Surgical Site Infection

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Overview

- Define Hospital Associated Infections
- Surgical site infection (SSI)
- Wound classification
- Care bundles
- Antibiotic prophylaxis

Hospital Acquired Infection

- Nosocomial infection
- Infections occurring more than 48 hours after hospital admission
- Evidence of poor quality health service delivery
- Avoidable cost
  - Increased ALOS (Average Length of Stay)
  - Further interventions
  - Delayed return to work

for example: patient with pneumonia if sepsis related to pneumonia this is not hospital acquired infection, if related for example to VTI → hospital acquired infection

(ممكن كان عنده نوع infection تاني بس دخل بس) الي هون هو اللي صار بعد اكثر من ٤٨ ساعة من دخوله infection

Hospital Acquired Infections relating to surgery

1. Surgical site infections

(catheter related infection)

1. Urinary Tract Infection (CAUTI)
2. Indwelling Catheter/cannula Infection
3. Ventilated Associated Pneumonia

Impact

Burden-US

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

Mortality

- 3 % mortality
- 2-11 times higher risk of death (especially in major surgeries)
- 75% of deaths among patients with SSI are directly attributable to SSI not from the surgery itself

Morbidity

- 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

Impact

Length of Hospital Stay

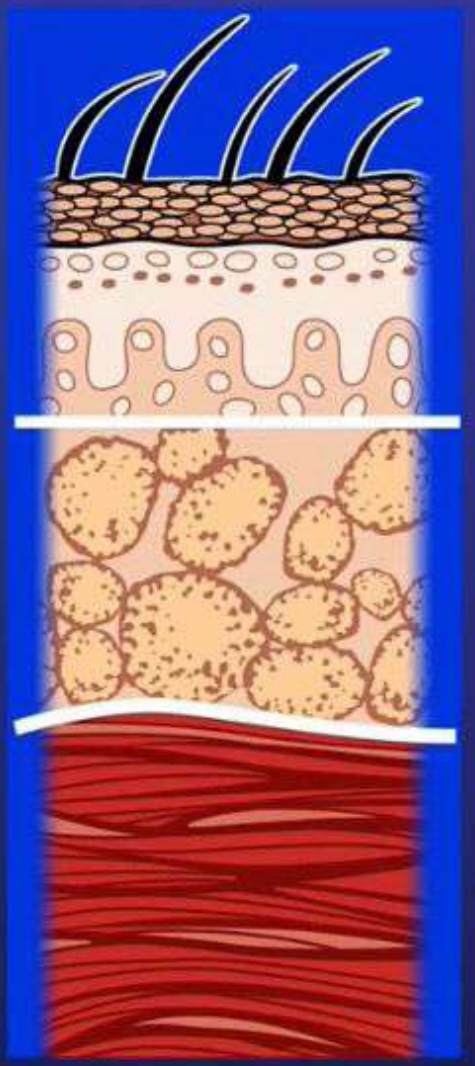
- ~7-10 additional postoperative hospital days

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 (delayed recovery and return to work and other daily activities)

