Surgical Site Infection Prevention

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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

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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

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Anderson et al. ICHE, 2008, 29 (S1)

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

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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

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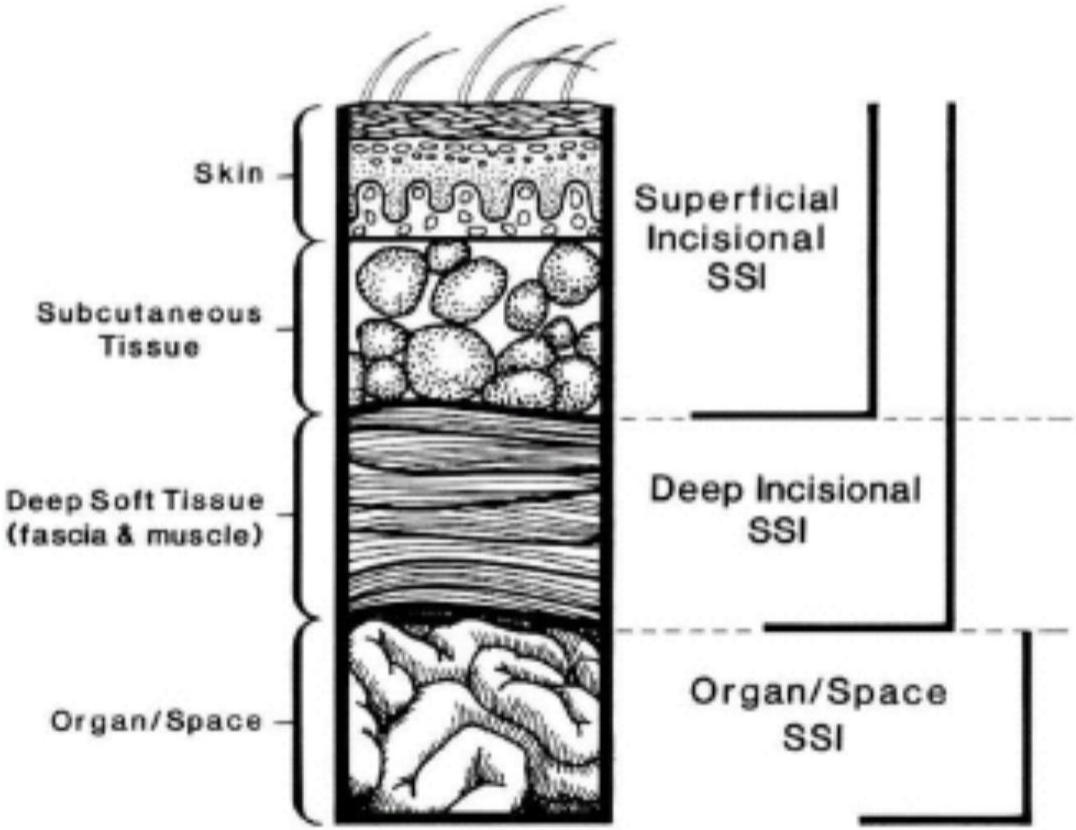
CDC Definitions of Surgical Site Infections



