

Surgical Site Infection Prevention



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M E D I C I N E

Objectives

1. Discuss risk factors for SSI
2. Describe evidence-based best practices for SSI prevention
3. State principles of antibiotic prophylaxis
4. Discuss novel interventions to decrease SSI

Impact of SSI

- Burden
 - 2-5% of surgical patients develop SSI
 - Approximately 500,000 SSI in US annually
- Outcomes
 - 7-10 additional hospital days
 - 2-11 times higher risk of death
 - Majority of deaths are directly attributable to SSI
 - \$3,000 - \$29,000 excess cost per SSI
 - \$10 billion annually in excess cost

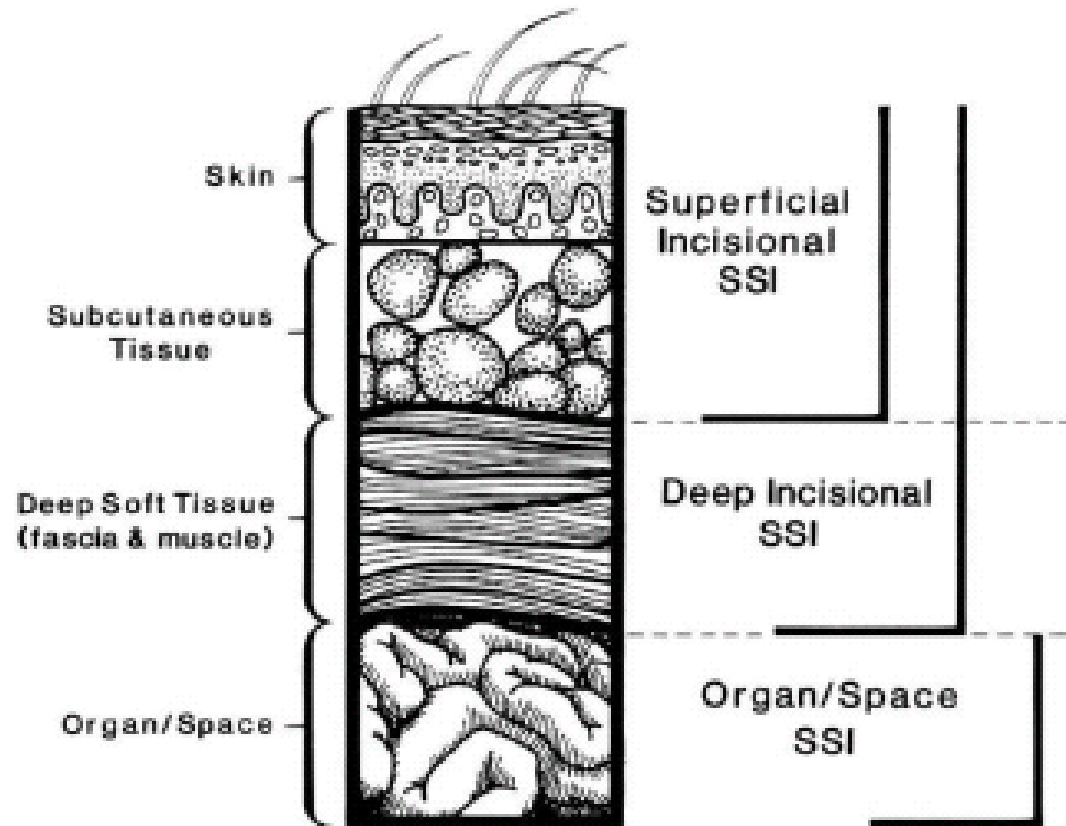
Surveillance

- **National Healthcare Safety Network (NHSN)**
 - Formerly NNIS
 - CDC program that reports aggregated surveillance data from U.S. hospitals
 - Standardized definitions for infection and risk-stratification methodology
 - National data on pooled mean and percentiles
 - We use NHSN to perform SSI surveillance for surgical procedures including craniotomy, laminectomy, spinal fusion, C-section, and CABG

CDC Definitions of Surgical Site Infections

- SSI
 - occurs within 30 days after the procedure (or within 1 year if an implant)
 - has at least one of the following:
 - purulent drainage from the incision
 - organisms isolated from an aseptic culture of the incisional fluid or tissue
 - incision deliberately opened by the surgeon when the patient has signs or symptoms of infection such as pain, erythema, or edema (unless the culture is negative)
 - diagnosis of a superficial SSI made by the surgeon or attending physician

