



A TRADITION OF INDEPENDENT THINKING

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Safe Patient Care "Bugs and Drugs" The ongoing challenge of MDROs and AMR

2017

@SPC2016Cork ***#bugsndrugs***

Safe Patient Care 2017: The Ongoing Challenge of MDROs and AMR

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

Dr D Corcoran

Infection Prevention and Control

What has been will be again,
what has been done will be done again;
there is nothing new under the sun.

Ecclesiastes 1:9

Infection Prevention and Control

- Hand hygiene
- Safe patient environment

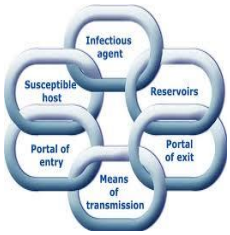
Infection Prevention and Control

In Addition

Antimicrobial stewardship

Surveillance Laboratory
Clinical

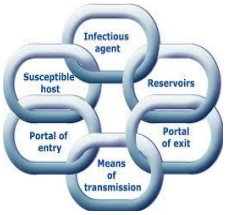
Why hand hygiene and environmental cleanliness?



Chain of infection:important issues in control of infection

- 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

Environment as reservoir increases risk



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

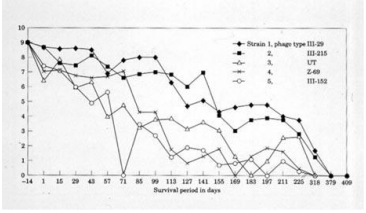
But the hospital environment is clean, isn't it?

- Lax *et al* (2017), Science Translational Medicine

- Examined the flora in a new hospital (1 year)
- Flora on surfaces was the same as patient's
- Patients initially acquired flora predating stay
- Patient flora subsequently altered initial flora

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

Persistence in the environment



Persistence in the environment

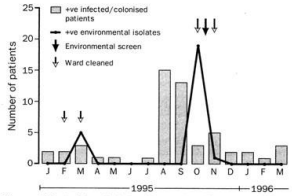


Figure: **Effect of hospital cleaning on GRE in patients and environment**
Chadwick and Oppenheim, 1996

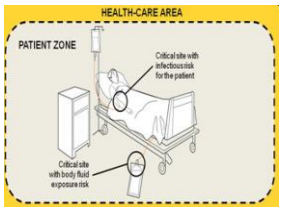
Persistence in the environment

RESULTS

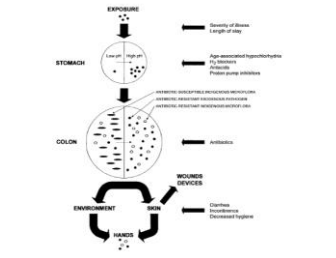
- Persistence of bacteria

Type of bacterium	Duration of persistence (range)
Acinetobacter spp.	3 days to 5 months
Bordetella pertussis	3 – 5 days
Campylobacter jejuni	up to 6 days
Clostridium difficile (spores)	5 months
Chlamydia pneumoniae, C. trachomatis	< 30 hours
Chlamydia psittaci	15 days
Corynebacterium diphtheriae	7 days – 6 months
Corynebacterium pseudotuberculosis	1–8 days
Escherichia coli	1.5 hours – 16 months
Enterococcus spp. including VRE and VSE	5 days – 4 months
Haemophilus influenzae	12 days

Bacterial microflora in patient room



Complicated by clinical interventions



One further example

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

J Hosp Infect 2012;**80**:1-5. Best *et al*

- Aerosols containing *Clostridium difficile*
- Recoverable from air 25cm above seat
- Surface contamination noted from 90 min

Conclusion

The whole world is covered in a veneer of faeces

It is only the thickness of that veneer that varies

G. Keusch

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

1. Problem organisms:(non-MDRO)

- Norovirus
- *Clostridium difficile*

Faecal spread. Survive well in the enviroment, forming a potential reservoir

NB Not all problem organisms in healthcare facilities are multidrug resistant.
Cleaning is every bit as relevant for these

2. Old reliables

- MRSA
  Shed from Skin, respiratory tract, wounds etc.

- VRE
  Shed from GI tract, may colonise skin, wounds etc.

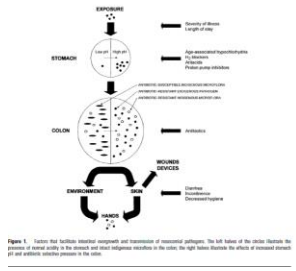
Survive very well in the environment.
Environment becomes a potential reservoir.

