Hotel Microbiology

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Today’s Topics

- Organisms associated with outbreaks in hotels
- Importance of fomites in spread of pathogens
- Norovirus outbreaks in hotels: case examples involving fomites
- Bacterial hotspots in hotels
- Movement of virus in a hotel
- Impact of interventions on virus spread
Results

- Virus detected
  - Next four rooms cleaned by the maid
  - On surfaces (table tops) in the conference room
  - On 1/3 of the conference attendees hands
  - On the coffee pot handle of the breakfast area

Why Hotels?

- Large number of persons in one place
- Number of persons change daily
- Persons come from different regions all over the world
- Exposure occurs over days/weeks
- Major cost to hotels (closure, clean-up, lost business)
- Challenging in terms of infection control
Vehicles of Exposure (Hotel Outbreaks)

- Food
- Food Handlers
- Water (aerosols)
- Fomites
- Swimming pools
- Hot tubs
- Lobby Water Fountains
- Air conditioning systems

Organisms Most Commonly Associated with Documented Outbreaks in Hotels

Legionella

Norovirus
The Curse of the Cruise Ships

- Floating hotels (have to report outbreaks of norovirus)
- >50 outbreaks of norovirus
- One documented outbreak of influenza on a long cruise

The Gamblers Grunts

- Channel 10 News, Ashville
- Jan. 20, 2010

- Workers at Harrah’s Casino in Cherokee are battling a virus that’s sickened nearly 250 people.
- A cleaning crew is wiping down more than 3,000 slot machines with a bleach and water mix. Door knobs, escalator handrails and restrooms are also sanitized hourly.
What are Fomites?

- Inanimate objects involved in the spread of disease

Role of fomites in transmission of a disease

- Pathogen falls on fomites e.g. phone, computer
- Person picks up pathogen through contaminated fomite.
- Person touches nose or eyes with contaminated fingers and becomes infected with pathogen.
- Sick person sneezes, coughs and pathogens falls on fomite or get aerosolized.
Hand Contact in Adults

- Adults touch their face 15.5 times per hour
  - 2.5 eyes
  - 5 nose
  - 8 lip

Transfer of Microbial Tracer from the Office to Home
How Efficient is Transfer?
(Lopez et al, 2009)

- Type of suspending media
  - Greater transfer when suspended in feces than phosphate buffered saline
- Hand/object contact
  - Type of interaction with object (i.e. doorknob vs. push button)
  - Finger vs. hand

Fomites – not all the same

- Acrylic
- Ceramic tile
- Glass
- Stainless steel
- Formica
Hotel Outbreaks – Case Examples

Houseboats

- Same houseboats rented to elder hostel group
- Rented to three different groups over a month
- Groups had no contact
- Norovirus outbreaks occurred on all groups
## Norovirus – Houseboat Outbreak

![Bar graph showing the number of cases by date.]

## Detection of Norovirus on Houseboat Fomites

<table>
<thead>
<tr>
<th>norovirus RT-PCR swab sample results (n=20) by surface type and boat number.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boat number</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td><strong>Total percent Positive</strong></td>
</tr>
</tbody>
</table>

*ns, not sampled.*
Prolonged Outbreak of Norovirus in a Hotel

- Outbreak of norovirus over a six month period

- Fomites positive for norovirus
  - Carpet (recent vomit) - 62%
  - Carpet (no vomit) - 75%
  - Toilet hands, taps, basins - 39%
  - Phones, door handles - 24%
  - Cushions, curtains - 20%

Outbreak of Norovirus Associated with Environmental Contamination in a Hotel

- Outbreak began on two widely spread floors after vomiting incidences

- The infection among guests spread widely on the two floors after cleaning by staff.
Bacterial Hotel Hot Spots

Hotel Study - Tucson, AZ

Numbers of Different Bacteria Found on Hotel Bathroom Surfaces

<table>
<thead>
<tr>
<th>Colony Forming Units/Plate</th>
<th>Pseudomonas sp.</th>
<th>Staphylococcus sp.</th>
<th>Total Coliform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathroom Floor</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Bathtub Surface</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Toilet Tank Surface</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Sink Counter</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
Hotel Study -Tucson, AZ