CDC Definitions of Surgical Site Infections



Horan et al. ICHE, 1992, 13:606

Risk Stratification

- ASA score (3,4 or 5)
- Duration of operation (>75th percentile)
- Wound classification
 - CLEAN
 - CLEAN-CONTAMINATED
 - CONTAMINATED
 - DIRTY-INFECTED

Risk Factors for SSI

- Age
- Obesity
- Malnutrition
- Prolonged pre-operative stay
- Infection at distal sites
- Cancer
- Hyperglycemia
- Immunosuppression
- ASA class
- Comorbidities

Host Factors

Surgical/ Environmental Factors

- Abdominal site
- Wound classification
- Duration of surgery
- Urgency of surgery
- Procedure
- Hair removal
- Intraoperative contamination
- Prophylactic antibiotics
- Surgical technique
- Surgical volume
- Prior procedures
- Poor hemostasis
- Drains/foreign bodies
- Hypothermia
- Oxygenation

Microbial Factors

- Nasal/skin carriage
- Virulence
- Adherence
- Inoculum

Strategies to Prevent SSI

- **SSI prevention strategies target the:**
 - Pre-operative period
 - Intra-operative period
 - Post-operative period
 - Intrinsic, patient-related factors
 - Extrinsic, procedural factors

Strategies to Prevent SSI

- **Must consider whether any given SSI risk factor is:**
 - **Modifiable**
 - Antimicrobial administration, glucose, temperature, hair removal, oxygenation, etc.
 - **Not-modifiable**
 - Age, co-morbidities, severity of illness, wound class, etc.

Existing Guidelines and Requirements

- Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines
- CMS Surgical Infection Prevention Collaborative
- Surgical Care Improvement Project (SCIP)
- Institute for Healthcare Improvement (IHI)
- Federal requirements for reporting of quality data (CMS)

CMS Surgical Infection Prevention Collaborative

- Created in 2002
- 3 performance quality measures
 - Administration of antimicrobial prophylaxis within 1 hour prior to incision (2 hours for Vancomycin and fluoroquinolones)
 - Use of a recommended antimicrobial agent
 - Discontinuation of antimicrobial prophylaxis within 24 hours after surgery
- Hysterectomy; hip and knee arthroplasty; cardiac surgery, vascular surgery, colorectal surgery

Surgical Care Improvement Project (SCIP)

- Created in 2003
- Extension of Surgical Infection Prevention Collaborative
- In addition to the 3 antimicrobial prophylaxis measures, SCIP adds 3 more performance quality measures:
 - Proper hair removal (no razors)
 - Glucose control <200 mg/dL for 2 days after cardiac surgery
 - Maintenance of peri-operative normothermia for colorectal surgery

Interventions to Prevent SSI

- Hair Removal
 - No hair removal unless hair will interfere with the procedure
 - NO razor shaving, use clippers if necessary
 - If necessary, remove hair close to the time of surgery and outside the OR to prevent contaminating the OR environment

Shaving vs. Clipping

- Shaved 2.8% (46/1627) SSI vs. clipped 1.4% (21/1566) SSI, RR=2.02 (95%CI 1.21-3.36)
- Shaving must not be performed

Tanner J, Woodings D, Moncaster K. Cochrane Reviews, 2006, Issue 2, No CD004122, pub 2.

Interventions to Prevent SSI

- Glucose control
 - Reduce hemoglobin A1c to $<7\%$ prior to elective surgery when possible
 - Control blood glucose levels during the peri-operative period

Hyperglycemia : Abdominal and Cardiovascular Operations

	<u>Glucose POD#1</u> <u><220 mg%</u>	<u>>220 mg%</u>
Any Infection	12%	31%
“Serious” Infection	5.7-fold increase for any glucose \geq 220 mg%	

Pomposelli. JPEN 1998;22:77

Interventions to Prevent SSI

- Temperature
 - One of the SCIP measures for colorectal surgery
 - One randomized controlled trial of 200 patients showed significantly lower SSI with normothermia during colorectal surgery
 - Hypothermia causes vasoconstriction, reduces oxygen tension, increases bleeding, and increase LOS even for un-infected patients

