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
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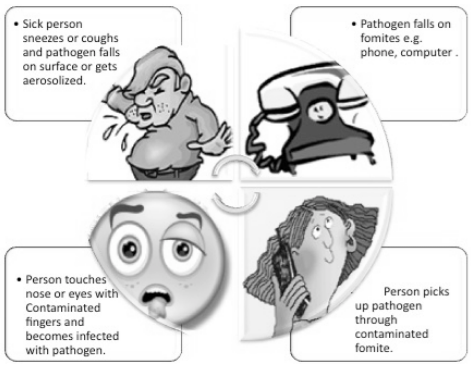
Did you know??

- 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



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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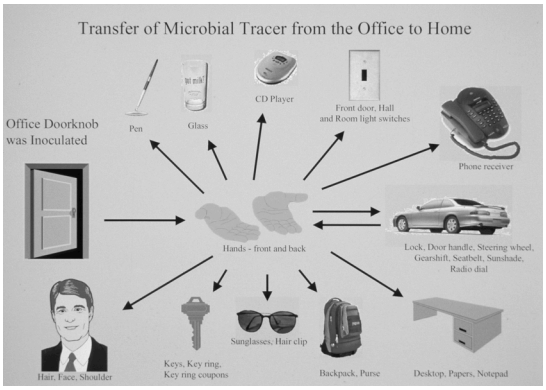

Life in the 21st Century

- 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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Vehicle	*Bacteria per 100 sq. cm.*
Commuter Train	117,000
Bus	83,176
Airplane	3,127
Family Car	5,220
Toilet Seat	186

Coliform Bacteria/ E. coli

- **70% of surfaces in buses tested included E. coli**
- **6% of toilet seats have coliforms and E. coli**

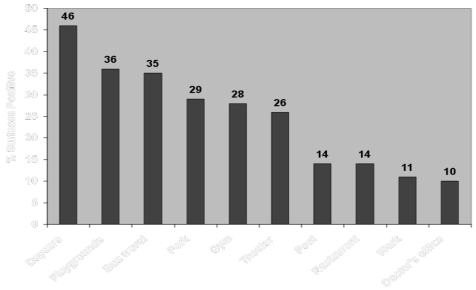
	Left Shoe	Right Shoe
1	1,000 66,000,000	110 61,000,000
2	400 68,000,000	10 27,000,000
3	10 23,000,000	20 11,000,000
4	240 27,000,000	90 17,000,000
5	140 21,000,000	30 4,200,000
6	100 15,000,000	640 2,600,000

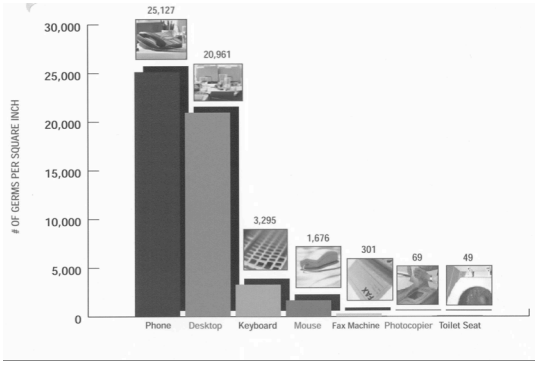
Bacteria (10^5)

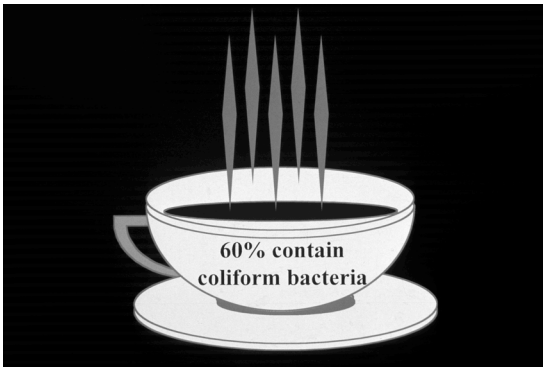
Virus (10^7)

Movement of organisms on shoes during walking – keeping in step with you

Environments Most Contaminated With Body Fluids







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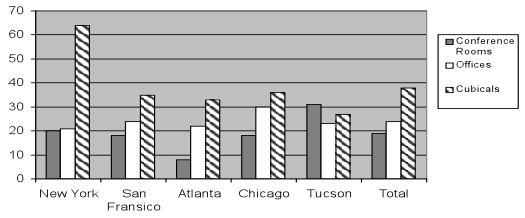
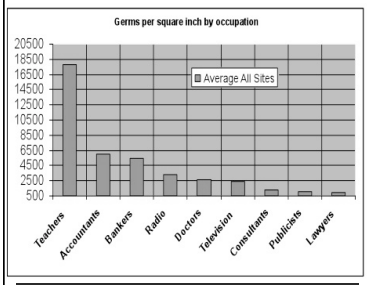
Parainfluenza on Office Fomites Fall 2004



Teaching: The "Germiest" Profession?

