



Twitter: @SafePatientCar1  
# bugsndrugs

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## Safe Patient Care 2019

### Management of the Environment in relation to Multidrug Resistant Organisms (MDROs)

Dr D Corcoran

Twitter: @SPC2016Cork

Safe Patient Care Conference 2019

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## Infection Prevention and Control

- Hand hygiene
- Safe patient environment

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## Infection Prevention and Control

In Addition

Antimicrobial stewardship

Surveillance    Laboratory  
                          Clinical

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## Infection Prevention and Control

• Why this particular emphasis on hand hygiene and the safe patient environment?



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## Malaria Vector Model

- $R_0 \propto C^2$
- $R_0$  = Reproduction Rate (number of secondary cases arising from one primary case in a totally susceptible population)
- C = Number of contacts
- Emphasises the importance of reducing contact



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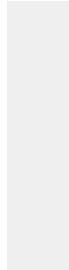
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## Stochastic Model

$$R_0 = \frac{(n-1)\beta\beta^i}{(\mu+\gamma)n^i\mu^i}$$

$R_0$  = Reproduction rate  
 $n$  = No. of patients,  $n^i$  = No of HCWs  
 $\beta$  = HCW/Pt spread,  $\beta^i$  = Pt/HCW spread  
 $\mu$  = Pt removal rate,  $\mu^i$  = Hand hygiene rate  
 $\gamma$  = Detection rate

Emphasises the importance of reducing contact




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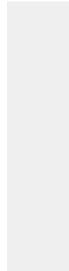
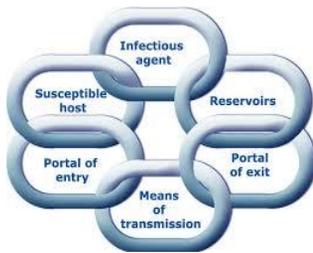
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## How can unnecessary contact be reduced? "Breaking the Chain of Infection?"




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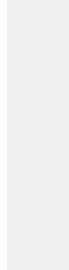
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## Chain of infection: Critical control points

- Pathogen: vaccination, clean environment
- Reservoir (patient): diagnosis/screening, treatment, standard precautions +/- isolation
- Portal of Exit: standard precautions
- Means of Transmission: hand hygiene, standard precautions, environmental hygiene
- Portal of entry: standard precautions
- New Host: immunisation, treatment




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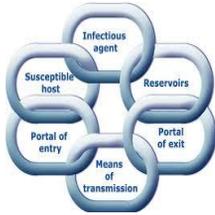
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## Consider the Environment as a reservoir



- Environment as reservoir increases risk
- Patient and environment are reservoirs




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## Breaking the chain of infection



- Hand hygiene
- Environmental hygiene

### Because

The patient zone is rapidly contaminated by the patient's flora, becoming a reservoir

Corollary is that all surfaces are cleaned regularly and, also, after the patient is discharged




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## But the hospital environment is clean, isn't it?



- Lax *et al* (2017), Science Translational Medicine
- Hospital flora is dynamic

Patient enters a reservoir  
 Patient acquires flora from reservoir  
 Patient alters reservoir  
 Patient leaves a reservoir behind




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### Complicated by clinical interventions

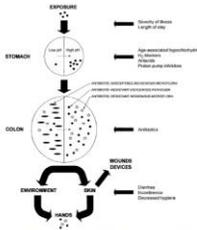


Figure 1. Factors that facilitate bacterial emergence and transmission of resistant pathogens. The left column shows the process of faecal entry to the stomach and stool release into the colon, the right column shows the effects of increased faecal and oral antibiotic resistance pressure in the colon.




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### Example

- Many hospital lavatories do not have covers
- Are aerosols created by toilet flushing?




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### Dynamic flora

- Aerosols containing *Clostridium difficile*
- Recoverable from air 25cm above seat
- Surface contamination noted from 90 min
- *J Hosp Infect* 2012;**80**:1-5. Best *et al*




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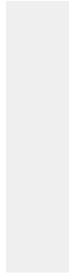
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## Hospital microflora

- Hospital microflora is dynamic
- Changed by patients and staff by virtue of being there
- Changed by medical interventions
  
- NB resistant organisms selected by antibiotic use
- Some part of this is inevitable as newer antibiotics are used
- Our task is to slow down development of antibiotic resistance as long as possible



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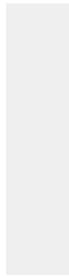
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## Environmental Cleaning

- Not only for MDROs
- Many hospital pathogens are quite sensitive
  
- Cleaning is every bit as important for these
  
- *C. difficile*
- *Staph. aureus*
- *Strep. pyogenes*
- viruses



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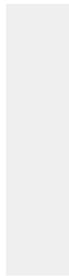
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## More resistant organisms

- MRSA
- VRE
  
- Carbapenemase-resistant enterobacterales (CRE)
  
- Carbapenemase-producing enterobacterales (CPE)



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## CPE acquisition and colonisation

- Gut carriage of enterobacterales
- Survive in environment (hospitals)
- Colonisation/Carriage state
- Spread usually within healthcare environments and between healthcare environments
  
- Eventually possible endemicity in healthcare settings
- Spread outside healthcare settings
- CPE infections may be almost untreatable



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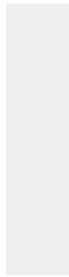
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## Where are the resistant organisms found?

