



Green Cleaning and Disinfecting

What Does that Look Like?

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Green Cleaner Evolution

- 15-20 Years ago - hit or miss if they worked
 - Created negative image for green products
 - Still persists today
- Green cleaners of today are much improved
 - On par or exceed traditional products
 - Still need to pilot test products to see if they work for you
 - TURI Lab provides assistance
 - In the lab
 - In the field

So How Do You Go Green

- Work with Third Party Certifiers
 - Performance requirement for their certifications
 - Independent verification of product safety and performance
 - Green Seal www.greenseal.org
 - EPA
 - Safer Choice www.epa.gov/saferchoice
 - Design for the Environment www.epa.gov/pesticide-labels/design-environment-logo-antimicrobial-pesticide-products
 - Ecologo www.ul.com/resources/ecologo-certification-program
- Environmentally Preferable Products Lists
 - State generated contract helps take the guess work out of product selection
 - Reduce environmental and public health impact
 - <https://www.mass.gov/doc/fac85/download>

Cleaning, Sanitizing & Disinfecting, What's the Difference?

- Cleaning
 - Removes dirt/soil from surface
- Sanitizing
 - Reduces (kills) 99.9% to 99.999% of tested bacteria
 - Cannot claim killing viruses or fungi
- Disinfecting
 - Destroys 99.99% of all forms of microbial life, bacteria, virus, but not necessarily their spores
- Cannot Disinfect a Dirty Surface

Clip from community service project at FMAC

Safer Disinfecting Chemicals-Processes

- EPA Listed Active Ingredients

- Citric Acid
- Caprylic Acid
- Hydrogen Peroxide
- L-Lactic Acid
- Ethanol
- Isopropanol
- Peroxyacetic Acid
- Sodium Bisulfate

- Other Methods/Active Ingredients

- Dry Steam Vapor
- Hypochlorous Acid
 - Electrolyzed water
 - NaDCC
- Aqueous Ozone
- UVC light
- All Purpose Cleaners
 - Possible but not validated yet

EPA-DfE Authorized Antimicrobial Pesticide

- Acute Exposure
 - Least-hazardous classes (Category IV, III)
- Chronic Exposure
 - Carcinogenic, endocrine disruptor properties, developmental, reproductive, mutagenic, or neurotoxicity
- Full Product Review
 - Active and inert ingredients
- Personal Protection Equipment
 - Does not require use
- No Unresolved Issues
 - Adverse effects, Performance, Regulatory
- Identical Formulation
 - Matches existing formulation already approved by DfE

<https://www.epa.gov/pesticide-labels/design-environment-logo-antimicrobial-pesticide-products>

EPA-Regulated Disinfecting Devices

- Instrument used to destroy bacteria and viruses
 - Works by physical means
 - Electricity, light, mechanics or heat
 - <https://www.epa.gov/safepestcontrol/pesticide-devices-guide-consumers#1>
- Do not require registration
 - But are regulated to prevent “false or misleading claims”
 - Manufacturer must have scientific data to support the claims

Other Options



- Superheated steam vapor device
 - Very effective for cleaning and rapid sanitizing/disinfecting
 - Harder-to-kill viruses, such as canine parvovirus
 - Similar human coronavirus, such as coronavirus 229E
 - Kill rates 99.99% under 10 seconds
 - Expected to be effective on Sars-CoV-2 according to the EPA
 - They are not conventional "steam" cleaners or pressure washers
 - They are devices that use only a little water and a little electricity to clean, disinfect, and deodorize most surface



Other Options

- Hypochlorous Acid (HOCl)
 - Dominant active ingredient when operated in pH range of 4-6
 - Other ranges will have mixture of chemicals
- TURI testing looking at potential Cl₂ exposure during usage

