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Prof. A. Denver Russell Memorial Teleclass

Infection prevention – *it's not just washing hands*.

Peter Hoffman
Consultant Clinical Scientist
Antimicrobial Resistance and Healthcare-associated Infection Reference Unit

Hosted by Prof. Jean-Yves Maillard
University of Cardiff, Wales

2001-2016 15 YEARS TELECLASS EDUCATION

www.webbertraining.com April 26, 2016

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Levels of evidence in infection prevention

Infection prevention is not the natural home of evidence-based practice

Adequately controlled studies are rare

Changes in response to outbreaks are multiple (planned and unplanned)

Infection levels will rise and fall naturally, these may coincide with interventions

It is easier to publish good news stories than "we did this and nothing happened" stories

Single examples and anecdote are often all that exists

Extrapolation and analogy are much used

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Ignaz Semmelweiss

Genuine early (and scorned) contribution to infection prevention.

Epidemiology directed interventions

Credited with the intervention of handwashing (actually disinfection)

Often forgotten that he also got the students to disinfect their instruments between autopsy and ward.

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Gloves

In many developed healthcare systems, the use of gloves for patient contact in high-risk areas is now routine and very common in other areas.

The acronym PPE should have two definitions:

1 - *Personal* protective equipment

2 - *Patient* protective equipment

In reality, acronym 1 prevails.

Staff feel safe wearing gloves; distanced from the distasteful aspects of patient care.

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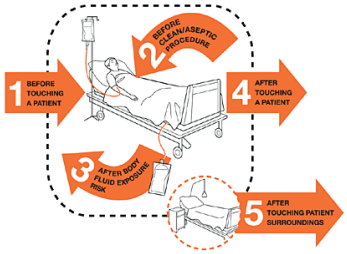
Gloves

In most cases, gloves do not get changed with an equivalence of the 5 moments of handwashing.



Glove use tends to be task-specific e.g. patient off commode and disposing of the bedpan. Many contact surfaces during that process.

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Gloves

In the era of high glove use in critical situations, we are still fixated on handwashing

We teach about handwashing, we do handwashing audits, we have handwashing champions

And for gloves ……?

This is a near evidence free* area – but surely at least as important as handwashing/rubbing.

Wilson et al. (2015) J Infection Prevention **16**; 24-31

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The environment & hands

Frequent hand contact surfaces:

In the absence of gross soiling, contamination applied by touch will be very superficially located and most of it will be transferred to the next hands to make contact with that surface (just like transient contamination on hands).

So most contamination will go from contact 1 to contact 2, far less to contact 3 and subsequent contacts.

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Frequent hand contact surfaces

If a hand contact surface (e.g. door handle) has 100 contacts per day, cleaning it once per day will decontaminate it between contact 100 and contact 101 (1%).

Cleaning it twice per day will decontaminate it between contacts 50 and 51, and contacts 100 and 101 (2%).

Similarly 4 times a day gives 4% decontamination between contacts.

The general recommendations are to clean frequent hand contact surfaces more frequently in outbreaks or high risk areas but: *If a surface is a vector of infection, would increased attention to staff glove/hand hygiene be more productive than increased cleaning frequencies*?

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Disinfecting the environment?

Original by Graham Ayliffe in the 1960s, then repeated every decade or so since:

Clean a floor – remove 80% of the contamination

Disinfect a floor – remove 95% of contamination

An hour later, the contamination is what it was prior to the intervention.

- Where does routine cleaning contribute?
- Where does terminal cleaning contribute?

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Routine cleaning and *C. difficile*

Wilcox (JHI 2003, 54; 109-114). Two identical wards: detergent cleaning in one, hypochlorite used in the other – significantly less *C difficile* infection in the hypochlorite ward; swap over – no difference.

"*These results provide some evidence that use of hypochlorite for environmental cleaning may significantly reduce incidence of CDI, but emphasize the potential for confounding factors*".

Dettenkoffer (JHI 2004 **56** 78-9) analysing the Wilcox data, noted a significant increase in the hypochlorite ward on swap-over "*We would like to point out that the authors' statement in favour of hypochlorite-based products to control CDI is not supported by the results of their study*"

This is the origin of the use of hypochlorite or other sporicidal agents in areas of increased *C difficile* infection.

