Surgical Site Infection Prevention

Last updated 2015
Objectives

• Review the epidemiology of surgical site infections (SSI)
• Explore causes and mechanisms of SSI
• Describe evidence-based practices for prevention of SSI
• Review SSI surveillance definitions and methods
SSI Epidemiology

- SSI occurs within 30 days following surgery
  - Some procedures are monitored up to 90 days
- 1.9% of hospitalized surgical patients acquire SSI
  - 3% die
  - 75% of deaths are attributable to the SSI
  - Many result in long term disability
- SSI increases hospital length of stay by 7-10 days
  - Cost estimates vary, ~$30,000 per SSI
  - Most estimates do not account for re-hospitalization, outpatient treatment, post-discharge expenses, quality of life for the patient, or any long term disability costs

NHSN Patient Safety Manual, Chapter 9: SSI
Pathogenesis of SSI

• **Endogenous**
  – Patient Flora
    • Skin
    • GI tract
    • Mucous membranes
  – Seeding from pre-existing sites of infection

• **Exogenous**
  – Surgical personnel flora
  – Breaks in aseptic techniques
  – Inadequate hand hygiene
  – Contaminated garments
  – Equipment, surgical tools, materials within operative field or environment, including ventilation
SSI Pathogens

- *Staphylococcus aureus* - 30.0%
- Coagulase-negative staphylococci - 13.7%
- *Enterococcus* spp - 11.2%
- *Escherichia coli* - 9.6%
- *Pseudomonas aeruginosa* - 5.6%
- *Enterobacter* spp - 4.2%
- *Klebsiella pneumonia* - 3.0%
- *Candida* spp - 2.0%
- *Klebsiella oxytoca* - 0.7%
- *Acinetobacter baumannii* - 0.6%

N = 7,025
Jan 2006-Oct 2007

SSI Prevention Objectives

- National HAI Prevention Action Plan
  - SSI reduction of 25% from 2009 baseline
  - 95% adherence rates to Surgical Care Improvement Project (SCIP) process measure
  - 2013 Goal: 25% reduction in admission and readmission SSI (0.75 SIR) – on track to meet target
CDI Prevention Strategies

Core Strategies

- Higher levels of scientific evidence
- Demonstrated feasibility

- Standard practice

Supplemental Strategies

- Some scientific evidence
- Variable levels of feasibility

- Consider implementing in addition to Core when infections persist or rates are high
Core SSI Prevention Strategies - 1

Administer antimicrobial prophylaxis in accordance with evidence-based standards and guidelines
- Administer within one hour prior to incision; within two hours for vancomycin and fluoroquinolones
- Select appropriate agents based on:
  - Surgical procedure
  - Most common SSI pathogens for the procedure
  - Published recommendations
- Discontinue antibiotics within 24 hours after surgery; within 48 hours for cardiac surgery
Core SSI Prevention Strategies - 2

- Identify and treat remote infections
  - Before elective operation
  - Postpone operation until infection resolved
- Do not remove hair at the operative site unless it will interfere with the operation
  - Do not use razors
  - Remove hair by clipping or by use of a depilatory agent
Core SSI Prevention Strategies - 3

• Use appropriate antiseptic agents and techniques for skin preparation
• Keep operating room doors closed during surgery except as needed for passage of equipment, personnel, and the patient
• Mechanically prepare the colon (e.g., enemas, cathartic agents) for colorectal surgery patients
  – Administer non-absorbable oral antimicrobial agents in divided doses on the day before the operation
Core SSI Prevention Strategies - 4

- Maintain immediate postoperative normothermia
- Protect primary closure incisions with sterile dressings for 24-48 hours post-op
- Control blood glucose level during immediate post-operative period
  - Example: Measure blood glucose level at 6AM on post-op day 1 and 2 (Procedure day = Day 0)
  - Maintain post-op blood glucose level at <200mg/dL
Supplemental SSI Prevention Strategies - 1

- Nasal screen for *Staphylococcus aureus* on patients undergoing
  - elective cardiac surgery, orthopedic, neurosurgery procedures with implants
  - decolonize carriers with mupirocin prior to surgery

NOTE: These supplemental strategies are not part of the 1999 HICPAC Guideline for Prevention of Surgical Site Infections
Supplemental SSI Prevention Strategies - 2

