



Surgical Site Infection (SSI) Toolkit

Activity C: ELC Prevention Collaboratives

S.I. Berríos-Torres, MD

Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

Draft - 12/21/09 --- Disclaimer: The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.





Outline



- **Background**
 - Impact
 - HHS Prevention Targets
 - Pathogenesis
 - Epidemiology
- **Prevention Strategies**
 - Core
 - Supplemental
- **Measurement**
 - Process
 - Outcome
- **Tools for Implementation/Resources/References**



Background: Impact

Burden-US

- ~300,000 SSIs/yr (17% of all HAI; second to UTI)
- 2%-5% of patients undergoing inpatient surgery

Mortality

- 3 % mortality
- 2-11 times higher risk of death
- 75% of deaths among patients with SSI are directly attributable to SSI

Morbidity

- long-term disabilities

Anderson DJ, et al. Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 2008;29:S51-S61 for individual references



Background: Impact

Length of Hospital Stay

- ~7-10 additional postoperative hospital days

Cost

- \$3000-\$29,000/SSI depending on procedure & pathogen
- Up to \$10 billion annually
- Most estimates are based on inpatient costs at time of index operation and do not account for the additional costs of rehospitalization, post-discharge outpatient expenses, and long term disabilities

Anderson DJ, etal. Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 2008;29:S51-S61 for individual references



Background: HHS Prevention Targets

- **Reduce the admission and readmission SSI Standardized Incidence Ratio (SIR) by at least 25% from baseline**
 - Outcome – SSI SIR
- **95% adherence rates to each SCIP/NQF infection process measure**
 - Process - Adherence to SCIP/NQF infection process measures

<http://www.hhs.gov/ophs/initiatives/hai/prevtargets.html>
Appendix G



Background: Pathogenesis

Pathogen Sources



Endogenous

- Patient flora
 - skin
 - mucous membranes
 - GI tract
- Seeding from a distant focus of infection



Background: Pathogenesis

Pathogen Sources



Exogenous

- Surgical Personnel (surgeon and team)
 - Soiled attire
 - Breaks in aseptic technique
 - Inadequate hand hygiene
- OR physical environment and ventilation
- Tools, equipment, materials brought to the operative field



Background: Pathogenesis Organisms Causing SSI January 2006-October 2007

| | |
|----------------------------------|-------|
| <i>Staphylococcus aureus</i> | 30.0% |
| Coagulase-negative staphylococci | 13.7% |
| Enterococcus spp. | 11.2% |
| <i>Escherichia coli</i> | 9.6% |
| <i>Pseudomonas aeruginosa</i> | 5.6% |
| Enterobacter spp | 4.2% |
| <i>Klebsiella pneumoniae</i> | 3.0% |
| Candida spp. | 2.0% |
| <i>Klebsiella oxytoca</i> | 0.7% |
| <i>Acinetobacter baumannii</i> | 0.6% |

N=7,025

Hidron AI, et.al., Infect Control Hosp Epidemiol 2008;29:996-1011
Hidron AI et.al., Infect Control Hosp Epidemiol 2009;30:107–107(ERRATUM)



Background: Epidemiology Emerging Challenges

Challenges in detecting SSIs

- Lack of standardized methods for post-discharge/outpatient surveillance
 - Increased number of outpatient surgeries
 - Shorter postoperative inpatient stays

Antimicrobial Prophylaxis

- Increasing trend toward resistant organisms may undermine the effectiveness of existing recommendations for antimicrobial prophylaxis



Background: Epidemiology

Important Modifiable Risk Factors

- Antimicrobial prophylaxis
 - Inappropriate choice (procedure specific)
 - Improper timing (pre-incision dose)
 - Inadequate dose based on body mass index, procedures >3h, or increased blood loss
- Skin or site preparation ineffective
 - Removal of hair with razors
- Colorectal procedures
 - Inadequate bowel prep/antibiotics
 - Improper intraoperative temperature regulation



Background: Epidemiology

Additional Modifiable Risk Factors

- Excessive OR traffic
- Inadequate wound dressing protocol
- Improper glucose control
- Colonization with preexisting microorganisms
- Inadequate intraoperative oxygen levels



Prevention Strategies

- **Core Strategies**
 - High levels of scientific evidence
 - Demonstrated feasibility

- **Supplemental Strategies**
 - Some scientific evidence
 - Variable levels of feasibility

