Practical Approaches for Monitoring Cleaning in Healthcare Facilities

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Hosted by Bruce Gamage
Provincial Infection Control Network of BC

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Disclosures

- Research support
  - GOJO, Clorox, Pfizer, Merck, EcoLab, Altapure
- Consultant
  - Synthetic Biologics

2

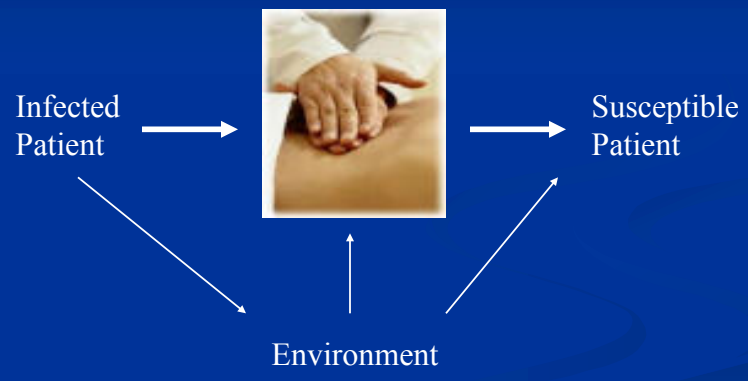
Objective

- To discuss practical approaches to improve environmental cleaning through monitoring and feedback

Deshpande A, Donskey CJ. Practical approaches for assessment of daily and post-discharge disinfection in healthcare facilities. Curr Infect Dis Rep 2017;19:32

3

Transmission of healthcare-associated pathogens



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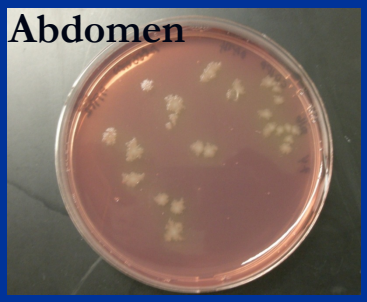
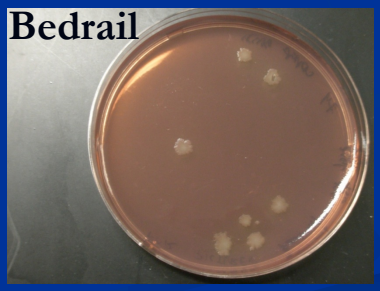
Acquisition of *C. difficile* on hands after contact with skin and environment

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

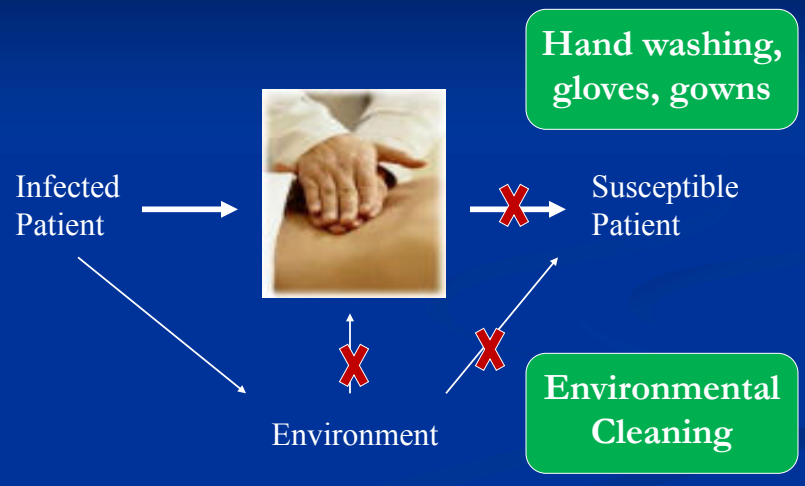




Guerrero DM, et al. Acquisition of spores on gloved hands after contact with skin of CDI patients and with environmental surfaces in their rooms. AJIC 2012;40:556-8

5

Basic infection control practices



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

6

Strategies to improve environmental disinfection

Product substitution	New technologies	Improve standard cleaning and disinfection
• Quaternary ammonium disinfectant • Improved hydrogen peroxide • Peracetic acid • Bleach		

