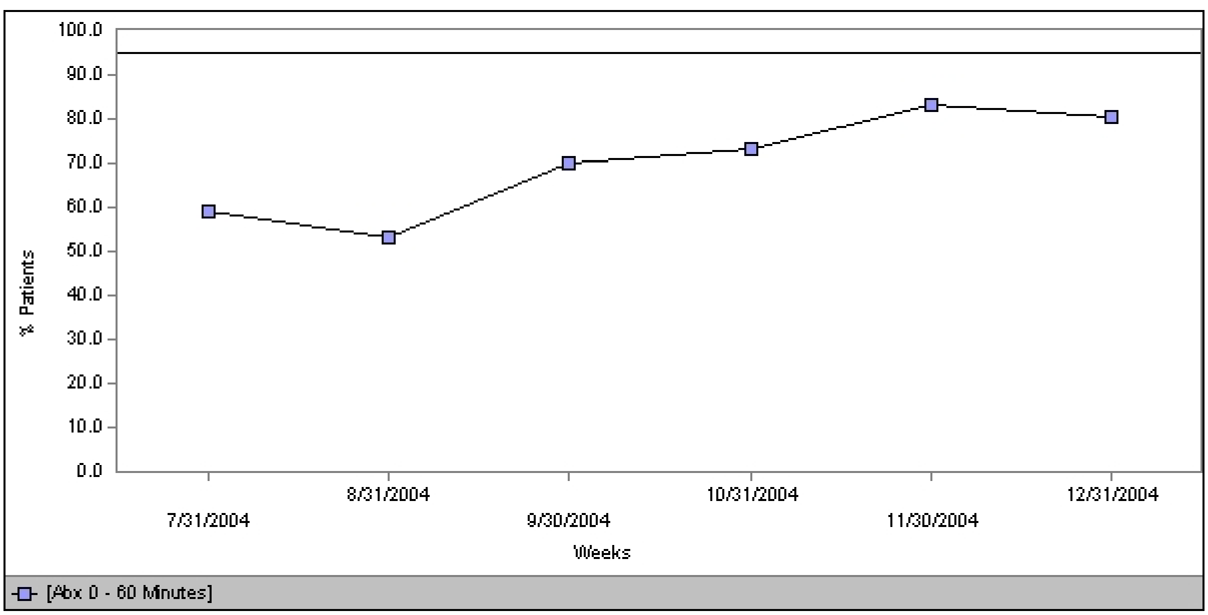
Run Charts

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

Using run charts has a variety of benefits:

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

On-time Prophylactic Antibiotic Administration



First Test of Change

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

Example: Appropriate hair removal

> The team decides to test removing razors from one operating room for one surgery. They identify a surgeon who supports theavoidance of razors, and let the surgeon know that the razors will be removed. On their PDSA form, they predict that the surgeon will cope well without razors in the room. They then conduct the test. They note that the surgeon becomes frustrated because s/he wishes to use clippers to remove hair and there are no working clippers in the room. The team's study of the data indicates that they should repeat this test, after first making sure there is a set of operable clippers available in the operating room.
>
> Ideally, teams will conduct multiple small tests of change simultaneously across all four components of care. This simultaneous testing usually begins after the first few tests are completed and the team feels comfortable and confident in the process.

Implementation and Spread

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

In order to maximize the reduction in overall hospital mortality related to surgical site infections, however, hospitals must spread improvements begun in a pilot population to the universe of surgical populations. Organizations that successfully spread improvements use an organized, structured method in planning and implementing spread across populations, units, or facilities. You can find information about planning, tracking, and optimizing spread at www.ihi.org.

Barriers

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

1. **Lack of support by leadership**

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

2. **Uneven physician acceptance of new practices**

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

Appendix A

Measure Information Form:
Percent of Surgical Patients with Timely Prophylactic Antibiotic Administration

Intervention(s): Reducing Surgical Site Infection

Definition: Percentage of surgical patients with antibiotic administration within 60 minutes prior to surgical incision

Goal: 95% or higher

Matches Existing Measures:
- JCAHO Core Measure SIP-1a
- Surgical Care Improvement Project (SCIP) measure SCIP-1a

CALCULATION DETAILS:

Numerator Definition: Number of selected surgical patients whose prophylactic antibiotics were initiated within 60 minutes prior to surgical incision (See definition of terms below for which surgeries are included for this measure.)

Note: Cases for which either vancomycin or fluoroquinolone were used as prophylactic antimicrobial: These antibiotics need to be administered within TWO hours of surgery start time. Patients receiving these antibiotics within two hours of surgery start time will count in the numerator.

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: Number of selected surgical patients. (See definition of terms below for which surgeries are included for this measure.)

Denominator Exclusions:
- **Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases**
- **Patients who received antibiotics within 24 hours prior to arrival (except colon surgery patients taking oral prophylactic antibiotics)**
- Patients who received antibiotics more than 24 hours prior to surgery (except colon surgery patients taking oral prophylactic antibiotics)

- Colon surgery patients who received oral prophylactic antibiotics only, and who received no antibiotics during stay
- Patients who are less than 18 years of age
- Patients with physician-documented infection prior to surgical procedure
- Patients who had other procedures that required general or spinal anesthesia that occurred within 24 hours prior to this procedure during this hospital stay (during separate surgical episodes)

Measurement Period Length: Monthly

Definition of Terms:

- Selected surgical patient: A patient having had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery. (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.)

