

# A NEW LOOK AT SURGICAL SITE INFECTION

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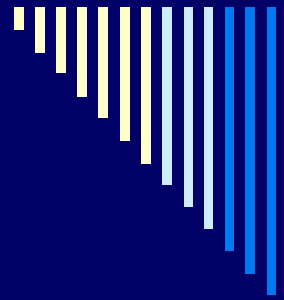
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# SURGICAL SITE INFECTION

- Magnitude of the problem
    - 27 million operations annually
    - NNIS infection rate, 1986-1996 = 2.6%
    - Most assessments indicate that infection rate is under-reported
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## Would reductions in SSI be cost effective?

- Reduction of SSI and hospital acquired infection have been classified as low cost –high yield initiatives by the Agency for Health Care Quality and Research. (2001)



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# SURGICAL SITE INFECTION

## □ Determinants of infection

### ■ Bacterial inoculum

- Bacterial counts in human intestine show  $10^3$ - $10^4$  bacteria/ml of distal small intestine content;  $10^5$ - $10^6$ /ml in right colon; and  $10^{12}$  bacteria/ gm of feces (left colon). Infection occurs with presence of  $10^5$  bacteria/gm of tissue. One microgram of feces contains enough bacteria to cause an infection

### ■ Bacterial virulence

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# SURGICAL SITE INFECTION

- Determinants of infection, continued
    - Wound microenvironment
      - Iron, hypoxia, fluid, necrotic tissue, and foreign bodies all promote infection
    - Host defenses
      - Shock, hypoxemia, transfusion, chronic illness (especially diabetes), tobacco use, hypoalbuminemia, malnutrition, hyperglycemia, hypothermia, corticosteroids
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# SURGICAL SITE INFECTION

- Wound classification
    - Clean: expected infection rate 2%
    - Clean-contaminated: expected infection rate 4-10%
    - Contaminated: infection rates exceed 10%
    - Dirty: infection rates exceed 25%
  - Emergency operations have 2-4 times the risk of infection compared to elective operations.
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# SURGICAL SITE INFECTION

- Surgical site infection risk prediction
    - CDC SSI infection risk score
      - 1 point for contaminated or dirty wound
      - 1 point for ASA classification 3, 4, or 5
      - 1 point for duration of operation beyond 75<sup>th</sup> percentile of operation durations in NNIS database ( T point)
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# SURGICAL SITE INFECTION

□ ASA physical status classification

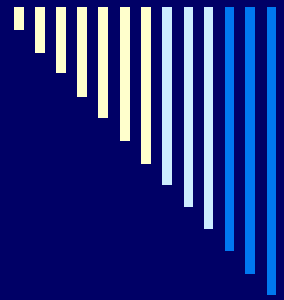
Class 1	Normal health
Class 2	Mild systemic disease, no limitation
Class 3	Severe disease with limitations but not incapacitating
Class 4	Severe disease, constant threat to life
Class 5	Moribund patient



# SURGICAL SITE INFECTION

□ Prediction of infection rates

Operation type	Risk 0	Risk 1	Risk 2	Risk 3
Colon	3.2%	8.5%	16%	22%
Vascular	1.6%	2.1%	6.1%	14.8%
Cholecystectomy	1.4%	2%	7.1%	11.5%
Organ Transplant	0%	4.4%	6.7%	18%



## When you know the risk, what do you do?

- Tell the patient what risk category they are in!
- Most patients/families understand complications they know about ahead of time.
- Write in the chart an estimate of postoperative infection rate and add that this issue was discussed.

