Current Research Needs in Green Cleaning

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Agenda

• Pathogen transmission from surfaces – The problem – Three characteristics
• The solution and challenges
• Cleaning v. cleanliness
• Improving cleaning practice
• Green Chemistries
• Conceptual modeling for future studies
A 2013 Perspective

Developmental Emphasis

1990 – 2009

Next Decade

Healthcare Environmental Cleaning Goal

Providing a safer patient environment

Shinier Floors

Hygienic Practice (Technologic Enhancements)

Near-Patient Surface Bio-burden Reduction

Disinfectant Efficacy
How is Environmental Cleaning being evaluated in this hospital?

Are Shiny Floors Enough??
A 2013 Perspective

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Disinfectant Efficacy

Hygienic Practice (Technological Enhancements)
# A 2013 Perspective

## Developmental Emphasis

<table>
<thead>
<tr>
<th>1990 – 2009</th>
<th>Next Decade</th>
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<tbody>
<tr>
<td>Shinier Floors</td>
<td>Providing a safer patient environment</td>
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### Healthcare Environmental Cleaning Goal
- Near-Patient Surface Bio-burden Reduction
- Disinfectant Efficacy

### Hygienic Practice and Product Enhancements
The Problem
You Can’t Escape from Germs!
Increased acquisition risk from prior room occupant

8 studies as of October 2010

Two additional studies showed very significant risk without quantification – Martinez (VRE) and Wilks (Acinetobacter)
The Problem

With Healthcare Pathogens

Three Concepts
1. Contaminated surfaces around patients are the rule

<table>
<thead>
<tr>
<th>Surface</th>
<th>VRE</th>
<th>MRSA</th>
<th>C. difficile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed Rails</td>
<td>++++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Bed Table</td>
<td>++++</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Door Knobs</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Doors</td>
<td>+++</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Call Button</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Chair</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Tray Table</td>
<td>+++</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Toilet Surface</td>
<td>+</td>
<td></td>
<td>++++</td>
</tr>
<tr>
<td>Sink Surface</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Bedpan Cleaner</td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>
Surface Contamination of Near-patient Environment

23 Studies

% CONTAMINATED

C. DIFFICILE
VRE
MRSA
2. Concept

All pathogens traditionally associated with health care transmission survive well on surfaces
### Survival of Pathogens on Dry Environmental Surfaces

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Duration</th>
</tr>
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<tbody>
<tr>
<td>C. difficile</td>
<td>&gt; 5 months</td>
</tr>
<tr>
<td>Staphylococci</td>
<td>7 months</td>
</tr>
<tr>
<td>VRE</td>
<td>4 months</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>5 months</td>
</tr>
<tr>
<td>Norovirus</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Adenovirus</td>
<td>3 months</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>3 months</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>4 weeks</td>
</tr>
</tbody>
</table>
Outbreak v. Non-outbreak VRE

Figure 1. Survival of an outbreak strain (E745; open squares) and a non-outbreak strain (E802; filled triangles) of vancomycin-resistant Enterococcus faecium (VREFm).
3. Concept

Good News:
Pathogen density is generally low

Bad News:
Infective doses are low to very low
The microbial ecology of patient zone surfaces

**All** Pathogens traditionally associated with health care transmission survive well on surfaces.

Organism density is generally low but infective doses are low.

Most near-patient surfaces are sterile or contain < 2.5 ACC / cm². Therefore, simple cleanliness (culture, ATP) can not be used as a surrogate for thoroughness of cleaning (the most misunderstood aspect of EH).
The Solution and the Challenge
The Solution and the Challenge

Green Cleaning
Green Cleaning

2
Moving Targets
Green Cleaning

What is Green?

2 Moving Targets
Green Cleaning

What is Green?

What is Clean?

2 Moving Targets
Green Cleaning

What is Green?

What is Clean?

Quantitative Cleanliness

Cleaning v. Cleanliness
What is a “Clean” surface?

