

# Time to Clean Dark Corners



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# Why the debate on HAI and hospital cleaning?

- There is no evidence; cleaning has never been regarded as an evidence-based science
- No way of measuring the cleaning process nor its impact on the environment
- Aesthetic considerations make cleaning difficult to assess
- Confounded by fabric and maintenance deficits
- We cannot see the enemy
- It costs money

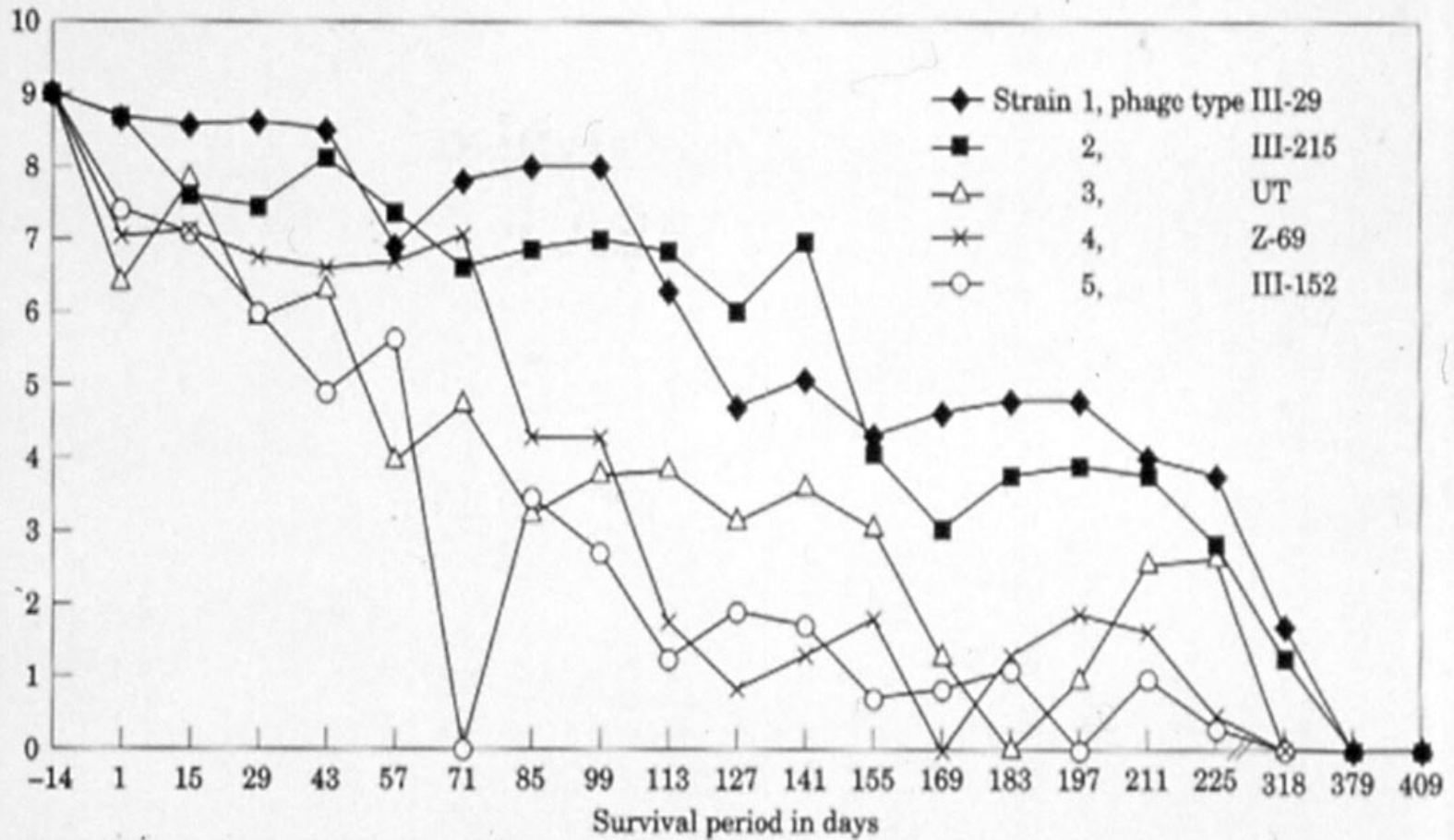
*Cleaning has always been taken for granted.*

# Some hardy invaders

- *Clostridium difficile*
- Norovirus
- *Acinetobacter* spp
- Vancomycin-resistant enterococci (VRE)
- *Staphylococcus aureus* including MRSA

**What makes these organisms particularly important regarding hospital cleaning?**

# Survival of different strains of MRSA in hospital dust



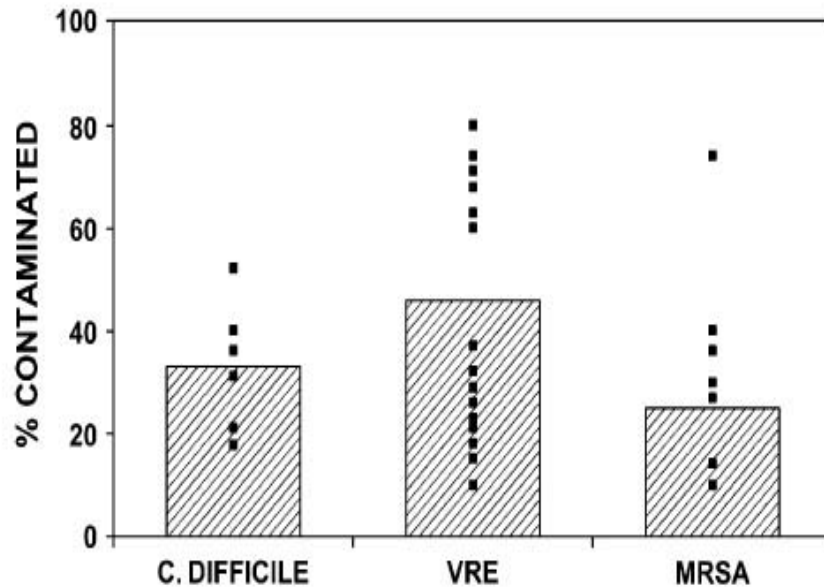
# Where are the pathogens in a hospital?



## Significant bacterial isolates from six inanimate surfaces in intensive care

| Site                    | No. of Cultures | Number of isolates |                      |                     |                    | Total     |
|-------------------------|-----------------|--------------------|----------------------|---------------------|--------------------|-----------|
|                         |                 | <i>S.aureus</i>    | <i>Acinetobacter</i> | <i>Enterobacter</i> | <i>Pseudomonas</i> |           |
| Patient Chart           | 13              | 3                  | 1                    | 2                   | ---                | 6         |
| Table top               | 13              | 1                  | 2                    | ---                 | ---                | 3         |
| Telephone Upper Surface | 13              | 1                  | 1                    | ---                 | 1                  | 3         |
| Telephone Lower Surface | 13              | 2                  | ---                  | ---                 | 1                  | 3         |
| Coffeepot handle        | 13              | 1                  | 1                    | ---                 | ---                | 2         |
| Door push plate         | 13              | ---                | ---                  | ---                 | 1                  | 1         |
| <b>Total</b>            |                 | <b>8</b>           | <b>5</b>             | <b>2</b>            | <b>3</b>           | <b>18</b> |

# *C.difficile*, VRE and MRSA are found on hand-touch sites in the clinical environment



**Fig 1.** The proportion of environmental surface cultures positive for *C difficile*, VRE, and MRSA reported in the literature. Each point represents a separate study and the column, the mean for that pathogen.<sup>26-47</sup>

|                | VRE     | MRSA | C. difficile |
|----------------|---------|------|--------------|
| Bed Rails      | +++++++ | +    | +++          |
| Bed Table      | +++++++ | +    |              |
| Door Knobs     | ++      | ++   | +            |
| Doors          | +++     | +    |              |
| Call Button    | +++     | +    | ++           |
| Chair          | ++      | +    | ++           |
| Tray Table     | +++     | ++   |              |
| Toilet Surface | +       |      | ++++         |
| Sink Surface   | +       | +    | +++          |
| Bedpan Cleaner |         |      | +            |

**Fig 2.** The relative frequency with which surfaces in the near patient environment have been found to culture VRE, MRSA, and *C difficile*. Each + represents a single report in the literature.<sup>19,21,26,27,30,31,33-36,39,40,42-44,46-49</sup>

# What's so important about **hand touch** surfaces?



These are the places to find transmissible microbes!