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

Deep Incisional SSI → anything below the deep fascia

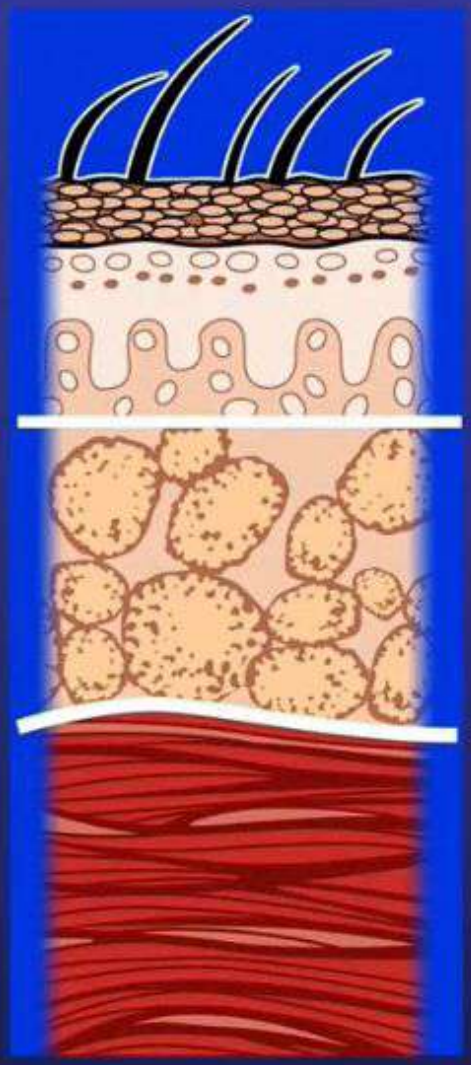


Superficial incisional SSI

Deep soft tissue (fascia & muscle)

Deep Incisional SSI

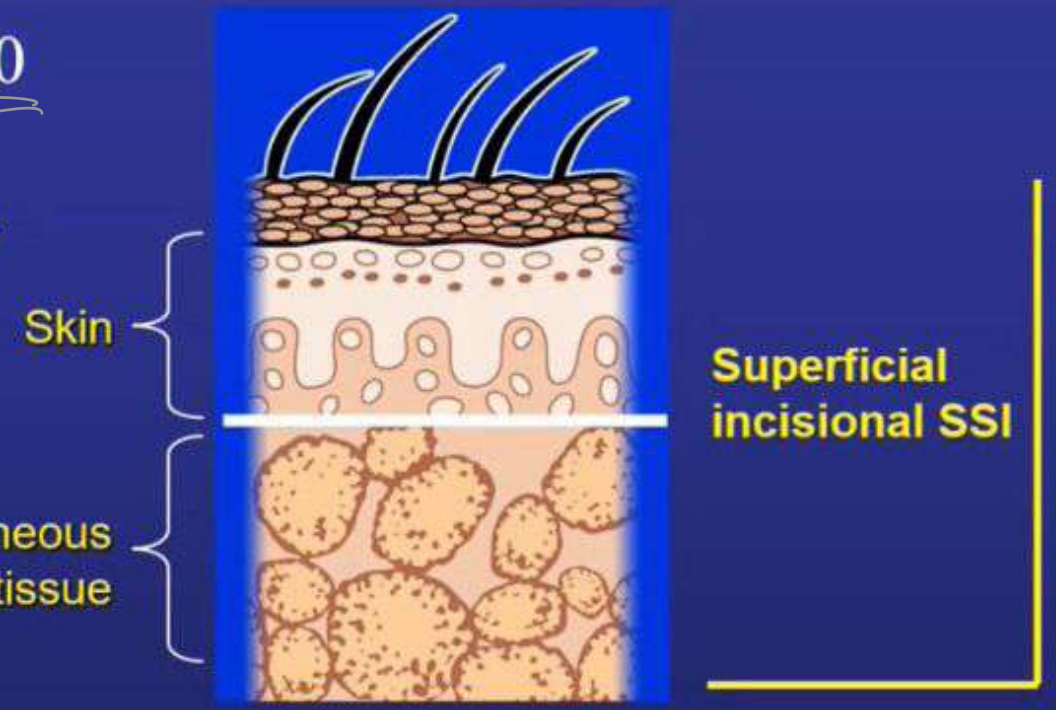
Infection occurs within 30 days and the only if no implant is left in place or within 1 year if implant is in place infection appears to be related to the operation and the infection involves the deep soft tissue (e.g., fascia and muscle layers)



