Clostridium difficile - Prevention is Better Than Cure

Professor Mark Wilcox, University of Leeds

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Environmental aspects of
Prevention is better than cure

Clostridium difficile infection

Professor Mark H. Wilcox
Clinical Director of Microbiology/Pathology
Leeds Teaching Hospitals & University of Leeds, UK
Lead on CDI
Regional Microbiology Network of Health Protection Agency

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maria@webbertraining.com

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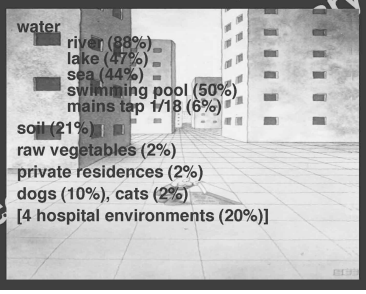
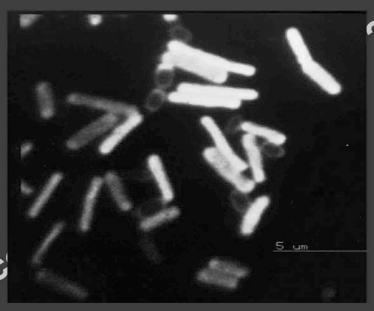
C. difficile in the environment

al Saif *et al. J Med Microbiol* 1996; 45: 133-7



water
- river (88%)
- lake (47%)
- sea (44%)
- swimming pool (50%)
- mains tap 1/18 (6%)

soil (21%)
raw vegetables (2%)
private residences (2%)
dogs (10%), cats (2%)
[4 hospital environments (20%)]



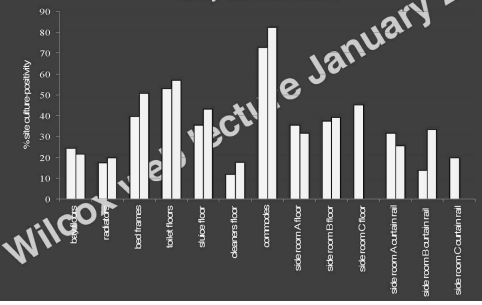
Environmental *C. difficile*
Elderly Medicine ward

	6/10	13/10	27/10	5/12	4/1	31/1	9/4
bay floors		+				+	
toilet floors				+		+	+
sluice floor						+	+
commodes					+	+	
radiators					+		
air vents							

9/4/96 22/32 (69%)

Fawley, Wilcox *et al. Epidemiol Infect* 2001; 126: 343-50.

Frequency of *C. difficile* culture-positive environmental sites commonly associated with patients and healthcare workers on study wards A and B



Environmental *C. difficile* in isolation rooms: prevalence study results

2/33 rooms no *C. difficile* recovered

10/33 positive for 2 weeks

4/33 positive for 4 weeks

after 4 weeks 26% of sites still *C. difficile* +ve

Verity, Wilcox *et al. J Hosp Infect* 2001; 49: 204-209.

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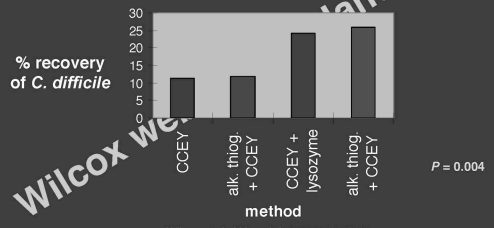
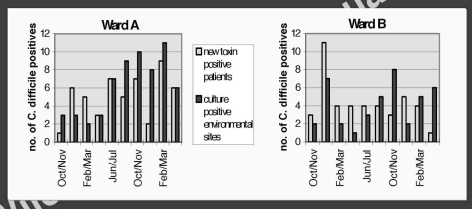
Comparison of *C. difficile* environmental recovery rates with four different culture methods



Wilcox *et al. J Hosp Infect* 2000;44:65-69.

or **egg**

Correlation between environmental *C. difficile* colonisation and clinical incidence of disease



Fawley, Wilcox *et al. Epidemiol Infect* 2001; 126: 343-50.

