

Infection Control of *C. difficile*: Why are we failing and which special approaches could help us succeed?

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Objectives

- To discuss real-world challenges to effective control of *C. difficile* transmission
- To discuss special approaches to consider if basic control measures are failing

Transmission of *C. difficile*



Contamination of hands with *C. difficile*

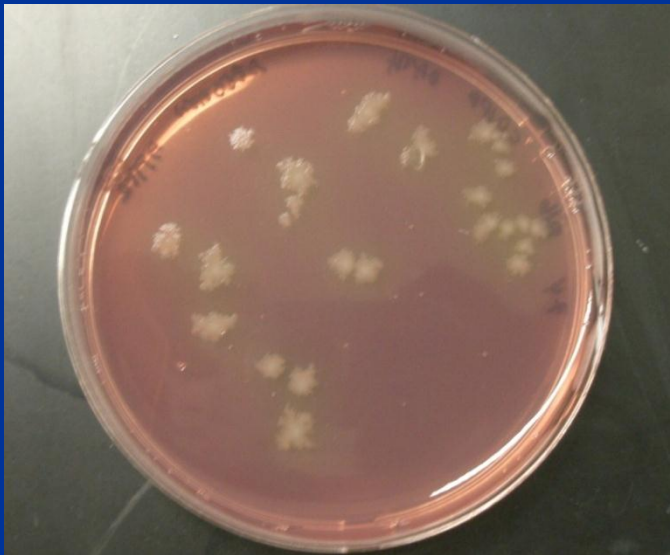


Bobulsky G, et al. Clin Infect Dis 2008;46:447-50

Contaminated environmental surfaces are an important source of hand contamination

- Skin contact: 50% of hand cultures positive

Abdomen

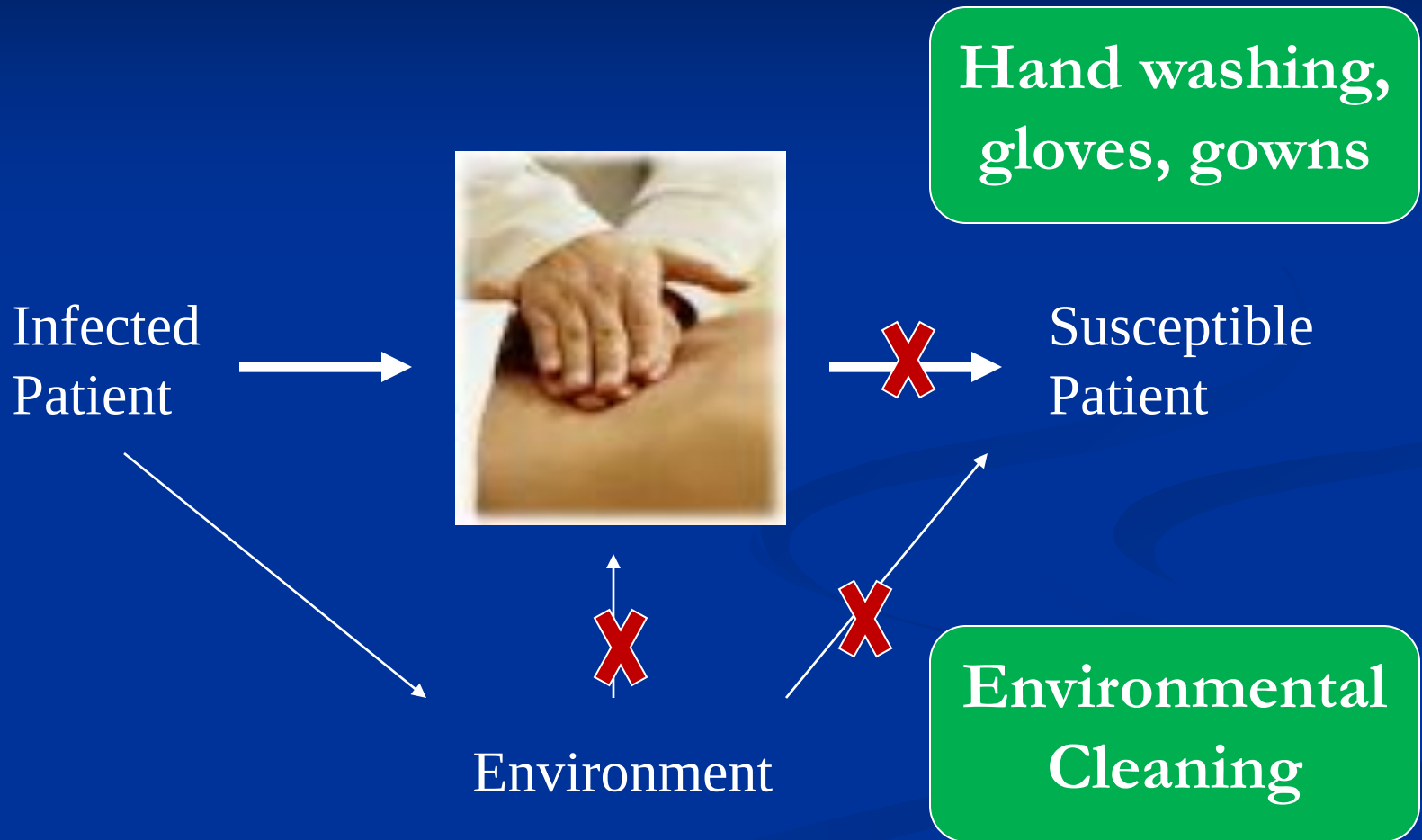


- Environment contact: 50% of hand cultures positive

Bed rail



Basic infection control practices



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

Why do basic practices often fail to control *C. difficile*?

