Cleaning and Disinfection Practices

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Overview: Cleaning & Disinfection of the Healthcare Environment

- What is “environmental cleaning and disinfection” anyway??
- Healthcare Environment is it a Reservoir?
  - “public” versus “patient-care” areas
- Cleaning monitoring:
  - UV marker
  - ATP
  - Bioburden
What is Environmental Cleaning Anyway?

- **Cleaning: detergent & physical action**
  Removal of debris, organic material (e.g., patient secretions) and microorganisms

- **Disinfection: killing action**
  Exposure to “agent” that kills microorganisms
  → chemical (liquid, vapor, gas)
  → UV light, steam

Health Care: Cleaning & Disinfection
(PIDAC 2009)

- **Non-patient care areas:**
  - cleaning

- **Patient-care areas:**
  - cleaning & disinfection
  - high-touch surfaces
  - frequency: risk stratification
  - compliance monitoring
Hospital grade Disinfectants:
(DIN from Health Canada)

- **Alcohols** (60-95% ethyl or isopropyl)
  - USE: some equipment;
  - no rinse needed

- **Chlorine**: 1:10 or 1:100 use-dilution
  - USE: Hydrotherapy equipment, blood spills
  - rinse needed for 1:10 use-dilution
  - toxic fumes → workplace safety issues
  - PPE needed

- **Phenolics** (not in nurseries or food contact surfaces)
  - USE: floors, walls, furnishing, IV poles
  - one-step commercial formulations

Hospital grade Disinfectants:
(DIN from Health Canada)

- **Quaternary Ammonium compounds** (QUATs®)
  - USE: floors, walls, furnishing
  - narrow microbicidal spectrum

- **Iodophors** (not antiseptic formulations)
  - USE: hydrotherapy tanks, hard surfaces, & equipment that doesn’t touch mucous membranes

Hospital grade Disinfectants:
(DIN from Health Canada)

- **Accelerated Hydrogen Peroxide** (AHP)
  - not antiseptic formulations

  - 0.5% (1:16 dil of 7% stock): some kill
    - USE: surfaces in patient rooms
    - No rinse needed

  - 0.5% (ready to use, TB claim): excellent kill
    - USE: surfaces in patient rooms
    - No rinse needed

  - 4.5% (ready to use, thickened): 
    - USE: toilet bowls, sinks, commodes ONLY
    - Rinse needed, PPE needed

  - 3% (ready to use): 
    - USE: floors, walls, furnishings
    - PPE needed
DISINFECTANT ISSUES:  
BEWARE!!!

- **Contact time:**  
  Liquid on a surface will dry in ~ 3 mins → must be re-applied if recommended contact time is longer than 3 mins

- **Rinse off residuals:**  
  Some disinfectants must be rinsed off after contact time due to irritation to patient skin (e.g. bleach 5000 ppm)

- **PPE:**  
  Some disinfectants require PPE

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Microfiber cloths for cleaning

- **Rutala et al 2007:**  
  - String mops not as effective as microfiber mops for microbial removal  
  - Microfiber effective without disinfectant

- **Moore et al 2006:**  
  - Microfiber cloths vary in efficiency  
  - Some microfiber cloths transfer organisms and re-contaminate surface during cleaning

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Newest Aid for Healthcare??

Along with hospital-issue gown patients will get microfiber slippers!!

Available in Safeway!!
The Healthcare Cleaning Dance:
Do you do the “watoosey” or the “two-step”??

Cleaning & Disinfection:
- **Two-step**: detergent to clean surface followed by application of disinfectant; no rinsing
- **One-step**: cleaning agent that also disinfects; no rinsing
- **Watoosey??**: detergent to clean surface followed by application of disinfectant; must be removed by rinsing

Other Novel Methods for Environment Disinfection:
- Fogging:
  - VHP,
  - Ozone gas,
  - super-oxidized water,
- UV irradiation:
- Steam:

Room Fogging: VHP vapour

Works → but rapidly re-contaminated (both MRSA and other bacteria)

Hardy K et al Rapid recontamination with MRSA of the environment of an intensive care unit after decontamination with hydrogen peroxide vapour. | Hosp Infect 2001;66:360-368

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Infection Transmission: Environmental role

“A culture report should not dictate the practice of Standard Precautions”
(Bartley et al 2008)

“A culture report should not dictate the practice of Hospital Cleaning/Disinfection”
(opinion: M. Alfa 2011)

Ensure ROUTINE cleaning/disinfection is done well →
the highest risk of transmission is just prior to the diagnosis of the patient having an ARO!

Healthcare Challenge: “Bum to Toilet Ratio”!!

- Shared toilets
  - Multiple patients in same room
  - Two rooms; one toilet

- Inadequate cleaning of one toilet facility may affect many patients!

VRE, MRSA, ESBLs, C. difficile, Acinetobacter spp

Improvements in cleaning; reduce all AROs!

HEALTHCARE ENVIRONMENT IS IT A RESERVOIR??
Is it Clean Enough???

Visual assessment: crude measure

NEED TO ENSURE SURFACES ARE CLEANED EVEN IF THEY DON'T LOOK VISIBLY DIRTY:
YOU CAN'T SEE THE MICROBES

Microbial survival on surfaces

**Prolonged survival when suspended in dust/organic debris of up to six months to a year has been reported (Dancer 2007, Hardy 2007)

Environmental detection: MRSA in Stool of patient with diarrhea

- Bedside rails: 100%
- Blood pressure cuff: 88%
- Television remote: 75%
- Bedside Table: 63%
- Toilets: 63%

If MRSA (+) but not in stool; ~ 30% environmental contamination

Do caregivers acquire MRSA from environment?

