Safer Chemicals Best Practice Case Study #2

The Canadian Coalition for Green Health Care
Coalition canadienne pour un système de santé écologique

GreenCare™ Community

Aqueous Ozone Cleaning System Assessment at Vancouver Coastal Health

Project Objectives

Part of British Columbia's GreenCare Sustainability Strategic Framework focuses on delivering patient care with zero toxicity with a goal to *minimize waste generated and toxic chemicals used by the health care system and supporting operations.* It was with this guiding principle in mind that Vancouver Coastal Health (VCH) and its supporting partners set out to explore aqueous ozone (AO) as a safe and more environmentally-sustainable alternative to chemical cleaners currently in use at VCH and Providence Health Care's (PHC) hospitals, health centres and residential homes.

With project leadership provided by Lower Mainland Facilities Management and Lower Mainland Business initiatives Support Services, and together with their support services provider Crothall Healthcare, the team set about to first conduct a *Chemical Toxicity Baseline Study* with BC-based Prism Engineering. Step two included exploring AO as a safer alternative. Crothall Healthcare had been using AO for floor cleaning* in another BC hospital and were confident the pilot would have positive results.

Aqueous Ozone

AO employs a technology that infuses oxygen and electricity into ordinary tap water, creating a solution that can be used to sanitize hospital surfaces. VCH's Infection Control Department had approved the solution for all general purpose cleaning, which is over 27,000 litres or 75% of the annual chemical cleaner use. These cleaners discharge over 2,500 kg of chemicals of concern into the environment, or 70% of the total annual chemical discharge. A switch to the AO solution would replace a large proportion of existing chemical cleaners used in health care sites across BC's lower mainland.

Current Cleaning Methodology

Cleaning products are currently dispensed by housekeepers using an automated dilution system. Wearing safety gloves, staff dispense water and chemicals into cleaning buckets, floor cleaning machines and small cart-mounted pails. Microfibre® cloths and mops are placed into the bucket to absorb cleaner. The cleaning solution is then applied directly to surfaces such as floors, furniture, switch plates, mirrors, glass and counter tops. Once the first wipe has picked up dirt and other fibres, a second wipe is performed to disinfect factoring in a recommended ten-minute drying time.

Assessing Environmental Impacts of Cleaning Chemicals at VCH Sites

To best determine the environmental impacts of the chemical products currently in use, the research team examined relevant Medical Safety Data Sheets (MSDS), conducted a literature review and explored the options for capturing data from hospital waste water. Their focus was on the following:

1. Volume of cleaning chemicals
2. Types of chemicals, including chemicals of concern, and weights
3. Water waste
4. Packaging waste, and
5. Transportation and Life Cycle Analysis (LCA).

While it was not possible to determine the specific ecological impacts from cleaning products without further study, other environmental impacts of the current system highlight the benefits of switching to the new technology.

Benefits of Aqueous Ozone

A number of benefits accrue when conventional cleaning products are exchanged for AO technology including:

1. Reduced risk to human health
2. Additional cleaning benefits
3. Eligibility for LEED credit, and
4. Favourable financial implications
5. Reduced environmental impacts (chemicals of concern, water consumption, reduced packaging)

Study Results

The following tables show both volume and weight of chemicals consumed under the current cleaning regime.

Use		VOLUME (Litres/Year)
GENERAL CLEANERS To be replaced	Toilet Bowl Cleaner	9,478
	Floors	11,985
	Multi-Surface General Purpose Cleaner	3,083
	Glass & Steel	2,103
	Carpets	638
General Cleaners - to be replaced		27,287 (76%↓)
PATIENT ROOM Will Remain	General Patient Room Disinfectant	4,493
	Disinfectant	3,933
	Multi-purpose Cleaner Degreaser	328
Patient Room Totals - not to be replaced		8,754 (24%)
TOTAL		36,041

Table 1: Volume of Cleaning Chemicals

Cleaner Product Quantities

Housekeeping used over 36,000 litres of cleaning product per year across VCH and PHC sites in 2016. Using specific gravity and chemical quantity figures on the relevant MSDS sheets combined with litres of product used, the total weight of chemicals used at VCH and PHC sites in 2016 was calculated: 4,052 kg. Of this, 90% or 3,631 kg is associated with a Chemical of Concern (Table 2). The implementation of AO will result in a decrease of approximately 2,538 kg/year, or 70% less chemicals concern being discharged into the environment.

