NOSOCOMIAL INFECTIONS

Dr. Ruth Soto
Assistant Professor
Infectious Diseases Division
Department of Medicine
UPR-SCHOOL OF MEDICINE

TOPIC OUTLINE

- EPIDEMIOLOGY OF NOSOCOMIAL INFECTIONS
- NOSOCOMIAL PNEUMONIA
- OVERVIEW OF TREATMENT OF PNEUMONIA IN HOSPITALIZED PATIENT
- BLOODSTREAM INFECTIONS

EPIDEMIOLOGY

- Almost all clinically evident infections that do not originate from patient's original admitting diagnosis.
- Most infections become clinically evident after 48 hours of hospitalization.
- Infections that occur after the patient's discharge from the hospital if the organisms were acquired during the hospital stay.

NOSOCOMIAL INFECTIONS

Consider 4 important factors…

1. The host
2. The microbes
3. The environment
4. Treatment

THE PROBLEM…

- People in hospital are already sick!
- They may have poor general resistance to infection
- Lack of immunity
  - Extremes of age
  - Immunocompromised (eg HIV+, cancer chemotherapy)

THE PROBLEM…

- Reduced immunity
  - Diabetes, severe burns
- Poor local resistance
  - Poor blood supply to tissues
- Surgery
  - Wounds, sutures
- Medical devices
  - Catheters, prostheses, tubing etc

THE PROBLEM…

- There is continuous usage of antibiotics in hospitals especially in ICU
- As a result there will be a natural selection for strains that are antibiotic resistant – infections are getting harder to treat
- This has led to problems with multi-resistant bacteria e.g. MRSA, VRE, ESBLs
- Antibiotic treatment can also lead to alterations in normal flora and allow pathogens cause

ISSUES

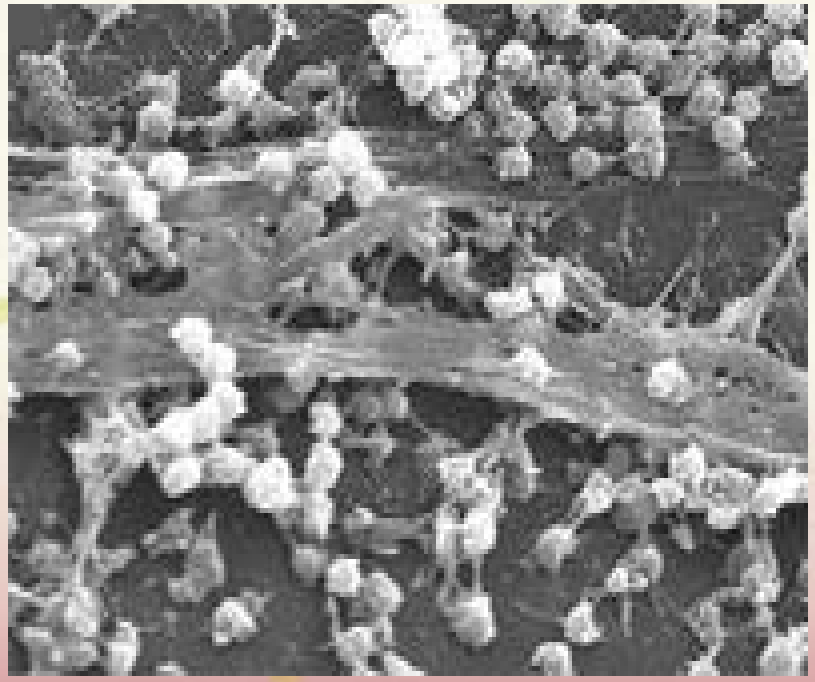
- Nosocomial infections are often caused by **opportunistic pathogens** i.e. those which do not normally cause infection in healthy people
- May be from normal flora or environment
- Antibiotic resistance is a problem

ETIOLOGICAL AGENTS

- *Pseudomonas aeruginosa*
- staphylococci
- *E. coli* and other coliforms
- streptococci and enterococci
- *Bacteroides fragilis*
- *Candida albicans*

ETIOLOGICAL AGENTS

- Biofilms are microbial communities (cities) living attached to a solid support eg catheters/ other medical devices
- Biofilms are involved in up to 60% of nosocomial infections
- Antibiotics are less effective at killing bacteria when part of a biofilm



