Cleaning the “Grey Zones” of Hospitals
Dr. Makeda Semret, McGill University, Montreal
A Webber Training Teleclass

Cleaning the “Grey Zones” of Hospitals

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Disclosures

• Funding from GSK and Pfizer for investigator-initiated research studies (on flu and CAP)
• In-kind contribution from Biomerieux (for research on Hospital Associated Infections in Ethiopia)
• In-kind contribution from Clorox (for environmental cleaning study at St Mary’s Hospital)

No conflicts relevant to this study

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Learning Objectives

At the end of this talk, participants will be able to:

• Recognize the existence of cleaning gaps and Grey Zones (GZ) in their institutions
• Develop an approach to assess the relative risk (in terms of transmission) posed by Grey Zones
• Integrate transmission patterns and hospital design to inform environmental cleaning strategy

Cleaning of the hospital environment

Routine cleaning is important to ensure a clean and dust-free hospital environment. There are usually many micro-organisms present in “visible dirt”, and routine cleaning helps to eliminate this dirt. Administrative and office areas with no patient contact require normal domestic cleaning. Most patient care areas should be cleaned by wet mopping. Dry sweeping is not recommended. The use of a neutral detergent solution improves the quality of cleaning. Hot water (80°C) is a useful and effective environmental cleaner. Bacteriological testing of the environment is not recommended unless seeking a potential source of an outbreak.

- Any areas visibly contaminated with blood or body fluids should be cleaned immediately with detergent and water.
- Isolation rooms and other areas that have patients with known transmissible infectious diseases should be cleaned with a detergent/disinfectant solution at least daily.

All horizontal surfaces and all toilet areas should be cleaned daily.

“Practical guidance for infection control in healthcare facilities” WHO guidelines
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The hospital environment

Hospital surfaces frequently contaminated with microorganisms (shed from patients), which can survive on inanimate surfaces for long durations

<table>
<thead>
<tr>
<th>Organism</th>
<th>Length of Survival on Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>7 days – 1 year</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td>5 months</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>&lt;1 hour – 30 months</td>
</tr>
<tr>
<td>E. coli</td>
<td>&lt;1 hour – 16 months</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
<td>3 days – 5 months</td>
</tr>
<tr>
<td>Adenovirus</td>
<td>7 days – 3 months</td>
</tr>
<tr>
<td>Norovirus</td>
<td>8 hours – 14 days</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>6 hours – 16 months</td>
</tr>
<tr>
<td>VRE</td>
<td>5 days – 4 months</td>
</tr>
</tbody>
</table>


Your 5 moments for hand hygiene at the point of care*

1. BEFORE PATIENT CONTACT
2. BEFORE A CLEAN/ASEPTIC PROCEDURE
3. AFTER BODY FLUID EXPOSURE RISK
4. AFTER PATIENT CONTACT
5. AFTER CONTACT WITH PATIENT SURROUNDINGS

*Adapted from the WHO Alliance for Patient Safety 2006

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Effect of cleaning on reducing HAI

Difficult to assess role of environmental cleaning experimentally because of many confounders

Some studies have shown no benefit for “extra measures” in terms of reducing MRSA acquisition

Very few comparative studies directly assessing the impact of cleaning strategies on colonization or infection rates

Best practices for environmental cleaning

- Physical removal of dust and organic debris by mopping/rubbing/scrubbing
- Disinfecting (with hospital grade disinfectant)
- Double or “terminal” cleaning of rooms with sporicidal agent for selected rooms (eg. Rooms occupied by VRE, C. difficile patients)
  
  Normally by trained housekeeping staff

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But in real life..

