Screening, masks and isolation precautions: when and for what microorganisms?

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Prologue (1)
• Did you ever save the life of a patient?
• Do you still know his/her name?

Prologue (2)
Contrary to curative, especially heroic medicine, in infection prevention the "saved patient" remains anonymous.

Transmission of nosocomial infections

The 3 major routes of transmission of infectious pathogens

<table>
<thead>
<tr>
<th>Route</th>
<th>Infectious unit</th>
<th>Principle</th>
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<td>Staphylococcus aureus, Group A Streptococci, Clostridium difficile, Multidrug-resistant microorganisms (ESBL, MRSA, VRE etc)</td>
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Transmission of nosocomial infections

**Droplet Transmission**
- Host defenses
- Nosocomial flora

**Airborne Transmission**
- Host defenses
- Nosocomial flora

**Common Vehicle Transmission**
- Host defenses
- Nosocomial flora

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**The 3 major routes of transmission of infectious pathogens**

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<td>Droplet</td>
<td>Respiratory droplets &gt; 5 µm</td>
<td>Droplets are deposited on mucous membranes; close contact ≤1m for transmission</td>
<td>Neisseria meningitidis, Influenza virus</td>
</tr>
<tr>
<td>Airborne</td>
<td>Droplet nuclei ≤5 µm or contaminated dust particles</td>
<td>Inhalation of droplet nuclei; remain suspended in the air for long periods; migrate long distances</td>
<td>Mycobacterium tuberculosis, Varicella zoster virus</td>
</tr>
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**Strategies for infection control**

**Antibiotic control**
- Restriction of use, guidelines, rotation

**Specific measures**
- Specifically targeted against VAP
- Specifically targeted against SSI
- Specifically targeted against BSI
Evidence-based practice to reduce CVC-related infections

Number of recommendations by category
- Category 1A: 31
- Category 1B: 31
- Category 1C: 4
- Category 2: 28
- Unresolved issues: 4

2009 CDC guideline draft for prevention of CVC-related BSI

Basic hygiene measures

Hand hygiene
- After contact with blood, body fluids, secretions, excretions, contaminated items immediately before gloving and after removing gloves between patient contacts – between dirty and clean body site care
- For anticipated contact with mucous membranes, non-intact skin

Gloves
- For anticipated contact with mucous membranes, non-intact skin

Mask, eye protection, face shield
- To protect mucous membranes of the eyes, nose and mouth during procedures and patient-care activities likely to generate splashes or spray of blood, body fluids, secretions and excretions

Gowns
- To protect skin and prevent soiling of clothing during procedures and patient-care activities likely to generate splashes or spray of blood, body fluids, secretions and excretions

Patient-care equipment handling
- To ensure that skin, mucous-membranes and clothing are not exposed to equipment soiled with any body fluids
- To ensure that reusable equipment is not reused until it has been appropriately reprocessed
- To ensure that single-use items are discarded properly

Sharp object handling
- Avoid recapping used needles
- Place used sharp objects and needles in puncture-resistant containers


Standard precautions – BASIC MEASURES

Component
- Hand hygiene
- Gloves
- Mask, eye protection, face shield
- Gowns
- Patient-care equipment handling
- Sharp object handling

Field of application
- After contact with blood, body fluids, secretions, excretions, contaminated items immediately before gloving and after removing gloves between patient contacts – between dirty and clean body site care
- For anticipated contact with mucous membranes, non-intact skin
- To protect mucous membranes of the eyes, nose and mouth during procedures and patient-care activities likely to generate splashes or spray of blood, body fluids, secretions and excretions
- To protect skin and prevent soiling of clothing during procedures and patient-care activities likely to generate splashes or spray of blood, body fluids, secretions and excretions
- To ensure that skin, mucous-membranes and clothing are not exposed to equipment soiled with any body fluids
- To ensure that reusable equipment is not reused until it has been appropriately reprocessed
- Avoid recapping used needles

Transmission of Panton-Valentine Leukocidin-Producing Staphylococcus aureus to a Physician during Resuscitation of a Child

Martin Chalamet, Philippe Bidet, Gérard Lina, Mostapha Mokhtari, Marie-Claude André, Dominique Gendre, Édouard Bingen, and Josette Raymond

Clinical Infectious Diseases 2005;41:29-30
Basic hygiene measures

Transmission-based precautions

Exceptions

Influenza

ESBL

Standard precautions

daily work

Transmission-based precautions

CONTACT

<1m.

glove

gown

single room

or cohorting

Transmission-based precautions

DROPLET

- mask when <1meter

- for every patient transfer

single room

or cohorting

Efficacy repeatedly reported

Extended spectrum betalactamase-producing bacteria

J Infect 2003;47:273-95 (review)

Vancomycin-resistant enterococci

Kouffman CA JAC 2003; 51:S23-30 (review)

Methicillin-resistant Staphylococcus aureus

Muto CA et al. ICHE 2003;24:362-86 (review)

