

Debate – High Tech Decontamination of the Environment

H Humphreys, M Kiernan, P Carling, P Hoffman

Broadcast live from the 2014 conference of the Healthcare Infection Society, in Lyon

HIS2014
The 9th Healthcare Infection Society International Conference 2014 in association with the French Society for Hospital Hygiene
16 – 18 November 2014, Lyon Convention Centre, France

HEALTHCARE INFECTION SOCIETY
SPH

Debate – High-Tech Decontamination of the Environment

Motion
“This house believes that hospitals which do not use high tech decontamination are doing their patients a disservice”

Speaking in favour of the motion:
Prof. Hilary Humphreys and Prof Philip Carling

Speaking against the motion:
Mr. Martin Kiernan (for Prof Markus Dettenkofer) and Mr. Peter Hoffman

www.webbertraining.com November 18, 2014

Debate – High-Tech Decontamination of the Environment

Motion
“This house believes that hospitals which do not use high tech decontamination are doing their patients a disservice”

Hilary Humphreys
Department of Clinical Microbiology
The Royal College of Surgeons in Ireland (RCSI)
& Beaumont Hospital, Dublin, Ireland

9th International HIS International Conference
18th November 2014

Declaration

The views expressed are in a personal but professional capacity & do not necessarily reflect those of the RCSI or Beaumont Hospital

I have recent research collaborations with Pfizer (Ireland). I have also recently received lecture & other fees from AstraZenca & Astellas.

Why must we do better?

1. The healthcare environment is complex & represents a serious risk given patient vulnerability & microbial ingenuity
2. Current approaches are inadequate & endanger patients
3. Technological advances can make us less dependant on failed solutions

The Challenges in Surface Decontamination

The patient
High CFU (50/cm²) on skin of VRE patients

The pathogen
Many pathogens survive on dry surfaces for long periods

Practice
Previous occupancy of a room with a patient colonised with certain microbes increases the risk for subsequent patients

Infect Control Hosp Epidemiol 2011;32: 689-699

Survival of Microbes on Surfaces

- No difference between resistant & antibiotic susceptible variants
- Humid conditions enhance survival
- Inoculum size & the presence of protein affect survival

Bacterium	Survival range
<i>Acinetobacter</i> spp.	3 days to 5 months
<i>Clostridium difficile</i> (spores)	5 months
<i>Escherichia coli</i>	1.5 hours to 16 months
Enterococci (including VRE)	5 days to 4 months
<i>Klebsiella</i> spp.	2 hours to over 30 months
<i>Staphylococcus aureus</i> (including MRSA)	7 days to 7 months

BMC Infect Dis 2006; 6: 130

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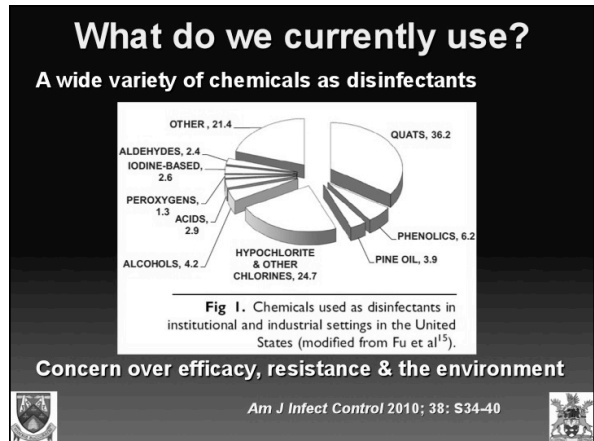
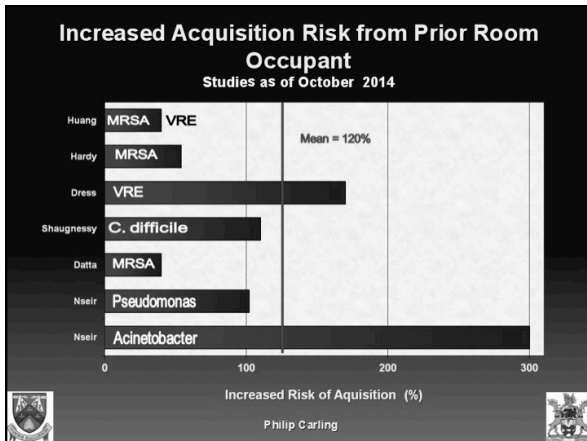
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MRSA Spread from Patients

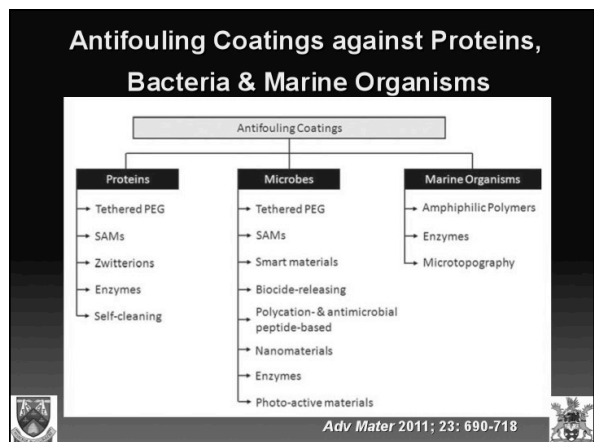
- 92/939 (10%) patients +ve for MRSA in extensive screening study
- 65/1,252 (5%) environmental sites positive adjacent to MRSA patients; mattresses, 14% & air, 8%
- MRSA isolated from environment of MRSA-ve patients, *Eur J Clin Microbiol Infect Dis* 2012, 3151-3161

Eur J Clin Microbiol Infect Dis
DOI 10.1007/s10096-014-2205-9



What can we do?