• Screen preoperative blood glucose levels and maintain tight glucose control post-op day 1 and 2 in patients undergoing select elective procedures (e.g., arthroplasties, spinal fusions)
• Redose antibiotic at 3 hour intervals in procedures with duration >3 hours*
  Adjust antimicrobial prophylaxis dose for patients who are obese (body mass index >30)

*See exceptions to this recommendation in Engelmann, 2007

NOTE: These supplemental strategies are not part of the 1999 HICPAC Guideline for Prevention of Surgical Site Infections
Supplemental SSI Prevention Strategies - 3

- Use at least 50% fraction of inspired oxygen intraoperatively and immediately postoperatively in select procedure(s)
- Perform surveillance for SSI
- Feedback surgeon-specific infection rates
Updated SSI Prevention Guideline

CDC and HICPAC* updated SSI prevention guidelines document

• Posted for public comment Jan-Feb 2014
• Introduces several new and updated prevention strategies
• Draft in final review, April 2014
• Waiting for publication

*Healthcare Infection Control Practices Advisory Committee
SSI Surveillance Requires...

• Consistent use of standard methods and definitions for identifying procedures performed and SSI that result

• Capture of sufficient risk factor data for each procedure performed

• Application of risk adjustment methods for meaningful comparisons (i.e., over time within your hospital or to national referent data)
Surgical Procedure Definition

An NHSN operative procedure meets the following criteria:

• Takes place in an OR (meeting FGI or AIA criteria)
• At least one incision (including laparoscopic approach) is made through the skin or mucous membrane, or reoperation via an incision that was left open during a prior operative procedure
• included in Table 1: *NHSN Operative Procedure Category Mappings to ICD-9-CM Codes and CPT Codes*
Surgical Closure

• SSI surveillance required for procedures in which there is BOTH primary and non-primary surgical closure

• Closure definitions adapted from American College of Surgeons and NSQIP
  – **Primary Closure** – closure of the skin level during original surgery, regardless of the presence of wires, wicks, drains, devices or objects extruding through the incision
    • Includes surgeries where skin is closed by some means.
    • If any portion of the incision is closed at the skin level, in any manner, a designation of primary closure should be assigned
  – **Non-primary Closure** – closure other than primary
Procedure Risk Factor Data

For each procedure:

- Gender
- Age
- Height
- Weight
- Surgical wound class
  - clean, clean-contaminated, contaminated, or dirty
- ASA score - as proxy for underlying illness
- Yes/No: Emergency, Trauma, Anesthesia type
- Endoscope (decreases risk)
- Duration
- Diabetes status
- Incisional closure type
Duration of Operative Procedure

- Interval between the surgery start time and the surgical procedure finish (PF) time
  - Defined by Association of Anesthesia Clinical Directors (AACD)
  - Reported as hours and minutes

- PF time:
  - All instrument and sponge counts are completed and verified correct **AND**
  - All in OR post-op radiographic studies are complete, **AND**
  - All dressings/drains are secured, **AND**
  - Physicians/surgeons have completed all procedure-related activities on the patient.
Surgical Wound Class

**Clean**
Operation where no inflammation encountered
Respiratory, alimentary, genital, urinary tracts *not* entered
Operation following non-penetrating (blunt) trauma
Primarily closed with no open drainage

*Clean wound classification is not used in denominator data entry for APPY, BILI, CHOL, COLO, REC, SB, and VHYS*

**Contaminated**
Operation following open, fresh, accidental wounds
Operation with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from GI tract
Includes operation where acute, non-purulent inflammation encountered

**Clean - Contaminated**
Operation entering respiratory, alimentary, genital, or urinary tracts
No evidence of infection, no major break in technique, no unusual contamination encountered
Operation involving biliary tract, appendix, vagina, and oropharynx

**Dirty**
Operation involving old traumatic wounds with retained devitalized tissue, or existing clinical infection or perforated viscera
Definition suggests the organisms causing post-op infection were present before the operation
Identifying SSI

- Surgical services, surgical units, and OR staff need to assist in SSI surveillance
- Evaluate both clinical and microbiological findings post-op
  - Cannot rely on wound cultures alone to find SSI
- Evaluate surgical patients during hospital stay
  - Rounds on units
  - Pharmacy reports of antimicrobial use
  - Temperature charts/logs
  - Operating room schedule of surgeries/re-operations
- Monitor surgical patients for readmission
- Perform post-discharge surveillance
  - Consider using procedure billing codes (i.e., ICD-9) to validate data
SSI Surveillance Period