Superficial Incisional SSI

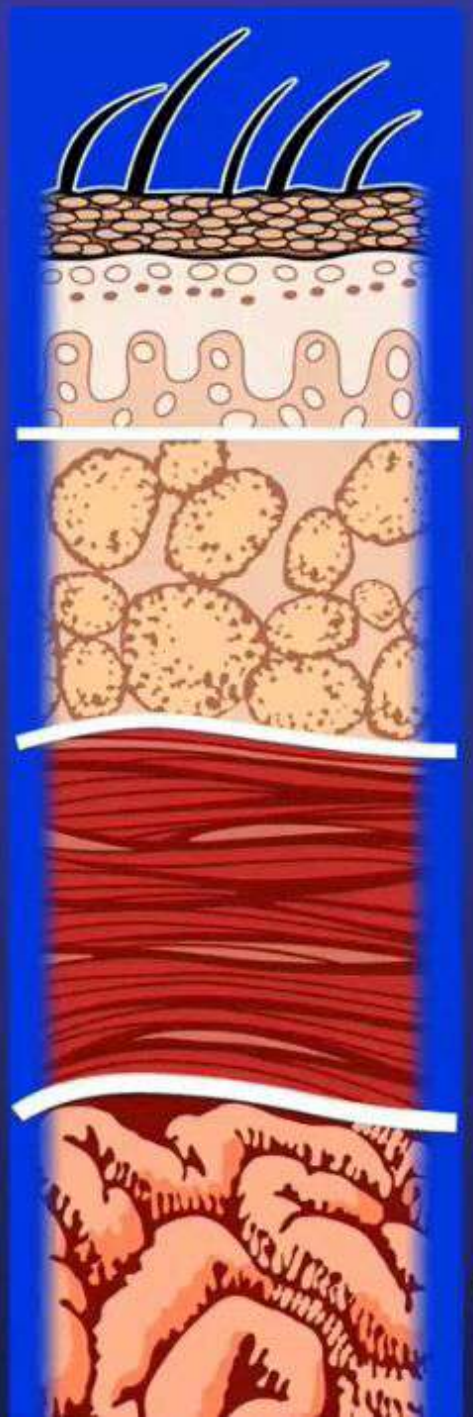
anything above the deep fascia

Infection occurs within 30 days after the operation and involves only skin or subcutaneous tissue of the incision



Organ/Space SSI

Infection occurs within 30 days after the operation only if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and the infection involves any part of the anatomy, other than the incision, which was opened or manipulated during the operation



Superficial incisional SSI

Deep incisional SSI

Organ/space

Organ/space SSI

Mangram AJ et al. *Infect Control Hosp Epidemiol*

SSI – Wound Classification

classified according to the type of surgery

- Class 1 = Clean
- Class 2 = Clean contaminated ← Prophylactic antibiotics indicated
- Class 3 = Contaminated ← Prophylactic antibiotics indicated
- Class 4 = Dirty infected ← Therapeutic antibiotics

Mangram AJ et al. *Infect Control Hosp Epidemiol.* 1999;20:250-278.

Clean

Operation where no inflammation encountered

Respiratory, alimentary, genital, urinary tracts ***not*** entered (no entering in any of the cavities)

Operation following non-penetrating (blunt) trauma

Primarily closed with no open drainage (for example: herniotomy (only herniation of the sac))

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

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

Dirty

Operation involving old traumatic wounds with retained devitalized tissue, **or** existing clinical infection **or** perforated viscera

(fecal peritonitis perforated diverticular disease peritonitis due to appendicitis)

Definition suggests the organisms causing post-op infection were present before the operation

* prophylactic antibiotics → 24 hours
more than 24 hours → therapeutic

Types of Surgery

Clean	Hernia repair breast biopsy	1.5%
Clean-Contaminated	Cholecystectomy Elective bowel resection	2-5%
Contaminated	Emergency bowel resection	5-30%
Dirty/infected	Perforation, abscess	5-30%

SSI – Risk Factors
Operation Factors

- Duration of surgical scrub
- Maintain body temp
- Skin antisepsis
- Preoperative shaving
- Duration of operation
- Antimicrobial prophylaxis
- Operating room ventilation
- Inadequate sterilization of instruments
- Foreign material at surgical site
- Surgical drains
- Surgical technique
  - Poor hemostasis
  - Failure to obliterate dead space
  - Tissue trauma

SSI – Risk Factors
Patient Characteristics

- Age
- Diabetes
  - HbA_{1C} and SSI
  - Glucose > 200 mg/dL postoperative period (<48 hours)
- Nicotine use: delays primary wound healing
- Steroid use: controversial
- Malnutrition: no epidemiological association
- Obesity: 20% over ideal body weight
- Prolonged preoperative stay: surrogate of the severity of illness and comorbid conditions
- Preoperative nares colonization with *Staphylococcus aureus*: significant association
- Perioperative transfusion: controversial
- Coexistent infections at a remote body site
- Altered immune response

SSI – Risk Stratification NNIS Project

3 independent variables associated with SSI risk

- Contaminated or dirty/infected wound classification
- ASA > 2
- Length of operation > 75th percentile of the specific operation being performed

NNIS=National Nosocomial Infections Surveillance.