ETIOLOGICAL AGENTS

- There are many different sources of pathogens when in hospital
  - Own normal flora (endogenous)
  - Infected patients
  - Traffic of staff and visitors
  - Environment *e.g.* fungi, *Legionella*
  - Blood products
  - Surgical instruments eg vCJD

THE ECONOMIAL IMPACT

The overall annual direct medical costs of HAI to U.S. hospitals ranges from $28.4 to $33.8 billion

NOSOCOMIAL PNEUMONIA

- Nosocomial pneumonia is the 2nd most common hospital-acquired infections after UTI. Accounting for 31 % of all nosocomial infections
- Nosocomial pneumonia is the leading cause of death from hospital-acquired infections.
- The incidence of nosocomial pneumonia is highest in ICU.

NP- THE PROBLEM

- The reported crude mortality for HAP is from 30% to greater than 70%.
- The presence of HAP increases hospital stay by an average of 7 to 9 days per patient and has been reported to produce an excess cost of more than $40,000 per patient
- occurs at a rate of between 5 and 10 cases per 1,000 hospital admissions
- The incidence of nosocomial pneumonia in ventilated patients was 6-20**-fold higher** than non-ventilated patients

CLASSIFICATION OF HAP

- HAP-HOSPITAL ACQUIRED PNEUMONIA
- VAP-VENTILATOR ASSOCIATED PNEUMONIA
- HCAP-HEALTH CARE ASSOCIATED PNEUMONIA

HAP

- VAP occurs in 9-27% of all intubated patients
- The risk of VAP is highest early in the course of hospital stay, and is estimated to be 3%/day during the first 5 days of ventilation, 2%/day during Days 5 to 10 of ventilation, and 1%/day after this

HAP

- Early-onset HAP and VAP;
  - occur within the first 4 days of hospitalization
  - carry a better prognosis
  - and are more likely to be caused by antibioticsensitive bacteria
- Late-onset
  - 5 days or more
  - more likely to be caused by multidrug-resistant (MDR) pathogens, and are associated with increased patient mortality and morbidity

MORTALITY OF HAP

Increased mortality rates were associated with:

- Bacteremia
- Pseudomonas aeruginosa or Acinetobacter species
- Medical rather than surgical illness
- Treatment with ineffective antibiotic therapy

HAP

TABLE 2. RISK FACTORS FOR MULTIDRUG-RESISTANT PATHOGENS CAUSING HOSPITAL-ACQUIRED PNEUMONIA, HEALTHCARE-ASSOCIATED PNEUMONIA, AND VENTILATOR-ASSOCIATED PNEUMONIA

- Antimicrobial therapy in preceding 90 d
- Current hospitalization of 5 d or more
- High frequency of antibiotic resistance in the community or in the specific hospital unit
- Presence of risk factors for HCAP:
  - Hospitalization for 2 d or more in the preceding 90 d
  - Residence in a nursing home or extended care facility
  - Home infusion therapy (including antibiotics)
  - Chronic dialysis within 30 d
  - Home wound care
  - Family member with multidrug-resistant pathogen
- Immunosuppressive disease and/or therapy

ETIOLOGY

- aerobic gram-negative bacilli, such as Escherichia coli, P. aeruginosa,, Klebsiella pneumonia, and Acinetobacter species
- Infections due to gram-positive cocci, such as Staphylococcus aureus, particularly methicillin-resistant S. aureus (MRSA) have been rapidly emerging in the United States

