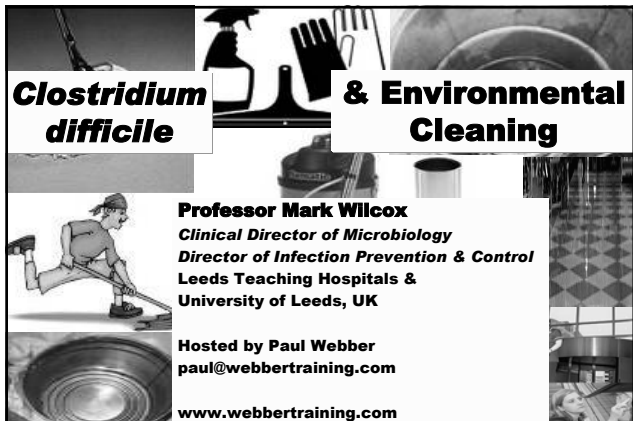


# Clostridium difficile and Environmental Cleaning

## Professor Mark Wilcox

### A Webber Training Teleclass



**Clostridium difficile & Environmental Cleaning**

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## Objectives

1. Discuss role of environment in HAI and in CDI
2. Describe the nosocomial spread of CD
3. Discuss evidence for use of hypochlorite cleaning to reduce CDI incidence

*C<sub>D</sub>i*

## Incidence of *C. difficile* diarrhoea

- most published studies on CDD incidence report whole hospital as opposed to unit specific rates
- CDD incidence in 15 secondary and 6 tertiary hospitals in Sweden
 

Rehabilitation and Geriatrics	~1 per 100 admissions
Whole hospital rate	~0.2 per 100 admissions
- CDD is endemic in many/most elderly medicine units (e.g. 2.2-5.1 cases per 100 admissions)

Karlstrom et al. *Clin Infect Dis* 1998 26, 141-5.

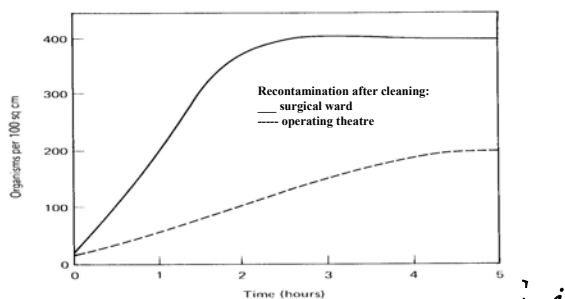
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## Evidence for role of environmental contamination

- ... in the aetiology of hospital-acquired infection is poor
- attempts to reduce infection rates by enhancing environmental cleaning alone generally unsuccessful

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## Effect of floor cleaning on bacterial recovery



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## Evidence for role of environmental contamination

- ... in the aetiology of hospital-acquired infection is poor
- attempts to reduce infection rates by enhancing environmental cleaning alone generally unsuccessful

### HOWEVER

- environmental persistence of *C. difficile* spores
- endemicity of *C. difficile*
- enhanced virulence of particular *C. difficile* strains
- sporulation of *C. difficile* can actually be enhanced when cultured in faeces exposed to non-chlorine based hospital cleaning agents<sup>1</sup>

<sup>1</sup>Wilcox & Fawley, *Lancet* 2000; 356: 1324.

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*Clostridium difficile*  
spore  
environment  
  
PubMed ... 9 hits

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### *C. difficile* environmental epidemiology

- in areas where carriers had diarrhoea, 85 (9.3%) of 910 cultures of floors/other surfaces were CD positive
  - areas where no known carriers 2.6% of sites CD positive ( $P < 0.005$ )
- CD was isolated from
  - hands and stools of asymptomatic hospital personnel
  - sewage and soil
  - from the home of a patient
- CD inoculated onto a floor persisted there for five months

Kim et al. *J Infect Dis* 1981; 143: 42-50.

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### *C. difficile* environmental epidemiology

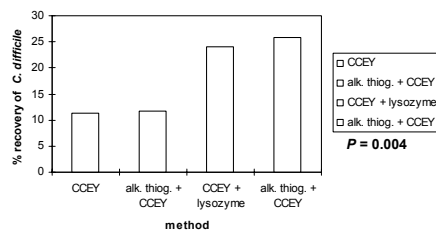
- water
  - river (88%)
  - lake (47%)
  - sea (44%)
  - swimming pool (50%)
  - mains tap 1/18 (6%)
- soil (21%)
- raw vegetables (2%)
- private residences (2%)
- dogs (10%), cats (2%)
- [4 hospital environments (20%)]



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

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



Wilcox, Fawley & Parnell. *J Hosp Infect* 2000; 44: 65-9.