- Post-operative monitoring period determined by NHSN procedure category
- 14 NHSN procedure types require 90-day monitoring period
- All other procedure categories monitored for 30 days regardless of presence of an implant
- For all NHSN procedure categories, superficial SSI are monitored for 30 days only

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<tr>
<th>BRST*</th>
<th>CRAN</th>
<th>HPRO</th>
<th>RFUSN</th>
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<td>FUSN</td>
<td>KPRO</td>
<td>VSHN*</td>
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<tr>
<td>CBGB</td>
<td>FX</td>
<td>PACE</td>
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<td>CBGC</td>
<td>HER</td>
<td>PVBY*</td>
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NHSN SSI Surveillance Definition

Categorized based on depth of infection
Superficial Incisional SSI

- Infection occurs within 30 days after surgical procedure
- Involves only skin and subcutaneous tissue of the incision

- Meets at least 1 of 4 criteria:
  1. Purulent drainage from the superficial incision
  2. Organism isolated from incision culture or fluid (obtained aseptically)
  3. Diagnosis of superficial SSI by surgeon or attending physician or other designee
  4. Incision opened by surgeon or desigee; culture positive or not cultured

- AND

  - at least 1 of the following:
    - Pain or tenderness
    - Localized swelling
    - Erythema
    - Heat
Superficial Incisional SSI

• Do not report stitch abscess as an SSI (defined as minimal inflammation and discharge confined to points of suture penetration).
• Do not report a localized stab wound infection as an SSI.
• Do not report Cellulitis by itself, it is not an SSI.
**Deep Incisional SSI**

- Infection occurs within 30 after surgical procedure (unless its one of the 13 procedures followed for 90 days)
- Involves deep soft tissues of the incision, e.g. fascial & muscle layers
  - Meets at least 1 of 3 criteria:
    - 1. Purulent drainage from deep incision
    - 2. Abscess or evidence of infection involving deep incision detected on gross anatomical or histopathologic exam or imaging test
    - 3. Deep incision spontaneously dehisces OR opened by surgeon, attending physician or designee and is culture positive or not cultured*

Patient has at least 1:
- fever > 38°C
- localized pain, or tenderness

*A culture negative finding does not meet this criteria*
Organ/Space SSI

- Infection occurs within 30 after surgical procedure (unless its one of the 13 procedures followed for 90 days) AND
- Involves any part of body deeper than the fascial/muscle layers, opened or manipulated during the surgical procedure AND
- Meets at least 1 of 3 criteria:
  - 1. Purulent drainage from drain placed into organ/space
  - 2. Organism isolated from an aseptically-obtained culture of fluid or tissue in the organ/space
  - 3. Abscess or evidence of infection involving the organ/space that is detected on gross anatomical or by histopathologic or imaging test AND
- Meets surveillance definition for a specific NHSN infection site

NHSN Patient Safety Manual: Chapter 9, Table 4
### Organ/Space SSI Sites

<table>
<thead>
<tr>
<th>Code</th>
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<th>Site</th>
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</thead>
<tbody>
<tr>
<td>BONE</td>
<td>Osteomyelitis</td>
<td>LUNG</td>
<td>Other infections of the respiratory tract</td>
</tr>
<tr>
<td>BRST</td>
<td>Breast abscess or mastitis</td>
<td>MED</td>
<td>Mediastinitis</td>
</tr>
<tr>
<td>CARD</td>
<td>Myocarditis or pericarditis</td>
<td>MEN</td>
<td>Meningitis or ventriculitis</td>
</tr>
<tr>
<td>DISC</td>
<td>Disc space</td>
<td>ORAL</td>
<td>Oral cavity (mouth, tongue, or gums)</td>
</tr>
<tr>
<td>EAR</td>
<td>Ear, mastoid</td>
<td>OREP</td>
<td>Other infections of the male or female reproductive tract</td>
</tr>
<tr>
<td>EMET</td>
<td>Endometritis</td>
<td>PJII</td>
<td>Periprosthetic Joint Infection</td>
</tr>
<tr>
<td>ENDO</td>
<td>Endocarditis</td>
<td>SA</td>
<td>Spinal abscess without meningitis</td>
</tr>
<tr>
<td>EYE</td>
<td>Eye, or other conjunctivitis</td>
<td>SINU</td>
<td>Sinusitis</td>
</tr>
<tr>
<td>GIT</td>
<td>GI Tract</td>
<td>UR</td>
<td>Upper respiratory tract</td>
</tr>
<tr>
<td>HEP</td>
<td>Hepatitis</td>
<td>USI</td>
<td>Urinary System Infection</td>
</tr>
<tr>
<td>IAB</td>
<td>Intraabdominal, not specified</td>
<td>VASC</td>
<td>Arterial or venous infection</td>
</tr>
<tr>
<td>IC</td>
<td>Intracranial, brain abscess or dura</td>
<td>VCUF</td>
<td>Vaginal cuff</td>
</tr>
<tr>
<td>JNT</td>
<td>Joint or bursa</td>
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</table>