- Do what we currently do but do it better?
- Don't rely on human frailty by using walk away technology
 - Alter the surface components
 - Hydrogen peroxide & UV radiation



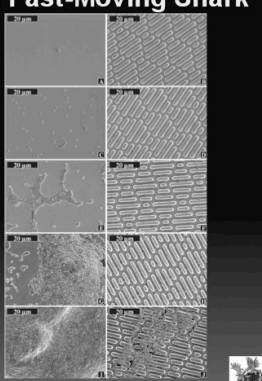
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Sharket AF™ – Skin of Fast-Moving Shark

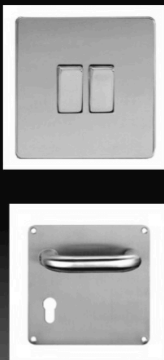
- Microbial retention depends on cell surface pits
- Diamond-like array
- *S. aureus* biofilm assay
- Delays biofilm formation on surface



Bionterphases 2007; 2: 89-94

Copper & HCAI

1. Copper has been used as an antimicrobial agent for centuries
2. Documented efficacy *in vitro*
3. Clinical trials show reduced microbial numbers & beginning to show reduced infection rates



J Hosp Infect 2012; 81: 217-223

Copper & *Clostridium difficile*

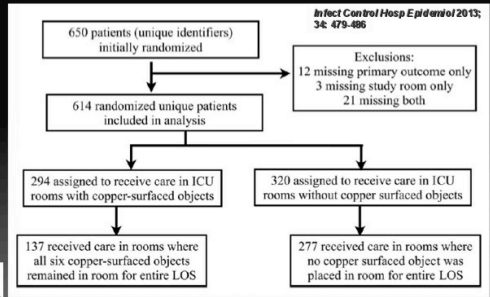
Stainless steel had no activity against *C. difficile*
2-3 log reduction in spores at 3 h with no impact from soil load

Surface/exposure time	Mean <i>C. difficile</i> cfu/mL remaining (range)	
	NCTC 11204	027
Stainless steel		
0 min	7.6×10^6 (6.8–8.3)	5.6×10^6 (5.5–5.6)
30 min	7.3×10^6 (6.8–7.8)	3.2×10^6 (2.4–4.0)
Copper		
0 min	1.2×10^6 (1.0–1.4)	4.6×10^6 (3.6–5.6)
30 min	0*	0*

J Antimicrob Chemother 2008; 62: 522-525

Copper Surface & HAI Rates

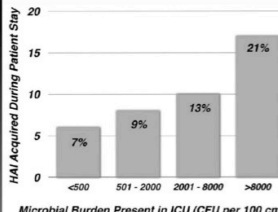
- Three medical centres, ICUs, coffee-alloy surfaces, weekly sampling of objects



Infect Control Hosp Epidemiol 2013; 34: 479-486

Copper Surfaces & HAI Rates

	Copper	Control	p
No HAI/colonisation	93%	87%	
HAI/colonisation	7%	13%	0.02
HAI only	3.4%	8.1%	0.13
Colonisation only	1.7%	3.8%	0.063
ICU LOS > 7 days	21.9%	21.9%	0.96
RIP in ICU	14%	16%	0.64



Infect Control Hosp Epidemiol 2013; 34: 479-486

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY | OCTOBER 2010, VOL. 31, NO. 10

ORIGINAL ARTICLE

Room Decontamination with UV Radiation

William A. Rutala, PhD, MPH; Maria F. Gergen, MT (ASCP); David J. Weber, MD, MPH

Organism	No. of samples	Log reduction (indirect)
MRSA	40	3.85
VRE	32	3.25
MDR <i>A. baumannii</i>	37	3.79
<i>C. difficile</i> spores	35	2.43

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Site	CFUs before UV	CFUs after UV
Toilet seat (6)	559	9
Tray table (8)	171	4
Bathroom floor near toilet (6)	940	53

Hydrogen Peroxide (HPO) & the Hospital Environment

Study & Microbe	Sites sampled	Sampling method	Decontamination Method	Result (+ve)
French et al. MRSA	Floors, beds, lockers, taps,	Moistened swabs	HPO vapour	66% to 1.2%
Boyce et al. C. difficile	Rooms, bathrooms	Moistened cellulose sponges	HPO vapour	25.6% to 0%
Bates et al. Serratia spp.	Incubators, plugs, curtains	Not stated	HPO vapour	8.3% to 0%
Otter et al. VRE	Floors, beds, frames, etc	Moistened swab	HPO vapour	6.7% to 0%

J Hosp Infect 2011; 78: 171-177

Endemic C. difficile & Enhanced Terminal Cleaning

American Journal of Infection Control 41 (2013) 537-41

Known pathogen	Pre-intervention	Intervention
Note		
Occupied	Daily cleaning with QAC	Daily cleaning with QAC
Newly vacated	Cleaning with QAC	Cleaning with QAC
VRE/MRSA/MDRO/NE		
Occupied	Daily cleaning with bleach	Daily cleaning with bleach
Newly vacated	Cleaning with bleach	Cleaning with bleach + HPV
C. difficile		
Occupied	Daily cleaning with bleach	Daily cleaning with bleach
Newly vacated	Cleaning with bleach	Cleaning with bleach + HPV
MRSA/C		
Occupied	Daily cleaning with bleach	Daily cleaning with bleach
Newly vacated	Cleaning with bleach	Cleaning with bleach + HPV
MRSA/C		
Occupied	2 Rounds of cleaning with bleach	2 Rounds of cleaning with bleach
Newly vacated	4 Rounds of cleaning with bleach	Cleaning with bleach + HPV

- No change in hand hygiene practice
- Antimicrobial use largely unchanged but levofloxacin use increased