Not highly evidence-based but not a particularly disruptive or costly intervention.

Despite this grade of evidence, there is a belief that you should use sporicides against *C difficile* in the healthcare environment.

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Sporicidal wipes

The disinfectant from wipes will only work whilst it remain wet on a surface (20 - 60 seconds?)

The standard European test to determine sporicidal activity (EN13704) uses a 60 minute exposure.

So a wipe can contain a proven sporicide, yet not be sporicidal in actual use.

We need a test of sporicides where conditions relevant to their actual use is assessed – primarily realistically short exposure times.

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Hydrogen peroxide fumigation and *C. difficile*

This is where interventions get more costly and disruptive.

The standard-bearer for this as an effective intervention comes from this paper:

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).

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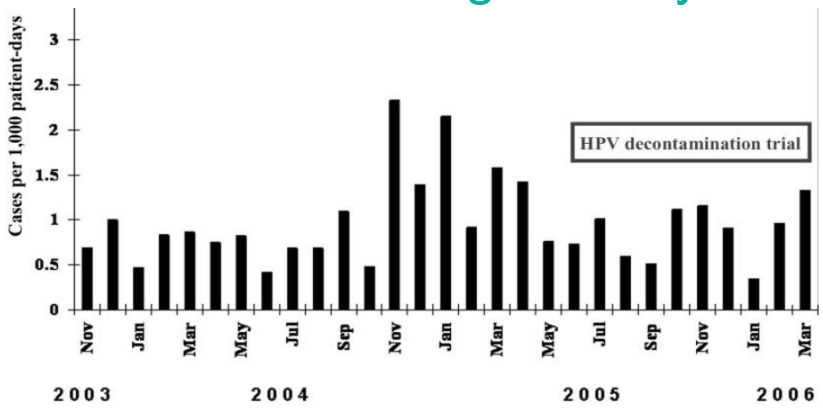
Intervention data – original analysis



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

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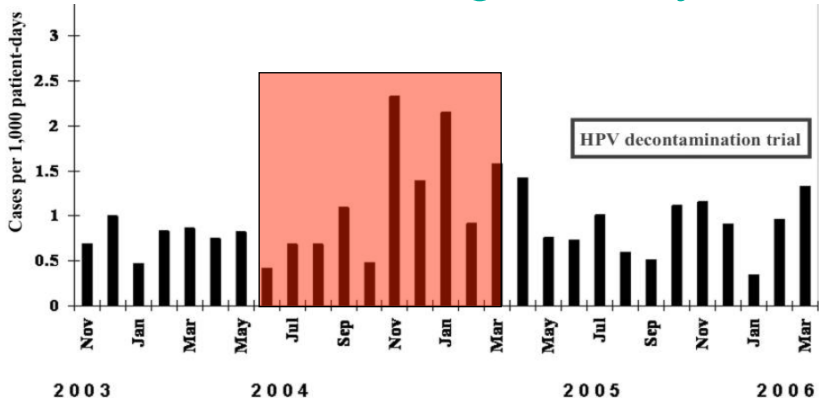
Intervention data – original analysis



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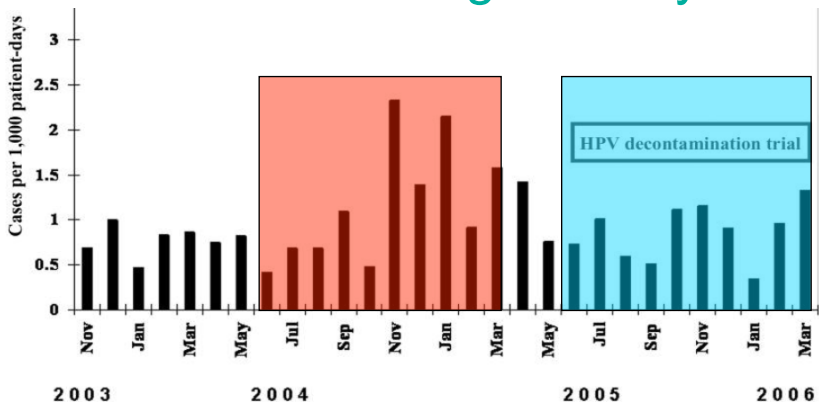

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Why reading-frames of equivalent months?