Temperature and SSI Following Colectomy

	<u>Normothermia</u>	<u>Hypothermia</u>	<u>P</u>
SSI	6	18	.009
Collagen deposition	328	254	.04
Time to eat	5.6d	6.5d	<.006

Kurz. NEJM 1996;334:1209

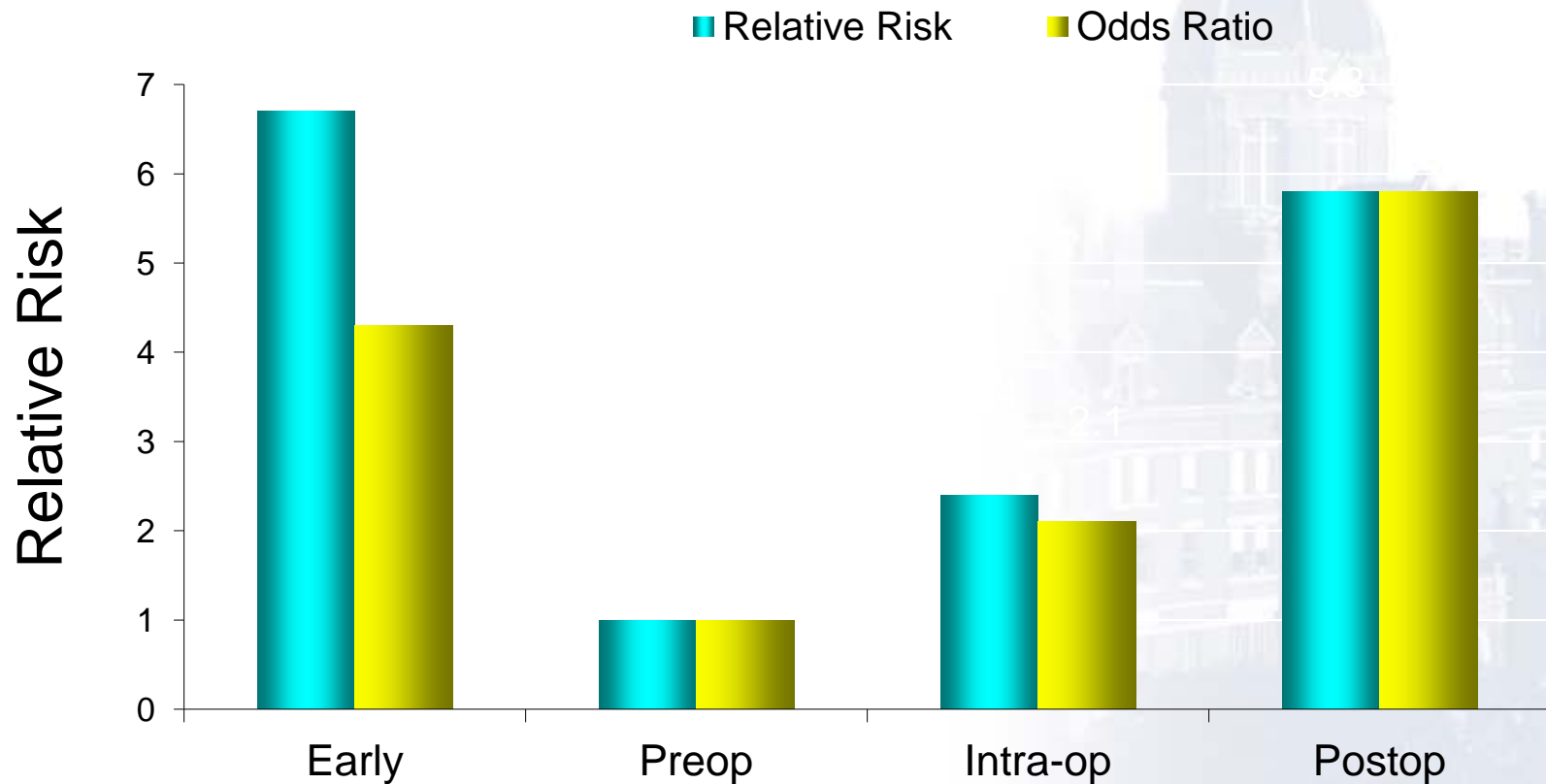
Interventions to Prevent SSI

- Antimicrobial Prophylaxis
 - Right agent
 - Right time
 - Right dose
 - Right duration

Antimicrobial Prophylaxis

- Timing
 - Administer within 1 hour prior to incision to maximize tissue concentration
 - 2 hours allowed for vancomycin and fluoroquinolones
- Redosing
 - Redose based on duration of procedure
 - Every 3-4 hours or as appropriate based on half-life of the agent
 - For every 1500 ml of blood loss

Give antibiotics within 60 minutes of incision



Classen. NEJM. 1992;328:281.