CDAD Rate/1000 Patient Days

Hydrogen Peroxide & C. difficile NAP1

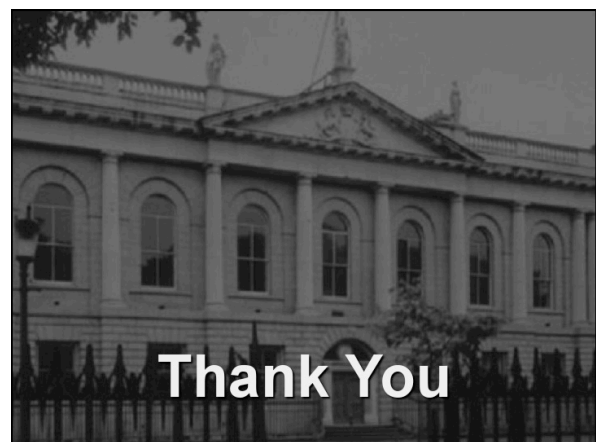
Infect Control Hosp Epidemiol 2008; 29:723-729

- Before & after study with HPV on five wards
- C. difficile cases, antimicrobial & PPI use monitored
- Sponge samples before 11/43 (25.6%) & after 0/37 (0%)
- Significantly lower rate of CDI on five affected wards (2.28 vs 1.28/1,000 patient days)

Cases per 1,000 patient-days

Conclusions

1. Current approaches do not prevent patients acquiring HCAI from the healthcare environment
2. Microbes in the hospital are adaptable
3. New technologies have proven antimicrobial activity & reduce infection rates
4. Trials are challenging & difficult to do
5. Vacating rooms should be possible if it were not for our over-crowded hospitals
6. Don't rely on human frailty



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Against the motion

Martin Kiernan - @emrsa15
Nurse Consultant
Southport and Ormskirk Hospital NHS Trust, UK

Disclosures

- Have been a member of advisory boards for Pfizer and Vernacare and have presented at educational meetings that have been supported by Advanced Sterilisation Products, Johnson and Johnson and GAMA healthcare
- The views presented before you are my own

Linking the Environment and Infection

- We have moved forward
 - Dettlenkofer (2004) AJIC
 - quality of evidence poor; no convincing evidence that disinfection of surfaces reduces infection
 - Donskey (2013) AJIC
 - High quality studies support environmental decontamination as a control strategy
- Debate continues
 - But not as much as it used to..
 - Cleaning was not considered to be an evidence-based profession



UV-visible marker showing failure of terminal cleaning
Carling PC *et al.* ICHE 29:1-7 (2008)

- Ultraviolet marker was used to test whether items felt to be high touch in patient isolation rooms would be cleaned
- Overall, 49% of objects/surfaces were not cleaned (range 35-81%)
- Wide variation in cleaning particular items
 - Poor were toilet handles, bedpan cleaners, light switches and door handles – under 30%

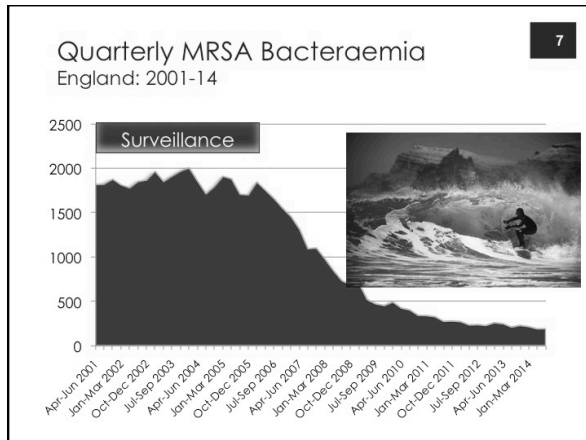
Hands are still an issue

- Door knobs, bed rails, curtains, instrument dials, computer keyboards contaminated by hands
 - MRSA on the door handles of 19% of rooms with MRSA
 - Oie S, Hosokawa I, Kamiya A. J Hosp Infect. 2002;51(2):140-3.
 - 42% of nurses contaminated gloves with MRSA with no direct patient contact but did touch the environment in rooms of MRSA patients
 - Boyce JM, Potter-Bynoe G *et al* ICHE 1997;18(9):622-7
- High-tech disinfection impossible with patients in-situ

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Evidence for cleaning as a control mechanism for MRSA?

- One extra cleaner into two wards (Mon-Fri); each ward receiving extra detergent-based cleaning for six months in a prospective cross-over design
 - Ten hand-touch sites on both wards screened weekly
 - Patients monitored for MRSA infection
 - Patient and environmental MRSA isolates were characterized using DNA finger-printing

Dancer SJ, White LF, et al BMC Med. 2009;7:28.

What did they find?

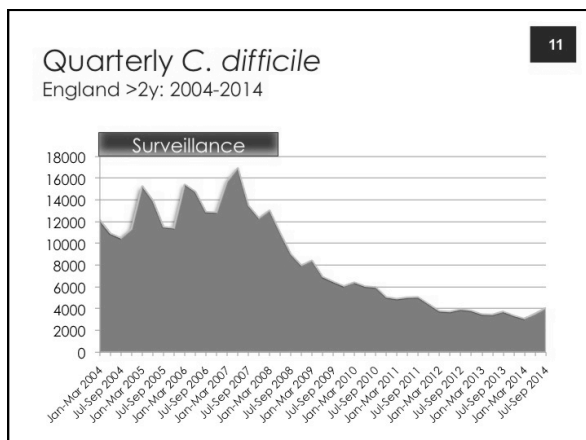
- Extra cleaner responsible for
 - 33% reduction in colony counts on hand-touch sites
 - 27% reduction in new MRSA infections
 - despite busier wards and more MRSA patient-days
- They expected 13 infections during enhanced cleaning periods but 4 occurred
 - Molecular studies demonstrated identical strains from hand-touch sites and patients
 - Some of which were months apart

Dancer SJ et al BMC Med. 2009;7:28.