Operative Antibiotic Prophylaxis

- Decreases bacterial counts at surgical site
- Given within 60 minutes prior to starting surgery (knife to skin)
- Repeat dose for longer surgery (T 1/2)
- Do not continue beyond 24 hours
- Determinants – prevailing pathogens, antibiotic resistance, type of surgery
- Not a substitute for aseptic surgery or good technique

Procedure	Antimicrobial Agent	Dose	Timing	Duration
Dental	Cephalexin, cephradine, amoxicillin	2 gm PO	1 hour prior to procedure	Discontinued within 24 hours of the procedure. For most outpatient/office-based procedures a single pre-procedure dose is sufficient.
Ophthalmic	Gentamicin, tobramycin, ciprofloxacin, gatifloxacin, levofloxacin, moxifloxacin, ofloxacin, or meomycin-gramicidin-polymyxin B cefazolin	Multiple drops topically over 2 to 24 hours or 100 mg subconjunctivally	Consult ophthalmologist or pharmacist for dosing regimen	
Orthopaedic†	Cefazolin Cefuroxime OR Vancomycin	1-2 g IV 1.5 g IV 1 g IV	Begin dose 60 minutes prior to procedure	
Vascular	Cefazolin OR Vancomyin	1-2 g IV 1 g IV	Begin dose 60 minutes prior to procedure	
Gastrointestinal				
Esophageal, gastroduodenal	Cefazolin	1 -2 g IV	Begin dose 60 minutes prior to procedure	
Biliary tract	Cefazolin	1-2 g IV		
Colorectal	Neomycin + erythromycin base (oral)	1 g	Dependent on time of procedure, consult with GI physician and/or pharmacist	
	OR metronidazole (oral)	1 g		
Head and neck	Clindamycin + gentamicin OR cefazolin	600-900 mg IV 1.5 mg/kg IV 1-2 g IV	Begin dose 60 minutes prior to procedure	
Obstetric and gynecological	Cefoxitin, cefazolin Ampicillin/sulbactam	1-2 g IV 3 g IV	Begin dose 60 minutes prior to procedure	
Genitourinary	Ciprofloxacin	500 mg PO or 400 mg IV	1 hour prior to procedure Begin dose 60	

CDC Prevention Strategies

Core Strategies

- High levels of scientific evidence
- Demonstrated feasibility

- Should become standard practice

Supplemental Strategies

- Some scientific evidence
- Variable levels of feasibility

- Consider implementing <u>in addition to Core</u> when infections persist or rates are high

CDPH California Department of Public Health

Healthcare-associated Infections HAI Elimination

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

try to treat the infection before the operation whenever possible

- **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***

→ hypothermia increases the rate of infection bleeding . . .

*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, etal. 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 Cardica 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
- .

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.

Pathogen Sources

Endogenous (if contaminated or dirty surgery more likely the cause is Endogenous)

