

**All That Glistens is Not Clean  
Dr. Elaine Cloutman-Green,  
A Webber Training Teleclass**

**All That Glistens is Not Clean**

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London

Hosted by Bruce Gamage  
Provincial Infection Control Network of BC

[www.webbertraining.com](http://www.webbertraining.com)

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- This talk will aim to discuss the current evidence for a role in the environment in transmission of HCAI and to evaluate the current suggested guidance for determining if an environment is safe for patients based upon its microbiology.

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### Healthcare Associated Infections

- The United Kingdom Department of Health defines healthcare associated infection (HCAI) as “any infection by any infectious agent acquired as a consequence of a person’s treatment by the UK National Health Service NHS or which is acquired by a health care worker in the course of their NHS duties”
- In high income countries HCAI affects approximately 5 – 15% of patients\*
- Low income countries rates are in the region of 15 – 19%\*

\*Pan S-C, Chen E, Tien K-L, Hung IC, Sheng W-H, Chen Y-C, et al. Assessing the thoroughness of hand hygiene: “Seeing is believing”. American Journal of Infection Control. 2014;42(7):799-801.

#### CDC/NHSN SURVEILLANCE DEFINITION OF HEALTH CARE-ASSOCIATED INFECTION

For the purposes of NHSN surveillance in the acute care setting, the CDC defines an HAI as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be no evidence that the infection was present or incubating at the time of admission to the acute care setting.

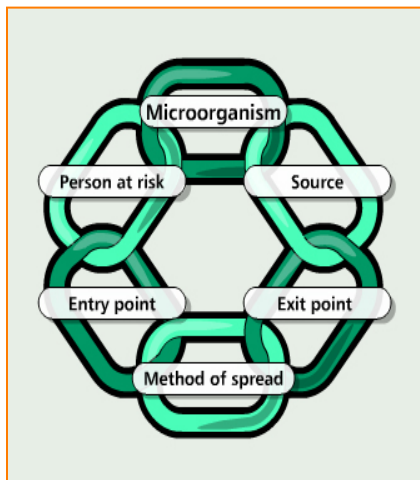
HAIs may be caused by infectious agents from endogenous or exogenous sources.

- Endogenous sources are body sites, such as the skin, nose, mouth, gastrointestinal (GI) tract, or vagina that are normally inhabited by microorganisms.
- Exogenous sources are those external to the patient, such as patient care personnel, visitors, patient care equipment, medical devices, or the health care environment.

Am J Infect Control. 2008 Jun;36(5):309-32. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting.

### Common Infection Control Interventions

- Cleaning
- Surveillance
- Personal protective equipment (PPE)
- Isolation
- Hand hygiene
- Typing
- Immunisation
- Antibiotic stewardship
- Device management



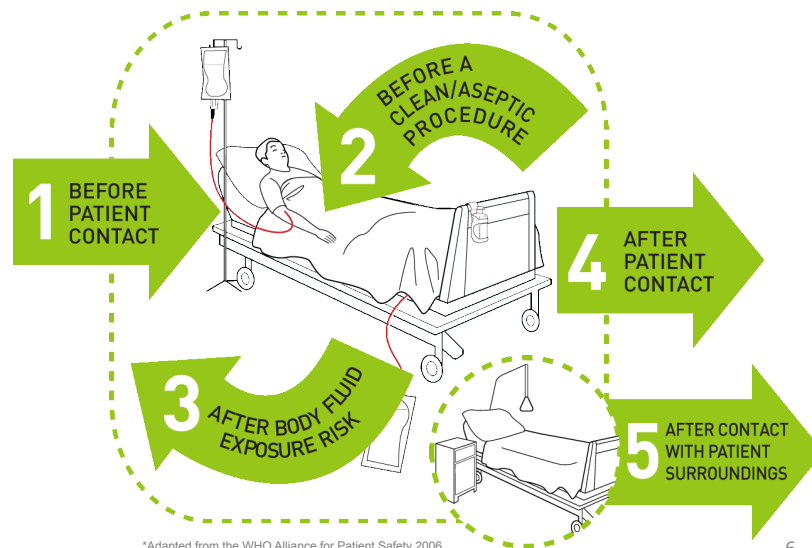
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## Hand Hygiene

- Hand contamination occurs by touching patients and the environment
- Hand hygiene is a simple but effective tool to reduce the spread of infections, but will it ever be enough on its own?
- Compliance with hand hygiene varies widely between groups of health care workers
- Not all stages of the WHO 'Five moments of hand hygiene' are complied with to the same extent
- Most audits do not capture all stages

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## Your 5 moments for hand hygiene at the point of care\*



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## Is Hand Hygiene the Only Answer?