Environmental *C. difficile*

% environmental sites +ve	no. HCP personnel / env. cultured (%)
0	0/25
1-25	0/11
26-50	1/12 (8)
>50	9/25 (36)*

*$P < 0.01$

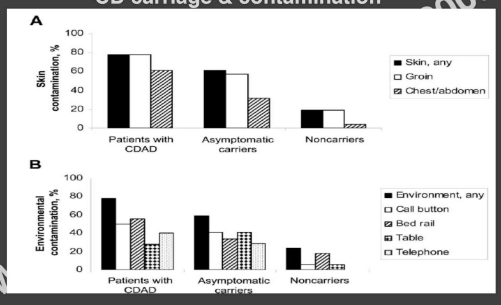
Samore et al. *Am J Med* 1996; 100:32-40

CDI transmission pressure

- 'CDAD pressure' = a modified form of colonization pressure based on symptomatic CDAD cases
- Retrospective cohort and nested case-control studies of patients admitted to US hospital during 2003
- 36 275 patients were included in the cohort, of which 382 had CDAD
- Median CDAD pressure was higher for case patients than non-case patients (2.1 vs 0.3; P<0.001)
- only 1 patient with CDAD had a CDAD pressure of 0
- Nested case-control study, CDAD pressure remained an independent risk factor for CDAD after adjustment for other risk factors (incl. antibiotics)

Dubberke E *et al. Arch Intern Med* 2007;167:1092-7.

CD carriage & contamination



Riggs et al. *Clin Infect Dis* 2008;45:992-8.

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Current (CDI) cleaning controversies

- Detergent *vs* disinfectant (chlorine) products
- Microfibre products
- Steam cleaning
- H_2O_2 vapour

- Dichloroisocyanurate *vs.* hypochlorite
- 1000 ppm *vs.* 5000 ppm
- Surface damage, residue removal
- Routine use, just for CDI cases, terminal clean

Current (CDI) cleaning controversies Microfibre cleaning

- Dry cleaning
- Water based cleaning
- Reprocessing, efficacy, lifespan
- Damage to fibres
- User dependability, 8-fold method
- Not all products equal efficacy

Moore & Griffith. *J Hosp Infect* 2006;64:379-85.
Wren *et al. J Hosp Infect* 2008;70:265-71.

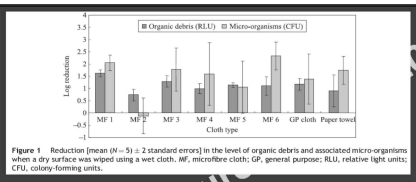


Figure 1 Reduction [mean ($N = 5$) ± 2 standard errors] in the level of organic debris and associated micro-organisms when a dry surface was wiped using a wet cloth. *MF*, microfibre cloth; *GP*, general purpose; *RLU*, relative light units; *CFU*, colony-forming units.

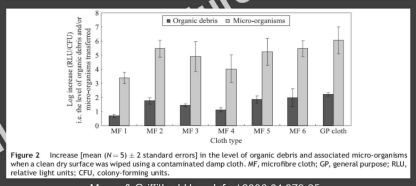
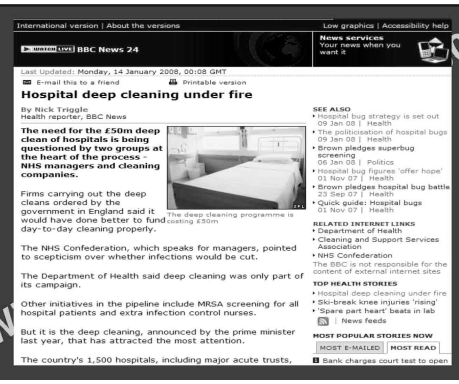


Figure 2 Increase [mean ($N = 5$) ± 2 standard errors] in the level of organic debris and associated micro-organisms when a clean dry surface was wiped using a contaminated damp cloth. *MF*, microfibre cloth; *GP*, general purpose; *RLU*, relative light units; *CFU*, colony-forming units.

Moore & Griffith. *J Hosp Infect* 2006;64:379-85.

% bleach *vs.* ppm chlorine

- In the UK 10,000 ppm available chlorine generally corresponds to a 1:10 (10%) dilution of household bleach, but the strength of individual proprietary brands of household bleach may vary
- In the US 1:10 (10%) yields 5000 ppm
- Studies invariably refer ONLY to dilution factor (which strength was the parent bleach?!)



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Hospital deep cleaning under fire

By Nick Triggle
Health reporter, BBC News

The need for the £50m deep clean of hospitals is being questioned by two groups at the heart of the process - NHS managers and cleaning companies.

Firms carrying out the deep cleans ordered by the government in England said it would have done better to fund day-to-day cleaning properly.

The deep cleaning programme is costing £50m

The NHS Confederation, which speaks for managers, pointed to scepticism over whether infections would be cut.

The Department of Health said deep cleaning was only part of its campaign.

