

Webinar 3: Environmental Cleaning May 2012



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Cleaning the Healthcare Environment
to Prevent *Clostridium difficile*
Transmission

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Disclosure

- Research funding: ViroPharma, Ortho-McNeal, Merck, GOJO, Pfizer, STERIS, Cubist
- Consultation: 3M, GOJO, STERIS, EcoLab

Objectives

- Relate shedding of *Clostridium difficile* to contamination of environmental surfaces
- Discuss best practices for environmental cleaning and disinfection, including agents and timing of cleaning
- Give examples of successful strategies employed by the Cleveland VAMC team to improve environmental cleaning practice

Transmission of healthcare-associated pathogens

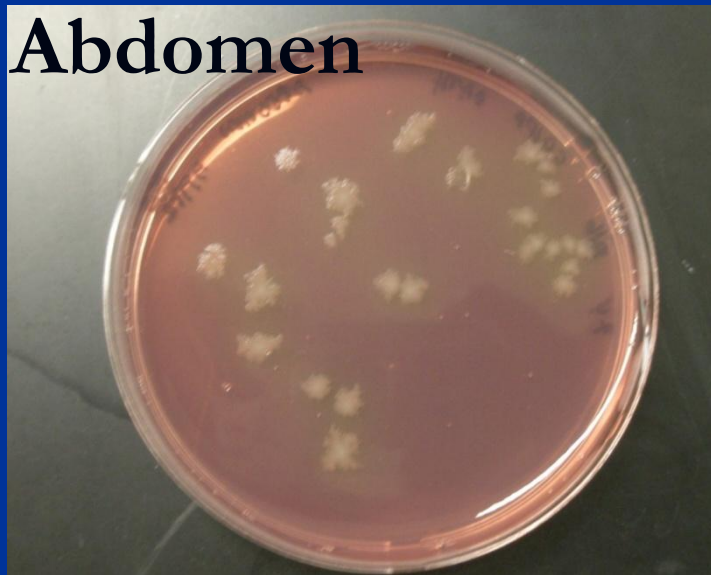


Contamination of hands after examining a patient with *C. difficile* infection

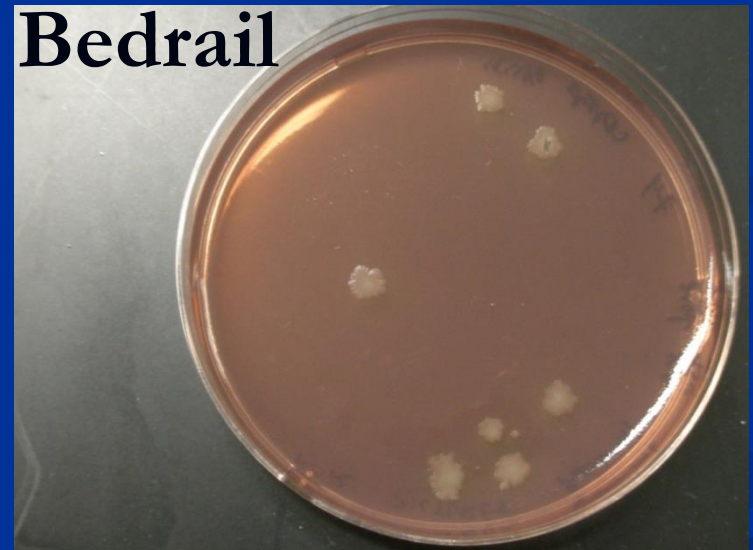


Acquisition of *C. difficile* on hands after contact with skin and environment

- Hand contamination after contact with skin sites: 50%

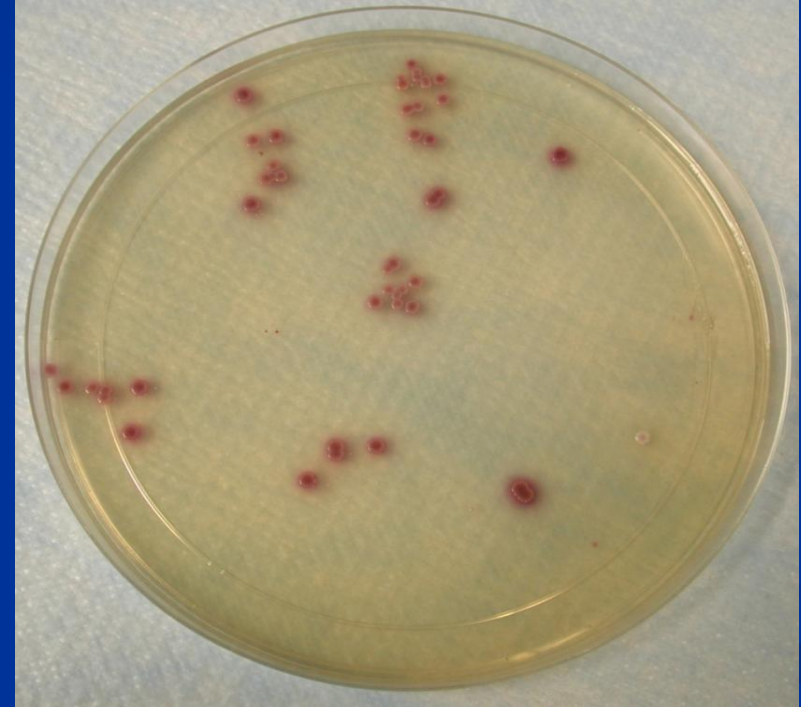


- Hand contamination after contact with high-touch surfaces: 50%



Acquisition of MRSA on hands after contact with skin and environment

- Skin contact: 40% of hand cultures positive
- Environment contact: 45% of hand cultures positive



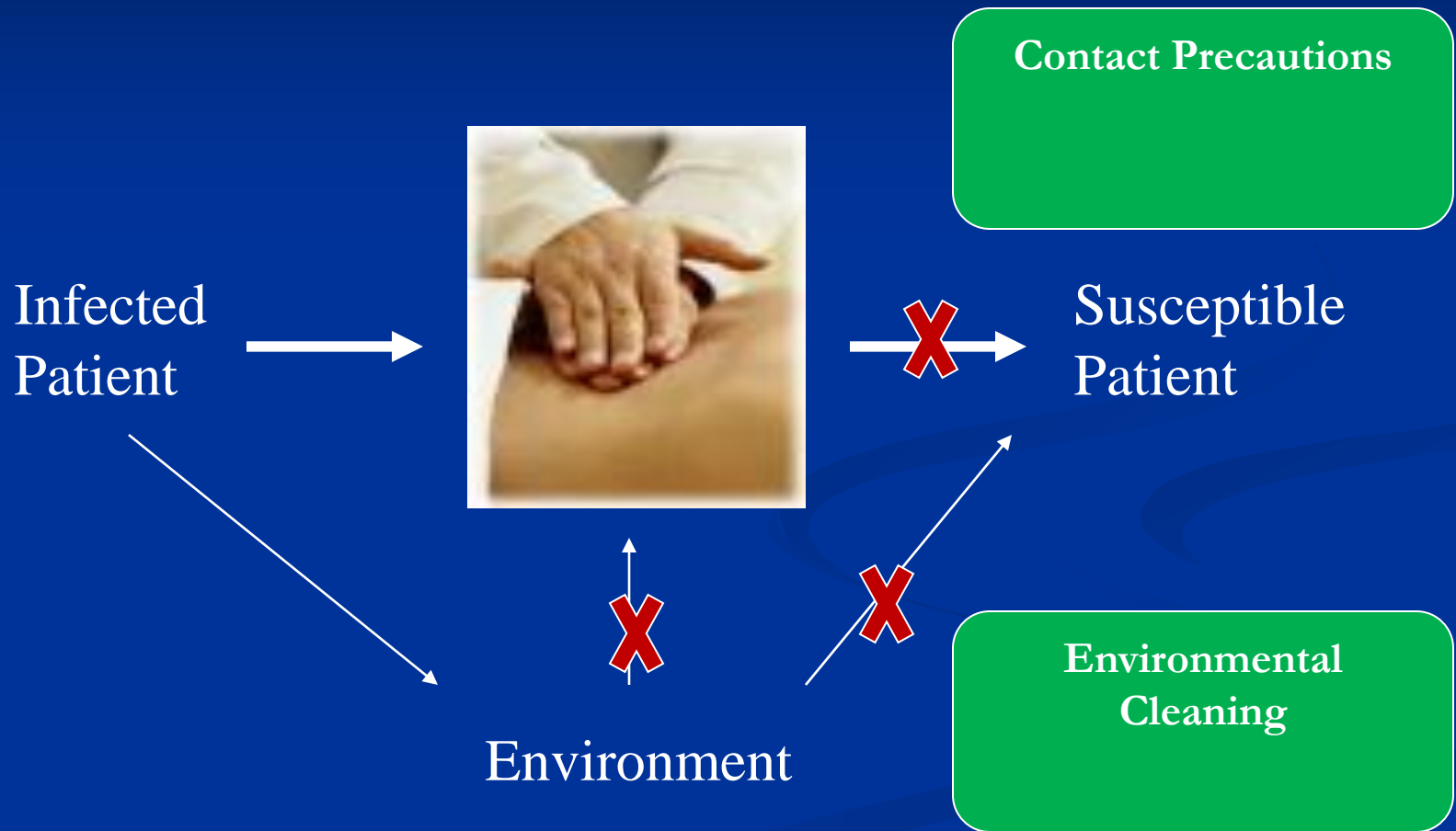
Stiefel U, et al. *Infect Control Hosp Epidemiol* 2011;32:185-7; Donskey CJ, Eckstein BC. *N Engl J Med* 2009;360:e3; Boyce JM et al. *Infect Control Hosp Epidemiol* 1997;18:622-7; Bhalla A, et al. *Infect Control Hosp Epidemiol* 2004;25:164-7; Hayden MK, et al. *Infect Control Hosp Epidemiol* 2008;29:149-154.