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### Prospective study of antibiotic induced risk of *CDi* results

- a highly significant increased incidence of *C. difficile* colonisation in patients who received CTX as opposed to PT  
(26/34 vs. 3/14,  $p = 0.001$ )
- a highly significant increased incidence of *C. difficile* diarrhoea in patients who received CTX as opposed to PT  
(18/34 vs. 1/14,  $p = 0.006$ )

Settle CD et al. *Aliment Pharmacol Ther.* 1998;12:1217-23

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### Prospective study of antibiotic induced risk of *CDi* environmental *CD* contamination

- |  |   |
|--|---|
| <b>Ward A</b> <ul style="list-style-type: none"> <li>• winter (CTX) study period marked increase in environmental <i>CD</i> contamination (13% to 56%, <math>p &lt; 0.0001</math>)</li> <li>• summer (PT) study period marked decrease in environmental <i>CD</i> contamination (56% to 31%, <math>p = 0.03</math>)</li> </ul> | <b>Ward B</b> <ul style="list-style-type: none"> <li>• winter (PT) study period no significant increase (26% to 40%, <math>p = 0.17</math>)</li> <li>• summer (CTX) study period no significant increase (40% to 38%, <math>p = 1.00</math>)</li> </ul> |
|--|---|

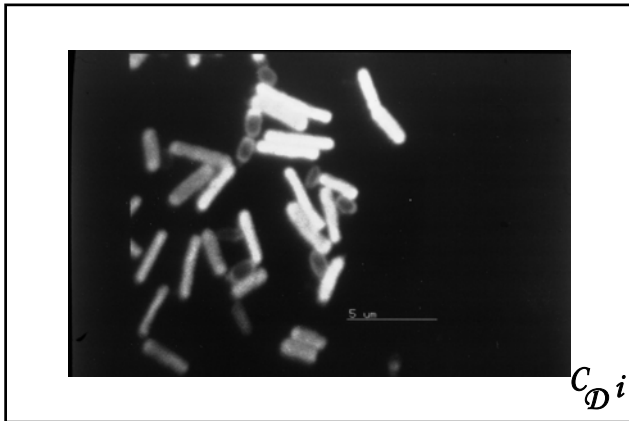
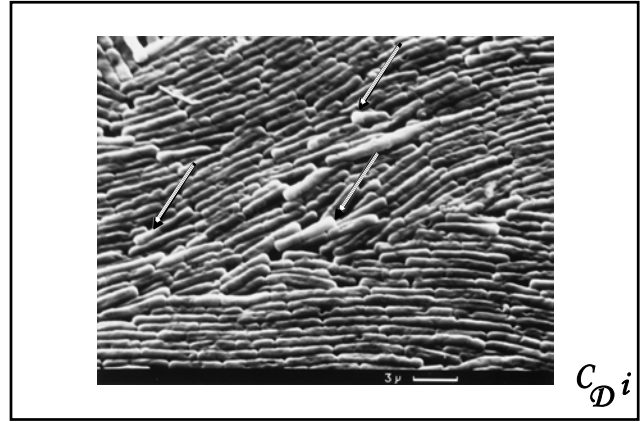
Settle CD et al. *Aliment Pharmacol Ther.* 1998;12:1217-23

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**Environmental *C. difficile***  
Elderly Med 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.

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	08/97	09/97	10/97	11/97	12/97	01/98
Bay floors					+	+
Radiators					+	+
Bed frames			+	+	+	+
Toilet floor					+	
Sluice floor					+	+
Commodes			+	+	+	+
Side room floors			+	+	+	+
Side room curtain rails						

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**Environmental *C. difficile***

% environmental sites +ve	no. +ve personnel / no. 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.