Calculate as: (numerator / denominator); as a percentage

Comments:

- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.
- For cases involving use of an inflatable cuff or tourniquet to the operative site, the antibiotic should be fully infused prior to inflation of the cuff.
- Start time for administration is easier to track than end time, so use start time to determine administration within 1 hour. Since most antibiotics can be rapidly infused, end time should be close to start time.
- The goal is to have the antibiotic dose fully infused prior to the incision; ideally, infusion is completed between 60 minutes prior to incision (120 minutes in the case of vancomycin or fluoroquinolones when used for cephalosporin allergy).
- Patients for whom antibiotic start time or incision time is not recorded are counted as NOT obtaining prophylactic antibiotics on time (i.e., a zero in the numerator).

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

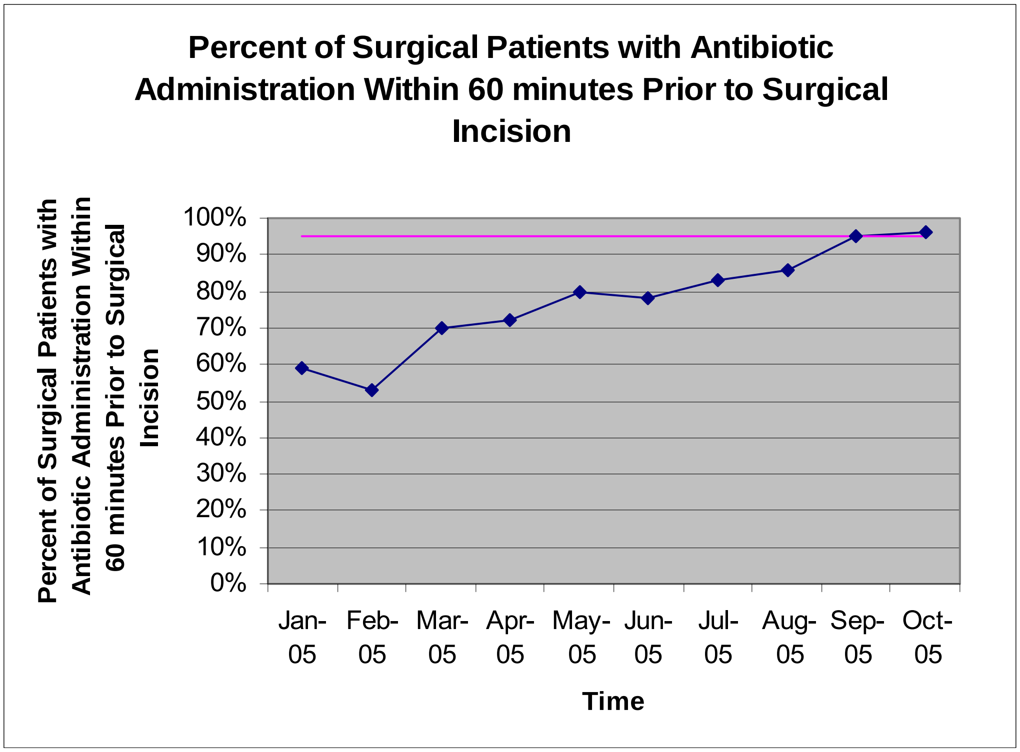
Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

Sampling Strategy:
Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

Measure Rate Worksheet
Percent Patients Receiving Timely Prophylactic Antibiotic Administration

1. What is the total number of patients during the previous month who had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery? (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

2. What is the total number of patients who had principal diagnosis codes suggestive of preoperative infectious disease? (For ICD-9-CM Principal Diagnosis Code of selected diagnoses, refer to Appendix A, Tables 5.09in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

3. Subtract the total from #2 above from the total for #1 above and enter here. ___

4. What is the total number of patients in #3 above whose age was < 18 years on admission? ____

5. Subtract the total to #4 above from the total to #3 above and enter here. ___

6. What is the total number of patients in #5 above who had an admission diagnosis of infection? ___

7. Subtract the total for #6 above from the total for #5 above and enter here. ___

8. What is the total number of patients in #7 above who had physician documentation of being treated for an infection prior to anesthesia? ___

9. Subtract the total for #8 above from the total for #7 above and enter here. ___

10. What is the total number of patients excluding colon surgery patients taking oral antibiotics who received antibiotics within 24 hours prior to arrival? ___

11. Subtract the total for #10 above from the total for #9 above and enter here. ___

12. What is the total number of patients who were not given antibiotics at any time from arrival through the first 48 hours after surgery end time? ____

13. Subtract the total for #12 above from the total for #11 above and enter here. ___

This is the denominator for the measure.