Risk of acquiring pathogens from prior room occupants

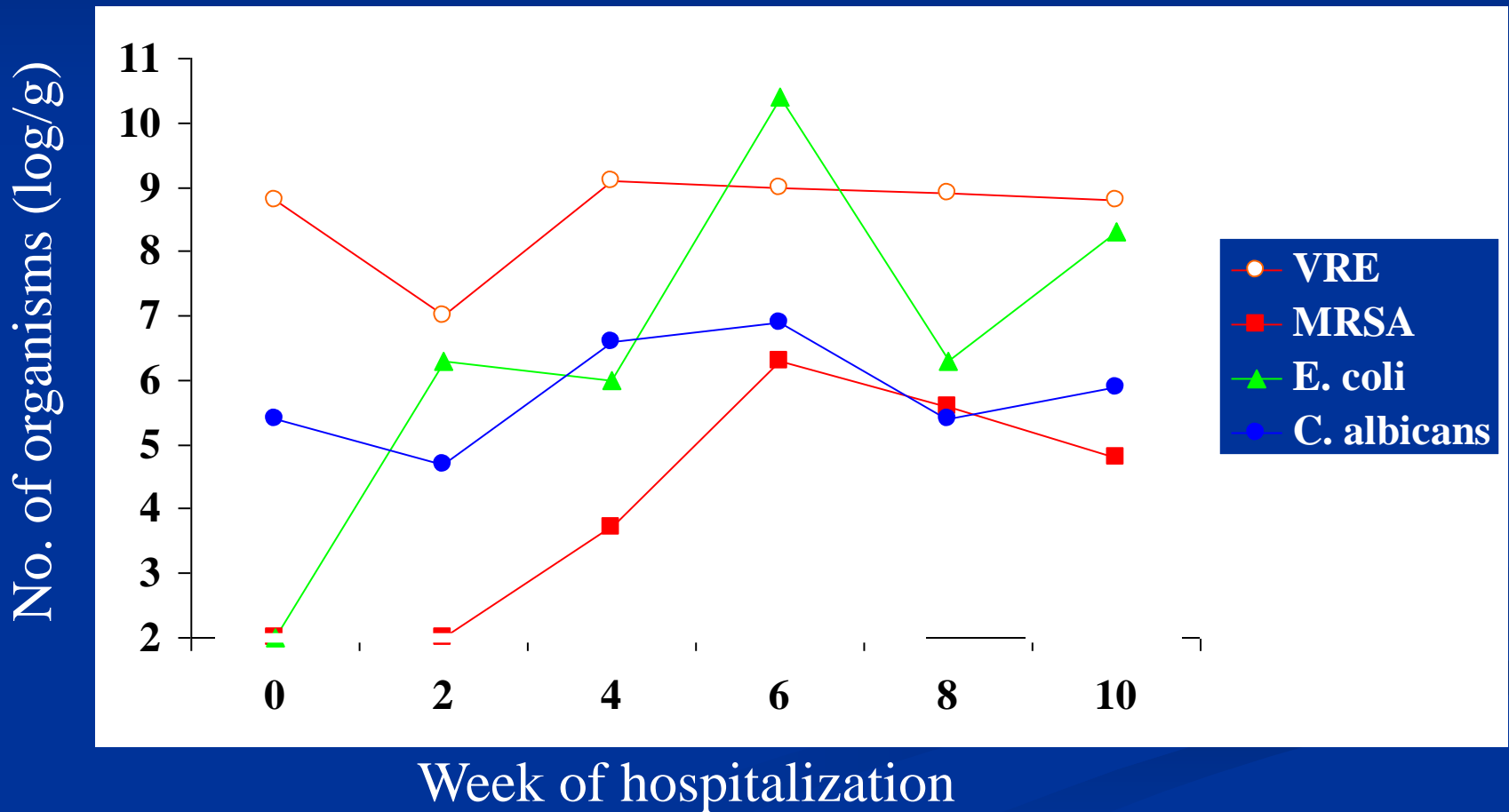
Ref.	Pathogen	Risk for acquisition of pathogen
1	MRSA and VRE	Admission to a room previously occupied by a colonized patient
2	VRE	Admission to room with contamination after terminal cleaning
3	VRE	Admission to a room previously occupied by a VRE-colonized patient or with positive environmental cultures
4	MRSA	Strong evidence that 3/26 (12%) MRSA acquisitions were from the environment
5	<i>C. difficile</i>	Admission to a room previously occupied by a patient with <i>C. difficile</i> infection

1). Huang SS, et al. Arch Intern Med 2006;166:1945-51; 2). Martinez JA, et al. Arch Intern Med 2003;163:1905-12; 3). Drees M, et al. Clin Infect Dis 2008;46:678-85; 4). Hardy KJ, et al. Infect Control Hosp Epidemiol 2006;27:127-32; 5). Shaugnessy M, et al. Infect Control Hosp Epidemiol 2010

Basic practices for prevention of CDI



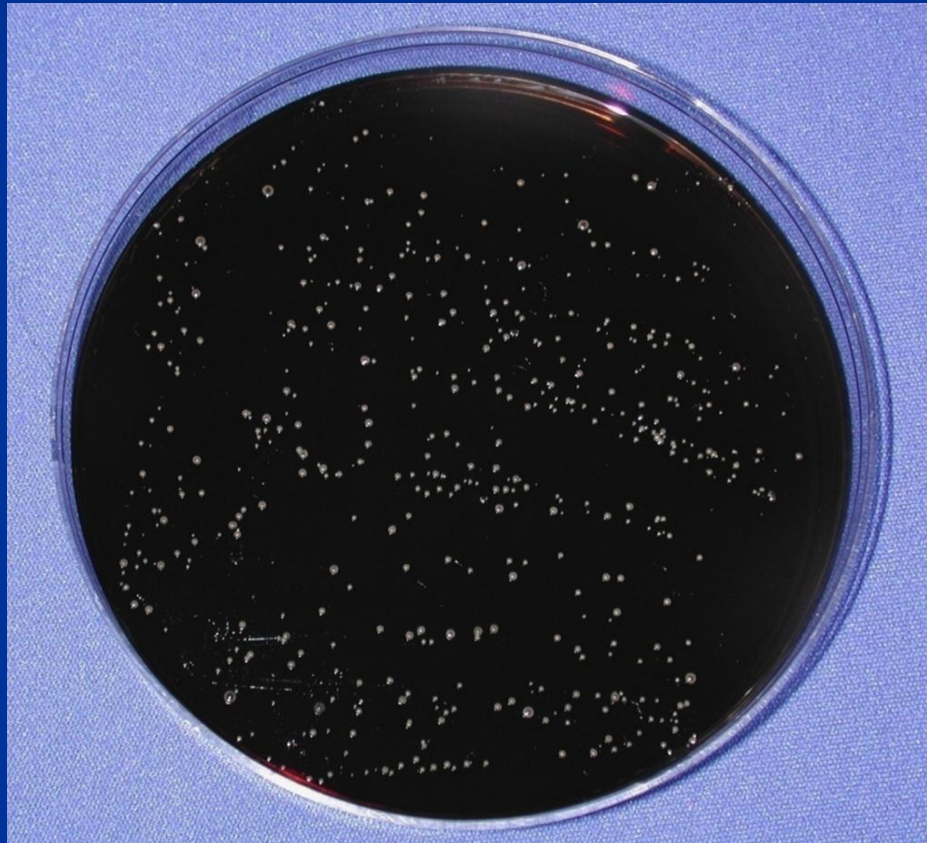
Coexistence of multiple nosocomial pathogens in the intestinal tract of a patient who developed *C. difficile* infection



What are some of the challenges we face when trying to optimize cleaning and disinfection?

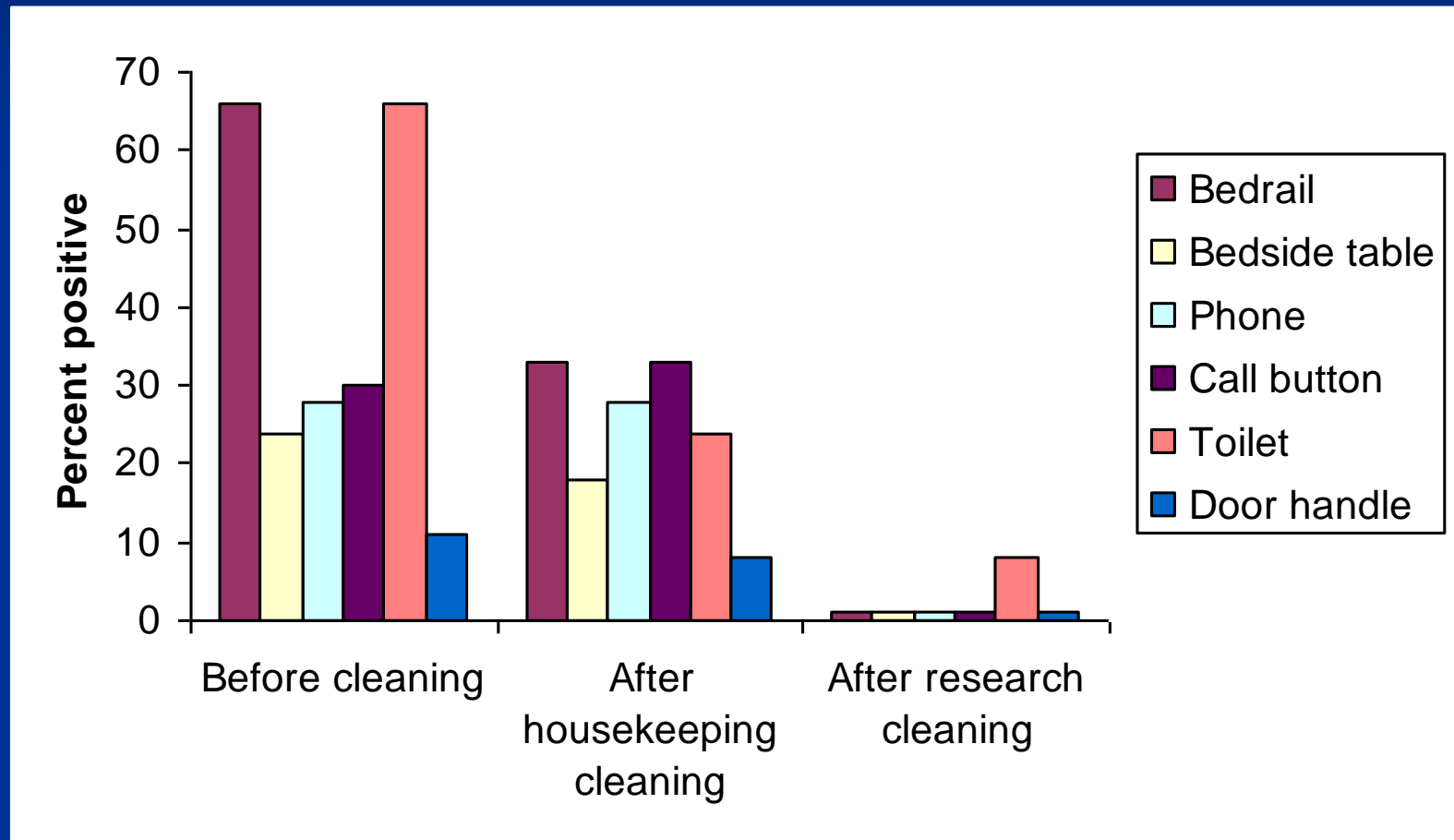
1. Education alone doesn't work

Contamination of a call button with
VRE after terminal cleaning



Eckstein B, et al. BioMed Central Infect Dis 2007

Environmental contamination with *Clostridium difficile*



Practice **NOT** Product

Routine monitoring and feedback is essential

Methods

- 1). Direct observation
- 2). ATP bioluminescence
- 3). Fluorescent markers
- 4). Cultures