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"

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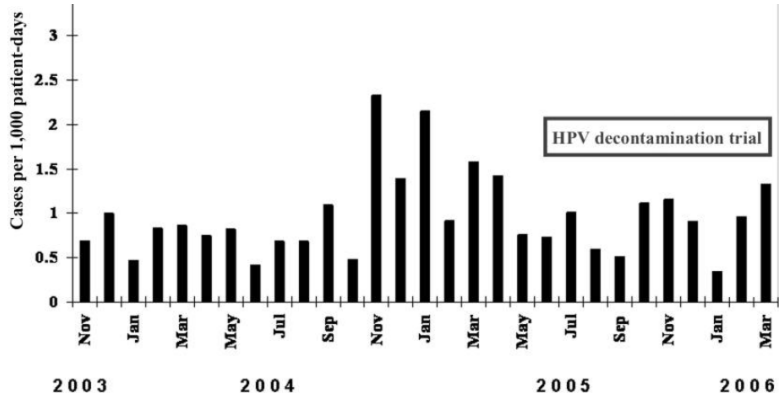
Intervention data – alternative analysis



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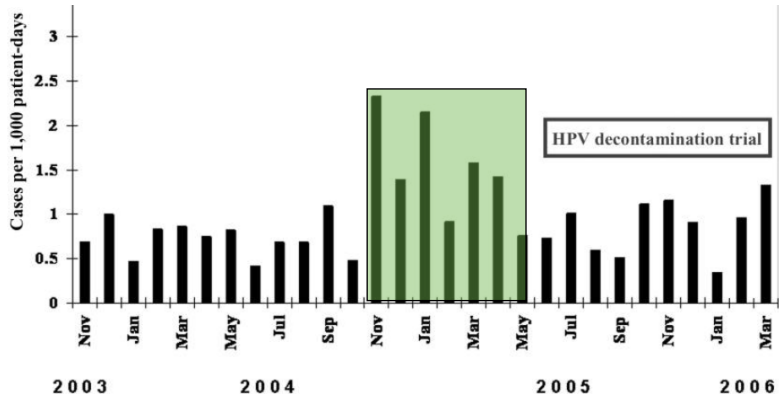
Intervention data – alternative analysis



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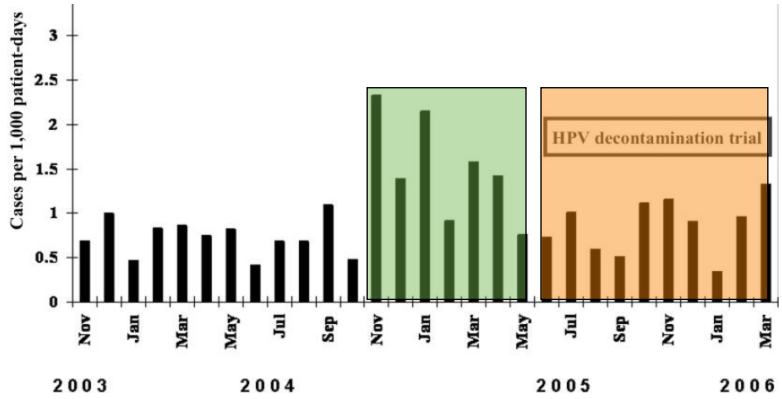

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And for multi-drug resistant organisms?

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

Catherine L. Passaretti,[1,2,3] Jonathan A. Otter,[4] Nicholas G. Reich,[5,6] Jessica Myers,[5] John Shepard,[1] Tracy Ross,[7] Karen C. Carroll,[7] Pam Lipsett,[8] and Trish M. Perl[1,2,5]

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 MDROs compared with standard cleaning protocols.

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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"

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Study design	
Intervention wards (H_2O_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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Copper?

Copper Surfaces Reduce the Rate of Healthcare-Acquired Infections in the Intensive Care Unit

Cassandra D. Salgado, MD;[1] Kent A. Sepkowitz, MD;[2] Joseph F. John, MD;[3] J. Robert Cantey, MD;[1]
Hubert H. Attaway, MS;[4] Katherine D. Freeman, DrPH;[5] Peter A. Sharpe, MBA;[6]
Harold T. Michels, PhD;[7] Michael G. Schmidt, PhD[4]

CONCLUSIONS. Patients cared for in ICU rooms with copper alloy surfaces had a significantly lower rate of incident HAI and/or colonization with MRSA or VRE than did patients treated in standard rooms. Additional studies are needed to determine the clinical effect of copper alloy surfaces in additional patient populations and settings.