There is the possibility that some of these chemicals may adhere to the surfaces and not discharged with the water, and as provided in Table 6, the actual quantities of chemicals discharged to waste water could be up to 30% of the estimated quantities.

By switching to aqueous ozone technology, the risk of environmental impacts will decrease.

Use		Chemical Weight (Kg/Year)	Chemical of Concern Weight (Kg/Year)
GENERAL CLEANERS To be replaced	Toilet Bowl Cleaner	332	332
	Floors	1,816	1,816
	Multi-Surface General Purpose Cleaner	362	299
	Glass & Steel	126	42
	Carpets	79	49
Replacement Totals		2,715 (67%↓)	2,538 (70%↓)
PATIENT ROOM Will Remain	General Patient Room Disinfectant	1,123	944
	Disinfectant	139	99
	Multi-purpose Cleaner Degreaser	75	50
Patient Room Totals - not to be replaced		1,337	1,093
TOTALS		4,052	3,631

Table 2: Type and Weight of Cleaning Chemicals

** Note there is a difference between cleaners and disinfectants. While cleaners remove particles such as dirt and dust, disinfectants are antimicrobial agents that kill microorganisms living on objects.*

Water Used for Cleaning

It is important to note that water is used in three ways when preparing cleaning solutions:

1. Purchased: As a product included in purchased cleaner concentrate
2. Dilution: To dilute concentrated cleaning product
3. System Flushing: To flush the cleaning dispensing system between product use

Water Used for Cleaning	Volume Litres/yr
Purchased water within cleaning products (VCH & PHC 2016)	~ 32,020
Dilution water needed to use cleaning product	17,584,496
Subtotal: Assume this water volume stays the same with AO	17,616,500
System Flushing Water (flushing required when switching cleaners)	3,303,830 Before AO
Water Use with AO	330,383 After AO
Water Savings with AO	**2,973,447 (90%↓)**

Table 3: Water used for Cleaning.

Packaging Waste

Attention must also be paid to the impacts of packaging waste associated with traditional cleaning chemicals. Estimates show a total number of 21,493 packages, including plastic and cardboard shipping containers.

Type of Packaging Waste	# Containers/yr
2.5 L Plastic bottles of cleaner containers purchased (2016)	17,100 (83%↓)
Cardboard shipping containers	4,393 (72%↓)

Table 5: Types of Packaging Waste

Exposure Risk by Cleaner Type

Although more research would need to be done on the specific chemical cleaners used by VCH and PHC cleaning staff, including further mapping out of the cleaning process to quantify number of exposures and well as paths to exposure, we do know healthcare cleaning staff are at some risk of adverse human health impacts. One study states "… sensitization may occur even at trace concentrations."

Multiple studies show increasing incidences of asthma and asthma-like symptoms among cleaning staff. Epidemiological investigations support a direct link to developing or worsening respiratory symptoms and there is evidence to support claims that cleaning products negatively impact human health, however, specific chemicals responsible for respiratory symptoms have not yet been identified. No such complaints have been presented to VCH to date.

Type of Cleaner	Inhalation	Dermal
Floor cleaning	Low	Low
Floor stripping/waxing	High	Low
Window/Mirror	Medium	High
Sink	Medium	High
Counter	Medium	High
Toilet bowl	Medium	Medium

*Table 4: Exposure Risk by Cleaner Type ***

Advantages of Aqueous Ozone - Human Health

Housekeeping staff are no longer at risk of any of the health hazards associated with the use and handling of conventional cleaning products. This means a decreased risk of adverse short- and long-term health impacts related to diluted products that are absorbed firstly through inhalation and secondly, skin contact. Study findings reveal:

Skin Contact: Elimination of mild irritation to severe burns with symptoms of redness to blisters and pain associated with skin contact.

Inhalation: Elimination of inhalation symptoms ranging from irritation to corrosion of nose throat and respiratory tract with symptoms of coughing and difficulty breathing. AO not used with spray bottle, but with soaked cloth.