Criteria for these sites can be found in the [NHSN Help system](https://www.cdc.gov/nhsn/PDFs/pscManual/17pscNosInfDef_current.pdf) (must be logged in to NHSN) for the Surveillance Definitions for Specific Types of Infections chapter.
Infection Present at Time of Surgery (PATOS)

- Evidence of an infection present at the time of an index surgery (i.e., present pre-operatively)
- Required field when reporting an SSI event
- Not required when reporting the procedure (i.e., not a field on the denominator form)
- Evidence of infection must be documented in a pre-operative or intra-operative note
Infection Present at Time of Surgery (PATOS) - 2

• Only select PATOS=YES if it applies to the depth of the SSI that is being attributed to the procedure

• Examples:
  – If a patient had evidence of an intra-abdominal infection at the time of surgery and then later returns with an organ space SSI, the PATOS field would be selected as a YES.
  – If the patient returned with a superficial or deep incisional SSI, the PATOS field would be selected as NO.
Infection Present at Time of Surgery (PATOS) - 3

- The patient does not have to meet the NHSN definition of an SSI at the time of the primary procedure but there must be notation that there is evidence of infection or abscess present at the time of surgery.
- SSI reported with PATOS=YES will be excluded from the SSI SIR.
  - PATOS-related SSI will be analyzed separately.
- Refer to the NHSN SSI Protocol for more examples.
SSI Following Multiple Procedures

• If >1 operative procedure is done through a single incision and an SSI occurs
• First, attempt to determine the procedure associated with the infection
• If it is not clear, use the NHSN principal operative procedure selection list to determine the priority procedure for which to attribute the SSI
  – Example: For abdominal surgeries
    • COLO is higher priority (higher infection risk) than SB
    • SB is higher than REC
    • REC is higher than GAST
**SSI – Event Details**

**A** SSI was identified before the patient was discharged from the facility following the operation.

**P** SSI was identified only as part of post-discharge surveillance, including ED visit without readmission. If readmitted, use RF or RO as appropriate.

**RF** SSI was identified due to patient readmission to the facility where the operation was performed.

**RO** SSI was identified due to patient admission to a facility other than where the operation was performed.

Detected: Required.
Check the box to indicate when/how the SSI was identified.

*Secondary Bloodstream Infection: Yes No
**Died: Yes No
SSI Contributed to Death: Yes No
Pathogens Identified: Yes No
*If Yes, specify on pages 2-3.

Discharge Date:
SSI Prevention Collaboratives and Bundles

- **Centers for Disease Control and Prevention (CDC)**
  (http://www.cdc.gov/HAI/pdfs/toolkits/SSI_toolkit021710SIBT_revised.pdf)
- **Institute for Healthcare Improvement (IHI)**
  (http://www.ihi.org/Engage/Memberships/MentorHospitalRegistry/Pages/InfectionPreventionSSI.aspx)
- **Surgical Care Improvement Project (SCIP)**
  (https://www.qualitynet.org/dcs/ContentServer?cid=1137346750659&pagename=Medqic/Content/ParentShellTemplate&parentName=TopicCat&c=MQParents)
- **World Health Organization (WHO)**
  (www.who.int/patientsafety/safesurgery/en/)
Questions?

For more information, please contact any HAI Liaison Team member.

Thank you.