--

14. What is the total number of patients in #13 above whose prophylactic antimicrobial consisted of vancomycin or fluoroquinolones? ___

15. What is the number of patients in #14 above whose antibiotic was administered within 0 to 120 minutes of surgical incision time? ____

16. What is the total number of patients in #13 above whose prophylactic antimicrobial did not consist of vancomycin or fluoroquinolones? ____

17. What is the number of patients in #16 above whose antibiotic was administered within 0 to 60 minutes of surgical incision time? ____

18. Add the results from # 15 and from #17 above. ____

This is the numerator for the measure.

Measure Information Form:
Percent of Surgical Patients with Appropriate Selection of Prophylactic Antibiotic

Intervention(s): Reducing Surgical Site Infection

Definition: Percent of surgical patients receiving prophylactic antibiotic consistent with JCAHO / CMS guidelines

Goal: 95% or higher

Matches Existing Measures:
- JCAHO Core Measure SIP-2a
- Surgical Care Improvement Project (SCIP) measure SCIP-2a

CALCULATION DETAILS:

Numerator Definition: Number of selected surgical patients receiving prophylactic antibiotics consistent with the JCAHO / CMS guidelines recommended for their specific surgical procedure. (See definition of terms below for which surgeries are included for this measure.)

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: Number of selected surgical patients. (See definition of terms below for which surgeries are included for this measure.)

Denominator Exclusions:
- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients who were receiving antibiotics within 24 hours prior to arrival (except colon surgery patients taking oral prophylactic antibiotics)
- Patients who were receiving antibiotics more than 24 hours prior to surgery (except colon surgery patients taking oral prophylactic antibiotics)
- Patients who did not receive any antibiotics before or during surgery, or within 24 hours after surgery end time (i.e., patient did not receive prophylactic antibiotics)
- Patients who did not receive any antibiotics during this hospitalization
- Patients who are less than 18 years of age
- Patients with physician-documented infection prior to surgical procedure

Measurement Period Length: Monthly

Definition of Terms:

- Selected surgical patient: A patient having had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery. (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.)
- Appropriate antibiotics consistent with JCAHO / CMS guidelines: The following table describes the JCAHO guidelines, and should be used for the purposes of this measure. More detailed information may be found online at http://www.jcaho.org/pms/core+measures/2zgsip2.pdf.

Surgical Procedure	Approved Antibiotics
Cardiac or Vascular	Cefazolin, Cefuroxime or Cefamandole If β-lactam allergy: Vancomycin* or Clindamycin*
Hip/Knee Arthroplasty	Cefazolin or Cefuroxime If β-lactam allergy: Vancomycin* or Clindamycin*
Colon	Oral: after effective mechanical bowel preparation, Neomycin Sulfate + Erythromycin Base **OR** Neomycin Sulfate + Metronidazole Administered for 18 hours preoperatively Parenteral: Cefotetan, Cefoxitin or Cefmetazole **OR** Cefazolin + Metronidazole If β-lactam allergy: Clindamycin + Gentamicin, or Clindamycin + Ciprofloxacin**, or Clindamycin + Aztreonam **OR** Metronidazole with Gentamicin, or Metronidazole + Ciprofloxacin**
Hysterectomy	Cefotetan, Cefazolin, Cefoxitin, or Cefuroxime If β-lactam allergy: Clindamycin + Gentamicin, or Clindamycin + Ciprofloxacin**, or Clindamycin + Aztreonam **OR** Metronidazole + Gentamicin, or Metronidazole + Ciprofloxacin** **OR** Clindamycin monotherapy
Special Considerations	*For cardiac, orthopedic, and vascular surgery, if the patient is allergic to β-lactam antibiotics, Vancomycin or Clindamycin are acceptable substitutes.

	** Levofloxacin 750 mg given once may be substituted for Ciprofloxacin.

Calculate as: (numerator / denominator); as a percentage

Comments:
- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

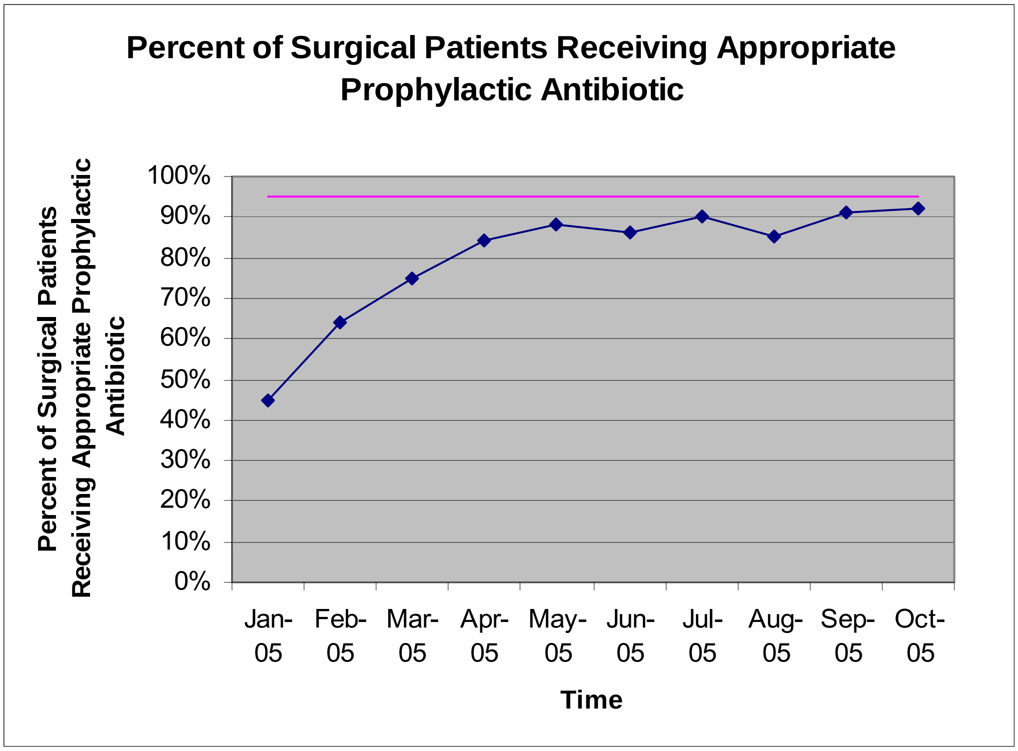
Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