Contamination of a patient call button with VRE after housekeeping cleaning

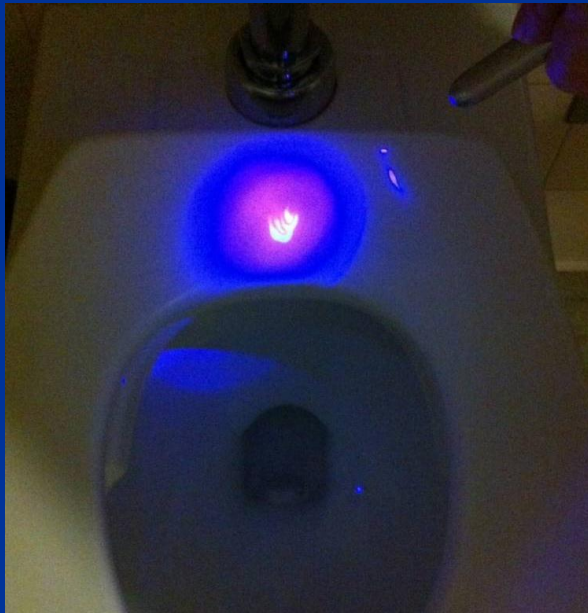


VRE = vancomycin-resistant *Enterococcus*

Eckstein B, et al. BioMed Central Infect Dis 2007

Regular monitoring and feedback are essential

Fluorescent marker on a toilet
seat after housekeeping cleaning

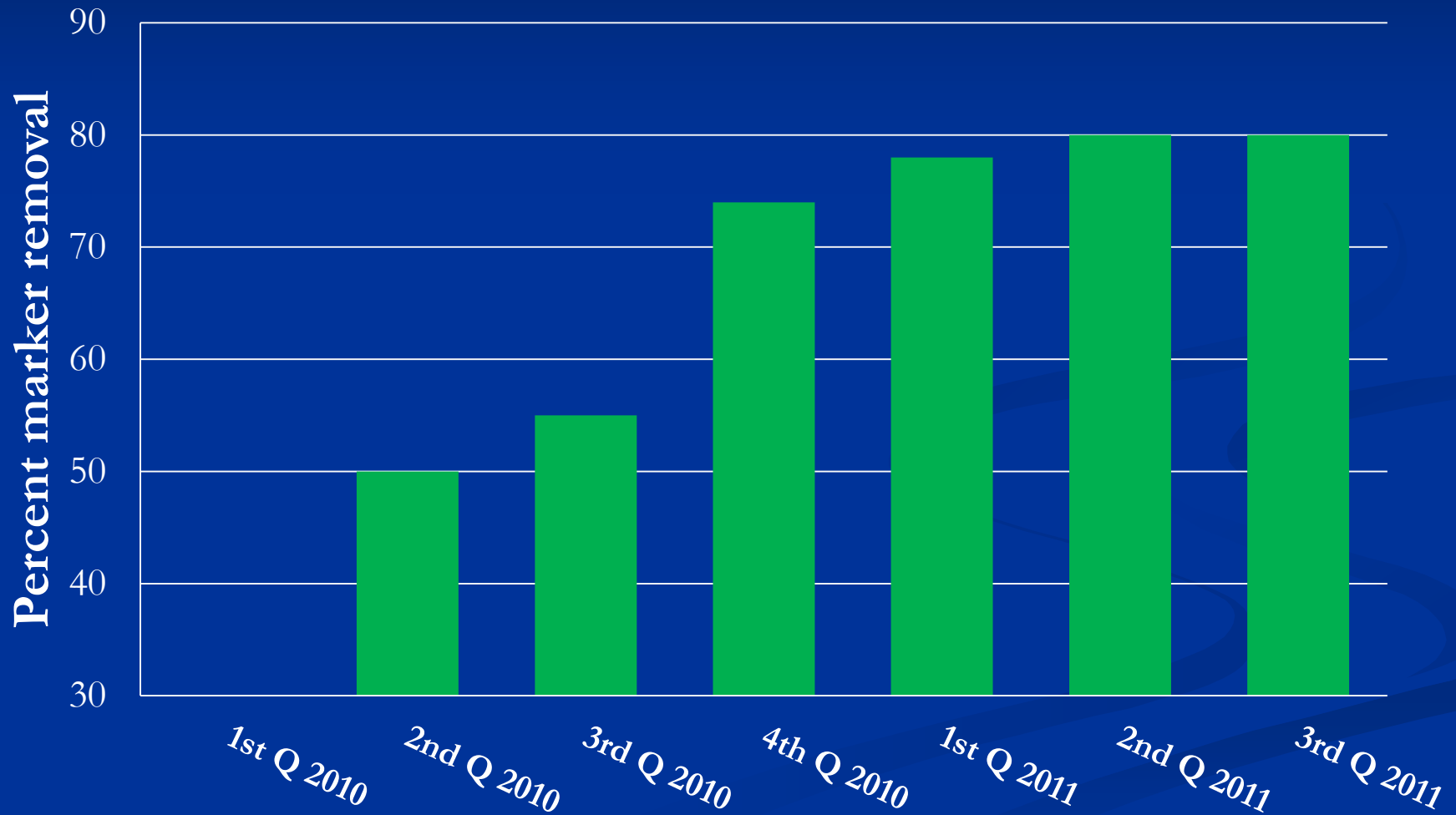


Methods

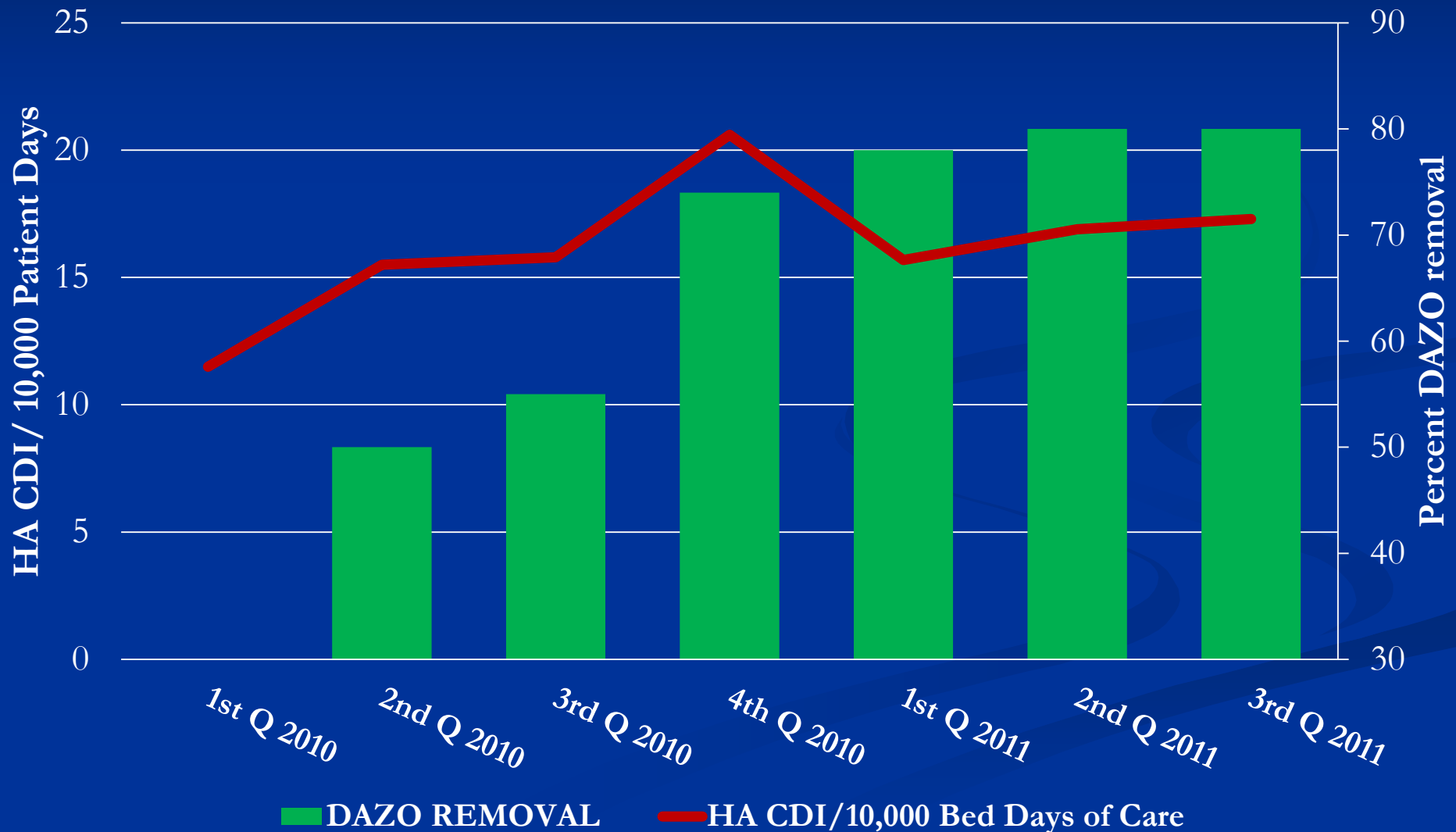
- 1). Direct observation
- 2). ATP bioluminescence
- 3). Fluorescent markers

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

Improvement in cleaning based on fluorescent marker removal



No decrease in incidence of *C. difficile* infections



Automated UV Radiation Device



- Mobile, automated, easy to use
- Kills *C. difficile* spores (2-3 log reduction)
- ~1 hour for *C. difficile* rooms
- ~15 minutes for non-spore forming organisms