- Hand hygiene compliance averages 50%<sup>§</sup> in the literature, at Great Ormond Street Hospital compliance is routinely ~95%
  - Mathematical modelling has indicated need >50% compliance to prevent VRE transmission<sup>#</sup>
  - Other studies have suggested >70% is required to prevent HCAI\*
  - Law of diminishing returns may apply with the greatest benefits seen in the first 20% of compliance<sup>#</sup>
  - When cleaning and/or hand hygiene fail the environment acts as a source
- <sup>§</sup>Huttunen R, Syrjänen J. Healthcare workers as vectors of infectious diseases. *European Journal of Clinical Microbiology & Infectious Diseases*. 2014.
- <sup>#</sup>Vernon MO, Trick WE, Welbel SF, Peterson BJ, Weinstein RA. Adherence with hand hygiene: does number of sinks matter? *Infect Control Hosp Epidemiol*. 2003;24(3):224-5.
- \*Traa MX, Barboza L, Doron S, Snyderman DR, Noubary F, Nasraway SA. Horizontal Infection Control Strategy Decreases Methicillin-Resistant *Staphylococcus aureus* Infection and Eliminates Bacteremia in a Surgical ICU Without Active Surveillance. *Critical Care Medicine*. 2014:1.

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## What Is Meant By the Environment?

- Air
  - Mechanically ventilated environments
- Water
  - Water sources on wards
    - Taps
    - Sterile water
    - Equipment
- Surfaces
  - Near patient and shared area

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**THE ROLE OF SURFACES**

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**A Retrospective View**

- 1968 E. H. Spaulding three categories of surfaces within clinical environments:
  - **Non-critical = most surfaces within bed spaces as they only come into contact with intact skin**
  - Semi-critical
  - Critical
- Maki (1982) said that the inanimate environment contributed negligibly to HCAI
- Despite this both the CDC and DoH have issued guidance on the frequency and standard of cleaning that should be reached

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What Needs To Happen for the  
Environment to be a Risk?

- Microorganisms must be able to contaminate the environment:
  - Skin scales
  - Aerosols/droplets
    - Vomit
    - Diarrhoea
    - Respiratory secretions
  - Dust
- Once there microorganisms need to be able to survive

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**Environmental Survival**

Organism	Infectious Dose (if known)	Length of Survival on Surfaces
<i>Staphylococcus aureus</i>	<15 Colony Forming Unit/10 <sup>6</sup> (oral dose)	7 days – >1 year
<i>Clostridium difficile</i>	1CFU (in mouse models)	5 months
<i>Klebsiella spp.</i>	No experimental evidence	<1 hour – 30 months
<i>E. coli</i>	10 CFU	<1 hour – 16 months
<i>Acinetobacter spp.</i>	No experimental evidence	3 days - 5 months
Adenovirus	<150 viral copies	7 days – 3 months
Norovirus	10 – 100 viral copies	Norovirus (including Feline Calicivirus) 8 hours – 14 days
<i>Pseudomonas aeruginosa</i>	10 <sup>8</sup> (oral dose)	6 hours – 16 months
VRE	No experimental evidence	5 days – 4 months

Kramer A, Schwebke I, Kampf G. BMC Infectious Diseases. 2006;6(1):130.