Sampling Strategy:
Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

Measure Rate Worksheet
Percent of Surgical Patients with Appropriate Selection of Prophylactic Antibiotic (JCAHO/CMS SIP-2)

1. What is the total number of patients during the previous month who had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery? (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

2. What is the total number of patients who had principal diagnosis codes suggestive of preoperative infectious disease? (For ICD-9-CM Principal Diagnosis Code of selected diagnoses, refer to Appendix A, Tables 5.09in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

3. Subtract the total from #2 above from the total for #1 above and enter here. ___

4. What is the total number of patients in #3 above whose age was < 18 years on admission? ____

5. Subtract the total to #4 above from the total to #3 above and enter here. ___

6. What is the total number of patients in #5 above who had an admission diagnosis of infection? ___

7. Subtract the total for #6 above from the total for #5 above and enter here. ___

8. What is the total number of patients in #7 above who had physician documentation of being treated for an infection prior to anesthesia? ___

9. Subtract the total for #8 above from the total for #7 above and enter here. ___

10. What is the total number of patients, excluding colon surgery patients taking oral Neomycin Sulfate + Erythromycin Base or oral Neomycin Sulfate + Metronidazole, who received antibiotics within 24 hours prior to arrival? ___

11. Subtract the total for #10 above from the total for #9 above and enter here. ___

12. What is the total number of patients, excluding colon surgery patients taking oral Neomycin Sulfate + Erythromycin Base or oral Neomycin Sulfate + Metronidazole, who were not given antibiotics at any time from arrival through the first 48 hours after surgery end time? ____

13. Subtract the total for #12 above from the total for #11 above and enter here. ___

14. What is the total number of patients whose antibiotics are not included in Table 2.1, Appendix C of the JCAHO Specification Manual for National Hospital Quality Measures, 2005? ____ (Appendix C can be found online at http://www.jcaho.org/pms/core+measures/appendixc.pdf)

15. Subtract the total for #14 above from the total from #13 above and enter here.__

16. What is the total number of patients whose antibiotics were not prophylactic antibiotics (i.e, antibiotics that were not administered prior to surgery, during surgery, or within 24 hours after surgery end time to prevent the incidence of operative wound infections)? ____

17. Subtract the total for #16 above from the total for #15 above and enter here. ___

18. What is the total number of patients, other than colon surgery patients receiving oral or parenteral antibiotics, who received antibiotics via a route other than intravenous?___

19. Subtract the total for #18 above from the total for # 17 above and enter here. ___

    This is the denominator for the measure.

----

20. What is the total number of patients in #20 who received prophylactic antibiotics appropriate for their surgery type and allergy status as defined in the Antibiotic Selection Regimen for Surgery in the JCAHO Specification Manual for National Hospital Quality Measures, 2005? (The Antibiotic Selection Regiment for Surgery can be found online at http://www.jcaho.org/pms/core+measures/2zgsip2.pdf) ____

    This is the numerator for the measure.

Measure Information Form: Percent of Surgical Patients with Appropriate Prophylactic Antibiotic Discontinuation

Intervention: Reducing Surgical Site Infection

Definition: Percent of surgical patients whose prophylactic antibiotics were discontinued within 24 hours after surgery end time

Goal: 95% or higher

Matches Existing Measures:
- JCAHO Core Measure SIP-3a
- Surgical Care Improvement Project (SCIP) measure SCIP-3a

CALCULATION DETAILS:

Numerator Definition: Number of selected surgical patients whose prophylactic antibiotics were discontinued within 24 hours after surgery end time. (See definition of terms below for which surgeries are included for this measure.)

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: Number of selected surgical patients with no evidence of prior infection. (See definition of terms below for which surgeries are included for this measure.)