42% of 12 nurses contaminated gloves with MRSA by touching objects in room of patients with MRSA in wound or urine

**WITHOUT ANY PATIENT CONTACT!**

Boyce J. Environmental contamination makes an important contribution to hospital infection. J Hosp Infect 2007;65:50-54.

Evidence of Infection Transmission

**MRSA:**
- Patients in ICU who acquired MRSA had same strain as found in the ICU environment (Hardy et al. Infect Control Hosp Epidemiol 2006)

**MRSA & VRE:**
- Patients admitted to room previously occupied by patient with MRSA or VRE have significantly higher risk of acquiring these AROs (Drees et al. Clin Infect Dis 2008, Huang et al. Arch Int Med 2006)

How to Break the Chain of Transmission?

**ENSURE:**
- Environmental cleaning/disinfection
- Hand hygiene

**Sounds Easy!! Why isn’t it working??**
Efficacy of Bleach (5,000 ppm) in presence of organic material

[killing of C. difficile spores]

The Physical Action of Cleaning is critical NO MATTER WHAT AGENT is used for cleaning/disinfecting

Monitoring Cleaning Compliance

- **Quality Program:**
  - audit cleaning compliance
  - provide weekly feedback to staff
  - part of yearly performance appraisal

Audit: Cleaning Compliance

1. **UV Marker:** [shows surface was wiped]
   - Carling et al 2008: 49% of surfaces clean after "terminal cleaning"
   - Alfa et al 2008: 20 – 50% of toilets clean after routine cleaning
   - Carling et al 2008: 57.1% ICU surfaces clean after patient discharge
   - Alfa et al 2010: UVM useful to assess clinical cleaning intervention

2. **ATP:** [measure of organic & microbe level]
   - Cooper et al 2007: < 500 RLU/cm²
   - Griffith et al 2007: 0 – 14% of surfaces “clean” after routine cleaning
   - Mulvey et al 2011: environment cleaning < 100 RLU/cm²

3. **Viable count:** [measure of microbe level]
   - Dancer et al 2004: < 5 cfu/cm²
   - Griffith et al 2007: 50 – 90% of surfaces “clean” after routine cleaning

Audit tools; recommended by PIDAC
Environmental Cleaning: UV Marker

- Visibly Clean: NOT ADEQUATE
- UV marker to audit cleaning

UV Marker Audit

- Staff aware of study but do not get any feedback
- Dedicated ward staff pulled for discharge cleaning
- Cleaning compliance person specific
- Visibly clean may be thought to not need cleaning
- Visitors disrupt ability to clean room

UV Marker Audits: Impact of Feedback on Compliance

- New Staff Training: Ensure Trainers meet compliance targets

Data from Adriana Tratjman's M.Sc. thesis
Use of Oxivir<sub>TB</sub> (Accelerated Hydrogen Peroxide) as a bleach alternative

**Graph:**
- Arm 1: 50 patients, 133 samples, CDAD, twice daily cleaning, Oxivir<sub>TB</sub>
- Arm 2: 68 patients, 254 samples, CDAD, twice daily cleaning, PerDiem
- Arm 3: 68 patients, 179 samples, Diarrhea, once daily cleaning, PerDiem

**ATP monitoring of Environmental Cleaning**
- ATP is present in living cells: both human and bacterial cells
- ATP measured by assay that detects “relative light units” or RLUs

**ATP Assay**
- Is **not a linear correlation** with microbial numbers (~10<sup>3</sup> cfu/sample to be detected)
- Reflects total human cellular and bacterial cellular residuals
- Protein, carbohydrate in pure form (i.e. not in a living cell) will NOT show any RLUs when tested by the ATP assay.
- Rapid test

**Human White cell**
- Low level of RLUs

**Bacteria**
- High level of RLUs
**ATP Monitoring of Healthcare Environmental surfaces**

**Validation for Healthcare?**
- what RLU to target?
  - < 500 RLUs/cm², < 100 RLUs/cm²

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**ATP Benchmark: Hospital clean**

- [Mulvey et al 2011 J Hosp Infect]
- Detergent based cleaning: reduced ATP by 32%
- Cleaning did not always eliminate MRSA or MSSA
- Limited correlation between cfu/cm² and ATP level
- Recommended 100 RLU as benchmark for adequate cleaning [Hygiena ATP assay]
- After cleaning with detergent 22% of high touch sites failed [i.e. >100 RLU]

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**Environmental Monitoring**

- UV Marker reliably shows if surface wiped; inexpensive, easy to do
- ATP reflects viable organisms and patient secretions; easy to do, validation for appropriate healthcare benchmark still needs to be established

Use validated cutoff (manufacturer recommended or literature)
Establish accepted % compliance e.g. 90%
Baseline of ~ 1 month with feedback: develop action plan if <90%
Agent used for cleaning & disinfection

- PIDAC: recommends routine cleaning & disinfection of high risk health care areas [frequency based on risk-assessment]
- Detergents (many) at their use-dilution and usual contact times have little to no microbial killing ability
- Transfer/recontamination of surfaces during cleaning is reduced if agent has killing ability
- **Focus on optimizing routine cleaning: risk highest is prior to implementation of isolation precautions**

Environmental cleaning:

- Re-contamination from patient etc occurs rapidly; need ongoing & effective environmental cleaning process
- Whatever product used → **AUDIT** to ensure cleaning is done properly
- Focus cleaning on “High-touch” areas for greatest impact in reducing spread of AROs

**BATTLEFRONT: INFECTION**

**HOUSEKEEPING IS THE FRONT LINE IN THE “BATTLE OF THE BUGS”!**

**BE SURE YOU HAVE OPTIMIZED YOUR DEFENCES!**

**TRAINING**

**OPTIMAL KILLING AGENT**

**FEEDBACK ON COMPLIANCE**
References