- Most hospitals apply their own standards for cleaning
- Between hospitals and within institutions, there is variability in terms of
  - Available Resources
  - Frequency of cleaning
  - Monitoring of quality of cleaning
  - Nature of surfaces cleaned

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Rates of Cleaning for 15 Types of High-Risk Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>Percentage cleaned</td>
</tr>
<tr>
<td>Stick</td>
<td>82 ± 12</td>
</tr>
<tr>
<td>Toilet seat</td>
<td>76 ± 18</td>
</tr>
<tr>
<td>Tray table</td>
<td>77 ± 15</td>
</tr>
<tr>
<td>Bedside table</td>
<td>64 ± 22</td>
</tr>
<tr>
<td>Toilet handle</td>
<td>66 ± 22</td>
</tr>
<tr>
<td>Side rail</td>
<td>60 ± 11</td>
</tr>
<tr>
<td>Call bell</td>
<td>59 ± 19</td>
</tr>
<tr>
<td>Telephone</td>
<td>49 ± 16</td>
</tr>
<tr>
<td>Chair</td>
<td>48 ± 16</td>
</tr>
<tr>
<td>Toilet door knobs</td>
<td>28 ± 23</td>
</tr>
<tr>
<td>Toilet bowl</td>
<td>28 ± 23</td>
</tr>
<tr>
<td>Bedside cleaner</td>
<td>29 ± 18</td>
</tr>
<tr>
<td>Bariatric chair</td>
<td>28 ± 19</td>
</tr>
<tr>
<td>Bathroom (light switch)</td>
<td>22 ± 21</td>
</tr>
</tbody>
</table>

Carling et al: Identifying opportunities to enhance environmental cleaning in 23 acute care hospitals, ICHE 2008
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Studies of cleaning/disinfection strategies


Studies assessing monitoring


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Categories of environmental surfaces

- Spaulding classification:
  - Critical, Semi critical, and Non critical
- Environmental surfaces further divided into:
  - Housekeeping surfaces (e.g., floors, walls, table tops, bedrails, ..)
    - Low touch vs High touch
  - Medical equipment surfaces (e.g., knobs on machines, instrument carts, IV poles, ..)

Potentially contaminated surfaces

![Image of hospital room with marked areas representing VRE culture positive sites]


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Contaminated medical equipment

Can come into contact with the patient and serve as a direct source of transmission
Or
Source for contamination of healthcare worker’s hands or gloves
➢ Most are “non critical” items
➢ Often, (can)not cleaned by housekeeping.

Definition of Grey zones

• *Oxford dictionary: Noun “an intermediate area between 2 opposing positions (...) not clearly or easily defined, or not covered by an existing category or set of rules”*

• Surfaces that are not routinely cleaned, often *because* their cleaning has not been clearly assigned to a category of health care worker (and is left to individual users)
• Often these are equipment and clinical materials used by many service providers
• Specific items vary from institution to institution
  — some are high touch (eg mobile BP equipment)
  — others are rarely in direct contact with patients (eg. Computer keyboards)

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Hypothesis and study objective

- Grey Zones, particularly those that are high-touch, are potentially significant reservoirs of infection
- The impact of cleaning the Grey Zones on transmission of hospital-acquired infections should be measurable
- Study provides an opportunity to assess the role of environmental cleaning on patient outcomes
  (Cannot assess impact of NOT cleaning environment!)

Our setting

- Acute care hospital, 280 beds
- Hand hygiene compliance rate 58-65% (based on 3 audits performed over preceding 4 years)
- VRE incidence: 3.5/1,000 patient-days
- MRSA incidence: 1.8/1,000 patient-days
- *C. difficile* incidence: 0.8/1,000 patient-days

Majority of transmissions: on medical wards A&B

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Study setting

<table>
<thead>
<tr>
<th>Ward A</th>
<th>Ward B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse/patient ratio 1:5 – 1:8</td>
<td>Nurse/patient ratio 1:5 – 1:6</td>
</tr>
<tr>
<td>Capacity 49 beds; 50% for active medical care</td>
<td>Capacity 34 beds; 100% active medical care</td>
</tr>
<tr>
<td>Built in 1940</td>
<td>Built in 1970</td>
</tr>
<tr>
<td>5 single rooms with private bathrooms; 2,3, 4-bedded rooms with shared bathrooms</td>
<td>4 single rooms with private bathrooms; 15 2-bedded rooms with shared bathrooms</td>
</tr>
</tbody>
</table>