Denominator Exclusions:
- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients who were receiving antibiotics at the time of admission (except colon surgery patients taking oral prophylactic antibiotics)
- Patients who were receiving antibiotics more than 24 hours prior to surgery (except colon surgery patients taking oral prophylactic antibiotics)
- Patients who did not receive any antibiotics before or during surgery, or within 24 hours after surgery end time (i.e. patient did not receive prophylactic antibiotics)
- Patients who were diagnosed with and treated for infections within two days after surgery date
- Patients who did not receive any antibiotics during this hospitalization
- Patients less than 18 years of age
- Patients with physician documented infection prior to surgical procedure of interest

- Patients who had other surgical procedures performed during this admission after the first procedure

Measurement Period Length: Monthly

Definition of Terms:
- Prophylactic antibiotics: Antibiotics given solely for the purpose of prevention of surgical infection (i.e., not those being given therapeutically for treatment of active infections)
- Selected surgical patient: A patient having had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery. (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.)

Calculate as: (numerator / denominator); as a percentage

Comments:
- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.
- Available evidence indicates that the discontinuation of prophylactic antimicrobials at 24 hours is appropriate for all patients, regardless of the presence of postoperative drains or tubes.

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

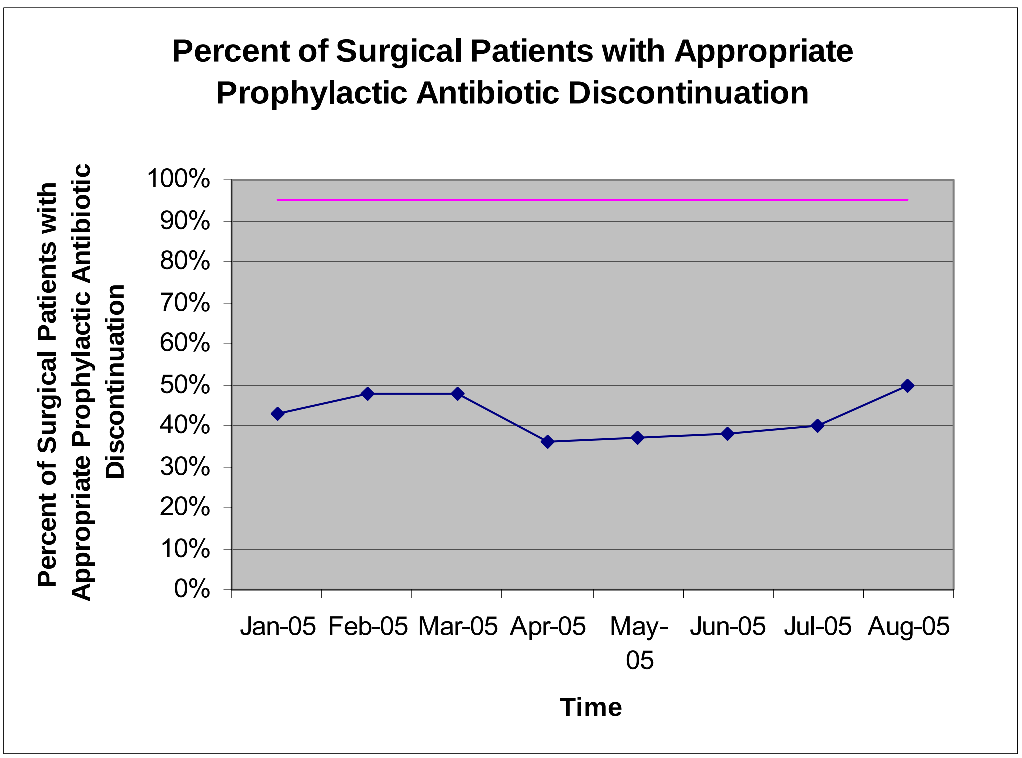
Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

Sampling Strategy:
Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *“N”*	Minimum required sample *“n”*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

Measure Rate Worksheet
Percent of Surgical Patients with Appropriate Prophylactic Antibiotic Discontinuation
(JCAHO/CMS SIP-3)

1. What is the total number of patients during the previous month who had an inpatient surgical procedure of the following type: CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery? (For ICD-9-CM Principal Procedure Code or ICD-9-CM Other Procedure Code of selected surgeries, refer to Appendix A, Tables 5.01-5.08 in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

2. What is the total number of patients who had principal diagnosis codes suggestive of preoperative infectious disease? (For ICD-9-CM Principal Diagnosis Code of selected diagnoses, refer to Appendix A, Tables 5.09in the JCAHO specifications manual; this information is available online at http://www.jcaho.org/pms/core+measures/appendixa.pdf.) ___

3. Subtract the total from #2 above from the total for #1 above and enter here. ___

4. What is the total number of patients in #3 above whose age was < 18 years on admission? ____

5. Subtract the total to #4 above from the total to #3 above and enter here. ___

6. What is the total number of patients in #5 above who had an admission diagnosis of infection? ___

7. Subtract the total for #6 above from the total for #5 above and enter here. ___

8. What is the total number of patients in #7 above who had physician documentation of being treated for an infection prior to anesthesia? ___

9. Subtract the total for #8 above from the total for #7 above and enter here. ___

10. What is the total number of patients excluding colon surgery patients taking oral antibiotics who received antibiotics within 24 hours prior to arrival? ___