Frequently used **hand-touch** surfaces are **high-risk** surfaces

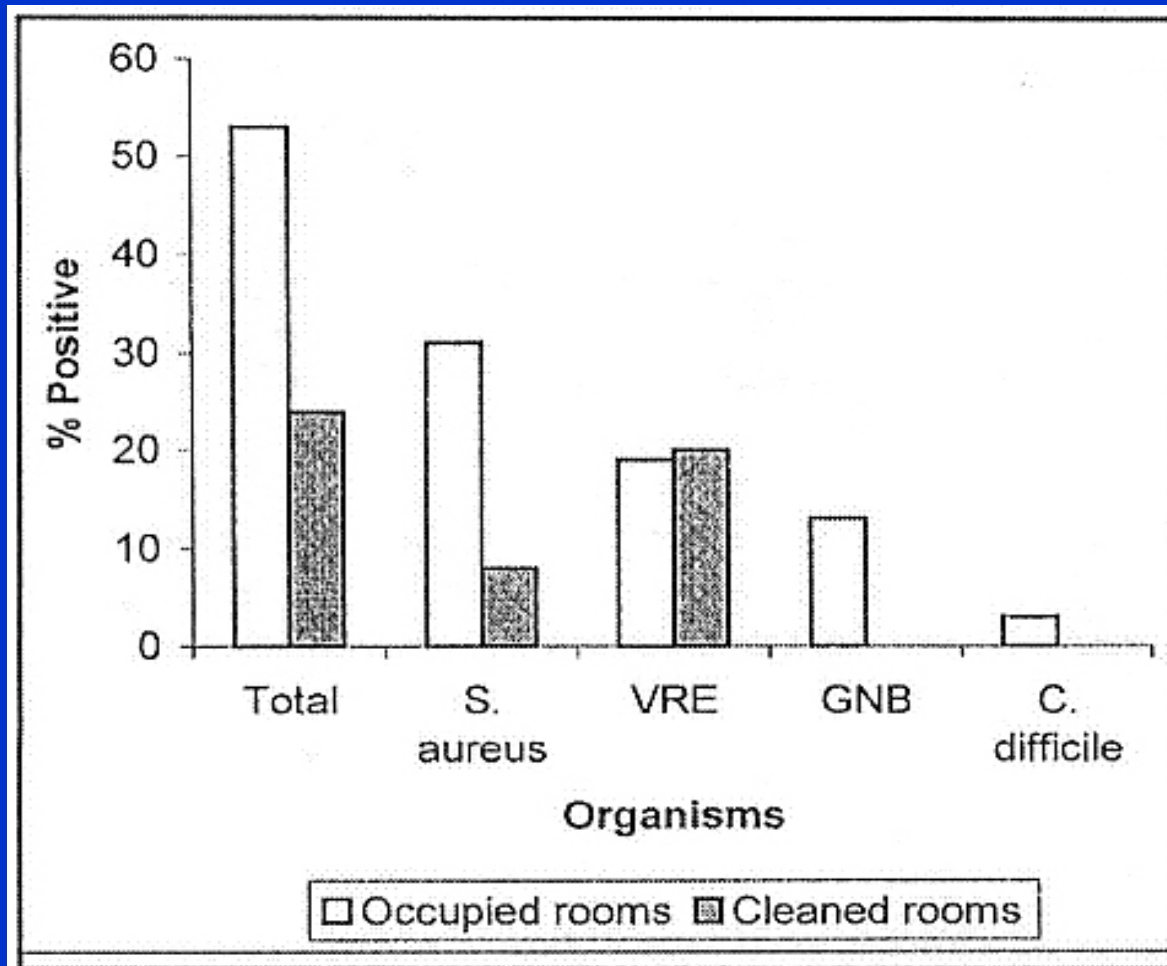
*The closer the surface is to a patient, the more critical it is likely to be*

*Biotrace, 2003*

Detection of pathogen transmission in neonatal nurseries using DNA markers as surrogate indicators

*Oelberg DG et al, Paediatrics 2000*

## Persistent contamination of near- patient hand-touch sites



**FIGURE.** Percentage of hand imprint cultures yielding pathogens after contact with environmental surfaces near patients in occupied patient rooms or in rooms that had been cleaned after patient discharge. VRE = vancomycin-resistant *Enterococcus*; GNB = gram-negative bacillus.

**It is just as easy to become contaminated by touching a patient's environment as it is by touching the patient**



**MRSA and VRE in the environment are picked up by attendant staff**

*Boyce et al, ICHE 1997; Huang et al, Arch Intern Med 2006; Drees et al, ICHE 2008; Hayden et al, ICHE 2008*

# Are **hand-touch** sites routinely cleaned?

Routine cleaning practices were assessed by applying a fluorescent solution to different sites in side-rooms.

These sites were examined after patient discharge. They were considered cleaned if the fluorescent material was removed or substantially disrupted.

Although 40% sites were cleaned properly, they tended to be the more traditional sites (toilets and sinks) whereas sites such as telephones, doorknobs and other **hand-touch** surfaces were scarcely cleaned at all.

# How clean are hospital surfaces?

**82-91% Visually clean**

**10-24% ATP clean**

**30-45% Microbiologically clean**

## What is clean?

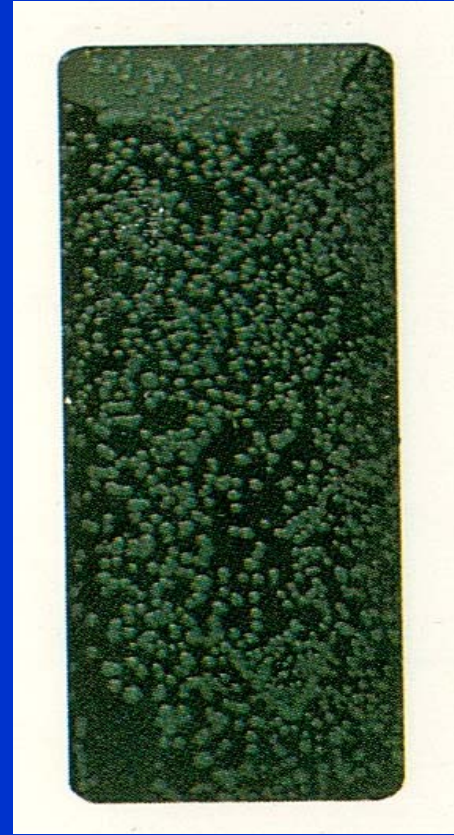
“what an individual thinks it is”