Toilet lid after cleaning



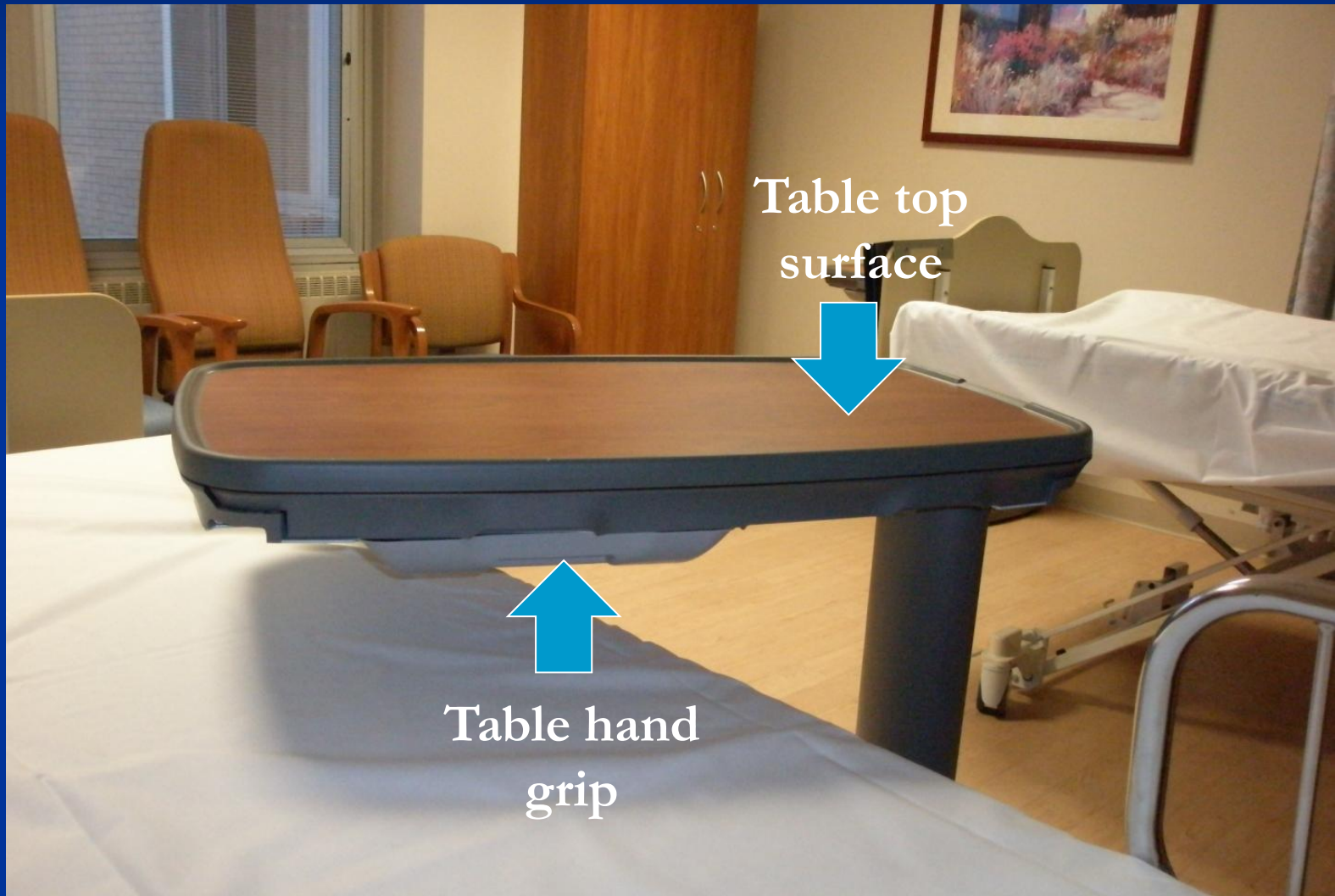
1). Hayden MK, et al. Clin Infect Dis 2006;42:1552-60; 2). Boyce JM, et al. Infect Control Hosp Epidemiol 2009;30:678-84; 3). Carling P, et al. Infect Control Hosp Epidemiol 2008;29:1035-41; 4). Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1187-93; 5). Munoz-Price LS, et al. Infect Control Hosp Epidemiol 2011;32:283-5

2. Current methods of monitoring are not ideal

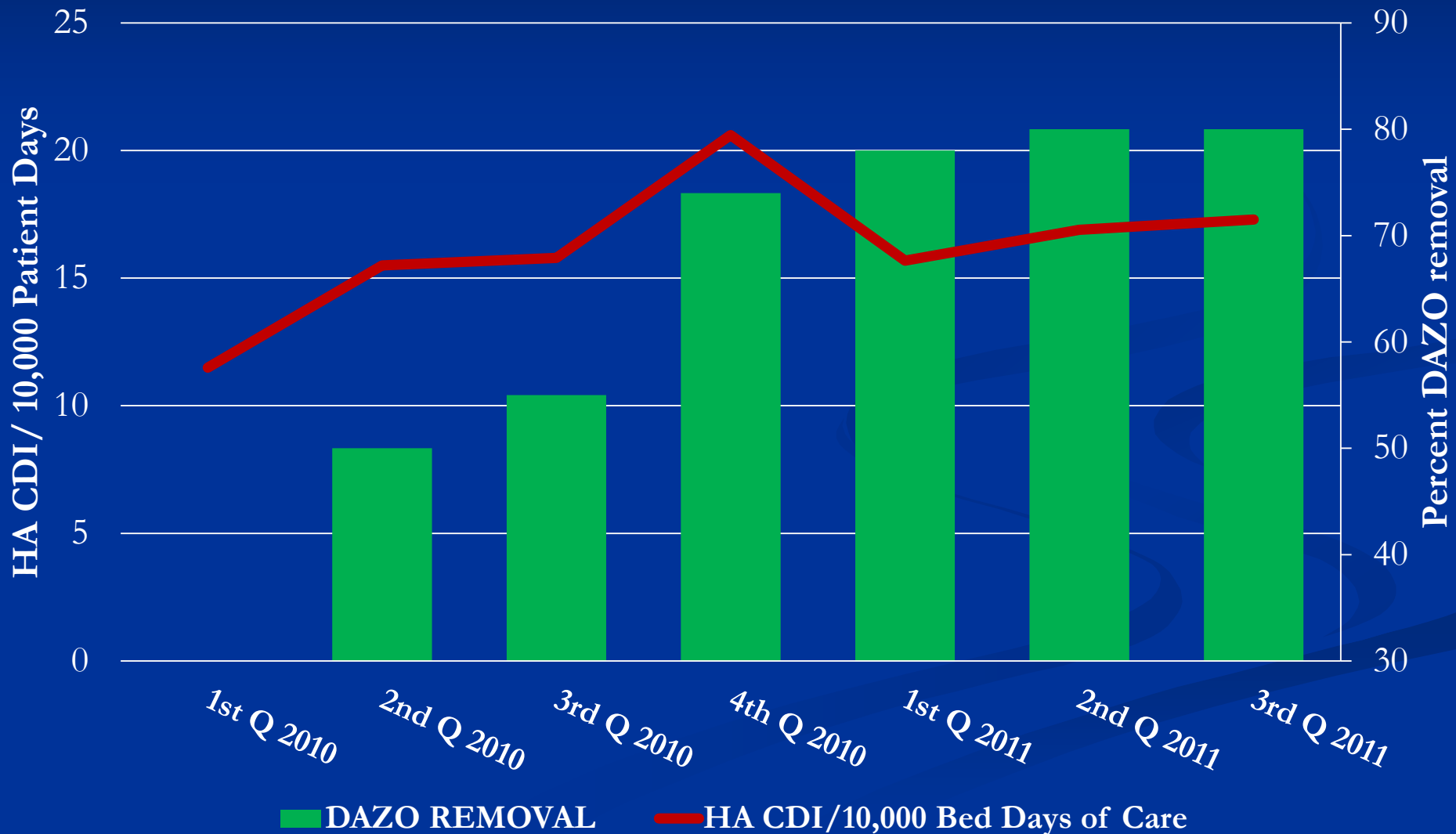
Ref	Fluorescent marker method culture results
1	Despite intervention, 27% of rooms contaminated with MRSA or VRE after cleaning (versus 45% at baseline)
2	33% of toilet seats in CDI rooms with complete marker removal grew <i>C. difficile</i>
3	35% of CDI rooms with complete marker removal grew <i>C. difficile</i> from 1 or more high-touch sites (vs 100% of rooms with no removal)
4	21% of sites with complete marker removal not clean based on aerobic colony counts

1). Goodman ER et al. Infect Control Hosp Epidemiol 2008;29:593-9; 2). Alfa MJ, et al. BMC Infect Dis 2008;8:64; 3). Sitzlar B, et al. Unpublished data; 4). Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1187-93

Removal of marker may not correlate with cleaning of alternate sites on the same surface



No decrease in CDI incidence despite effective cleaning intervention



3. Variability in EMS Employee Performance



Boyce JM, et al. Variations in hospital daily cleaning performance. *Infect Control Hosp Epidemiol* 2010;31:99-101.

4. Confusion about who cleans what

Wall-mounted vital signs equipment



Dumigan DG, et al. *Am J Infect Control* ;38:387-92;

