



Nosocomial outbreaks

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Nosocomial infection

...hospital-acquired infection, health-care associated infection...

- Infection acquired in the hospital due to exposure to the pathogen in the hospital
- Development of infection after 48 hours of hospital admission (CDC)



Burden of nosocomial infections

- Increased morbidity, mortality
 - 10% of in-patients acquire an infection in the hospital
- Increased costs
 - Prolonged hospital stay, additional medical procedures and treatment
- 30% preventable



Health care setting

- Devices: endoscope, catheter, ventilator..
- Medical procedures: surgery..
- Medical personnel: doctors, nurses..
- Patient: immunocompromised, susceptible
- Dangerous residents: MRSA, VRSA, VRE, ESBL*, *C. difficile* ribotype 027

*methicillin-/vancomycin-resistant *S.aureus*; vancomycin-resistant *Enterococcus*; extended spectrum beta-lactamases



Patients at risk

- Immunocompromised patient
 - Malignancy, immunosuppressive treatment, HIV infection
- Other factors
 - Severe underlying disease, age, obesity
- Intensive care units
 - Medical, surgical, neonatal, burn units



Antimicrobial resistance

1945 – Penicillin

1948 – Penicillin-resistant *S.aureus*

1959 – Methicillin

1961 – Methicillin-resistant *S.aureus*

1998 – Vancomycin-resistant *S.aureus*

- Use, overuse and wrong use of antibiotics
- Knowledge → Attitude → Behaviour



What can be worse than a nosocomial infection?

A Nosocomial Outbreak!!!

An unusual increase in the number of nosocomial infections (time, place, person)

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History of nosocomial outbreaks

- First well-documented outbreak
 - Puerperal (child-bed) fever in a hospital in Vienna, 1847
 - Ignác Semmelweis, Hungarian physician gathered and analysed mortality data
 - Autopsy room → Maternity wards
 - Handwashing intervention (chlorine solution)
- Modern epidemiology
 - *S. aureus* hospital outbreaks worldwide, 1950s
 - CDC projects from 1970s
 - Intensive research from 1990s





1847





2006



Nosocomial outbreaks - examples

- Unusual transmission
 - *ESBL Klebsiella pneumoniae*
 - Maternity wards, contaminated ultrasonography gel (France, 1993)
- Rare pathogen
 - *Malassezia pachydermatis*
 - Neonatal ICU, associated with colonization of health care workers' pet dogs (US, 1995)
- Emergence of more virulent strain
 - *C. difficile* ribotype 027
 - Increased severity of diarrhoea, recent outbreaks in US, Canada, Netherlands, England



Nosocomial outbreak database

- Database providing information to facilitate interventions
- A learning tool
 - What kind of data to collect? Control selection?
- Search by pathogen, ward type etc.
- Osaka University, Japan
- <http://health-db.net/infection/top1.htm>



Infection Outbreak Database

- About this Project
- Field definition
- Database search**
- List of reference

display by
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 table

Search keyword

Pathogens
Vancomycin-R Enteroco. VRE

Infection Sites
bacteremia

Type of Investigation
case report

Mode of Transmission
airborne

Ward/Service
Bone Marrow Transplant

Search reset

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[BACK](#) [NEXT](#)

[Details of this paper\(with Results and Discussion\)](#) [Print All the search results](#)

Author: Quale J, Landman D, Atwood E, Kreiswirth B, Willey BM, Ditore V, Zaman M, Patel K, Saurina G, Huang W, Oydna E, Burney S.
Title: Experience with a hospital-wide outbreak of vancomycin-resistant enterococci
Journal: [Am-J-Infect-Control. 1996 Oct; 24\(5\): 372-9](#)
year: 1996
Pathogen: VRE, enterococci, vancomycin-resistant
Duration: 5 years
Dates: 1991-1994
Country: U.S.A., New York City
No. of Beds:
Hospital: Veterans Affairs Medical Center at Brookly, tertiary-care, university-affiliated
Type of Investigation: microbiological: retrospective review of microbiological record
Mode of Transmission: contaminated environment?
Infection Sites: respiratory culture (27), urine (63), wound (31), blood (26)

Characteristics of nosocomial outbreaks

- Location
- Type of infection
- Pathogens
- Source
- Mode of transmission
- Preventive/control measures

Gastmeier et al. How Outbreaks Can Contribute to Prevention of Nosocomial Infections: Analysis of 1022 Outbreaks. Infection Control and Hospital Epidemiology; 2005 26(4);357-361



Location

- Hospital – 83%
 - 50% in intensive care units
- Outpatient care – 12%
- Nursing home – 5%

Special problems:

- Hospital staff with part-time job in nursing homes (transmissing pathogens in both ways)
- Nursing home: no infection control personnel, underreporting of outbreaks, gastroenteritis, scabies



Type of infections

- Bloodstream – 37%
- Gastrointestinal* – 29%
- Pneumonia – 23%
- Urinary tract – 14%
- Surgical site – 12%
- Other lower respiratory – 10%
- Central nervous system – 8%
- Skin and soft tissue – 7%

*Probable underreporting



Most frequently reported pathogens*

Nosocomial infections

- *Staphylococcus aureus*
- Enterococci
- *E. coli*
- *Pseudomonas aeruginosa*
- Streptococci
- *Enterobacter* spp.