Severe Acute Respiratory Syndrome


Park BJ Emerg Infect Dis 2004; 10:244-8


Extended spectrum betalactamase-producing bacteria

J Infect 2003;47:273-95 (review)

Systemic syndromes

Neisseria meningitidis sepsis

Haemophilus influenzae meningitis

Carriage & RTI caused by MDRO

Respiratory infections

Haemophilus influenzae, pneumonia, epiglottitis

Group A streptococci, pharyngitis

Mycoplasma pneumoniae

Pertussis

Serious viral infections

Adenovirus

Influenza

Mumps

Parvovirus B19

Rubella

Transmission-based precautions - DROPLET PRECAUTIONS

Apply for patients known or suspected to have diseases transmitted by large droplets

J.D., 60 ans, BPCO sévère, état fébrile sous CoAmoxiClav depuis 4 semaines suite à une pneumonie à pneumocoques. Dyspnée stade IV, hypoxémique, hypercapnie, toux, expectorations. Hémocultures positives.
Transmission-based precautions - AIRBORNE PRECAUTIONS

| Respiratory infections | Measles | Varicella and disseminated zoster | Tuberculosis, pulmonary and laryngeal |

Transmission-based precautions - PROTECTION

- Mask
- Gown
- Single room mandatory
- High-filtration mask for every transfer
- Special track for garbage (terminal cleansing)
- BE CAREFUL with dust generating activities

Requirements for personal barrier equipment

<table>
<thead>
<tr>
<th>Activity</th>
<th>Gloves</th>
<th>Gown</th>
<th>Mask</th>
<th>Eye protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated contact with any body fluid</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Contact with mucous membrane or non-intact skin</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>During all patient-care activities likely to generate splash or spray of any body fluid</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Protection against contact-transmitted pathogens</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Protection against droplet-transmitted pathogens</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Protection against airborne-transmitted pathogens</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

1. Blood, bloody or non-bloody body fluid, excretions and secretions, except sweat
2. Surgical mask
3. High-efficiency particulate air (HEPA) respiratory systems, N95 standard mask
... and what about screening for MDR microorganisms?

« Ever give a talk on MDRO screening? »

STOP

STOP admission screening and preemptive isolation

Patient X, transferred from Lybia...
... can kill patient Y (next bed)

Spread of KPC-containing *Klebsiella pneumoniae* from Greece - Travelling

Epidemiology and Genetics of ESBL-containing Bacteria

Reservoirs – colonized and infected patients, biofilms (esp. g-tubes), environmental sites (esp. urinals)

Modes of Transmission

- Plasmid spread among bacteria
- Bacterial spread among patients

Risk Factors – debility, nursing home residence, decubitus ulcers, g-tubes, urinary catheters, antibiotics (β-lactam, ceph, FQ), lapses in hand and environmental hygiene

Genetics – ESBLs can be generated by a single amino acid mutation in a variety of common beta-lactamases
UMMC ESBL

• Among patients who acquired a ESBL *Klebsiella pneumoniae*, 78% were similar in PFGE type and had overlapping hospital length of stay.

• Among patients who acquired a ESBL *E. coli*, 39% were similar in PFGE type and had overlapping hospital length of stay.


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**Reasons for ESBL epidemic**

- Human migration
- Food chain
- Cross transmission
- Antibiotic overuse

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**Screening for resistance**

- Rate of laboratories that detect ESBL correctly:
  - 42% of ICARE laboratories
  - 51% of NISS laboratories
  - 2% of WHO laboratories
  - 85% of EARSS laboratories
  - 40% of SARI laboratories

Steward CD et al. DMID 2000;38:59
Hageman JC et al. ICHE 2003;24:356
Tenover et al. JCM 2001;39:241
Steward et al. JCM 2001;39:2864
Meyer et al. Infection 2003;31:208

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**Sensitivity of ESBL screening**

- Rectal Screening:
  - Of 28 ESBL-carriers 11 were identified by rectal screening (39,3%)
  - No good data available
  - Sensitivity of different screening sites
  - Comparison stool/rectal swabs
  - Frequency of swabbing

Thouerez et al. ICHE 2004;25:838-41

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**Screening programs in endemic settings**

- Screening and isolation of ESBL positive patients
  - patient to patient transmissions 4.7% of cases

Kola A et al. JHI 2007

- Screening for 3rd gen. cephalosporin resistant Enterobacteriaceae once weekly without isolation
  - patient to patient transmissions 6.8% of adult cases and 12.8% of paediatric cases

von Baum et al. CMI 2004;10:436

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Source: European Antimicrobial Resistance Surveillance System (EARSS), 2009

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*Third-generation cephalosporin-resistant* *Escherichia coli*, blood and CSF, 2008

Country with:

- Significant increase (2005-2008)
- Significant decrease (2005-2008)

Sensitivity of different screening sites:

- Comparison stool/rectal swabs

Frequency of swabbing:

- Patient to patient transmissions 4.7% of cases

Kola A et al. JHI 2007

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Source: European Antimicrobial Resistance Surveillance System (EARSS), 2009
• Situation 2006:
  • Low nosocomial ESBL-E transmission rate
  • High prevalence of ESBL-E carriage among patients from regions with endemic rates or previously identified carriers
  • On-admission screening should be considered for high-risk populations

Bilan du dépistage BLSE réalisé au SMIG pour toute admission entre le 15.03.10 et le 11.06.10

1623 admissions:
- 1111 frottis anaux dont 51 nouveaux cas BLSE
  → portage BLSE à l’admission: 4.6%
  → acquisition BLSE à la sortie: 5.5%

Risk factor analysis:
- We were unable to develop a risk profile with sufficient accuracy to predict previously unknown carriage of ESBL
- Diabetes mellitus, connective tissue disease and liver failure as independent risk factors for ESBL-E carriage upon admission (area under the ROC curve, 0.68)
- Missing info: Transmission in the community? Travel history? Outpatient antibiotics? Food?

Limitations of both studies JAMA vs. Ann Intern Med

- No conventional cultures to confirm positive results of the molecular tests
- No random assignment of individual wards to the study arms
- No discharge screening for MRSA

MRSA screening

Table: MRSA Screening Comparison

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Aim</td>
<td>Evaluate the efficacy of universal rapid MRSA screening</td>
<td>Examine the effect of screening &amp; decolonization on MRSA rates</td>
</tr>
<tr>
<td>Country</td>
<td>Switzerland</td>
<td>USA</td>
</tr>
<tr>
<td>Setting</td>
<td>Surgery</td>
<td>Hospital-wide</td>
</tr>
<tr>
<td>Design</td>
<td>Cross-over</td>
<td>Before-after</td>
</tr>
<tr>
<td>Control group</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Rapid test</td>
<td>Yes (homemade)</td>
<td>Yes (commercial)</td>
</tr>
<tr>
<td>Decolonization</td>
<td>Yes</td>
<td>Partial</td>
</tr>
<tr>
<td>Total study period</td>
<td>24 months</td>
<td>45 months</td>
</tr>
<tr>
<td>Admission MRSA prevalence</td>
<td>5.1%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Baseline MRSA infection rate</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Hand hygiene compliance</td>
<td>Excellent</td>
<td>Unknown</td>
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<tr>
<td>Conclusion</td>
<td>Rapid MRSA screening did not reduce nosocomial MRSA infections</td>
<td>Universal admission screening reduced MRSA disease</td>
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**Aim**
Evaluate the efficacy of universal rapid MRSA screening

**Country**
Switzerland

**Setting**
Surgery

**Design**
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24 months

**Admission MRSA prevalence**
5.1%

**Baseline MRSA infection rates**
Medium

**Hand hygiene compliance**
Excellent

**Conclusion**
Rapid MRSA screening did not reduce nosocomial MRSA infections

**Author, Journal, Year**
Harbarth, JAMA 2008

**Results of the STAR*ICU Trial**

**Strategies to Reduce Transmission of Antimicrobial Resistant Bacteria in Adult Intensive Care Units**

W. Charles Huskins, MD, MSc
Mayo Clinic College of Medicine, Rochester, MN

**Conducted by the Bacteriology and Mycology Study Group (BAMSG)**
19 US academic medical centers

**Results**

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<th>Strategy</th>
<th>MRSA or VRE</th>
<th>MRSA</th>
<th>VRE</th>
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<tr>
<td>Standard control</td>
<td>p = 0.35</td>
<td>p = 0.59</td>
<td>p = 0.53</td>
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<tr>
<td>Intensive control</td>
<td>p = 0.35</td>
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**Incidence Density of New Colonization / Infection Events in Intensive vs. Standard Control Strategy ICUs**

- Compared with culture screening, use of rapid screening tests was not associated with a significant decrease in MRSA acquisition rate (RR 0.87, 95% CI 0.61–1.24).

**Tacconelli E et al. Lancet Infect Dis 2009; 9: 546-54**
**Possible reasons for failure**

- Central laboratory facility
  - No rapid testing available
- High rates of acquisition in both arms
- No intensive search & destroy
  - No uniform decontamination approach
  - No environmental control
  - No HCW screening
- Universal gloving policy

**Possible explanations**

**Conclusions**

- Promote hand hygiene compliance
- Use barrier precautions (gloves & gowns, hand antiseptics) for caring of colonized patients, especially with ESBL-producing *Klebsiella* spp
- Prevent outbreaks arising from transfer of patients to other units, hospitals
- Screen high-risk patients
- Educate health care staff on importance of control of ESBLs
- Outbreaks: group together patients with ESBL-producing organisms in cohorts

**IC questions for speakers**

- What are the most appropriate infection control measures to be applied for hospitalised patients with ESBL colonisation or infection?
- What strategies should be applied to improve hand hygiene compliance in hospitals with high rate of MDR microorganisms?

**Message for the Quinolone-Fans...**

*Leave the Queen Alone!*

**Merci!**