Goodman ER, et al. *Infect Control Hosp Epidemiol* 2008;29:593-9

5. Confusion about products



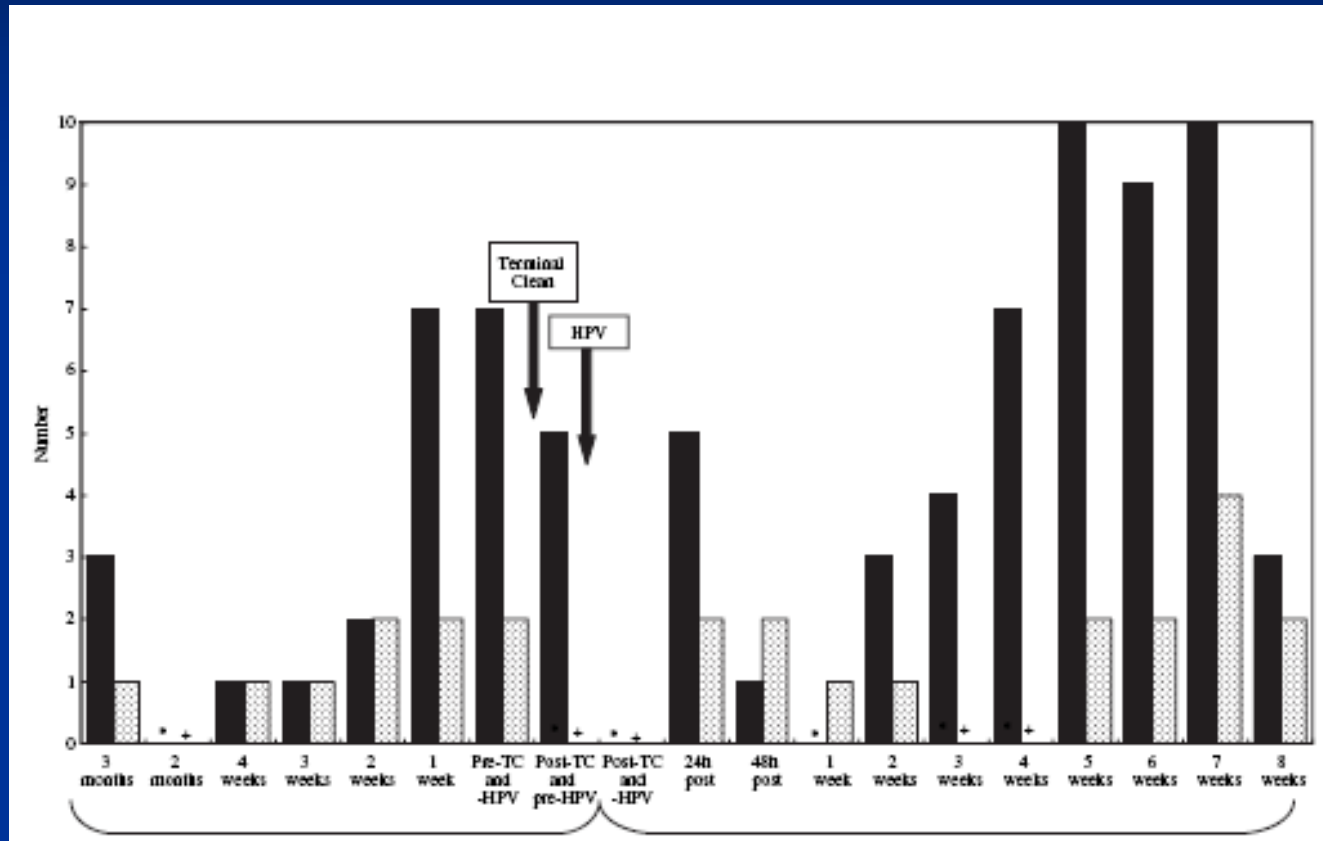
Dharan S, et al. J Hosp Infect 1999;42:113-7

6. Cleaning can be difficult

Daily cleaning?



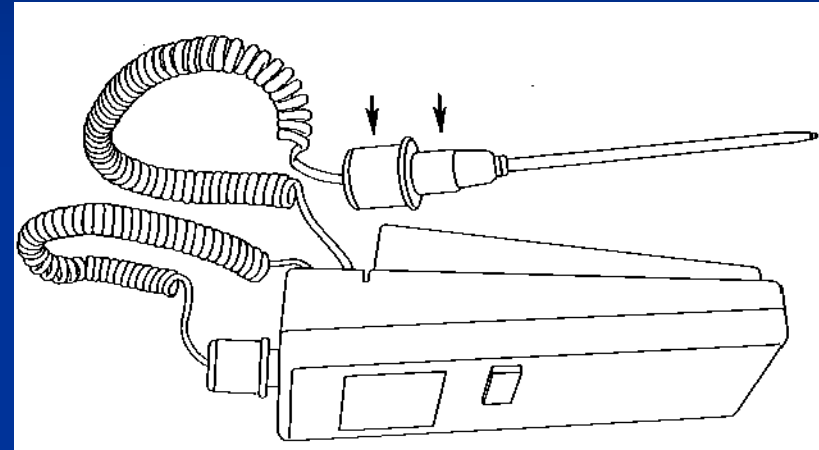
7. Recontamination after cleaning



- 1). Hardy KJ, et al. Rapid recontamination with MRSA of the environment of an ICU after decontamination with hydrogen peroxide vapor. *J Hosp Infect* 2007;66:360-8;
- 2). Otter JA, et al. Assessing the biological efficacy and rate of recontamination following hydrogen peroxide vapor decontamination. *J Hosp Infect* 2007;67:182-8

8. Portable equipment

- Electronic thermometers²⁻⁴
- Blood pressure cuffs
 - As contaminated as bedside commodes (10% vs. 12%)⁵
 - 33% contaminated⁶
- Bedside commodes⁷
- Stethoscopes⁸



1). Cohen SH, et al. ICHE 2010;31:31:431-55; 2). Brooks SE et al. ICHE 1992;13:98-103; 3). Jernigan JA, et al. ICHE 1998;494-9; 4). Livornese LL, et al. Ann Intern Med 1992;117:112-116; 5). Manian FA, et al. ICHE 1996;17:180-182; 6). Walker N, et al. J Hosp Infect 2006;63:167-9; 7). Fawley WN and Wilcox MH. Epidemiol Infect 2001;126:343-50; 8). Vajravelu R, et al. ICAAC 2010

9. Privacy curtains and toilets?

“Flushing lidless toilet sends spray of diarrhea-causing bacteria into air”



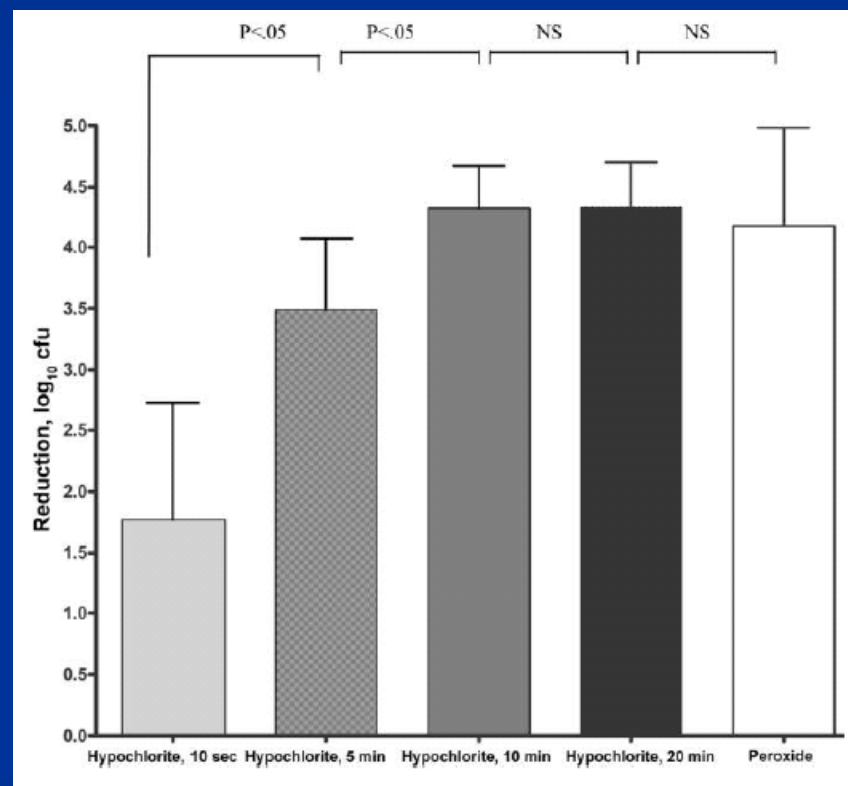
Trillis F, et al. Infect Control Hosp Epidemiol 2008;29:1074-Best EL, et al. Potential for aerosolization of *C. difficile* after flushing toilets: The role of toilet lids in reducing environmental contamination risk. J Hosp Infect 2012;80:1-5

10. Technical difficulties

Technical factors

- Sufficient contact time to kill pathogens
- Pre-cleaning to remove organic material
- Mechanical removal

Reduction of *C. difficile* spores by hypochlorite vs time



Barbut F, et al. Infect Control Hosp Epidemiol 2009;30:507-14.

Bleach

- Dried on surfaces in ~4 minutes
 - 2 applications required for optimal activity
- Did not spread uniformly on surfaces such as toilet bowls and ceramic tiles (i.e., tended to form small droplets)

Best practices for cleaning and disinfection

1. Do we need to use a sporicidal product (e.g., bleach) for *C. difficile* rooms?

SHEA/IDSA Guideline for prevention of CDI in acute care

- “Facilities should consider using a 1:10 dilution of sodium hypochlorite (household bleach) in outbreak settings and settings of hyperendemicity (high rates)”¹

1. Dubberke ER, et al. Strategies to prevent CDI in acute care hospitals. *Infect Control Hosp Epidemiol* 2008;29:S81-S92

2. Cohen SH, et al. Clinical Practice Guidelines for *C. difficile* infection in adults. *Infect Control Hosp Epidemiol* 2010;31 (www.idsa.org practice guidelines)

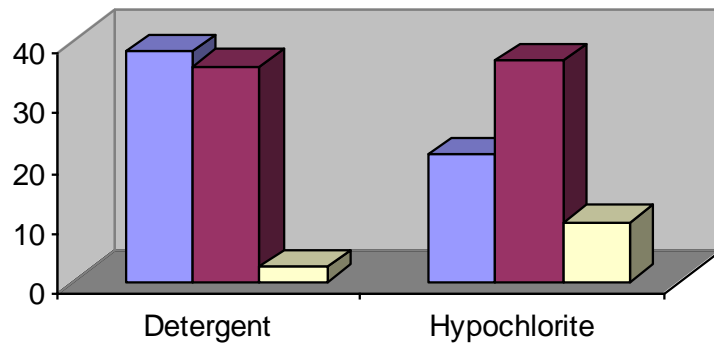
Substitution of hypochlorite for non-sporicidal cleaning agents to control *C. difficile*

Ref	Setting	Effect on CDI rates	Monitoring to ensure efficacy of disinfection
1	Medical Ward	Outbreak ended	Surface contamination reduced to 21% of initial levels
2	Bone marrow transplant (BMT) unit, Medical Ward, ICU	Significant decrease on BMT unit, but not on the other 2 wards	No
3	2 medical wards	Decreased on 1 of 2 wards	No decrease in prevalence of environmental contamination with hypochlorite use
4	Medical and surgical ICUs	Decreased on both units	No
5	3 hospitals	48% decrease in prevalence density of CDI	No
6	2 medical wards	85% decrease in hospital acquired CDI	Yes (ATP bioluminescence)

- 1). Katz G. Am J Epidemiol 1988;127:1289-94; 2). Mayfield JL. Clin Infect Dis 2000;31:995-1000; 3). Wilcox MH. J Hosp Infect 2003;54:109-114; 4). McMullen KM. Infect Control Hosp Epidemiol 2007;28:205-7; 5). Hacek DM. Am J Infect Control 2010;38:350-3; 6). Orenstein R. Infect Control Hosp Epidemiol 2011;32:1137-9