Contaminated

Sterile
What is a “Clean” surface?

Contaminated

What is a “Clean” surface?


ATP - proposed “Standard” 2000 - 2011

Culture Based - proposed “Standard” 2003 - ??
Surface evaluation using ATP bioluminescence

Swab surface  →  luciferase tagging of ATP  →  Hand held luminometer

Used in the commercial food preparation industry to evaluate surface cleaning before reuse and as an educational tool for more than 30 years.
The ATP tool in context

Industrial Use
- Developed in the 1970s for commercial food preparation
- Very clean surfaces – important
- High-grade disinfectants + Rinsing
- Testing immediately after cleaning and just before use is the standard

Healthcare Use
- Griffiths – JHI studies – Effectively debunked the “visibly clean “ standard using dipslide cultures and ATP tool and showed that most surfaces had both high bacterial and ATP counts (89% of surfaces “Failed”)
- The Hygienic standard is proposed
ATP bioluminescence environmental evaluation in healthcare settings

Evaluation of ATP bioluminescence swabbing as a monitoring and training tool for effective hospital cleaning

2007
Correlation between ATP bioluminescence (RLU/Swab) and aerobic colony count (cfu/swab)

Bioluminescence
PPV = 63%  NPV= 71%

Satisfactory by RLUs but Unsatisfactory by # CFU
What is a “Clean” surface?

Contaminated

Clean = < 2.5 CFU/cm²

Culture Based - proposed “Standard” 2003 - ??

Sterile
## Defining the Difference Between Cleaning and Cleanliness

<table>
<thead>
<tr>
<th></th>
<th>Cleanliness</th>
<th>Cleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>A measure of bacteria on a surface</td>
<td>Measured by evaluating process</td>
</tr>
<tr>
<td><strong>Defined Criteria</strong></td>
<td>No “Cleanliness Standard”</td>
<td>Compliance with existing cleaning policy</td>
</tr>
<tr>
<td><strong>Improvement shown</strong></td>
<td>None</td>
<td>Two</td>
</tr>
<tr>
<td></td>
<td>to decrease bacterial transmission (Published)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bioburden, thoroughness of recent cleaning, effectivness of disinfectant,</td>
<td>Thoroughness of evaluated cleaning practice</td>
</tr>
<tr>
<td></td>
<td>recent contamination or lack of</td>
<td></td>
</tr>
<tr>
<td><strong>CDC endorsed</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>to improve patient safety</td>
<td></td>
</tr>
</tbody>
</table>
Using tools that measure cleanliness to systematically evaluate cleaning process
Is there a simpler way to evaluate cleaning process in healthcare?
The Health Care Environmental Hygiene Study Group Hospitals Program

To develop a surrogate marking system to objectively evaluate and improve the thoroughness of environmental cleaning/disinfection of the near-patient environment
The Targeting Solution

A mixture of several glues, soaps and a targeting dye which:

- Dries rapidly
- Environmentally stable
- Readily wetted by spray disinfectants
- Easily removed with light abrasion
- Inconspicuous
Target After Marking
Target Enhanced
Evaluation of the thoroughness of disinfection cleaning has shown substantial opportunities for improvement in all health care venues studied in the U.S., Canada, Ireland and Australia.
Baseline Environmental Evaluation of 3 Acute Care Hospitals

Mean = 47.7 %
Baseline Environmental Evaluation of 35 Acute Care Hospitals

Mean = 48.5 %

(20,056 Objects)
Baseline Environmental Evaluation of 82 Acute Care Hospitals

Mean = 54 %

(44,340 Objects)
PROPORTION OF OBJECTS CLEANED AS PART OF TERMINAL ROOM CLEANING IN 20 ACUTE CARE HOSPITALS
Thoroughness of Environmental Cleaning

| = 95% CI

Mean = 32%

>110,000 Objects

DAILY CLEANING
TERMINAL CLEANING
Cleaning in 104 US Hospitals

- Iowa
- 36 Hospitals

TDC Score (%)