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

Pathogen Sources

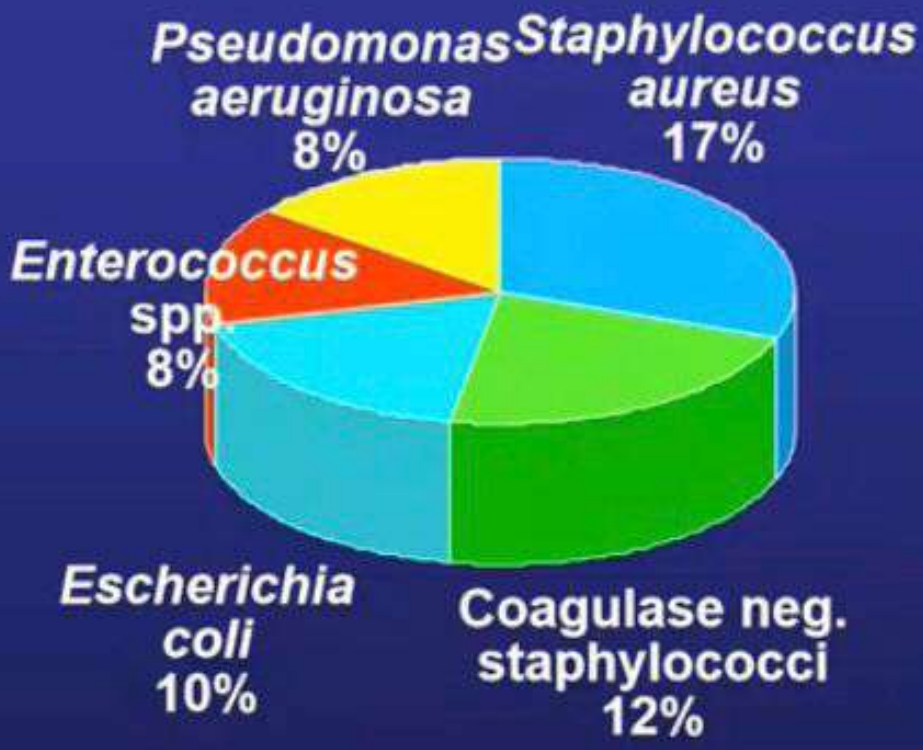
Exogenous

(if clean surgery more likely the cause of infection is exogenous)

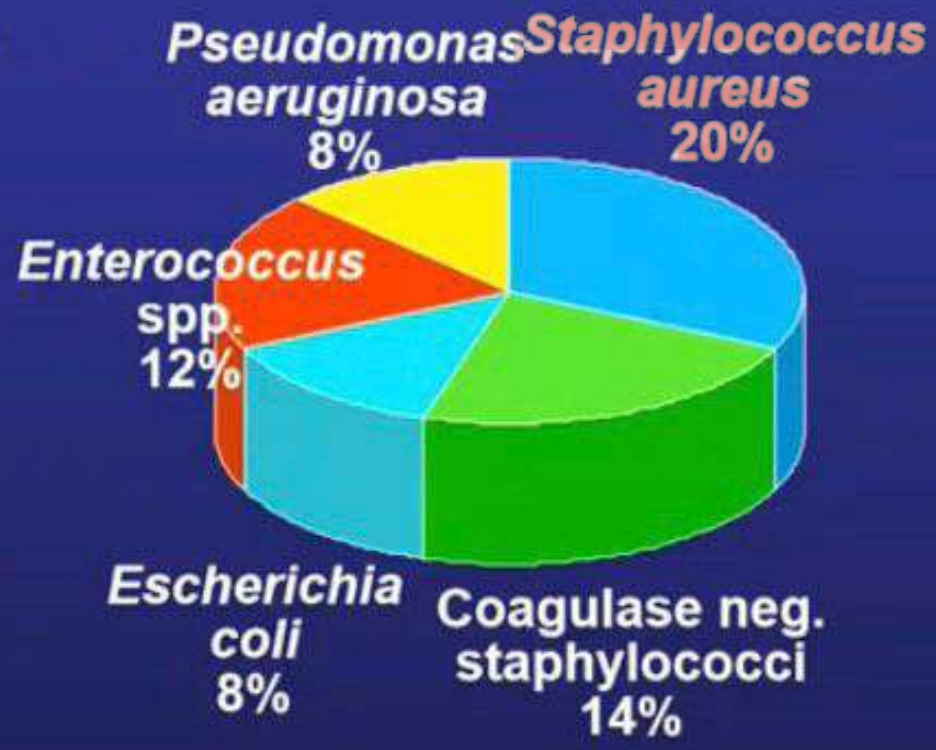
- Surgical Personnel (surgeon and team)
  - Soiled attire
  - Breaks in aseptic technique
  - Inadequate hand hygiene
- OR physical environment and ventilation
- Tools, equipment, materials brought to the operative field