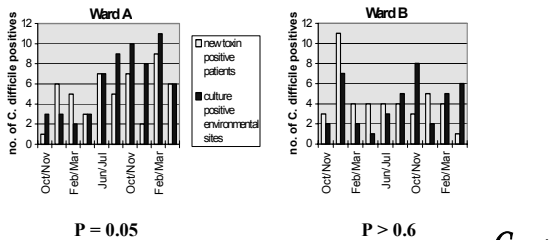
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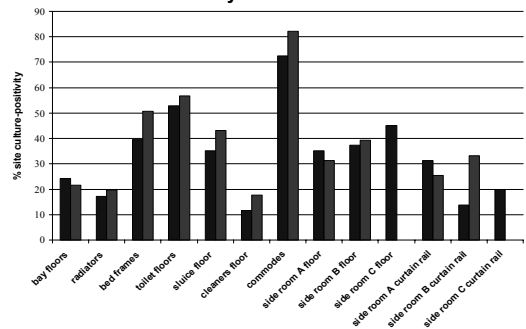
#### Correlation between environmental *C. difficile* colonisation and clinical incidence of disease



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

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



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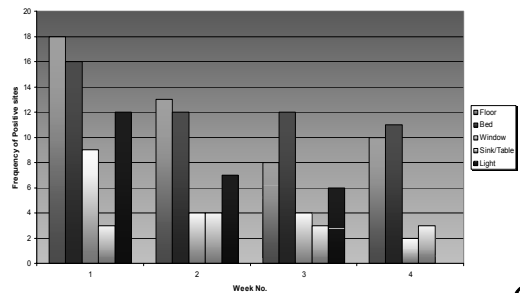
#### Environmental *C. difficile* in isolation rooms prevalence study results

- 2/33 rooms no *C. difficile* recovered
  - 5/33 rooms *C. difficile* positive for 1 week
  - 10/33 positive for 2 weeks
  - 12/33 positive for 3 weeks
  - 4/33 positive for 4 weeks
- after 4 weeks 26% of sites still *C. difficile* +ve

Verity, Wilcox, Fawley et al. *J Hosp Infect* 2001; 49: 204-9.

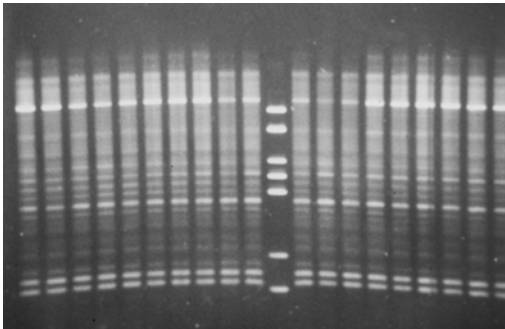
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#### Summary distribution of environmental *C. difficile* in side rooms by week over one month

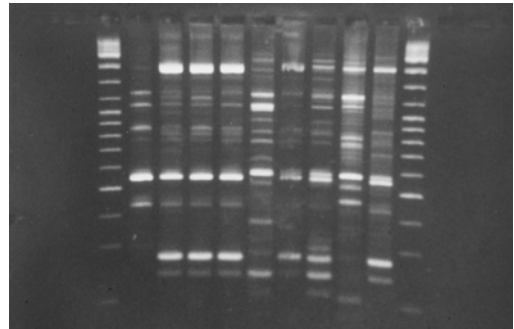


Verity, Wilcox, Fawley et al. *J Hosp Infect* 2001; 49: 204-9.

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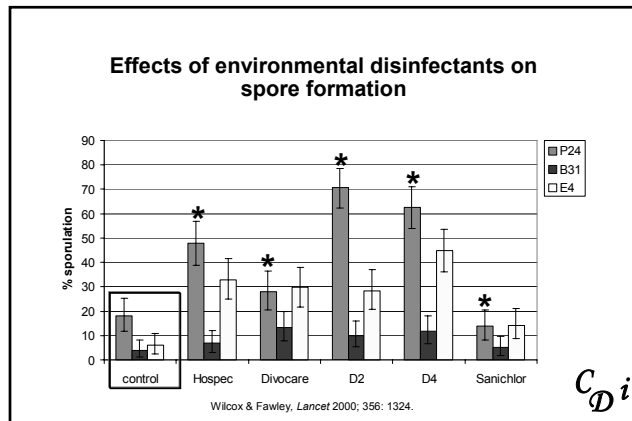
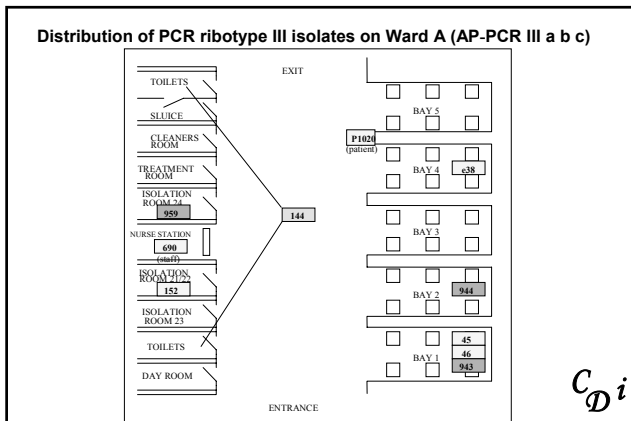