**We should not define cleanliness without  
indicating how we would assess it**

# Would microbiological standards help?

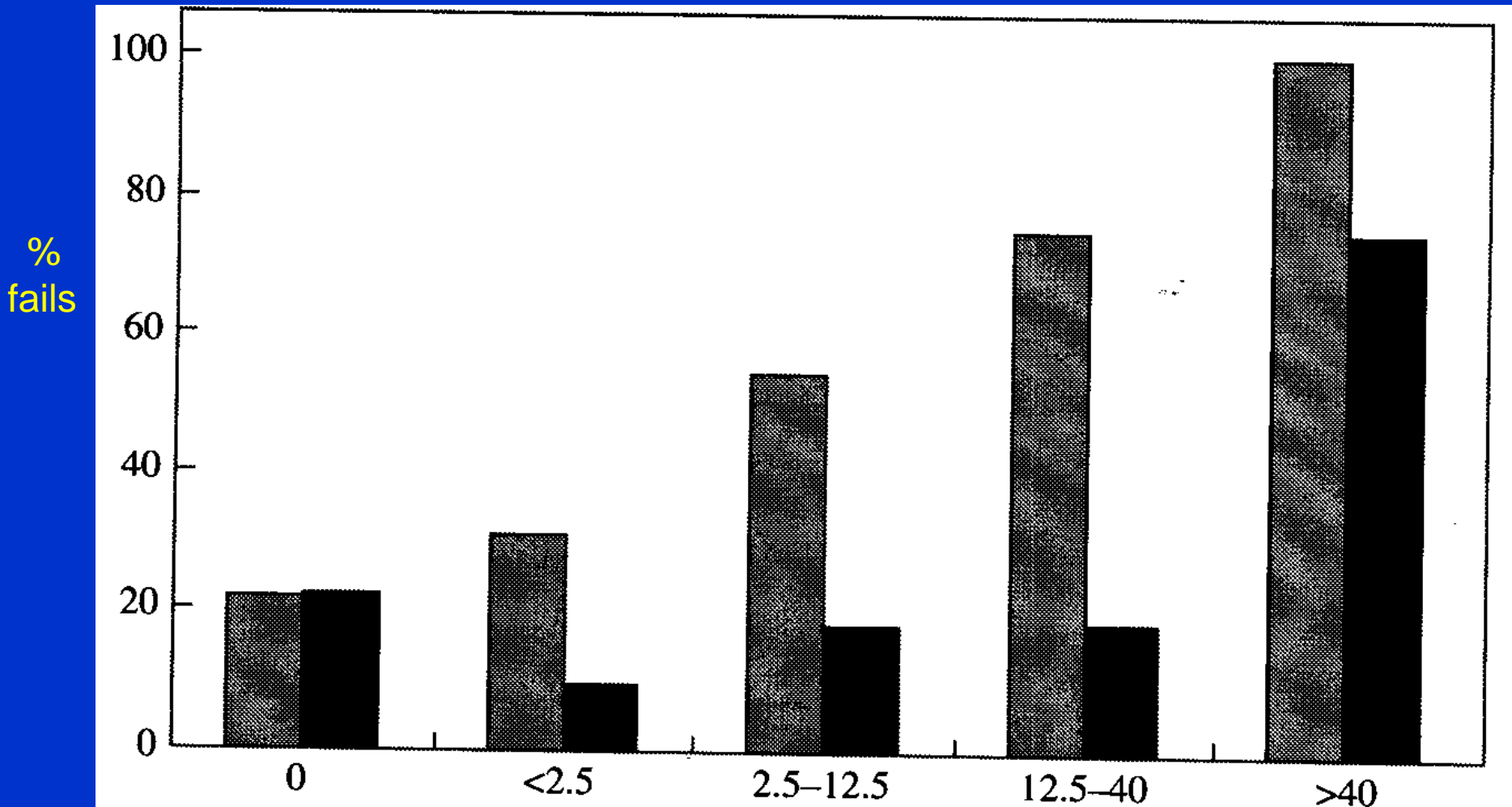


**5 cfu/cm<sup>2</sup>**



**45 cfu/cm<sup>2</sup>**

Relationship between the aerobic colony count from a surface and its pass or fail using either ATP assessment (grey bars; fail if >250 relative light units) or visual assessment (black bars). Graph shows percentage of fails by ATP and visual assessment for each range of aerobic colony count.



Aerobic colony count (cfu/cm2)

Lewis et al, JHI 2008

# Hospital-acquired infection: are there lessons from the food industry?

Comparison of approaches to monitoring cleaning efficacy between food and healthcare industries.

## FOOD

Isolation of pathogens from environmental surfaces causes concern

Environmental surface sampling in food manufacturing used as part of a preventative strategy

Range of surface-sampling techniques used, including visual, microbiological and rapid methods in coordinated and integrated approaches

## HEALTHCARE

Isolation of pathogens from environmental surfaces may or may not cause concern

Environmental surface-sampling only likely to be used in response to an outbreak

Assessment of cleaning efficacy dominated by visual inspections (ICNA, PEAT, Healthcare Commission etc)

# What happens if you apply hygiene standards for surface level cleanliness in the clinical situation?

We chose standards designating aerobic colony counts (ACCs)  $> 5\text{cfu/cm}^2$  from **hand-touch** sites and the presence of *Staphylococcus aureus* and/or MRSA as hygiene failures.

*White et al, AmJIC 2008*

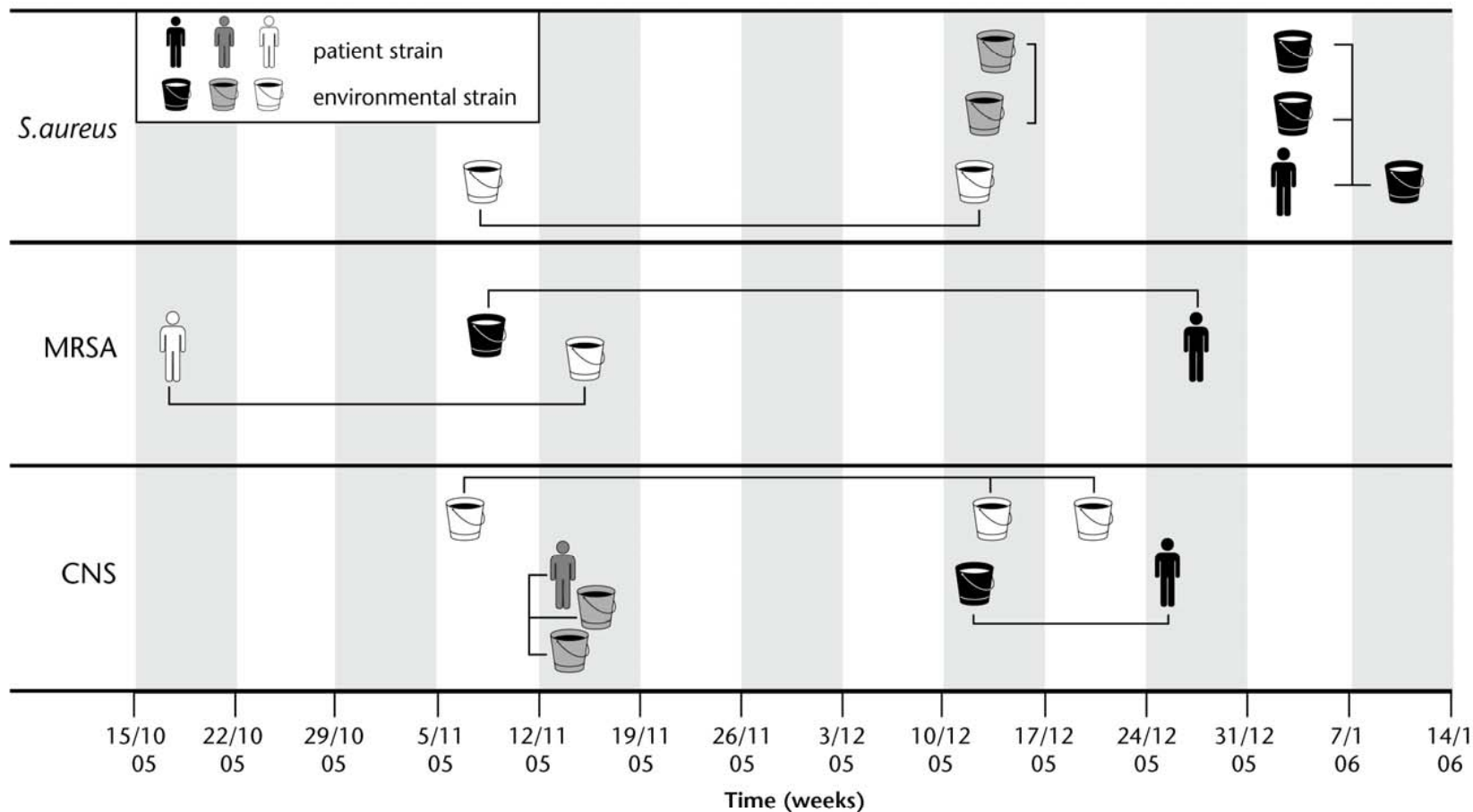
# Comparison of hygiene fails between individual hand-touch sites in a surgical ITU over a ten week period