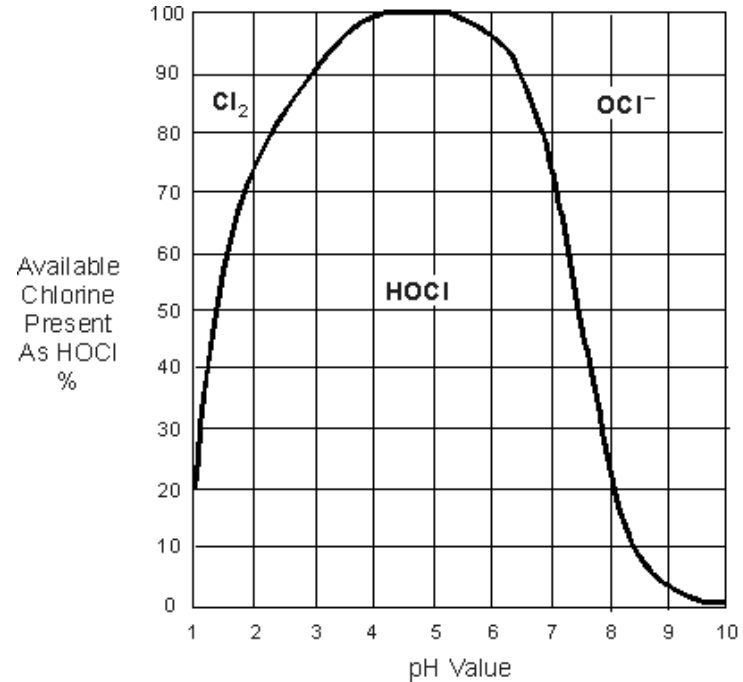


Table 1. Percentages of HOCl and OCl⁻

pH	% HOCl	% OCl ⁻	% HOCl	% OCl ⁻
	32°F	32°F	68°F	68°F
4	100.0	0.0	100.0	0.0
5	100.0	0.0	97.7	2.3
6	98.2	1.8	96.8	3.2
7	83.3	16.7	75.2	24.8
8	32.2	67.8	23.2	76.8
9	4.5	95.5	2.9	97.1
10	0.5	99.5	0.3	99.7
11	0.05	99.95	0.03	99.97

Basics of Electrolyzed Water Systems

- Electrical charge passes through salt (NaCl) and water solution
- Sodium separates from chloride
- Chloride is negatively charged => attracted to the positive side of the electrical charge bonds with oxygen and hydrogen from the water
 - Converted from Cl^- to HOCl
 - known as hypochlorous acid
- Vinegar (acidic) is the key to getting just the right pH
 - Without the right pH, will get a solution that is mostly bleach (sodium hypochlorite)
 - Lower the pH and hypochlorite converts to hypochlorous acid

Some of the In-home systems

- Force of Nature
 - Provides capsule with salt and vinegar mixture
- Ecolox
 - Add salt
- Scrubbr
 - Add salt
- GenEon
 - Add provide packet salt solution
- Aviair
 - Add salt, or salt and vinegar

So Why is HOCl not on EPA's DfE List

- Remember that list of things EPA looks for?
 - Has no unresolved compliance or enforcement actions associated with it
- Well, here's the deal
 - During Drinking Water Treatment
 - Chlorine reacts with organic matter naturally present in water to form by-products such as trihalomethanes (THMs), potentially cancer-causing
 - Inadequate epidemiological evidence of carcinogenicity in humans for all four THM compounds
 - Rate of formation for THMs is relatively slow—on the order of days for ultimate formation
- For home use electrolyzed water systems, organic matter is not present in water

Other Options

- Aqueous Ozone

- A product of water and air in the presence of an electrical charge

- Generation of ozone in water (1)
- Oxidation - attacking organism/soils (2-3)
- Return to oxygen (4)



- Aqueous ozone is not stable for long periods of time

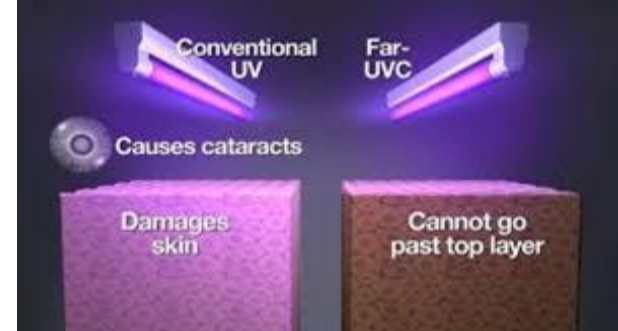
- Some units add stabilizers to extend activity
- TURI testing will look at potential O₃ exposure during generation and usage