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**Evidence for role of hypochlorite to control CDi (i)**

- 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

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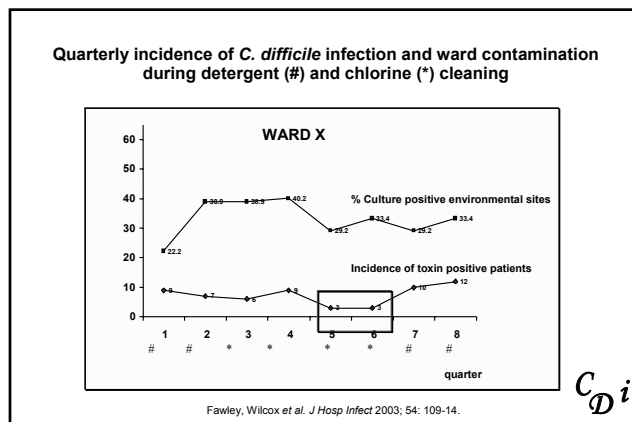
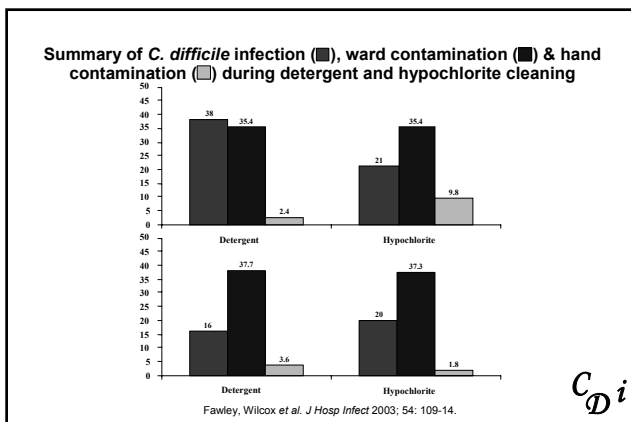
Kaatz *et al.* Am J Epidemiol 1988; 127: 1289-94.

**Evidence for role of hypochlorite to control CDi (ii)**

- Mayfield *et al.* found that incidence of CDI in patients on a bone marrow transplant unit decreased significantly following substitution of a quaternary ammonium solution by hypochlorite for environmental disinfection
- after quaternary ammonium solution based cleaning was reintroduced, CDI incidence increased almost to baseline level
- environmental *C. difficile* prevalence was not measured
- antibiotic use altered during the study period
- results were not reproducible for patients on other units

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



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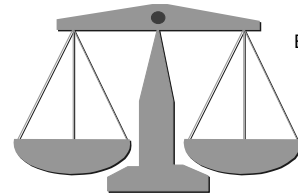
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#### Role of hypochlorite for environmental cleaning

- health & safety
- sustainability – toxicity
- environmental cost – toxicity
- effectiveness vs organic load
- combination products

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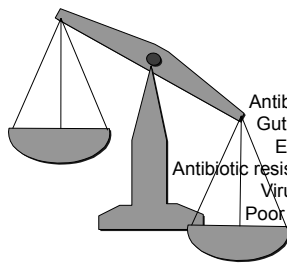
#### Risk of CDi



Elderly patient

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#### Risk of CDi



Elderly patient  
Antibiotic exposure  
Gut flora inhibition  
Exposure to CD  
Antibiotic resistant CD strain  
Virulent CD strain  
Poor host response

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For More Information on  
Teleclass Education . . .

Contact Paul Webber  
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