Weinstein RA, Hota B. Contamination, Disinfection, and Cross-Colonization: Are Hospital Surfaces Reservoirs for Nosocomial Infection? Clinical Infectious Diseases. 2004;39(8):1182-9. 12

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**Local Evidence That There Is a Role of the  
Environment**

- Local evidence from Great Ormond Street Hospital:
  - Outbreaks have been linked to specific objects acting as a source
  - Norovirus - 3 month outbreak linked to the staff biscuit tin
  - MRSA outbreak linked to a ventilation grid
  - 2 *Klebsiella pneumoniae* outbreaks linked to sinks

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**Experimental Evidence for Organism  
Movement in the Clinical Environment**

- Inoculation of cauliflower mosaic virus DNA onto phone in an NICU cubicle
- Virus spread to 58% of ward sampling sites within 7 days of inoculation
- Spread to all five other cubicles
- Door handles in other cubicles became positive first

- Oelberg DG, Joyner SE, Jiang X, Laborde D, Islam MP, Pickering LK. Detection of Pathogen Transmission in Neonatal Nurseries Using DNA Markers as Surrogate Indicators. *Pediatrics*. 2000;105(2):311-5.

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**Evidence Against the Environment  
Having a Role**

- One random cross over trial demonstrate that cleaning which reduced environmental contamination and hand carriage of *S. aureus* did not impact on MRSA acquisition

– Wilson APR, Smyth D, Moore G, Singleton J, Jackson R, Gant V, et al. The impact of enhanced cleaning within the intensive care unit on contamination of the near-patient environment with hospital pathogens: A randomized crossover study in critical care units in two hospitals. *Critical Care Medicine*. 2011;39(4):651-8.

- Two studies found that cleaning with disinfectant rather than detergent did not impact on rates of HCAI – focussed on floors

– Danforth D, Nicolle LE, Hume K, Alfieri N, Sims H. Nosocomial infections on nursing units with floors cleaned with a disinfectant compared with detergent. *The Journal of hospital infection*. 1987;10(3):229-35., Dettenkofer M, Wenzler S, Amthor S, Antes G, Motschall E, Daschner FD. Does disinfection of environmental surfaces influence nosocomial infection rates? a systematic review. *American Journal of Infection Control*. 2004;32(2):84-9.

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**Clinical Evidence for the Role of the  
Environment**

- An additional cleaner led to a reduction in Total Viable Counts (TVCs) and a reduction in HCAI MRSA
- As data directly linking environmental loads is difficult to interpret a different approach has been taken
- Links risk of acquisition to being admitted into a room previously occupied by a positive patient

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**Clinical Evidence for the Role of the  
Environment**

- Eight studies related to hospital transmission and previous occupation
- Based on VRE, *Acinetobacter baumannii*, *Clostridium difficile*, MRSA
- On average patients 73% (28.8% - 87.5%) more likely to acquire if previous room occupant colonised/infected

• Carling PC, Parry MF, Bruno-Murtha LA, Dick B. Improving environmental hygiene in 27 intensive care units to decrease multidrug-resistant bacterial transmission. *Critical Care Medicine*. 2010;38(4):1054-9.

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**MONITORING CLEANING  
EFFICIENCY**

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## Environmental Monitoring

- Undertaken for two main reasons:
  - To monitor cleaning
  - To detect specific pathogens
    - To ensure pathogen removal
    - To enable risk assessment
    - To hunt for environmental sources
- Select your sampling method linked to the reason you are sampling

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## Monitoring Cleaning

- Cleaning should aim to remove epidemiologically significant organisms
- Cleanliness is difficult to define and there is little consensus about what constitutes a clean surface:
  - Estimated that 5 – 70% of micro-organisms in patient bed spaces are there due to ineffective surface disinfection\*
  - Some commentators believe that expenditure on cleaning is only justified for aesthetic purposes#

\*Humphreys H. Self-disinfecting and Microbiocide-Impregnated Surfaces and Fabrics: What Potential in Interrupting the Spread of Healthcare-Associated Infection? *Clinical Infectious Diseases*. 2013;58(6):848-53

#Fraise AP. Decontamination of the environment. *Journal of Hospital Infection*. 2007;65:58-9.

