

VUmc VU University Medical Center Amsterdam

Preventing spread of nosocomial infections: isolation practices and additional precautions

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### Overview

- Why isolation precautions?
- Types of isolation precautions
- When to apply extra precautions
  - Examples



Middle Ages – Hotel Dieu in Paris



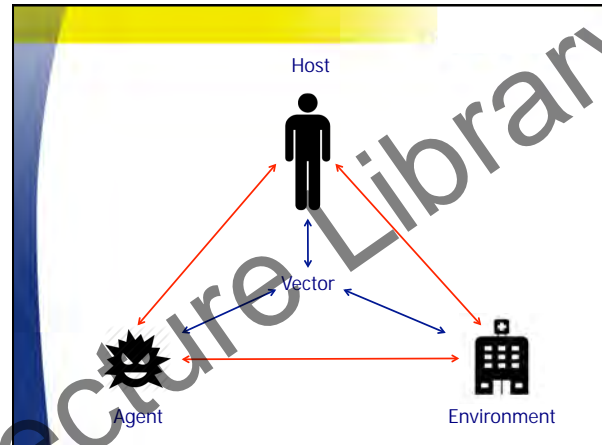
2016 – New Hospital in Stockholm

### Why isolation precautions

- Hospitals:
  - bring together sick people for diagnosis and treatment → efficient, necessity
  - drawback: many people together in confined environment (crowding) promotes spread of infections
- Crowding of sick people = crowding of people more vulnerable to infection

### Why isolation precautions

- Infectious = contagious = spreading or capable of spreading to others
- Infectious diseases can be transmitted from one person to another
- How transmission occurs and infection develops depends on several factors



### Host-Agent-Environment

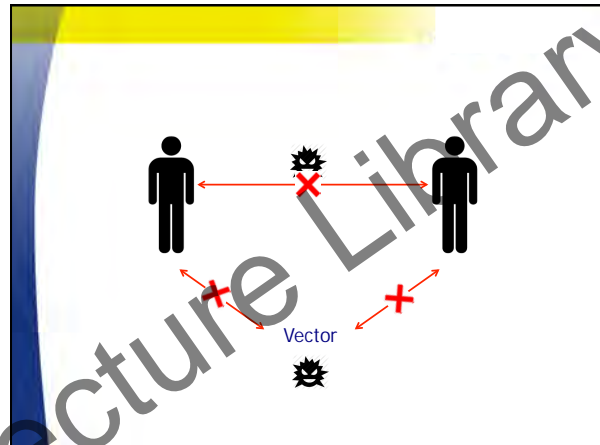
- Host:
  - age
  - genetic predisposition
  - nutritional status
  - medical conditions
  - immunosuppression
  - treatment with antimicrobial agents
  - behaviour
  - ...

### Host-Agent-Environment

- Agent:
  - ability to survive in the environment
  - ability to attach, invade, multiply in the host
  - mode of transmission
  - duration of infectivity
  - resistance to antimicrobial agents
  - ...

### Host-Agent-Environment

- Environment:
  - immunity of immediate contacts
  - incidence of infection in contacts
  - human population density
  - movement and mixing
  - vector or reservoir density
  - resistance to interventions in vector/reservoir
  - climate and environmental change
  - antibiotics in the environment
  - sanitation ...



### Possible interventions in hospitals

- Host:
  - Immunization of health-care workers
  - Post-exposure prophylaxis
- Agent:
  - rapid recognition of communicable diseases
  - interrupt transmission by isolation precautions
- Environment:
  - disinfection/sterilization of medical devices

### Transmission routes

- Contact
  - Direct: person-to-person
  - Indirect: person-to-object-to-person
- Droplet (< 1 m)
- Airborne (> 1 m)
- Common vehicle: medical devices, food, water

### Precautions to prevent transmission

- Two major sets of precautions
  - Standard precautions
  - Transmission-based precautions

### Precautions to prevent transmission

- Standard precautions:
  - to be used **always!**
- Transmission-based precautions:
  - for patients known or suspected to be infected or colonized with specific infectious agents

### Standard Precautions

- To be used **ALWAYS!**
- **THE** most important strategy to prevent transmission of microorganisms among patients and healthcare personnel
- Why **ALWAYS?** Because it is impossible to differentiate between patients who could be a source of infection and patients who are not

### Standard Precautions

- Hand hygiene**
- Personal protective equipment**
- Safe injection precautions**

**Personal protective equipment**


**Gloves**

- Non-sterile gloves: when it is likely that you may come in contact with blood, secretions or excretions, mucous membranes, broken skin
- Sterile gloves: surgery, insertion of sterile medical devices (e.g. IV-lines)
- Only during patient-related care
- Change between patients
- Disinfect hands after removing gloves

**Personal protective equipment**

**Gowns**


- During procedures that are likely to cause splashes of blood, secretions or excretions
- Wear properly closed
- Remove when soiled
- Change between patients
- Hand hygiene after removal!