Microbiology of SSIs

1986-1989
(N=16,727)

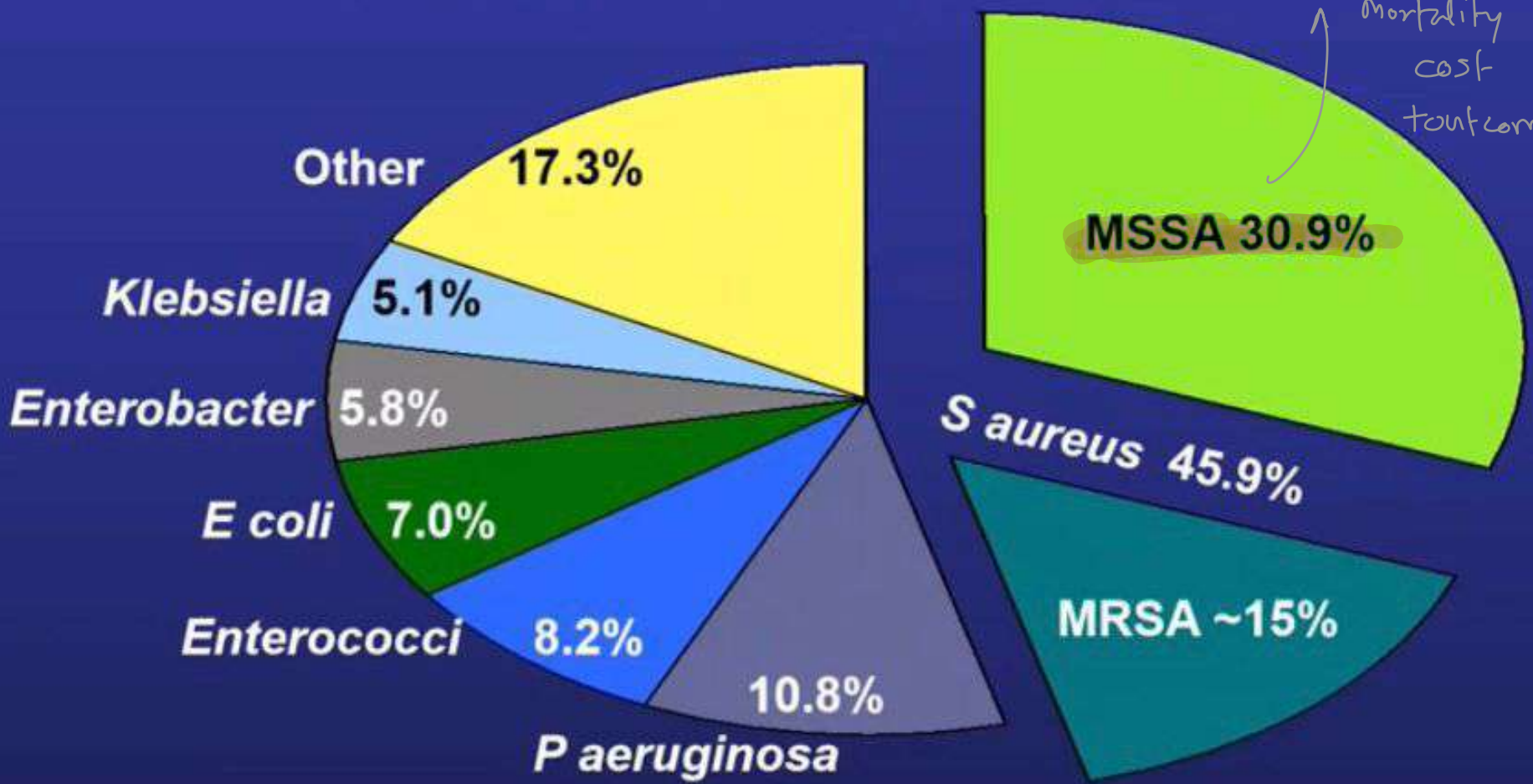


1990-1996
(N=17,671)



