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Hygiene measures, isolation and therapy

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Advanced**

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Conflict of interest

No conflicts of interest to declare.

Healthcare-related infections

Importance (1)

- Frequent

- Prevalence: 5 – 15 % of patients
- 50 % in intensive care units

- *JAMA 2009: International study of the prevalence and outcomes of infections in ICU*
- www.ecdc.Europe.eu 2013

- Important

- Morbidity and Mortality
- Cost
 - Therapy
 - Prolonged hospital stay

Healthcare-related infections

Importance (2)

- Increase
 - vulnerable patients
 - invasive procedures
 - missing data
- Caused by multidrug resistant and epidemiologically important micro-organisms

Invasive isolates of CPE positive *K.pneumoniae*

Figure 3.9. *Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2013

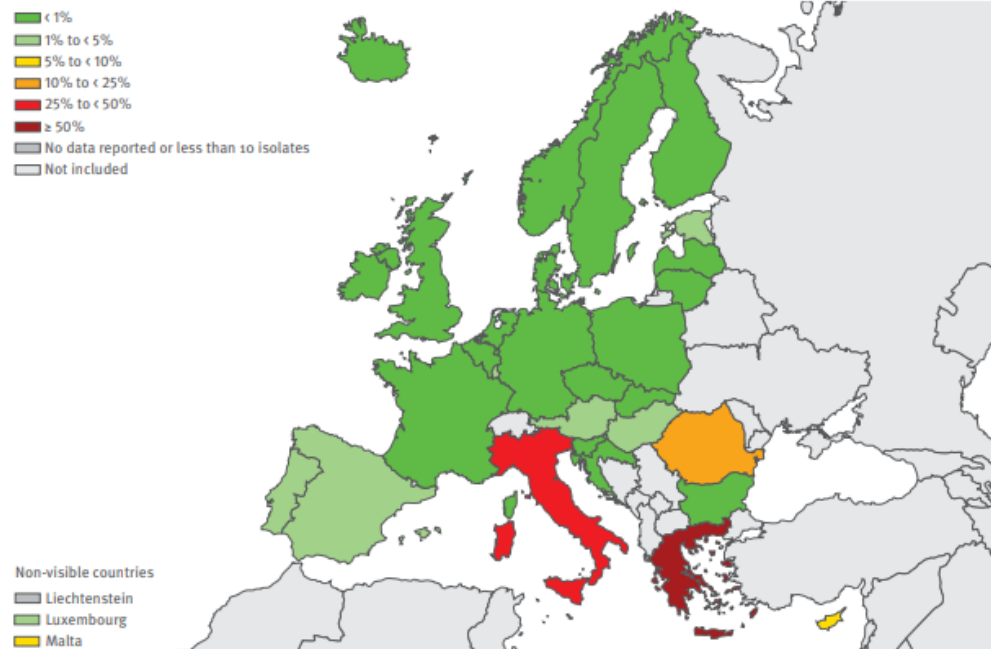
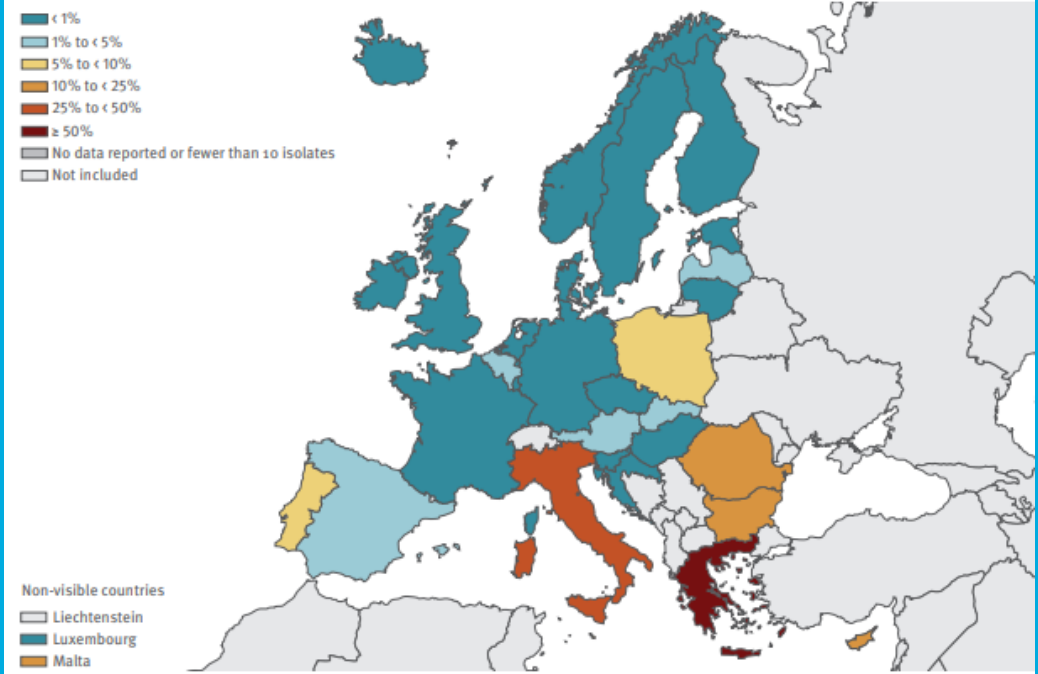


