Infection Prevention and Control "Building Capabilities"
2015

A TRADITION OF INDEPENDENT THINKING

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University College Cork, Ireland
Coláiste na hOllscoile Corcaigh
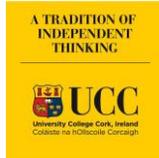
Cleaning and Decontamination of the Environment and Equipment

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Learning objectives

· **Understand what is meant by cleaning, decontamination, disinfection, sterilization**

· **Understand how the environment and equipment can be a significant reservoir of pathogens in the healthcare environment- and how this reservoir can be eliminated**

· **Understand the importance of the "patient zone" or Moment 5 WHO 5 Moments for Hand Hygiene in relation to the environment and equipment**

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The Chain of Infection

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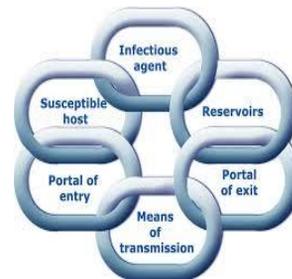
Cleaning

· **The removal of visible soil (organic and inorganic material) from objects and surfaces**

· **Normally accomplished manually or mechanically using water with detergents or enzymatic products**

· **Thorough cleaning essential before disinfection and sterilization**

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Decontamination

· **Removal of pathogenic microorganisms from objects so they are safe to handle, use or discard**

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Disinfection

- A process that eliminates many or all pathogenic microorganisms, except bacterial spores on inanimate objects

- Liquid chemicals often used

- Unlike sterilization, disinfection is not sporicidal

- High level disinfection

- Low level disinfection

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Sterilization

- A process that destroys or eliminates all forms of microbial life

- Chemical and physical methods

- Pressurised steam, ethyline oxide gas

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Equipment- what standards are required?

- Sterilization?

- Disinfection?

- Decontamination??

- Cleaning- using detergents only?

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Spaulding Classification

Table 4-1: Classification of infection risk associated with the decontamination of RIMD

Risk	Application	Recommendation
Critical	Items in close contact with a break in the skin or mucous membrane or introduced into a sterile body area, e.g. theatre surgi-	Requires Sterilization
Semi-critical	Items in close contact with intact skin, mucous membranes or body fluids, par-ticularly after use on infected patients or prior to use on immunocompromised pa-tients, e.g. endoscopes	Requires high level disinfec-tion* (Sterilization preferred where practicable)
Non-critical	Items in contact with healthy skin or mu-cous membranes or not in contact with patient, e.g. blood pressure cuff	Can be processed by cleaning (and low level disinfection where necessary)

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Decontamination of Reusable Medical Devices Lifecycle

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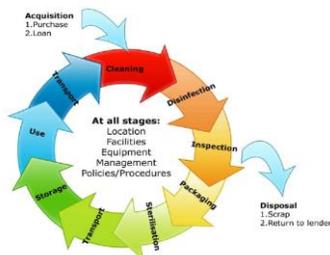
Environmental cleaning- why bother?

- Many pathogens can be transmitted by the environment:
  - MRSA, VRE, multi-resistant Gram negative bacteria, *C. difficile*
  - Norovirus

- Pathogens shed by patients and staff

- Contaminate surfaces and increase risk of acquisition for other patients

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Environmental cleaning- why bother?

- Risk of acquiring VRE, MRSA, *Acinetobacter* spp., *Pseudomonas* spp., *C. difficile* increased if a new admission placed in a room previously occupied by a patient known to be colonized or infected with one of these pathogens
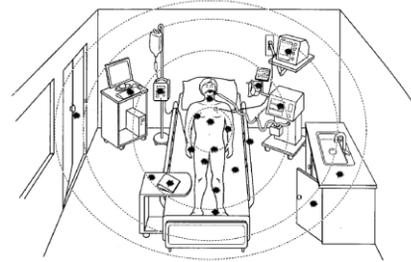

Figure 1. Patient and environmental sources of methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococcus (VRE) in an intensive care unit room. *Expanding circles* highlight the patient as the major reservoir and epicenter for MRSA and VRE. *Splotches* represent locations where MRSA and VRE are commonly found.

## Survival times of pathogens in the environment

TABLE 1 Survival times and infectious doses retrieved or extrapolated from published studies[a]

| Organism	Survival time	Infectious dose
Methicillin-resistant *Staphylococcus aureus*	7 days–>7 mo	4 CFU
Acinetobacter	3 days–>5 mo	250 CFU
Clostridium difficile	>5 mo	5 spores
Vancomycin-resistant *Enterococcus*	5 days–>4 mo	$<10^3$ CFU
Escherichia coli	2 h–16 mo	10^2-10^5 CFU
Klebsiella	2 h–>30 mo	10^2 CFU
Norovirus	8 h–7 days	<20 virions

[a] Survival times and infectious doses of a range of pathogens according to, or extrapolated from, original studies, some of which involved animal-based research (2, 7–14).