Aqueous Ozone

- Safe when used in proper, low concentrations
 - Enozo (0.5-1 ppm)
 - EPA No. 089373-MA-001
 - Green Seal® Certified (cleaning)
 - Generally regarded as safe (GRAS) by the FDA
 - ADEPT: Active Diamond Electrolytic Process Technology
 - Passes through a solid diamond plate and encounters a direct electrical current
 - <https://enozo.com/technology/>
 - Tersano iClean Mini (1-3 ppm)
 - EPA No. 89093-CAN-01
 - Power of Stabilized Aqueous Ozone cleaning
 - Diamond electrode core
 - https://cdn.shopify.com/s/files/1/0298/2389/3557/files/PathogenSummarySheet_200420_EN.pdf?v=1594766312
 - CleanCore Solutions Aqueous Ozone (1-1.5ppm)
 - <https://cleancoresol.com/wp-content/uploads/2020/05/20-CCS-PathogenSum-F2.pdf>

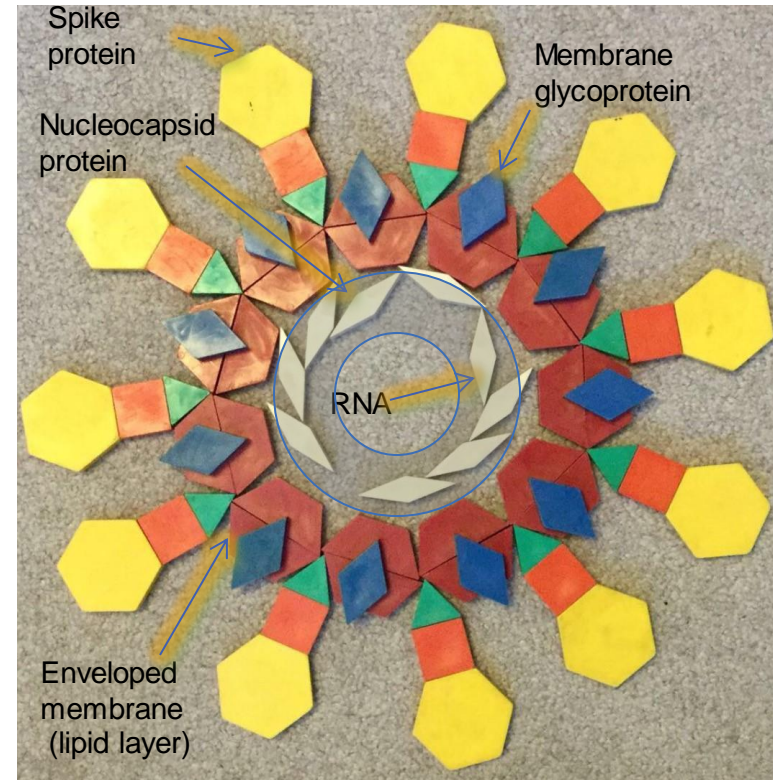
Other Options

- Ultraviolet Light
 - UV light has been used to eliminate pathogens for decades
- Does it work against SARS-CoV-2?
 - It takes the right kind of UV in the right dosage
 - UVC - Wavelength 200-280 nm
 - 254 nm inactivates: H1N1 influenza, Severe Acute Respiratory Virus (SARS-CoV), Middle Eastern Respiratory Syndrome (MERS-CoV)
 - Causes lesions in DNA and RNA
 - Effectively killing/inactivating microorganism or virus



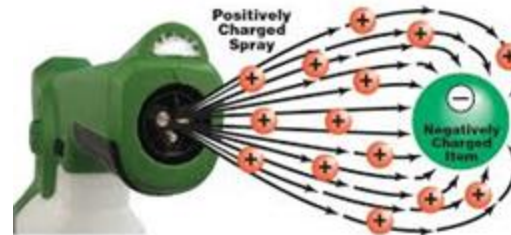
Other Options

- All Purpose Cleaners-Degreasers
 - Does soap work on the SARS-CoV-2 and most viruses?
 - Virus is a self-assembled nanoparticle in which the weakest link is the lipid (fatty) bilayer
 - Theoretically, degreasers should work on dissolving this layer
- Possible but not validated directly yet