The Collaborative should at a minimum include core prevention strategies. Supplemental prevention strategies also may be used. Most core and supplemental strategies are based on HICPAC guidelines. Strategies that are not included in HICPAC guidelines will be noted by an asterisk () after the strategy. HICPAC guidelines may be found at www.cdc.gov/hicpac



Prevention Strategies: Core Preoperative Measures

Administer antimicrobial prophylaxis in accordance with evidence based standards and guidelines

- Administer within 1 hour prior to incision*
 - 2hr for vancomycin and fluoroquinolones
- Select appropriate agents on basis of
 - Surgical procedure
 - Most common SSI pathogens for the procedure
 - Published recommendations

*Fry DE. Surgical Site Infections and the Surgical Care Improvement Project (SCIP): Evolution of National Quality Measures. Surg Infect 2008;9(6):579-84.



Prevention Strategies: Core Preoperative Measures

- **Remote infections-whenever possible:**
 - Identify and treat before elective operation
 - Postpone operation until infection has resolved
- **Do not remove hair at the operative site unless it will interfere with the operation; do not use razors**
 - If necessary, remove by clipping or by use of a depilatory agent



Prevention Strategies: Core



Preoperative Measures (continued)

- **Skin Prep**
 - Use appropriate antiseptic agent and technique for skin preparation
- **Maintain immediate postoperative normothermia***
- **Colorectal surgery patients**
 - Mechanically prepare the colon (Enemas, cathartic agents)
 - Administer non-absorbable oral antimicrobial agents in divided doses on the day before the operation

*Fry DE. Surgical Site Infections and the Surgical Care Improvement Project (SCIP): Evolution of National Quality Measures. Surg Infect 2008;9(6):579-84.



Prevention Strategies: Core Intraoperative Measures



- **Operating Room (OR) Traffic**
 - Keep OR doors closed during surgery except as needed for passage of equipment, personnel, and the patient



Prevention Strategies: Core Postoperative Measures



- **Surgical Wound Dressing**
 - Protect primary closure incisions with sterile dressing for 24-48 hrs post-op
- **Control blood glucose level during the immediate post-operative period (cardiac)***
 - Measure blood glucose level at 6AM on POD#1 and #2 with procedure day = POD#0
 - Maintain post-op blood glucose level at <200mg/dL
- **Discontinue antibiotics within 24hrs after surgery end time (48hrs for cardiac)***

*Fry DE. Surgical Site Infections and the Surgical Care Improvement Project (SCIP): Evolution of National Quality Measures. Surg Infect 2008;9(6):579-84.





Prevention Strategies: Supplemental Preoperative



- Nasal screen and decolonize only *Staphylococcus aureus* carriers undergoing elective cardiac and other procedures (i.e., orthopaedic, neurosurgery procedures with implants) with preoperative mupirocin therapy*
Bode LGM, et al. Preventing SSI in nasal carriers of Staph aureus. NEJM 2010;362:9-17
- Screen preoperative blood glucose levels and maintain tight glucose control POD#1 and POD#2 in patients undergoing select elective procedures (e.g., arthroplasties, spinal fusions)*

NOTE: These supplemental strategies are not part of the 1999 HICPAC Guideline for Prevention of Surgical Site Infections



Prevention Strategies: Supplemental Perioperative



- Redose antibiotic at the 3 hr interval in procedures with duration >3hrs (* See exceptions to this recommendation in*Engelman R, et al. The Society of Thoracic Surgeons Practice Guideline Series:Antibiotic Prophylaxis in Cardiac Surgery, Part II:Antibiotic Choice. Ann Thor Surg 2007;83:1569-76
- Adjust antimicrobial prophylaxis dose for obese patients (body mass index >30)* Anderson DJ, Kaye KS, Classen D, et al. Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 2008;29 (Suppl 1):S51-S61
- Use at least 50% fraction of inspired oxygen intraoperatively and immediately postoperatively in select procedure(s)* Maragakis LL, Cosgrove SE, Martinez EA, et al. Intraoperative fraction of inspired oxygen is a modifiable risk factor for surgical site infection after spinal surgery. Anesthesiology 2009;110:556-562. and Meyhoff CS, Wetterslev J, Jorgensen LN, et al. Effect of high perioperative oxygen fraction on surgical site infection and pulmonary complications after abdominal surgery: The PROXI randomized clinical trial. JAMA 2009;302:1543-1550.

NOTE: These supplemental strategies are not part of the 1999 HICPAC Guideline for Prevention of Surgical Site Infections





Prevention Strategies: Supplemental Postoperative



- Feedback of surgeon specific infection rates.