Same floorings, wall coverings, furniture
Same housekeeping staff and cleaning policy

Screening and surveillance

- Screening for MRSA and VRE at admission for higher risk patients
  - Previous admission (last 12 months) or employment in a healthcare institution
  - Previous positive (at any time) or close contact with positive case
- Weekly ward surveillance screens
- Discharge screening on all patients
- No screening for *C. difficile* carriage, but testing of all diarrhea cases for presence of *C. difficile*

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Infection control policy

- All patients identified as positive for MRSA, VRE or C. difficile are placed under isolation, or kept in cohorts with others harboring the same organism – with contact precautions
- Hand hygiene measures – antiseptic hand rubs beside each room, and hand washing sink in each hallway of wards

Environmental cleaning on wards

- Daily mopping of hospital surfaces (floors in hallways and in patient rooms), daily cleaning of bathrooms with disinfectant, and thorough cleaning/disinfection of rooms after patient discharge
- “Double cleaning” (bleach-based product) of rooms occupied by VRE and C. difficile patients after their discharge

But several patient care items not assigned to housekeeping (so not consistently cleaned)
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GZ items routinely found on wards

<table>
<thead>
<tr>
<th>Grey zone item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laundry hampers in rooms</td>
</tr>
<tr>
<td>Mobile sphygmomanometer</td>
</tr>
<tr>
<td>Portable blood pressure</td>
</tr>
<tr>
<td>Rolling walker</td>
</tr>
<tr>
<td>Manual scale</td>
</tr>
<tr>
<td>Patient lift</td>
</tr>
<tr>
<td>Foot stool</td>
</tr>
<tr>
<td>Leads for cardiac monitor</td>
</tr>
<tr>
<td>Shower chair</td>
</tr>
<tr>
<td>Suction gauge</td>
</tr>
<tr>
<td>Oxygen tanks</td>
</tr>
<tr>
<td>Roll board</td>
</tr>
<tr>
<td>Clean linen cart in hallway</td>
</tr>
<tr>
<td>Clean linen bins in hallway</td>
</tr>
<tr>
<td>Cart for patient charts</td>
</tr>
<tr>
<td>Utility cart</td>
</tr>
<tr>
<td>Laundry cart</td>
</tr>
<tr>
<td>Printer for cardiac monitor</td>
</tr>
<tr>
<td>Code red monitor</td>
</tr>
</tbody>
</table>

INTERVENTION
➢ Assign a trained housekeeper for specific cleaning of these items
➢ Establish cleaning frequency
➢ Monitor the efficacy of cleaning
➢ Measure outcomes (transmission rates) to enable cost effectiveness analysis

Table 1
Items listed as grey zones on each ward, and cleaning frequency

<table>
<thead>
<tr>
<th>Grey zone item</th>
<th>Frequency of cleaning</th>
<th>Grey zone item in use on ward(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laundry hampers in rooms</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Mobile sphygmomanometer</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Portable blood pressure</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Rolling walker</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Manual scale</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Patient lift</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Foot stool</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Leads for cardiac monitor</td>
<td>Daily (between patients)</td>
<td></td>
</tr>
<tr>
<td>Shower chair</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Suction gauge</td>
<td>Daily (between patients)</td>
<td>A, B</td>
</tr>
<tr>
<td>Oxygen tanks</td>
<td>Daily (between patients)</td>
<td>A</td>
</tr>
<tr>
<td>Roll board</td>
<td>Daily (between patients)</td>
<td></td>
</tr>
<tr>
<td>Clean linen cart in hallway</td>
<td>Weekly</td>
<td>A, B</td>
</tr>
<tr>
<td>Clean linen bins in hallway</td>
<td>Weekly</td>
<td>A, B</td>
</tr>
<tr>
<td>Cart for patient charts</td>
<td>Weekly</td>
<td>B</td>
</tr>
<tr>
<td>Utility cart</td>
<td>Weekly</td>
<td>B</td>
</tr>
<tr>
<td>Laundry cart</td>
<td>Weekly</td>
<td>B</td>
</tr>
<tr>
<td>Printer for cardiac monitor</td>
<td>Weekly</td>
<td>B</td>
</tr>
<tr>
<td>Code red monitor</td>
<td>Weekly</td>
<td>A</td>
</tr>
</tbody>
</table>

