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

Disclosures

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

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Objective

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


Transmission of healthcare-associated pathogens

Infected Patient → Environment → Susceptible Patient

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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

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Basic infection control practices

- Hand washing, gloves, gowns
- Environmental Cleaning
- Susceptible Patient
- Infected Patient
- Environment


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Strategies to improve environmental disinfection

<table>
<thead>
<tr>
<th>Product substitution</th>
<th>New technologies</th>
<th>Improve standard cleaning and disinfection</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Quaternary ammonium disinfectant&lt;br&gt;• Improved hydrogen peroxide&lt;br&gt;• Peracetic acid&lt;br&gt;• Bleach</td>
<td>![Image of UV light disinfection]</td>
<td>![Image of person holding disinfectant]</td>
</tr>
</tbody>
</table>

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

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


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### Microbiological plausibility

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

![Quat wipe vs Bleach wipe](image)


### Crossover trial of improved hydrogen peroxide versus a quaternary ammonium disinfectant

<table>
<thead>
<tr>
<th></th>
<th>Improved hydrogen peroxide</th>
<th>Quaternary ammonium disinfectant</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean aerobic colony counts</td>
<td>14</td>
<td>22</td>
<td>.003</td>
</tr>
<tr>
<td>% surfaces with no growth</td>
<td>48%</td>
<td>35%</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Incidence of nosocomial colonization or infection*</td>
<td>8</td>
<td>10</td>
<td>.07</td>
</tr>
</tbody>
</table>

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

New technologies

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

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

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

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Fluorescent markers

Phil Carling

Fluorescent marker on a toilet seat after housekeeping cleaning


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
  - Reductions in MRSA and VRE transmission and C. difficile infection


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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
- Monitoring by EVS personnel may not correlate with findings of independent observers
- Marker may not be thoroughly removed from irregular surfaces despite wiping


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

Sitzlar B. ICHE 2013;34:459-5

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Pathogens often recovered from sites with complete marker removal

<table>
<thead>
<tr>
<th>Ref</th>
<th>Fluorescent marker method culture results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Despite intervention, 27% of rooms contaminated with MRSA or VRE after cleaning (versus 45% at baseline)</td>
</tr>
<tr>
<td>2</td>
<td>33% of toilet seats in CDI rooms with complete marker removal grew <em>C. difficile</em></td>
</tr>
<tr>
<td>3</td>
<td>21% of sites with complete marker removal not clean based on aerobic colony counts</td>
</tr>
</tbody>
</table>


Fluorescent markers do not detect defective products

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


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

- 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


Improved cleaning after providing education and feedback based on ATP readings \(^1\)


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Failure rates at different ATP benchmarks before vs after cleaning

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”

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Dazo</td>
<td>68</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>ATP</td>
<td>78</td>
<td>38</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Visual</td>
<td>95</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Baseline dirty</td>
<td>Dazo</td>
<td>75</td>
<td>40</td>
<td>84</td>
</tr>
<tr>
<td>n = 103</td>
<td>ATP</td>
<td>76</td>
<td>35</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Visual</td>
<td>94</td>
<td>10</td>
<td>81</td>
</tr>
</tbody>
</table>

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

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

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Correlation between ATP readings and cultures in cleaned CDI rooms


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.
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

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

Confusion about products


Confusion about who cleans what

Wall-mounted vital signs equipment

Portable equipment

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

1. Suwntarat N. Quantitative assessment of interactions between hospitalized patients and portable medical equipment and other fomites. AJIC 2017

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

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Movement of wheelchairs within the hospital and LTCF

Alhmidi H, et al. SHEA 2018

Thermometers


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Dedicated teams of motivated workers for isolation rooms

An environmental disinfection odyssey


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


Monitoring and feedback can be time-consuming

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

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

<table>
<thead>
<tr>
<th></th>
<th>Aerobic</th>
<th>Anaerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
</tr>
</tbody>
</table>


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Effective implementation of UV-C devices requires monitoring and feedback


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

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February 8, 2016
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 Bordeaux, France

March 8, 2016
INFECTION PREVENTION IN NURSING HOMES AND PALLIATIVE CARE
Speaker: Prof. Patricia Stone, Columbia University, New York

March 15, 2018
CLOSTRIDIUM DIFFICILE ASYMPTOMATIC CARRIERS – THE HIDDEN PART OF THE ICEBERG

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