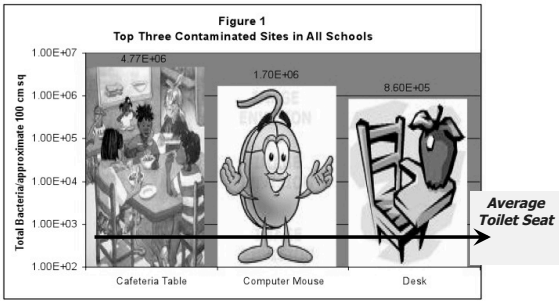


- The most bacteria per square inch was found on surfaces commonly used by school teachers

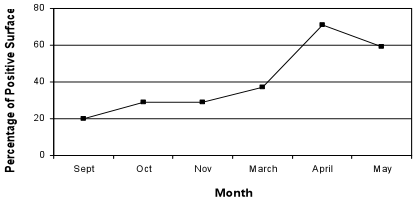
Measures taken of the phone, desk and computer mouse.

Let's Go to School

School Study (Grade K thru 12)- 2009



Day Care Study Results



- Samples positive in daycare for influenza A by month.

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

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

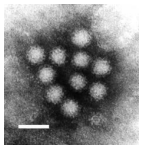
Touch Screens

- Bacteria isolated from self checkout screens in grocery stores

- E.coli
- MRSA
- Clostridium

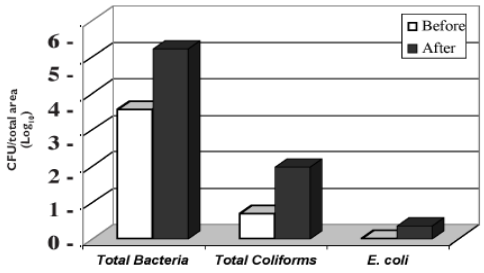
Viruses Isolated from School Desks Grades 3-4

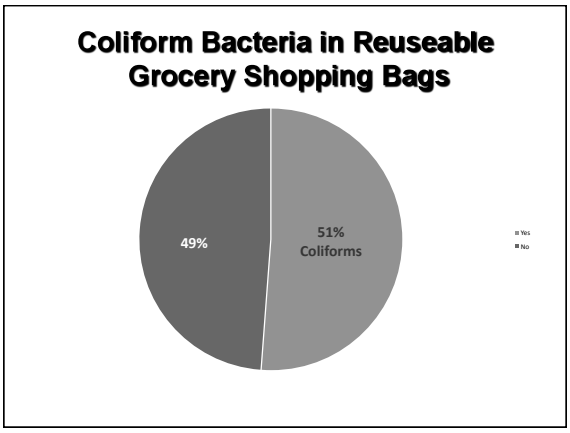
- Most common viruses isolated on classroom desks
  - Influenza
  - Norovirus
  - Parainfluenza