Slips and Falls: Improved average coefficient of friction of floors after cleaning with AO in range of 0.59 - 0.69. Considered a low to moderate risk of slipping when dry.

Evidence from a recent study at the Chatham-Kent Health Alliance also shows marked decrease in rates of slips and falls incidents since the implementation of AO cleaning.

Advantages of Aqueous Ozone - Cleaning Performance

Staff evaluation of the AO process revealed the following:

Performs as well, or better, for general purpose cleaning (surfaces not requiring disinfection) determined through two rounds of tests by VCH Infection Control.

Greater consistency in cleaning practice, as housekeepers don't have to switch between multiple chemicals for different surface types.

No streaks on surfaces or windows, giving the surface a cleaner appearance.

Potential to reduce transmission of hospital acquired infections as AO includes some disinfection properties, while general purpose cleaners currently used do not.

Floors and furniture are maintained for longer time periods as they are not subjected to the corrosive properties of chemical cleaners.

Green Seal and LEED Certified

Both AO systems evaluated meet compliance with standard GS-37 governing industrial cleaning products: "Green Seal Standard for Cleaning Products and Industrial & Institutional." Key areas of the standard include Product Performance, Human Health Protection, Environmental Protection, Packaging, Training and Labeling.

The Green Seal also allows for Leadership in Energy and Environmental Design (LEED) certification under the Indoor Air Quality (Credit 3.3) category, providing other provisions of the Green Cleaning: Purchase of Sustainable Cleaning Products and Materials are met. Intent – *Reduce the environmental impacts of cleaning products, disposable janitorial paper products and trash bags.*

A co-benefit also includes Green Cleaning status under the Healthier Hospitals Safer Chemicals framework and possible Level 1 Commitment.

Credits

We would like to thank the following collaborators for their commitment to this project:

Sonja Janousek, Lower Mainland Facilities Management

Infection Prevention & Control Department, Vancouver General Hospital

Lower Mainland Business Initiatives & Support Services, Vancouver Coastal Health

Amritpal Brar, Crothall Healthcare

Christine Obee, Prism Engineering

CleanCore Technologies

Tersano Inc.

** *Bello, A., M. Quinn, M.M., Perry, M.J., Milton, D.K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks-a pilot study of hospital cleaners. Environmental Health, 8(11) 1.*

Summary of Environmental Results if Aqueous Ozone Used

Environmental	Value	Notes
Quantity of general cleaners used (litres/yr)	↓ 27,287 (76%)	
Chemicals in general cleaners (kg/yr)	↓ 2,715 (67%)	Possible range 30 – 100% • 815 – 2,715
Chemicals of Concern in general cleaners (kg/yr)	↓ 2,538 (70%)	Possible range 30 – 100% • 762 – 2,538
Water use (litres/yr)	↓ 2,973,447 (90%)	Reduced water costs: • Purchase of water • Waste water cost
Packaging waste (# containers/yr) **Plastic** **Cardboard**	↓ 17,100 (83%↓) 4,393 (72%↓)	~ Reduced # collection lifts ~ Reduced labour for: • materials handling • secure recycling markets (* plastic market)
Transportation delivery GHG emissions / LCA	↓	No actual estimates

Table 6: Summary of Environmental Results if AO Used

Summary of Other Benefits to Using Aqueous Ozone

Researchers are confident in saying the use of AO brings with it possible reduced risks to human health including reduced slips and fall incidents, skin contact and issues associated with inhalation of chemicals. Further, enhanced cleaning performance was noted including a greater consistency in cleaning practices, no streaks on surfaces, the potential to reduce Hospital Acquired Infections, and longer life/reduced deterioration of floors and furniture. The technology also meets EcoLogo and Green Seal standards, can provide LEED credits and forms part of the Healthier Hospitals Safer Chemicals Challenge framework. While transportation and LCA impacts could not be fully evaluated in this study, it is expected that with reduction of transportation for product delivery there would be associated GHG reductions.

From a financial perspective, it would cost less to use AO than the five regularly used cleaning chemicals. Other costs would also be reduced, including water and sewer charges, packaging and recycling costs as well as reduced labour costs associated with slips and falls and other health impacts.

Very small increased electricity costs would occur as a result of running the AO unit.