Nosocomial outbreaks

- *Staphylococcus aureus*
- *Pseudomonas aeruginosa*
- *Klebsiella pneumoniae*
- *Serratia marcescens*
- Hepatitis B, C virus
- *Legionella pneumophila*

*Probable underreporting: *Salmonella* spp., *Campylobacter* spp., norovirus, rotavirus, respiratory viral infections



Source of outbreak

- Patient – 26%
- Medical equipment / device – 12%
- Environment – 12%
- Medical personnel – 11%
- Contaminated drug – 4%
- Contaminated food – 3%
- Care equipment – 3%
- Unclear source – 37%



Mode of transmission

- Contact – 45%
- Invasive technique – 16%
- Inhalation – 15%
(droplet, airborne)
- Ingestion – 4%
- Unclear mode of transmission – 28%



Managing hospital outbreaks

- Patient, health personnel screening, surveillance
- Isolation, cohorting
- Handwashing, hand disinfection
- Sterilisation, disinfection
- (Change) antibiotic therapy
- Modification of care / equipment
- Protective clothing
- Restriction of work load
- Vaccination



Nosocomial Pneumonia

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SHORT VIEW SUMMARY

Diagnosis

- Classic clinical signs for ventilator-assisted pneumonia (VAP) include fever, leukocytosis, purulent secretions, worsening oxygenation, infiltrates, and pathogenic cultures. These signs are neither sensitive nor specific. Paucity of neutrophils or lack of organisms on Gram stain make VAP unlikely, but their presence is not specific. Stable oxygenation/ventilator settings argue against clinically significant disease.
- Quantitative bronchoalveolar lavage (BAL) cultures are 51% sensitive, are 77% specific, and have a positive predictive value of 67% for histologically confirmed VAP.
- Randomized controlled trials of quantitative BAL cultures versus endotracheal aspirates for diagnosis have found no difference in duration of mechanical ventilation, length of stay, mortality, superinfection, or acquired resistance rates. Endotracheal aspirates are therefore preferred.
- Obtain diagnostic studies to guide therapy: blood and endotracheal aspirate cultures, urine pneumococcal and legionella antigens, ± viral studies.

Microbiology

- Most common pathogens: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella* sp., and *Acinetobacter* sp. Drug resistance is common: 50% of *S. aureus* isolates are methicillin-resistant, 25% to 30% of *Pseudomonas* and *Klebsiella* isolates are ceftazidime and cefepime resistant, and 60% of *Acinetobacter* isolates are carbapenem resistant.
- Risk factors for methicillin-resistant *S. aureus* (MRSA) and multidrug-resistant gram-negative pathogens include recent broad-spectrum antibiotics, prolonged hospitalization, poor functional status, hemodialysis, and severe illness.

Treatment

- Initiate broad-spectrum antibiotics as soon as pneumonia is suspected. Use vancomycin or linezolid plus two antipseudomonal agents for empiric therapy. Consider a loading dose of vancomycin 25 to 30 mg/kg for seriously ill patients. Include anaerobic coverage if there is frank aspiration.
- Reassess the likelihood of pneumonia daily; if the diagnosis no longer seems likely, then stop antibiotics.
- Narrow treatment as soon as susceptibilities are available. Avoid double coverage. If cultures are negative and the patient is improving, trim or stop antibiotics.
- Vancomycin and linezolid are similarly effective for MRSA. Dose vancomycin 15 to 20 mg/kg every 8 to 12 hours. The goal trough is 15 to 20 mg/L. There is an increased risk of clinical failure if the vancomycin minimal inhibitory concentration is greater than 1 mg/L.