7

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

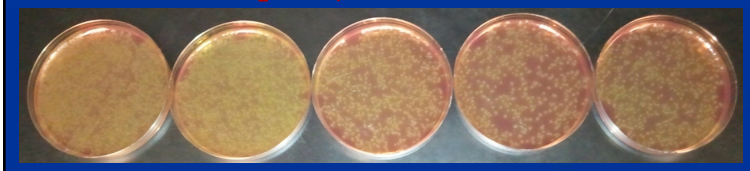
Ref	Setting	Effect on CDI rates	Monitoring to ensure efficacy of disinfection
1	Medical Ward	Outbreak ended	Surface contamination reduced to 21% of initial levels
2	Bone marrow transplant (BMT) unit, Medical Ward, ICU	Significant decrease on BMT unit, but not on the other 2 wards	No
3	2 medical wards	Decreased on 1 of 2 wards	No decrease in prevalence of environmental contamination
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

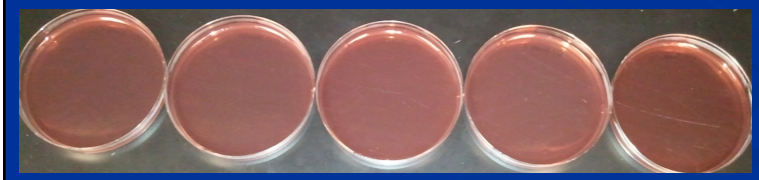
8

Microbiological plausibility

Transfer of *C. difficile* spores by a nonsporicidal wipe



Quat wipe



Bleach wipe

Cadnum JL, et al. Infect Control Hosp Epidemiol 2013;34:441-2

9

Crossover trial of improved hydrogen peroxide versus a quaternary ammonium disinfectant

	Improved hydrogen peroxide	Quaternary ammonium disinfectant	P value
Mean aerobic colony counts	14	22	.003
% surfaces with no growth	48%	35%	<.0001
Incidence of nosocomial colonization or infection*	8	10	.07

*, composite of VRE and MRSA colonization or infection and Clostridium difficile infection

Boyce JM, et al. Am J Infect Control 2017;45:1006-10; Alfa MJ, et al. Am J Infect Control 2015;43:141-6 (substitution of improved hydrogen peroxide wipes for a daily cleaner applied using cotton rags associated with reduced HAIs)

10

New technologies

11

Impact of UV-C radiation devices on healthcare-associated infections

- Multiple quasi-experimental studies have reported reductions in CDI and other HAIs with UV-C [1-8]
- Cluster randomized, multicenter, crossover study[9]
  - No decrease in CDI for bleach versus bleach plus UV
  - Significant reduction in targeted MDROs (MRSA, VRE, Acinetobacter, *C. difficile*) when UV added to a quaternary ammonium disinfectant
- Systematic review: UV-C reduced CDI and VRE[8]

1. Miller R. AJIC 2015;43:1350-3; 2. Levin J. AJIC 2013;41:746-8; 3. Nagaraja A. AJIC. 4. Vianna PG. AJIC 2016;44:299-303; 5. Haas JP. AJIC 2014;42:586-90; 6. Nagaraja A. AJIC 2015, July 6; 7. Pegues DA. ICHE 2017;38:39-44 (CDI decreased 25% on 3 study units and increased 16% on non-study units); 8. Marra AR. ICHE 2017; 9. Anderson D. Lancet 2017;389:805-814.

12

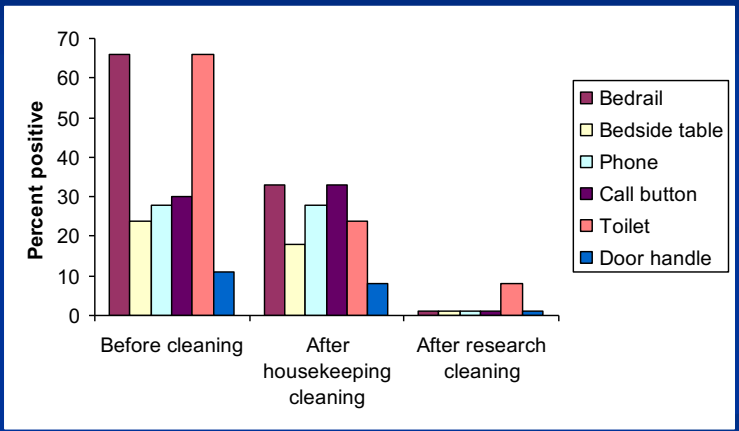
Improving standard cleaning and disinfection