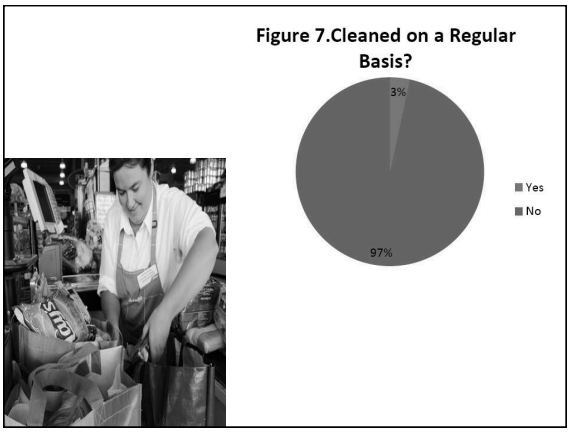


Impact of Wiping Table Top in Restaurants with Cleaning Cloths

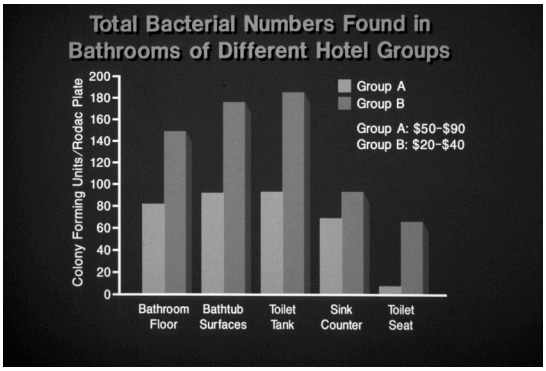
FIGURE 3. Bacteria found on tabletops before and after cleaning in restaurants



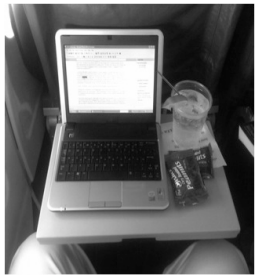




Let's Travel



Airplane Trays



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

Everybody uses the toilet

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

Microorganisms Associated with Outbreaks in Public Toilets

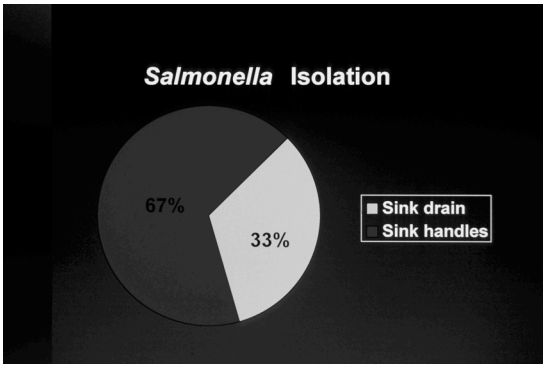
- ***Shigella*** **– Diarrhea**
- ***Salmonella*** **– Diarrhea**
- ***Hepatitis A virus*** **– Liver Disease**
- ***Norovirus*** **– Vomiting and Diarrhea**

Coliform and *E. coli* Isolation from Public Restrooms (% of surfaces positive)

Location	Coliforms	*E. coli*
Airports	23.8	5.6
Fast Food Restaurants	21.9	1.5
Hospitals (Public Areas)	17.3	2.0
Overall	20.7	3.1

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



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

	1 stall/ urinal	2 stalls/ urinals	3 stalls/ urinals	4+ stalls/ urinals
Total coliforms	31.5%	13.1%	18.6%	20.9%
E. coli	5.2%	2.0%	1.9%	5.0%

Coliform and *E.coli* in Public Restrooms

- Female restrooms were significantly more contaminated that men's restrooms
- The middle stall was more contaminated
- Airports were the most contaminated and hospitals the least

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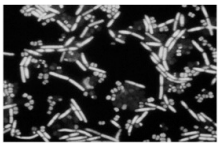
- **Determine occurrence and identification of bacteria in open refillable (bulk) soap dispensers in public facilities**
- **Microbial contamination of soap has been linked to infections and outbreaks in hospitals**

Study Findings

Total Number of Open Refillable Soap Samples	Number of Samples with Bacteria	Number of Samples with Coliforms (usually > 1,000,000/mL)
541	133 (25%)	87 (16%)



No bacterial contamination was found in soap dispensed from sealed systems

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%)

So Why Aren't we Sick all the Time?

- **It's are about probabilities**
- **The odds of the right series of events happing 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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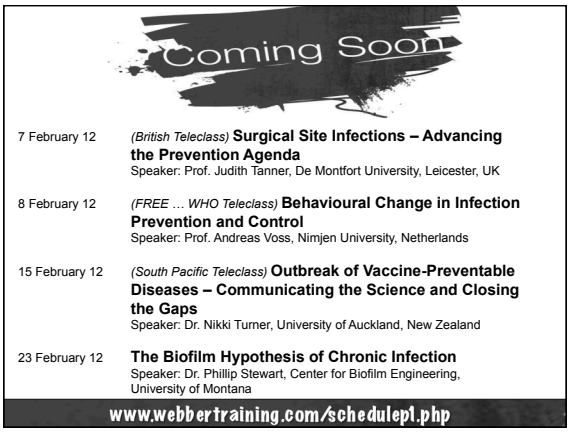

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