PRE INTERVENTION
POST INTERVENTION
Disinfection cleaning can be programmatically improved - 13 studies as of July 2010

Thoroughness of Cleaning Score (%)
Is it a surprise that this degree of improvement was resource neutral??
Does improving the thoroughness of the cleaning process work?
Improving Disinfection Cleaning to Decrease Environmental Surface Contamination

% Relative Improvement from Baseline

- Improvement in Cleaning Practice
  - A: 80%
  - B: 64%
  - C: 80%
  - D: 64%

- Decrease in Environmental Pathogens
  - A: 80%
  - B: 64%
  - C: 80%
  - D: 64%
Brigham & Woman’s ICU Study

Result of the intervention

MRSA Acquisition Decreased 50% (p<0.001)
VRE Acquisition Decreased 28% (p<0.02)

Datta B, Arch Int Med
March 2011
CDC Recommendations

Acute Care Hospitals should implement a:

Level I Program:
Basic interventions to optimize disinfection cleaning policies, procedures and ES staff education and Practice. When completed move to Level II Program

Level II Program:
All elements of Level I + Objective monitoring

Options for Evaluating Environmental Cleaning
October 2010
Original research article

Methods for assessing the adequacy of practice and improving room disinfection

Philip Carling MD a,b,*

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b Department of Infectious Diseases, Carney Hospital, Boston, MA
What else can be done to provide a safer surface environment for our patients?
SHEA abstracts related to surface environmental hygiene issues

Number of abstracts

<table>
<thead>
<tr>
<th></th>
<th>SHEA 2005</th>
<th>DECENNIAL 2010</th>
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</thead>
<tbody>
<tr>
<td>Number</td>
<td>2</td>
<td>37</td>
</tr>
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</table>
Single intervention clinical studies of environmental hygiene

Studies = 44

- Enhanced Cleaning
- Other Disinfectant
- HPV
- UV
Single intervention clinical studies of environmental hygiene

Non-outbreak Studies in which TDC was objectively monitored during the intervention = 8
What is “Green”? 
What is “Green”?

1950 to about 2005

- Highly Potent and Toxic Disinfectants
- Less Potent and ? Toxic Disinfectants
- Detergents
What is “Green”?

2005 to Present

Highly Potent and Toxic Disinfectants

Less Potent and ? Toxic Disinfectants

Green Detergents
What is "Green"?

Next Two Years

- Less Potent and ? Toxic Disinfectants
- Green Detergents
What is “Green”?  
Next Two Years  
Green Detergents
What is “Green”?

Next Two Years

Green Disinfectants

Green Detergents
The bottom line for future clinical studies
Life is strange!!
Life is strange!!

Your answer??
Life is strange!!

Compared to what???

Your answer??
A Conceptual Model for Objective Environmental Hygiene Clinical Research
Better / Safer

Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Better / Safer
Better / Safer

Objective Outcome Measurement

Cost
- Personnel
- Equipment
- Chemicals

Basic Intervention
Better / Safer

Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Basic Intervention

TDC = 80%
Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Fixed Cost

Evaluable Performance Measure

Better / Safer
Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Better / Safer

Tier I Enhancements
Better Chemicals
Super Microfiber
Killer Surfaces, etc.
P = < .0001

Quartinary Ammonium Disinfectant

Novel Disinfectant
Objective Outcome Measurement

- Cost
  - Personnel
  - Equipment
  - Chemicals

- Tier II Enhancements
  - HPV, UVC, etc.??

- Better / Safer
Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Better / Safer

Tier II Enhancement
+ Basic Intervention
Defining the Cost/Benefit in various settings

Objective Outcome Measurement

Cost

Personnel
Equipment
Chemicals

Better / Safer
Objective Outcome Measurement

Defining the Cost/Benefit in various settings

Cost

Personnel
Equipment
Chemicals

LTCF

BMT Unit

Better / Safer
Thanks for inviting me!

Questions – Comments?

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