Figure 3.11. *Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2017



European Antimicrobial Resistance Surveillance Network (EARS-Net)

Belgian situation

= 107500 patients with a HAI infection every year

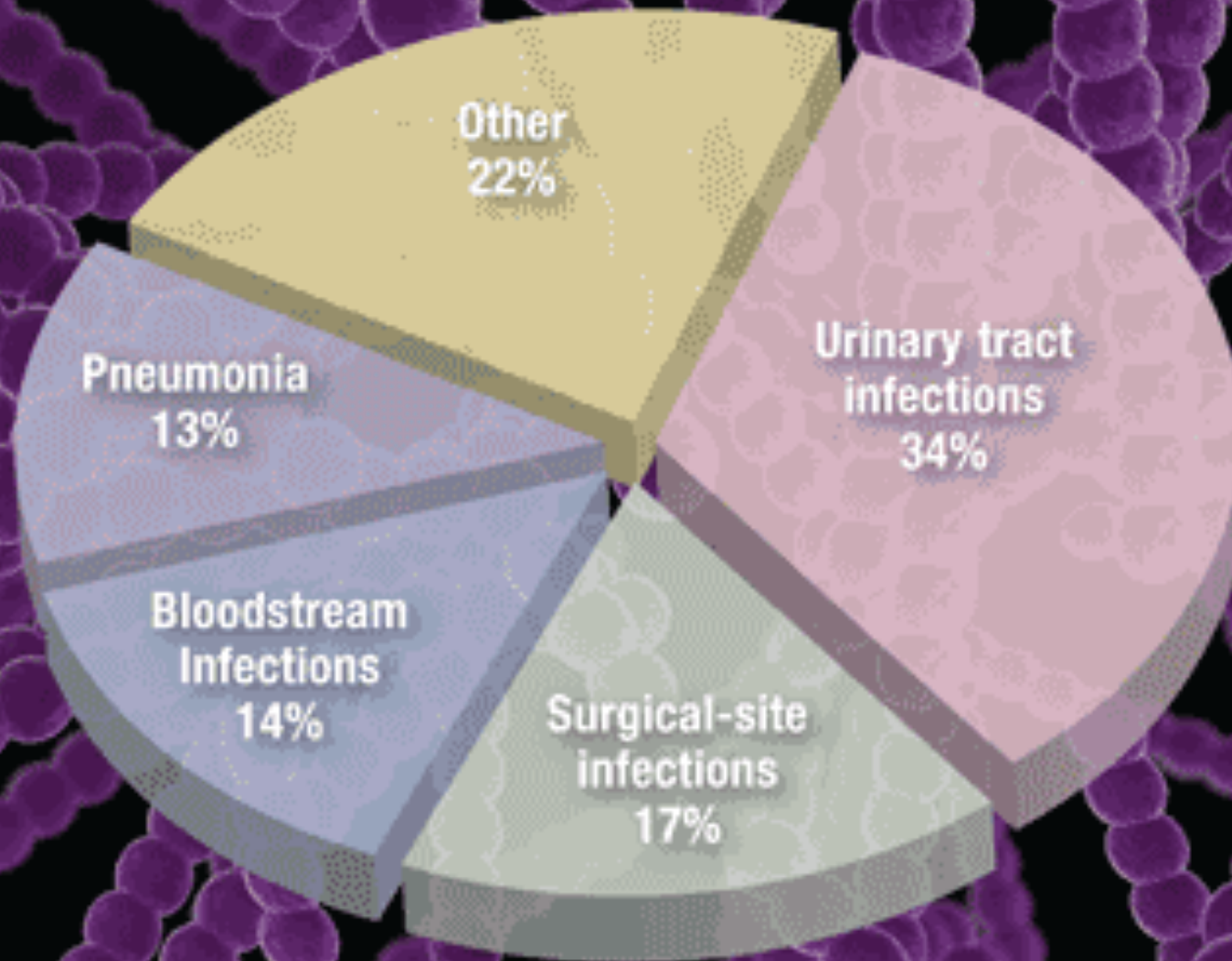
MORTALITY/MORBIDITY

= 2500 à 3000 directly related deaths

COST

- Mean cost/day (2005) = € 264.37
- HAI = + 4 days
= additional cost of € 1057.48 for every HAI
- Total cost in Belgium = € 113.679.100

Types of Health Care–Associated Infections in Hospitals



Prevention (1)

1 - 100 % (50 %)

- proof?
- New riskfactors
- “Irreducible minimum”



SENICSTUDY 1974 – 1984

“Study of the efficacy of nosocomial infection control programs”

32 % = preventable if

- adequate surveillance + feedback
- adequate control programs
- adequate staff:- 1 ICN/250 beds and MD

Prevention (2)

More recent systematic reviews :

- *Harbarth et al, J. Hosp. Infect., august 2003*
 - 20% reduction (10 – 70%)
 - Mainly in catheter-related bacteraemia (> 50%)

- *Umscheid et al, Infect Control Hosp epidemiol, 2011*

Reasonably preventable with current evidence-based strategies:

- *CLABSI and CAUTI (most preventable): 65 – 70%*
- *VAP and SSI: 55%*
- *CLABSI most preventable deaths and highest associated costs*

Origin of infections? Source of contamination

Source, Reservoir