Other initiatives in the pipeline include MRSA screening for all hospital patients and extra infection control nurses.

But it is the deep cleaning, announced by the prime minister last year, that has attracted the most attention.

The country's 1,500 hospitals, including major acute trusts,

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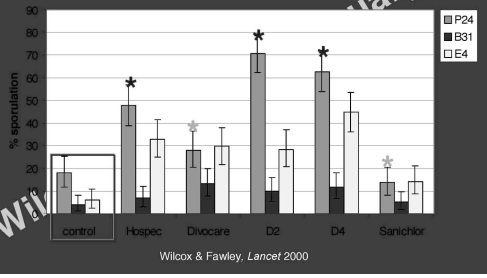
In vitro effects of environmental disinfectants on spore formation (i)



Wilcox & Fawley, *Lancet* 2000

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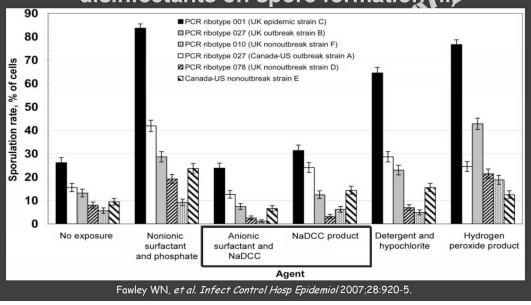


Fawley WN, *et al. Infect Control Hosp Epidemiol* 2007;28:920-5.

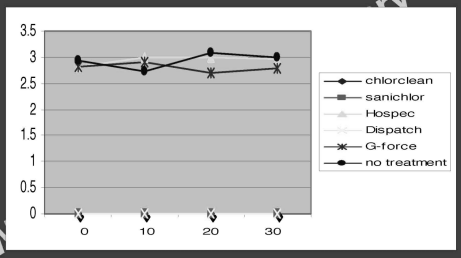
Detergent / germicide concentrations and activity *vs.* vegetative *C. difficile*

Active component(s)	Brand	Manufacturer	Working concentration[a]	MIC, as a proportion of working concentration
Anionic surfactant and NaDCC	Chlor-clean	Guest Medical	1,000 ppm chlorine	1/4
Nonionic surfactant and phosphate	Hospec	Youngs Detergents	0.10%	1/16
Detergent and NaOCl	Dispatch	Caltech Industries	5,500 ppm NaOCl	1/64
Hydrogen peroxide	G-Force	JohnsonDiversey	1 : 64 dilution[b]	1/128
NaDCC	Sanichlor	Ecolab	1,000 ppm chlorine	1/4

NOTE. MIC, minimum inhibitory concentration; NaDCC, sodium dichloroisocyanurate; NaOCl, hypochlorite.
[a] According to manufacturer's guidelines.
[b] Concentration of hydrogen peroxide not stated by the manufacturer.

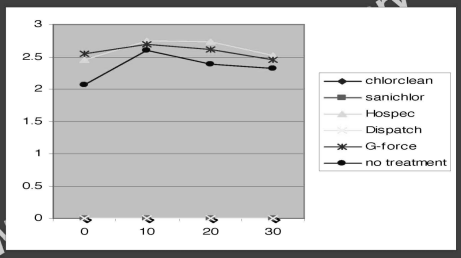
Fawley WN, *et al. Infect Control Hosp Epidemiol* 2007;28:920-5.

Effects of environmental disinfectants & detergents on CD 001 spores



Fawley WN, *et al. Infect Control Hosp Epidemiol* 2007;28:920-5.

Effects of environmental disinfectants & detergents on CD 027 spores



Fawley WN, *et al. Infect Control Hosp Epidemiol* 2007;28:920-5.

Environmental intervention CDI studies

- Kaatz *et al. Am J Epidemiol* 1988;127:1289-93
- Mayfield *et al. Clin Infect Dis* 2000;331:995-1000.
- Wilcox *et al. J Hosp Infect* 2004;54:109-14.
- Other studies

Evidence for role of chlorine-based cleaning to control CDi

- Kaatz *et al.* reported an outbreak of CDI
- ended following introduction of disinfection with hypochlorite (unbuffered hypochlorite - 500 ppm available chlorine)
- surface contamination decreased to 21% of initial levels
- phosphate buffered hypochlorite (1600 ppm available chlorine, pH 7.6) was even more effective
- use resulted in a 98% reduction in surface contamination

Kaatz *et al. Am J Epidemiol* 1988; 127: 1289-94.

