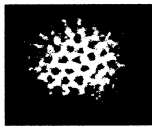
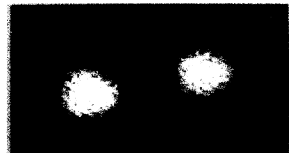


Norovirus

Virus Morphology



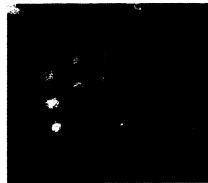
Rotavirus (60-80 nm)



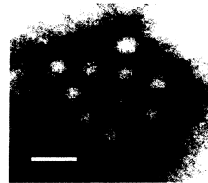
Adenovirus (70-90 nm)



Astrovirus (27-30 nm)



Sapovirus (27-35 nm)



Norovirus (27-35 nm)

www.virology.net/Big_Virology/BV/FamilyIndex.html

Noroviruses

- Norovirus (formerly Norwalk-like viruses-NLV) is a genus within the family *Caliciviridae*. SS-RNA with a capsid structure provides increased resistance to chemical disinfection.
- Causes acute gastroenteritis in humans; fecal-oral transmission primarily, although droplet and fomite transmission may facilitate spread.
- Infective dose as low as 10-100 particles.
- Outbreaks have been reported in hospitals, homes, camps, schools, restaurants, hotels, rehabilitation centers and cruise ships
- Outbreaks in hospitals have increased in recent years and this may lead to the closure of wards
- This group of viruses cannot be grown in cell culture so feline calicivirus used as a surrogate

Environmental Contamination Norovirus

- Hospital-11/36 (31%) environmental swabs were positive for RT-PCR. Positive swabs were from lockers, curtains and commodes and confined to the immediate environment of symptomatic patients. *J Hosp Infect* 1998;39:39.
- Hotel-61/144 (42%) were positive for NLV RNA. Cheesbrough et al. *Epid. Infect* 2000;125:93.
- Rehabilitation Center-Norovirus detected from patients and three environmental specimens (physiotherapy instrument handle, toilet seat (2-room of symptomatic guest, public toilet) RT-PCR. *Epid Infect* 2002;129:133-138.
- LTCF-5/10 (50%) of the environmental samples were positive for norovirus by RT-PCR. Wu et al. *ICHE* 2005;26:802.

Some positive PCR results may represent non-infectious virus.

Environmental Survival Norovirus

- **Distilled water or saline: Survival 0-2 days** West AP, et al. J Clin Path 1992;48:228
- **Sterile river water: Survival 2 to 20-30 days** Shahamat M, et al. Appl Environ Micro 1993;59:1231
- **Tap water at 4°C: 4 days** Fan EG, et al. J Gastroenterol Hepatol 1998;13:1096
- **At 20°C a 9-log₁₀ reduction of FCV between 21-28 days in a dried state**
Doutree et al. J Hosp Infect 1999;41:51
- **At 20°C a 9-log₁₀ reduction of FCV between 14-21 days in suspension**
Doutree et al. J Hosp Infect 1999;41:51
- **At 20°C a 3-log₁₀ reduction in infectivity (two animal caliciviruses) occurred in 1 week.** Duizer et al. Appl Env Micro 2004;70:4538.

Role of the Environment Norovirus

1. **Prolonged outbreaks on ships suggest norovirus survives well**
2. **Outbreak of GE affected more than 300 people who attended a concert hall over a 5-day period. Norwalk-like virus (NLV) confirmed in fecal samples by RT-PCR. The index case was a concert attendee who vomited in the auditorium. GI illness occurred among members of 8/15 school parties who attended the following day. Disinfection procedure was poor.** Evans et al. Epid Infect 2002;129:355
3. **Extensive environmental contamination of a hospital ward.**
Suggest transmission most likely occurred through direct contact with contaminated fomites.

Inactivation of Feline Caliciviruses

Doultree et al. J Hosp Infect 1999;41:51

Disinfectant	Log Reduction	Contact Time
Glutaraldehyde, 0.5%	5	1
Hypochlorite, 1000 and 5000 ppm	5	1
QUAT	0	1
Iodine, 0.8%	5	1
Ethanol, 75%	1.25	1

Surface Disinfection

Norovirus

- School outbreak of NLV—cleaning with QUAT preparations made no impact on the course of the outbreak. The outbreak stopped after the school closed for 4 days and was cleaned using chlorine-based agents. Marks et al. *Epid Inf* 2003;131:727
- Detergent-based cleaning to produce a visibly clean surface consistently failed to eliminate norovirus contamination. A hypochlorite/detergent formulation of 5000 ppm chlorine was sufficient to decontaminate surfaces. Barker et al. *J Hosp Infect* 2004;58:42.