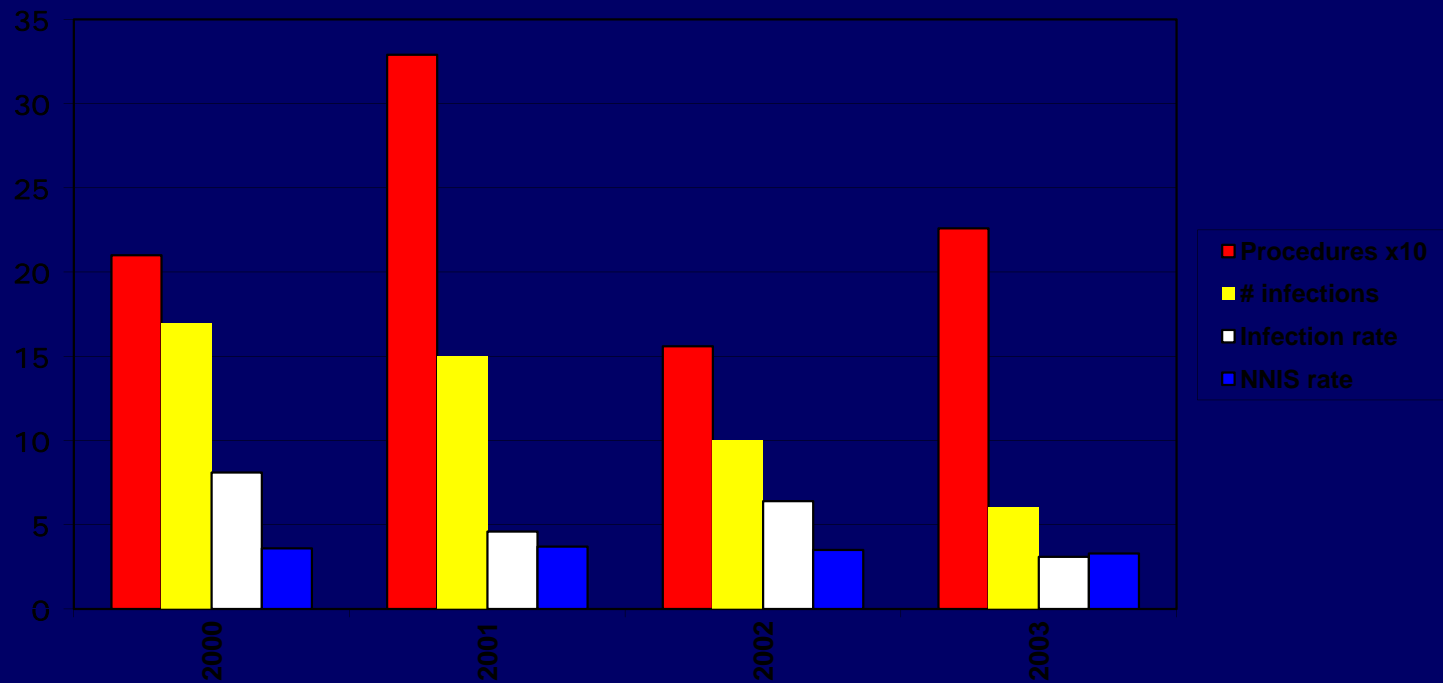


## WOUND INFECTION RATE – OPEN HERNIA REPAIR WITH MESH

YEAR	2001	2002	2003
RATE	1.0%	0.6%	0

Source: TGH Infection Control Office

# WOUND INFECTION RATE - CELIOTOMY

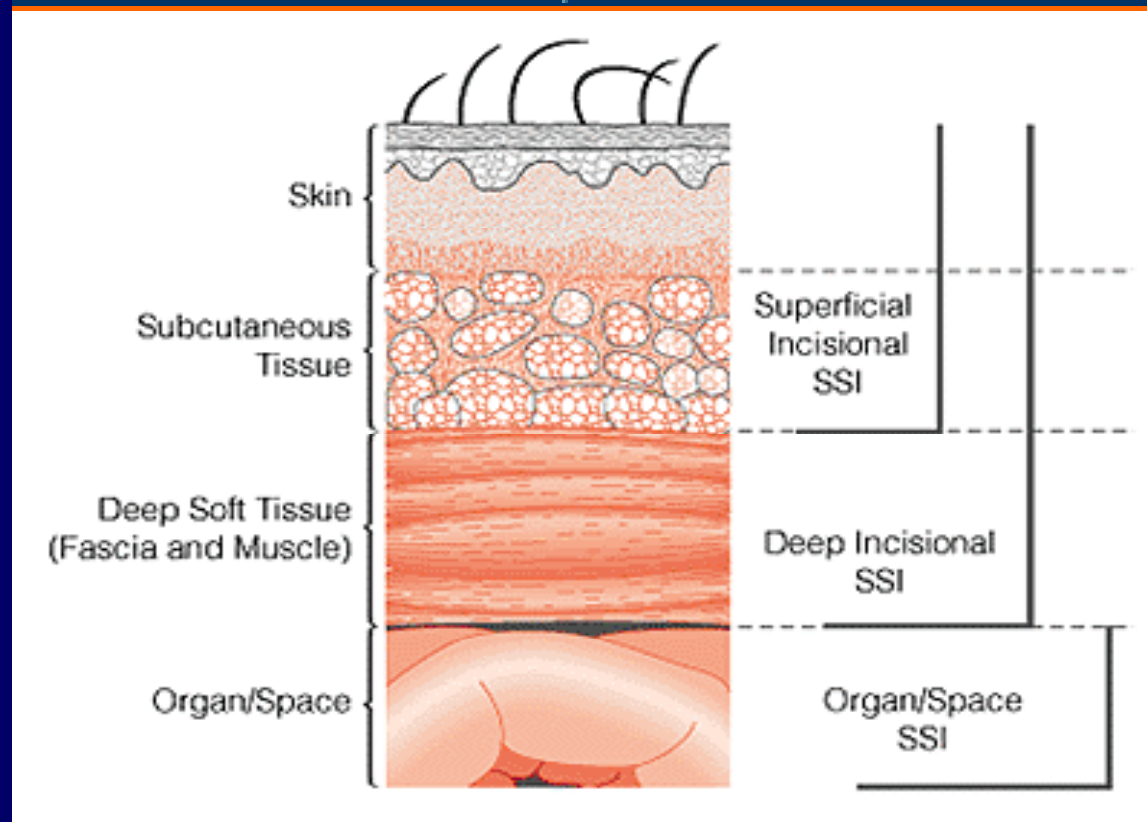


Source: TGH Infection Control Office

# SURGICAL SITE INFECTION

Medscape®

www.medscape.com



Source: ACS Surgery © 2003 WebMD Inc.



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# SURGICAL SITE INFECTION

- When is a wound infected?
    - Superficial wound infection
      - Within 30 days of operation
      - Involves only skin and subcutaneous tissue
      - At least one of the following
        - Purulent drainage
        - Organisms isolated from tissue
        - At least one sign of inflammation
        - Wound opened or fluid drained by surgeon
        - Physician declares wound infected
    - Circumcision or episiotomy infections or stitch abscesses not included
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# SURGICAL SITE INFECTION

- Deep incisional infection
    - Occurs within 30 days or 1 year if implant is in place
    - Involves deep soft tissues and at least one of the following:
      - Purulent drainage from deep tissues
      - Fascial dehiscence or surgeon opens fascia because of infection
      - Deep abscess identified
      - Physician declares infection present
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# SURGICAL SITE INFECTION

- Organ space infection
    - Occurs within 30 days or 1 year with implant
    - Involves anatomic structures not opened or manipulated during the operation and at least one of the following:
      - Purulent drainage from drain placed in space
      - Organisms isolated from fluid from space
      - Identification of abscess at subsequent procedure
      - Diagnosis by surgeon or physician
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# SURGICAL SITE INFECTION

- Prevention of SSI
    - Remote site infection/colonization control
      - Check patient and staff for infection
      - Short preoperative hospital stay
    - Preoperative skin washing
      - Chlorhexidine shower
    - Preoperative hair removal