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## Methods for Monitoring Cleaning

- Visual inspection
  - Qualitative data
- ATP
  - Quantitative data (although still swab based)
- Fluorescent marking
  - Qualitative data
- Total viable counts/aerobic colony counts
  - Quantitative data - sampling method undertaken using contact plates

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## Visual Inspection

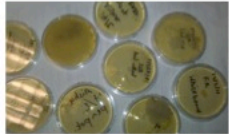



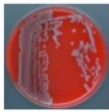




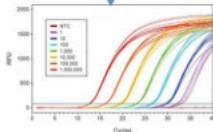

- Department of Health guidance:
  - Surfaces free of dirt, dust and debris
- Study found that of 82% of sites that were considered visual clean, only 30% were bacteriologically clean (using the Dancer surface standards)

• Al-Hamad A, Maxwell S. How clean is clean? Proposed methods for hospital cleaning assessment. *Journal of Hospital Infection*. 2008;70(4):328-34

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## Monitoring Microorganisms

Contact Plates	Swabs		
 Non-selective Selective  	<b>Direct Culture</b>   Dip slides	<b>Enrichment</b>   	<b>Molecular</b>    Enzyme based tests

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## TVC Interpretation Guidance

- Griffith cut off = 2.5CFU/cm<sup>2</sup> (60 CFU/contact plate)\*
- Dancer cut off = 5CFU/cm<sup>2</sup> (120 CFU/contact plate)#
- Assumptions of the Dancer criterion:
  - An increased microbial burden suggests insufficient cleaning
  - A heavy microbial burden masks the chance of finding a pathogen
  - If microbial contamination is heavy there is an increased chance of finding an epidemiologically related pathogen

\*Griffith CJ, Malik R, Cooper RA, Looker N, Michaels B. Environmental surface cleanliness and the potential for contamination during handwashing. *American Journal of Infection Control*. 2003;31(2):93-6

#Dancer SJ. How do we assess hospital cleaning? A proposal for microbiological standards for surface hygiene in hospitals. *Journal of Hospital Infection*. 2004;56(1):10-5.

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### London Hospitals Study

Summary of ward and outpatient aerobic colony count screening results using the suggested <2.5 CFU/cm<sup>2</sup> (60 CFU) and <5 CFU/cm<sup>2</sup> (120 CFU) standards

Location	Bed space <sup>a</sup> failures at <5 CFU/cm <sup>2</sup> standard	Bed space <sup>a</sup> failures at <2.5 CFU/cm <sup>2</sup> standard	Total sampling site <sup>b</sup> failures at <5 CFU/cm <sup>2</sup> standard	Total sampling site <sup>b</sup> failures at <2.5 CFU/cm <sup>2</sup> standard
PICU bed space	31 (78%) (n = 40)	39 (98%) (n = 40)	52 (11%) (n = 480)	137 (28%) (n = 480)
PICU shared ward area	N/A	N/A	30 (13%) (n = 240)	80 (33%) (n = 240)
New neurology HDU	33 (59%) (n = 56)	52 (93%) (n = 56)	59 (9%) (n = 657)	190 (29%) (n = 657)
Old neurology HDU	8 (50%) (n = 16)	16 (100%) (n = 16)	29 (19%) (n = 155)	43 (28%) (n = 155)
Outpatients	N/A	N/A	29 (20%) (n = 148)	62 (42%) (n = 148)
MICU bed space	10 (83%) (n = 12)	12 (100%) (n = 12)	8 (12%) (n = 69)	38 (55%) (n = 69)
MICU shared ward area	N/A	N/A	5 (11%) (n = 45)	13 (29%) (n = 45)
SICU bed space	16 (64%) (n = 25)	20 (80%) (n = 25)	52 (27%) (n = 192)	82 (43%) (n = 192)
SICU shared ward area	N/A	N/A	9 (20%) (n = 75)	24 (32%) (n = 75)
<b>Total</b>	<b>98 (66%) (n = 149)</b>	<b>139 (93%) (n = 149)</b>	<b>289 (15%) (n = 1986)</b>	<b>645 (32%) (n = 1986)</b>

HDU, high dependency unit; MICU, medical intensive care unit; N/A, not applicable; PICU, pediatric intensive care unit; SICU, surgical intensive care unit.