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graph TD; A([Source, Reservoir]) -- Cross-infection --> B([Healthcare-related infection]); B -- Endogenous or auto-infection --> C([Own colonizing micro-organisms from GI tract, RT,...]);
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Cross-infection

Healthcare-related infection

Endogenous or auto-infection

Own colonizing micro-organisms from GI tract, RT,...

Endogenous infection

Normal flora \Rightarrow Pathogenic flora

- Due to
- immune suppression
 - broad spectrum antibiotics
 - transfer from another infected/colonized body site

Prevention = very difficult:

- optimizing immunity (?)
- restrictive antibiotic use
- prevention of colonization – aseptic techniques

Cross contamination / infection

Source, reservoir

Environment

Health care worker

Patient

- surfaces, materials
- air
- water, liquids
- medication
- food
-

colonized
infected

colonized
infected

Transmission

Susceptible host

Cross contamination / infection

Source, reservoir



Ways of transmission

- **Airborne:** airborne droplet nuclei or small particles size $< 5 \mu$
- **Droplet transmission** of larger droplets size $> 5 \mu$
- **Contact transmission**
 - **direct:**
 - between patients
 - between patient and healthcare worker
 - **indirect:**
 - through materials
 - **by hands**

Contamination of the host

- How to prevent contamination?
- How to prevent evolution from contamination to infection?
- Risk factors of patients for a colonization or infection?

