

Reduction in virus Transmission in Homes with the use of Alcohol/Quat Hand Rubs



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Disclosures

➤ Charles P. Gerba

- I disclose personal financial relationships with commercial interests relevant to this educational activity
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sdd1 Disclose only Clorox?
shunna dean dean, 4/18/2016

Intervention Studies

Epidemiology

- Difficult to isolate potentially a large number of confounding factors
- Lacks precision
- Requires a large number of individuals
- Long observation time
- Can not see more than a 20 to 50% reduction in illness
- Difficult to do for specific pathogens (clinical specimens required)
- Costly

Risk Assessment

- Confounding factors can be controlled
- Good precision
- Small numbers of individuals needed (or none at all)
- Short observation time
- Can determine what is achievable in terms of reduction in risk of infection for a specific pathogen
- Can determine importance of specific exposure routes
- Far less costly

What data do you need to model risk of infection via fomites

- Occurrence and concentration of pathogen or tracer on the surface
- Frequency of fomite contact (Beamer et al., 2015)
- % transfer of pathogen to the hand (Lopez et al. 2014)
- Frequency of face contact (Nicas and Best, 2008)
- % transfer to the mouth, nose, eye or skin (Rusin et al 1998)
- Dose response for pathogen of interest (QMRA Wiki)

Assessing the Effectiveness of Hygiene Interventions in the Real World using Risk Assessment

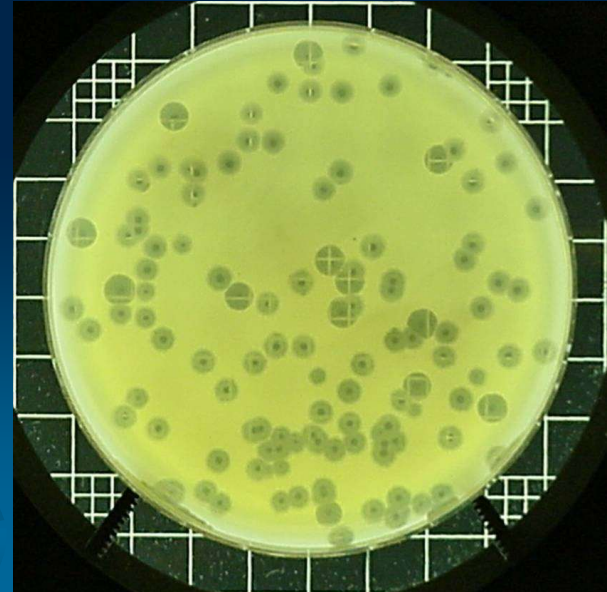
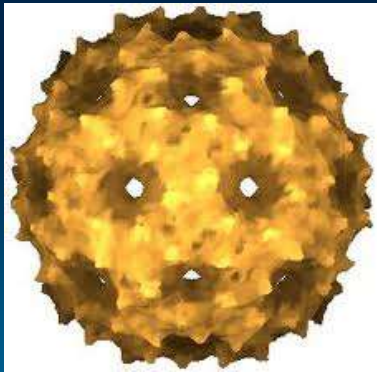
- **Phage Tracers**

- Can determine importance of specific exposure routes
- Determine how quickly a virus spreads by contamination of hands and/or specific fomites
- Determine the spread of a virus in a specific location (offices, home, hospital). Identify what fomites present the greatest risk.
- Determine the reduction in the risk of infection by an intervention (Published examples)
 - Office
 - Nursing home
 - Home
 - Hotel
 - Out patient clinic

Tracer Virus

Bacteriophage MS-2

- ~23 nm in diameter
- single stranded RNA
- no lipid layer
 - similar in shape and size to the cold virus (rhinovirus) and norovirus
- commonly used as a model for disinfectant testing and environmental tracer



Question: Does the use of a hand sanitizer reduce the risk of infection in households?

1) Add MS-2 virus to one hand of an adult in a family of 4 to 6 (does not know hand has been inoculated) – on a weekend day

2) Test hands and surfaces in the house after 4 and 8 hours



Virus spread in a Home

- Results

- Virus detected on the hands of all family members hands in the household
- Virus detected on ~98% of the sites tested positive for virus including
 - » Kitchen table, countertops
 - » Bathroom counters
 - » Living room light switches, TV remotes
 - » Bedroom door handle, sheets, light switches

House Hold Hand Towels (442 towels tested)



Total
Bacteria

Coliforms

E. coli

Average

9.2E+08


3.9E+05

1.1E+04

3% contain *Salmonella* spp.



