The Role of Fomites in the Transmission of Disease in Public Environments

Prof. Charles Gerba, University of Arizona

Teleclass Sponsored by Virox Technologies Inc. (www.virox.com)

The Role of Fomites in the Transmission of Disease in Public Environments

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Hosted by Bruce Gamage
Provincial Infection Control Network of British Columbia

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Did you know??

- 80% of all common infections (colds, flu, diarrhea) can be spread through the environment (air, water, food, fomites)

What are Fomites?

- Inanimate objects i.e. desk tables, door knobs, pencils, toilet seats involved in disease transmission

Role of fomites in transmission of a disease

- Sick person sneezes or coughs and pathogen falls on surface or gets aerosolized.
- Person touches nose or eyes with contaminated fingers and becomes infected with pathogen.
- Person picks up pathogen through contaminated fomites.
- Pathogen falls on fomites e.g. phone, computer.

Mouthing Events in Children (per hour)

- 81 times under two years
- 42 times two thru five years
- A child swallows the about of dirt on six kitchen floor tiles per day

Hand Contact in Adults

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

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Transfer of Microbial Tracer from the Office to Home

Life in the 21st Century
- Most of our time is spend indoors
- More people work in offices than ever before
- We travel more than ever before
- We spend more time in public places
- We are more mobile and have more electronic equipment (e.g. cell phones, ipods)
- We share more common surfaces (fomites) with more people than ever before in history

Bringing More People together in the 21st Century in One Place
- Emergency situations
  - Housing
  - Medical care
  - transport
- Cruise ships
- Sporting events
- Recreational/Holiday groups
  - Houseboats
  - Rafting trips

Identifying Critical Control Points
Home/Work/Play/Shopping

Let’s go to Work

Bus Travel increases Risk of Respiratory Infections
- The more you ride a bus the more likely you will get a cold (6 times more likely)
- Troko et al 2011 BMC Infectious Diseases

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<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Bacteria per 100 sq. cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commuter Train</td>
<td>117,000</td>
</tr>
<tr>
<td>Bus</td>
<td>83,178</td>
</tr>
<tr>
<td>Airplane</td>
<td>3,127</td>
</tr>
<tr>
<td>Family Car</td>
<td>5,220</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>186</td>
</tr>
</tbody>
</table>

Coliform Bacteria/ E. coli
➢ 70% of surfaces in buses tested included E. coli
➢ 6% of toilet seats have coliforms and E. coli

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Parainfluenza on Office Fomites Fall 2004

Percentage of Fomites Positive for Parainfluenza

Teaching: The “Germiest” Profession?

The most bacteria per square inch was found on surfaces commonly used by school teachers.

Let’s Go to School

School Study (Grade K thru 12)- 2009

Day Care Study Results

Impact of Disinfectant Wipes on Absenteeism

Study
- Two school semesters
- 3rd and 4th graders

Intervention
- Children’s desk wiped with a disinfectant wipe at the end of each school day

Results
- 50% reduction in absenteeism

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Let’s go Shopping

E. coli Isolation from Shopping Carts
- Maine 80%
- Atlanta 79%
- Chicago 70%
- Tucson 0%
- Los Angeles 10%

- Recent study has associated Salmonella and Campylobacter infections in children and placement in shopping carts

Touch Screens
- Bacteria isolated from self checkout screens in grocery stores
  - E.coli
  - MRSA
  - Clostridium

Viruses Isolated from School Desks Grades 3-4
- Most common viruses isolated on classroom desks
  - Influenza
  - Norovirus
  - Parainfluenza

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Coliform Bacteria in Reusable Grocery Shopping Bags

Figure 7. Cleaned on a Regular Basis?

Let's Travel

Total Bacterial Numbers Found in Bathrooms of Different Hotel Groups

Airplane Trays

Everybody uses the toilet

➤ MRSA – positive on four different flights
➤ Norovirus isolated on one flight

➤ Average residence time in the aircraft restroom for adults
➤ Men
  • 106 seconds
➤ Women
  • 154 seconds

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Microorganisms Associated with Outbreaks in Public Toilets
- Shigella – Diarrhea
- Salmonella – Diarrhea
- Hepatitis A virus – Liver Disease
- Norovirus – Vomiting and Diarrhea

<table>
<thead>
<tr>
<th>Location</th>
<th>Coliforms</th>
<th>E. coli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport</td>
<td>23.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Fast Food Restaurants</td>
<td>21.9</td>
<td>1.5</td>
</tr>
<tr>
<td>Hospitals (Public Areas)</td>
<td>17.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Overall</td>
<td>20.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Aerosols are Produced during Toilet Flushing
- Fecal bacteria and viruses are ejected from the toilet during flushing.
- The droplets settle out in the restroom contaminating the restroom with fecal microorganisms

Salmonella Isolation
- Sink drain: 67%
- Sink handles: 33%

Presence of Total Coliforms and E. coli Relative to Number of Stalls

<table>
<thead>
<tr>
<th></th>
<th>1 stall/urinal</th>
<th>2 stalls/urinals</th>
<th>3 stalls/urinals</th>
<th>4+ stalls/urinals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total coliforms</td>
<td>31.5%</td>
<td>13.1%</td>
<td>18.6%</td>
<td>20.9%</td>
</tr>
<tr>
<td>E. coli</td>
<td>5.2%</td>
<td>2.0%</td>
<td>1.9%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

Coliform and E. coli in Public Restrooms
- Female restrooms were significantly more contaminated than men’s restrooms
- The middle stall was more contaminated
- Airports were the most contaminated and hospitals the least

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Study Findings

<table>
<thead>
<tr>
<th>Total Number of Open Refillable Soap Samples</th>
<th>Number of Samples with Bacteria</th>
<th>Number of Samples with Coliforms (usually &gt; 1,000,000/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>541</td>
<td>133 (25%)</td>
<td>87 (16%)</td>
</tr>
</tbody>
</table>

Occurrence of MRSA in the Community

- Cars (2% of all sites tested)
  - Steering wheel
  - Car seat
- Offices (2%)
- Phones
- Fire houses
  - Living quarters (~25%)
- Homes with infected individual (30%)
- Phone
- Make-up kit
- TV remote
- Hair brushes (50%)

No bacterial contamination was found in soap dispensed from sealed systems

So Why Aren’t we Sick all the Time?
- It’s rare about probabilities
- The odds of the right series of events happening to result in an illness
- The more contaminated surfaces you touch the greater the odds you will become infected
- The game is to keep the odds in your favor

Reducing Risk of Infection from Fomites

- Hand washing
  - 30 to 50% reduction in illness
- Alcohol gel sanitizers
  - 30 to 50% reduction in absenteeism
- Disinfection of fomite surfaces
  - 50% reduction in absenteeism in schools
- Use of bleach and hot water in laundering
  - Reduces risk of transmission

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7 February 12 (British Teleclass) Surgical Site Infections – Advancing the Prevention Agenda
Speaker: Prof. Judith Tanner, De Montfort University, Leicester, UK

8 February 12 (FREE ... WHO Teleclass) Behavioural Change in Infection Prevention and Control
Speaker: Prof. Andreas Voss, Nimjen University, Netherlands

15 February 12 (South Pacific Teleclass) Outbreak of Vaccine-Preventable Diseases – Communicating the Science and Closing the Gaps
Speaker: Dr. Nikki Turner, University of Auckland, New Zealand

23 February 12 The Biofilm Hypothesis of Chronic Infection
Speaker: Dr. Phillip Stewart, Center for Biofilm Engineering, University of Montana

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