2 approaches to prevent HAI

- Horizontal strategies: to reduce all infections, not pathogen specific
 - Standard Precautions (hand hygiene, cough etiquette, PPE, gloving)
 - Bundles of care (Clabsi, VAP)
 - Chlorhexidine bathing
 - Selective Digestive Decontamination
- Vertical strategy: substantially reduces 1 pathogen, is pathogen specific

2 approaches to prevent HAI

- Horizontal strategies to reduce all infections, not pathogen specific
- Vertical strategy: substantially reduces 1 pathogen, is pathogen specific
 - Active surveillance (eg for MRSA, VRE,..)
 - Contact precautions (eg for MRSA infection)
 - Decolonization (eg for MRSA)

How to prevent cross-infections?

Source, Reservoir

STANDARD PRECAUTIONS

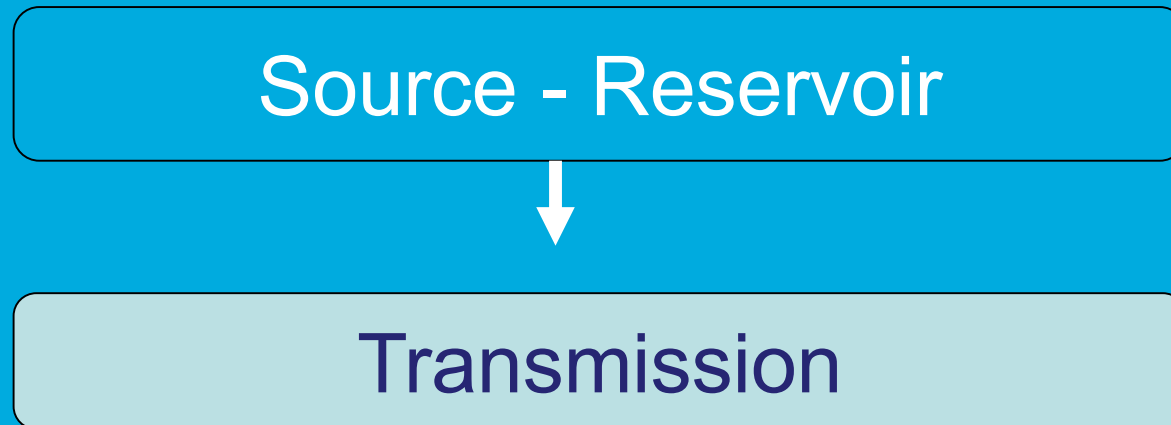
- environnement: cleaning, disinfection, sterilisation
- HCW: personal hygiene and hand hygiene
- patient: personal protective equipment
 - contact blood / bodyfluids
 - prevention of needlesticks/sharps-related injuries
 - vaccination
- principles of asepsis, bundles of care

Transmission



Susceptible host

How to prevent cross-infections?



TRANSMISSION - BASED PRECAUTIONS

= known or suspected contamination / infection
gloves and gown to \longrightarrow strict isolation

- Airborne
- Droplet
- Contact transmission

CDC Guidelines for Isolation precautions, 2007, last update July 2019

Decolonization strategies

- Universal ↔ Targeted

- In risk populations ↔ known colonized

- ICU patients, surgical, LTC nursing home residents, dialysis, ...
- Known colonized with MRSA, VRE, ...

- Nasal topical

- Topical skin

- Oral

- Selective digestive or oropharyngeal

Decolonization strategies - targets

- S.aureus: MSSA and MRSA
- VRE
- Gram-negative organisms !MDR

Decolonization strategies – products (1)

- Nasal:
 - Mupirocine nasal ointment 2%:
 - S.aureus (MRSA + MSSA) first choice
 - 90% effective at 1 week – 60 % long term
 - Best effect ≥ 6 doses;
recommended twice daily – 5 days
 - ↓ infections in Surgery (cardiac, orthopedic, Neuro), dialysis, ICU and LTC; less clear for CA MRSA

Decolonization strategies – products (2)

- Nasal:
 - Mupirocine: S.aureus first choice
 - Alternative agents
 - Povidone- iodine 5% nasal ointment
 - Alcohol-based nasal antiseptic
 - Bacitracin
 - Retapamulin
 - Under investigation
 - Tea tree oil
 - Photodynamic therapy
 - Omiganan Pentahydrochloride
 - lysostaphin

Decolonization strategies – products (3)