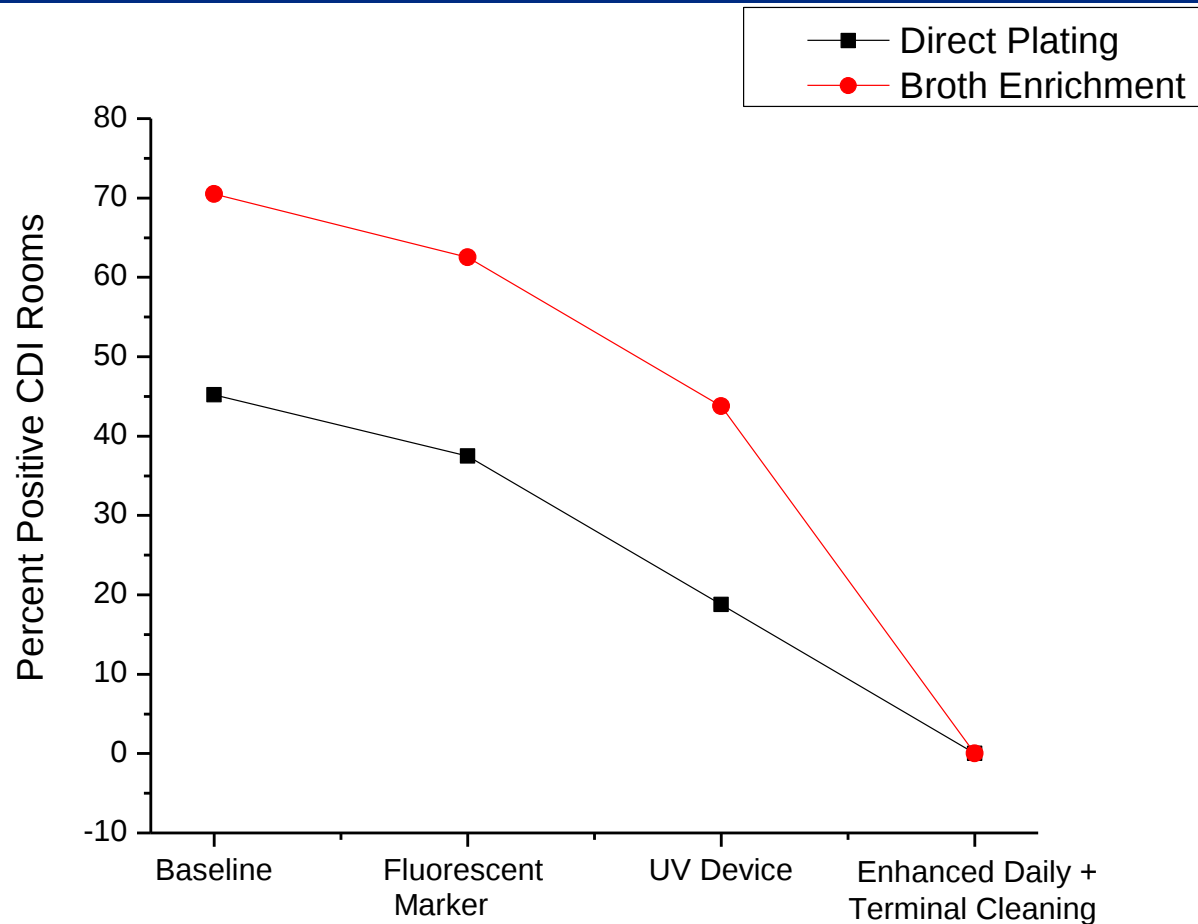
Nerandzic MM. BMC Infect Dis 2010;10:197; Nerandzic MM. PLOS One 2010; Rutala WA, et al. Infect Control Hosp Epidemiol 2010;31:1025-31; Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1016-28; Stübich M, et al. Infect Control Hosp Epidemiol 2011;32:286-8; Havill NL, et al. Infect Control Hosp Epidemiol 2012;33:507-12

Log reduction in *C. difficile* spores with UV device versus bleach

	Direct UV exposure	Indirect UV exposure
UV device	2 - 4 log	1 - 2.4 log
Bleach	6 log	6 log

Nerandzic MM. BMC Infect Dis 2010;10:197; Rutala WA, et al. Infect Control Hosp Epidemiol 2010;31:1025-31; Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1016-28; Havill NL, et al. Infect Control Hosp Epidemiol 2012;33:507-12

Spore contamination in *C. difficile* isolation rooms after cleaning



Gap: practical and effective methods to monitor room disinfection

■ Low-tech

- Aerobic culture using *C. difficile* selective broth supplemented with thioglycolate as a reducing agent

■ High-tech

- Terbium fluorescence – heated spores release dipicolonic acid (DPA) which reacts with terbium to produce a unique fluorescence spectrum

What if basic practices are implemented and we are still failing to control *C. difficile*?

Consider Special Approaches

- Preemptive isolation

- Prolong duration of isolation

- Daily disinfection of high-touch surfaces

- Screen for and isolate asymptomatic carriers

Potential benefits of special approaches

$$\text{Transmission reduction} \sim \frac{\text{Patient days} \times \text{Transmission risk (spore shedding)}}{\text{Effort required for interventions}}$$