11. Subtract the total for #10 above from the total for #9 above and enter here. ___

12. What is the total number of patients who were not given antibiotics at any time from arrival through the first 48 hours after surgery end time? ____

13. Subtract the total for #12 above from the total for #11 above and enter here. ___

14. What is the total number of patients whose antibiotics are not included in Table 2.1, Appendix C of the JCAHO Specification Manual for National Hospital Quality Measures, 2005? ____ (Appendix C can be found at the following link http://www.jcaho.org/pms/core+measures/appendixc.pdf)

15. Subtract the total for #14 above from the total from #13 above and enter here.__

16. What is the total number of patients whose antibiotics were not prophylactic antibiotics (i.e, antibiotics that were not administered prior to surgery, during surgery, or within 24 hours after surgery end time to prevent the incidence of operative wound infections)? ____

17. Subtract the total for #16 above from the total for #15 above and enter here. ___

18. What is the total number of patients who had other types of surgery in addition to CABG, cardiac surgery, hip arthroplasty, knee arthroplasty, colon surgery, hysterectomy, and vascular surgery? ___

19. Subtract the total for #18 above from the total for #17 above and enter here. ___

20. What is the total number of patients who developed a postoperative infection <= 2 days after surgery end date? ___

21. Subtract the total for #20 above from the total for #19 above and enter here. ___

    This is the denominator for the measure.

----

22. What is the total number of patients in #21 whose prophylactic antibiotics were discontinued <= 24 hours (1440 minutes) after surgery end time. ___

This is the numerator for the measure.

Measure Information Form:
Percent of Major Cardiac Surgical Patients with Controlled Post Operative Serum Glucose

Intervention(s): Reducing Surgical Site Infection

Definition: Percent of major cardiac surgical patients with controlled post operative glucose (< 200mg/dL.)

Goal: 95% or higher

Matches Existing Measures:
- Surgical Care Improvement Project (SCIP) measure SCIP-4

CALCULATION DETAILS:

Numerator Definition: Number of major cardiac surgical patients with controlled post operative glucose (< 200 mg/dL)

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: All major cardiac surgical patients

Denominator Exclusions:
- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients less than 18 years of age
- Patients with physician-documented infection prior to surgical procedure
- Burn or transplant patients

Measurement Period Length: Monthly

Definition of Terms:
- Major cardiac surgical patient: A patient having had an inpatient cardiac surgical procedure. Specific ICD-9-CM codes will be forthcoming as SCIP defines them.
- Controlled post operative glucose: The blood glucose values on postoperative day (POD) one and two drawn closest to 6:00 a.m. (0600)

Calculate as: (numerator / denominator); as a percentage

Comments:

- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.
- Blood glucose values on both POD 1 and 2 must be below 200 mg/dL for the patient to be included in the numerator; an average glucose value of below 200 mg/dL is not sufficient.

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

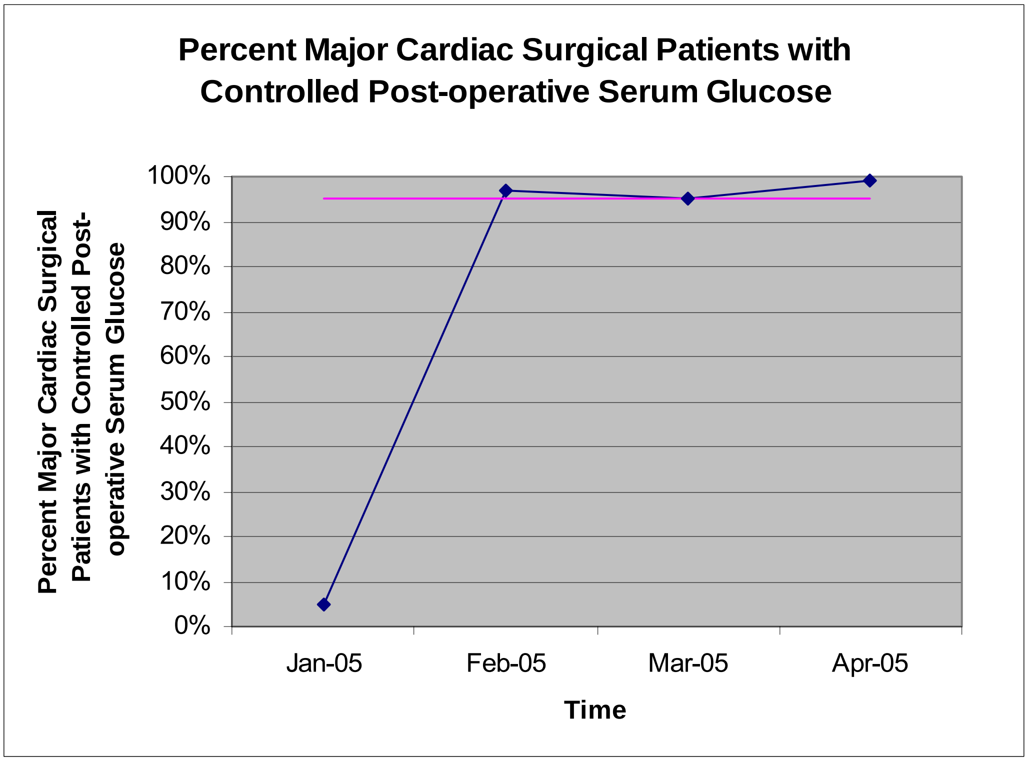
Sampling Strategy:

Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

N/A

Measure Information Form:
Percent of Surgical Patients with Appropriate Hair Removal

Intervention(s): Reducing Surgical Site Infection

Definition: Percent of selected surgical patients with appropriate surgical site hair removal. No surgical site hair removal, or surgical site hair removal with clippers or depilatory, is considered appropriate. Shaving is considered inappropriate.