Infect Control Hosp Epidemiol 2013;34(5):479-486

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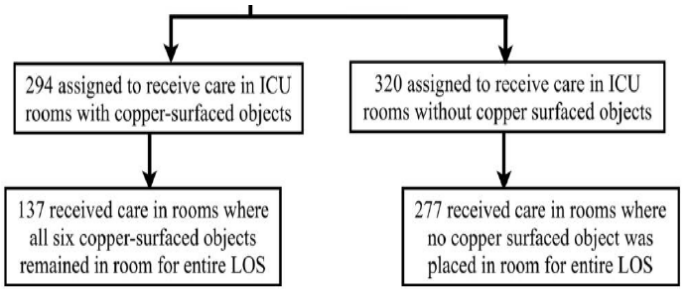

Between 3 hospitals, 8 rooms had copper items and 8 did not. The copper items were bed rails, overbed tables, intravenous poles and arms of the visitor's chair in all + nurses' call button, computer mouse, bezel of the touchscreen monitor and the palm rest of a laptop computer varying between centres

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TABLE 3. Hospital-Acquired Infections and Pathogens among Patients Admitted to Copper and Noncopper (Control) Rooms

Type of infection	Copper room	Noncopper room
BSI[a]	*n* = 3 Gram positive: 2 (1 *Enterococcus*, 1 CNS) *Candida*: 2	*n* = 11 Gram positive: 7 (3 CNS, 2 VRE, 1 *Enterococcus*, 1 MSSA) Gram negative: 3 (1 *Pseudomonas*, 1 *Escherichia coli*, 1 *Serratia*) *Candida*: 1
Pneumonia[b]	*n* = 10 Gram positive: 5 (2 MRSA, 2 MSSA, 1 *Streptococcus*) Gram negative: 1 (*Pseudomonas*)	*n* = 8 Gram positive: 4 (2 MRSA, 2 MSSA) Gram negative: 4 (2 *Pseudomonas*, 2 *Enterobacter*)
UTI[c]	*n* = 4 Gram negative: 2 (*E. coli*) *Candida*: 2	*n* = 5 Gram positive: 3 (1 MRSA, 1 MSSA, 1 *Enterococcus*) Gram negative: 2 (1 *Pseudomonas*, 1 *E. coli*) *Candida*: 1
Other[d]	*n* = 0	*n* = 5 Gram positive: 2 (*Clostridium difficile*) Gram negative: 1 (*E. coli*)

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"*Our study demonstrated that placing a copper alloy surface onto 6 common, highly touched objects in ICU rooms reduced the risk of HAI by more than half at all study sites*".

Some analyses view this statement as an overambitious assumption of cause and effect.

Much of the difference was in BSI. Data to show comparable risk factors between the two groups here was not given.

How relevant were the surfaces (*bed rails, overbed tables, intravenous poles, arms of the visitor's chair, nurses' call button, computer mouse, touchscreen monitor bezel, palm rest of a laptop*) to BSI

Yes, copper seems to reduce the count of contaminants on it, but it is difficult to see how these surfaces could have so much influence on BSI acquisition.

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Publication bias

When is the last time you saw a "*We did this and it had no effect*" paper in infection prevention?

They exist, but are in the minority. Compare that with your real-life experience.

- Something interesting observed: Publication
- Nothing interesting observed: No publication

So if, say, 10 hospitals try the same intervention and only in one does it coincide with an effect …….