- Education
- Written policies and procedures
- Recognition of environmental services personnel
- Institutional commitment
- Monitoring and feedback essential
  - Objective monitoring tools

Carling P. Am J Infect Control 2013;41:520-5;
Havill NL. Am J Infect Control 2013;41:S26-S30

13

Process not product

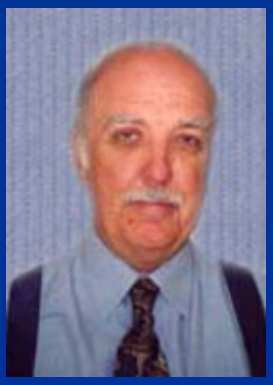


Eckstein B, et al. Reduction of *C. difficile* and VRE contamination after an intervention to improve cleaning methods BioMed Central Infect Dis 2007;7:61

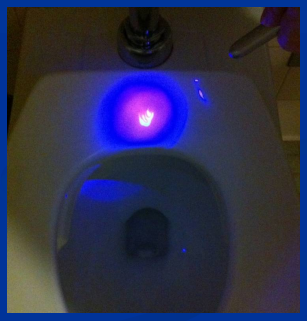
14

Fluorescent markers

Phil Carling



Fluorescent marker on a toilet seat after housekeeping cleaning



1. Carling PC, et al. Clin Infect Dis 2006;42:385-8; 2. Carling P, et al. Infect Control Hosp Epidemiol 2008;29:1035-41; 3. Carling P. Am J Infect Control 2013;41:520-525

15

Advantages of the fluorescent marker method

- Can provide aggregate feedback on thoroughness of cleaning
- Can provide immediate, objective feedback to individual employees
- Evidence of benefits
  - Improvements in thoroughness of cleaning [1]
  - Reductions in MRSA and VRE transmission and *C. difficile* infection [2-4]

1. Carling PC. ICHE 2008;29:1035; 2. Goodman ER. ICHE 2008;29:593-9; 3. Datta R. Arch Intern Med 2011;171:491-4; 4. Smith A. J Hosp Infect 2016;92:161-6

16

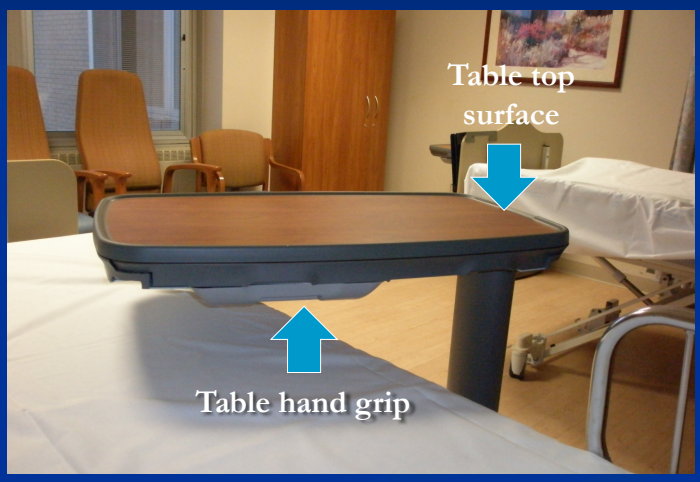
Limitations of the fluorescent marker method

- EVS personnel may focus efforts on removal of marks rather than improving cleaning
  - Obtain own black lights to locate marks [1]
- Monitoring by EVS personnel may not correlate with findings of independent observers [2]
- Marker may not be thoroughly removed from irregular surfaces despite wiping