VRE Environmental sampling ICU
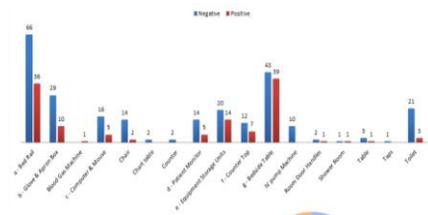
P1144 Molecular characterisation of VRE from the hospital environment and correlation with clinical VRE samples during an outbreak in a tertiary referral centre
C. Fenelon*, C. Wrenn, S. Fitzgerald, K Schaffer, E. O'Mahony, L. Fenelon, D. Keating, D. O'Brien
ECCMID London 2012
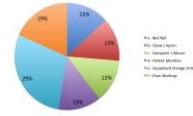
Now we all agree on the importance of environmental cleaning- how should we do it?

Requirements for Effective Healthcare Cleaning Programmes

- Trained staff

- Ongoing education

- Ongoing monitoring/audit

- Feedback

- Upgrading of practice

3

Barriers to effective cleaning

- Resources
- Workload/ staffing levels
- Training
- Communication
- High bed occupancy rates and rapid bed turnover
- Poor ventilation
- Clutter
- Inappropriate storage
- Equipment design

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- Cleaning policies vary considerably, rely on resources

- Data on clinical outcomes often limited or not performed during environmental cleaning studies

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Controversies

- Choice of cleaning fluid- detergent and/or disinfectant?

- How should cleaning be monitored?

- When should we use bleach?

- What about automated methods and newer technologies?

- How often should an occupied room or bed space be cleaned?

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How do we measure "clean"?

- Visual inspection

- Microbiological methods

- Chemical methods

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How do we measure "clean"?

- Microbiological methods
  - Overall aerobic colony count and pathogen specific count for a defined surface area
  - provide an indication of the quality of cleaning

- Chemical methods (ATP bioluminescence)
  - Techniques used by industry- base standards on presence or absence of indicator organisms
  - ATP monitoring more useful for detecting areas that need cleaning attention

- Fluorescent markers

- Need to establish standards for different hospital areas e.g outpatients versus leukaemia unit

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Review

The stethoscope and healthcare-associated infection: a snake in the grass or innocent bystander?

N. O'Flaherty*, L. Fenelon

St Vincent's University Hospital, Dublin, Ireland

There is a concern that stethoscopes may transmit infectious agents which could result in healthcare-associated infection (HCAI). The aim of this review was to evaluate the available literature as to the role of the stethoscope in the development of HCAI. A literature search was conducted across several databases for relevant studies and reports. Stethoscopes were consistently shown to harbour bacteria. The mean rate of stethoscope contamination across 28 studies was 85% (range: 47–100%). The majority of bacteria isolated were deemed to be non-pathogenic. The most frequently isolated organisms were coagulase-negative staphylococci. The mean level of contamination was in excess of the French Normalization standard for cleanliness (which equates to <20 colony-forming units per membrane) in all six studies in which contamination levels were quantified. Potentially pathogenic organisms cultured from stethoscopes included: Staphylococcus aureus, Pseudomonas aeruginosa, vancomycin-resistant enterococci, and Clostridium difficile. There was evidence that bacteria can transfer from the skin of the patient to the stethoscope and from the stethoscope to the skin. However, studies were not designed to detect a correlation between stethoscope contamination and subsequent HCAI. Surveys assessing cleaning practices revealed a suboptimal commitment to stethoscope disinfection among doctors and medical students. The optimum method for stethoscope cleaning has not been defined, although alcohol-based disinfectants are effective in reducing bacterial contamination. In conclusion, a link between contaminated stethoscopes and HCAI has not yet been confirmed, but transfer of bacteria between skin and stethoscope has been shown. The available information would suggest that stethoscopes should be decontaminated between patients.

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What about chlorine (bleach)? Many publications supporting its use during outbreaks...

- **J Hosp Infect.** 2012 Dec;82(4):234-42.
- **Significant reduction in vancomycin-resistant enterococcus colonization and bacteraemia after introduction of a bleach-based cleaning-disinfection programme**

"**Significant reductions** in newly recognized VRE colonizations (208/1948 patients screened vs 324/4035, a 24.8% reduction, *P* = 0.001) and environmental contamination (66.4% reduction, *P* = 0.012) were observed "

What about chlorine (bleach)? Many publications supporting its use during outbreaks...