Was the extra cleaning cost effective?

- Costing exercise
 - Cleaner earned £12,320 a year and the consumables were £1,100
 - One MRSA surgical site infection estimated at £9,000
 - Reduction by 5-9 cases
 - The hospital saved £45,000-£81,000 without the additional costs of cleaner/consumables
 - Annual saving for two wards was between £31,600 - £67,600

Dancer SJ et al BMC Med. 2009;7:28.



Is our focus wrong?

- there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns -- the ones we don't know we don't know
 - Rumsfelt, 2002

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We only act on what we know

- Contamination of the environment with *C. difficile* spores more common in symptomatic cases than asymptomatic carriers: 49% v 29%
 - But still significant in the asymptomatic group
 - Kim et al *J. Infect Dis* 1981
- We tend to focus high-tech solutions on what we know and not what we do not

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Transmission MDR Organisms

Nseir S, Blazejewski C, Lubret F et al. *Clinical Microbiology and Infection* 17(2) pp1201-8 (2010)

- Prospective cohort study: successive occupiers of ICU room at risk from previous occupants
 - *Pseudomonas aeruginosa* (OR 2.3, p<0.02)
 - *Acinetobacter baumannii* (OR 4.2, p<0.001)
- 'Quality' audits showed that 56% of rooms were not cleaned correctly
 - Failure in room door knobs (45%), monitor screens (27%) and bedside tables (16%)

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Missing information

- What did the 'quality' audits consist of?
 - Methodology, what was looked at, etc
 - No attempt to look at the results of the cleaning audits to see if transmissions occurred when cleaning was poor
 - No description of any divisions in cleaning duties
 - Cleanliness of clinical equipment not mentioned

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Who is really caring for the environment of care?

Dumigan DG, Boyce JM et al *AJIC* 38:387-92 (2010)

- Procedures for cleaning patient care environments, but often confusion about the division of labour when it comes to cleaning responsibilities
- Systems to monitor cleaning effectiveness are frequently suboptimal
 - Implemented ATP monitoring and reported improvement
 - looked at 'housekeeping' items only

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Audit of Equipment

Anderson RE, Young V et al, *JHI* 78(3) 2011

- Many items of *clinical* equipment in patient care do not receive appropriate cleaning attention
 - Average ATP score indicated that surfaces cleaned by professional cleaning staff were 64% lower than those by other staff (P=0.019)
- Nurses don't clean very well – of 27 items cleaned by clinical staff, 89% failed the benchmark

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'Low Risk' items

Creamer E., Humphreys, H; *JHI* (2008) 69 pp 8-23

- "While designated a low-risk item, it is clearly evident that the hospital bed poses a potential risk of infection to patients if not adequately decontaminated"
- Regular, e.g. weekly, decontamination is advised
 - Ideally decontaminate a bed by thermal disinfection between patients
 - If endemic with MRSA and VRE at least try to ensure that the critical components, e.g. mattresses and pillows, are processed in a thermal disinfection unit

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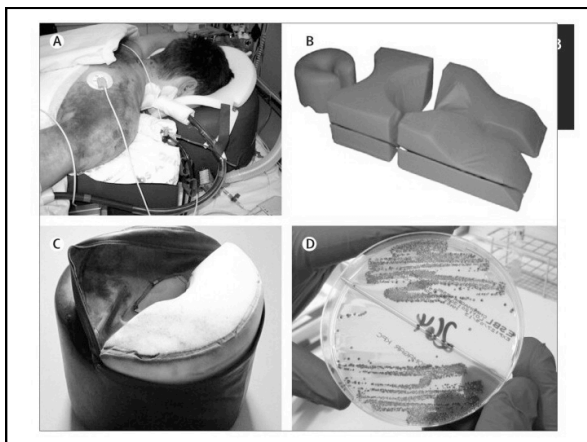


Examination of Pillow Cores
Mottar R., Roth M et al AJIC (2006) 34(5) E107-108

- Patient pillows and control (unused) tested
- Pillow seams and label tags were found to be mechanism for contamination allowing for drainage wicking from outside the pillow to the pillow core
- Multiple pathogens found growing within pillow cores of all patient pillows
 - correlation to organisms from colonised and infected patients
- Pillows do not just go under heads..

CPE contamination
Lippmann N., Lubbert C et al Lancet ID (2014)

- Large outbreak of KPC in Germany
 - Environmental reservoir sought
 - Ward pillows and mattresses not externally positive
 - Attributed to frequent steam cleaning of pillows and mattresses
 - Positioning pillows for ARDS internally contaminated and remained so for 6 months



Levels of evidence

- We seem to need high quality evidence that high tech disinfection is effective because of the cost
 - Yes the total spend on low tech may be the same and do we know whether this is effective?

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Using wipes for cleaning

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- Common use but label claims may be misleading
 - Mode of action, technique, absorption etc etc
 - No evidence for use against biofilms
 - Sattar SA, Maillard JY. AJIC 2013;41(5 Suppl):S97-104.
- Repeatedly using a wipe transfers organisms and C. difficile spores from contaminated to clean areas in significant numbers
 - Siani H, Cooper C et al. AJIC 2011;39(3):212–218
 - Cadnum J, Hurlless K et al, ICHE 2013; 34(4) 441-2

Please vote against the motion

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- Please note the question
 - That hospitals that do not use high technology solutions are doing their patients a disservice
- I have yet to see a study that has looked at Hospitals using High Tech vs Low Tech
- Concentrating the same effort (and spend) on low technology and education (convincing) may have the same (or better) effect
 - High-tech should not be the backstop for poor practice



This house believes that hospitals which do not use high tech decontamination are doing their patients a disservice”

Phil Carling

Professor of Clinical Medicine

*Boston University School of Medicine
Boston Medical Center, Boston, Massachusetts*

9th International Healthcare Infection Society International Conference
18th November 2014

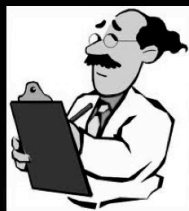
Declaration

The views expressed are in a personal but professional capacity & do not necessarily reflect those of Boston University School of Medicine

I have served as a consultant to Ecolab, Steris and AORN. I have patents licensed to Ecolab, Inc. St Paul, Minnesota.