Methods of Application

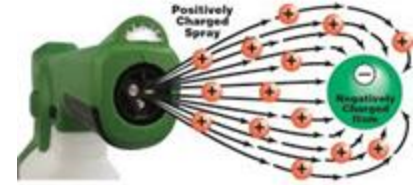
- Wipe on
- Immerse into solution
- Spray bottle
- Electrostatic sprayer
- Fogger
- Mister



Safety Still Matters

- Use as Directed
 - CLEAN FIRST still applies
 - Recommended concentration
 - Appropriate dwell time
 - Proper PPE
- Disinfectant product's safety and effectiveness may change based on how it is used
- Need EPA approval to add delivery method
 - Electrostatic, fogger, misting

Electrostatic Sprayers



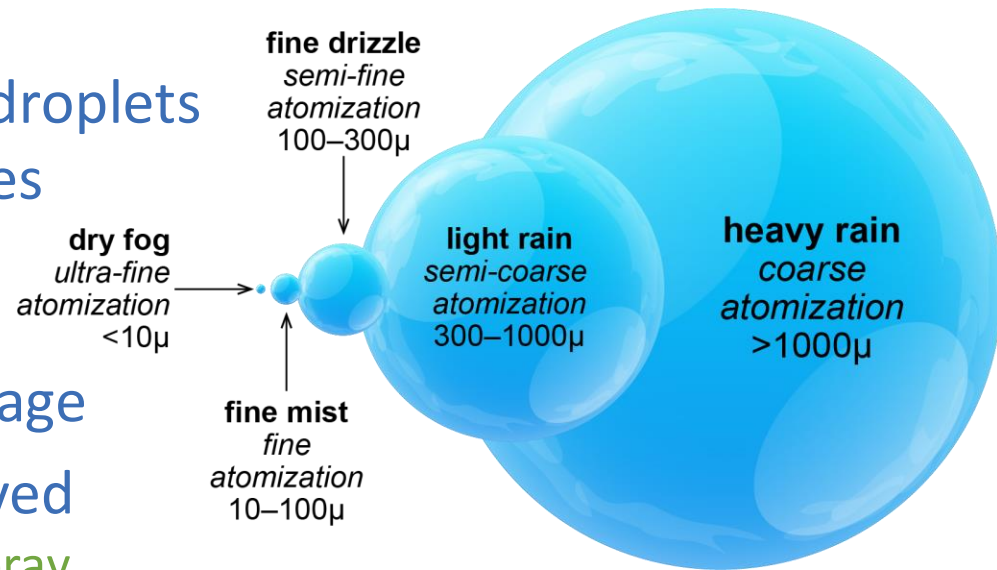
- Most electrostatic sprayers generate charged particles
 - Charged particles stick to these surfaces
 - Particles repel each other and have a better chance to stick to something else
- Traditional wipes/trigger sprays require significant effort and are prone to human error
 - Including missed surfaces

Electrostatic Sprayers

- Limited information on electrostatic spray systems vs. conventional spray systems to inactivate SARS-CoV-2
 - General studies showing both effective on certain pathogens on variety of surfaces
 - Electrostatic sprayer systems are more efficient than manual application for delivery times
- Electrostatic spray systems
 - Best suited for disinfection of pre-cleaned surfaces
 - Lack the benefit of manual removal of debris and microorganisms