Hypothesis: Transmission risk varies

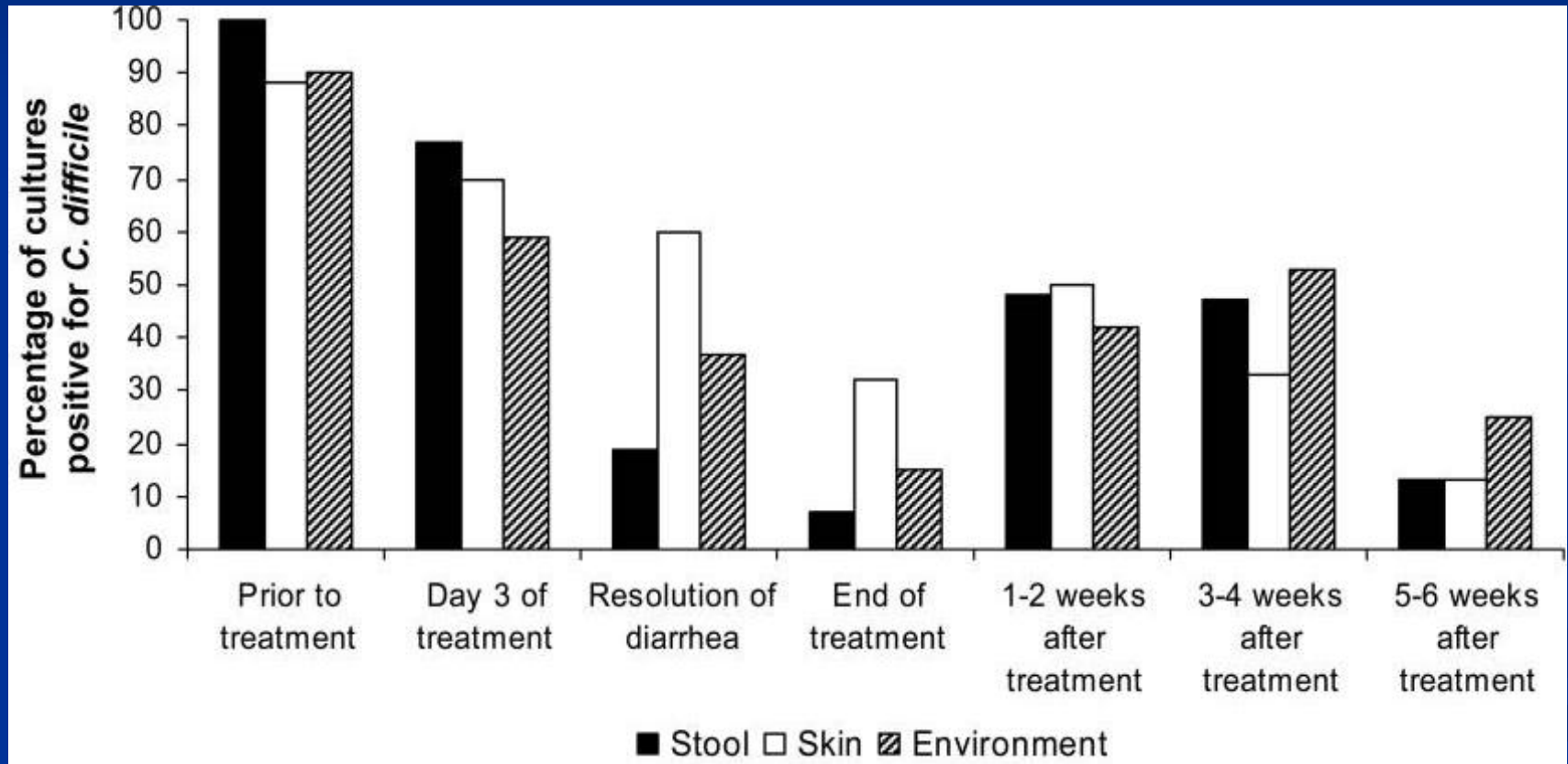
Super shedders



Minimal shedding



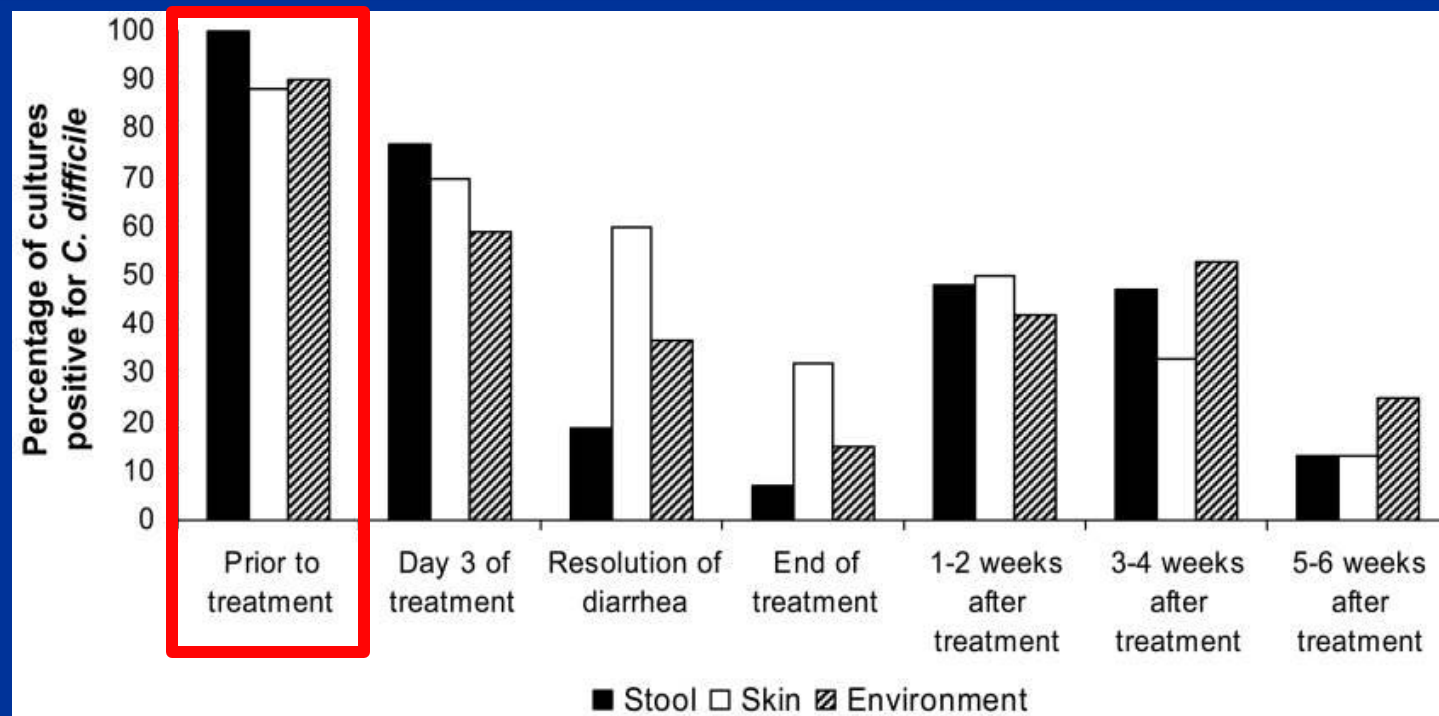
Shedding of spores before, during, and after treatment



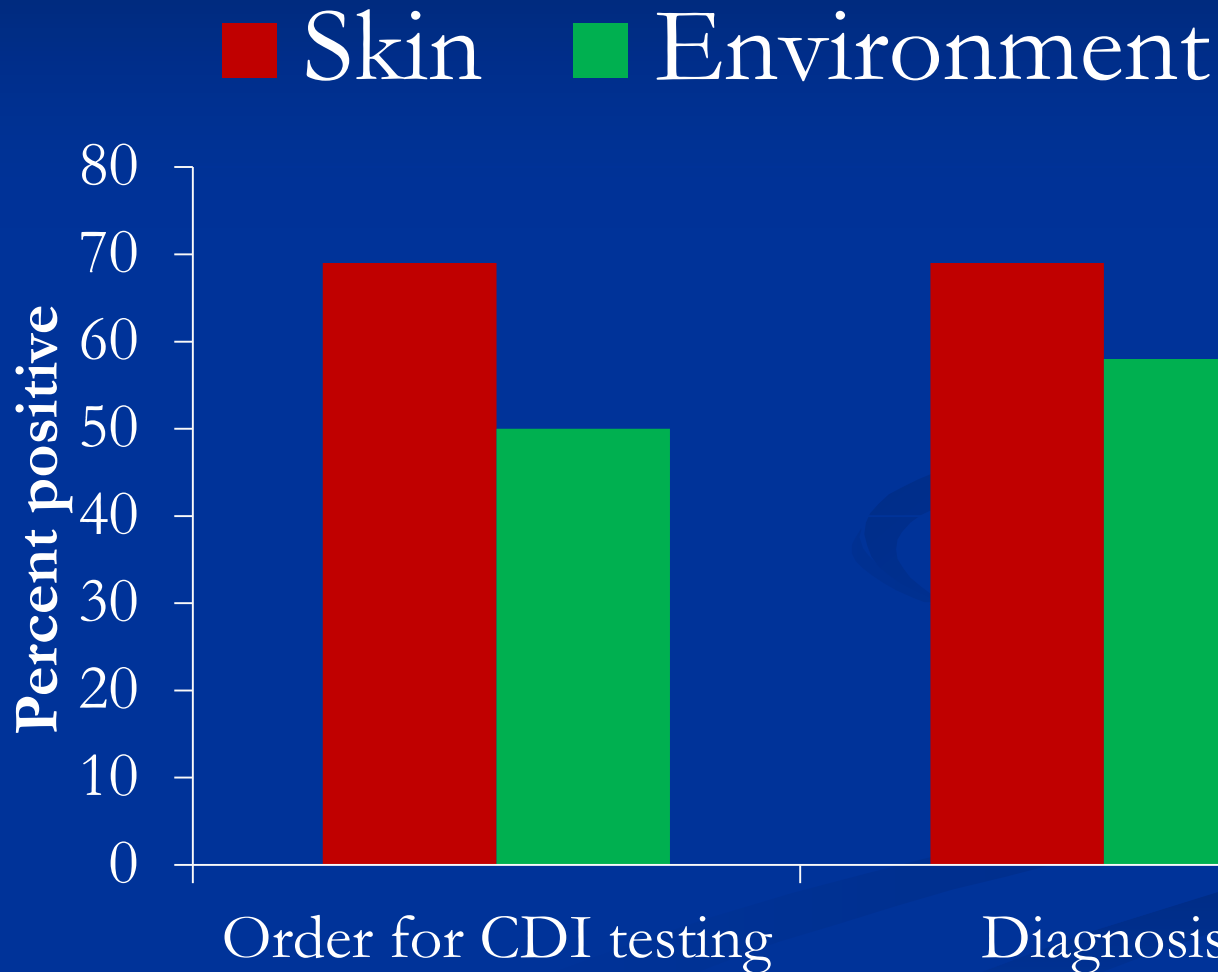
Sethi AJ, et al. Persistence of skin contamination and environmental shedding of *C. difficile* during and after treatment of *C. difficile* infection. ICHE 2010;31:21-7