Horan et al. ICHE, 1992, 13:606

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Risk Stratification

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

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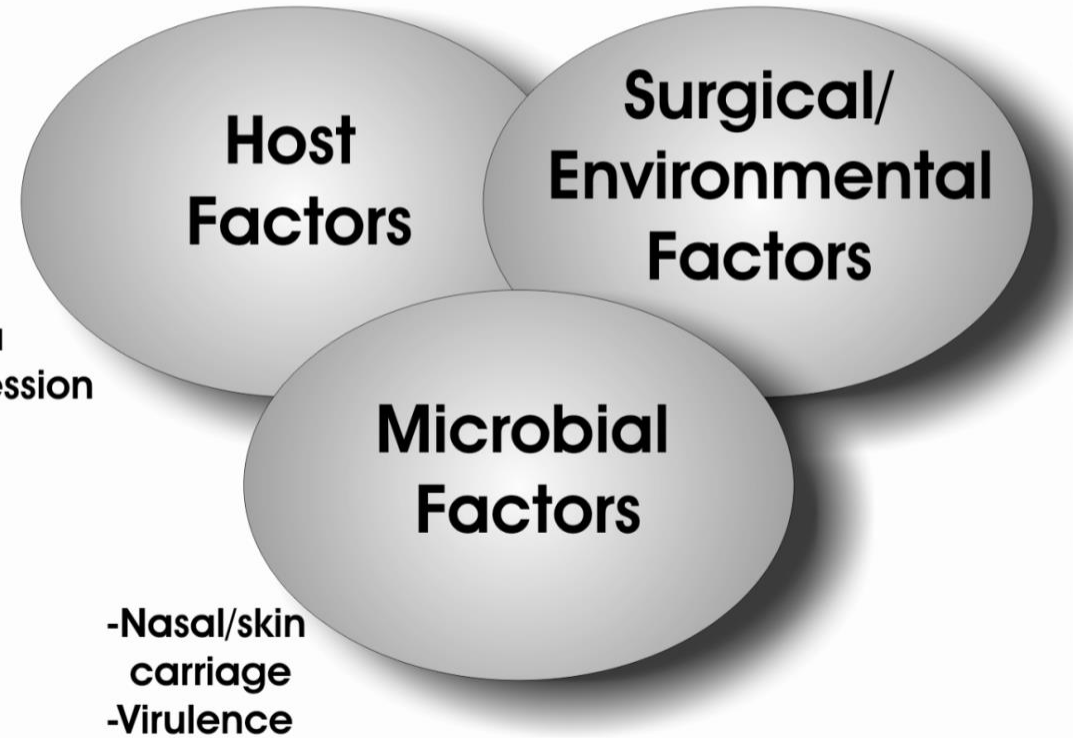
Risk Factors for SSI



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

-Nasal/skin carriage
-Virulence
-Adherence
-Inoculum

-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

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

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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.

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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)

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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

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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

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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

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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.

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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

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Hyperglycemia : Abdominal and Cardiovascular Operations

	Glucose POD#1	
	<220 mg%	>220 mg%
Any Infection	12%	31%
"Serious" Infection	5.7-fold increase for any glucose ≥ 220 mg%	

Pomposelli. JPEN 1998;22:77

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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

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Temperature and SSI Following Colectomy

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

Kurz. NEJM 1996;334:1209

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Interventions to Prevent SSI

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

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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