**Personal protective equipment**

**Masks, Eye Protection, Face Shields**

- During procedures that are likely to cause splashes or sprays of blood, secretions or excretions




**Safe injection precautions**



- One needle
- One syringe
- One time

### Transmission-based precautions: based on transmission routes



- Contact
  - Direct: person-to-person
  - Indirect: person-to-object-to-person
- Droplet (< 1 m)
- Airborne (> 1 m)
- Common vehicle: medical devices, food, water



### Contact precautions:

- For epidemiologically important microorganisms that can be transmitted by:
  - Direct contact: skin-to-skin or patient's skin to staff clothing
  - Indirect contact: surfaces or patient care items
- Single patient room preferred





### Contact precautions:

- Examples:
  - MRSA
  - VRE
  - *Clostridium difficile*
  - .....



### Droplet precautions:

- For epidemiologically important microorganisms that can be transmitted by droplets (large particles) :
  - coughing, sneezing
  - specific procedures
- Single patient room preferred



### Droplet precautions:

- Examples
  - Invasive *Neisseria meningitidis* disease (meningitis, pneumonia, sepsis)
  - Diphtheria
  - Mumps
  - .....

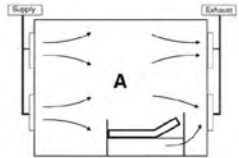
### Airborne precautions:

- For infectious agents that can be transmitted by small droplet nuclei ( $\geq 5 \mu$ ) that can remain suspended in air for long periods
  - can travel with air currents, can be inhaled
  - special protection, air handling, filtration, ventilation

### Airborne precautions:


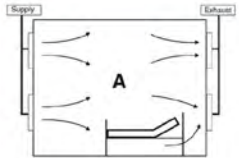
- Private room with:
  - Negative air pressure
  - 6 or more air changes per hour
  - Air filtration
  - Door always closed!



<http://www.cdc.gov/tb/publications/factsheets/prevention>

### Airborne precautions:

- Examples
  - Tuberculosis
  - Measles
  - Varicella
  - Etc...

<http://www.cdc.gov/tb/publications/factsheets/prevention>



Transmission-based precautions:  
based on transmission routes

Common vehicle: medical devices, food, water

- Medical devices: sterile or high-level disinfected
- Food: prepared according to HACCP = Hazard Analysis and Critical Control Points
- Water: potable, prevention of *Legionella*

Transmission routes

- Contact
  - Direct: person-to-person
  - Indirect: via common vehicle
- Droplet (> 5 μm)
- Airborne (< 5 μm)
- Common vehicle: medical devices, food, water

**Is it really so simple?**

**No.....**

Transmission-based precautions:

- Many pathogens have more than one transmission routes (e.g.: contact + droplet)
- Host factors (susceptibility)
- Hospital: crowded and high-risk environment

Transmission-based precautions

- Factors to take into consideration:
  - Transmission routes
  - Severity of disease
  - Multidrug resistance
  - Outbreak situation



### Examples

1. May 2003, VU University medical center Amsterdam admits patient:
  - ✓ just arrived from Hong Kong
  - ✓ high temperature
  - ✓ headache and muscle ache
  - ✓ respiratory tract infection
2. July 2013, Dutch hospital admits patient:
  - ✓ repatriated from South European hospital
  - ✓ severe burn wounds
  - ✓ contact precautions for MRSA screening:
    - MRSA negative
  - ✓ burn wounds: colonized with "panresistant" *Pseudomonas aeruginosa*

### Examples

3. Department of Hematology  
Bloodcultures with vancomycin-resistant enterococci

Month	Number of patients
Nov 1998	1
Dec 1998	1
Jan 1999	1
Feb 1999	1
Mar 1999	2
Apr 1999	2
May 1999	2
June 1999	2

### Examples

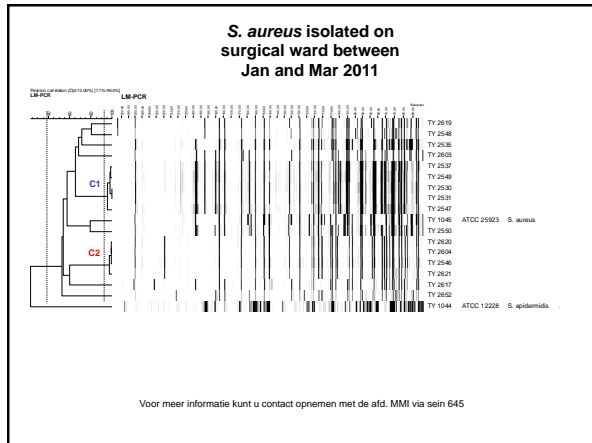
3. Typing of VRE with AFLP (Amplified Fragment Length Polymorphism)