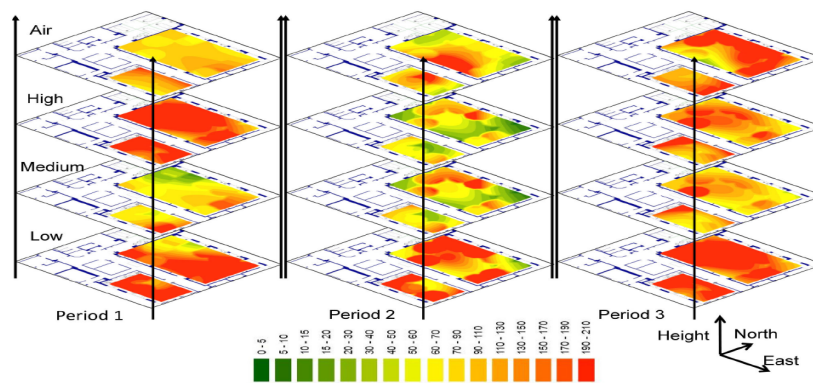
<sup>a</sup>Bed space includes all sampling sites tested within that bed space.

<sup>b</sup>Total sampling sites includes all samples within that area.

- Cloutman-Green E, D'Arcy N, Spratt DA, Hartley JC and Klein N. How Clean is Clean – Is a New Microbiological Standard Required? Am J Infect Control. 2014 Sep;42(9):1002-3

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### A Different Way to Use TVC Data



**Estimation of the counts of micro-organisms.** Results were adjusted on bedside, bed occupancy, height level (for surface analysis), Ward and location. Total Viable Count (TVC) estimations for the three cross-sectional surveys at the different height levels including air sampling are presented at each location. The coloured scale showed the values of TVC.

\* Gaudart J, Cloutman-Green E, Guillas S, D'Arcy N, Hartley JC, Gant V, Klein N. Healthcare environments and spatial variability of healthcare associated infection risk: cross-sectional surveys. PLoS One. 2013 Sep 19;8(9):e76249

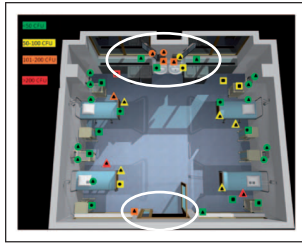
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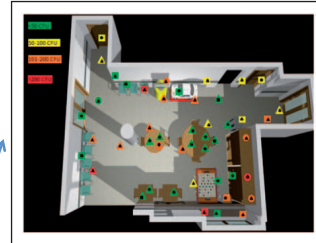
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### The Same Technique May Not Be Right for All Areas

- Ward Space
- Outpatient Space



Ward sampling sites and colony forming unit (CFU) recovery. Circles indicate high height objects, squares for medium height and triangles for low. Internal shapes in black indicate touch-frequency; circles for high, squares for medium and triangles for low. Colours are representative of CFU counts as per the figure key.



Outpatient's area sampling sites and colony forming unit (CFU) recovery

Outpatients have higher levels of contamination that are more generally distributed

- D'Arcy N, Cloutman-Green E, Lai K, Margaritis D, Klein N, Spratt DA. Potential exposure of children to environmental microorganisms in indoor healthcare and educational settings. *Indoor and Built Environment*, May 2014; vol. 23, 3: pp. 467-473

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### Relationship Between TVCs and Pathogens

Site Sampled	TVC	Species Cultured
Crash trolley	6	<i>Pantoea</i> species
Exit doors	0	<i>Enterobacter cloacae</i>
Exit doors	0	<i>Klebsiella</i> species
Floor under sink	148	<i>Pantoea</i> species
Floor under sink	150	<i>Klebsiella</i> species
Floor under sink	180	<i>Pantoea</i> species
Floor under sink	188	<i>Enterobacter</i> species
Nurses station	39	<i>Pantoea</i> species
Phones	65	<i>Pantoea</i> species
Suspended shelf surface	42	<i>Enterobacter cloacae</i>
Trolley surface	0	<i>Pantoea</i> species

- One study found a significant association between CFUs >2.5/cm<sup>2</sup> and MRSA detection from the same site<sup>#</sup>
- Other studies have found no correlation between TVCs and MRSA\*
- Our study for Enterobacteriaceae did not indicate a correlation
  - We used enrichment culture

<sup>#</sup> Dancer SJ, White L, Robertson C. Monitoring environmental cleanliness on two surgical wards. *International Journal of Environmental Health Research*. 2008;18(5):357-64.