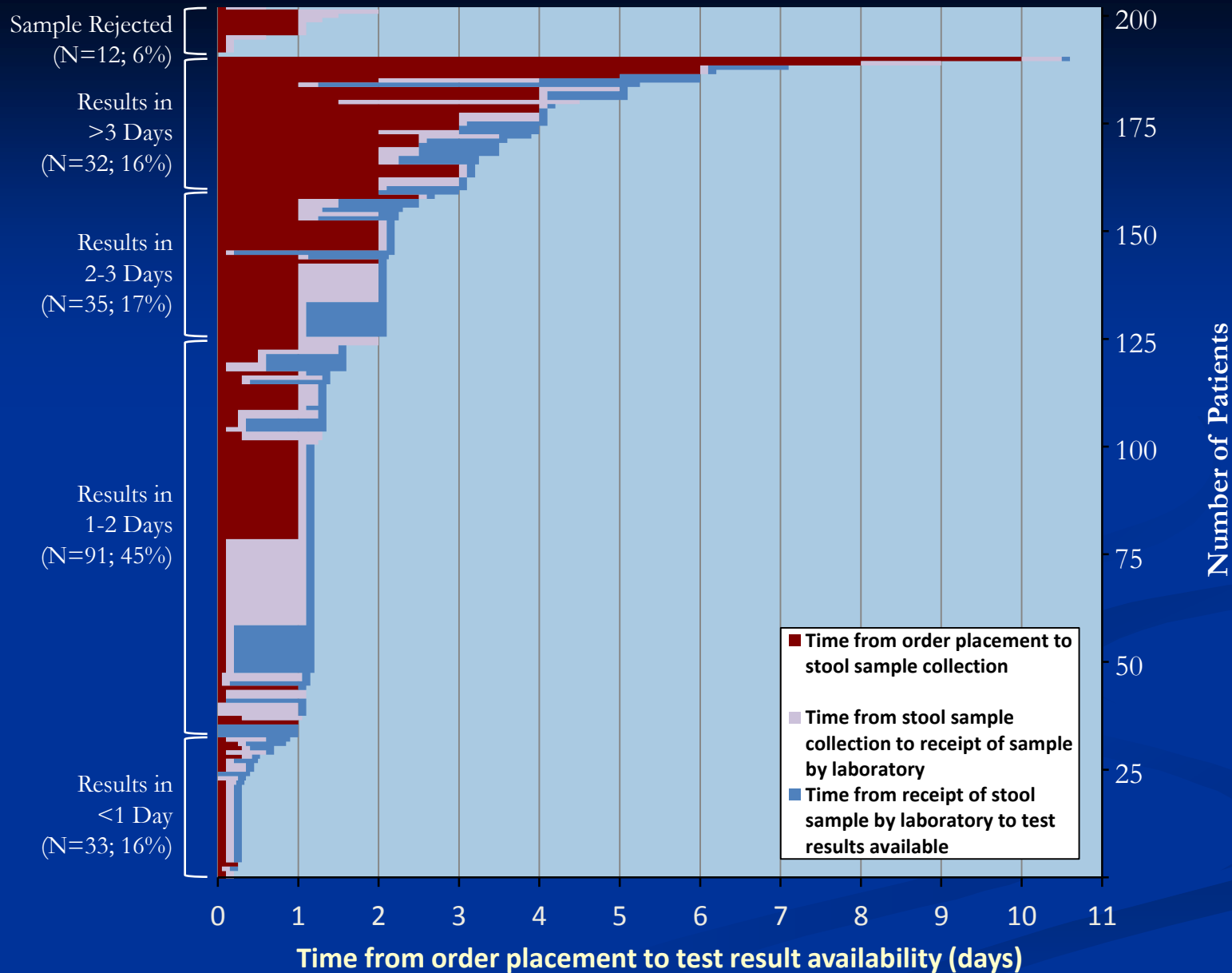
1). Expedite identification and isolation of infected patients

- Preemptive isolation while test results are pending



Shedding of spores at the time of the order for *C. difficile* testing





12% of all *C. difficile* tests rejected due to leaking of sample or labeling error