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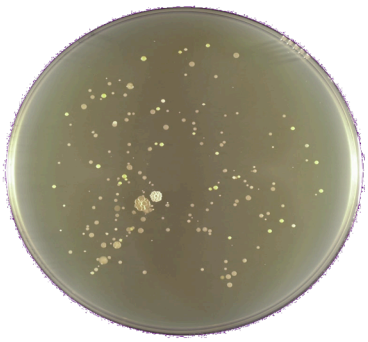
Operating theatre ventilation

The main source of microbial contamination is skin scales

1 m^3 air – empty room



1 m^3 air – 1 person in room

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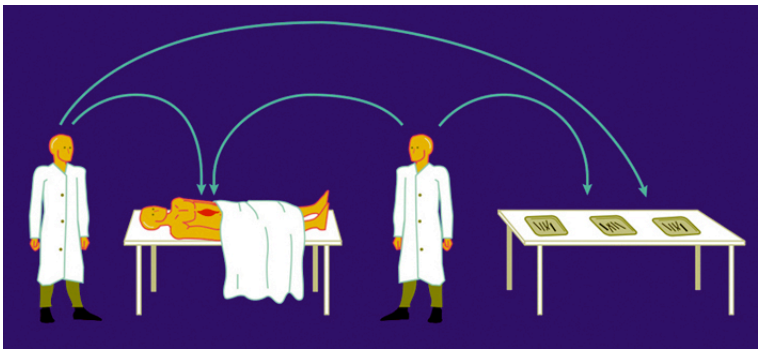
Pathways into the wound



Probably the majority of airborne bacteria that end-up in a surgical wound, do so via exposed instruments.

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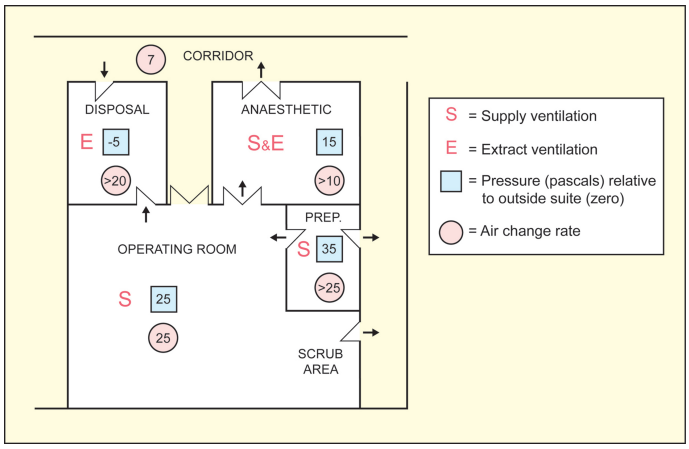
Conventionally ventilated theatre suite



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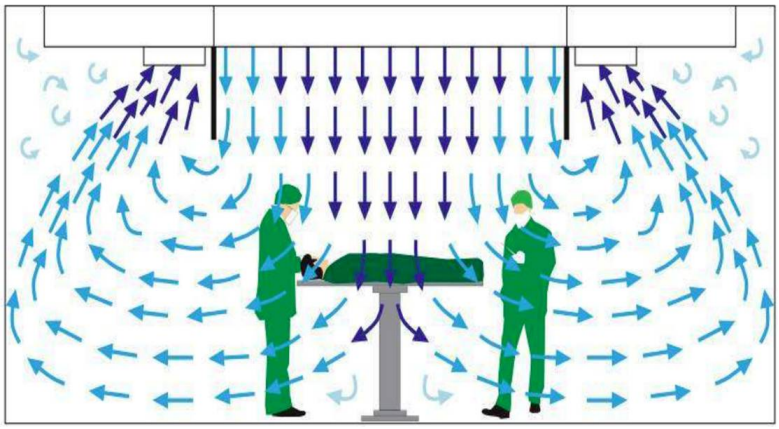
Ultraclean ventilated ("laminar flow") theatre



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In the 1970/80s

Work by Owen Lidwell showed (BMJ 1982 **285** 10-14) a definite protective effect in total hip replacement (THR) and total knee replacement (TKR)

- Infection rates: 1.5% in conventional and 0.6% in ultraclean

So, cleaner air equates with fewer infections – makes perfect sense

- 98% UK hip arthroplasties now done in ultraclean ventilation (so any control group lost)

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Maybe things are not that straightforward …..

The keeping of national registers of surgical infection has enabled large-scale but crude analysis.