HAP ETIOLOGY

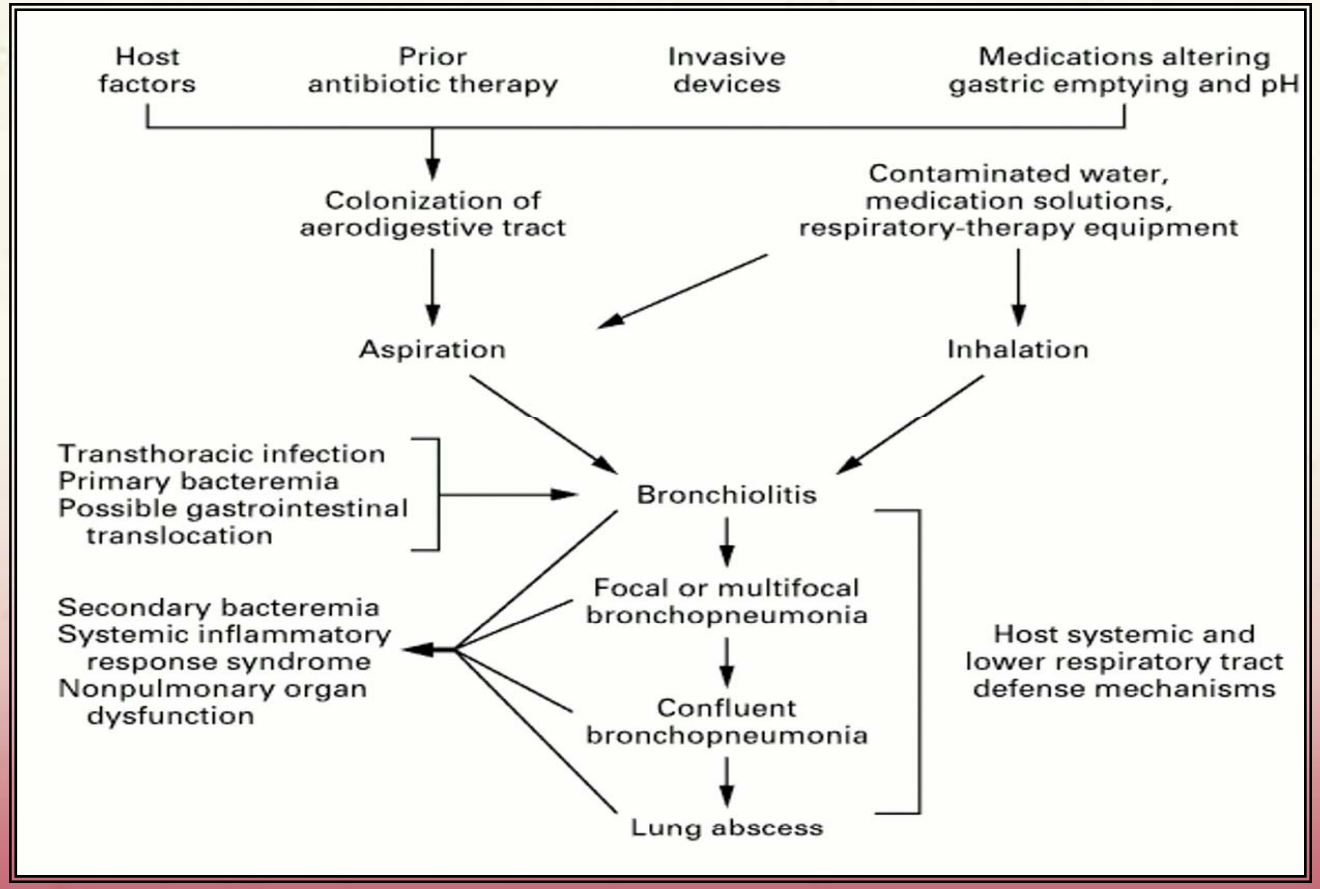
TABLE 4. INITIAL EMPIRIC THERAPY FOR HOSPITAL-ACQUIRED PNEUMONIA, VENTILATOR-ASSOCIATED PNEUMONIA, AND HEALTHCARE-ASSOCIATED PNEUMONIA IN PATIENTS WITH LATE-ONSET DISEASE OR RISK FACTORS FOR MULTIDRUG-RESISTANT PATHOGENS AND ALL DISEASE SEVERITY

Potential Pathogens	Combination Antibiotic Therapy*
Pathogens listed in Table 3 and MDR pathogens *Pseudomonas aeruginosa* *Klebsiella pneumoniae* (ESBL$^+$)† *Acinetobacter* species†	Antipseudomonal cephalosporin (cefepime, ceftazidime) *or* Antipseudomonal carbepenem (imipenem or meropenem) *or* β-Lactam/β-lactamase inhibitor (piperacillin–tazobactam) *plus* Antipseudomonal fluoroquinolone† (ciprofloxacin or levofloxacin) *or* Aminoglycoside (amikacin, gentamicin, or tobramycin) *plus*
Methicillin-resistant *Staphylococcus aureus* (MRSA) *Legionella pneumophila*†	Linezolid or vancomycin†