| Total no. samples taken=20          | Hand-touch site (x8)    |           |                    |              |                   |       |                    |             |
|-------------------------------------|-------------------------|-----------|--------------------|--------------|-------------------|-------|--------------------|-------------|
|                                     | Cardiac monitor buttons | Bed frame | Curtain around bed | Work station | Computer keyboard | Phone | Blood gas analyser | Staff chair |
| No. of counts >5cfu/cm <sup>2</sup> | 7                       | 5         | 3                  | 0            | 1                 | 2     | 6                  | 1           |
| No. of MSSA &/or MRSA               | 3*                      | 5*        | 7                  | 0            | 4                 | 4     | 3*                 | 7*          |
| Total hygiene fails                 | 10                      | 10        | 10                 | 0            | 5                 | 6     | 9                  | 8           |

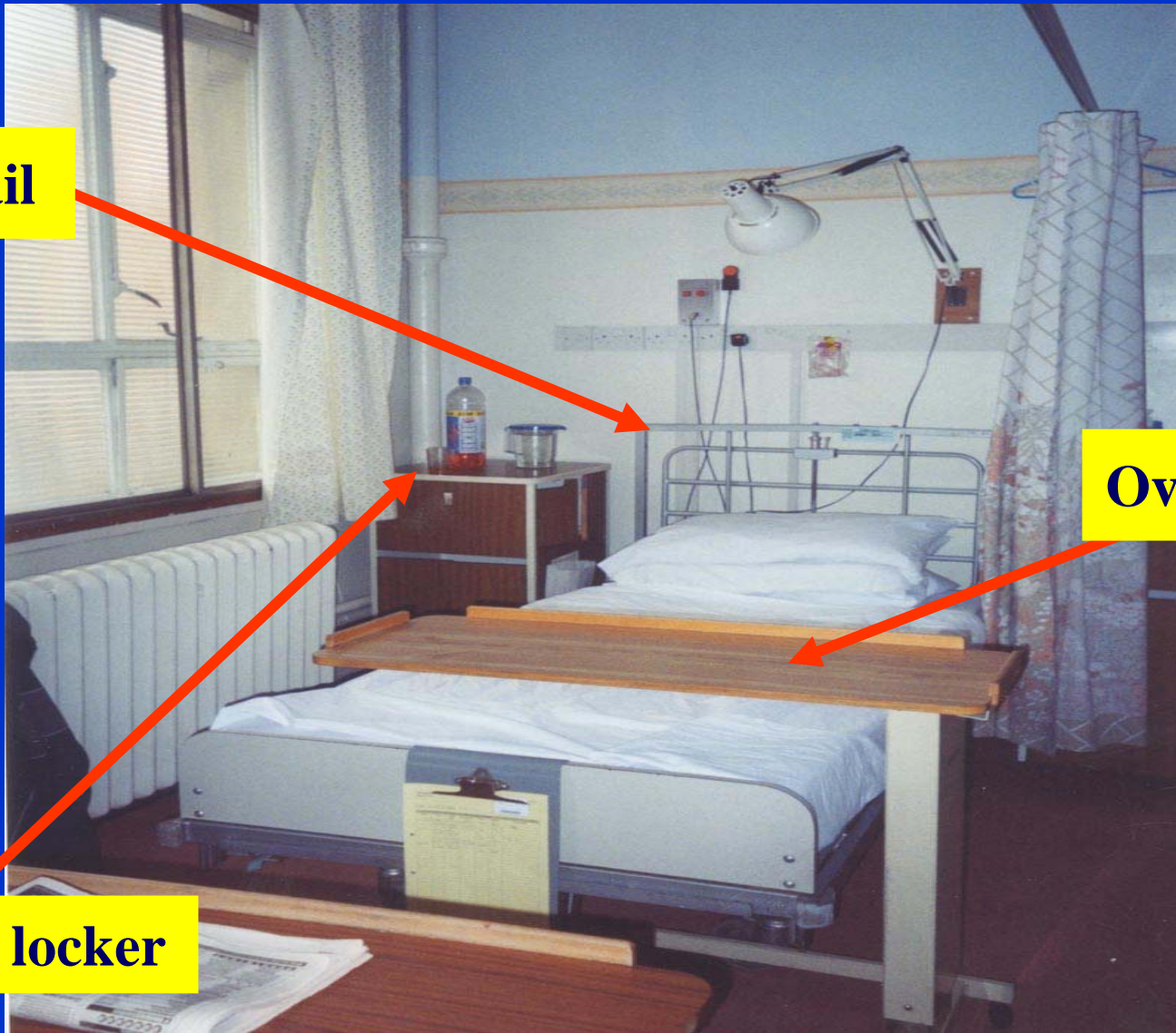
*Eight sites were screened weekly x2 for 10 weeks; indicator organisms were MSSA & MRSA*

*x\* PFGE match between hand-touch site and one or more patient isolates*

Fig 1. Temporal relationships between indistinguishable environmental and patient strains of MRSA, *S.aureus* and CNS from SICU