Total Bacterial Numbers Found in Bathrooms of Different Hotel Groups

<table>
<thead>
<tr>
<th>Location</th>
<th>Colony Forming Units/Plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathroom Floor</td>
<td>80</td>
</tr>
<tr>
<td>Bathtub</td>
<td>120</td>
</tr>
<tr>
<td>Toilet Tank</td>
<td>180</td>
</tr>
<tr>
<td>Sink Counter</td>
<td>60</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>20</td>
</tr>
</tbody>
</table>

Group A: $50-$90
Group B: $20-$40

TV Remote Controls*

<table>
<thead>
<tr>
<th>Total Bacteria</th>
<th>Coliforms</th>
<th>E. coli</th>
<th>Semen</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,500 to 430,000 Colony forming units</td>
<td>37.5%</td>
<td>12.5%</td>
<td>18.2%</td>
</tr>
</tbody>
</table>

16 tested for bacteria and 11 for semen
MRSA detected on one remote
Impact of Wiping Table Top in Restaurants with Cleaning Cloths in Hotels

FIGURE 3. Bacteria found on tabletops before and after cleaning in restaurants
What’s on Your Coffee Cup Lid?

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total Bacteria/Coliform Identifications</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>820</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>550</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>&lt;10</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>430</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>&lt;10</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>8</td>
<td>330</td>
<td>23</td>
</tr>
<tr>
<td>9</td>
<td>6.70E+05 Serratia spp</td>
<td>24</td>
</tr>
<tr>
<td>10</td>
<td>&lt;10</td>
<td>25</td>
</tr>
<tr>
<td>11</td>
<td>650</td>
<td>26</td>
</tr>
<tr>
<td>12</td>
<td>2.60E+03 Serratia spp</td>
<td>27</td>
</tr>
<tr>
<td>13</td>
<td>2.50E+03 E. coli</td>
<td>28</td>
</tr>
<tr>
<td>14</td>
<td>&lt;10</td>
<td>29</td>
</tr>
<tr>
<td>15</td>
<td>1.80E+03</td>
<td>30</td>
</tr>
</tbody>
</table>

Hotel Intervention Study

- How does a virus spread in a hotel?
- What is the role of cleaning in the spread of viruses?
- Do disinfectants and hand hygiene make a difference in the spread of virus?

Sifuentes et al., 2014. Use of hygiene protocols to control the spread of viruses in a hotel.
The Virus
Bacteriophage MS-2
- ~23 nm in diameter
- single stranded RNA
- no lipid layer
- inactivated by 99.99% by hand sanitizer
- similar in shape and size to the cold virus (rhinovirus)
- commonly used as a model for disinfectant testing

Methods
- **Contamination Sites**
  - Guest Room
    - outside door handle, one bedroom, and bathroom faucet
      - Morning while participants were attending a meeting in the conference center
Methods

- Conference Center
  - MS-2 was used to contaminate outside door handle and the kitchen faucet handle
    - Before the start of the morning meetings.
  - 8 Guests participated in study per overnight stay
  - All evaluations run on three separate overnight stays

Hotel

Hotel Suite
4 Bedrooms with Bath
Shared Bathroom
Shared Living Room
Shared Kitchen
2 Guests per Room

Bedroom, bath, and entrance door contaminated (in red)
## Conference Center

- Meeting Room
- Downstairs Bathroom
- Upstairs Bathroom
- Shared Kitchen
- 8 Hotel Guests plus Additional Attendees

MS-2 was used to contaminate entrance door handle and kitchen faucet handle (in red)