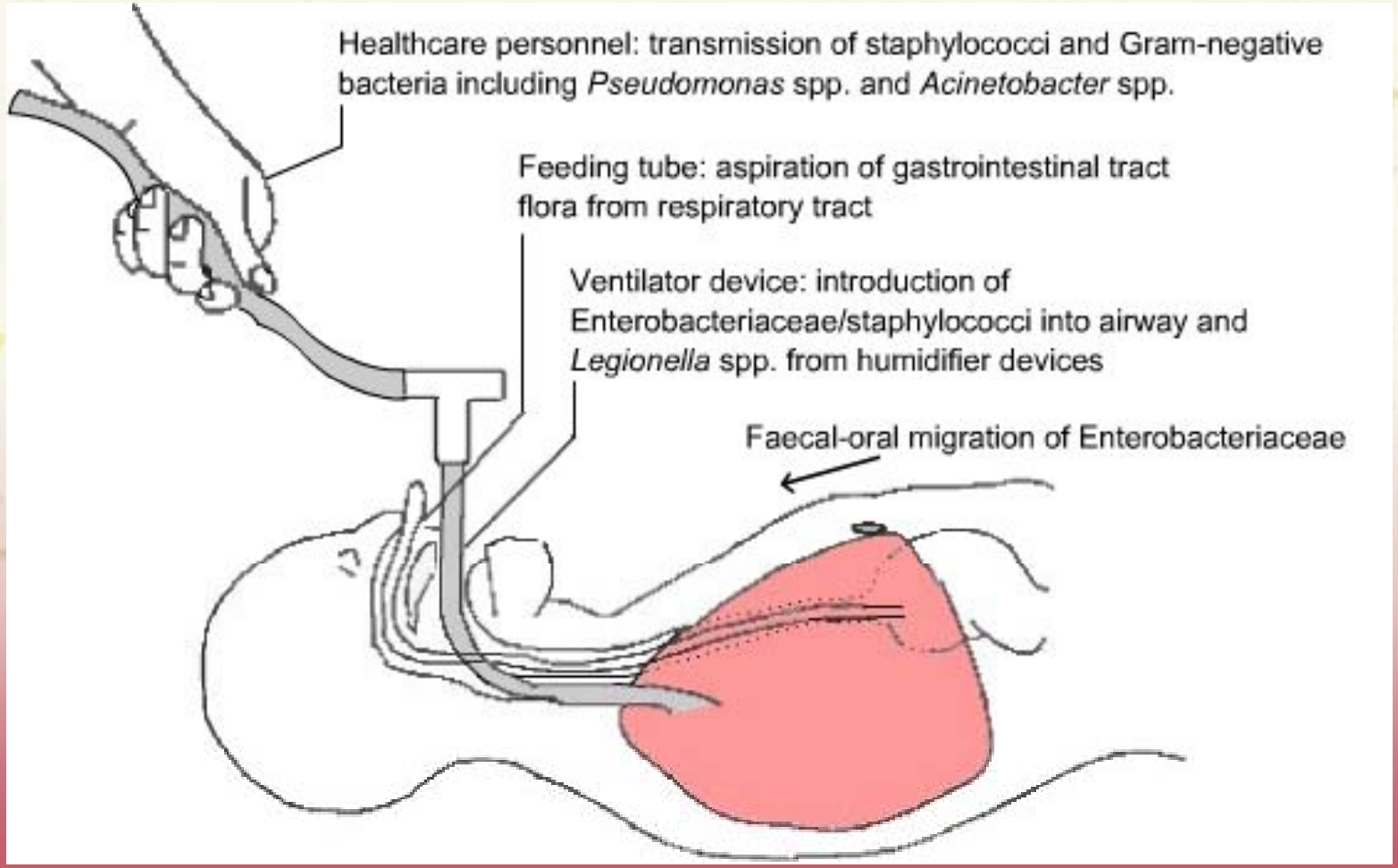
NOSOCOMIAL PNEUMONIA

- For pneumonia to occur, at least one of the following three conditions must occur:
  - Significant impairment of host defenses
  - Introduction of a sufficient-size inoculum to overwhelm the host's lower respiratory tract defenses
  - The introduction of highly virulent organisms into the lower respiratory tract

NOSOCOMIAL PNEUMONIA



VAP


Healthcare personnel: transmission of staphylococci and Gram-negative bacteria including *Pseudomonas* spp. and *Acinetobacter* spp.
Feeding tube: aspiration of gastrointestinal tract flora from respiratory tract
Ventilator device: introduction of Enterobacteriaceae/staphylococci into airway and *Legionella* spp. from humidifier devices
Faecal-oral migration of Enterobacteriaceae