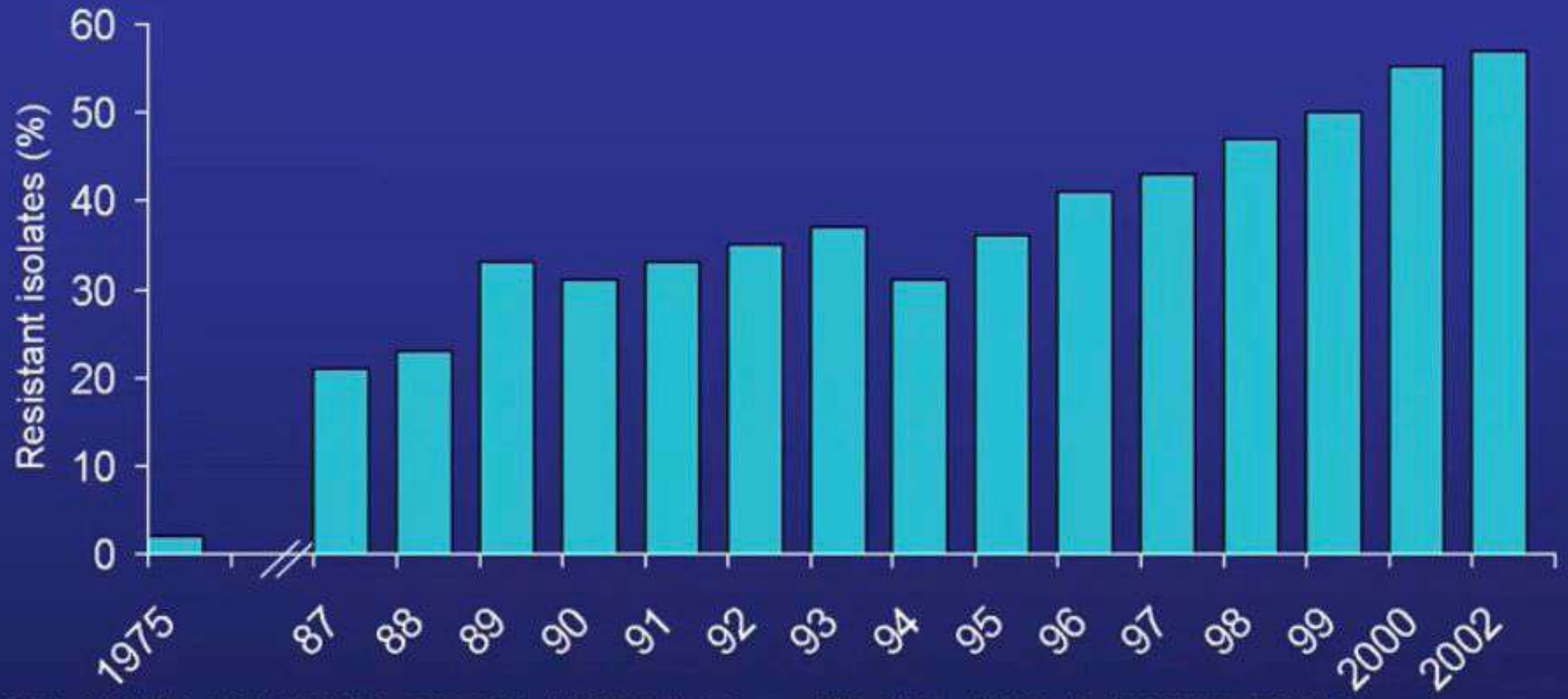
Predominance of *S aureus* in Skin and Skin Structure Infections (SSSIs)