Other countries still use both conventional and ultraclean for orthopaedic surgical procedures

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New Zealand

Hooper (2011) J Bone & Joint Surg (Br) **93 B**; 85-90

Looked at 51,485 1ry THRs and 36,826 1ry TKRs

Deep infection rates (%)	THR	TKR
Ultraclean	0.148	0.193
Conventional	0.061	0.100

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Germany

Brandt (2008) Ann Surg; **248**: 695–700

Looked at 28,623 THRs and 9,396 TKRs

Deep infection rates (%)	THR	TKR
Ultraclean	1.37	0.918
Conventional	0.903	0.646

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German non-orthopaedic data

Deep infection rates (%)	Appendectomy	Cholecystectomy	Colon surgery	Herniorrhaphy
Ultraclean	1.32	0.707	2.55	0.576
Conventional	1.09	0.484	2.73	0.354

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Cleaner air = more infection?!?!?!

This seems so counterintuitive yet reasonably robust.

Certainly in that ultraclean seems no better than conventional; possibly (some were statistically significant, other less so) that ultraclean is worse than conventional.

Are there issues other than microbial numbers at play here?

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Theatre discipline?

Do orthopaedic surgeons, given safer facilities, relax their theatre discipline?

The "risk homeostasis" approach says they might, but how valid is that?

What is "theatre discipline" and how do the individual components contribute to patient safety?

Is their practice so ritualised that it would be constant no matter what the surroundings?

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Patient normothermia maintenance?

Maintenance of patient body temperature ("normothermia"): There is an established link between perisurgical hypothermia and infection. The high level of airflow in ultraclean ventilation will reduce patient body temperature far more than the airflows at the same temperature in conventional ventilation. For me, this is the most likely explanation of the Brandt/Hooper observations.

- That Brandt also noted higher infection rates in appendectomy, cholecystectomy, (not colon surgery) and herniorrhaphy in ultraclean flow compared to conventional ventilation also favours this explanation.
  - These are not procedures where air quality is highly critical (normally done in conventionally ventilation) but where patient body temperature is probably far more important.
- It is possible to modify perioperative patient care and patient warming devices to maintain normothermia in laminar flow surgery – but how much difference will this make?

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In time, a review found that 32 patients from the hospital were sickened by an AmpC-hyperproducing *E. coli* between November 2012 and January 2014; all had complicated pancreatic and biliary disease, and all underwent endoscopic retrograde cholangiopancreatography (ERCP) or duodenoscopy at the hospital. Eleven of the infected patients died, but it is unclear whether the infections caused their deaths. The patients were in poor health at the time of exposure. All patients had complicated disease; some had cancer; and all had been on antibiotics multiple times.

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The UK has been there & done it

From the Hine report, DHSSPS – NI (2004):

"In May 2004 it was noticed that, following cleaning and reprocessing of one endoscope, drops of a stained fluid had leaked from the end of the instrument. On investigation … it was discovered that a single channel, the existence of which was not known to the staff undertaking the cleaning, had not been cleaned to the required standard".

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Duodenoscopes

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Duodenoscope decontamination

GOV.UK

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Guidance

Management and decontamination of flexible endoscopes (CFPP 01-06)

3.62 Decontamination staff who work in units where nasendoscopes are reprocessed should receive training to enable them to decontaminate that type of endoscope. Where more complex endoscopes are decontaminated, such as those with wire-carrying channels, staff doing this will require additional training to deal with them. Staff should be trained to decontaminate the most complex endoscope that they will have to reprocess.

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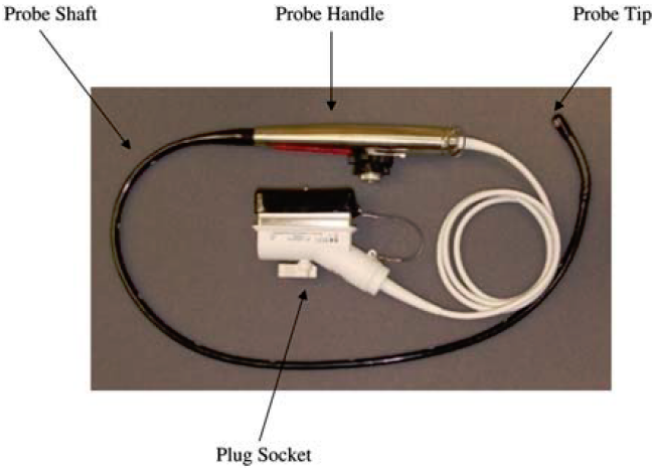
Transoesophageal echo (TOE/TEE) probe