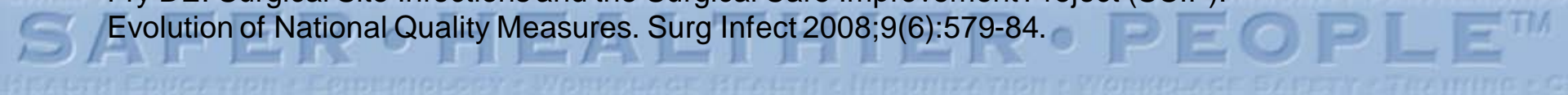
Measurement: Surgical Care Improvement Project (SCIP)



Process Measures

| Quality Indicator | Numerator | Denominator |
|---|---|---|
| Appropriate antibiotic choice | Number of patients who received the appropriate prophylactic antibiotic | All patients for whom prophylactic antibiotics are indicated |
| Appropriate timing of prophylactic antibiotics | Number of patients who received the prophylactic antibiotic within 1hr prior to incision (2hr: Vancomycin or Fluoroquinolones) | All patients for whom prophylactic antibiotics are indicated |
| Appropriate discontinuation of antibiotics | Number of patients who received prophylactic antibiotics and had them discontinued in 24 h (48h cardiac) | All patients who received prophylactic antibiotics |

Fry DE. Surgical Site Infections and the Surgical Care Improvement Project (SCIP): Evolution of National Quality Measures. Surg Infect 2008;9(6):579-84.



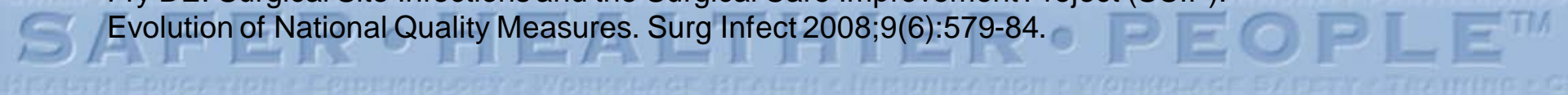


Measurement: Surgical Care Improvement Project (SCIP)



Process Measures (continued)

| Quality Indicator | Numerator | Denominator |
|---------------------------------|--|--|
| Appropriate hair removal | Number of patients who did not have hair removed or who had hair removed with clippers | All surgical patients |
| Normothermia | Number of patients with postoperative temperature $\geq 36.0^{\circ}\text{C}$ | All surgical patients |
| Glucose control | Number of cardiac surgery patients with glucose control at 6AM POD1 and POD2 (operation = POD0) | Patients undergoing cardiac surgery |





Measurement: Outcome Measures

SSI Rate



Patients with SSI after selected operations X100
Total # of selected operations performed

- Crude, unadjusted rate
- Can lead to erroneous conclusions regarding SSI risk by institution and/or surgeon
- NOT for reporting or inter-hospital comparisons



Measurement: Outcome Measures

Risk Adjustment (1)

NNIS Risk Index

Score to predict risk of acquiring SSI

- Widely used-targeted at surveillance
- Operation-specific
- Allows monitoring of trends
- Facilitates comparison
 - facility vs. national

Culver DH, Horan TC, Gaines RP. Surgical infection rates by wound class, operative procedure, patient risk index. Am J Med;1991:152S-157S.



Measurement: Outcome Measures

Risk Adjustment (2)

NNIS Risk Index



- Focus on high volume operations
- Employs Risk Stratification
 - American Society of Anesthesiologists (ASA) score (3, 4, or 5)
 - Wound Classification (contaminated or dirty)
 - Duration of Procedure (over T [proc specific] hours)
- Does not include many patient & perioperative related SSI risk factors
- Increased NNIS Risk index = Increased risk of SSI

Culver DH, Horan TC, Gaines RP. Surgical infection rates by wound class, operative procedure, patient risk index. Am J Med;1991:152S-157S.



Measurement: Outcome Measures

Risk Adjustment (2)

Standardized Incidence Ratio - SIR

$$\text{SIR} = \frac{\text{Observed \# SSI}}{\text{Expected \# SSI}}$$

Expected # SSI =
operations* in each proc risk category X NNIS rate
100

- Value >1.0 = more SSIs than expected
- Helps better identify outliers
- Will be used for comparison within NHSN in 2010

*Performed by a surgeon, a surgical subspecialty service or a hospital
Detailed explanation and examples in: Edwards JR, Horan TC. Risk-adjusted Comparisons.
In: Carrico R, ed. APIC Text of Infection Control and Epidemiology, 3rd ed. Washington DC
APIC 2009. Chapter 7, p.1-7.