Antimicrobial Prophylaxis

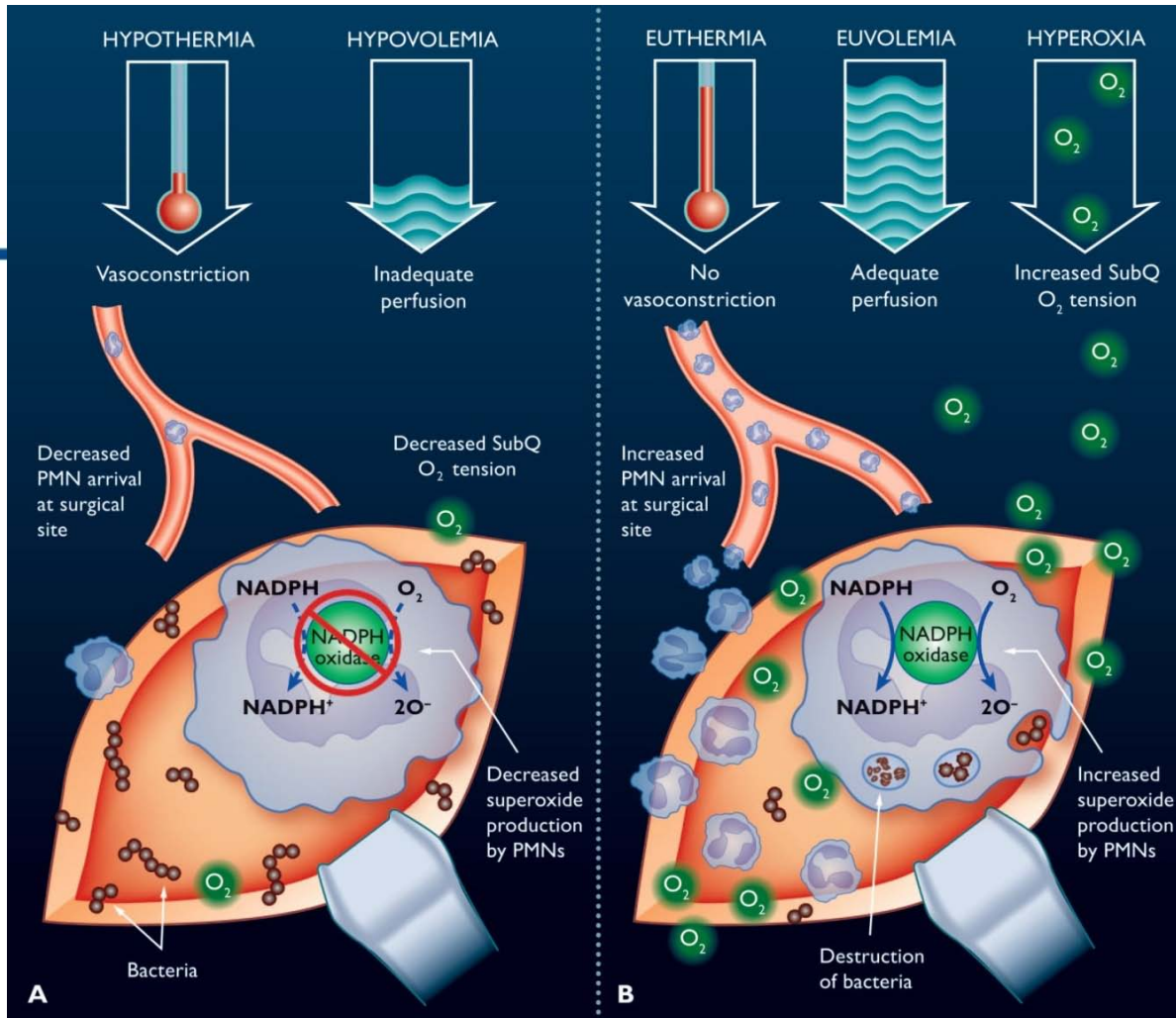
- Duration
 - Stop antimicrobial prophylaxis within 24 hours after surgery
 - For cardiac surgery, stop antimicrobial prophylaxis within 48 hours

Other thoughts...

