**Clostridium difficile**: Environmental Survival

Dr. Michelle Alfa, St. Boniface Hospital, Winnipeg

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**Overview:**
- Clostridium difficile; characteristics
- Infection; issues related to hospital transmission
- What is known regarding environmental survival
- What interventions have been tried

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**Clostridium difficile: Environmental survival**

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**C. difficile: Vegetative vs Spore**

Vegetative form: metabolically active
- Produces Toxin A & B (? Other)
- Killed by some antibiotics only
- Oxygen exposure kills

Spores: not metabolically active
- No Toxin production,
- Not affected by antibiotics
- Oxygen exposure doesn’t kill

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**Clinical Disease due to C. difficile**

  - overall: 22.5 cases/1000 admissions attributable mortality of 6.9%
  - >90yrs: 74.4 cases/1000 admissions attributable mortality of 14%
- USA: incidence: (Sohn et al ICHE 2005;26:676)
  - range: 3.1-13.1/1000 admissions

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**C. difficile infections: Issues related to hospital transmission**

1. Fecal shedding
   - diarrhea
   - asymptomatic carrier
2. Toilet facilities
   - commodes
   - shared toilets
3. Medical devices in contact with GI tract of CDAD patients
   (e.g. flexible endoscopes)
4. Hands of caregivers

Spores most important for long-term survival in environment

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**Published Data: *C. difficile* in Healthcare Environment**

- Bedpans; 25.9%, Toilet seats; 33.3%  
  (Kim et al 1981 JID 143:42-50)
- Side rooms; 35%  
  (Verity et al J Hosp Infect 2001;49:204-209)
- Commodes, Toilet floor 60 – 90%  
- Commodes, toilet floor 35%  
  (Fawley & Wilcox Epidemiol Infect 2001;126:343-350)

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**Fecal Shedding by patient:**

Rodac plate containing CDMN media to sample surface

Toxigenic *C. difficile* in toilets 1st week of enrolment:

CDAD: 12/16 (75%)
Diarrhea, no CDAD: 0/10 (0%)

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**Clostridium difficile** is definitely in the toilet facility of patients with CDAD

- Source of spores for other patients
- Source of hand-contamination of caregivers
- Can we reduce the levels in the patient environment by cleaning??

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**Cleaning: Whose job is it anyway??**

- Toilets; Housekeeping staff
  - 1/day routine
  - 2/day for CDAD
- Commodes;
  - no one designated as responsible
- Commodes may not be cleaned if no one responsible

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**CDAD Isolation Precautions**

- How are isolation precautions implemented?
- Who decides when to stop isolation precautions?
- Shared Toilet facilities
- How compliant are cleaning staff with following the protocol?

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**Cleaning assessed using “water soluble UV visible mark”**

100% (+++)
50% (++)
10% (+)
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**Efficacy of Cleaning for Patients on Isolation Precautions:**

<table>
<thead>
<tr>
<th>Conditions:</th>
<th>% Toilets Clean*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation: signoff to document cleaning (9 patients over duration of hospitalization)</td>
<td>64.7</td>
</tr>
<tr>
<td>Isolation: routine cleaning (7 patients over duration of hospitalization)</td>
<td>56.5</td>
</tr>
<tr>
<td>No Isolation: routine cleaning (10 patients over duration of hospitalization)</td>
<td>72.9</td>
</tr>
</tbody>
</table>

* Marker removed to ≤ 10% considered “clean”

**Environmental survival**

- Environmental persistence of spores may be due to sub-optimal cleaning (Fawley and Wilcox Epidemiol Infect 2001;126:343)
- Once the hospital environment becomes contaminated, it is very difficult to render *C. difficile* free (Verity et al J Hosp Infect 2001;49:204)
- Oh yes… What about bleach???

**Effect of Detergent versus Bleach (1000 ppm) for cleaning environments**
(Wilcox et al J Hosp Infect 2003;54:109-114)

- Data from environmental cultures do not support the conclusion that bleach can reduce incidence of CDAD compared to detergent (Dettenkofer et al letter to editor)

**Perasafe vs Bleach; Surface killing of *C. difficile* spores**

- Bleach at 1:10 dilution not effective in 10 minutes
- Perasafe; peracetic acid 0.26%, (H₂O₂, & acetic acid)

**Medical devices**

- GI tract: endoscopy
- High level disinfection does not kill high loads of spores
- Glutaraldehyde 2%, Peracetic acid, OPA
- No documented cases of *C. difficile* infection due to transmission via GI endoscopy

**Oxidizing agents: Surface killing of *C. difficile***

- 7% HP
- Bleach 5000ppm
- Bleach 1000ppm

- Time to 6 Log10 RF


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**The Toilet Environment**

- Wilcox and Fawley (Lancet 2000;356:1324)
- Suboptimal concentrations of some detergents (eg quats, monoethanolamine) stimulated spore formation in *C. difficile* in stool
- Toilet bowl brushes/mops???!!

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**Hands of caregivers**

- *C. difficile*, detected on hands of caregivers
- Spores stored in alcohol!!!
- Hand hygiene: waterless agents
- Soap & water, not alcohol based agents recommended for hand hygiene for care givers for patients on CDAD isolation precautions

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**TAKE-HOME MESSAGES:**

- *C. difficile* spores are in environment of CDAD patients
- Role of *C. difficile* environmental spores in disease transmission not clear
- Cannot assess role of environmental interventions without monitoring compliance with cleaning
- Bleach; not the solution
- 7% Hydrogen peroxide cannot be used for surface environmental cleaning/disinfection (it is an HLD)
- Focus on getting efficient cleaning compliance

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**Research Group**

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