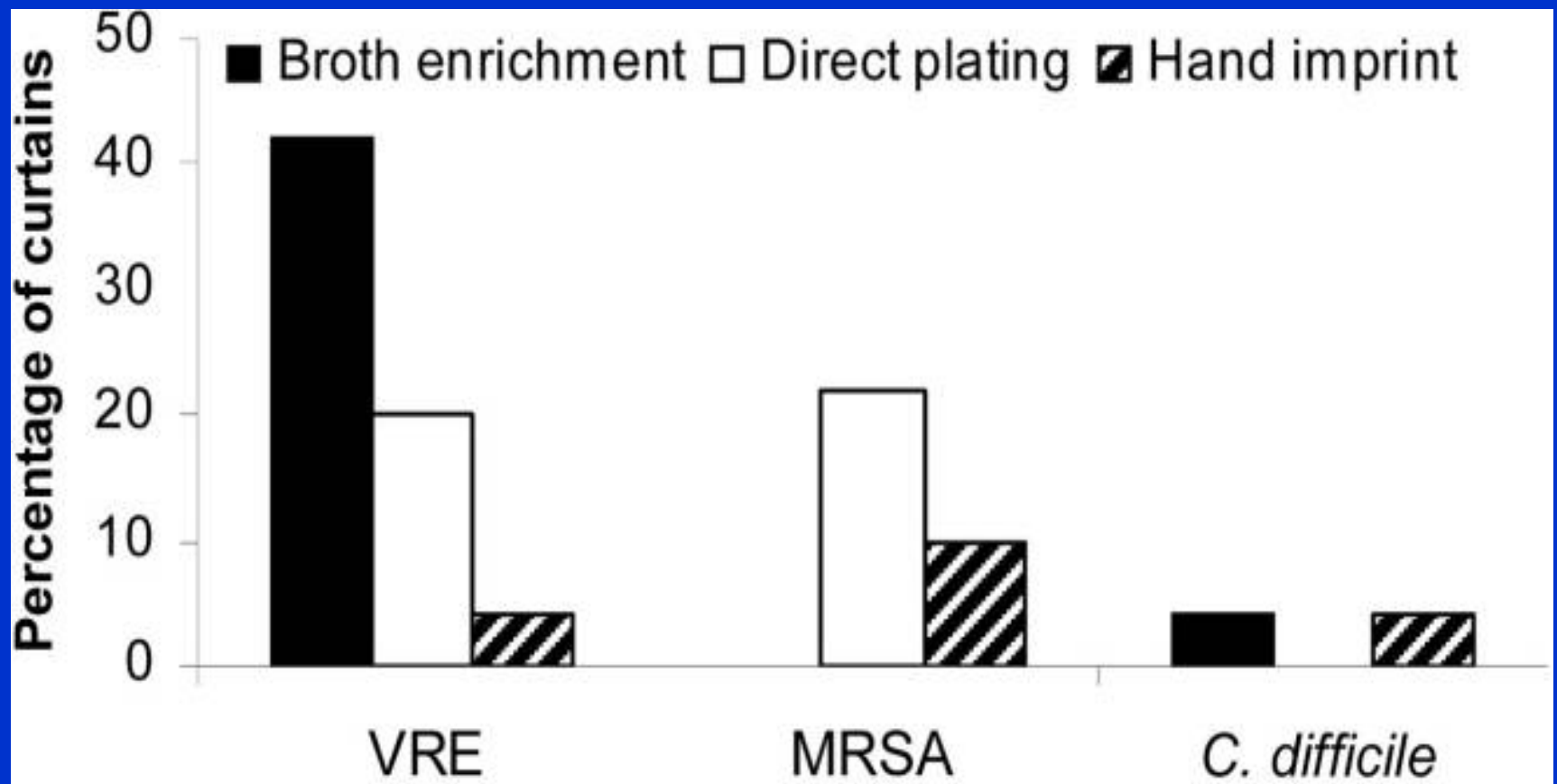
**Bed rail**



**Overbed table**

**Bedside locker**

**There is an association between near-patient MSSA/MRSA, 'microbial dirt' and bed occupancy rates**



**Rates of recovery of healthcare-associated pathogens from 50 hospital privacy curtains by 3 culture methods.**

**NB. No broth enrichment for MRSA; no direct plating cultures performed for *Clostridium difficile***

*Trillis F et al, ICHE 2008*

# Dial '0' for room service?



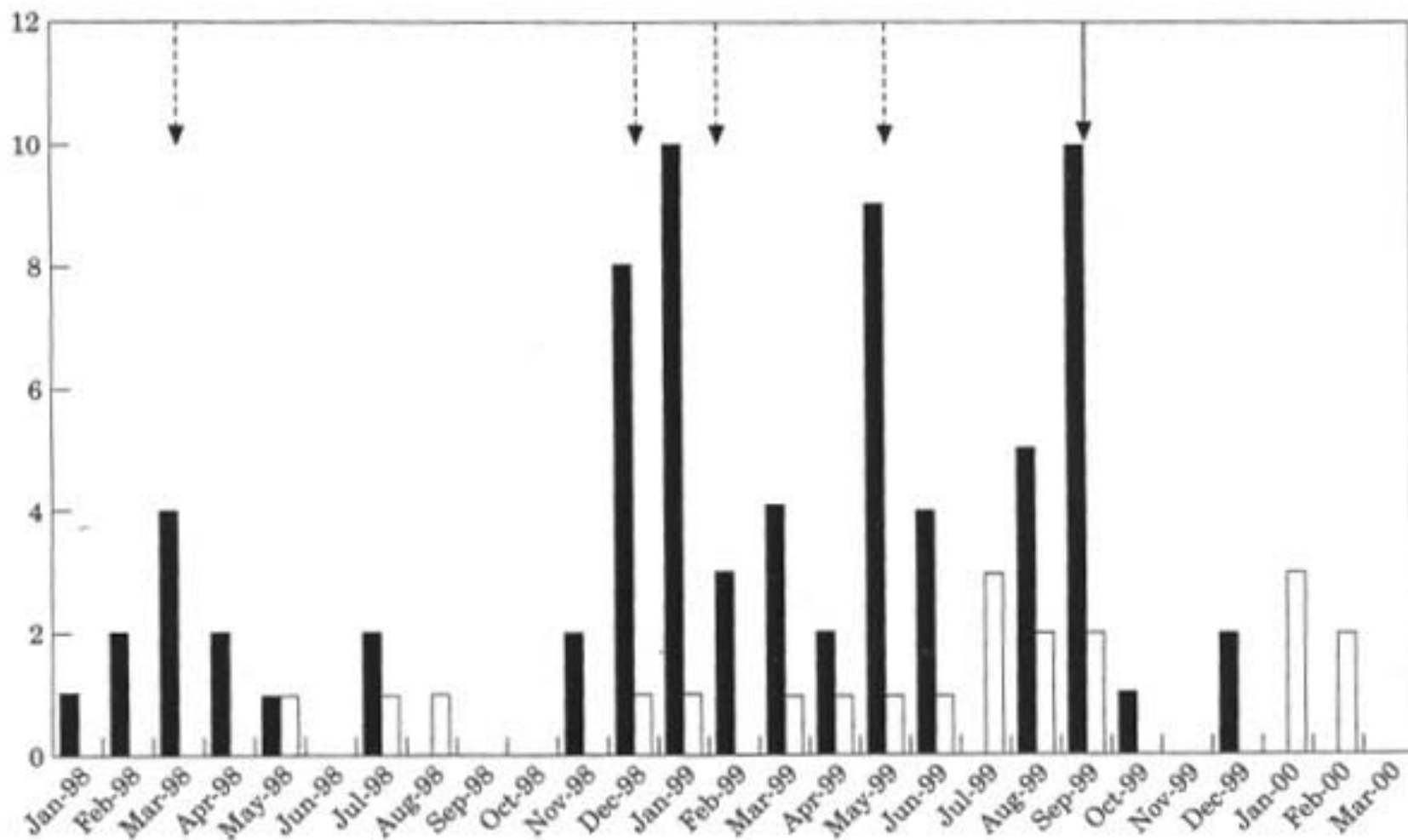
**Bacterial contamination of telephones in an intensive care unit**