Types of Bacteria Isolated in Hand Towels

- *Salmonella cholerasuis*
 - *Salmonella spp.*
 - *Escherichia coli*
 - *Enterobacter aerogenes*
 - *Enterobacter sakazaki*
 - *Enterobacter cloacae*
 - *Citrobacter youngae*
 - *Serratia odorifera*
- 

Statistical differences in Parameters studied – Hand Towels

	Total Bacteria	Coliforms	<i>E. coli</i>
Age of Towel	No	No	No
Frequency of Washing	0.01	No	<0.001
Last time washed	No	No	0.025
Washed one day ago	<0.001	<0.001	<0.001
Frequency of use	0.012	No	0.023

Does Handwashing Spread Microbes?

Sample Location	Automatic Faucet*	Manual Faucet*
Faucet	180,000	570
Countertop	103,000	57
Wall behind sink	58,000	330
Sink Bowl	20,800,000	71,600,000
Hand after washing	180,000	95,000

-Add $\sim 10^9$ MS-2 virus to hands before washing – males only

*Number of viruses as plaque forming units per 100 sq. cm



Effectiveness of Intervention Products Against MS-2 Virus

- Hand Sanitizer – persons in household ask to use alcohol hand rub once a day at a time they selected



Impact on Virus Occurrence with the Alcohol Hand Rub used once a Day (after 4 hours)

Area Sampled	Geometric Average of Virus Recovered		% Reduction
	Before Intervention	After Intervention	
Hands (not inoculated)	1,007	3	99.7
Inoculated hands	10,225	16	99.8
Bathroom	331	3	99
Living Room	1,512	4	99.7
Cell Phones	1,569	4	99.3
All fomites in household	615	4	99.3

Reduction in probability of infection as a function of initial rotavirus concentration on the hand (Alcohol hand rub)

Number of Virus on hand	Probability of Infection (%) Before	Probability of Infection (%) After	% Reduction
3000	81	49	49
1000	77	33	56
500	70	22	69
1	9	2.6	97

Virus Tracer Studies of Hygiene Interventions

Environment/Location	Purpose/product	Outcome	Reference
Office building	Hand sanitizer/disinfecting wipes	Reduced probability of infection by 77% by rhino and rotavirus	Reynolds, Beamer, et al. 2016. Arch Env Occ Hlth
Hotel/Conference Center	Hand sanitizer/disinfectant products for cleaning staff	Reduced spread of virus between rooms by cleaning staff by 87%	Sifuentes, Koenig et al., 2014. Food Env Virol
Nursing home	Hand sanitizer	Reduce spread of virus between patient rooms by >99%	Sassi, Sifuentes, et al., 2015. Am J Infect Contr
Home	Hand sanitizer	Use of hand sanitizer reduced the probability of infection by 47% to 98%.	Tamimi, Maxwell et al., 2015. Epidemiol Infect
Home	Bleach	Reduced probability of infection by Salmonella in kitchen sponge by 99%	Chaidez, Soto-Beltran et al., 2014. Let Appl Microbiol
EMS response	H2O2wipes	Reduced spread of virus among EMS vehicle and equipment surfaces by 16%	Valdez et al., 2015. Am J Infect Contr

What have we Learned from Interventions

- Hand sanitizers, disinfectant wipes and surface disinfectants greatly reduce exposure and spread of viruses and bacteria in indoor environments.
- Even low touch surfaces play a role in movement of organisms in indoor environments (i.e. floor).
- Significant reduction in the spread of organisms even with products with kills of less than 90% in laboratory studies.
- Disinfecting wipes more effective in reduction of bacteria than spray and wipe in households.

What have we Learned from Interventions

- Soft surfaces are just as important or more than hard surfaces in exposure
- QMRA can be used to estimate the reduction in infections from fomites to pathogens
- Simple interventions can have a significant impact on risk of infection in indoor environments



Questions

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