1. Kundrapu S. ICHE 2014;35:202-4; 2. Anderson DJ. ICHE

17

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



Sitzlar B. ICHE 2013;34:459-5

18

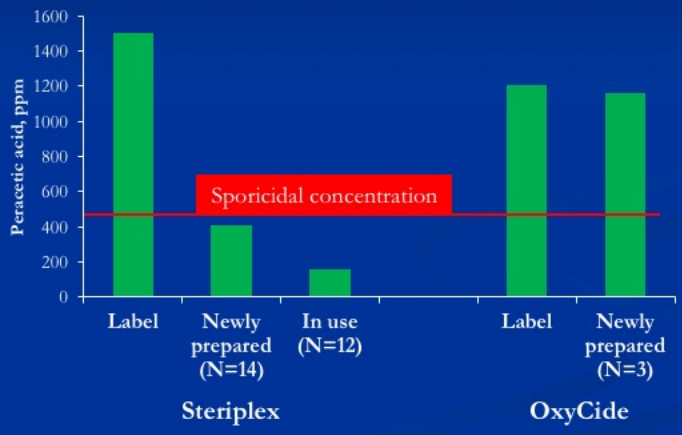
Pathogens often recovered from sites with complete marker removal

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 *C. difficile*
3	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. Boyce JM, et al. Infect Control Hosp Epidemiol 2011;32:1187-93

19

Fluorescent markers do not detect defective products



Cadnum JL, et al. An increase in healthcare-associated CDI associated with use of a defective peracetic acid-based disinfectant. ICHE 2017;38:300-5.

20

Steriplex

Malfunction of the Smart Cap reservoir led to insufficient amounts of the activator component, possibly due to sensitivity to certain shipping and handling conditions

Cadnum JL, et al. An increase in healthcare-associated CDI associated with use of a defective peracetic acid-based disinfectant. ICHE 2017;38:300-5.

21

Low-cost fluorescent marker: Tide free & gentle laundry detergent

22

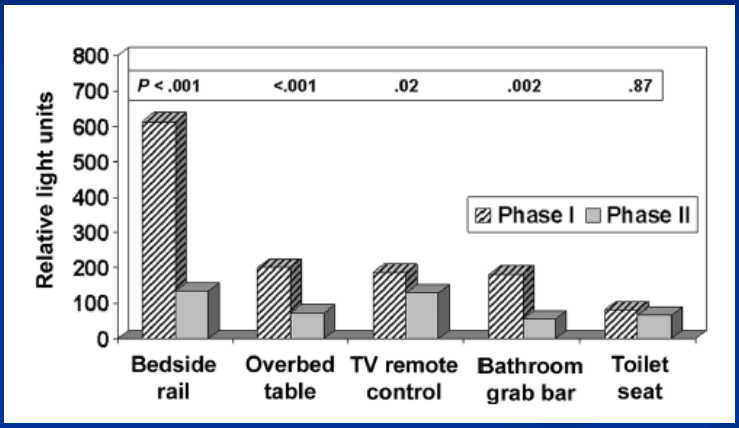
ATP bioluminesence

- Quantitative measurement of organic material (bacteria, food, bodily secretions)
- Expressed as relative light units (RLUs)
- No established benchmark for defining clean
- ATP readings may correlate with aerobic colony counts [3, 5]
- Rapid results can be used to provide immediate feedback to personnel

1. Boyce JM. ICHE 2009;30:678-84; 2. Boyce JM. ICHE 2011;32:1187-93; 3. Luick L. Am J Infect Control 2013;41:751-2; 4. Amodio E, Dino C. J Infect Public Health 2014;7:92-8; 5. Huang Y. AJIC 2015;43:882-6

23

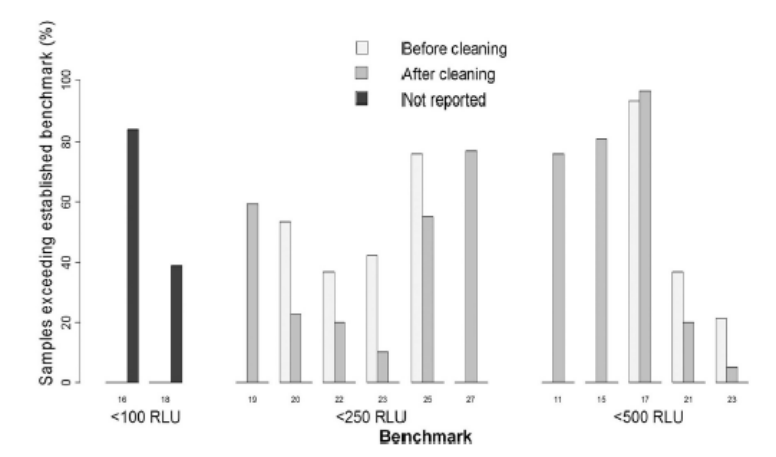
Improved cleaning after providing education and feedback based on ATP readings [1]