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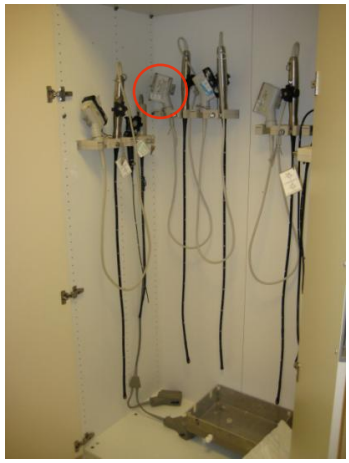
Transoesophageal ECHO (TOE/TEE) probes



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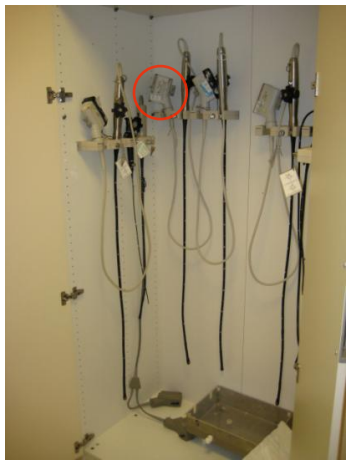
Transoesophageal ECHO (TOE/TEE) probes



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5 April 2012 Last updated at 13:17

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Morriston Hospital hepatitis B death: Lessons learned, says ABM health board

A cardiac patient who died after contracting hepatitis B at a Swansea hospital did not receive a high standard of care, say health chiefs.

An independent external review panel was asked to investigate the circumstances surrounding the hepatitis B infection.

The panel has made several recommendations about decontamination, infection prevention and control, staff training and auditing procedures.

It found that the most likely cause of the infection was a contaminated probe.

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ABM University Health Board Headquarters,

One Talbot Gateway,

Baglan Energy Park,

Baglan,

Port Talbot,

SA12 7BR

Expert External Report on the transmission of hepatitis B between two patients who underwent cardiac surgery at Morriston Hospital in Swansea in March 2011

Prepared by the Expert External Review Panel

January 2012

Patient identifiable information redacted report at: http://www.wales.nhs.uk/sitesplus/863/opendoc/189315

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European Journal of Echocardiography (2011) **12**; i17 – i23

European Journal of Echocardiography (2011) **12**, i17–i23
doi:10.1093/ejechocard/jer095

Guidelines for transoesophageal echocardiographic probe cleaning and disinfection from the British Society of Echocardiography†‡

P. Kanagala[1], C. Bradley[2], P. Hoffman[3], and R.P. Steeds[4]*

[1]Glenfield Hospital, Leicester, UK; [2]Hospital Infection Research Laboratory, Queen Elizabeth Hospital, Birmingham, UK; [3]Laboratory for Healthcare Infection, Health Protection Agency, London, UK; and [4]Department of Cardiology, University Hospital Birmingham NHS Foundation Trust, Queen Elizabeth Hospital, Birmingham B15 2TH, UK

Accepted after revision May 2011

The clinical utility of transoesophageal echocardiography (TOE) is well established. Being a semi-invasive procedure, however, the potential for transmission of infection between sequential patients exists. This has implications for the protection of both patients and medical staff. Guidelines for disinfection during gastrointestinal endoscopy (GIE) have been in place for many years.[1,2] Unfortunately, similar guidance is lacking with respect to TOE. Although traversing the same body cavities and sharing many similarities with upper GIE, there are fundamental structural and procedural differences with TOE which merit special consideration in establishing a decontamination protocol. This document provides recommendations for TOE probe decontamination based on the available evidence, expert opinion, and modification of the current British Society of Gastroenterology guidelines.