Leaking stool



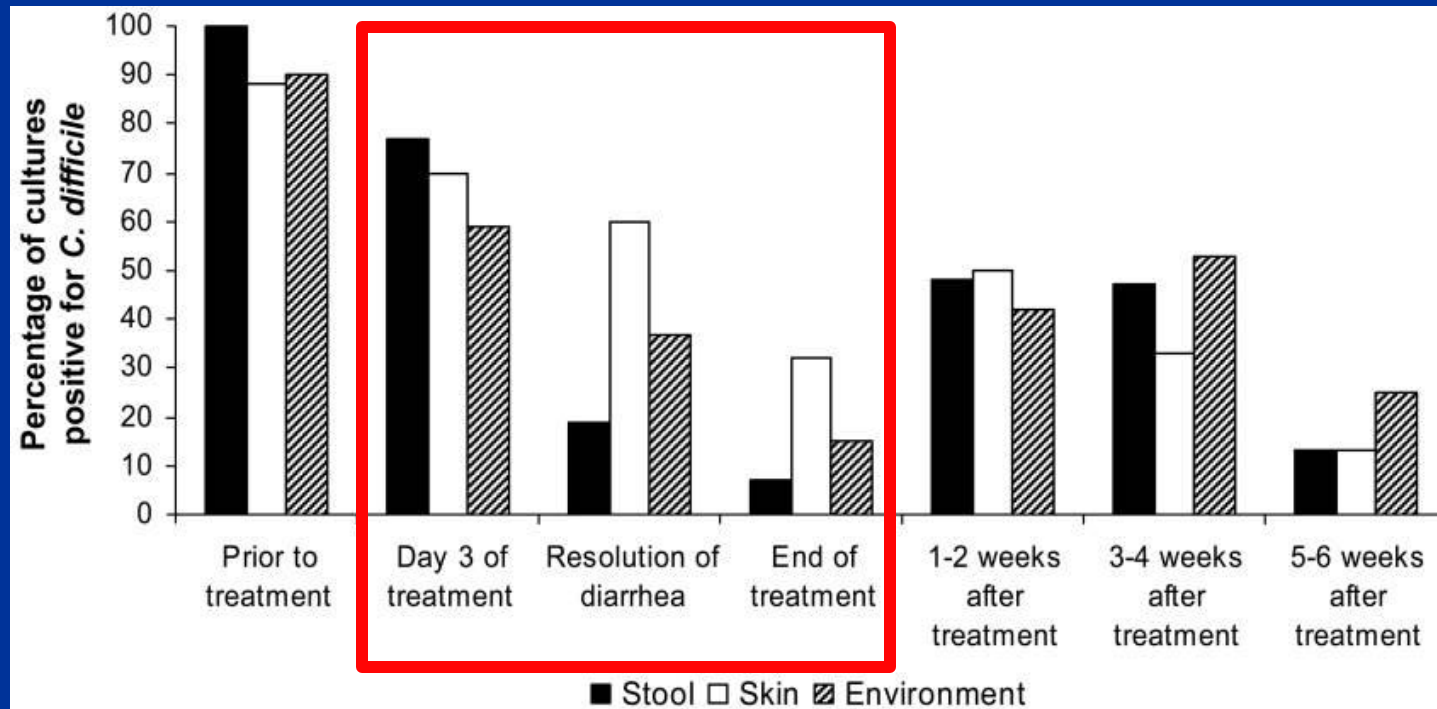
Mis-labeled samples



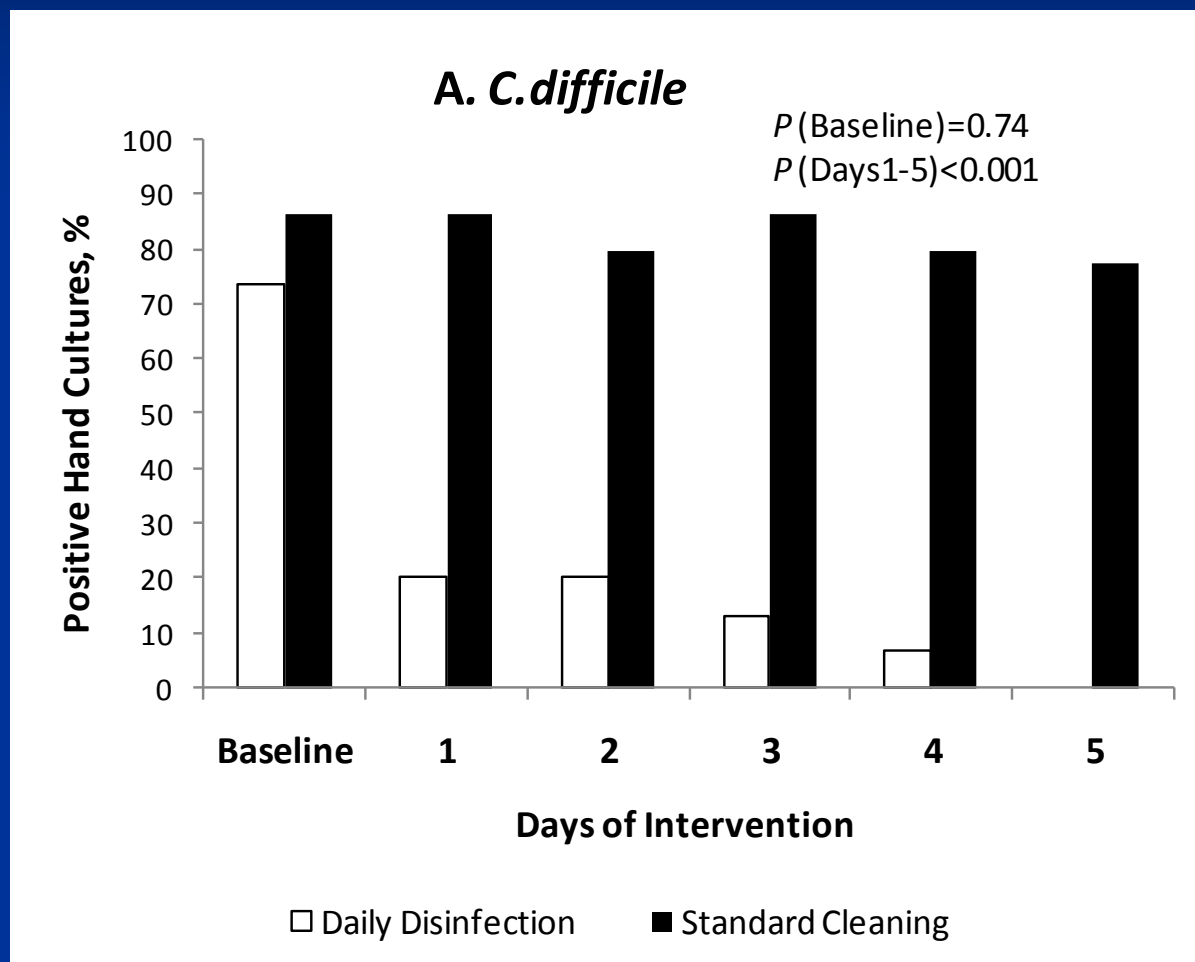
2). Source control

Daily disinfection of high-touch surfaces during CDI treatment

Improve bathing to reduce the burden of spores on skin



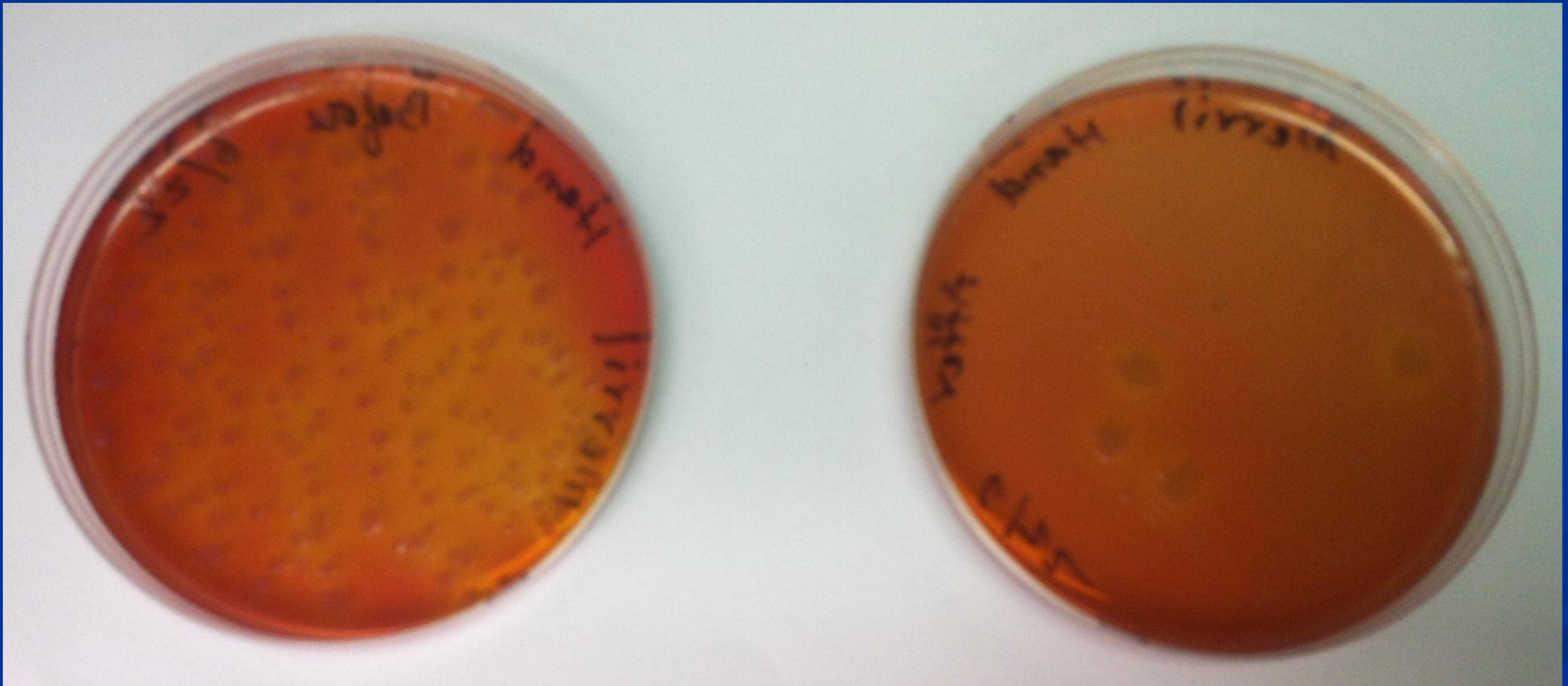
Daily disinfection of high-touch surfaces



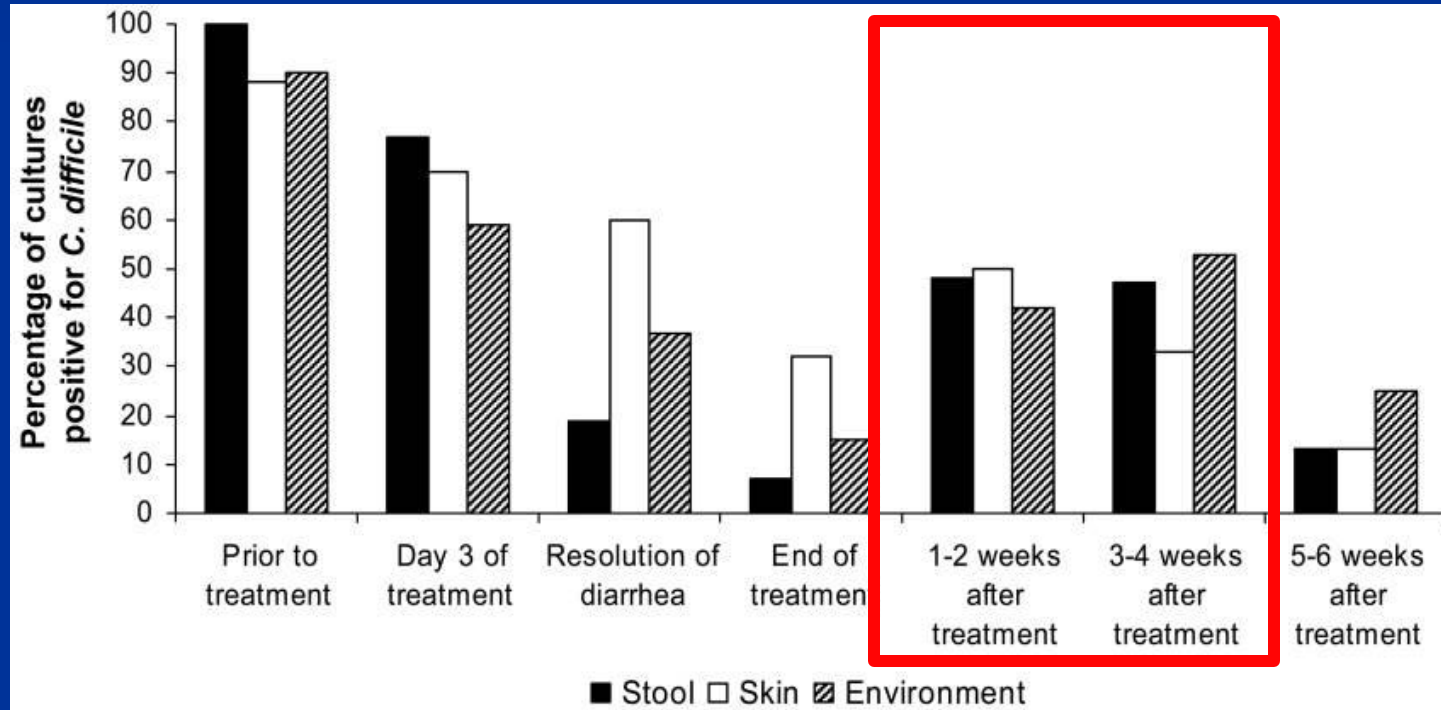
Patient hand washing for removal of *C. difficile* spores