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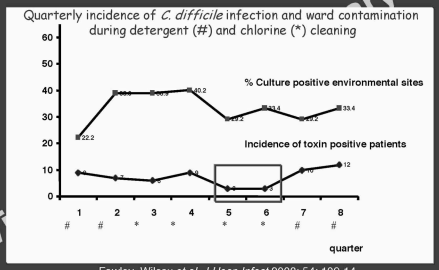
Evidence for role of chlorine-based cleaning to control CDi

- incidence of CDI in patients on a BMTU decreased significantly after substitution of a QAC by hypochlorite (5000 ppm) for environmental disinfection
- after quaternary ammonium solution based cleaning was reintroduced, CDI incidence increased almost to baseline level
- environmental *C. difficile* prevalence not measured
- antibiotic use altered during the study period
- results not reproducible for other units

Mayfield *et al. Clin Infect Dis* 2000; 31: 995-1000.

Evidence for role of chlorine-based cleaning (1000 ppm) to control CDi



Fawley, Wilcox *et al. J Hosp Infect* 2003; 54: 109-14.

Use of Hypochlorite Solution to Decrease Rates of *Clostridium difficile*–Associated Diarrhea

Kathleen M. McMullen, MPH; Jeanne Zack, BSN, CIC; Craig M. Coopersmith, MD; Marin Kollef, MD; Erik Dubberke, MD; David K. Warren, MD, MPH

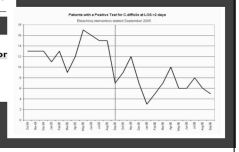
An increased rate of *Clostridium difficile*–associated diarrhea (CDAD) was noted in 2 intensive care units of a university-affiliated tertiary care facility. One unit instituted enhanced environmental cleaning with a hypochlorite solution in all rooms, whereas the other unit used hypochlorite solution only in rooms of patients with CDAD. The CDAD rates decreased in both units.

Infect Control Hosp Epidemiol 2007; 28:205-207

K-608

Significant Impact of Terminal Room Cleaning with Bleach or Reducing Nosocomial *Clostridium difficile* (Cdif).

D. M. HACEK, A. ROBICSEK, A. OGLE, A. FISHER, L. R. PETERSON; Evanston Northwestern Hlth.Care, Evanston, IL.



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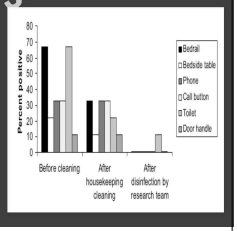
Research article — Open Access

Reduction of *Clostridium Difficile* and vancomycin-resistant *Enterococcus* contamination of environmental surfaces after an intervention to improve cleaning methods

Brittany C Eckstein[1], Daniel A Adams[1], Elizabeth C Eckstein[2], Agam Rao[3], Ajay K Sethi[4], Gopala K Yadavalli[1] and Curtis J Donskey*[1]

- All 9 rooms of patients with CDI positive cultures prior to cleaning vs. 7 (78%) after housekeeping cleaning (p = 0.5), *vs.* only 1 (11%) after bleach disinfection by research staff (p = 0.031)
- After an educational intervention, rates of environmental contamination after housekeeping cleaning were significantly reduced



UK CDI environmental cleaning guidance

- Environmental cleaning of rooms or bed spaces of *C. difficile* patients should be carried out at least daily using chlorine containing cleaning agents (at least 1000 ppm).
- All commodes, toilets and bathroom areas should be cleaned after each use with chlorine containing cleaning agents (at least 1000 ppm available chlorine).
- Terminal cleaning of either a bed space, bay or ward area after the discharge of patient with *C. difficile* should be thorough, all areas should be cleaned using containing cleaning agents (at least 1000 ppm available chlorine), and curtains changed.

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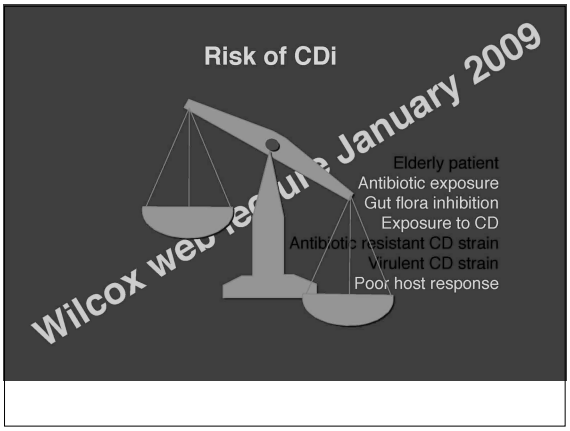

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