1. Boyce JM. Monitoring effectiveness of hospital cleaning practices by use of an ATP bioluinescence assay. ICHE 2009;30:678-84; 2. Branch-Elliman W. Direct feedback with the ATP luminometer as a process improvement tool for terminal cleaning of patient rooms. AJIC 2014;42:195-7

24

Failure rates at different ATP benchmarks before vs after cleaning



Amodio E, Dino C. J Infect Public Health 2014;7:92-8

25

Comparison of fluorescent marker and ATP methods to aerobic colony counts

Table 1
Diagnostic assessment of different environmental monitoring methods namely fluorescent marker Dazo, adenosine triphosphate assay, and visual inspection using aerobic culture as a "gold standard"

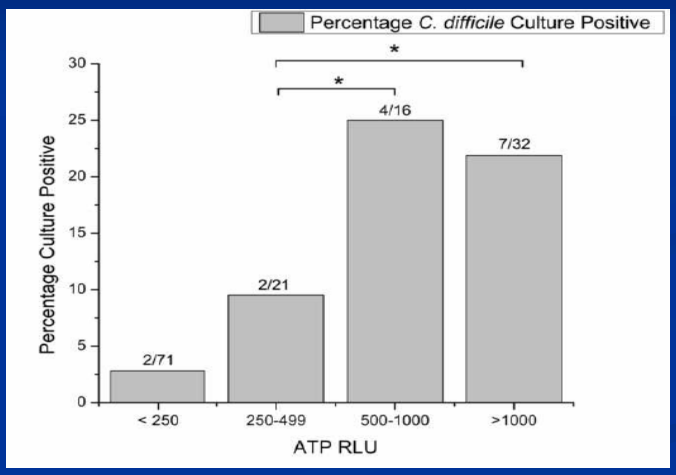
	Test	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Overall	Dazo	68	50	90	19
N = 250	ATP	78	38	90	20
	Visual	95	9	9	23
Baseline dirty	Dazo	75	40	84	28
n = 103	ATP	76	35	83	26
	Visual	94	10	81	29

ATP, adenosine triphosphate; *NPV*, negative predictive value; *PPV*, positive predictive value.

Luick L. Am J Infect Control 2013;41:751-2

26

Correlation between ATP readings and cultures in cleaned CDI rooms



Deshpande A, et al. Infect Control Hosp Epidemiol 2013;34:865-7

27

Chemical additive to colorize chlorine-based disinfectants to improve visualization

Mustapha A. Evaluation of novel chemical additive that colorizes chlorine-based disinfectants to improve visualization of surface coverage. AJIC 2018;46:119-121.

28

Direct observation of cleaning practices and interviews with EVS staff

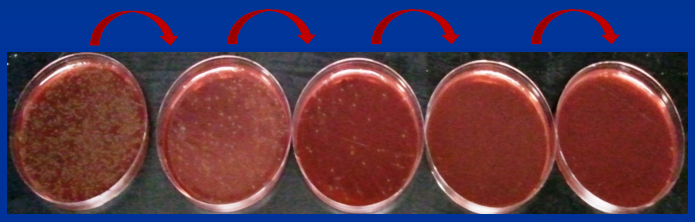
- Interviews with EVS staff
  - Knowledge deficits
  - Other issues that impact job performance
- Direct observation
  - Identifies variation in performance [1-2]
    - Time, number of wipes used, level of cleanliness
    - Incorrect application such as application of bleach followed by immediate wiping

Boyce JM. ICHE 2009;31:99-101; Rupp ME. ICHE 2013;34:100-2

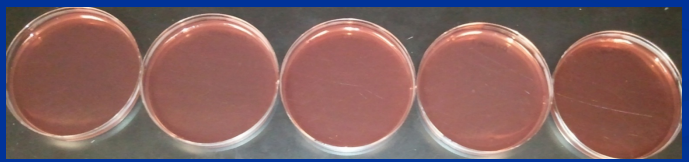
29

Fluorescent markers do not detect incorrect use of products

Transfer of *C. difficile* spores by a bleach wipe[1]