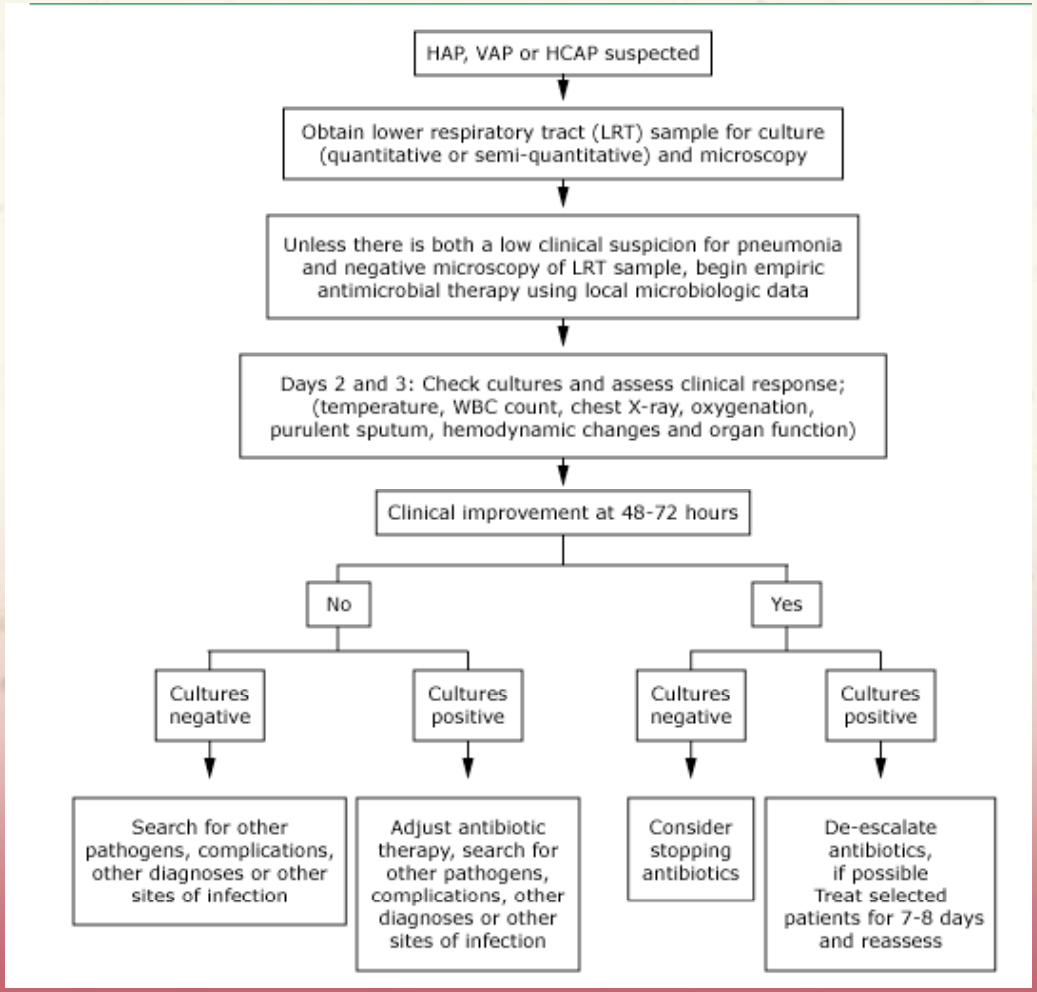
DIAGNOSIS

- new or progressive pulmonary infiltrate with fever, leukocytosis, or purulent tracheobronchial secretions
- Diferential diagnosis:
  - Aspiration pneumonitis (ie, chemical aspiration without infection)
  - Atelectasis
  - Pulmonary embolism

DIFERENTIAL DIAGNOSIS

- Acute respiratory distress syndrome (ARDS) Pulmonary hemorrhage
- Lung contusion
- Infiltrative tumor
- Radiation pneumonitis
- Drug reaction
- Bronchiolitis obliterans organizing pneumonia (BOOP)

