



The Hand is Quicker Than a Sneeze in the Spread of Disease
Prof. Chuck Gerba, University of Arizona
 Teleclass broadcast sponsored by GOJO (www.gojo.com)


**The Hand is Quicker Than a Sneeze
in the Spread of Disease**

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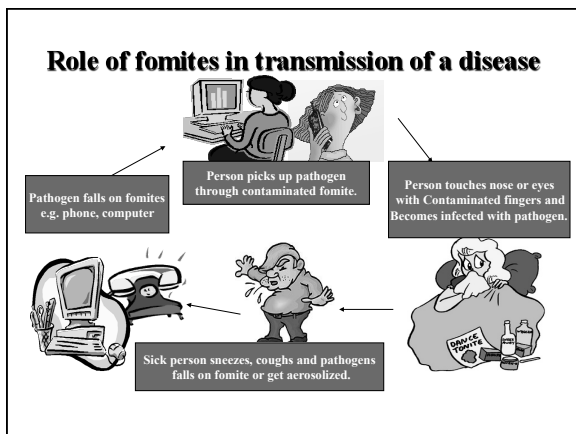
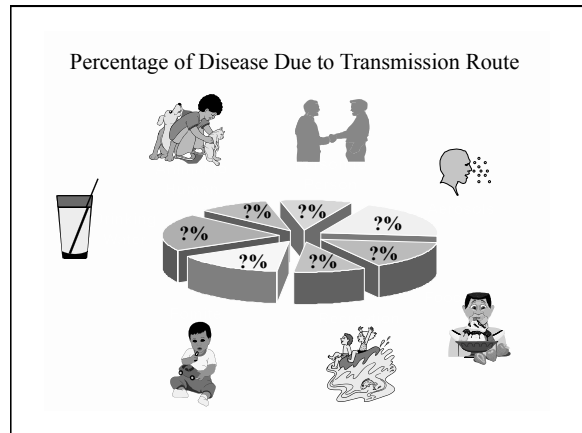
Soil, Water and Environmental Science 

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- ### Learning Objectives
- How we can use risk assessment in modeling disease transmission via fomites in indoor environments
 - How the nature of a fomite and pathogen effects their transfer to hands
 - Survival of pathogens on the hands
 - Speed and movement of microbes in indoor environments






How do we Logically Assessment the Spread and Control of Disease Transmission in Indoor Environments

?

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What is CAMRA?






- Established to model microbial risks from
 - Fomites
 - Drinking water
 - Aerosols

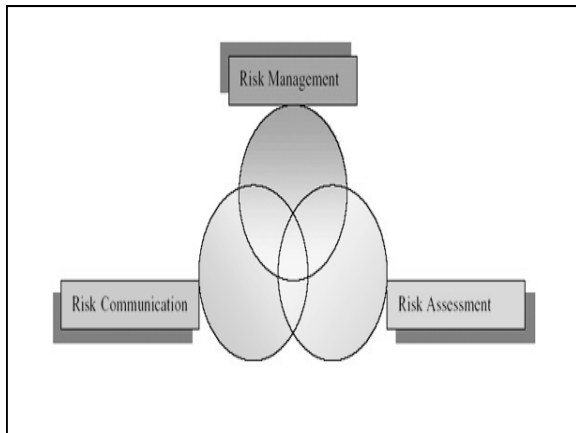
How do we use risk analysis?




Develop standards for toxic substances and pathogens in food and water



Assess cost: benefits of regulations

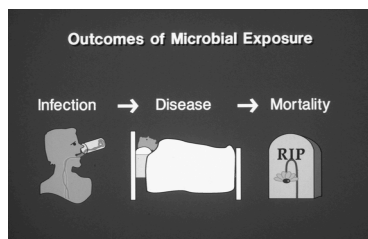


Risk Assessment



- Estimation of potential adverse effects associated with exposure of individuals or populations to hazards

Quantitative Microbial Risk Assessment is an approach that allows the expression of risks in a quantitative fashion in terms of infection, illness, or mortality from microbial pathogens



Risk Management



- The process for controlling risks
 - Wear gloves
 - Disinfect key fomites
 - Use hand sanitizers

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Risk Communication



The communication of risks to managers and practitioners

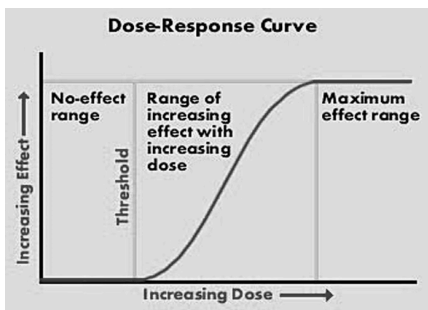
A failure in risk communication

Four Basic Steps in Risk Assessment

- Hazard Identification - identifying the organism (s) – MRSA, *C. difficile*, norovirus, *Salmonella*
- Dose-Response Assessment - relationship between the concentration of harmful substance and the probability of an adverse outcome (i.e. how many does it take to make you sick or kill you)