Bleach wipe after multiple uses



Fresh wet bleach wipe

1. Cadnum JL, et al. Infect Control Hosp Epidemiol 2013;34:441-2; 2. Manian FA, et al. Infect Control Hosp Epidemiol 2011;32:667-72 (Suspected transfer of MRSA and Acinetobacter from dirty to clean sites during room cleaning)

30

Confusion about products

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

31

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

32

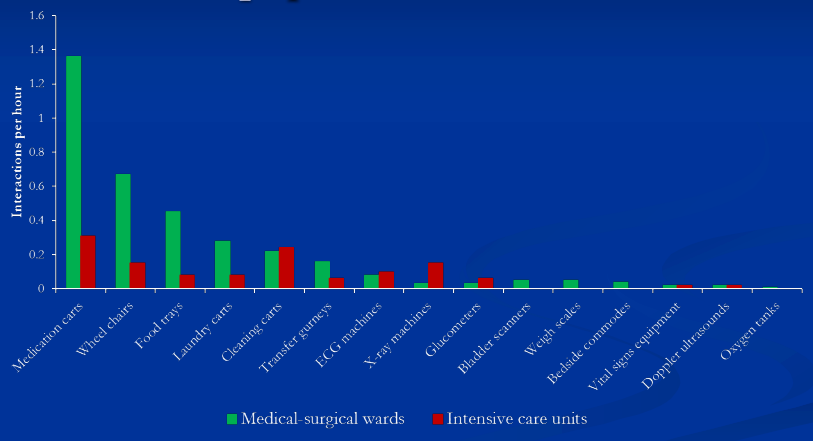
Portable equipment

- Hospitalized patients frequently have direct or indirect interactions with shared medical equipment and other fomites [1]
- Portable equipment is often contaminated with pathogens, but rarely cleaned [2]
- Portable equipment has been associated with outbreaks [3]

1. Suwantarat N. Quantitative assessment of interactions between hospitalized patients and portable medical equipment and other fomites. AJIC 2017; 2. Havill N. Cleanliness of portable equipment disinfected by nursing staff. Am J Infect Control 2011; 3. Kanamori H. The role of patient care items as a fomite in healthcare-associated outbreaks and infection prevention. Clin Infect Dis 2017

33

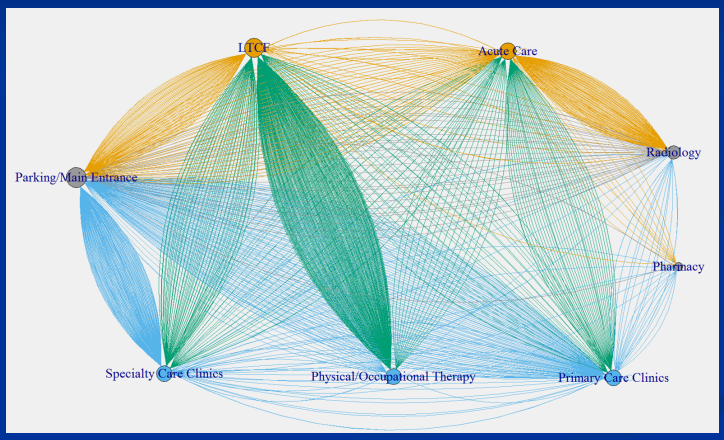
Quantitative assessment of interactions between hospitalized patients and portable medical equipment and other fomites



Suwantarat N, et al. Am J Infect Control 2017; 2017;45:1276-1278.

34

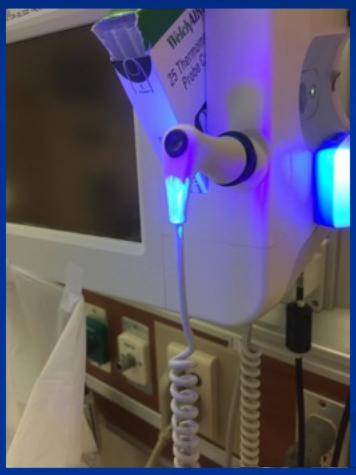
Movement of wheelchairs within the hospital and LTCF