      - Clipper not razor
    - Skin preparation
    - Antimicrobial prophylaxis
    - Surgical attire and drapes
    - Managing incision and tissue
    - Wound management
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# SURGICAL SITE INFECTION

- Newer ideas for prevention of SSI
  - Maintain core temperature and warm operative site
  - Stop tobacco use prior to procedure (use nicotine patch)
    - How long before?
  - Aggressive control of blood sugar
    - Much lower blood levels than previously thought; < 140 mmol/deciliter
  - Maintain high arterial pO<sub>2</sub> during operation and give supplemental O<sub>2</sub> after operation
  - Irrigate wound (the one the surgeon makes) with antibacterial fluid
  - Avoid narcotic PCA?
    - Association of PCA with increased infection rate a function of hypoxia?
  - Use antibacterial sutures?



# ANTIBIOTICS AND SURGICAL SITE INFECTION

## □ Definitions

- Prophylaxis – antibiotic is given before any contamination occurs
  - Effect is lost if given > 2 hr before or > 2 hr after contamination occurs
- Presumptive – antibiotic is given after contamination has occurred (e.g. GSW of abdomen with colon injury)

## □ What infection rate is reduced?

- Infection in the incision the surgeon makes (superficial or deep wound space) so long as there is no foreign body in the incision
  - Perioperative antibiotics have no effect on rates of organ space infection
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# ANTIBIOTICS AND SURGICAL SITE INFECTION

- How to get the best results from antibiotics
    - Be sure the patient gets the drug
      - Order the drug to be given at a time when you can witness the administration (e.g. during induction of anesthesia).
    - If the patient does not get the drug on time, antibiotics given up to 2 hours after the operation begins have an effect but greatly decreased.
    - Getting antibiotics on time will soon become a criterion by which level of surgeon payment is determined.
    - Use one or two doses of drug after operation is concluded. No reason to give antibiotics for more than 24 hours.
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# SURGICAL SITE INFECTION