DIAGNOSIS



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TREATMENT

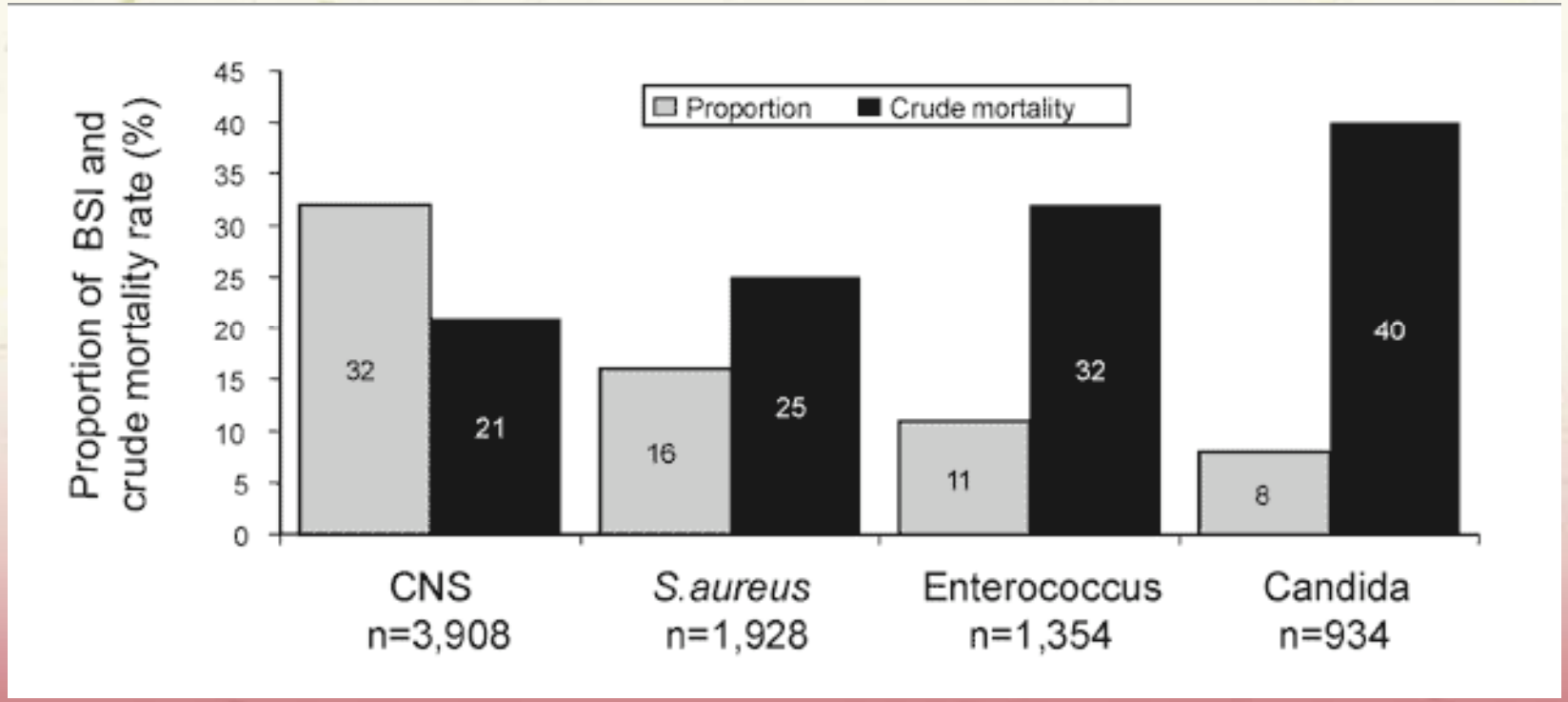
PREVENTION STRATEGIES

- orotracheal route of intubation should be used for intubation
- a new ventilator circuit for each patient
- circuit changes if the circuit becomes soiled or damaged, but no scheduled changes
- change of heat and moisture exchangers every 5 to 7 days or as clinically indicated

PREVENTION

- Closed endotracheal suctioning system changed for each patient as clinically indicated
- Subglottic secretion drainage in patients expected to be mechanically ventilated for more than 72 hours
- Head of bed elevation to 45 degrees (when impossible, as near to 45 degrees as possible should be considered)
- Consider: the use of rotating beds; oral antiseptic rinses.