- Potentially anywhere in the environment
- NB within the patient zone/hand touch surfaces e.g.
  - Bedframes
  - Medical equipment
  - Computer keyboards/mouse
  - Curtains
  - Door handles
  - Flat surfaces within patient area/furniture
  - Ventilation ducts/radiators
  - Call bells
  
- Any surface: high, medium or low touch



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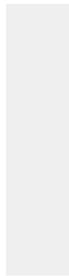
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## Management of the environment and MDROs

- Hand Hygiene
  
- Removes contamination by the environment
- Difficult
- Training
- Audit
  
- National programmes



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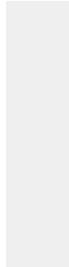
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## Cleaning the environment

- Near-patient surfaces
- Sinks
- Mattresses
- Clinical equipment
- Treatment room
- Non-clinical areas/Bathrooms
  
- Liaison with  
Nursing & other ward staff  
Hospital management  
Cleaning services  
Estates & facilities



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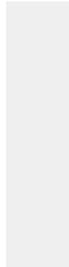
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## Cleaning: logistics and problems

- Daily (ensuring hand touch surfaces cleaned)
- On discharge
  
- Logistics
  - Room preparation & patient moving
  - Turnaround times (post-cleaning time, esp H2O2)
  - Staff training, audits, monitoring
  - Specialist equipment & damage to materials
  - Staffing



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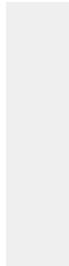
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## Cleaning: how and what to use

- Standard, enhanced, deep...thorough
- Warm soapy water, detergent
- Hypochlorite
- Newer methods
  
- Ensure training in place to optimise cleaning of relevant sites



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## Cleaning protocols

- Everybody has a responsibility for a clean environment
- Whatever type of cleaning (routine, deep etc.):
- Have a plan
- Use a process that works every day
- Understand that it is a journey/process
- Progress from cleanest areas to the dirtiest
- Consider the products and the equipment




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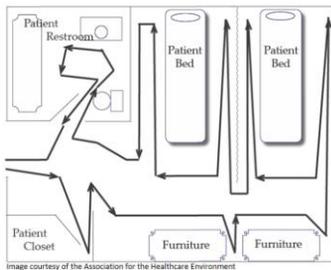
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## Cleaning Protocols (cont)

Logical Pattern of Cleaning, From Cleanest to Dirtiest



Pattern is specific to private or semi-private rooms, but approach can be applied to any setting

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## Cleaning: newer methods

- Steam
  - Hydrogen peroxide gas (NB)
  - Copper biocide (residual effect noted)
  - Ultramicrofibre (UMF) mops (polyester/polyamide)
  - UMF + Copper based biocide
  - UV light
- (Hamilton *et al JHI* 2010; **74**:62-71)




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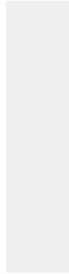
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## Hydrogen peroxide

- Reaches all areas
- Used especially in outbreaks
  
- In addition to cleaning
- Expensive
- Requires room downtime
  
- No convincing evidence that it is better than a thorough physical clean



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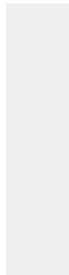
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## The patient environment

- Minimise devices
  
- Minimise equipment clutter
  - Impedes cleaning
  - Acts as an environmental reservoir



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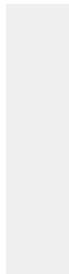
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## Improving the environment

- Maintenance of fabric
- Regular upgrading
  
- Infection Prevention and Control Building Guidelines for Acute Hospitals in Ireland SARI 2008:

*"Newly built acute hospital inpatient accommodation should comprise 100% single-patient rooms. Newly built non-acute hospital inpatient accommodation should comprise a minimum of 50% single-patient rooms."*



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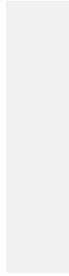
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## Environmental Audit

- Robust audit tool
- Multidisciplinary team
- Management support
- Timely report
- Feedback and QIP
- Report to senior management



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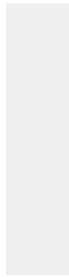
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## Continuous cleaning

- The healthcare environment is, therefore, constantly at risk of contamination
- Cleaning should also be constant. Needs to be resourced and valued in the healthcare setting



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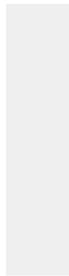
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## epic3 Guidelines 2014

- The hospital environment must be visibly clean; free from non-essential items and equipment, dust and dirt; and acceptable to patients, visitors and staff.
- Levels of cleaning should be increased (and disinfection considered) in cases of infection/colonisation when a known or suspected pathogen can survive in the environment, an environmental contamination may contribute to the spread of infection.



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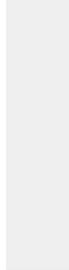
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## epic3 guidelines 2014

- Equipment used in patient care must be cleaned and decontaminated after each use with products recommended by the manufacturer.
- Healthcare workers need to be educated about maintaining a clean and safe care environment.



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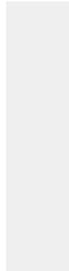
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## What if we can't do it?

- Antibiotic resistance is increasing, extending and becoming more complex
- The consequences of not performing hand hygiene and maintaining a safe patient environment have become more grave.
- Increased Morbidity and Mortality
- Ever increasing resistance to antibiotics, with some infections becoming untreatable
- > 50% mortality with CPE bloodstream infections



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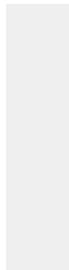
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## Conclusion

- Standard Precautions for ALL patient at ALL times (Hand and Environmental hygiene)
- Systems in place for cleaning, maintaining and improving the environment. It is everyone's responsibility
- Maximise available resources and aim to increase budgets for cleaning
- Healthcare associated infections do happen frequently. Learn from these incidents



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