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Cleaning method for GZ

- Wipe with wet rag (soaked in solution containing soap and water) to remove organic debris
- Disinfect using quaternary ammonium-based product (spray or apply with cloth and leave for 10’)
- Dedicated trained GZ cleaner weekdays 8-4PM

The GZ cleaning intervention

Cross over design

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ward A</td>
<td>Routine + GZ cleaning</td>
<td>Routine (control)</td>
</tr>
<tr>
<td>Ward B</td>
<td>Routine (control)</td>
<td>Routine + GZ cleaning</td>
</tr>
</tbody>
</table>

Monitoring:
- Spot visual checks (daily, by head nurse)
- Microbiological testing for growth of MRSA and VRE from random sampling of 15 GZ surfaces (after cleaning) (weekly, by infection control nurses)

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Monitoring of GZ cleaning

- Total 1556 swabs covering 108 surfaces (different items) tested for growth of VRE and MRSA after cleaning (to monitor quality of cleaning)
- One swab positive for growth of VRE (electronic patient scale on Ward A); 2 swabs positive for growth of MRSA (walker and IV pole on Ward B)
- GZ surfaces adequately cleaned, low microbial burden

Differences in patient populations

- Between Intervention (routine + GZ cleaning) and Control (routine cleaning only) periods for each ward: no significant differences
  - Similar ages, sex distribution, comorbidity scores, length of stay
- Between Wards A and B:
  - Ward A had on average older patients, longer lengths of stay and greater number of roommates per patient

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Differences in transmission rates

<table>
<thead>
<tr>
<th>Pathogen transmission</th>
<th>Control</th>
<th>Intervention</th>
<th>Poisson regression model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>IR</td>
<td>n</td>
</tr>
<tr>
<td>Methicillin-resistant Staphylococcus aureus</td>
<td>10</td>
<td>4.6</td>
<td>8</td>
</tr>
<tr>
<td>Vancomycin-resistant Enterococcus</td>
<td>20</td>
<td>2.0</td>
<td>19</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td>10</td>
<td>0.8</td>
<td>5</td>
</tr>
<tr>
<td>Any of 3</td>
<td>34</td>
<td>4.9</td>
<td>31</td>
</tr>
<tr>
<td>Total of 3</td>
<td>36</td>
<td>5.2</td>
<td>32</td>
</tr>
</tbody>
</table>

NOTE: Bold values are statistically significant P<0.05. IR: incidence rate; BRR: incidence rate ratio.

*Adjusted by age, sex, Charlson-comorbidity index scores, average number of roommates, and the correlation for repeated admissions across same patient.

Transmission rates

- Overall, lower transmission rates during the intervention (routine + GZ cleaning) compared with routine cleaning only noted on Ward B
- VRE transmission most significantly impacted
  - Incidence rate dropped from 6.2 to 3.2/1,000 patient-days (2-fold decrease, p = 0.03)
- Also decrease in C. difficile transmission but not statistically significant (small numbers)
- MRSA transmission rates unchanged

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Transmission patterns Ward A

- 9 of 11 VRE transmissions within 2 weeks
- 7 of 20 VRE transmissions within 4 weeks