*Conzanitis DA et al, Anaesthetist 1978*



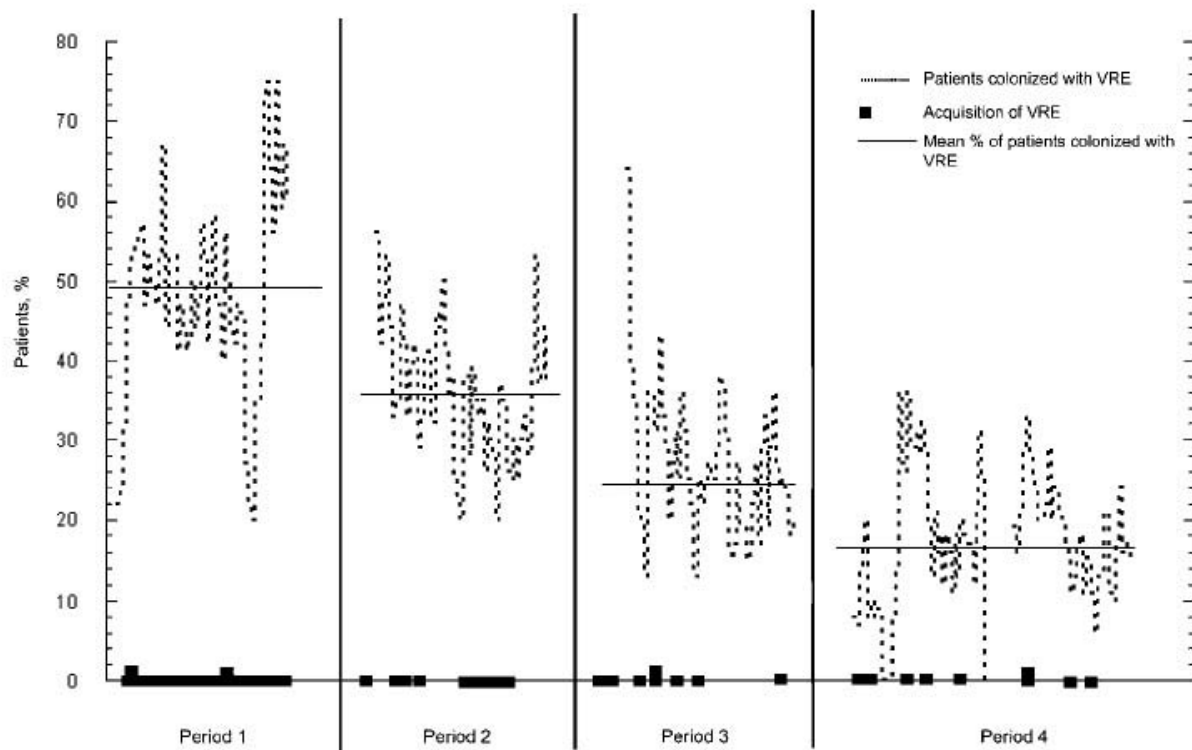
**What is the evidence  
for cleaning as a viable  
control mechanism for  
hospital-acquired  
infections ?**

# Evidence for cleaning in the control of an MRSA outbreak



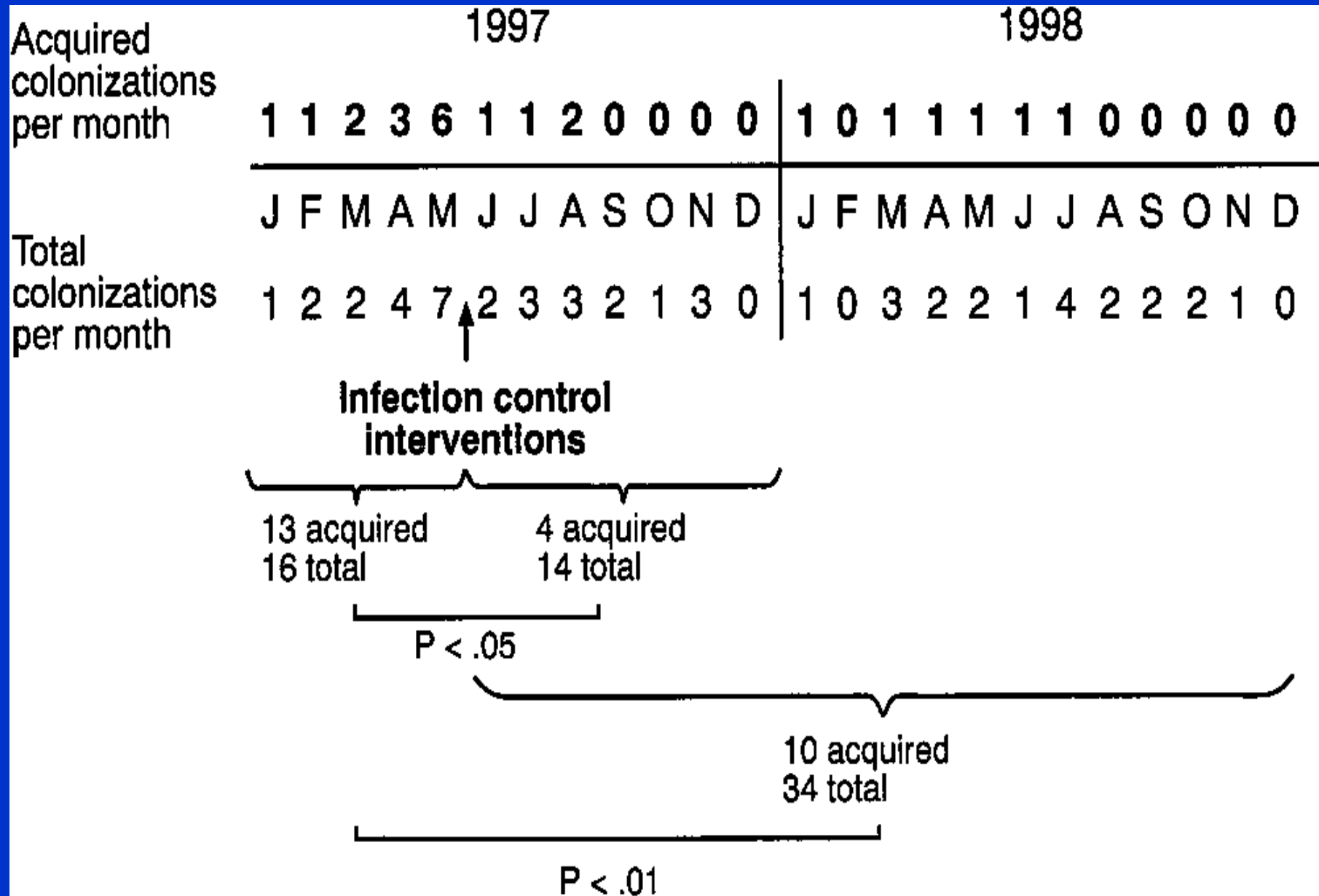
**Figure 1** Numbers of patients with newly acquired MRSA on the male surgical ward from January 1998 to end March 2000. Dark columns indicate the outbreak MRSA; Light columns indicate other miscellaneous strains; ---> Outbreak control measures; —> Intervention.