Four Basic Steps in Risk Assessment

- Exposure Assessment - Determining the concentration that you are exposed to.
- Risk Characterization - Estimating the potential impact (illness, death)



GREATEST AMOUNT OF UNCERTAINTY IN RISK ASSESSMENT IS RELATED TO ESTIMATING EXPOSURE TO THE PATHOGENS

Factors Important in Assessing Exposure

- Route of Exposure (hand, inhalation, ear, mouth)
- Duration of exposure
 - Entire work day?, a few hours
- Number of exposures
 - How many times in a day, month, year
- Degree of exposure
 - Number and types of surfaces touched
 - Numbers of pathogen on the surface


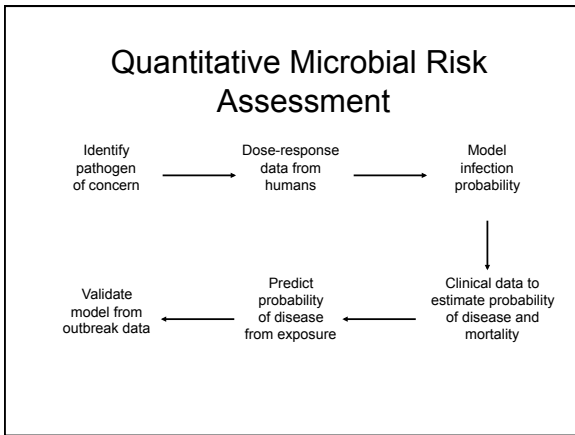
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Microbial Risks are usually defined as risk of infection from a one time exposure or over a period of one year

Microbial Risk Assessment

- What is an acceptable Microbial Risk?
- USEPA Guideline drinking water treatment should be treated to reduce the risk of *infection* to 1:10,000 per year (Surface Treatment Rule)

How good is QMRA ? Can Compare to Outbreaks

Comparison of Outbreak Data to Model Predictions for Assessments of Risks Associated with Exposure to *Salmonella*

Food	Dose (CFU)	Amount consumed	Attack rate (%)	Predicted P (%)
Water	17	1 liter	12	12
Pancreatin	200	7 doses	100	77
Ice cream	102	1 portion	52	54
Cheese	100-500	28 g	28-36	53-98
Cheese	10 ⁵	100 g	100	> 99.99
Ham	10 ⁶	50-100 g	100	> 99.99

Modified from Rose *et al.* (1995)

- ### Application of Microbial Risk Assessment
- Set Standards for pathogens on fomites/ water/food
 - Determine the cost/benefits of different intervention options
 - Assessment strategies for control of pathogens
 - Hand hygiene
 - Type of disinfectant
 - Frequency of disinfectant use
 - Self-sanitizing surfaces or fabrics

Hand Contact in Adults

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




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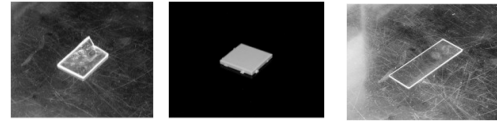
How Efficient is Transfer?