Transmission patterns Ward B

- 33 VRE transmissions over 6 months
- >34 VRE transmissions in over 6 months

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Transmission patterns

- Ward A: peaks of VRE transmission with majority cases occurring in a short time span (2-3 weeks): consistent with **focal outbreaks**
- Ward B: fairly constant VRE transmissions over long periods of time (months): consistent with **endemic transmission**
- Transmission of MRSA and *C. difficile* low-level and constant throughout the study

Effect of GZ cleaning

- 2-fold decrease in VRE transmissions on the ward where transmission followed an endemic pattern (patients had fewer roommates and private bathrooms, but “more acute”)
  - Actually the ward with highest burden of VRE
- No significant impact on ward where transmissions of VRE is clustered (index patients tend to have more roommates and share bathrooms - but rapidly controlled with cohorting/patient discharges)
Impact on MRSA transmission rates?

- No impact on MRSA seen in our study
  - Low baseline rates in our institution (decreasing elsewhere in Canada too)
  - Effect of standard cleaning and hand hygiene?
- Study conducted in 2 ICUs in the UK (Wilson et al, Crit care med 2011):
  - Reduction in recovery of MRSA from near patient surfaces BUT
  - No impact on patient acquisition of MRSA

Effect of enhanced cleaning on MRSA transmission (Dancer et al, 2009)

Additional cleaner led to reduction in microbial contamination of high-touch sites, and suggestion of reduction in HCAI MRSA (Dancer et al, BMC 2009)
Impact of GZ cleaning intervention

• When infrastructure is favorable and IPC program is functional (with screening, surveillance, isolation/cohorting etc) in place: shared patient care items (grey zones) are potential discrete reservoirs of infection

• Targeting GZ items cleaning can be cost-effective
  – VRE increases cost of hospitalization by 17,949$ /patient in Canada (Lloyd-Smith P et al, J Hosp Infect 2013)
  – Average salary for housekeeper: 35,000$

Cost effective if 1 housekeeper prevents 2 VRE acquisitions
Reduction from 60 to 30 VRE transmissions/year would lead to savings of 500,000$

Take home messages

• Environmental cleaning is critical for reducing healthcare associated infections.

• Few comparative studies have directly assessed the impact of different cleaning/disinfection strategies on actual patient outcomes

• Endemic (rather than clustered) transmission of healthcare pathogens, in institutions with multicomponent infection prevention strategies in place should prompt consideration of targeted extra-cleaning of clinical care items that are “non-critical” but high-touch

• Cross-over study design an alternative to randomized controlled trials to demonstrate impact and cost-benefit analysis

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Some references

- Guidelines for Environmental Infection Control in Health-Care Facilities, Recommendations of CDC and the Healthcare Infection Control
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Thank you!
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(FREE South Pacific Teleclass - Broadcast live from the 2017 AGIPC conference)
EVIDENCE CHALLENGES IN INFECTION PREVENTION AND CONTROL
Speaker: Prof. Frank Bowdon, Dr. Chong Ong, Emily Larsen, and Prof. Allen Cheng

Broadcast live from the 2017 conference of the Australasian College of Infection Prevention and Control

(European Teleclass)

THE ROLE OF RAPID DIAGNOSTICS IN PREVENTING HEALTHCARE INFECTION
Speaker: Dr. Hilary Humphreys, The Royal College of Surgeons in Ireland

BEYOND HIGH-TOUCH SURFACES, FLOORS, PORTABLE EQUIPMENT, AND OTHER POTENTIAL SOURCES OF HEALTHCARE INFECTION TRANSMISSION
Speaker: Prof. Curtis J. Donskey, Case Western Reserve University, Cleveland

(FREE Teleclass)

ENHANCED PERFORMANCE FEEDBACK AND PATIENT PARTICIPATION TO IMPROVE HAND HYGIENE COMPLIANCE
Speaker: Dr. Hugo Sax, University of Zurich Hospitals, and Dr. Andrew Stewardson, Hand Hygiene Australia

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