3. Multi-resistant Gram Negatives

- Extended spectrum ßlactamases (ESBL)
- Carbapenem resistant Enterobacteriaceae (CRE)
- Carbapenemase producing Enterobacteriaceae (CPE) (Not ESBL/Amp C+porin loss)

- Nomenclature complicated use ESBL or CRE

Multi-resistant Gram Negatives



Spread of resistance

- Determinants frequently on mobile genes (plasmids) so can spread from species to species
- Makes detection difficult
- Makes management difficult

Problems

- Almost untreatable infections
- No eradication regimen
- Gut carriage & epidemic potential
- Environmental contamination/reservoir

Enormous ICT workload

- Strict antimicrobial stewardship
- Strict infection control/cleaning /disinfection
- Screening, case finding, notification
- Time, money & effort

Where are the resistant organisms found?

- Screening for CRE in environment is difficult
  - Insensitive culture methods
  - Resistance is transferrable across species
- Surrogates
  - MRSA: shed from skin sites, wounds etc.
  - VRE: shed from GI tract, wounds etc

VRE outbreak

- VRE isolated from
  - Bedframes
  - Computer keyboards/mouse
  - Curtains
  - Door handles
  - Flat surfaces within patient area

i.e. within the patient zone/hand touch surfaces

MRSA in environment (not CUH)

- Furniture
- Floor
- Medical equipment
- Bed
- Flat surfaces
- Door handles
- Ventilator duct
- Radiator
- Nurse call bell

Mostly hand touch surfaces

CRE, VRE MRSA etc.

- Potentially anywhere in the environment
- Especially hospitals
- NB longer term care facilities

Management of the environment and MDROs

- Hand Hygiene

- Removes contamination from the environment
- Difficult
- Training
- Audit

- National programmes

Cleaning the environment

- Near-patient surfaces
- Sinks
- Mattresses
- Clinical equipment
- Treatment room
- Non-clinical areas

- Liaison with
  Nursing & other ward staff
  Hospital management
  Cleaning services
  Estates & facilities

Cleaning: logistics and problems

- Daily (ensuring hand touch surfaces cleaned)
- On discharge

- Logistics
  - Room preparation & patient moving
  - Turnaround times (post-cleaning intervals, esp H_2O_2)
  - Staff training & audits & monitoring
  - Specialist equipment & damage to materials… & people

Cleaning: how and what to use

- Standard, enhanced, deep…thorough
- Hot soapy water, detergent
- Hypochlorite
- Newer methods

- Ensure training in place to optimise cleaning of relevant sites

Cleaning: newer methods

- 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)

Hydrogen peroxide

- Reaches all areas
- Useful in outbreaks

- In addition to cleaning
- Expensive
- Requires room downtime

The patient environment

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

Carriage

- Carriage of GI organisms may be very prolonged (CRE, VRE). Duration unknown
- Skin carriage of MRSA may be sporadic but prolonged
- 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

Monitoring of cleaning

- Mulvey *et al JHI* 2011;**77**:25-30
- Confirms that visual inspection is not adequate
- Suggested a level of ATP bioluminescence may correlate to a degree with level of microbial soiling
- ATP/culture methods may help identify soiling and therefore risk if collected over time an interpreted accurately
- This is both difficult and expensive

Environmental Audit

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

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 environmenal contamination may contribute to the spread of infection.

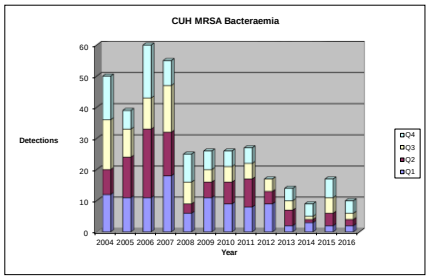
epic3 guidelines 2014

- 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.

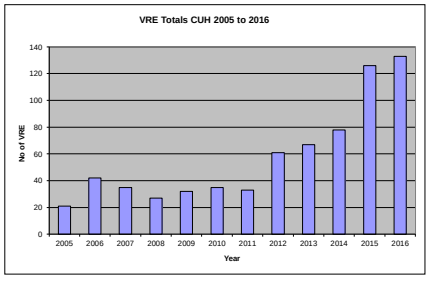
What if we can't do it?

- The consequences of not performing hand hygiene and maintaining a safe patient environment have become more grave.
- Morbidity and Mortality

MRSA bacteraemia



VRE colonisation



Consequences of CRE colonisation

- Tischendorf *et al* 2016 suggests a 16.5% risk of infection if colonised with CRE
- Mortality of CRE Bloodstream infection ranges 24%-41.5%

Should we be worried?

- Antibiotic resistance is
  - increasing within each antibiotic class
  - is extending to new antibiotic classes
  - is mediated by increasingly complex mechanisms within the organism
  - may be transferred from one species of bacterium to another
  - reduces antibiotic choice an may even remove the option of antibiotic treatment
  - The major problem not just for Infection Prevention and Control Teams but for all Health Care workers

THERE MAY BE NO LAST RESORT

Summary

- Standard Precautions for ALL patient at ALL times (Hand and Environmental hygiene)
- Systems in place for cleaning, and for the training and auditing required
- Maximise available resources and aim to increase budgets for cleaning
- Healthcare associated infections do happen frequently. Learn from these incidents