(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



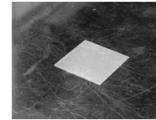
Fomites - not all the same



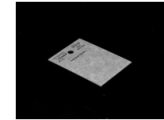
Acrylic

Ceramic tile

Glass

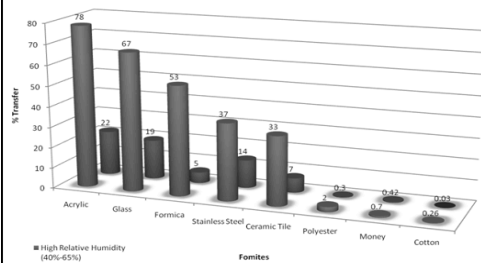


Stainless steel



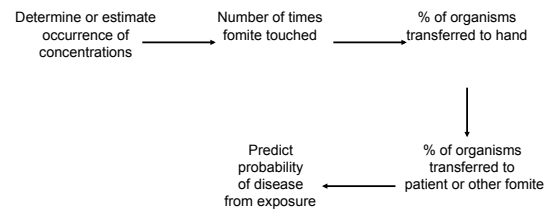
Formica

Transfer of MS2 Bacteriophage from Fomites to Fingers

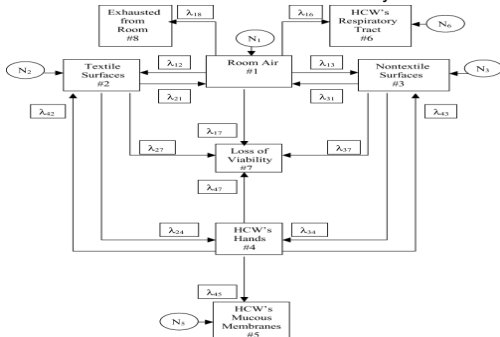


Blue high relative humidity = 40 to 65%; Red = 20 to 30%

Risk Assessment for Fomites

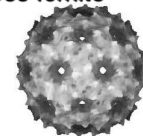


Model to assess transmission of a viral pathogen in a health care setting – WOW!!!
 Nicas and Sun 2006 - Risk Analysis



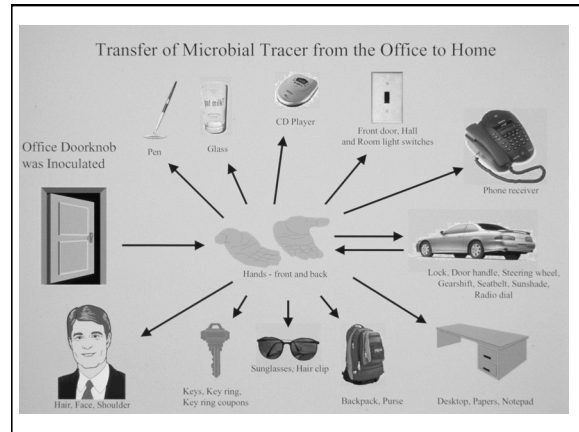
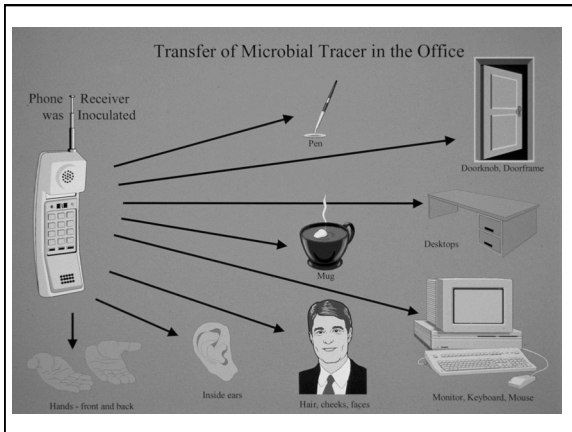
Another Approach – use tracers to model fate and risk from fomites/hands

➤ Bacteriophages have been used in day care and home studies to assess fomite contamination




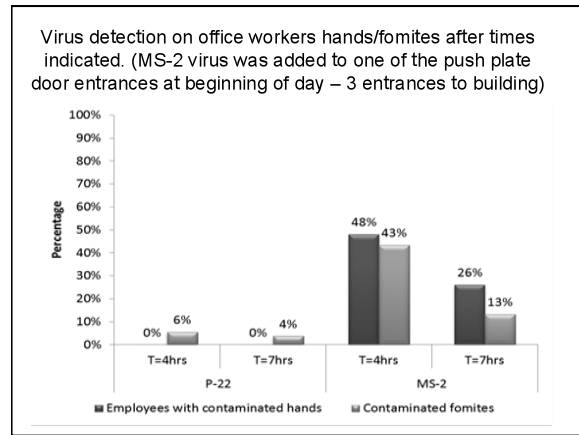
➤ MS-2 and phiX-174 used in tracer studies

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How fast does a virus move in an office Building?

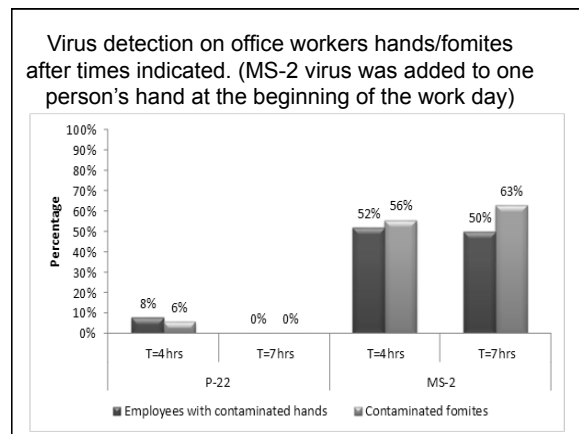
- Add a bacterial virus to the entrance door handle to an office building with 80 persons
- Collect samples after 2, 4 and 7 hours of fomites and hands