SENTRY – US and Canada 2000



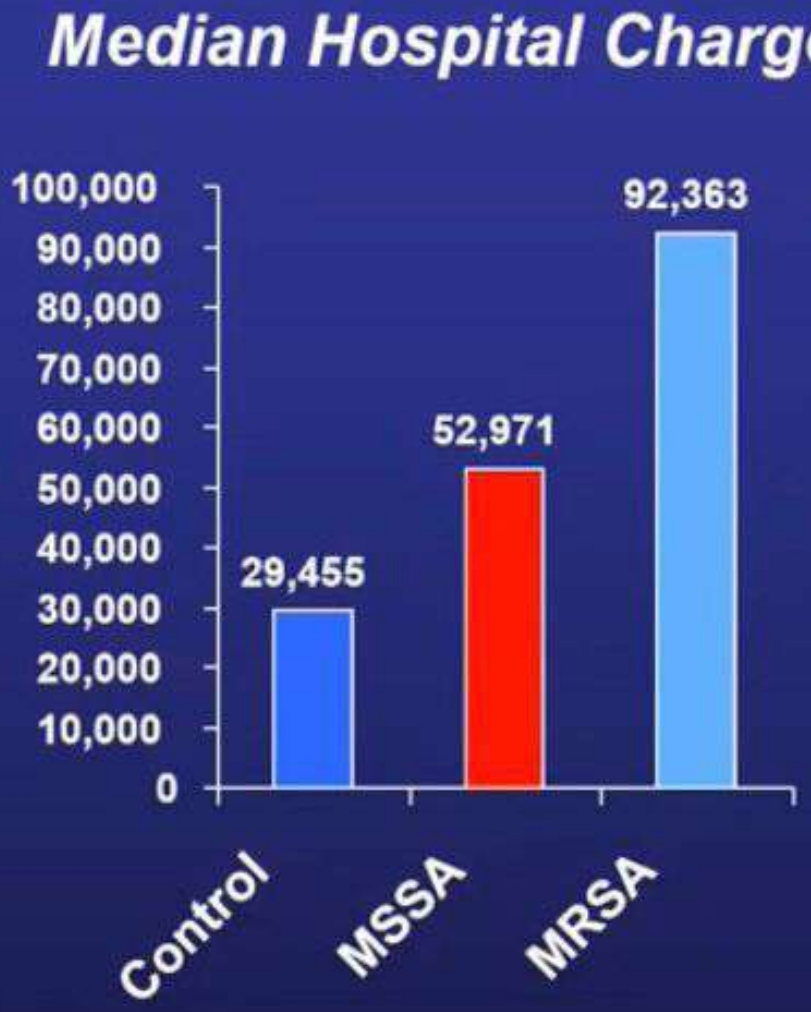
N=1,404 isolates

Progression of Methicillin Resistant *S aureus* – United States



CDC. *MMWR*. 1997;46:624-628, 635. (1975 data); Lowy FD. *N Engl J Med*. 1998;339:520-532. (1987-1997 data); CDC. NNIS System Report, January–November 1998. (1998 data); CDC. NNIS System Report, January 1990–May 1999, issued June 1999. *Am J Infect Control*. 1999;27:520-532. (1999 data); CDC.

Impact of MRSA on SSI



- N=479 patients
- MRSA greater 90-d mortality vs MSSA (adjusted odds ratio, 3.4; 95% CI: 1.5–7.2)
- MRSA longer LOS after infection (median additional days=5; $P<0.001$)
- MRSA associated with greater hospital charges (1.19-fold increase in hospital charges, $P=0.03$)

Importance of Timing of Surgical Antimicrobial Prophylaxis (AP)

- Prospective study of 2,847 elective clean and clean-contaminated procedures

- Early AP (2-24 hrs before incision):3.8%
- Postop AP (3-24 hrs after incision):3.3%
- Periop AP (< 3 hrs after incision): 1.4%
- Preop AP (<2 hrs before incision): 0.6%

Classen, 1992 (NEJM 326:281-286)

Surgical Technique

- Removing devitalized tissue
- Maintaining effective hemostasis
- Gently handling tissues
- Eradicating dead space → leaving the tissue increases the risk for hematoma
- Avoiding inadvertent entries into a viscus
- Using drains and suture material appropriately

Parameters for Operating Room Ventilation*

- Temperature: 68°-73°F (20 – 22.7 ° C) depending on normal ambient temp
- Relative humidity: 30%-60%
- Air movement: from "clean to less clean" areas
- Air changes: ≥15 total per hour
  ≥3 outdoor air per hour

*American Institute of Architects, 1996

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