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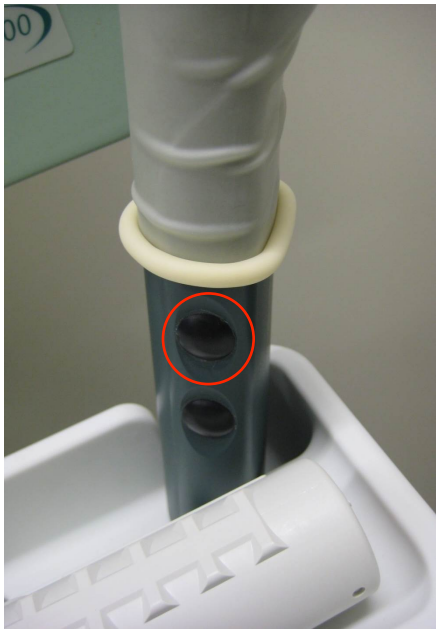

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Intracavity probe decontamination

Still an area in progress. A working group of the Healthcare Infection Society is due to report on this soon.

The solution is likely to involve a more methodical approach than often used at present.

This may entail the need for more probes.

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Conclusions

Hands are an important vector of microbial contamination in healthcare, but the existence of other vectors and their importance too must not be forgotten.

Infection prevention requires a methodical approach – identifying and interrupting specific routes of transmission. Killing microbes not on those routes of transmission is unlikely to have a beneficial result.

Do not accept published literature uncritically. Evidence appearing in peer-reviewed form is the start of a thought process, not the end of it.

Infection prevention has a poor evidence base, but that's what we have to work with. The knowledge and experience of the practitioner is an all-important factor.

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April 28 *(FREE Teleclass)*
INFECTION PREVENTION AND CONTROL WITH ACCREDITATION CANADA QMENTUM PROGRAM
Chingiz Amirov, Baycrest Health Sciences, Toronto
Sponsored by GOJO (www.gojo.com)

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SPECIAL LECTURE FOR 5 MAY
Prof. Didier Pittet, University of Geneva Hospitals
Sponsored by the World Health Organization

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Kate Gase, BJC Learning Institute, St. Louis

May 16 *(FREE Teleclass - Broadcast live from the 2016 IPAC-Canada conference)*
PHYSICIANS, FARMERS, AND THE POLITICS OF ANTIBIOTIC RESISTANCE

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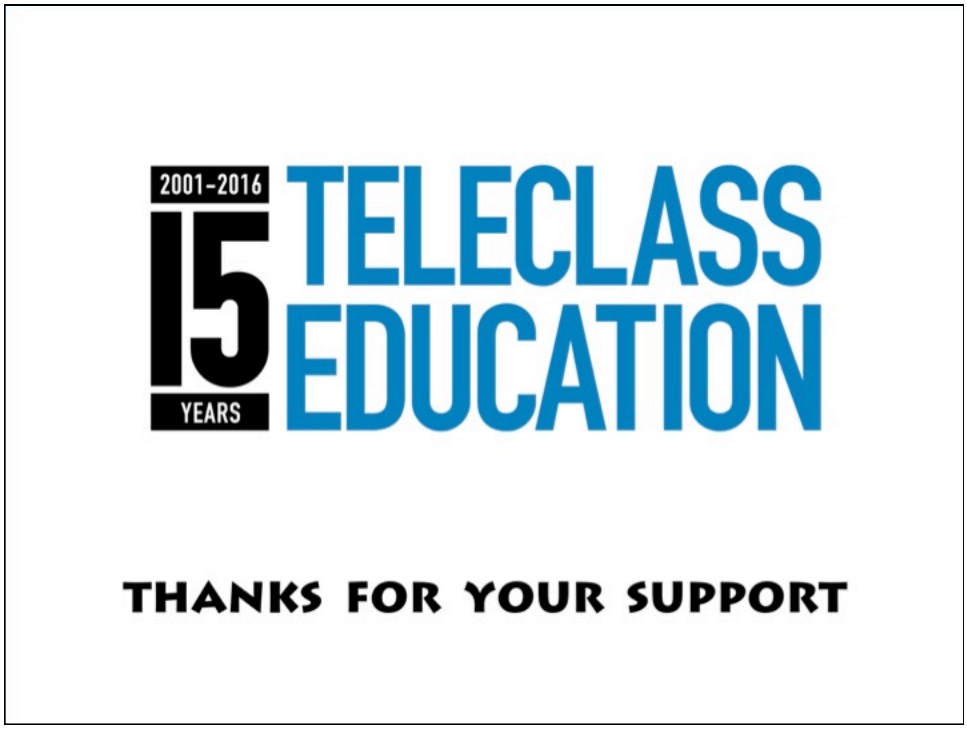
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