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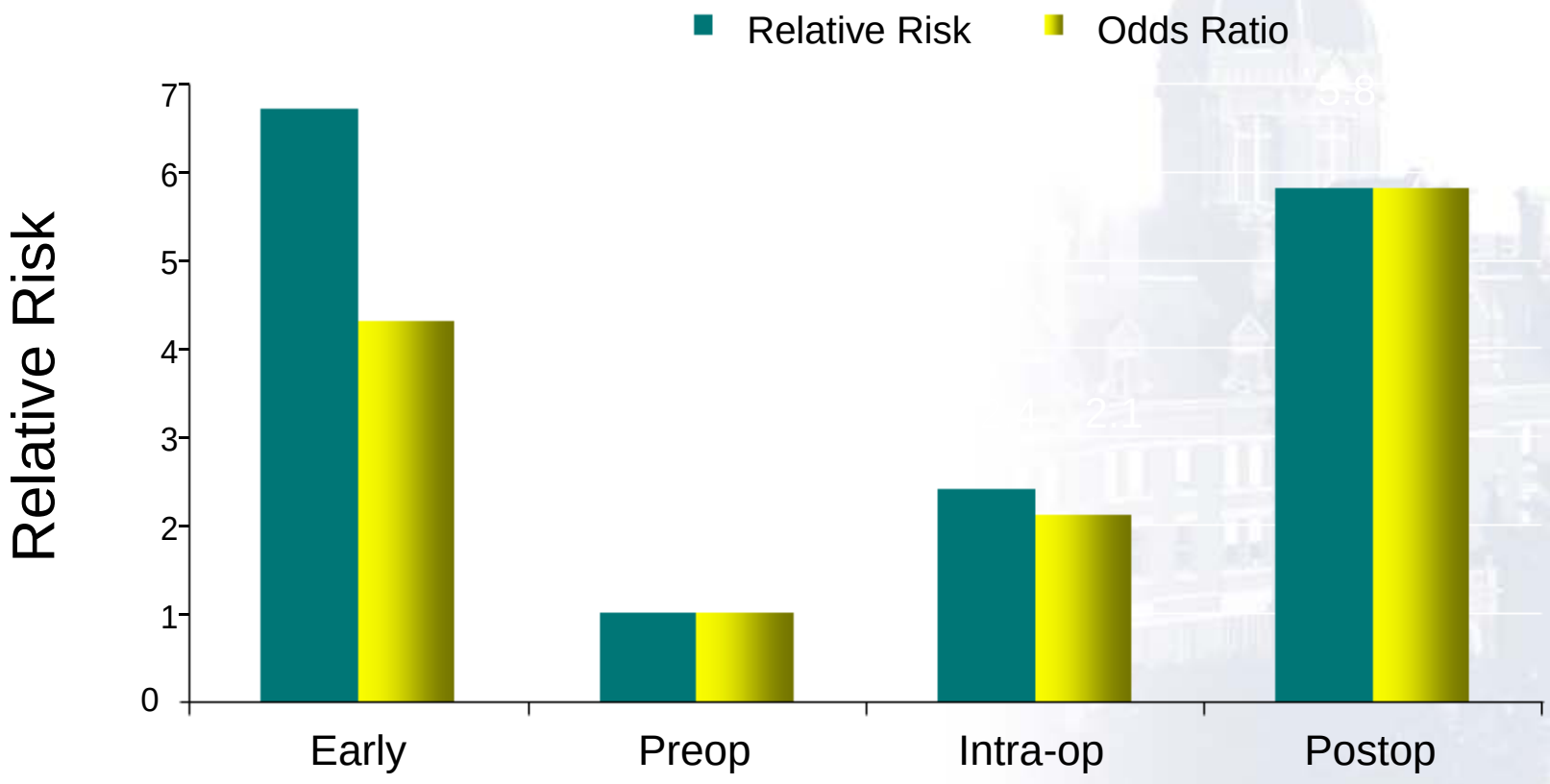
Give antibiotics within 60 minutes of incision



Classen. NEJM.1992;328:281.

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Antimicrobial Prophylaxis

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

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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

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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