Evaluation Considerations

- **Assess baseline policies and procedures**
- **Areas to consider**
 - **Surveillance**
 - **Prevention strategies**
 - **Measurement**
- **Coordinator should track new policies/practices implemented during collaboration**



References

- Casey AL, Elliott TSJ. Progress in the prevention of surgical site infection. *Curr Opin Infect Dis* 2009;22:370-375
- Chong T, Sawyer R. Update on the epidemiology and prevention of surgical site infections. *Curr Infect Dis Rep* 2002;4:484-490)
- Department of Health and Human Services. Action Plan to Prevent Healthcare-Associated Infections. <http://www.hhs.gov/ophs/initiatives/hai/infection.html> Accessed 17 February 2010
- Fry DE. A systems approach to the prevention of surgical infections. *Surg Clin N Am* 2009;89:521-537.
- Haynes AB, Weiser TG, Berry WR, et al,. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Eng J Med* 2009;360(5):491-499.



References

- Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. *Am J Infect Control* 2008;36:309-32
- Kirby JP, Mazuski JE. Prevention of surgical site infection. *Surg Clin N Am* 2009;89:365-389.
- Mangram AJ, Horan TC, Pearson ML, et al. Guideline for the prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol* 1999; 20:250-278.
- McKibben L, Horan T, Tokars JI, et al. Guidance on Public Reporting of Healthcare-Associated Infections: Recommendations of the Healthcare Infection Control Practices Advisory Committee. *Am J Infect Control* 2005;33:217-26.



References

- Nichols RL. Preventing surgical site infections. Clin Med Res 2004;2(2):115-118.
- Travis J, Carr JB, Saylor D, et.al., Coronary Artery Bypass Graft Surgery: Surgical Site Infection Prevention. J Healthcare Quality 2009;31:16-23
- Trussell J, Impact of a patient care pathway protocol on surgical site infection rates in cardiothoracic surgery patients. Am J Surg 2008;196:883-889.
- World Alliance for Patient Safety. WHO guidelines for safe surgery. Geneva: World Health Organization, 2008.
- Yokoe DS, Mermel LA, Anderson DJ, et.al. A compendium of strategies to prevent healthcare-associated infections in acute care hospital. Infect Control Hosp Epidemiol 2008;29:S12-S21.



References

SSI Bundles



- Canadian Getting Started Kit:
<http://www.saferhealthcarenow.ca/EN/Interventions/SSI/Pages/ask.aspx> (Select SSI Getting Started Kit)
- IHI:
<http://www.ihl.org/IHI/Programs/Campaign/SSI.htm>
(Select “Power Point Presentation with Facilitator Notes)
<http://www.100liveswashington.org/resources/SSI-summary.pdf>



References

SSI Bundles



- Australian:
http://www.health.vic.gov.au/sss1/downloads/prev_surgical.pdf
- Scottish:
<http://www.hps.scot.nhs.uk/haiic/ic/SSIPreventionBundle.aspx>



Resources for Implementation

WHO Surgical Safety Checklist



Surgical Safety Checklist



World Health Organization

Patient Safety

A World Alliance for Safer Health Care

Before induction of anaesthesia

(with at least nurse and anaesthetist)

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

Yes

Is the site marked?

Yes

Not applicable

Is the anaesthesia machine and medication check complete?

Yes

Is the pulse oximeter on the patient and functioning?

Yes

Does the patient have a:

Known allergy?

No

Yes

Difficult airway or aspiration risk?

No

Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?

No

Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

Confirm all team members have introduced themselves by name and role.

Confirm the patient's name, procedure, and where the incision will be made.

Has antibiotic prophylaxis been given within the last 60 minutes?

Yes

Not applicable

Anticipated Critical Events

To Surgeon:

What are the critical or non-routine steps?

How long will the case take?

What is the anticipated blood loss?

To Anaesthetist:

Are there any patient-specific concerns?

To Nursing Team:

Has sterility (including indicator results) been confirmed?

Are there equipment issues or any concerns?

Is essential imaging displayed?

Yes

Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:

The name of the procedure

Completion of instrument, sponge and needle counts

Specimen labelling (read specimen labels aloud, including patient name)

Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:

What are the key concerns for recovery and management of this patient?

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

Revised 1 / 2009

© WHO, 2009