“Hospitals which do not use high tech decontamination are doing their patients a disservice.”

You have heard the scientific evidence for our position....



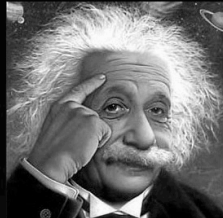
We would respectfully disagree

“Evidence of the effectiveness and cost-effectiveness of these technologies and their contribution to reductions in HCAI is not currently available.”

National Evidence-Based Guidelines for
Preventing Healthcare Associated
Infections in NHS Hospitals in England
January, 2014

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Now to look at the evidence



Introducing the Super Heroes!!



What's not to like about new toys?



These new machines are cool !! (D. Anderson, MD 2013)

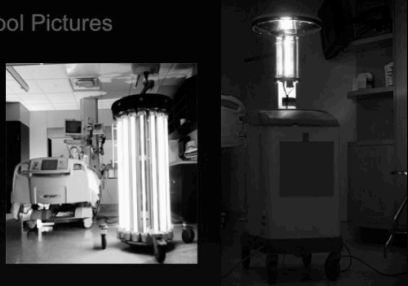
High-tech house cleaning

Advanced disinfection systems wield lethal weapons against pathogens



Evaluating Non-touch Technologies

Cool Pictures



While our colleagues may suggest to you that good clinical studies are needed

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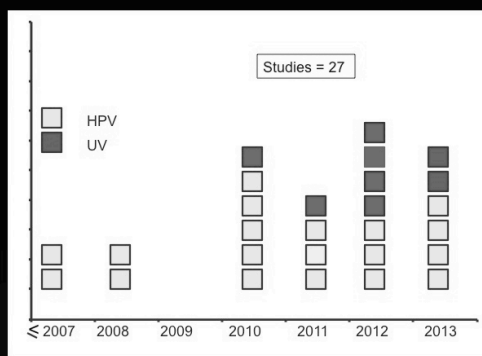
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While our colleagues may suggest to you that good clinical studies are needed

We say why??

1. Well designed patient room mock-up studies show they work fairly well.

2. There are plenty of published reports which say HPV and UVC work in clinical settings



Although it has been suggested that all of these reports relate to outbreaks, were not controlled and did not measure the impact of improved pre-cleaning...we would ask you to not take too seriously some of the limitations of evaluating outbreaks.

Problems with studying outbreaks

- “Post Hoc” reasoning
- Regression to the mean
- Single interventions are often not truly single when addressing an outbreak
- Defining an “outbreak”

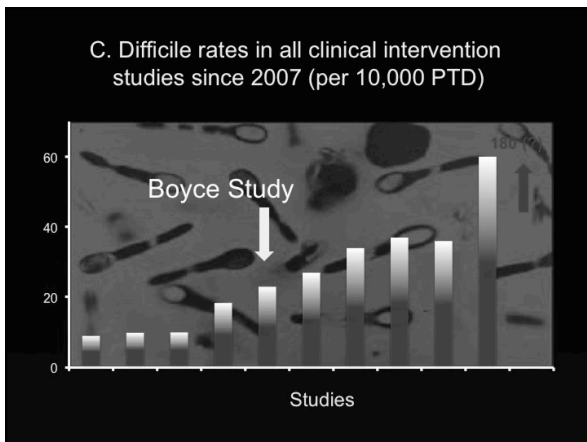
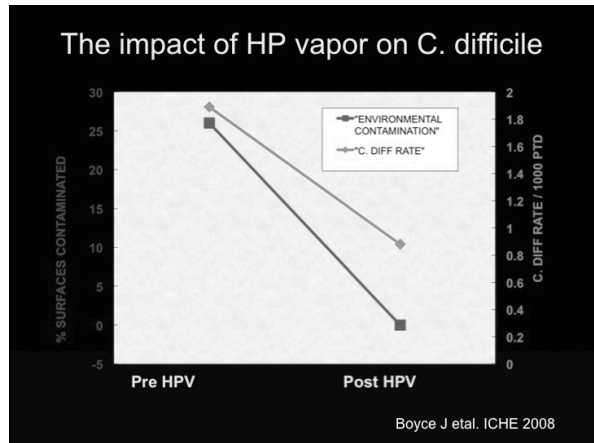
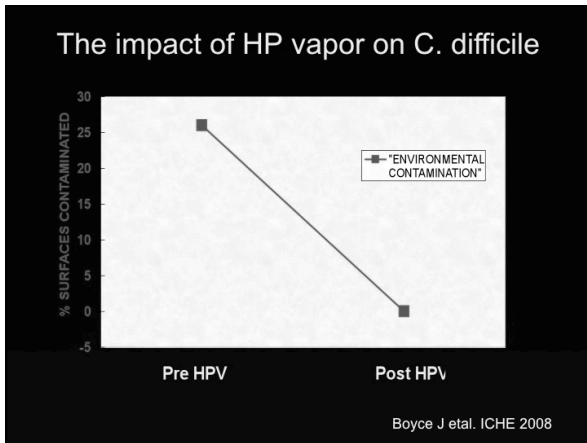
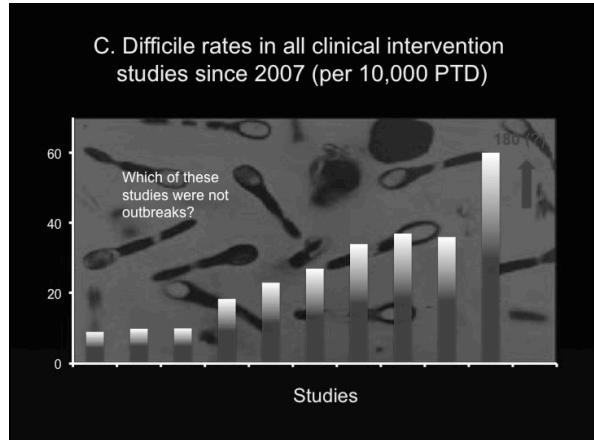
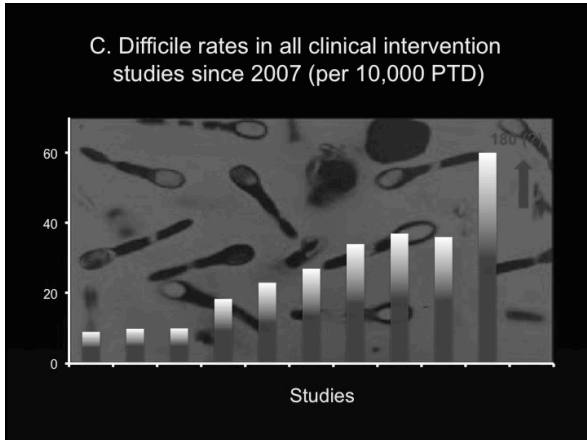
Although it has been suggested that all of these reports relate to outbreaks, were not controlled and did not measure the impact of improved pre-cleaning...we would ask...