***C. difficile* and Norovirus**

Due to the relative resistance of *C. difficile* spores and norovirus, during clusters, surfaces should be disinfected with a product shown to be effective (e.g., chlorine 5000ppm [1:10 bleach])

Prevention of *C. difficile*

- Role of the environment in transmission
- *C. difficile*
 - Microbiology and epidemiology
 - Environmental contamination
 - Environmental disinfection
 - Hand hygiene
- Norovirus
- MRSA
- Other issues: microfiber, computers, green products

MRSA

STAPHYLOCOCCAL ABSCESS



MRSA

- Frequency of environmental contamination in areas housing MRSA patients has ranged from 1 to 74% (23.1%, 53.6% from isolation rooms) of surfaces cultured.
- MRSA viable in the environment for days to weeks
- HCW can contaminate their hands or gloves by touching contaminated surfaces
- Cleaning or disinfecting the environment can reduce transmission but cleaning regimens, as currently practiced, may not eliminate MRSA from surfaces
- Since MRSA sensitive to all germicides, likely due to surfaces not cleaned/disinfected
- Need targeted methods to evaluate the thoroughness of room cleaning

Risk of Acquiring MRSA and VRE from Prior Room Occupants

- Admission to a room previously occupied by an MRSA-positive patient or VRE-positive patient significantly increased the odds of acquisition for MRSA and VRE (although this route a minor contributor to overall transmission). Arch Intern Med 2006;166:1945.
- Prior environmental contamination, whether measured via environmental cultures or prior room occupancy by VRE-colonized patients, increases the risk of acquisition of VRE. Clin Infect Dis 2008;46:678.

Practice or Product

Susceptibility of MSSA and MRSA to a Phenolic and Quaternary

Rutala et al. ICHE 1997;18:417

	Phenolic 1:256	Phenolic 1:128	QUAT 1:64	QUAT 1:32
MSSA	2/60	0/60	5/60	1/60
MRSA	0/60	0/60	4/60	1/60

TABLE 2
DISINFECTANT ACTIVITY AGAINST ANTIBIOTIC-SUSCEPTIBLE AND ANTIBIOTIC-RESISTANT BACTERIA

Product	Log ₁₀ Reductions							
	VSE		VRE		MSSA		MRSA	
	0.5 min	5 min	0.5 min	5 min	0.5 min	5 min	0.5 min	5 min
Vesphene IIse	>4.3	>4.3	>4.8	>4.8	>5.1	>5.1	>4.6	>4.6
Clorox	>5.4	>5.4	>4.9	>4.9	>5.0	>5.0	>4.6	>4.6
Lysol Disinfectant	>4.3	>4.3	>4.8	>4.8	>5.1	>5.1	>4.6	>4.6
Lysol Antibacterial	>5.5	>5.5	>5.5	>5.5	>5.1	>5.1	>4.6	>4.6
Vinegar	0.1	5.3	1.0	3.7	+1.1	+0.9	-0.6	2.3

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S aureus*; VRE, vancomycin-resistant *Enterococcus*; VSE, vancomycin-susceptible *Enterococcus*. Data represent mean of two trials (n=2). Values preceded by ">" represent the limit of detection of the assay. Assays were conducted at a temperature of 20°C and a relative humidity of 45%. Results were calculated as the log of Nd/No, where Nd is the titer of bacteria surviving after exposure and No is the titer of the control.

Rutala WA, Barbee SL, Aguiar NC, Sobsey MD, Weber DJ. Antimicrobial Activity of Home Disinfectants and Natural Products Against Potential Human Pathogens. *Infection Control and Hospital Epidemiology* 2000;21:33-38.

Not Product: Is It Practice?

Surface Disinfection

Effectiveness of Different Methods

Rutala, Gergen, Weber, 2008, Unpublished

Technique (with cotton)	MRSA Log ₁₀ Reduction (QUAT)
Saturated cloth	4.41
Spray (10s) and wipe	4.41
Spray, wipe, spray (1m), wipe	4.41
Spray	4.41
Spray, wipe, spray (until dry)	4.41
Disposable wipe with QUAT	4.55
Control: detergent	2.88

Patient Area Cleaning/Disinfecting

PC Carling et al, SHEA 2007 and ICHE 2008;29:1

- Monitor cleaning performance using an invisible fluorescent targeting method. Rooms (14 high-touch objects) were marked and evaluated after terminal cleaning.
- Results: 1,119 rooms and 13,369 objects were evaluated in 23 hospitals. Mean proportion of objects cleaned was 49%. Following education and process improvement feedback, cleaning improved to 77%
- Conclusion: Substantial opportunity for improving terminal cleaning/disinfecting activities.

Practice* NOT Product

*surfaces not wiped

Removing *S. aureus* from Surfaces

Cardiff University, 2008, Williams et al

- Step 1-steel discs with 10^6 - 10^7 *S. aureus* and measured efficacy of wipes; disinfectants more effective
- Step 2-measured bacterial transfer from wipes
- Step 3-measured the bactericidal activity; disinfectant wipes killed high numbers (2.68-3.55 \log_{10} reduction) but could not prevent cross contamination
- Press reported that wipes spread bacteria-unique methodology that did not represent clinical practice (e.g., 10 second exposure, *S. aureus* levels observed in healthcare)
- When wipes tested in conditions mimicking usage, we found them to be effective when used as recommended (gross filth should be removed before disinfecting, wipe surface and allow visible wetness for ≥ 1 minimum contact; use additional wipes to assure wet contact time; let air dry)