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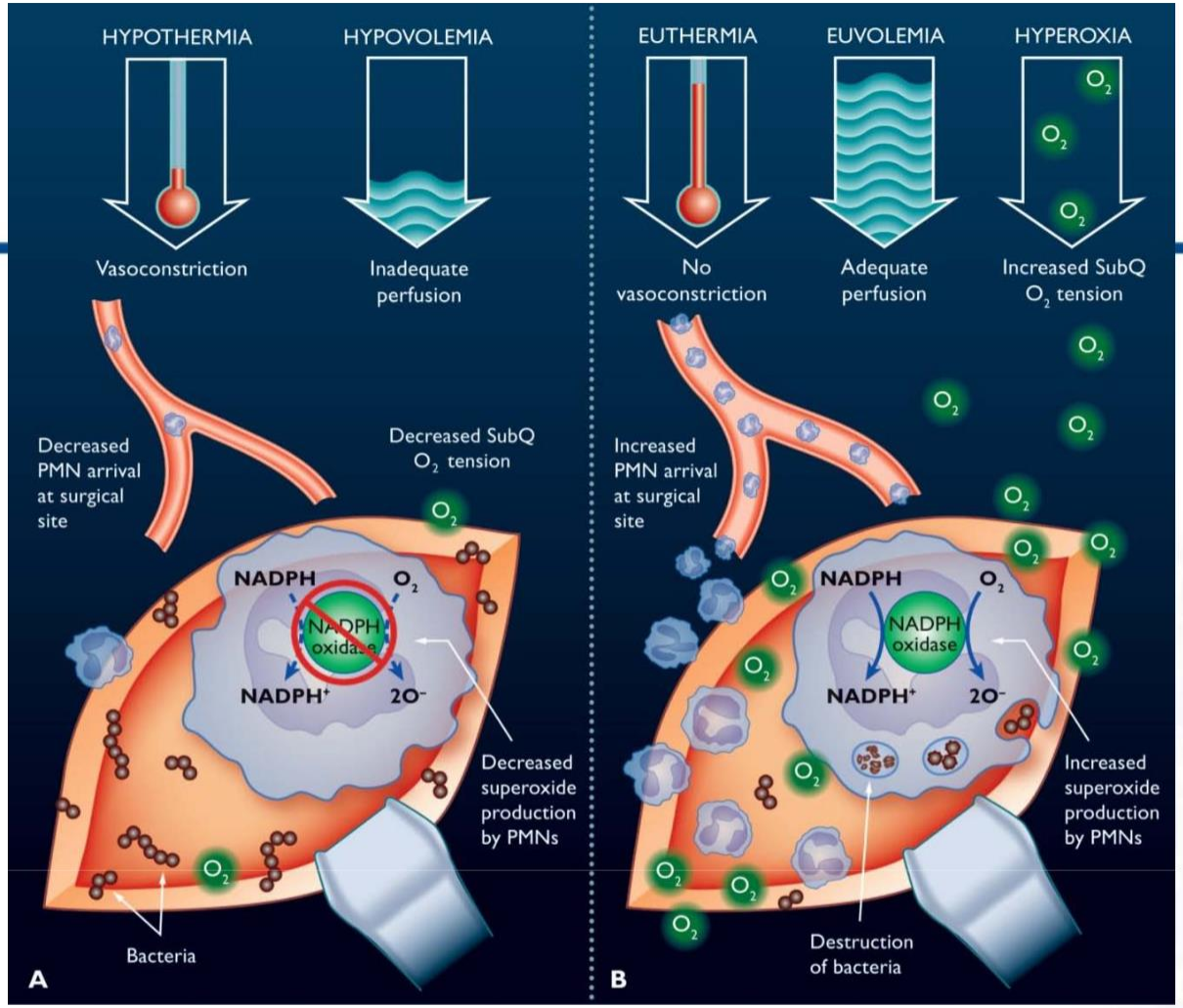

- Tissue oxygen delivery is key to native antimicrobial mechanisms
- Affected by body temperature, circulating volume, O_2 content

Mauermann et al., Anesthesiology 2006 105:413-21

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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

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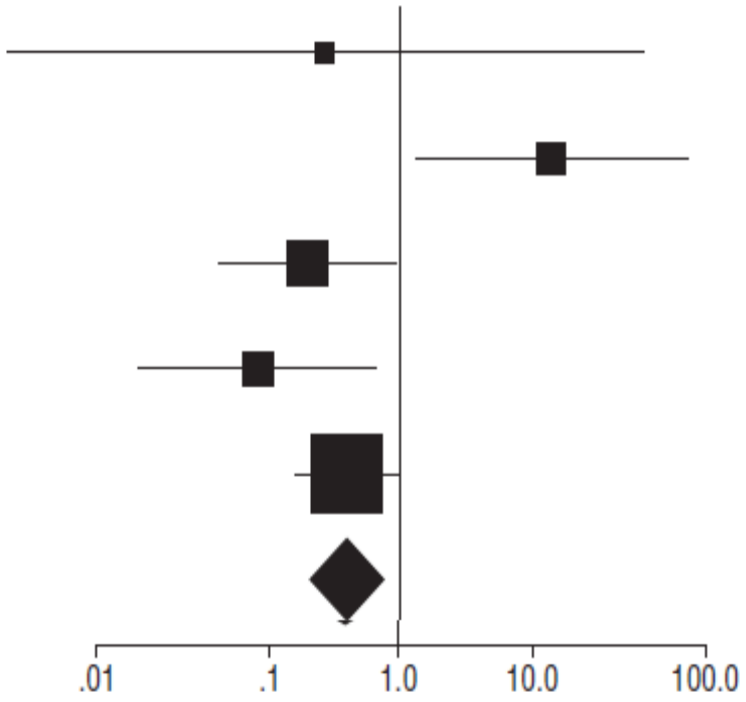
Meta-Analysis of RCTs



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)

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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

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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

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