What is an “Outbreak”?

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What about controlled studies?

4. Controlled studies are not the answer

- A. Given the cost, is it surprising that manufacturers are not interested?
- B. A single 5 hospital crossover study has just been completed in the USA and the results should start to be published in about a year although it may be difficult to draw unequivocal answers from it.

Should our patients be forced to wait?

Can 20% of US Hospitals be wrong?

HEALTHCARE
PURCHASING NEWS

2014

“Despite the high cost of these machines and significant personnel and logistical costs, we now have the opportunity to say we are using the best modern technology for our patients.”

Copper non-use guilt



He's already scared. The least you can do is slay the microscopic monsters that could make him sick.

Antimicrobial Copper touch surfaces continuously kill the bacteria* that cause hospital-acquired infections. Surrounding both the group and the hospital, it's critical that you combat them with the most effective antimicrobial surface material you can get: 99.9% improved Antimicrobial Copper. You can rely on study after scientific evidence and review the many Antimicrobial Copper products available to hospitals that are devoted to their patients.

www.anti-microbial-copper.com

Our colleagues may tell you about performance improvement programs for housekeepers with impressive results in terms of thoroughness of cleaning.

- But do we really want to empower these people??
- Think of the potential cost!



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While there is increasing evidence that daily cleaning is effective in clinical studies and that there is no role for machines in daily cleaning...We have solutions!

While there is increasing evidence that daily cleaning is effective in clinical studies and that there is no role for machines in daily cleaning...We have solutions!

Move the patient out of their room each morning (HPV) or shield the patient from UV rays with special blankets and eye shields (blinders)(UV).

While there is increasing evidence that daily cleaning is effective in clinical studies and that there is no role for machines in daily cleaning...We have solutions!

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Move the patient out of their room each morning (HPV) or shield the patient from UV rays with special blankets and eye shields (blinders)(UV).

Leadership



Empower patients to clean their own room as we are empowering them to optimize their own hand hygiene.



It has been rumored that there are logistical issues and hidden costs of actually using NTT or the need for complex systems to broadly implement its use given the fact that patients are discharged at all hours of the day and night.

It has been rumored that there are logistical issues and hidden costs of actually using NTT or the need for complex systems to broadly implement its use given the fact that patients are discharged at all hours of the day and night.

We are beginning to get some answers

We are beginning to get some answers

Abstract # 43723
Enhanced Terminal Room Disinfection: A Qualitative Summary of Perspectives from Environmental Services (EVS) and Nurse Managers
Rahman LP, Chen LP, Weber DP, Baska W, Moulding RP, Lewis SP, Seaton DP, Anderson DP and the CDC Prevention Epidemiology Program
DukeMedicine | Division of Infectious Diseases, Duke University Medical Center, Durham, NC | Respiratory Infection, University of North Carolina | School of Public Health, University of North Carolina | School of Medicine, University of North Carolina

Abstract # 43723
Enhanced Terminal Room Disinfection: A Qualitative Summary of Perspectives from Environmental Services (EVS) and Nurse Managers
Rahman LP, Chen LP, Weber DP, Baska W, Moulding RP, Lewis SP, Seaton DP, Anderson DP and the CDC Prevention Epidemiology Program
DukeMedicine | Division of Infectious Diseases, Duke University Medical Center, Durham, NC | Respiratory Infection, University of North Carolina | School of Public Health, University of North Carolina | School of Medicine, University of North Carolina

Nurses and EVS directors did encounter delays in D/C management when using UV-C...