- **Am J Infect Control.** 2010 Jun;38(5):350-3.
- **Significant impact of terminal room cleaning with bleach on reducing nosocomial Clostridium difficile**

"There was a **48% reduction in the prevalence density of C difficile** after the bleaching intervention (95% confidence interval: 36%-58%, P < .0001)"

Problems with chlorine

- **Contact time- second clean required**

- **Need to check product compatibility**

- **Corrosive- exacerbated by older/damaged equipment**

Newer/other modalities

- **UV irradiation**

- **Hydrogen peroxide**

- **Antimicrobial surfaces and coatings**

- **Silver**

- **Copper**

- **Polycationic antimicrobial surfaces**

Hydrogen peroxide

- **Sporicidal vapour**
- **Inactivates many pathogens- especially in surfaces that are difficult to clean**
- **Used to eliminate environmental reservoirs during outbreaks**
- **Caveats:**
  - **Risk of exposure to people- room needs to be vacant and sealed- cannot be used in occupied rooms**
  - **Cleaning must occur first- effect impeded by organic residue**
  - **Expensive**

An Evaluation of Environmental Decontamination With Hydrogen Peroxide Vapor for Reducing the Risk of Patient Acquisition of Multidrug-Resistant Organisms

Clinical Infectious Diseases 2013;56(1):27–35

- **30 month prospective cohort intervention in a 994 bed tertiary referral hospital**
- **Monthly environmental samples for MDROs taken**
- **Patients admitted to rooms decontaminated with HPV were 64% less likely to acquire any MDRO**
- **80% less likely to acquire VRE**
- **Worth the effort and expense??**

UV light

- Severs molecular bonds in DNA
- Shown to significantly reduce C. difficile, VRE and MRSA

- Caveats:
  - Impeded by presence of residual organic matter- cleaning required first
  - Not very effective for sites around corners or shielded by solid items
  - May damage plastics and polymers following repeated exposure
  - More study required here

Steam cleaning

- Rapidly effective against VRE, MRSA, Gram negative bacilli
- Can be applied to a variety of soft and hard surfaces without prior cleaning
- Caveats:
  - Cannot be used on electrical appliances
  - Need to ensure that temperature of steam and delivery to surface being decontaminated is constant
  - Burns, scalds, falls risk
  - Difficult to use on a busy ward

- These technologies may offer enhanced decontamination but they cannot replace routine daily cleaning

- Organic soil, liquids, waste and litter must be removed from floors and surfaces in order for these technologies to work

How often should an occupied room or bed space be cleaned?

Journal of Hospital Infection 86S1 (2014) S1-S70

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England

H.P. Loveday[a*], J.A. Wilson[a], R.J. Pratt[a], M. Golsorkhi[a], A. Tingle[a], A. Bak[a], J. Browne[a], J. Prieto[b], M. Wilcox[c]

How often should an occupied room or bed space be cleaned?

- Levels of cleaning should be increased in cases of infection and/or colonisation when a suspected or known pathogen can survive in the environment, and environmental contamination may contribute to the spread of infection
- Shared pieces of equipment used in the delivery of patient care must be cleaned and decontaminated after each use with products recommended by the manufacturer
- The hospital environment must be visibly clean; free from non-essential items and equipment, dust and dirt and acceptable to patients, visitors and staff

Critical surfaces that should get special attention during environmental cleaning

- Frequently touched surfaces
  - Telephones
  - Handles
  - Switches
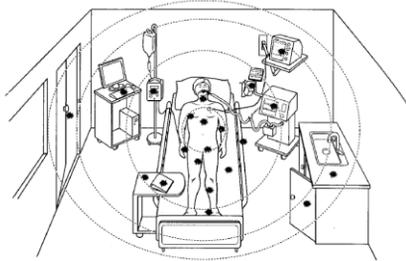 - Keyboards
  - Near-patient touch sites

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Importance of the Terminal Clean

- Augment cleaning regimen with a disinfectant
- Remove all detachable objects from room (bedding, curtains)
- Lighting, ventilation, curtain rails, upper surfaces of highly placed fixtures and fittings
- All other sites then cleaned downward to floor level

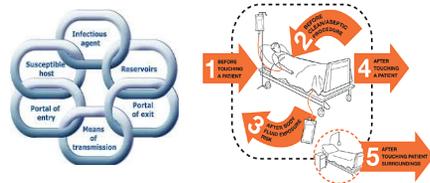- Check lists and audits essential

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Some basic principles of environmental cleaning

- Keep clutter to a minimum
- Recognise the importance of mechanical action and thoroughness of cleaning effort
- Clean from the top down
- Work flow "clean" to "dirty" patient areas
- Concept of patient zone
- Correct disposal of fluids-hand hygiene sinks are for this purpose only
- Use fresh solutions at the correct concentrations
- Allow the correct contact time for cleaning solutions if required (e.g. for chlorine)

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Environmental cleaning and correct cleaning and decontamination of equipment part of a multi-faceted strategy to control multi-drug resistant organisms and prevent HCAI

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Journal of Hospital Infection 91 (2015) 45–52

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Environmental challenges of identifying a patient zone and the healthcare zone in a crowded Vietnamese hospital

S. Salmon, M.L. McLaws

Figure 4. Two patients per bed. Left: two patients and one relative.

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Thank you!

Questions?

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