Before

After



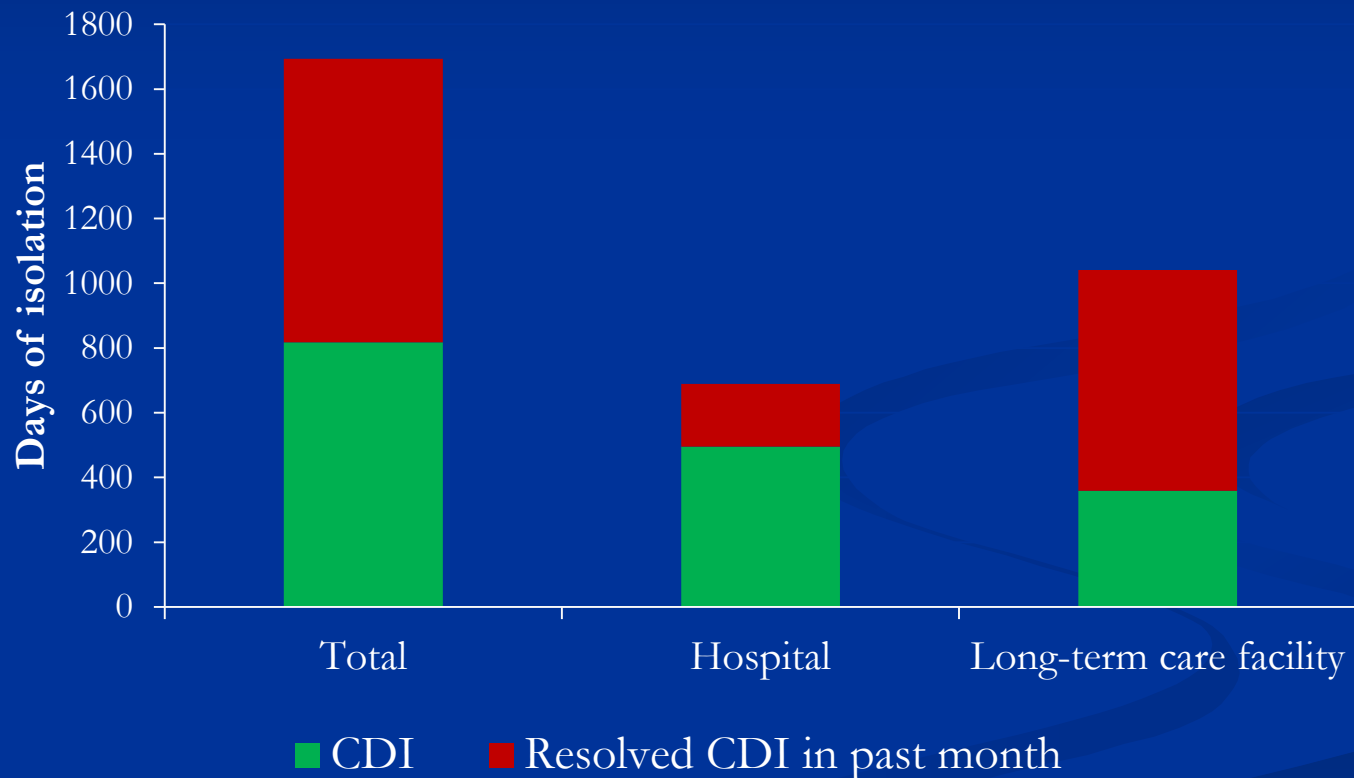
3). Prolong the duration of isolation

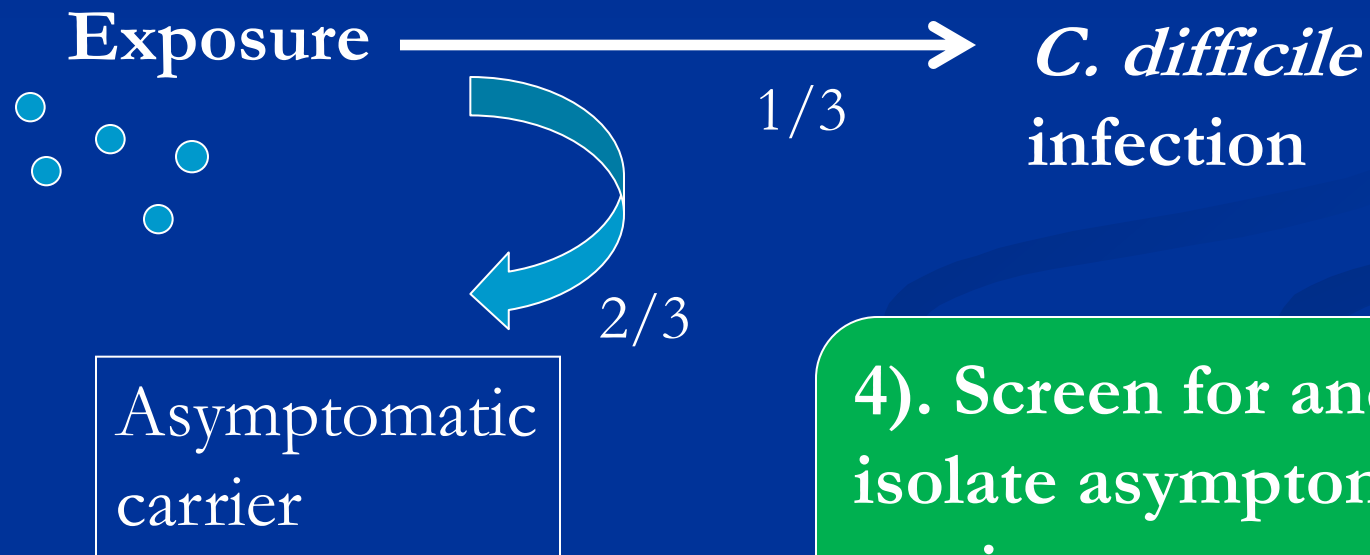


Comparison of CDI patients at diagnosis and 1-4 weeks after completion of treatment

	At time of diagnosis	1-4 weeks after treatment
<i>C. difficile</i> stool density	5.3 logs	3.3 logs
Positive skin culture	88%	40%
Positive environmental cultures, mean (N = 4)	1.7	0.86
Acquisition on hands after skin contact	76%	48%

How many additional days of isolation would be required if precautions were extended until discharge or 1 month after treatment?