- The ideal antimicrobial prophylactic drug
    - Cheap
    - Effective against expected pathogens but not overly broad spectrum
    - Therapeutic, long-lasting tissue levels
    - Only one dose needed for any operation regardless of duration
  - Available drugs
    - Cefazolin and cefoxitin are good but need to be redosed at 3 hours
    - Cefotetan comes close to ideal
    - Ceftriaxone effective and close to ideal but has a very broad spectrum
    - Vancomycin is frequently added for vascular and cardiothoracic operations but volume of distribution and tissue penetration are problematic and there is no proof of efficacy.
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# Suggested drugs for prophylaxis

Operation Type	Drug
GYN	Cefotetan or other cephalosporin
Arthroplasty	Cefazolin or cefuroxime
CT/Vascular	Cefazolin or cefuroxime possibly add anti-MRSA drug
Colon	Oral and/or systemic with cefotetan or cefuroxime



# DATA ON SERUM AND TISSUE ANTIBIOTIC LEVELS

- Edmiston, *et al*: Arch Surg, in press
  - Serum and tissue levels of cefazolin were assayed at varying intervals after a 2 gram IV dose which was repeated at 3 hour in 38 gastric bypass patients.
  - Patients were grouped according to BMI.
    - Group A = 40-49; Group B = 50-59; Group C =  $\geq$  60
  - Institutional resistance patterns were reviewed for S. Aureus; S. Epidermidis; E. Coli; and K. Pneumoniae



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# DATA ON SERUM AND TISSUE ANTIBIOTIC LEVELS

- ❑ Serum levels exceeded therapeutic levels in 90% of patients at all time points in all BMI groups.
  - ❑ Tissue levels showed failure to achieve therapeutic levels 46% of group A; 65% of group B; and 84% of group C.
  - ❑ Resistance pattern analysis disclosed resistance to cefazolin with rates of 36% for *S. Aureus*; 71% for *S. Epidermidis*; 23% for *E. Coli*; and 14% for *K. pneumoniae*
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# DATA ON SERUM AND TISSUE ANTIBIOTIC LEVELS

## □ Conclusion

- Current dosing strategies for 1<sup>st</sup> generation cephalosporin antibiotic prophylaxis fall short of optimum coverage in these high risk patients.





# Dosing of perioperative antibiotics

<u>DRUG</u>	<u>DOSE</u>
Cefazolin	20-30 mg/kg
Cefuroxime	50 mg/kg
Cefoxitin	20-40 mg/kg
Cefotetan	20-40 mg/kg
Clindamycin	3-6 mg/kg
Gentamicin	1.5 mg/kg
Metronidazole	15 mg/kg
Vancomycin	10-15 mg/kg



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# SURGICAL SITE INFECTION

- What to do about penicillin allergic patients?
    - More than 90% of patients who state they are allergic have no allergy demonstrated on further testing.
    - If operation is elective, take careful history. If major sensitivity is suspected, skin test patient.
    - If operation is emergency, cephalosporin is safe unless patient says specifically that they had a major reaction to  $\beta$  – lactam drugs.
    - Vancomycin an alternative
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# SURGICAL SITE INFECTION

- Skin preparation
    - Povidone iodine: apply and let it dry, do not dry it.
    - Chlorhexidine + alcohol is effective but there is the inflammability problem
  - Surgeon scrub
    - Iodine or chlorhexidine soap for hands and forearms for 120-180 seconds
  - Surgeon attire
    - Functions primarily to protect the surgeon
    - Use shoe/leg covers; arm covers; adhesive plastic drapes on front of gown to prevent strikethrough. If strikethrough occurs, replace wet materials.
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# SURGICAL SITE INFECTION

- What does not work
    - Antibiotic or antiseptic irrigation is no better than saline except, possibly, for subcutaneous tissue at time of closure.
    - Antiseptic impregnated adhesive drapes are not useful except, perhaps, to isolate stomas and other contaminated areas.
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# SURGICAL SITE INFECTION

- Are surgical infection rates more of a problem than we think??
    - Shortened hospital stays mean many infections come to light after discharge and may not be reported.
    - Infection surveillance is weak, especially in outpatient setting.
    - Definitions of infection inconsistent.
    - Prevention strategies inconsistent.
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# Keys to preventing SSI

- ❑ Have patient stop smoking. Even 2 weeks helps.
  - ❑ Have patient shower with chlorhexidine the evening before and morning of operation
  - ❑ Prevent hyperglycemia
  - ❑ Prevent fall in body temperature
  - ❑ Optimize oxygen tension
  - ❑ Don't shave operative site
  - ❑ Antibiotics – right antibiotic, on time, for proper duration, dosed appropriately
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