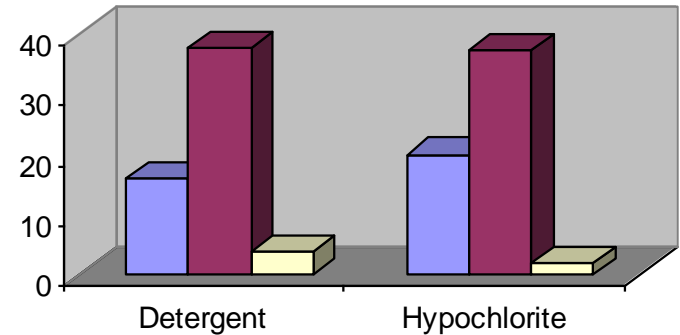
No decrease in environmental or hand contamination with hypochlorite

Ward A



■ Number CDI cases
■ % positive environmental cultures
■ % positive hand imprint cultures

Ward B

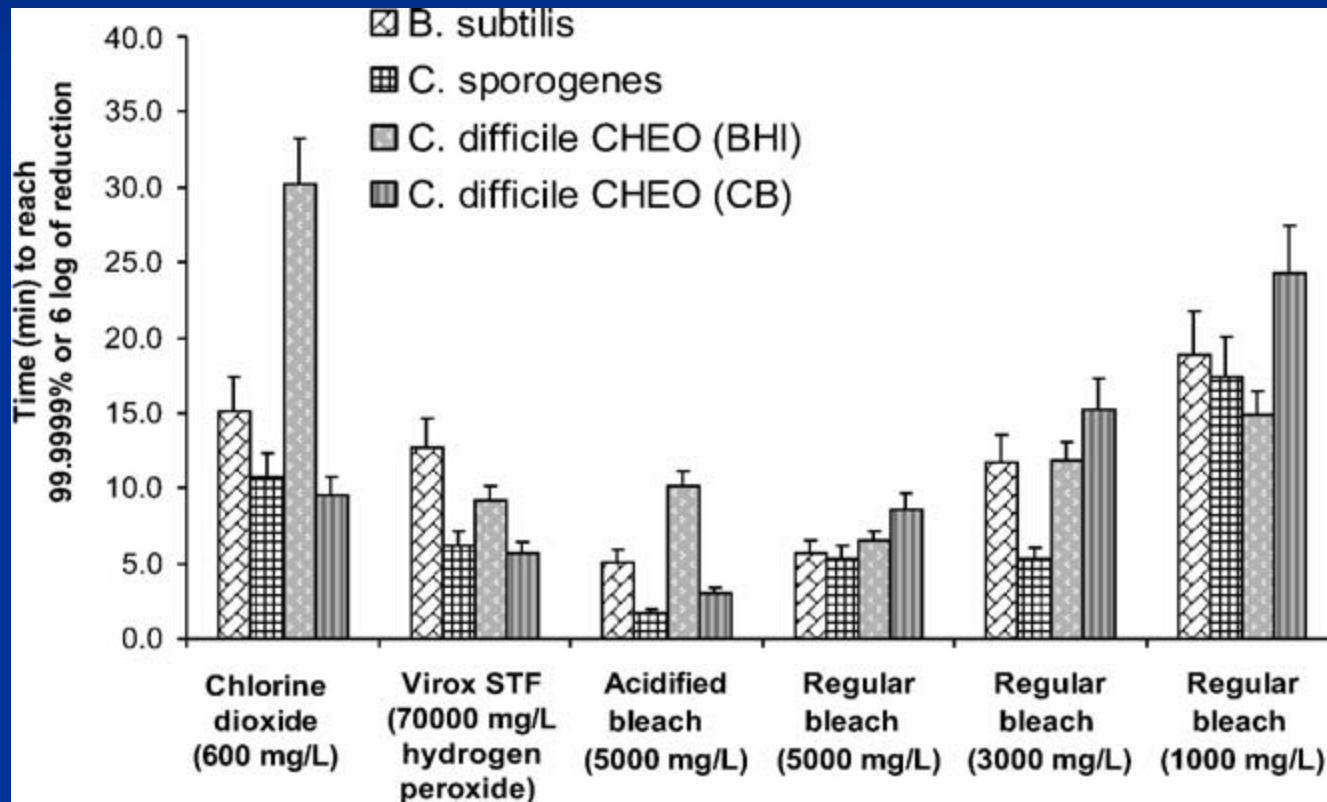


■ Number CDI cases
■ % positive environmental cultures
■ % positive hand imprint cultures

Transfer of MRSA and *Acinetobacter* from dirty to clean sites during terminal cleaning?

- Culture negative sites became culture positive after terminal cleaning
 - MRSA
 - 10 positive sites became culture negative
 - 6 negative sites became culture positive
 - *Acinetobacter baumannii*
 - 12 positive sites became culture negative
 - 3 negative sites became culture positive

2. What concentration of bleach is most effective?



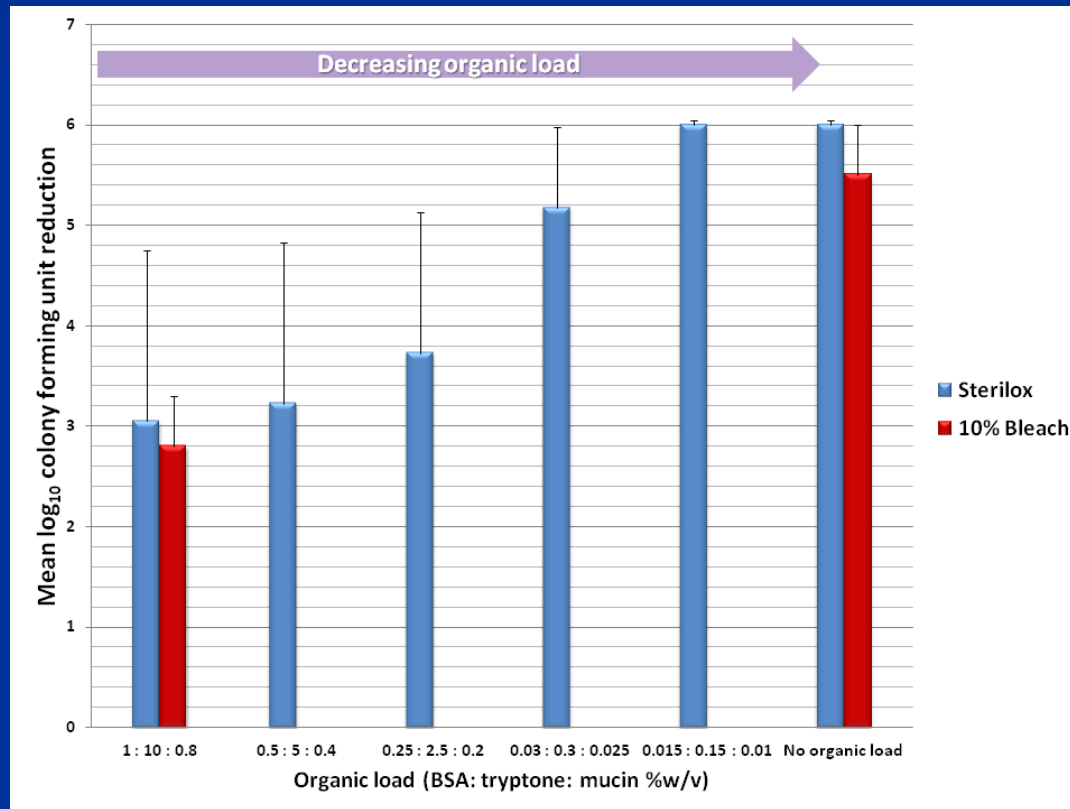
Concentrations of hypochlorite in bleach products

Product	Sodium hypochlorite concentration
1:10 bleach (Clorox germicidal bleach)	6,150 ppm *
1:50 bleach	1,230 ppm
1:100 bleach	615 ppm
Dispatch cleaner disinfectant towels with bleach	6,500 ppm
Clorox germicidal wipes	5,200 ppm

* Concentrations can also be expressed as % or as available chlorine (6,150 ppm = 0.615%; 1:10 Clorox germicidal bleach contains 5,842 ppm available chlorine)

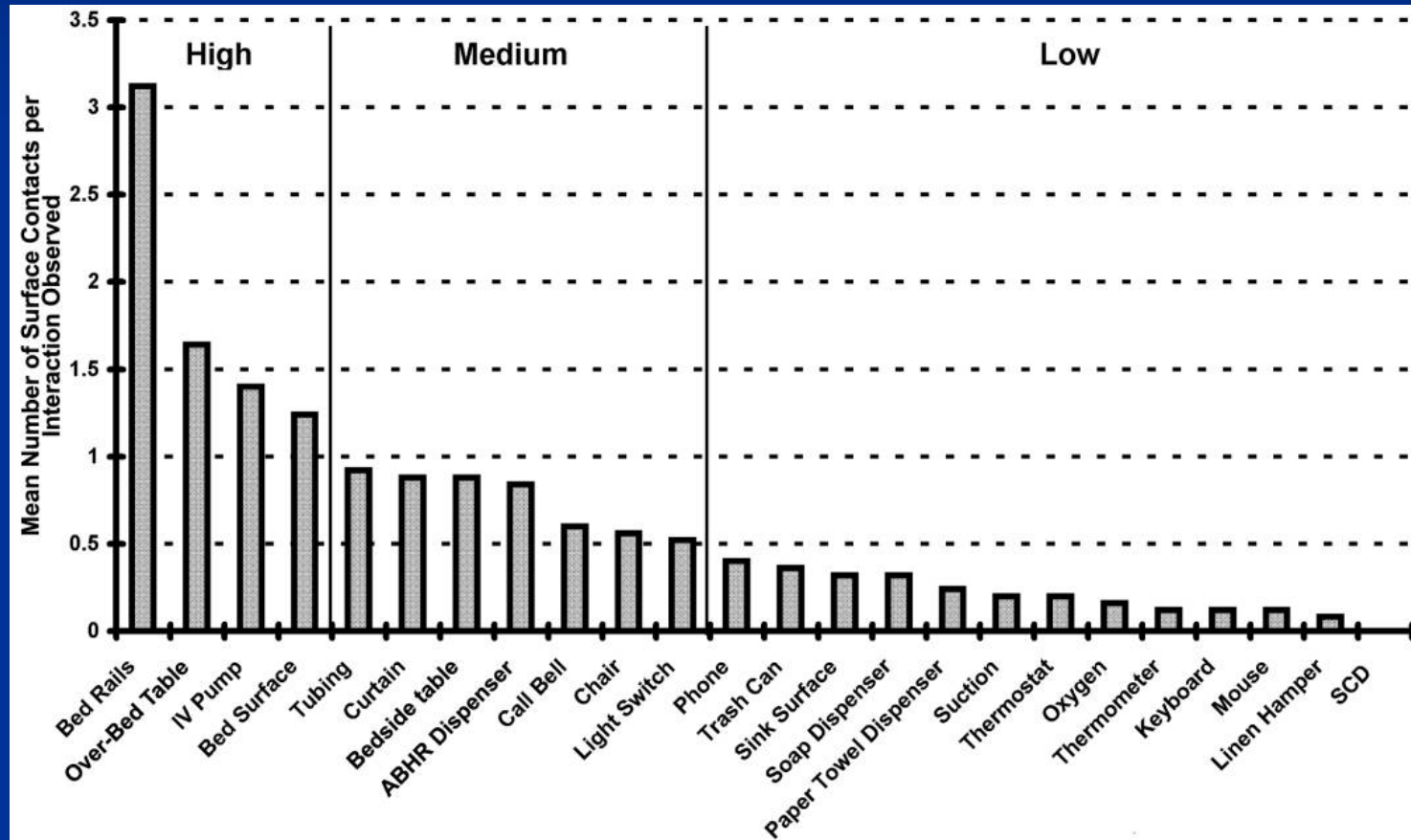
3. If bleach is effective, why do surfaces need to be pre-cleaned with a detergent?