Goal: 95% or higher

Matches Existing Measures:
- Surgical Care Improvement Project (SCIP) measure SCIP-17

CALCULATION DETAILS:

Numerator Definition: Number of selected surgical patients with no surgical site hair removal, or surgical site hair removal with clippers or depilatory

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: Number of selected surgical patients

Denominator Exclusions:
- **Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases**
- Patients less than 18 years of age
- Burn or transplant patients

Measurement Period Length: Monthly

Definition of Terms:
- Selected surgical patient: A patient having had an inpatient surgical procedure which falls within the SCIP included population for their measure (SCIP-17). Specific ICD-9-CM codes will be forthcoming as SCIP defines them. Note that our clinical recommendation is that no surgical patients receive inappropriate hair removal.

Calculate as: (numerator / denominator); as a percentage

Comments:

- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

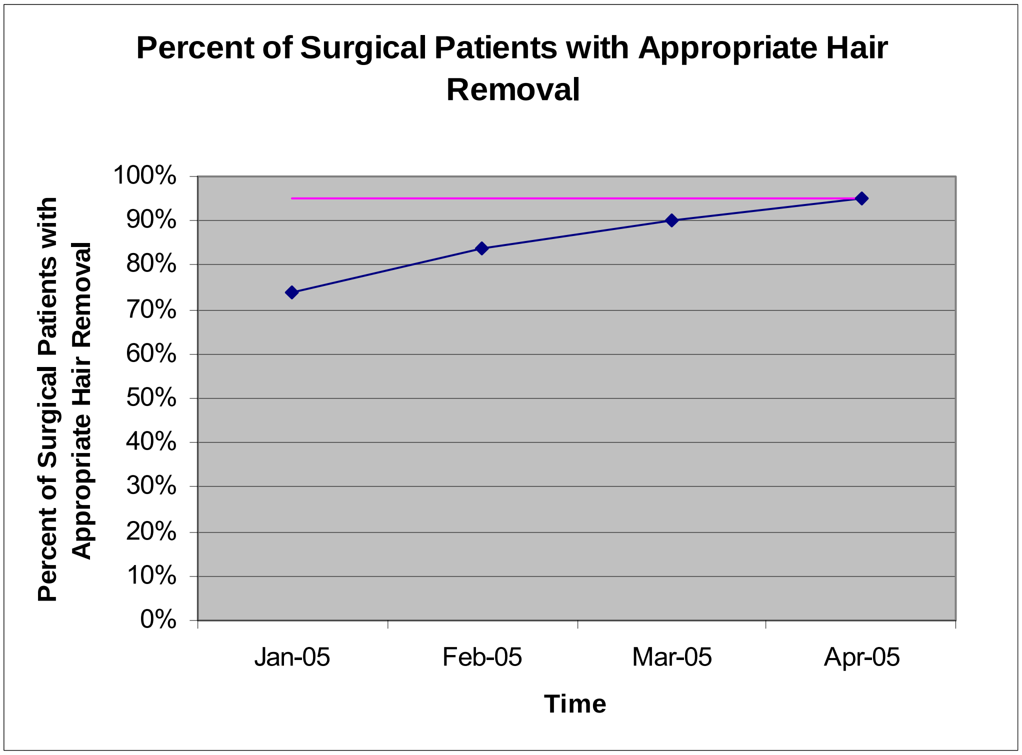
Sampling Strategy:

Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

N/A

Measure Information Form:
Percent of Colorectal Surgical Patients with Normothermia in PACU

Intervention(s): Reducing Surgical Site Infection

Definition: Percent of colorectal surgical patients with normothermia (36.0 - 38.0C or 96.80-100.40F) in post-anesthesia care unit (PACU)

Goal: 95% or higher

Matches Existing Measures:
- Surgical Care Improvement Project (SCIP) measure SCIP-18

CALCULATION DETAILS:

Numerator Definition: Number of colorectal surgical patients whose first temperature in PACU were within the range of 36-38 º C or 96.8-100.4 º F

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: All colorectal surgical patients

Denominator Exclusions:
- Patients who are less than 18 years of age
- Patients with physician-documented infection prior to surgical procedure
- Burn or transplant patients
- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases

Measurement Period Length: Monthly

Definition of Terms:
- Colorectal surgical patient: A patient having had an inpatient colorectal surgical procedure. Specific ICD-9-CM codes will be forthcoming as SCIP defines them.
- Normothermia: Core temperature 36-38 º C or 96.8-100.4 º F.