Alhmidi H, et al. SHEA 2018

35

Thermometers



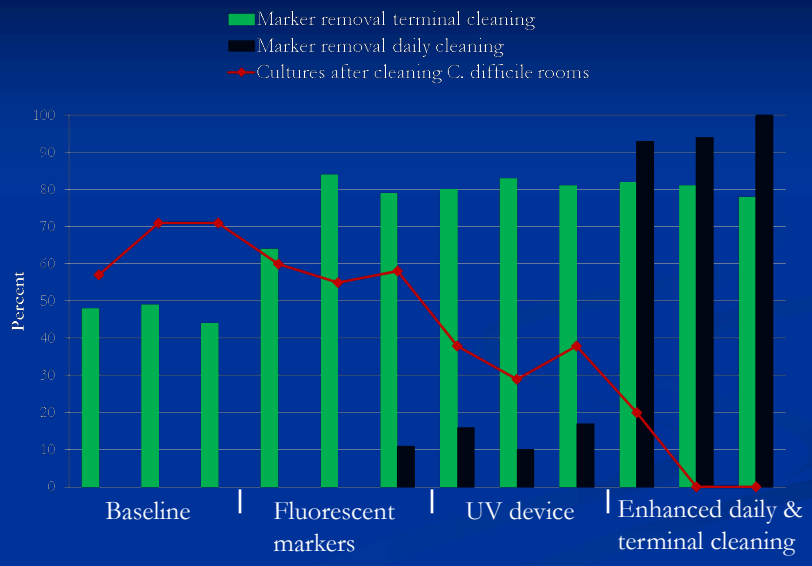
Alhmidi H, et al. Am J Infect Control in press.

36

Dedicated teams of motivated workers for isolation rooms

37

An environmental disinfection odyssey



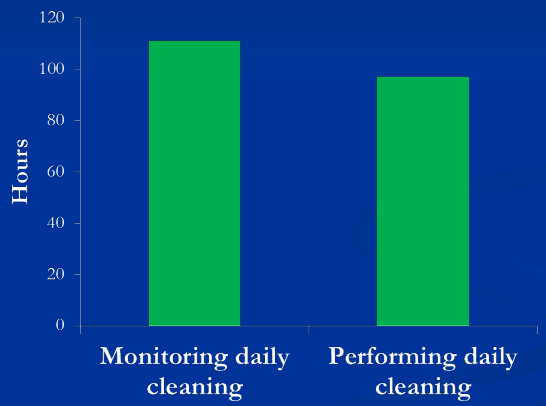
Sitzlar B, et al. Infect Control Hosp Epidemiol 2013;34:459-65

38

More cleaning, less screening: *C. difficile* daily disinfection team

Kundrapu S, et al. ID Week poster 1394; Infect Control Hosp Epidemiol (in press). 39

Monitoring and feedback can be time-consuming



Kundrapu S, et al. More cleaning, Less screening: Evaluation of the time required for monitoring vs performing environmental cleaning. ICHE 2014;35:202-4. 40

Environmental monitoring at the Cleveland VA Medical Center

- Fluorescent markers
  - Terminal cleaning all rooms
  - Daily cleaning *C. difficile* rooms
- Direct observation of environmental services personnel
- ATP
- Cultures

41

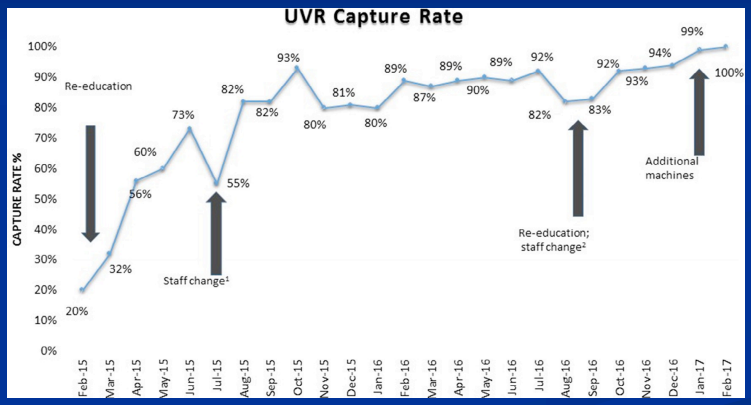
Microbiologic monitoring: culture for *C. difficile* without anaerobic conditions