Effect of organic material on effectiveness of bleach and Sterilox HG against *C. difficile* spores



4. What surfaces should be a priority for cleaning?

Mean frequency of healthcare worker contact with surfaces



Huslage K, et al. A quantitative approach to defining high-touch surfaces in hospitals. *Infect Control Hosp Epidemiol* 2010;31:850-3.

5. What sporicidal disinfectants are available that are alternatives to bleach?

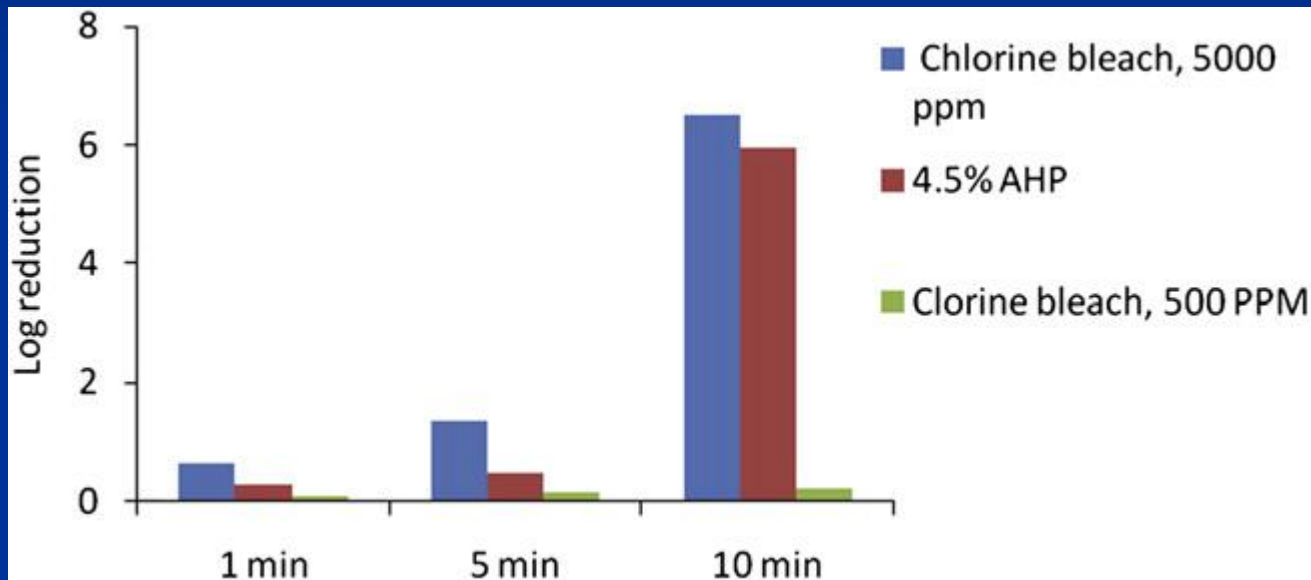
Virasept (EcoLab)

- 1-step detergent disinfectant
- Components
 - Peroxyacetic acid 0.05%
 - Octanoic acid 0.099%
 - Hydrogen peroxide 3.13%
- Kills *C. difficile* spores in 10 minutes
- Effective with 5% organic load (peracetic acid not affected as much as bleach by organic load)
- Compatible with materials

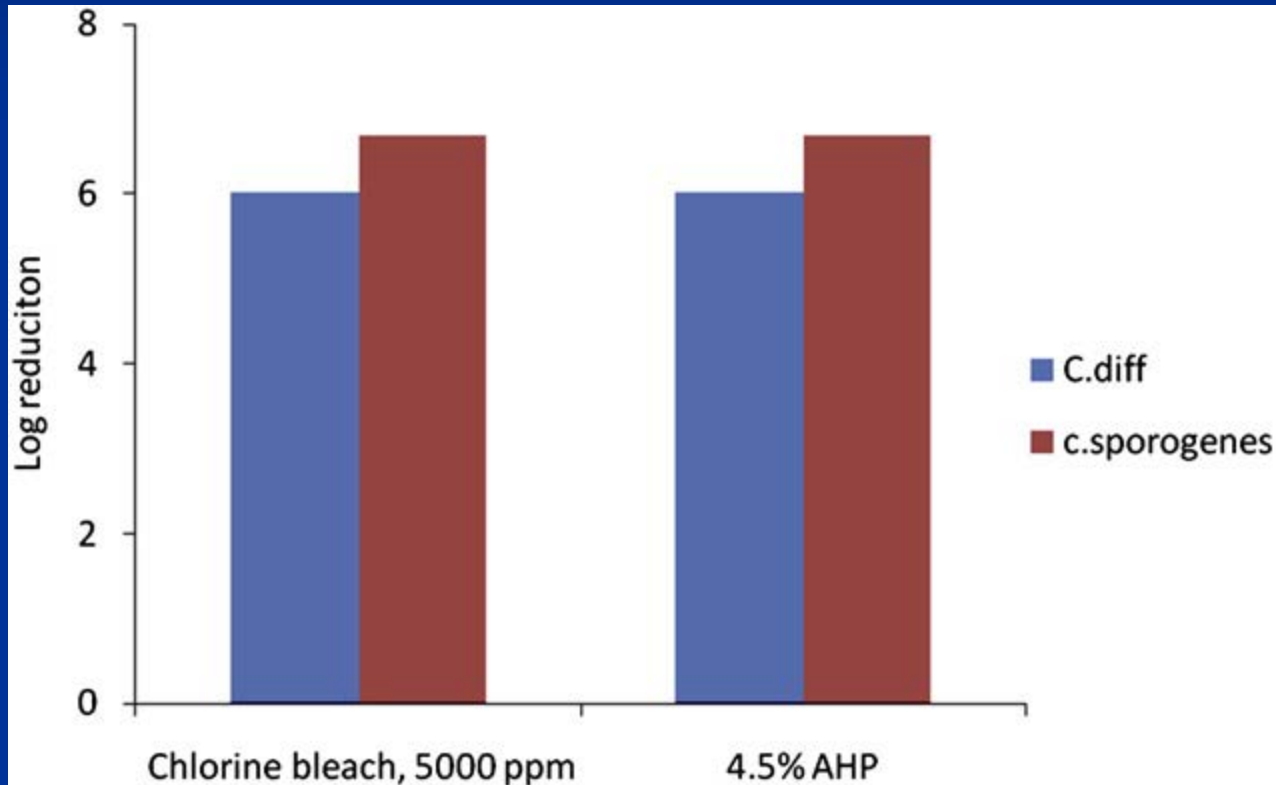
Sporicidal disinfectants

- Accelerated hydrogen peroxide (AHP)
 - Hydrogen peroxide (disinfectant) mixed with surfactants, wetting agents, and chelating agents to provide detergent effect
 - Sporicidal products contain 4.5% HP (Virox Technologies)
 - RESCUE Environment Surface Sporicide
 - RESCUE Sporicidal Gel (bathroom fixtures)
 - RESCUE Sporicidal Wipes
 - Widely used in Canada; anticipated EPA approval in the US in 2013

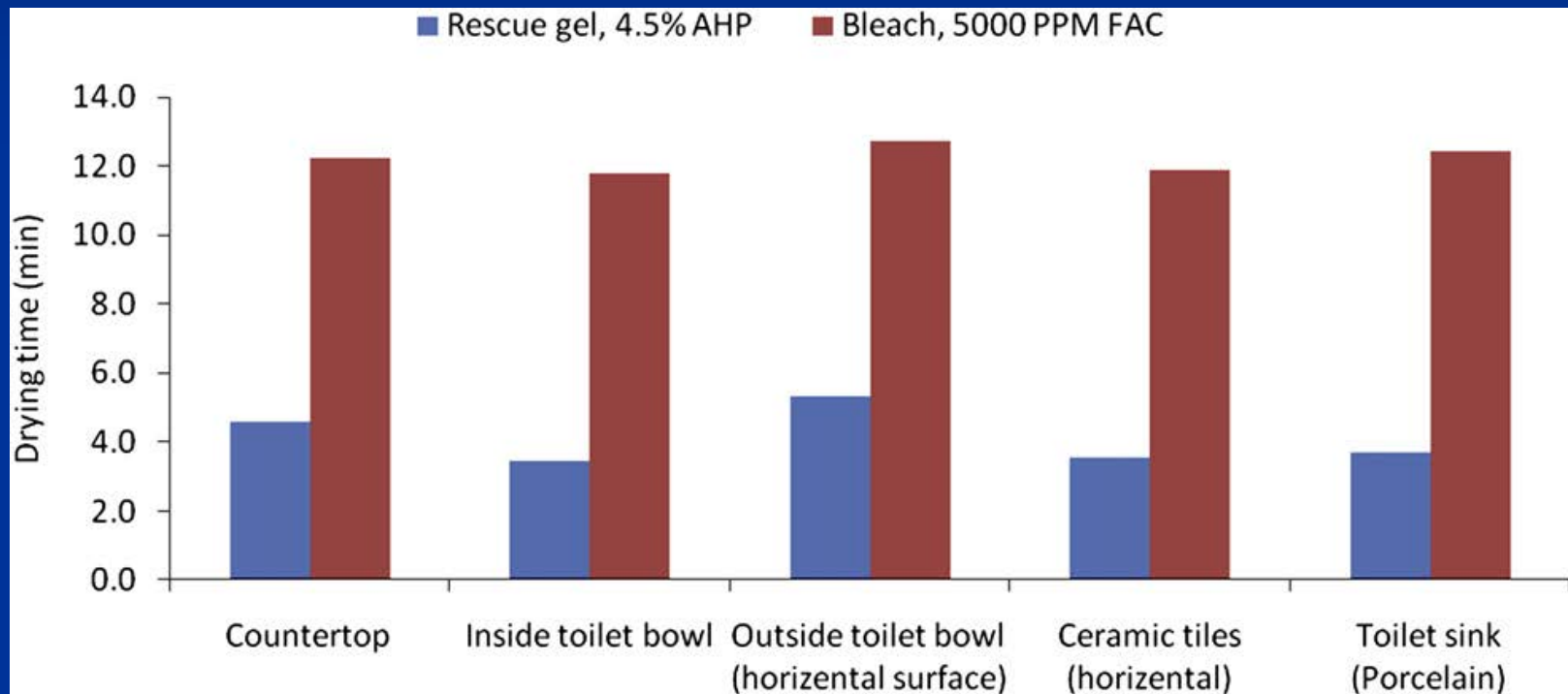
Efficacy of 4.5% accelerated hydrogen peroxide for killing of *C. difficile* spores