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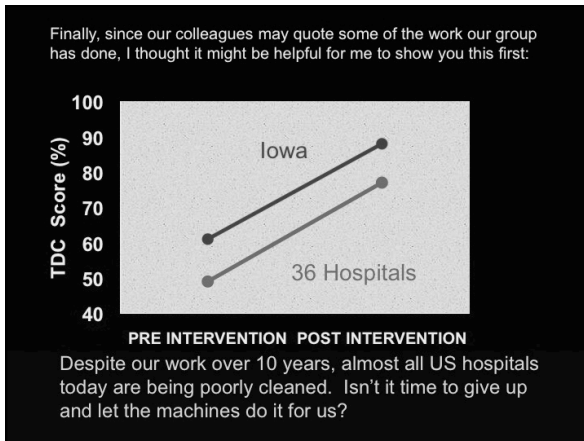
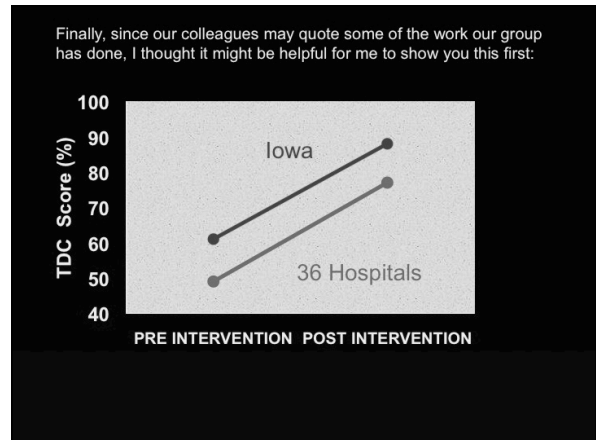
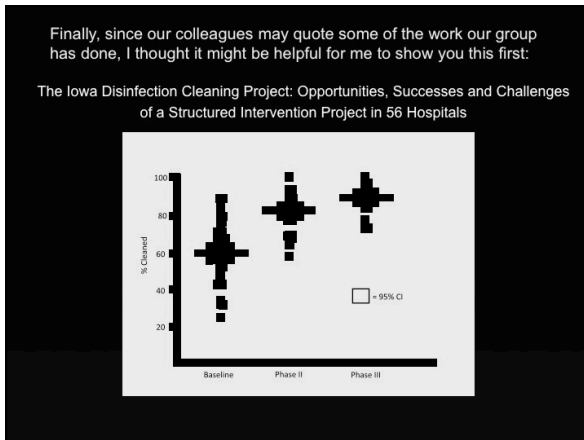
Leadership !!



Debate – High Tech Decontamination of the Environment

H Humphreys, M Kiernan, P Carling, P Hoffman

Broadcast live from the 2014 conference of the Healthcare Infection Society, in Lyon



HIS2014
The 9th Healthcare Infection Society International Conference 2014 in association with the French Society for Hospital Hygiene
16 – 18 November 2014, Lyon Convention Centre, France

HEALTHCARE INFECTION SOCIETY
SPH

Speaking against: “This house believes that hospitals which do not use high tech decontamination are doing their patients a disservice”

Peter Hoffman
Consultant Clinical Scientist
Antimicrobial Resistance and Healthcare Infections Reference Unit
Public Health England

A very broad topic

- I intend to address three technologies and show how, on a theoretical and evidential basis, they do not contribute to infection prevention in healthcare.

Antimicrobial surface coatings

- It is possible to buy many items with “proven” antimicrobial coatings:
 - Bedside lockers, pens, paper, document files, commodes, bedpan processors, paints, curtains, ceiling tiles, waste bins, socks, flooring, and many, many more

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Today GBP 28.26
 Price includes an International Service Fee. Taxes, Duties and Shipping additional.

Item #: 11048679

- Benny the Bear is super soft and safer for children
- Patented animal toy blends memory foam with silver nanotechnology
- World's first anti-microbial toy...more



Whitewater Expedition Baselayer Pants with S3 Anti-Microbial Scent Control
 Size: 4 602925 | M/L 4 710274 | This product is stocked seasonally

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 Ships to an address via FedEx, USPS or Ground Freight.

Antimicrobial surfaces

- These are most usually surfaces that contain a chemical disinfectant.
- That disinfectant will need to migrate from the surface into its target.
- So it must be soluble, but not too soluble or it will be all lost within the first few times that object is cleaned.
- Low solubility means that only low amounts will be released at a given time and available to act as a disinfectant.

BS ISO 22196:2011
 Measurement of antibacterial activity on plastics and other non-porous surfaces
 Status : Current Published : August 2011

ISO 22196 - outline

- The test inoculum is applied as a liquid to the test surface
- Inoculum cultured after 24 hours exposure; survivors enumerated
- If there is a reduction of 1,000-fold (3 log₁₀) or greater, the test has been passed.

- ISO 22196 uses a bacterial inoculum that is 1 part of nutrient broth in 500 parts of distilled water – virtually no organic matter.
 How does this relate to reality?
- *Organic matter inactivates disinfectants, particularly low concentrations of disinfectant*
 ➤ *This is not how patients produce contamination.*
- *It is highly probable that the very low concentration of disinfectant in liquids on antimicrobial surfaces would be inactivated by the organic matter present in most real-life contamination.*

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- The liquid inoculum is applied to the test surface, then covered by a film and put inside a petri dish that is then closed. The inoculum remains liquid throughout the test.
 - So disinfectant can migrate out of the surface and into its target for the whole of the test period
- How does this relate to reality?
- *Real life contamination is usually deposited on a surface by dry contact or by slightly moist contact that will dry rapidly.*
 - *This test uses far more effective contact between disinfectant and target than will occur in the majority of real-life instances.*

- The test exposure period is 24 hours, after which a pass will occur if there is a greater than 1,000-fold ($3 \log_{10}$) reduction in the bacterial challenge.

How does this relate to reality?

- *There are many important instances where sequential contacts occur far more rapidly than 24 hours.*
- *To demonstrate disinfectant activity after 24 hours does not show practically useful activity.*

- The test exposure is at 37°C, not normal room temperature.

How does this relate to reality?

- *The hotter the environment, the faster the microbicidal activity.*
- *Use of an elevated temperature will exaggerate any microbicidal effect.*

- Other microbes?