# Reduction in VRE after improving cleaning & hand-hygiene

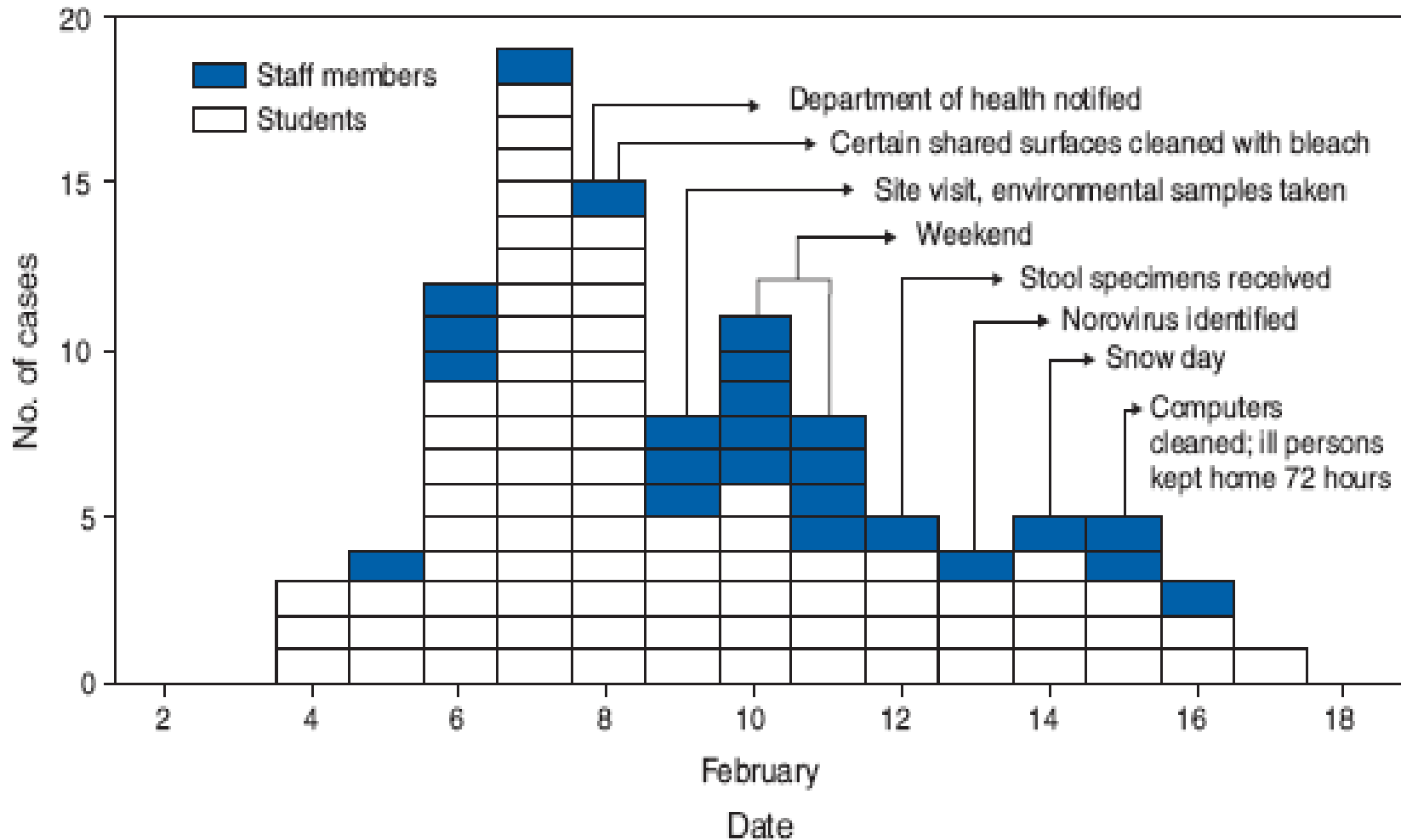


**Figure 1.** Daily percentage of patients colonized with vancomycin-resistant enterococcus (VRE), daily acquisition of rectal colonization with VRE, and mean percentage of patients colonized with VRE, by period. Period 1 was a baseline period (5 March–1 May 2001; duration, 58 days). Period 2 included environmental hygiene intervention (31 May–27 July 2001; duration, 58 days). Period 3 was a “washout” period in which there was no intervention (23 August–18 October 2001; duration, 57 days). Period 4 included hand hygiene intervention (8 November–7 February 2002; duration, 82 days).

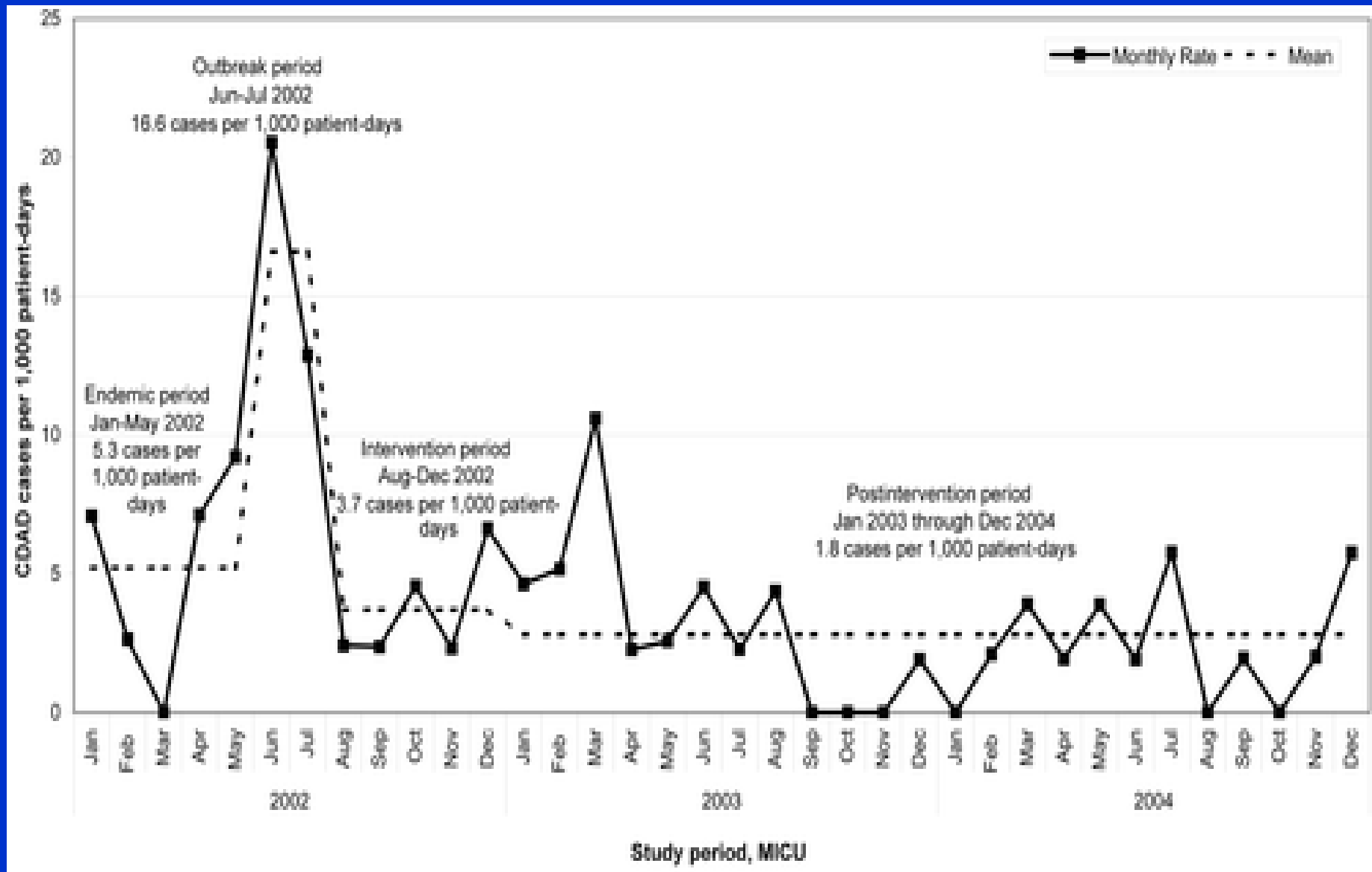
# Acinetobacter on computer keyboards



**FIGURE. Number of Identified cases (N = 103) In a school gastroenteritis outbreak, by date of symptom onset — District of Columbia, February 2–18, 2007**



# Rate of hospital-acquired *Clostridium difficile*-associated diarrhoea in a medical intensive care unit over a three year period



# Disinfectants vs Detergents

- Disinfectants do not degrade
- Expensive
- Toxic
- Incite mutation and resistance