Calculate as: (numerator / denominator); as a percentage

Comments:

- If more than one inpatient surgical procedure occurred during the index hospitalization, only the first surgical procedure should be considered for the purposes of this measure.

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review.

After the patients have been identified, manual review of the medical record will be required to look for documentation that this intervention was either provided or contraindicated. If documentation for either cannot be found, the measure should be considered as not being met.

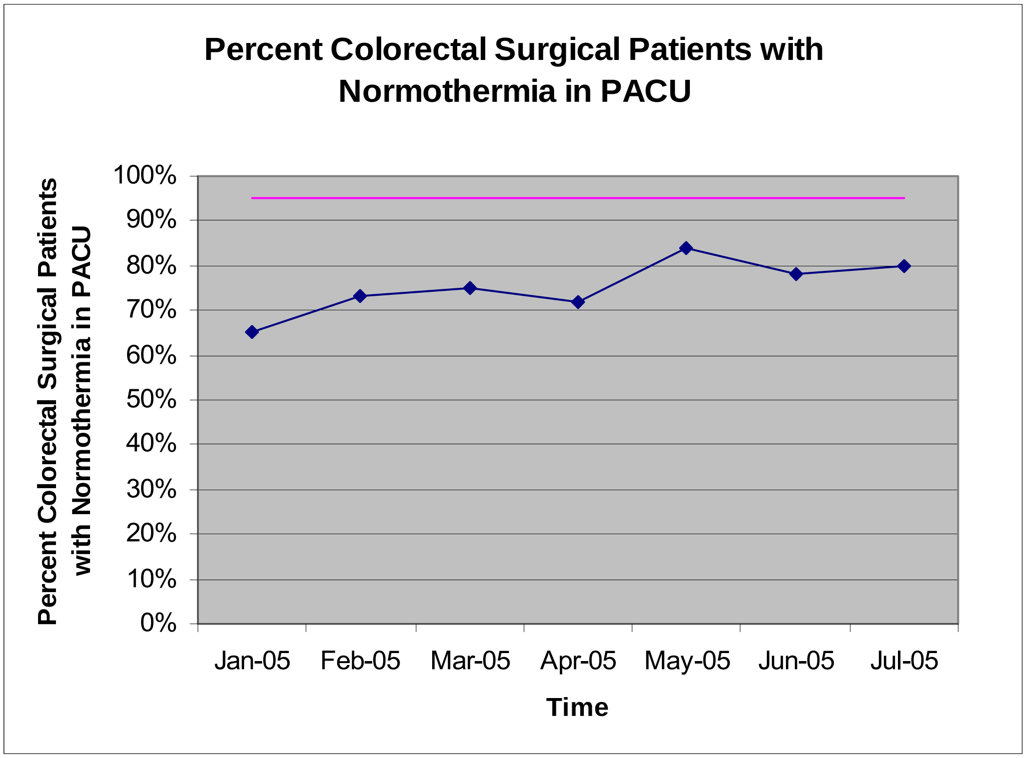
Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

Sampling Strategy:
Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

SAMPLE GRAPH:



DATA COLLECTION AND ANALYSIS TOOLS

N/A

Measure Information Form:
Percent of Clean Surgery Patients with Surgical Infection

Intervention(s): Reducing Surgical Site Infection

Definition: Rate of infection in patients undergoing clean surgery

Goal: Reduction of 50%

Matches Existing Measures: N/A

CALCULATION DETAILS:

Numerator Definition: Number of clean surgery patients having a postoperative wound infection

Numerator Exclusions: Same as denominator exclusions

Denominator Definition: Number of clean surgery patients

Denominator Exclusions:
- **Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases**
- Patients who are less than 18 years of age
- Patients with physician-documented infection prior to surgical procedure

Measurement Period Length: Monthly

Definition of Terms:
- Clean surgery patient: A patient having had a surgery in which the wound is clean, by the NNIS definition: "Uninfected operative wounds in which no inflammation is encountered and respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet criteria."
- Postoperative wound infection: A nosocomial infection as defined by NNIS (http://www.cdc.gov/ncidod/hip/NNIS/NosInfDefinitions.pdf)

Calculate as: (numerator / denominator); as a percentage

Comments: None

COLLECTION STRATEGY:

The primary sources for identifying patients are based on required data elements in administrative data and medical records. A hospital information system may be able to identify the patients from all discharges by sorting based on these elements. Another alternative is to work with the coding or medical records department to identify the patients at the time of coding and prepare a list or set aside records for review. Concurrent review has been used by some hospitals to collect data while patients are still in the hospital and also allows for the identification of missed interventions so that mitigation can occur before discharge.

Sampling Strategy:
Hospitals may decide to collect data using sampling if there is a sufficient volume of cases. The following sampling guidelines based on the sampling guidelines from JCAHO Core Measures may be useful:

Pre-exclusion sample size (n) based on pre-exclusion surgical patient population size (N):

Average Monthly Population Size *"N"*	Minimum required sample *"n"*
≥ 555	111
140 – 555	20% of population size
28 – 140	28
< 28	No sampling; 100% of population required

DATA COLLECTION AND ANALYSIS TOOLS

N/A