Efficacy of 4.5% accelerated hydrogen peroxide vs bleach for killing of *C. difficile* spores with 10 minute contact time



Drying time for 4.5% accelerated hydrogen peroxide vs bleach on surfaces



Disinfectant wipe with a *C. difficile* spore claim

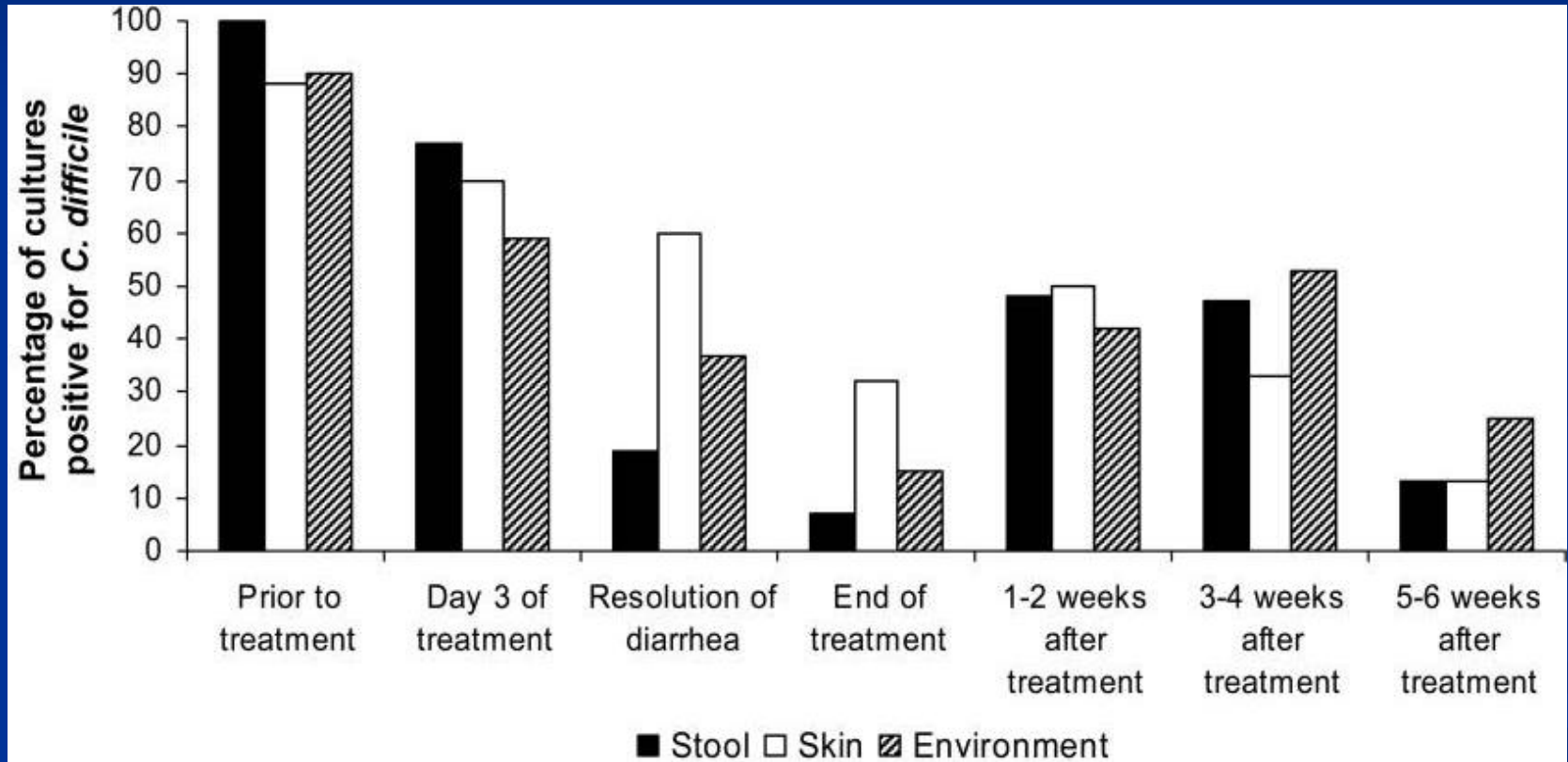
- KIMTECH One-Step Germicidal Wipe (Kimberly Clark)
 - 4.4% hydrogen peroxide and 0.23% peracetic acid

Production discontinued

6. Why is daily cleaning important?

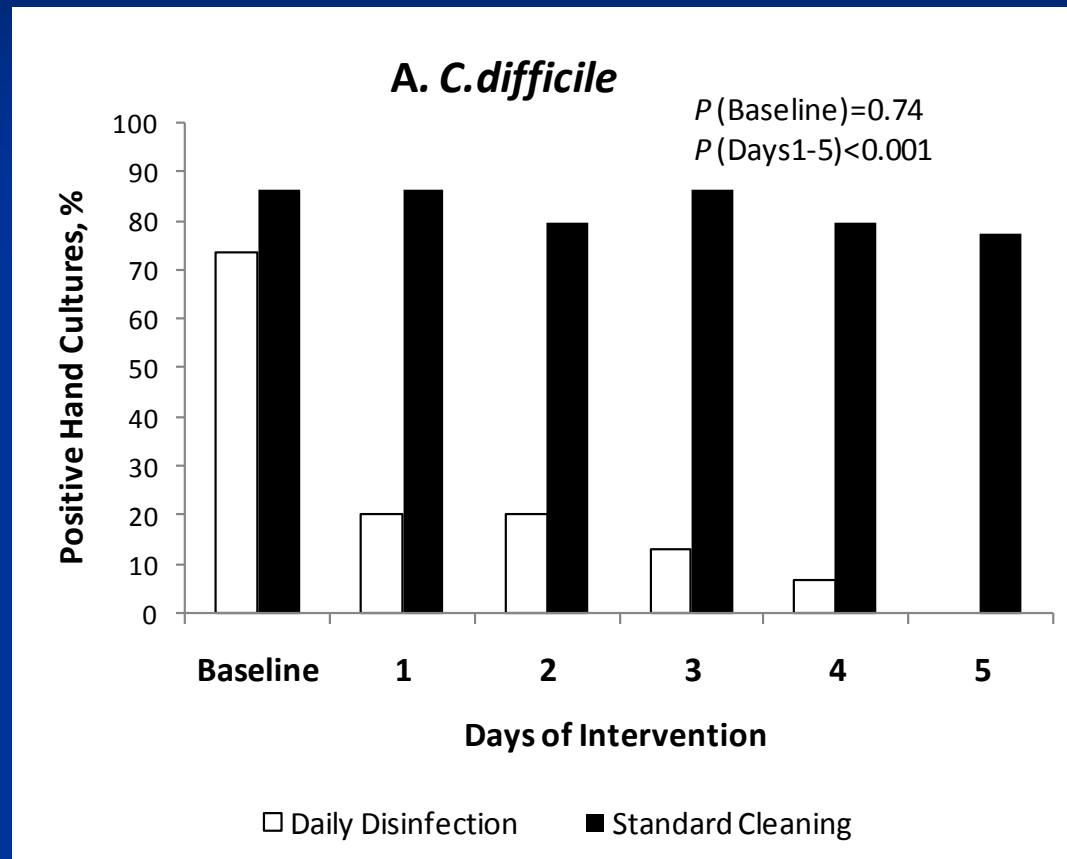
- An elderly person in your household develops watery diarrhea that is diagnosed as an infectious viral illness. There is another elderly person and young children in the household and the ill person uses a shared bathroom. Do you:
 1. Wait 10 days until the illness has completely resolved before cleaning the bathroom and other objects that the person contacts
 2. Disinfect surfaces daily or after each use of the bathroom to prevent transmission

Shedding of spores before, during, and after treatment of CDI



Sethi AJ, et al. Persistence of skin contamination and environmental shedding of *C. difficile* during and after treatment of *C. difficile* infection. ICHE 2010;31:21-7

Daily disinfection of high-touch surfaces – “Source Control”¹



1). Kundrapu S, et al. Daily disinfection of high-touch surfaces in isolation rooms to reduce contamination of healthcare workers' hands. Infect Control Hosp Epidemiol 2012 in press; 2). Wilson APR, et al. Crit Care Med 2011;39:651-8; 3). Ray AJ, et al. JAMA 2002;287:1400-01

The problem with daily disinfection of high-touch surfaces



7. Do we need new technologies to ensure adequate disinfection of CDI rooms?

If given a choice between improving infection control by changing human behavior or new technology, go with the technology every time.

Robert Weinstein, MD

Hydrogen peroxide vapor and aerosolized dry mist

	Hydrogen peroxide vapor (Bioquell)	Hydrogen peroxide aerosolized dry mist (ASP Glosair)
% hydrogen peroxide	35%	5%
Close vents/seal room	Yes	Yes
Sporicidal efficacy	>6 log reduction <i>C. difficile</i>	~4 log reduction <i>C. difficile</i>
Cycle time	2 hours 20 minutes - 3 hours	3.5 hours
Evidence of clinical impact	Yes – reduction in <i>C. difficile</i>	None published

Rutala WA, Weber DJ. Infect Control Hosp Epidemiol 2011;32:743-7; Holmdahl T, et al. Infect Control Hosp Epidemiol 2011;32:831-6; Havill NL, et al. Infect Control Hosp Epidemiol 2012;33:507-12; Boyce JM, et al. Infect Control Hosp Epidemiol 2008;29:723-9; Otter JA, et al. Infect Control Hosp Epidemiol 2009;30:574-7; Cooper T, et al. J Hosp Infect 2011;78:238-40; Dryden M, et al. J Hosp Infect 2008;1-3; Barbut F, et al. Infect Control Hosp Epidemiol 2009;30:507-14