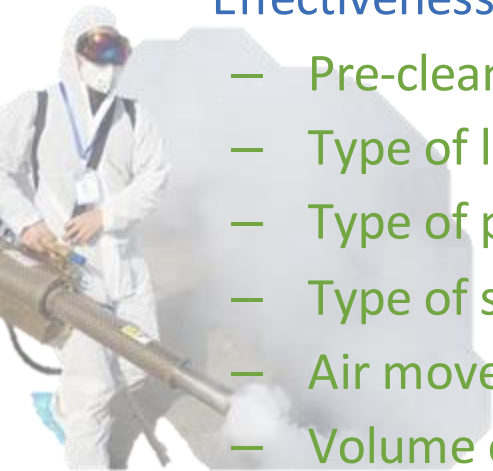
Foggers and Misters

- System delivers very small droplets
- Passively deposit on surfaces
 - Based on direction of spray
 - Rely on effect of gravity
- May result in uneven coverage
- Reentry times may be delayed
 - Compared to electrostatic spray
- Practical difference between foggers and misters
 - Foggers are used to introduce fog like cloud (10 microns)
 - Misters form rainy environment, produce little droplets (200 microns)
 - Fog floats, Mist falls



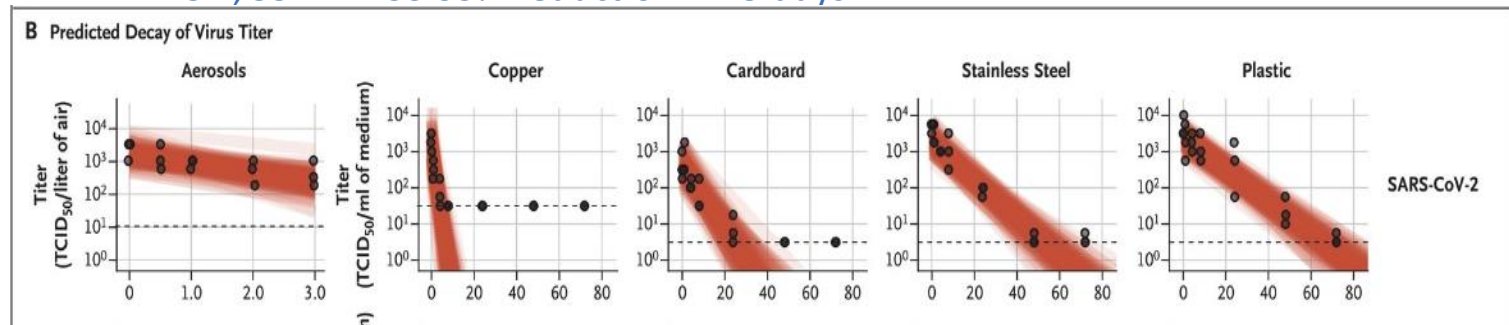
Foggers and Air Cleaning

- Vaporized disinfectants are able to remain airborne for longer period of time compared to micro-condensation aerosols
 - Possibly providing both air and surface disinfection
 - Aerosolized disinfectants have been found to be able to reduce the number of airborne microorganisms
- Effectiveness of each of these technologies depends on:
 - Pre-cleaning practices, organic load
 - Type of liquid sanitizer or disinfectant
 - Type of pathogen being targeted
 - Type of surface, size of space, location of the fogging apparatus
 - Air movement, relative humidity
 - Volume of disinfectant, and contact time



When to Disinfect

- Virus has limited life span on surfaces
 - <https://www.dhs.gov/science-and-technology/sars-calculator>
 - Viral survival on surfaces is driven by temperature, relative humidity (RH), and organic load
 - Higher Temp and RH the faster virus decays
 - 75 F, 55 RH = 99.99% reduction in ~5 days



<https://www.nejm.org/doi/full/10.1056/NEJMc2004973>

- Unoccupied spaces won't have virus to kill
- Disinfecting every space all the time is not practical

Why is cleaning and hand washing important?