1 = November '98  
 2 = March '99  
 3 = May '99  
 4 = ref strain  
 5 = ref strain

1 2 3 4 5

### Examples

4. March 2011, VU University medical center Amsterdam:
  - Increase in number of deep wound infections with *S. aureus* on a surgical ward
  - typing of all *S. aureus* strains isolated from postoperative wound infections since January 2011
  - two clusters



What isolation precautions would you take in each case?

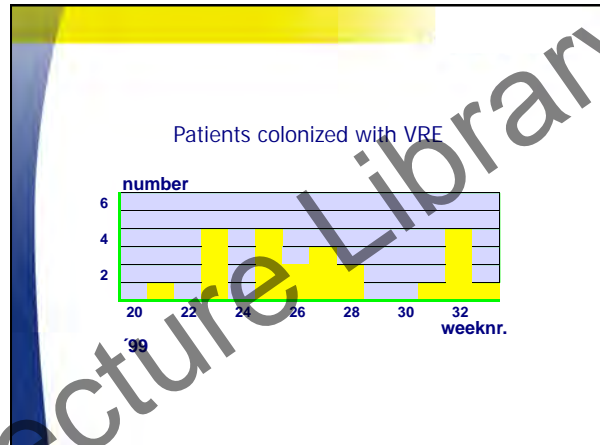
- Examples**
- May 2003, VU University medical center Amsterdam admits patient:
- ✓ just arrived from Hong Kong
  - ✓ high temperature
  - ✓ headache and muscle ache
  - ✓ respiratory tract infection
- SARS-Corona Virus
- ✓ Transmission routes: droplet and contact
  - ✓ Intermediate contagiousness
  - ✓ Outbreaks have been described
  - ✓ Very severe infection with high mortality
- stringent isolation precautions: contact, droplet and airborne precautions

- July 2013, Dutch hospital admits patient:
- ✓ repatriated from South European hospital
  - ✓ severe burn wounds
  - ✓ contact precautions and MRSA screening: → MRSA negative
  - ✓ burn wounds: colonized with "pan-resistant" *Pseudomonas aeruginosa*
- "pan-resistant" *P. aeruginosa*
- ✓ Transmission routes: Gram-negative rod: → contact
  - ✓ Can be quite contagious in hospital environment because of multidrugresistance
  - ✓ Untreatable infections
- Contact precautions and single room

### Outbreak of VRE on a hematology department

- ✓ Transmission route: contact  
survives well in the environment
- ✓ Contagious: yes, we have an outbreak
- ✓ Severity of infections: variable, depends on host
- ✓ Colonized patients without infections? Need for screening?

→ Contact precautions in single room and screening of other patients



### Control measures

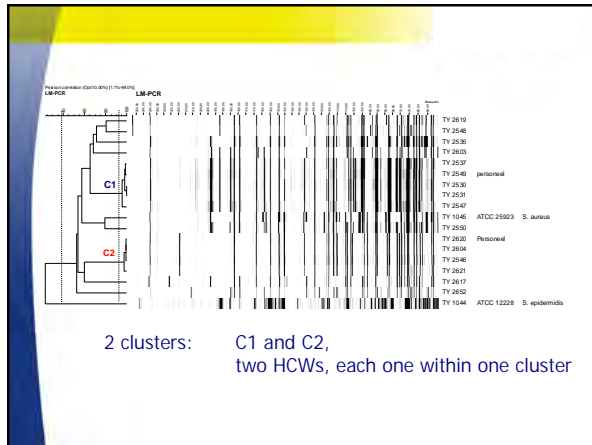
**VRE positive patients:** contact isolation in single rooms

**Patient contacts** (all patients on hematology ward between november and august): contact precautions at each admission, whatever the results of screening cultures

**New patients:** no special precautions

### Cluster of deep surgical wound infections caused by a single strain of susceptible *S. aureus*

- Outbreaks of *S. aureus* can be caused by a carrier among healthcare workers
- HCW of surgery department and ward were asked: two had skin disorders (eczema)
- Culture of nose and skin: *S. aureus*
- Typing of the strains:



### Conclusion

When do you take extra precautions?  
 For infectious agents that:

- can cause severe infections and/or
- are resistant to the drugs of choice in your hospital
- have caused an outbreak

What precautions?

Depends on:

- transmission routes
- contagiousness
- severity of infections

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