## Sampling Sites

<table>
<thead>
<tr>
<th>Hotel Room</th>
<th>Shared Kitchen in Room</th>
<th>Conference Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk 1 (Wood)</td>
<td>Kitchen Faucet (Chrome)</td>
<td>Chair 1 (Wood)</td>
</tr>
<tr>
<td>Chair 1 (Wood)</td>
<td>Kitchen Counter (Laminate)</td>
<td>Conference Table (Wood)</td>
</tr>
<tr>
<td>Desk 2 (Wood)</td>
<td>Refrigerator Handle (Plastic)</td>
<td>Top of Coffee Pot (Plastic)</td>
</tr>
<tr>
<td>Chair 2 (Wood)</td>
<td>Kitchen Light Switch (Plastic)</td>
<td>Light Switch (Plastic)</td>
</tr>
<tr>
<td>Outside Bedroom Door Handle (Stainless Steel)</td>
<td></td>
<td>Downstairs Bathroom Light Switch (Plastic)</td>
</tr>
<tr>
<td>Outside Bathroom Door Handle (Stainless Steel)</td>
<td></td>
<td>Downstairs Bathroom Faucet and Handle (Chrome)</td>
</tr>
<tr>
<td>Bathroom Faucet and Handle (Chrome)</td>
<td></td>
<td>Faucet Handle (Kitchenette) (Chrome)</td>
</tr>
<tr>
<td>Bathroom Counter (Laminate)</td>
<td></td>
<td>Refrigerator Handle (Plastic)</td>
</tr>
<tr>
<td>Toilet Handle (Chrome)</td>
<td></td>
<td>Upstairs Bathroom Counter (Laminate)</td>
</tr>
<tr>
<td>Shower Handle (Chrome)</td>
<td></td>
<td>Upstairs Bathroom Faucet (Chrome)</td>
</tr>
<tr>
<td>Bathroom Light Switch (Plastic)</td>
<td></td>
<td>Bathroom Light Switch (Plastic)</td>
</tr>
</tbody>
</table>
Virus Spread between Hotel Rooms

- Add MS-2 virus added to one person's hand or bathroom counter top
- Sample next series of rooms after maids clean and conference room at end of day tested for virus
- Conference attendees hands

Results

- Virus detected
  - Next four rooms cleaned by the maid
  - On surfaces (table tops) in the conference room
  - On 1/3 of the conference attendees hands
  - On the coffee pot handle of the breakfast area
Intervention

- Provide maids with antimicrobial products and disinfectant wipes for key surfaces
- Provide attendees with hand sanitizers
- Hand sanitizer
Effectiveness of Intervention Products Against MS-2 Virus

- Hand Sanitizer = 74.5% reduction of virus on the hands
- Disinfecting wipe = 50% reduction of virus on fomites

Interventions

- **Sanitizer Stands (alcohol gel hand sanitizer)**
  - Placed in the Conference Room, Common Area of Rooms, Café, Lobby.

- **Inhale Trays**
  - Contained Kleenex Cool Touch tissue, Kleenex Hand and Face moist wipes, and Kleenex sanitizer packets. Two trays were placed in the conference room, 1 in each room, 1 on lobby/check-in desk.
Interventions

- **Kleenex Disposable Hand Towels**
  - Bathrooms used reusable washcloths to dry hands, replaced with Kleenex Disposable hand towels.

- **Disinfecting wipes**
  - Disinfecting wipes provided to cleaning crew and disinfectant spray

Results

- Reduced virus detected on fomites in guest rooms by 90%
- Reduced virus on hands of guests by 50%
Findings Summary

Intervention reduced
• the occurrence of viruses in a hotel
• the occurrence of viruses in common areas of hotel
• the occurrence of viruses in guest rooms
• the amount of viruses on fomites
• the movement (spread) of viruses throughout a hotel
• the movement (spread) of viruses from rooms to common areas
• the movement (spread) of viruses from common areas to rooms
• the probability of infection from viruses which cause respiratory infection (Rhinovirus and Influenza) and diarrhea (Norovirus)

Findings Summary

• Viruses can spread in a hotel
• Housekeeping practices can spread viruses between guest rooms
• Hotel guests can spread viruses from their room to common areas (conference center, shared kitchen) of the hotel
• Hotel guests can spread viruses from common areas (conference center, shared kitchen) to guest rooms
Summary

- Hotels are ideal environments for the rapid spread of certain infectious agents
- Fomites and cleaning disinfecting procedures play a role in the transmission of enteric and respiratory viruses
- Better defined cleaning tools and cleaning/disinfecting protocols are needed
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