4). Screen for and isolate asymptomatic carriers

Asymptomatic carriage of *C. difficile* in a long-term care facility (LTCF) and hospital

	LTCF 2007	LTCF 2012	Hospital 2009
Prevalence	51%	28%	11%
Positive chest & abdomen culture	59%	18%	13%
Environmental contamination	50%	11%	5%

Extreme Makeover: VA Edition



Old LTCF

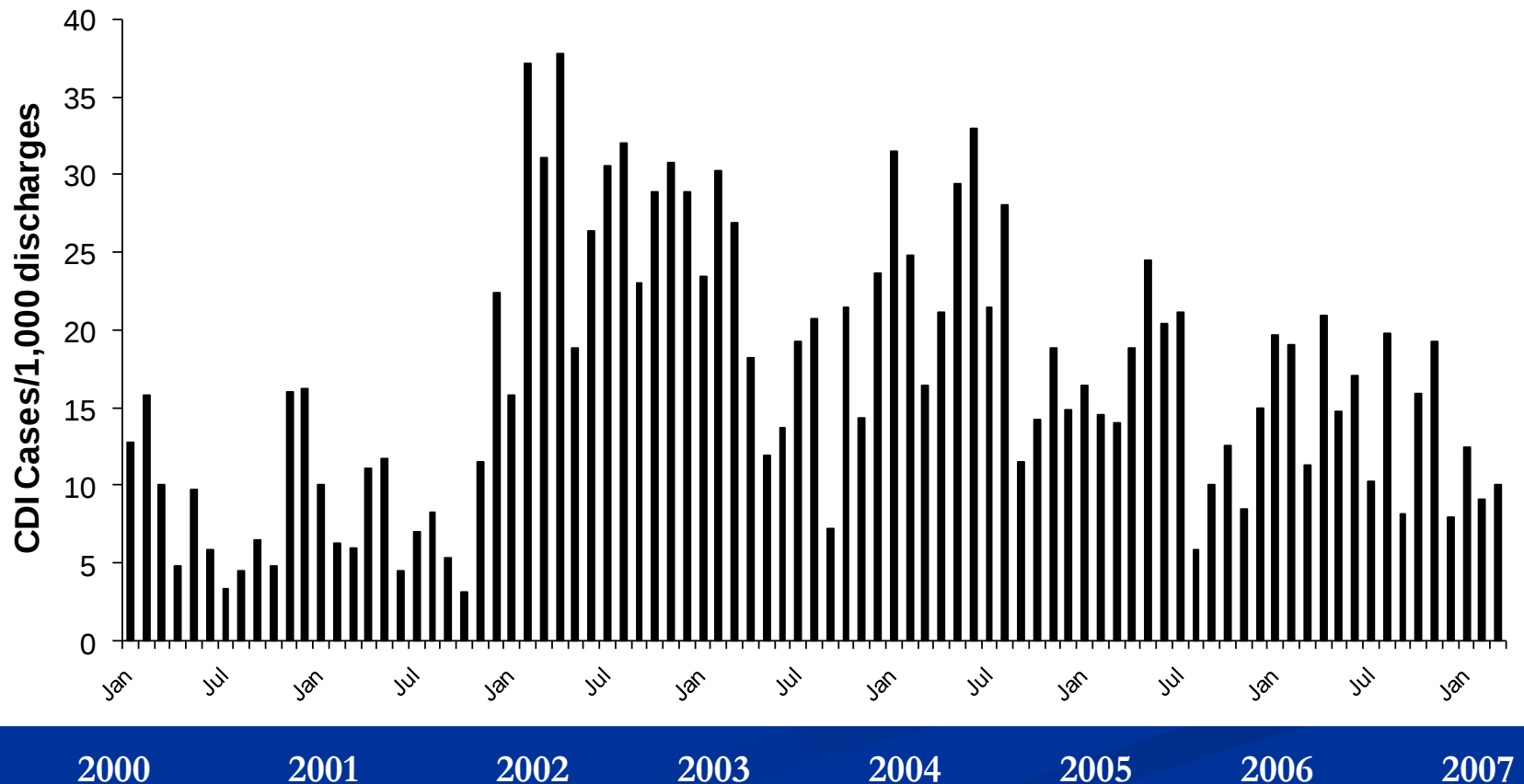


New LTCF

Summary

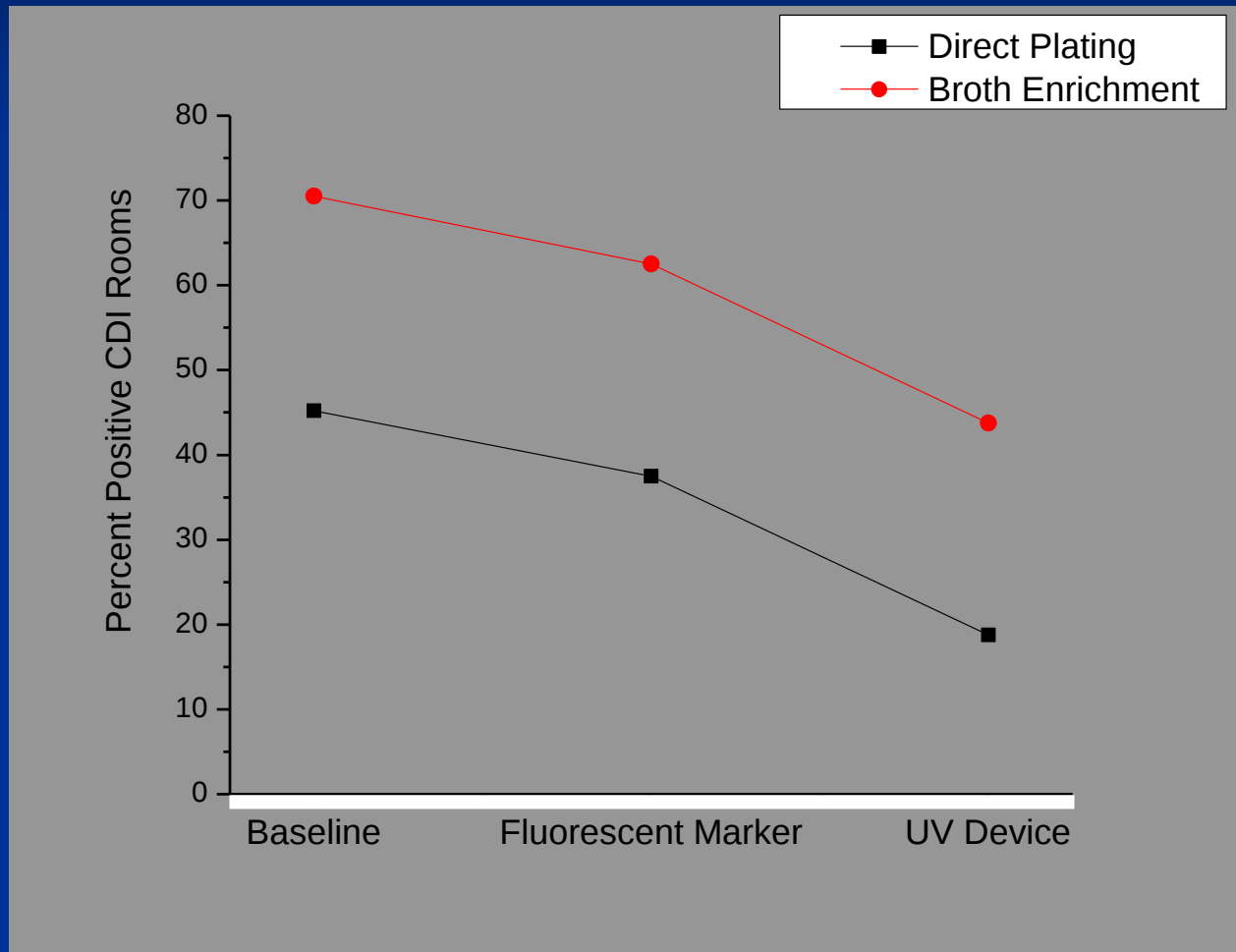
- Major challenges for infection control:
 - Poor implementation of basic practices
 - Inadequate methods to monitor effectiveness
- Special approaches that are promising:
 - Early identification and isolation of infected patients
 - Source control (e.g., daily disinfection of surfaces)
 - Environmental cultures to monitor disinfection

basic practices often fail to control *C. difficile*?



Jump RL, et al. Emerg Infect Dis 2010;16:827-9

Only modest reduction in contamination of CDI rooms after cleaning despite interventions



- 1). Sitzlar B, et al. Manuscript submitted;
- 2). Alfa MJ, et al. BMC Infect Dis 2008;8:64;
- 3). Goodman ER et al. Infect Control Hosp Epidemiol 2008;29:593-9