- **Topical skin**

- Chlorhexidine gluconate (biguanide)

- Bathing with 2% cloths or 4% CHG liquid body wash
- Gram +, -, and yeasts
- Very safe (skin irritation, CNS!)
- First choice site preparation central lines
- Decrease of BSI in ICU (up to 60%)
- Decrease of MDRO – VRE and MRSA acquisition
- Decrease of blood culture contamination
- Universal decontamination with cloth bathing and nasal mupirocin very successful in prevention of all- cause BSI in ICU, less clear in non-critical patients

Decolonization strategies – products (4)

- Nasal
- Topical skin
 - Chlorhexidine gluconate (biguanide)
 - (Hexachlorophane 3%)
 - Gram+
 - Systemic absorption - neurotoxicity
 - Povidone-iodine 4 – 10%
 - Gram+ and –
 - More rapid action but less persistent

Decolonization strategies – products (5)

- Topical skin

- Chlorhexidine gluconate (biguanide)

- (Hexachlorophane 3%)

- Povidone-iodine 4 – 10%

- (Triclosan 0,15-1%)

- Gram+ and –

- In soaps, toothpaste, acne preparation

- Resorption and resistance

- Sodium Hypochlorite

- Combined with intranasal mupirocin more effective than CHX + intranasal mupirocin for CA-MRSA

- Diluted: 2,5µl/ml of 6% sodium hypochlorite 15 min/ twice weekly

Decolonization strategies – products (6)

- Nasal
- Topical skin
- Oral
 - CHX in oral care in cardiac surgery patients effect on the prevention of VAP
 - Oral Agents: rifa, quinolones, clinda, doxy, trimethoprim-sulfamethoxazole
 - Insufficient in nasal secretions
 - In case of extranasal sites
 - Mono or combination therapy? Optimal dose? Duration? Risk of resistance

Decolonization strategies – products (7)

- Nasal, Topical skin, Oral, Oral Agents
- Selective Digestive (SDD) or oropharyngeal Decontamination SOD
 - Non absorbable: tobra, polymyxin, ampho, IV cefotaxim
 - Oral paste with antibiotics or antiseptics (CHX)
 - Effect on VAP, BSI, rectal and respiratory colonization but increase in resistance, esp in settings with endemic MDR gram-. Appropriate use not clear

Decolonization strategies – products (8)

- Nasal:
- Topical skin
- Oral
- Oral Agents
- Selective Digestive (SDD) or oropharyngeal Decontamination
SOD
- Fecal transplantation?
- Probiotics?

Decolonization prior to surgery

- Strongest evidence: = Prevention of SSI with gram+ because of endogenous spreading from one body site (nose, skin) to the wound of the same patient
- Esp cardiothoracic and orthopaedic procedures
- Regimen:
 - Mupirocin twice daily 3 – 5 d prior + CHX bath once daily 2 – 5 prior OR
 - Mupirocin + CHX bath night before+ morning of surgery and mupirocin twice daily 5 postop

+ Appropriate antibiotic prophylaxis

- Correct agent
- Right dose
- Correct time
- + correct skin antisepsis before the surgical incision

= As part of the bundle to prevent SSI

Universal Decolonization of skin with CHX + targeted nasal mupirocin

- Strongest evidence in ICU patients with effect on
 - Device-associated bacteraemia
 - All-cause bacteraemia
 - Colonization with and transmission of multidrug-resistant organisms (MRSA)
- General non-ICU patients?
 - Possible advantage for non-ICU patients with medical devices

Huang et al, Lancet, 2019

Risks of decolonization?

- Emergence of resistance?
 - For Mupirocine and *S. aureus* in widespread and prolonged use
 - CHG currently low resistance and of uncertain clinical significance but should be monitored
- Skin irritation

Conclusion

- Prevention of HCAI is possible with evidence-based interventions, in a bundle, combining a horizontal and vertical approach
- Strongest evidence for universal decolonization
 - In surgical patients, cardiac and orthopedic, as a strategy to prevent SSI
 - + targeted nasal mupirocin in ICU patients to prevent (device-related) blood stream infections
- Need to assess resistance and selection for resistance