*'....nature abhors a vacuum....'*

## Less toxic alternatives?

**Microfibre:** recontamination; decontamination

*Moore & Griffith, JHI 2006*

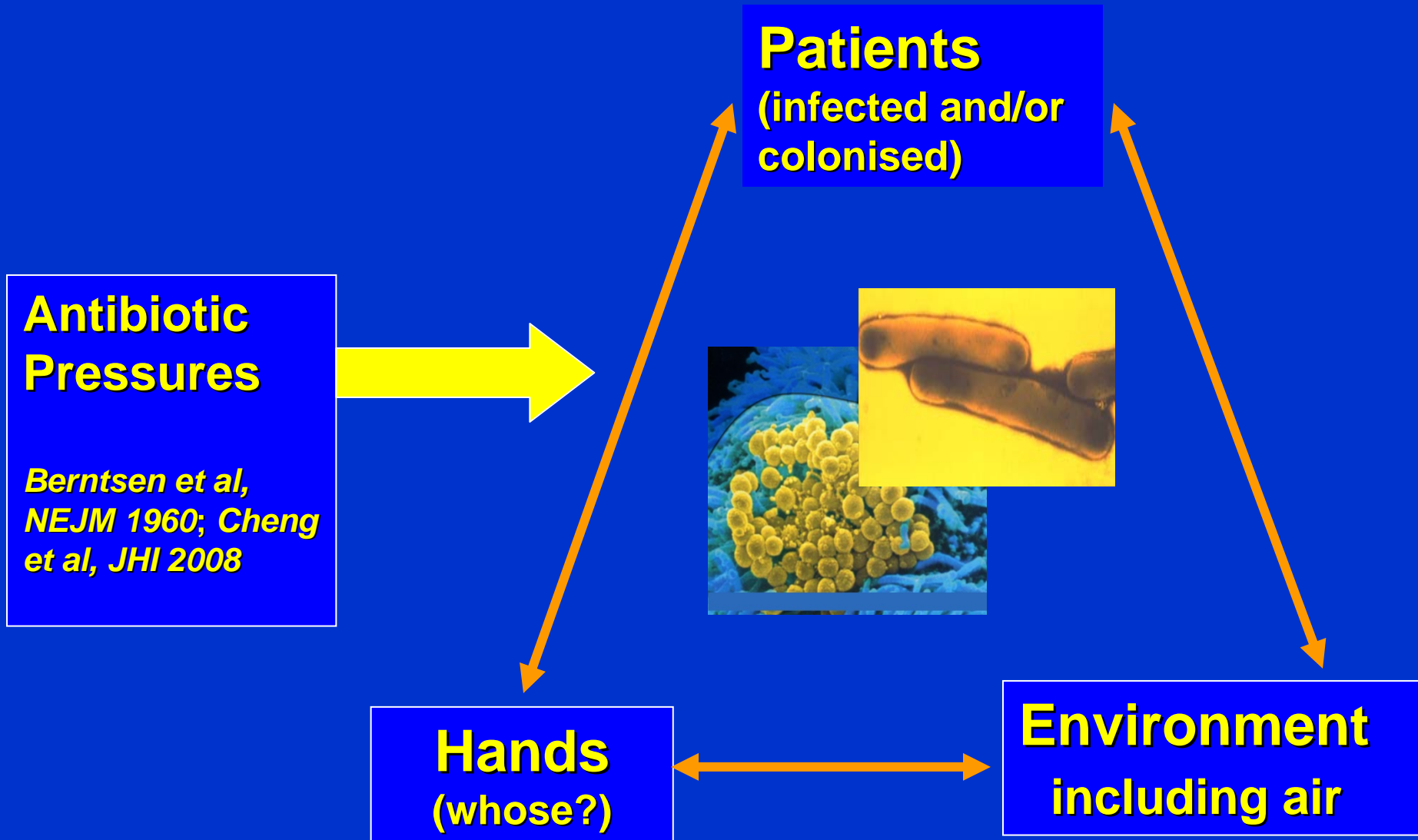
**Steam:** operator dependent; electrical items; aerosol potential

*Meunier et al, Pathol Biol 2008*

**Hydrogen peroxide:** expensive; single rooms only; not fabrics

*Shapey et al, J Hosp Infect 2008*

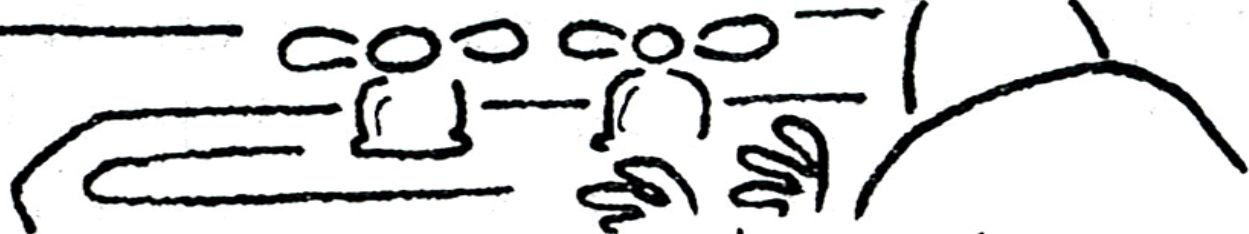
# DYNAMIC TRANSMISSION CYCLE OF HOSPITAL PATHOGENS



# GOVERNMENT GUIDE TO HANDWASHING

1. CREATE MESS.
2. WASH HANDS  
OF IT.

K. J. Lamb



# What's on YOUR hands??!



Imprint of a health care worker's gloved hand after examining a patient with *C.difficile*. The larger yellow colonies outlining the fingers are the spore-forming anaerobe. The patient had showered an hour before examination.

*Bobulsky GS et al, CID 2007*

**Does alcohol gel aid in the control of *C.difficile*?**

**No effect!** (*Boyce et al, ICHE, 2006*)

**Norovirus?**

**Probably not** (*Lages et al, JHI, 2008*)

**Acinetobacter?**

**Left wondering....**

*(Edwards et al, JMM 2007; Pittet et al, LID, 2008)*



**Alcohol enhances the pathogenicity of clinical CNS**

*(Milisaviljevic et al, AmJIC 2008)*

**....and vulnerable people drink it** (*24dash.com, 2008*)

# Are there benefits in using alcohol gel?

**Introducing alcohol hand antiseptic into a hospital reduced VRE but had no effect on MRSA**

*Larson et al, Behav Med 2000; Lai et al ICHE, 2006*

**Hand hygiene rates improved dramatically after introducing hand gel into two ICU's, but there were NO changes in the rates of device-associated infection, infection due to multi-resistant pathogens or *C.difficile***

*Rupp ME et al, ICHE 2008*

**Hand hygiene compliance and consumption of alcohol gel does not correlate with pathogen transmission in ICU**

*Eckmanns et al, JHI 2006*

**Excessive use of of hand hygiene products is not an efficient way of reducing infections in low-prevalence wards**

*Herud et al, AmJIC 2008*

**Maybe..... hand hygiene is not enough on its own**

**Hand hygiene compliance rates of 40% or so,  
should be adequate to prevent most staph  
outbreaks.....**

**So why do so many outbreaks continue to  
occur, despite the fact that recorded hand  
hygiene compliance rates are generally in the  
region of 40% ??**

# Reasons why we continue to see outbreaks of staphylococcal infection

- Hawthorne effect (observed vs. reality)
- Overcrowding/understaffing
- More colonised admissions (when the proportion of MRSA patients entering hospital is  $>5\%$ , then no amount of hand hygiene will control spread)
- Environmental contamination.....even if you do clean your hands, the first thing you touch has MRSA on it....

# There is a heavy bioburden on all **hand-touch** sites



Microbes can survive on surfaces for months. **X** denotes tested surfaces

*Hayden et al, SHEA 2004*

# The Hand-Touch equation



Hand

=



Hand-touch site

*Why is all the emphasis on cleaning hands and not on cleaning the things that they touch?*

# Conclusion

- Hospital-acquired infections and inadequate hospital cleaning are linked
- High risk sites are near-patient **hand-touch** sites
- We know which sites need cleaning, but not necessarily how often we should clean them
- Find the evidence for soap and water first, before powerful disinfectants destroy our environment
- *Hand hygiene alone is NOT enough; what about the other side of the Hand-Touch equation?*

# Acknowledgements



- Professor Cedric Mims
- Dr Penelope Redding
- Dr Ian Gould
- Karen Jennings and colleagues
- Beth, Annette and Janette
- Professor Chris Griffith
- Dr Elizabeth Scott
- Prof Chris Robertson
- Liza White

*Please note that the views expressed in this presentation are not necessarily representative of the views of the Hospital Infection Society nor NHS Lanarkshire*