Repeat, but add bacteriophage to one persons hand?*



*Person did not know hand was contaminated



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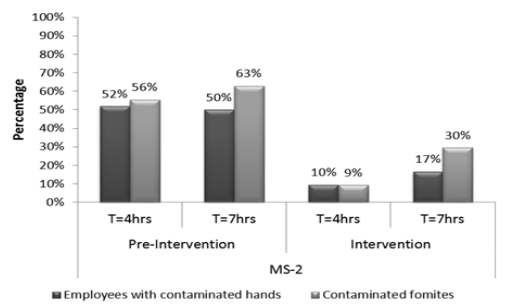
Intervention

- Talk about the importance of hand hygiene in disease transmission
- Supply hand sanitizers and disinfecting wipes at desk
- Supply hand sanitizer in break room
- 52% of the persons in the office agreed to participate

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

Impact of intervention on Occurrence of Virus on Employee's Hands



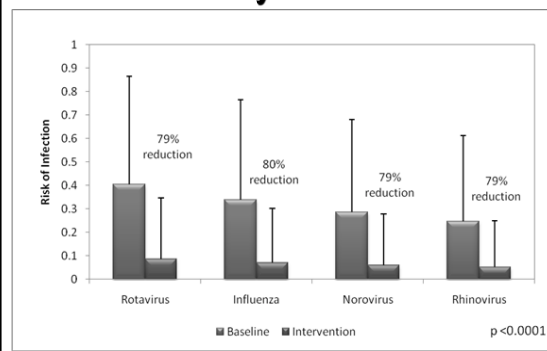
IS THERE A SIGNIFICANT DIFFERENCE BETWEEN VIRUS NUMBERS on Fomites BEFORE AND AFTER INTERVENTION AT T=4HOURS?

Coliphage	Answer to the question	p-value
MS-2	Yes	0.000067

Results

- • The number of people with viruses on their hands was reduced in half (50%). The occurrence of viruses in communal work areas was reduced by more than 80% after four hours and by 70%-100% after seven hours

Probability of Infection



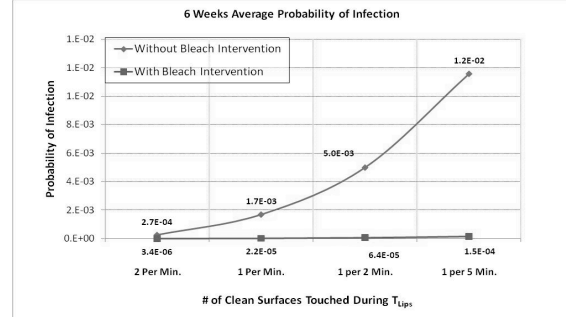
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Occurrence of *Salmonella* on kitchen cleaning clothes
 *Average of both positive and negative measurements

Treatment	Average <i>Salmonella</i> Concentration (MPN)	Standard Deviation	Maximum	Minimum	Number of Negative Observations	Number of Positive Observations
Without Bleach Intervention (Control)	661.28	8,108	110,000	0	173	7
With Bleach Intervention	8.44	88	1,200	0	178	2

Average 6-Week Probability of Infection from Handling Cleaning Clothes with and without Disinfectant Interventions



What we have learned

- We can model probabilities of infection from different exposure scenarios in indoor environments
- Can validate models from outbreak data
- Can quantify the impact of interventions on disease reduction
- Models suggest that a 50% reduction of a virus on fomites/hands can result in an 80% reduction in illness with 50% of population participating in the intervention



20 September **Inspiring Mature Minds – Adult Education in Infection Prevention and Control**
 Speaker: Barbara Catt, Sunnybrook Health Sciences Centre, Toronto

27 September **Emerging Carbapenem Resistance: What Do We Do Now?**
 Speaker: Prof. Andrew Simor, University of Toronto

02 October (FREE ... WHO Teleclass – Europe) **The Role of Education in Low and Middle Income Countries**
 Speaker: Prof. Shaheen Mehtar, Stellenbosch University, South Africa
 Sponsored by WHO First Global Patient Safety Challenge – Clean Care is Safer Care

11 October **Evaluating Chlorhexidine Baths for the Prevention of Central Line Associated Bloodstream Infections (CLABSIs)**
 Speaker: Prof. Silvia Munoz-Price, University of Miami Miller School of Medicine
 Sponsored by Sage Products Inc (www.sageproducts.com)

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