Prevention

- VAP rates are subjective and nonspecific. Therefore, preferentially select interventions proven to improve concrete outcomes.
- Noninvasive positive pressure ventilation, continuous aspiration of subglottic secretions, and ventilator-weaning protocols (especially paired daily spontaneous awakening and breathing trials) shorten the average duration of mechanical ventilation.
- Digestive decontamination decreases mortality, but there are ongoing concerns about the potential impact on antibiotic resistance rates, especially in units with high baseline resistance rates.
- Treat 7 to 8 days, but shorter for patients with rapid clinical improvement and longer for patients who are slow to improve or who have complications such as bacteremia, abscess, or empyema. Daily procalcitonin monitoring can safely shorten the duration of antibiotics.
- Adjunctive aerosolized antibiotics in addition to intravenous therapy enhance clearance of pulmonary cultures but have no impact on clinical cure rates or patient outcomes. Vibrating mesh plate is preferred for delivery. Aerosolization may be as effective as intravenous drug delivery, but nephrotoxicity is equally likely. Data are sparse.

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Nosocomial UTI

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Definition

- Nosocomial urinary tract infection (UTI) refers to UTI acquired in any institutional setting providing health care.
- Catheter-associated (CA)-bacteriuria is composed mostly of CA-asymptomatic bacteriuria (CA-ASB).
- CA-ASB should be distinguished from CA-UTI because treatment is usually indicated only for the latter.
- Significant bacteriuria: $\geq 10^7$ CFU/mL in a symptomatic person is an indicator of CA-UTI, whereas $\geq 10^5$ CFU/mL in an asymptomatic person is an indicator of CA-ASB.

Epidemiology

- Nosocomial UTIs, 97% of which are catheter associated, account for up to 40% of nosocomial infections in U.S. hospitals each year.
- Approximately 15% to 25% of patients in general hospitals have a catheter inserted at some time during their stay.
- About 5% to 10% of long-term care facility residents are managed with urethral catheterization.
- The incidence of bacteriuria associated with indwelling urethral catheterization with a closed drainage system is approximately 3% to 8% per day.

- The duration of catheterization is the most important risk factor for CA-bacteriuria.
- CA-bacteriuria comprises a large reservoir of antibiotic-resistant organisms and is a frequent target for inappropriate antimicrobial therapy.

Microbiology

- A broad range of bacteria can cause nosocomial UTI, and many are resistant to multiple antimicrobial agents. CA-bacteriuria is caused by a broad range of bacteria, including *Escherichia coli*, other Enterobacteriaceae, nonfermenters such as *Pseudomonas aeruginosa*, and gram-positive cocci, including coagulase-negative staphylococci and *Enterococcus* spp.
- Funguria, mostly candiduria, is reported in 3% to 32% of catheterized patients.

Diagnosis

- The majority of patients with CA-bacteriuria are asymptomatic, and signs and symptoms commonly associated with UTI, such as fever, dysuria, urgency, flank pain, or leukocytosis, are nonspecific.
- In the catheterized patient, pyuria does not differentiate CA-ASB from CA-UTI, but its absence suggests that CA-UTI is not the cause of symptoms.

Therapy (see Table 304-7)

- Screening and treatment of ASB are not recommended except in pregnant women and some patients who undergo genitourinary surgery.
- Urine cultures should be obtained before treatment of nosocomial UTI.
- Recommended treatment duration for CA-UTI ranges from 7 to 21 days, depending on the severity.
- Asymptomatic nosocomial candiduria rarely requires treatment.

Prevention

- Reducing exposure to urinary catheterization is the most effective way to prevent CA-bacteriuria.
- Indwelling urethral catheterization places the patient at greater risk for CA-bacteriuria than condom or intermittent catheterization.
- A closed catheter drainage system is indicated in all catheterized patients.
- Routine use of antimicrobial-coated urinary catheters is not supported by available data.
- Routine use of systemic antimicrobial agents to prevent CA-bacteriuria should be discouraged.
- Use of multiple infection control techniques and strategies simultaneously (*bundling*) is recommended to prevent CA-bacteriuria.

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Detection of nosocomial outbreaks

- Alert from an effective surveillance system
- Alert from – the physician
 - the nurse
 - the hospital microbiologist
 - the hospital epidemiologist

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Nosocomial transmission?

- Similar cases at one department / among similar patients
- Cases associated with invasive device
- Health personnel and patients with same infection
- Nosocomial pathogen



Problems with detecting outbreaks

- No detection
 - 2-3 patients with pneumonia in intensive care unit
- Detection → No investigation
 - Nursing homes
- Detection → Investigation → No reporting
 - If sanctions against reporting doctors, nurses
- False detection: pseudo-epidemics (artefacts)
 - E.g. consequent laboratory contamination
 - May lead to unnecessary antibiotic treatment



Summary

- Detection
 - Effective surveillance system, vigilant hospital personnel
- Investigation
 - Skilled hospital infection control practitioner, epidemiologist, microbiologist
- Prevention / Control
 - Appropriate infection control practices
 - Strategies to prevent and control antimicrobial-resistant pathogens (antibiotic-plan)



The ultimate goal: patient safety