BLOODSTREAM INFECTIONS



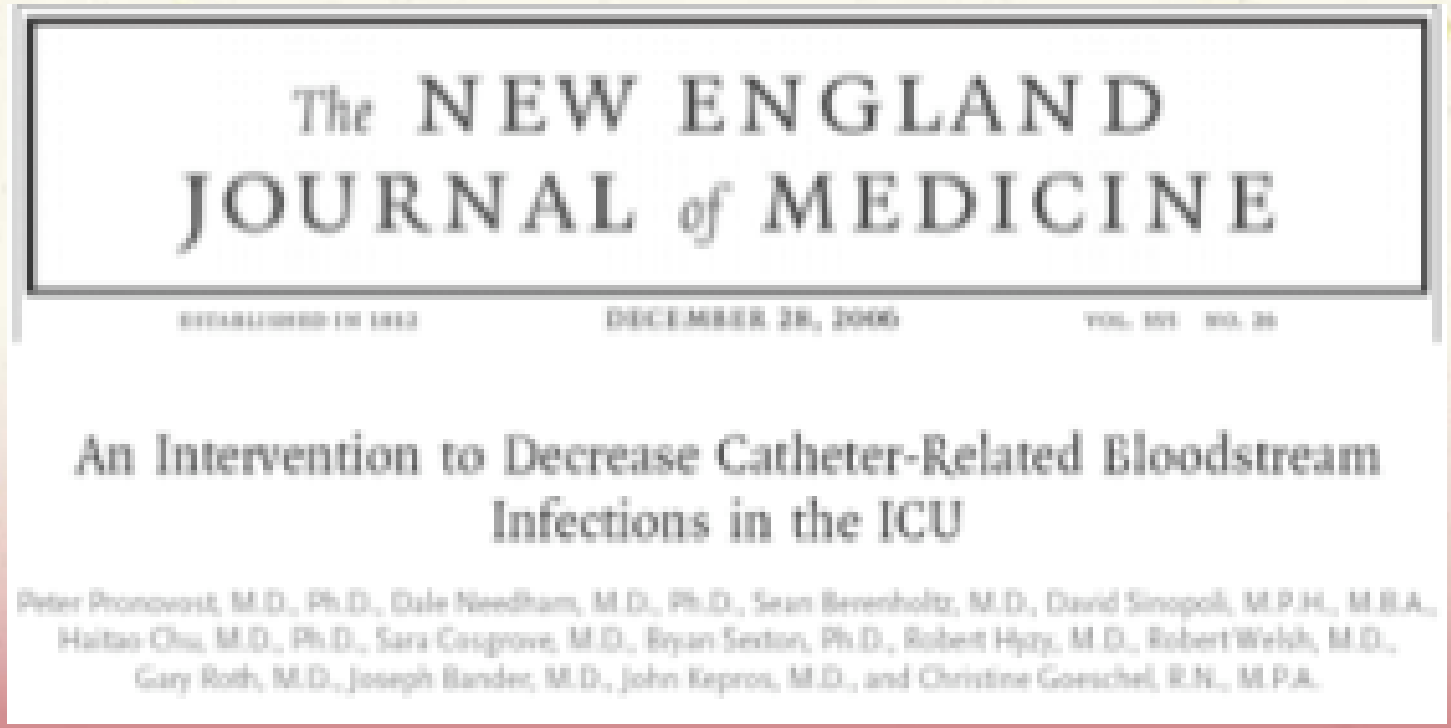
BLOODSTREAM INFECTIONS

- Blood streams infection incidence 5 per 1000pts-days
- It represents about 15% of all nosocomial infections
- Increases the mortality rate
- Prolongs patient stay in an intensive care unit (ICU) and in the hospital
- Generates substantial extra costs

CAUSES OF DEATH

- Primary bloodstream infection
- Pneumonia
- Infection of surgical site

BLOOD STREAM INFECTION



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 DECEMBER 28, 2006 VOL. 355 NO. 26

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., and Christine Goeschel, R.N., M.P.A.

KEYSTONE ICU PROJECT

- All ICUs in Michigan invited to participate 108 ICUs (mostly in Michigan) agreed;
- 103 reported data 18-month study period
- Required at least one physician and one nurse team leader

PREVENTION OF BSI

- Focused on 5 interventions:
  - Hand washing
  - Full barrier precautions during insertion
  - Cleaning the skin with chlorhexidine
  - Avoiding the femoral site, if possible
  - Removing unnecessary catheters

KEYSTONE ICU PROJECT

- Showed continuous and sustained improvement throughout study period Median baseline rate 2.7 infections per 1000 catheter days decreased to 0 infections per 1000 catheter days after implementation
- Mean rate of 7.7 infections per 1000 catheter days decreased to 1.4 per 1000 catheter days at study completion