Transference rates

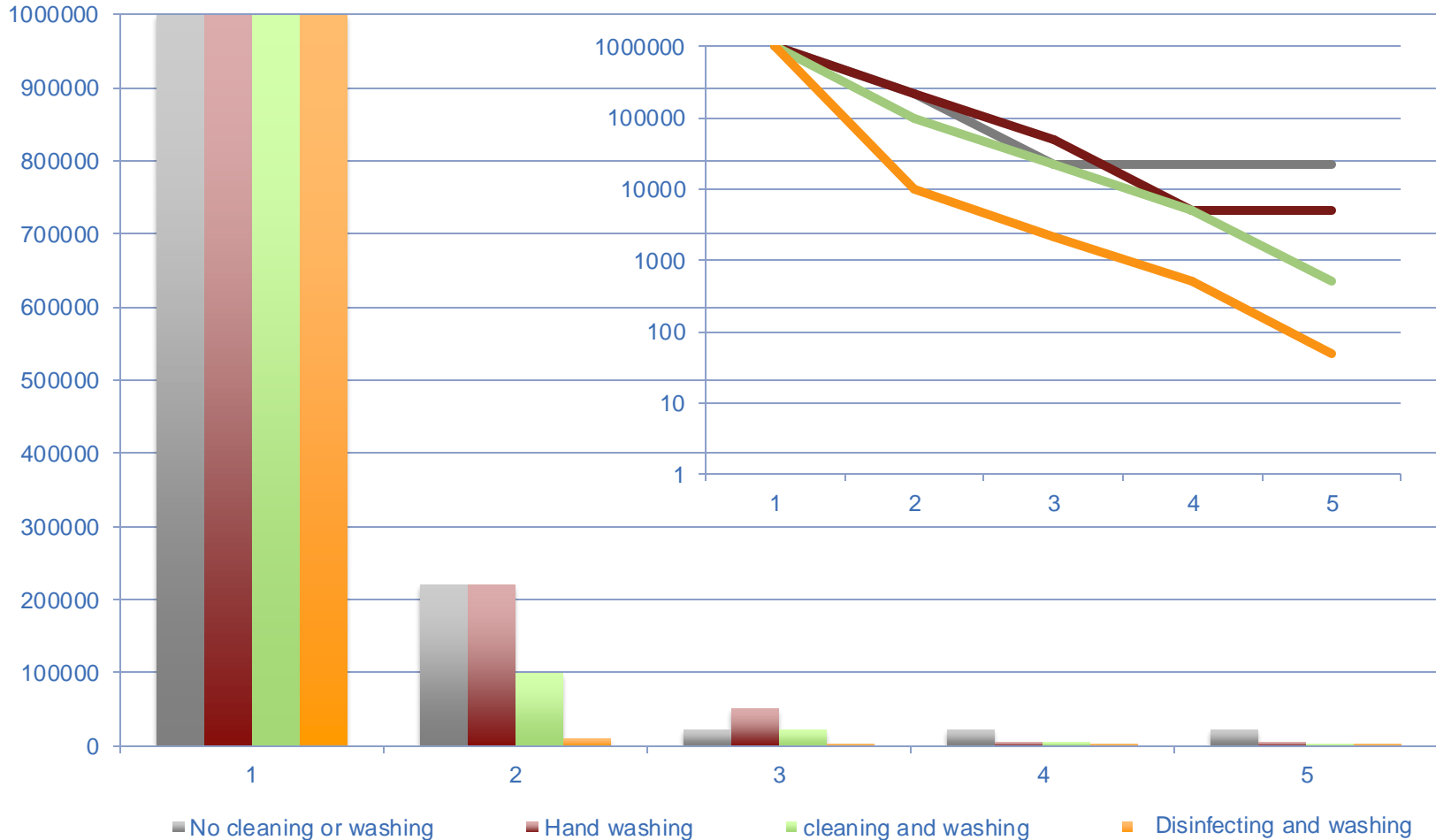
- No cleaning/disinfecting
 - Nonporous surface transference to hand
 - 5% low end
 - 22% high end
 - Hand to mouth, eye, nose transference
 - 10% estimated
- Cleaning control measures
 - For surface cleaned with all purpose cleaner with 90% reduction of virus
 - Hand washing removal rate of 77% from hand concentration



End of the Line vs. Upfront Cleaning

- 1,000,000 virus organisms
 - 22% transferred from surface to hand
 - 220,000 organisms on hand
 - Eek, I'm scared. Are you?
 - 10% transferred from hand to eye/mouth/nose
 - 22,000
- Good news: 97.8 % reduction
- Bad news: Not good enough
- What if we washed our hands?
 - 77% reduction for washing
 - 50,600
 - 10% transferred to face
 - 5,060
 - Now we are at 99.49% reduction
 - And we never cleaned the surface
- With a 90% cleaning removal rate, and hand washing:
 - 99.99% reduction
 - 4 log reduction without disinfection
- Initial 99.9% low end disinfection level, cleaning and hand washing:
 - 6 log reduction