Automated UV Radiation Device

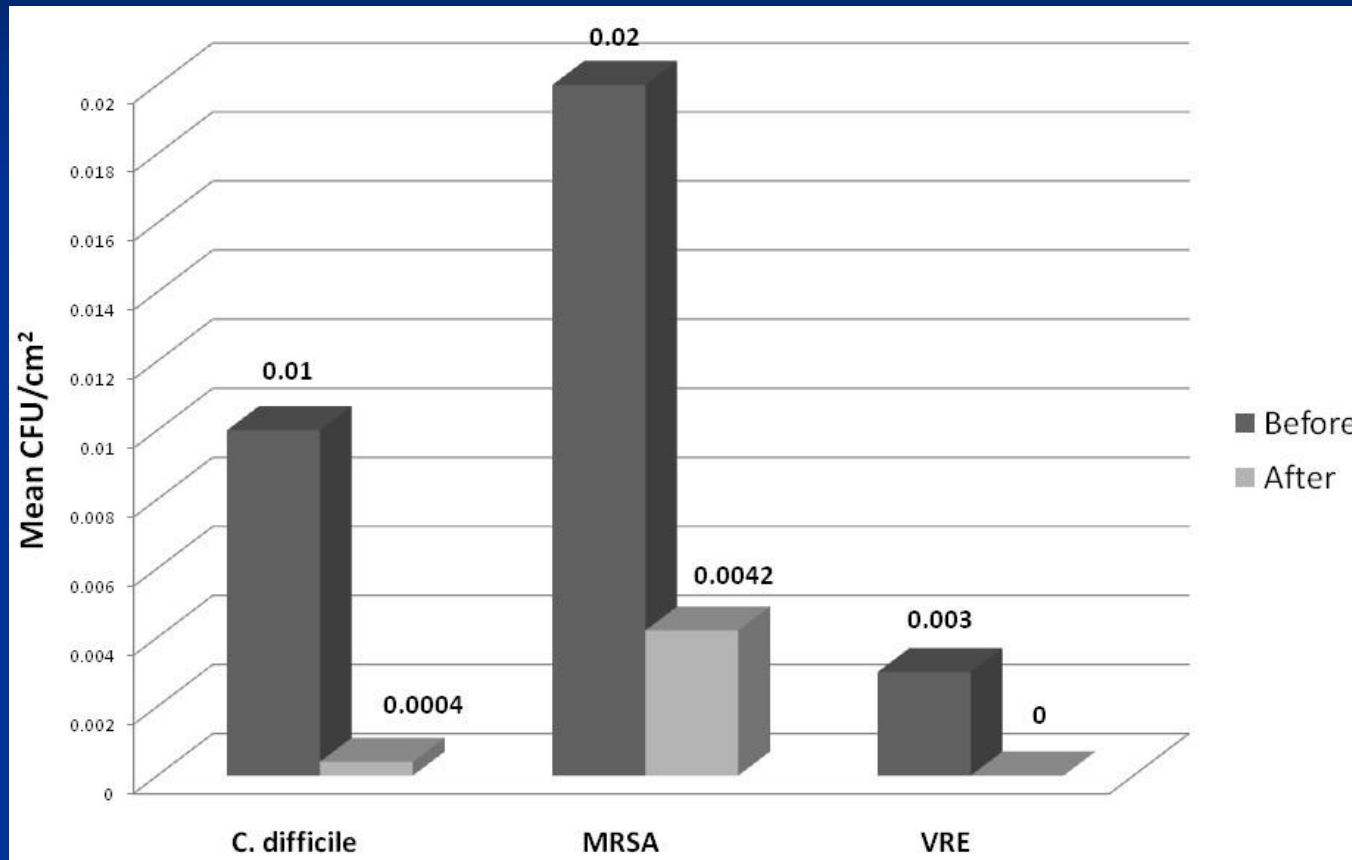


Tru-D UV device

- Uses UV-C radiation
- Mobile, automated, easy to use
- Kills *C. difficile* spores (>2-3 log reduction), MRSA, and VRE
- ~1 hour for CDI rooms;
- ~15 minutes for non-spore forming bacteria

Nerandzic MM. BMC Infect Dis 2010;10:197; Nerandzic MM. PLOS One 2010; Rutala WA, et al. Infect Control Hosp Epidemiol 2010;31:1025-31; Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1016-28; Stibich M, et al. Infect Control Hosp Epidemiol 2011;32:286-8

Reduction in contamination of surfaces by an automated UV device ¹

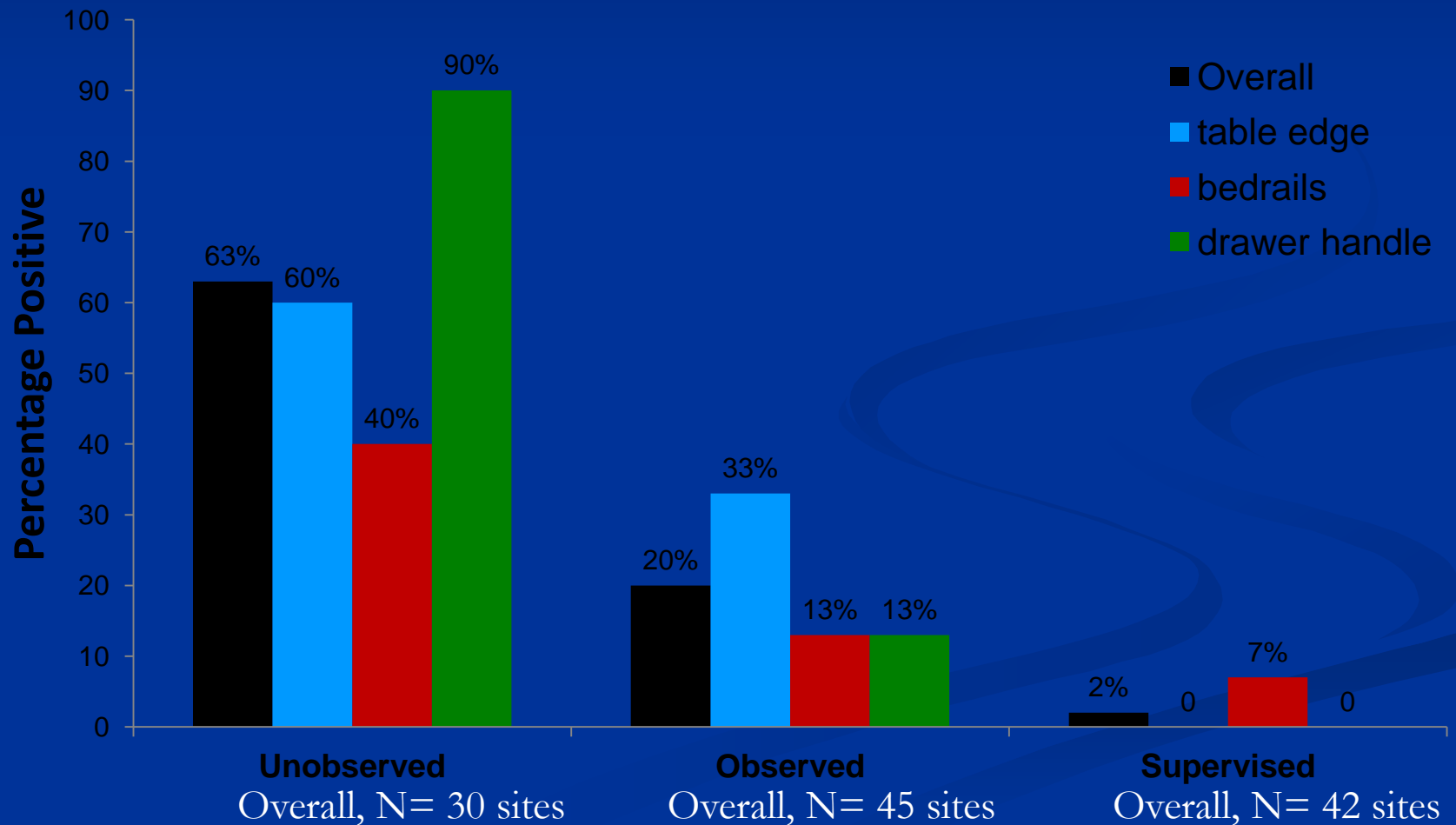


1). Nerandzic MM, et al. BMC Infect Dis 2010;10:197; 2). Rutala WA, et al. Infect Control Hosp Epidemiol 2010;31:1025-29; 3). Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:737-42; 4). Havill NL, et al. Infect Control Hosp Epidemiol 2012;33:507-12; 5). Stibich M, et al. Infect Control Hosp Epidemiol 2011;32:286-8

New technologies are great but-



Percentage of Sites Inoculated with Nontoxigenic *C. difficile* Still Positive after Housekeeping Cleaning with Bleach



Low-Tech



Hi-Tech



Dedicated personnel for *C. difficile* isolation rooms – “Specialists”

Maybe we need:

Less screening,

More cleaning

Murray Altose, MD

1). Weiss K, et al. Infect Control Hosp Epidemiol 2009;30:156-62; 2). Falk PS. Infect Control Hosp Epidemiol 2000;21:575-82; 3). Dancer SJ. BMC Medicine 2009;7:28

Conclusions

- There are multiple challenges to our efforts to achieve optimal cleaning and disinfection
- Effective strategies may include monitoring with feedback to environmental services personnel, daily disinfection of high-touch surfaces, and formation of dedicated teams for CDI rooms
- New products and technologies will have an increasing role in efforts to optimize cleaning

Supplemental slides

Should we use bleach only for *C. difficile* rooms or for all rooms?

Ref	Setting	Product and Application	Effect
1	3 hospitals	CDI rooms disinfected on discharge with 10% household bleach (5000 ppm hypochlorite)	48% decrease in prevalence density of CDI
2	2 medical wards	All rooms disinfected daily with Clorox bleach wipes with 0.55% active chlorine	85% decrease in hospital acquired CDI

1. Hacek DM. Am J Infect Control 2010;38:350-3
2. Orenstein R. Infect Control Hosp Epidemiol 2011;32:1137-9

When and how should portable equipment be cleaned?

- SHEA/IDSA Guideline for prevention of CDI
 - Use dedicated patient care items and equipment; if items must be shared, clean and disinfect the equipment between patients
 - Develop and implement protocols for disinfection of equipment and the environment

Dubberke ER, et al. Strategies to prevent CDI in acute care hospitals.
Infect Control Hosp Epidemiol 2008;29:S81-S92

What about contaminated clothing?

- Of 19 sites cultured in the laundry area in a long-term care facility, 1 (5%) was contaminated with *C. difficile*
- For 2 CDI patients, 4 of 7 (57%) articles of clothing were contaminated with *C. difficile* before washing versus 0 of 7 after washing
- Nine sites inside and outside the washer and dryer were negative after washing the clothing of CDI patients

Which is the best method to monitor environmental cleaning?

- 1). Direct observation
- 2). ATP bioluminescence
- 3). Fluorescent markers
- 4). Cultures
- 5). All of the above



Upcoming Activities

■ Webinar: June 26, 2012, 10-11am CT

“Implementing a Process of Improvement to Eliminate *Clostridium difficile* Infections”

Audience: Facilities that have signed up for the campaign or that will be attending a regional workshop

■ Regional Workshops

■ July 12th (Carterville), 13th (Springfield), 28th (Naperville)

■ 4th workshop?

■ Registration opens early June

Questions: chinyere.alu@illinois.gov; phone: 312-814-2565