- Put systems in place to ensure non-antibiotic and antibiotic factors are followed
- Don't forget about basics like hand hygiene, aseptic technique, disinfection and sterilization
- Minimize OR traffic and optimize air handling and room set up
- Proper hair removal, glucose control, smoking cessation, and skin preparation are important
- Maintenance of normothermia and level of administered oxygen (FIO₂ 80%) may be beneficial

Beneficial effects of oxygen therapy in wound healing and SSI

- Direct bacteriostatic and bacterocidal effect on microorganisms, esp. anaerobes
- Enhancement of PMN function, phagocytosis, microbial killing
- Enhancement of tissue repair mechanisms-fibroblast proliferation, collagen deposition, migration of epithelial cells



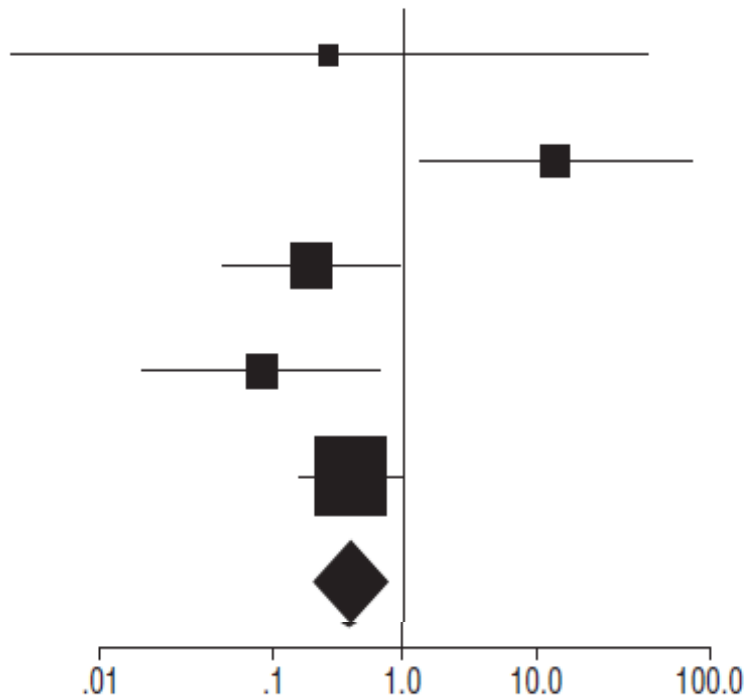
Tissue oxygen delivery is key to native antimicrobial mechanisms

Affected by body temperature, circulating volume, O₂ content

Randomized controlled trials examining supplemental O2 and SSI

- Greif et al., N Engl J Med 2000; 342: 161-7
- Myles et al., Anesthesiology 2007; 107:221-31
- Belda et al., JAMA 2005; 294: 2035-2042
- Pryor et al., JAMA 2004; 291: 79-87
- Mayzler et al., Minerva Anestesiol. 2005; 71: 21-5

Meta-Analysis of RCTs



- 1 Mayzler et al., 2005
 - 2 Pryor et al., 2004
 - 3 Belda et al., 2005
 - 4 Greif et al., 2000
 - 5 Myles et al., 2007
- Overall

Overall pooled odds ratio
0.742 (0.599-0.919
p=0.06)

Summary

- Good preclinical and clinical data exist to support the use of perioperative hyperoxygenation therapy
- Pryor et al. study has engendered debate, but has several flaws
- Pros: inexpensive, simple, low risk
- Cons: unclear benefit in a generalized population

Conclusions

- SSI is a common, preventable, adverse event
- Antimicrobial prophylaxis is a critical prevention strategy
 - Right agent, right dose, right timing, right duration
 - Redosing
- A broad array of patient and procedural factors affect the risk of SSI
- A multi-factorial and multi-disciplinary approach is needed for SSI prevention