\* Al-Hamad A, Maxwell S. How clean is clean? Proposed methods for hospital cleaning assessment. *Journal of Hospital Infection*. 2008;70(4):328-34., Galvin S, Dolan A, Cahill O, Daniels S, Humphreys H. Microbial monitoring of the hospital environment: why and how? *Journal of Hospital Infection*. 2012;82(3):143-51., Lemmen SW, Häfner H, Zolidann D, Amedick G, Luticken R. Comparison of two sampling methods for the detection of Gram-positive and Gram-negative bacteria in the environment: moistened swabs versus Rodac plates. *International Journal of Hygiene and Environmental Health*. 2001;203(3):245-8.

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**Methods for Monitoring Specific Pathogens**

- Dancer has also suggested that monitoring could be done for specific pathogens
- This is the approach that has been chosen for Great Ormond Street Hospital
- Screening can be performed using:
  - Selective contact plates
  - Direct plating
  - Enrichment – most commonly technique used for bacteria
  - Molecular techniques – used for viruses

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**You May Not See It But.....**

<b>Pre Clean</b>	<b>Cubicle 8</b>	<b>Cubicle 5</b>	<b>Cubicle 4</b>
Floor under sink	Not detected	36	32
Clinical waste bin	36	33	33
Chair arms	33	32	36
Bathroom door handle	35	34	35
Telephone	32	32	35
Bathroom taps	37	Not detected	34
Mattress top (patient)	32	37	37
Bed frame	33	33	37
Trolley	34	37	37
Window sill	39	35	39
Exit door handle	36	34	37
Corridor floor	36	32	Not detected

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## The Importance of Monitoring Cleaning

- BMT cubicles occupied by Adenovirus positive patients
- Post cleaning data (unpublished data)
  - Over a 5 year (2005-2009) period 794 surfaces screened in 48 cubicles
  - All cubicles passed a visual inspections
  - 28% of surfaces sampled were detected as positive
  - Objects present in cubicles such as: bed frames, mattresses, telephones, bathroom taps, exit door handles, and chair arms, were the objects most likely to be contaminated
  - Chair arms being significantly linked to contamination ( $p=0.008$ )

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## Cleaning Monitoring Algorithm

- On the basis of monitoring data a new algorithm was produced to decide whether a room was safe for patient admission
  - The cubicle is opened with no further cleaning required if no site has an adenovirus CT of  $<39$ .
  - If the cubicle has two sites with CTs of no lower than 34, then those sites are re-cleaned twice using NaDCC and the cubicle can be re-opened, as long as the sites positive to do not include the floor inside the room. If the floor inside the cubicle is positive than the cubicle undergoes a repeat 'deep clean' and is re-screened.
  - If the cubicle has more than two sites with a CT of 34 – 38 or if any one site has a CT of lower than 34, then the entire room must have a repeat 'deep clean' and be re-screened in full before opening.

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<b>Site</b>	<b>Post 1st L3C</b>	<b>Post 2nd L3C</b>	<b>Post 3rd L3C (untrained)</b>	<b>Post 3rd L3C (rescreen - trained)</b>
Floor under sink	34	38	40	Not detected
Clinical waste bin	35	39	Not detected	33
Chair arms	35	41	38	35
Bathroom door handle	Not detected	44	Not detected	38
Telephone	33	36	Not detected	35
Bathroom taps	Not detected	Not detected	Not detected	Not detected
Mattress top (patient)	Not detected	(parent) 37	(parent) 40	(parent) 38
Bed frame	39	(parent) Not done	(parent) Not detected	(parent) 35
Trolley	Not detected	41	Not detected	insufficient
Window sill	41	Not detected	Not detected	36
Exit door handle	Not detected	41	Not detected	40
Corridor floor	43	37	45	36

**OTHER MONITORING METHODS**

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## ATP

- adenylypyrophosphatase triphosphatase (ATPase)  
= used as a surrogate for microbial contamination
- Variance between systems
- Need to establish own hospital thresholds (Lewis 2008 suggests 250 relative light units)
- Not specific for microorganism contamination –  
can cross react with cleaning products and some materials
- Gives an immediate quantitative figure to help cleaners