Negative	Positive	Positive	Negative
Aerobic		Anaerobic	

Cadnum JL, et al. J Clin Microbiol 2014

42

Effective implementation of UV-C devices requires monitoring and feedback



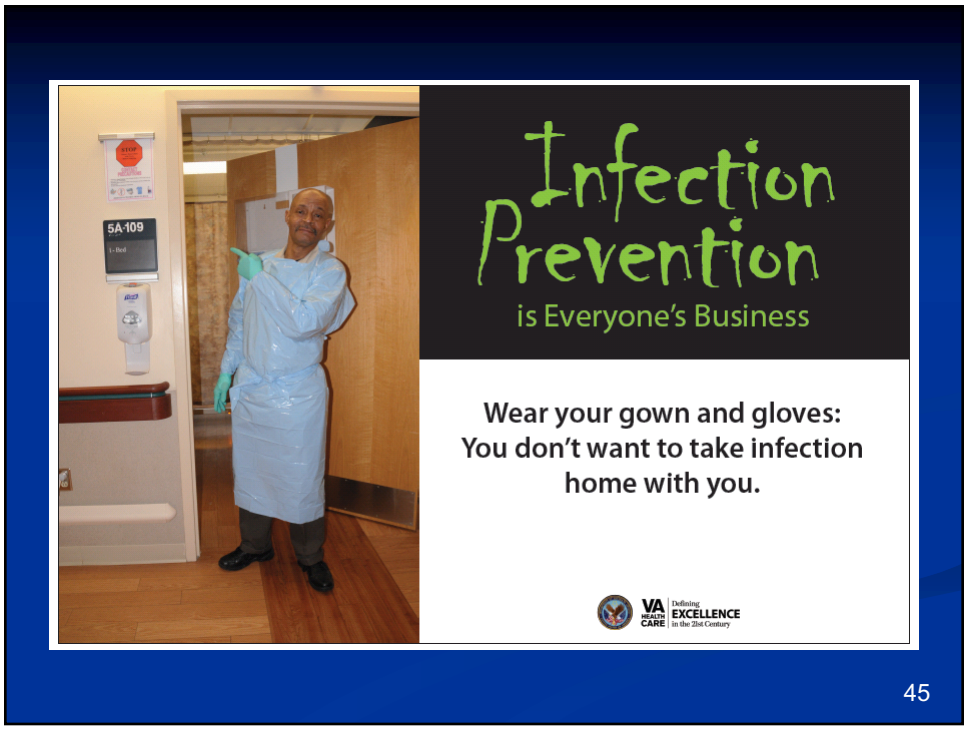
Fleming M. Deployment of a touchless UV light robot for terminal room disinfection: The importance of audit and feedback. AJIC 2017 Nov 3. pii: S0196-6553(17)31102-1. 43

Summary

- Monitoring and feedback is essential in order to improve cleaning and disinfection
- Current methods for monitoring have advantages and disadvantages
- Direct observation of practices is useful
- Monitoring and feedback can have a positive impact on EVS programs

44

Practical Approaches for Monitoring Cleaning in Healthcare Facilities
Dr. Curtis Donskey, Louis Stokes VA Medical Center, Cleveland, Ohio
A Webber Training Teleclass



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February 8, 2018	*(FREE Teleclass)* PATIENTS ARE YOUR PARTNERS - WHY AND HOW THIS PARTNERSHIP WORKS Speaker: **Ioana Popescu**, Canadian Patient Safety Institute, **Judy Birdsell** and **Kim Neudorf**, Patients for Patient Safety Coalition
February 15, 2018	REFUGEE HEALTH: A NEW PERSPECTIVE FOR INFECTION PREVENTION AND CONTROL Speaker: **Prof. Ruth Carrico**, University of Louisville
February 21, 2018	*(South Pacific Teleclass)* IMPROVING THE KNOWLEDGE AND RECEPTIVENESS OF MEDICAL STUDENTS TOWARDS HAND HYGIENE: EXPLORING NEW APPROACHES Speaker: **Dr. Rajneesh Kaur**, Research Associate, University New South Wales, Australia
February 22, 2018	ROOT CAUSE ANALYSIS TO SUPPORT INFECTION CONTROL IN HEALTHCARE PREMISES Speaker: **Dr Anne-Gaëlle Venier**, University Hospital Centre of Bordeux, France
March 8, 2018	INFECTION PREVENTION IN NURSING HOMES AND PALLIATIVE CARE Speaker: **Prof. Patricia Stone**, Columbia University, New York
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