- Viruses (e.g. noro, BBVs, etc.): Some, particularly the non-enveloped viruses such as noro, are not susceptible to some of the antimicrobials in coatings. BBVs would be deposited in high organic matter.
- Bacterial spores (e.g. *Clostridium difficile*): These are highly unlikely to be susceptible to the antimicrobials in coatings.

- The hazard is that, if users are convinced that the products do what they think they do, cleaning or disinfection will not take place.
"..... but it kills all the germs. Why do I need to clean it?"

Photocatalytic antibacterial surfaces

Microbicidal action from hydroxyl radicals resulting from UV on titanium dioxide.

- Assessed by: *BS ISO 27447:2009 Fine ceramics (advanced ceramics, advanced technical ceramics). Test method for antibacterial activity of semiconducting photocatalytic materials*

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BS ISO 27447:2009

- Uses 1 in 500 dilution of bacterial suspension in water as inoculum (no spores, no viruses)
- Done in a petri dish lined with wet filter paper, the inoculum covered by a thin film then petri dish closed with a “moisture conservation glass” - does not dry for the whole exposure period
- Exposure period 8 hours and upwards

Photocatalytic antibacterial surfaces

- There is nothing within current testing methods that suggests photocatalytic antibacterial surfaces in healthcare will have significant activity a reasonable time-frame and in their typical use conditions

Hydrogen peroxide non-contact systems

- The systems divide into those that use gaseous H₂O₂ – essentially fumigation (“vapour”) and those that use a fine spray: fogging (“mist”, “droplets”).
- The fumigant will disperse & penetrate better, no shadowing
- *But does it make a difference?*

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

Catherine L. Passarelli,^{1,2} Jonathan A. Otter,³ Nicholas G. Reich,^{1,4} Jessica Myers,¹ John Sheppard,¹ Tracy Ross,¹ Karen C. Carroll,¹ Pam Lipsch,¹ and Trish M. Pear^{1,5}

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

Results. The prior room occupant was known to be infected or colonized with an MDRO in 22% of 6350 admissions. Patients admitted to rooms decontaminated using HPV were 64% less likely to acquire any MDRO (incidence rate ratio [IRR], 0.36; 95% confidence interval [CI], 19–70, *P* < .001) and 80% less likely to acquire VRE (IRR, 0.20; 95% CI, .08–.52, *P* < .001) after adjusting for other factors. The risk of acquiring *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus*, and multidrug-resistant gram-negative rods individually was reduced, but not significantly. The proportion of rooms environmentally contaminated with MDROs was reduced significantly on the HPV units (relative risk, 0.65, *P* = .03), but not on non-HPV units.

Conclusions. HPV decontamination reduced environmental contamination and the risk of acquiring MDRO compared with standard cleaning protocols.

All MDRO?

- Discussion: “MRSA, MDR-GNR, and *C. difficile* acquisitions were not independently reduced when HPV was used”
- Results: “The significant reduction in MDRO acquisitions was mainly driven by the reduced incidence of VRE acquisition, which was approximately 5 times less likely in the MDRO-HPV cohort”

Study design

Intervention wards (H ₂ O ₂ fumigation)	Surgical ITU
	Neurosurgical ITU
	“High risk” surgical unit
Control wards (conventional environmental decontamination)	Medical ward
	Cardiothoracic surgical ward
	Surgical oncology

Discussion: “Our study has several limitations neither rooms nor units were randomly assigned the intervention, which may have introduced bias”

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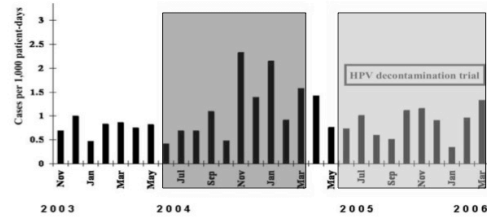
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Hydrogen peroxide fumigation against *C. difficile*

- Boyce et al *Infection Control & Hospital Epidemiology* (2008) 29: 723-9. "Impact of hydrogen peroxide vapor room decontamination on *Clostridium difficile* environmental contamination and transmission in a healthcare setting"
- "Intervention. Intensive HPV decontamination of 5 high-incidence wards followed by hospital-wide decontamination of rooms vacated by patients with *C. difficile*-associated disease".
- Incidence of *Clostridium difficile* associated disease (CDAD) was significantly lower during the intervention period than during the pre-intervention period on those 5 wards (1.28 vs 2.28 per 1,000 patient days) and hospital-wide (0.84 vs 1.36).

Hospital-wide *C. diff* incidence
Boyce et al



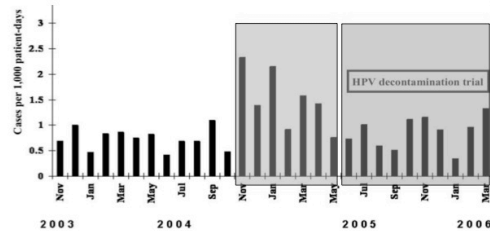
The pre-intervention period was June 2004 to March 2005; the intervention period was June 2005 to March 2006
November '04 to May '05: Isolation, contact precautions, soap & water for hand hygiene, hypochlorite disinfection. June '05 to March '06: Hydrogen peroxide fumigation

Hospital-wide *C. diff* incidence Boyce et al

Methods:

- "Because there may be seasonal variation in the incidence of CDAD, we compared the incidence of CDAD during the 10-month intervention period with the incidence during the same 10-month period in the preceding year"

Hospital-wide *C. diff* incidence
Boyce et al



The pre-intervention period was June 2004 to March 2005; the intervention period was June 2005 to March 2006
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Summary

- There is pressure on IPC Teams to recommend the application of technology, particularly during stressful situations
- The literature is over-optimistic (good news gets published, no news & bad news tend not to be)
- The evidence for high tech decontamination interventions does not stand up to scrutiny
- Do not be made to feel guilty by not using it.