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## Fluorescence

- Application of fluorescent markers to surfaces prior to cleaning, then study whether markers are removed
- Periodic qualitative check of cleaning
- Supposed to correlate well to ATP measurement\*
- When used to measure hospital cleaning 50% had marker removed, increasing to 82% with cleaning staff intervention

(Carling PC, Parry MF, Bruno-Murtha LA, Dick B. Improving environmental hygiene in 27 intensive care units to decrease multidrug-resistant bacterial transmission\*. Critical Care Medicine. 2010;38(4):1054-9.)

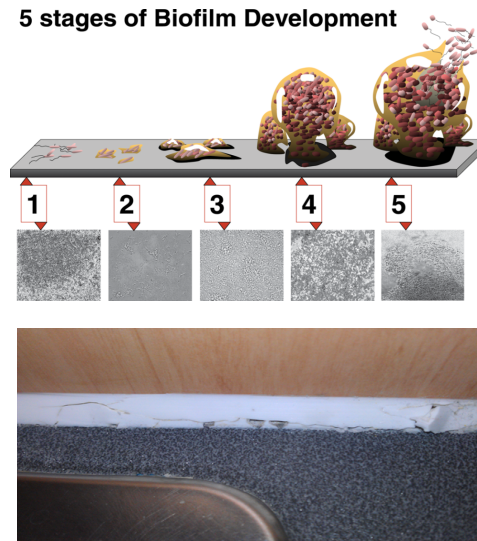
- \*Boyce JM, Havill NL, Havill HL, Mangione E, Dumigan DG, Moore BA. Comparison of Fluorescent Marker Systems with 2 Quantitative Methods of Assessing Terminal Cleaning Practices. Infection Control and Hospital Epidemiology. 2011;32(12):1187-93.

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**Issues With Routine Cleaning**

- Biofilm protect organisms within them
- Sessile state makes organisms intrinsically less sensitive
- Biofilms are often mixed species
- Increasing cleaning to remove biofilms can have unexpected consequences



**Novel Decontamination Technologies**

- Hydrogen peroxide
  - Two main platforms:
    - Glossair
    - Bioquell
  - Either dry mist or vapour depending on system
  - Safety issues possible with use
  - VRE acquisition has been reduced by 80% through use
- UV-C
  - Virucidal
  - Targets nucleic acids
  - Light travels in straight lines – doesn't work well on complex shapes due to shadows\*
  - Limited studies currently available

(Passaretti CL, Otter JA, Reich NG, Myers J, Shepard J, Ross T, et al. An Evaluation of Environmental Decontamination With Hydrogen Peroxide Vapor for Reducing the Risk of Patient Acquisition of Multidrug-Resistant Organisms. Clinical Infectious Diseases. 2012;56(1):27-35.)

\*Moore G, Ali S, Cloutman-Green EA, Bradley CR, Wilkinson MA, Hartley JC, Fraise AP, Wilson AP. Use of UV-C radiation to disinfect non-critical patient care items: a laboratory assessment of the Nanoclave Cabinet. BMC Infect Dis. 2012 Aug 3;12:174

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## Decontamination is NOT Cleaning

- Novel decontamination technologies **decontaminate** they **DO NOT CLEAN**
- Success of technologies depend upon prior cleaning
- Increased safety = increased cost and service disruption
- If can clean properly may not be worth the investment\*



\*Doan L, Forrest H, Fakis A, Craig J, Claxton L, Khare M. Clinical and cost effectiveness of eight disinfection methods for terminal disinfection of hospital isolation rooms contaminated with *Clostridium difficile* 027. *Journal of Hospital Infection*. 2012;82(2):114-21. 39

## Environmental Interactions are Complicated

- *C. difficile* cross over study
  - 2 elderly care medicine wards
  - Hypochlorite vs neutral detergent
  - Ward X had a decrease of cases from 8.9 – 5.3 cases/100 admission ( $p < 0.05$ )
  - Ward Y didn't show any significant decrease
- Decreasing HCAI is therefore complicated

• Wilcox MH, Fawley WN, Wigglesworth N, Parnell P, Verity P, Freeman J. Comparison of the effect of detergent versus hypochlorite cleaning on environmental contamination and incidence of *Clostridium difficile* infection. *Journal of Hospital Infection*. 2003;54(2):109-14.