Benefits of Disinfecting, Cleaning and Hand Washing

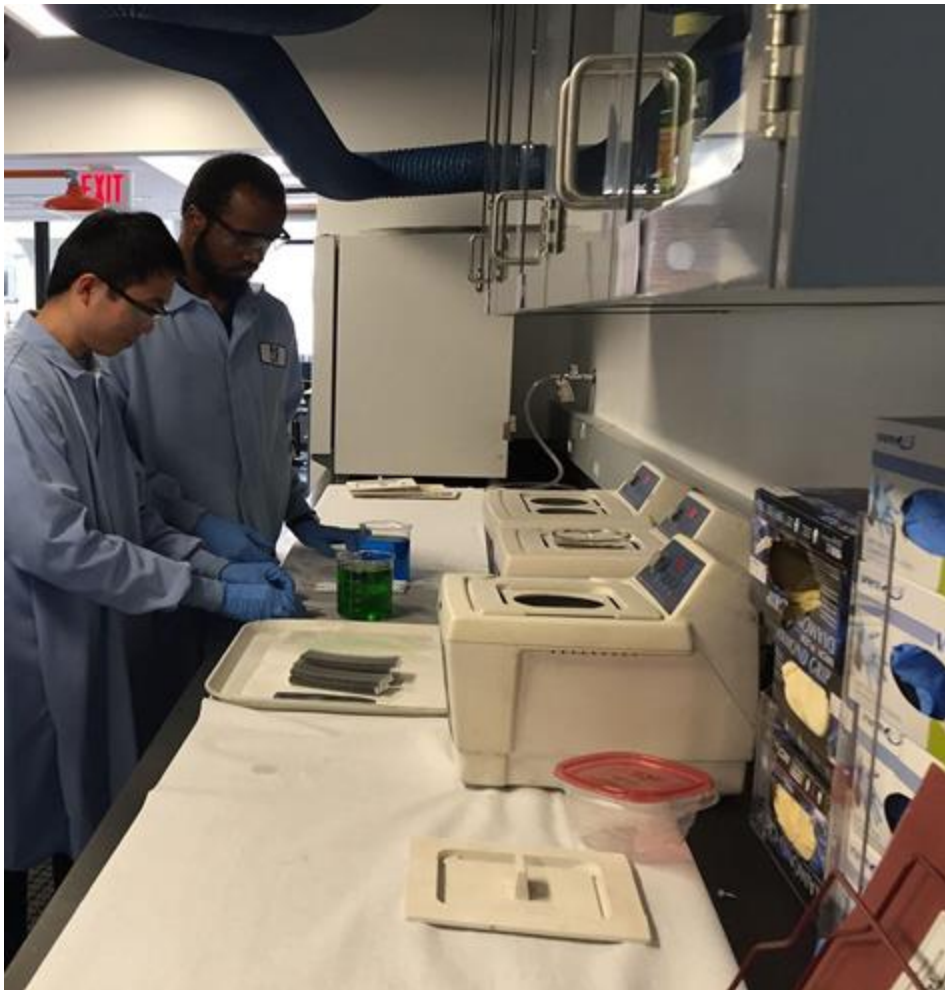


What Does This All Mean?

- Surface most likely will not start with high number of viable virus organisms
- Virus viability decreases overtime on a surface
- What level of virus can still cause infection
 - Not known but estimates are that a few hundred is enough
- Achieve reduction of virus from surfaces without harsh disinfecting chemicals
- You still can't disinfect a dirty surface
 - Cleaning
 - Disinfecting
 - Hand washing

TURI Lab Testing

- Performance assessment for bleach vs. hypochlorous acid
 - Products will be evaluated for effectiveness at killing MS2 bacteriophage
 - Products will be assessed for concentration and dwell times
- Exposure assessment
 - Exposure levels to Cl_2
 - Previous tests show Bleach release higher level than HOCl
- Additional products tested for performance
 - Steam, all purpose cleaners, aqueous ozone, probiotic products, UVc



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