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**IS IT ALL ABOUT CLEANING**

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**Is It All About Cleaning?**

- The hospital environment is complex
- Patients, staff and visitors interact with each other and the environment
- Cleaning even with interventions is rarely >85% successful\*
- However there are factors other than cleaning linked to risk:
  - Ward layout and content
  - Water sources – *Pseudomonas aeruginosa*, *Legionella*
  - Mechanical ventilation – protective and source isolation

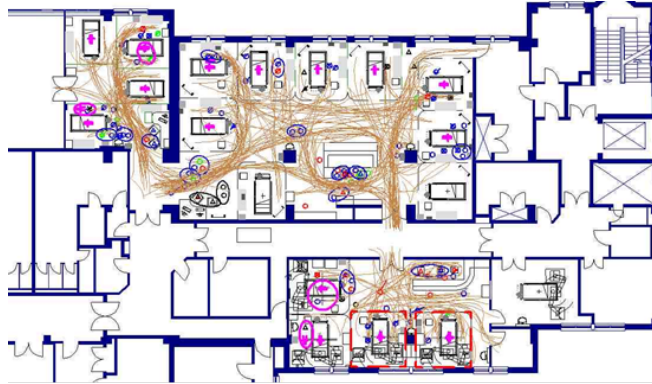
– \*Rutala WA, Weber DJ. Are Room Decontamination Units Needed to Prevent Transmission of Environmental Pathogens? *Infection Control and Hospital Epidemiology*. 2011;32(8):743-7.

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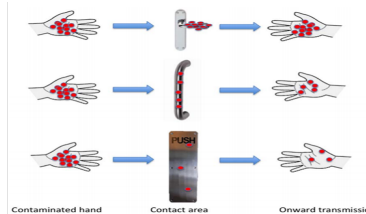
**Movement Tracing**



This figure shows the movement of all building users within the units for a period of 10 times 5 minutes of tracing in one day. This means that all movements through the units were traced for the duration of 5 minutes every 30 minutes for a total of 5 hours (10:30-13:00 and 14:30-17:00) on a working day.

**The Effect of Design**

- Sink visibility impacts on length and frequency of use, plus contamination
- Cloutman-Green E, Kalaycioglu O, Wojani H, Hartley JC, Guillas S, Malone D, Gant V, Grey C, Klein N. The important role of sink location in hand washing compliance and microbial sink contamination. *Am J Infect Control.* 2014. Vol. 42, Issue 5, Pages 554-555
- Door handle design impacts upon distribution of contamination
- Wojani H, Kehsa C, Cloutman-Green E, Gray C, Gant V, Klein N. Hospital door handle design and their contamination with bacteria: a real life observational study. Are we pulling against closed doors? *PLoS One.* 2012;7(10):e40171



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  - Serge Guillas
  - Hedijah Wojgani
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**Coming Soon**

*February 4 (South Pacific Teleclass)*

**IMAGERY AND INFECTION PREVENTION: AN UNDER APPRECIATED MEDIUM**

*Dr. Cath Murphy, Infection Control Plus, Australia*

*February 11 (Free WHO Teleclass - Europe)*

**WHO GUIDELINE AND SYSTEMATIC REVIEW ON HAND HYGIENE AND THE USE OF CHLORINE IN THE CONTEXT OF EBOLA**

*Dr. Joost Hopman, Radboud University Medical Center, The Netherlands*

*February 12* **SLEEP QUALITY IN ADULT HOSPITALIZED PATIENTS WITH INFECTION: AN OBSERVATIONAL STUDY**

*Prof. Farrin Manian, Harvard Medical School*

*February 19 (Free WHO Teleclass - Europe)*

**USE OF HYGIENE PROTOCOLS TO CONTROL THE SPREAD OF VIRUSES IN A HOTEL**

*Prof. Charles Gerba, University of Arizona College of Public Health*

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