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CONCISE COMMUNICATION

Evaluation of Hospital Floors as a Potential Source of Pathogen Dissemination Using a Nonpathogenic Virus as a Surrogate Marker

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Hospital floors are frequently contaminated with pathogens, but it is not known whether floors are a potential source of transmission. We demonstrated that a nonpathogenic virus inoculated onto floors in hospital rooms disseminated rapidly to the hands of patients and to high-touch surfaces inside and outside the room.

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Effective disinfection of contaminated surfaces is essential to prevent nosocomial transmission of pathogens such as *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus*, and norovirus.[1] Efforts to improve disinfection usually focus primarily on surfaces that are frequently touched by the hands of healthcare workers or patients (eg, bed rails and call buttons). Notably, hospital floors are often heavily contaminated[2–4] but are not considered an important source for pathogen dissemination because they are rarely touched. However, floors are frequently contacted by objects that are subsequently touched by hands (eg, shoes, socks, slippers). In addition, it is not uncommon for high-touch objects such as call buttons and blood pressure cuffs to be in contact with the floor (authors' unpublished observations). Therefore, we hypothesized that floors might be an underappreciated reservoir for pathogen transmission.

Benign surrogate markers, such as viral DNA and nonpathogenic viruses, provide a powerful tool to study routes of pathogen transmission. In healthcare and community settings, inoculation of these markers onto high-touch surfaces (eg, door knobs, telephone handles) has been followed by widespread dissemination to environmental surfaces and hands.[5-6] In the current study, we used bacteriophage MS2, a nonpathogenic, nonenveloped RNA virus, to examine the potential for dissemination of microorganisms from floors of isolation rooms to the hands of patients and to high-touch surfaces inside and outside of rooms.

METHODS

The study protocol was approved by the Cleveland Veterans Affairs Medical Center's Institutional Review Board. Bacteriophage MS2 15597-B1 (American Type Culture Collection) was prepared as previously described.[7] Ten ambulatory patients in contact precautions for *C. difficile* infection or carriage of methicillin-resistant *S. aureus* were enrolled. For each patient, a 30×30 cm area of the wood laminate floor adjacent to the bed was inoculated with 2 mL of sterile water containing 1×10^8 plaque-forming units of MS2/mL and allowed to air dry. Patients were not aware of the precise area of inoculation. Hospital personnel were not aware of the study. The protocol for cleaning of contact precautions rooms included daily disinfection of high-touch surfaces with bleach wipes each morning but floors were cleaned only if visibly soiled; compliance with daily disinfection was monitored with fluorescent markers with more than 85% of sites demonstrating marker removal during the study. Preliminary experiments demonstrated that the MS2 inoculum persisted on wood laminate floors for at least 3 days, with a 1 to 2 log decrease in recovery attributed to desiccation.

On days 1, 2, and 3 after inoculation of MS2, sterile premoistened swabs (BBL CultureSwabs; Becton Dickinson) were used to sample environmental sites, patients' hands, and the soles of patients' footwear in the late afternoon. Environmental sites inside the inoculated room were categorized as being surfaces less than or equal to 3 feet (bed rails, bedside table, call button, telephone, bed linen) or more than 3 feet (night stand, sink, door knob, chair, light switch, pulse oximeter, and intravenous infusion pole) from the patient bed; or portable equipment; or personal items (wheelchairs, cell phones, books, clothing) (Figure 1). Environmental sites outside the inoculated room included adjacent rooms (bed rail, bedside table, call button, telephone, and floor) and the nursing station

FIGURE 1. Illustration of high-touch surfaces sampled. Star, surfaces less than or equal to 3 feet from the center of the bed; square, surfaces more than 3 feet from the center of the bed; circle, personal items.

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TABLE 1. Recovery of Bacteriophage MS2 From Surfaces and Patients on Days 1, 2, and 3 After Inoculation of the Floor Adjacent to the Patient's Bed

	No. positive/ no. sampled (%), mean ± SEM $\log_{10}$ PFU recovered		
Variable	Day 1	Day 2	Day 3
Patients			
Hands	4/10 (40.0), 1.0 ± 0.4	5/8 (62.5), 1.5 ± 0.7	3/7 (42.9), 1.2 ± 0.3
Footwear	10/10 (100), 4.0 ± 0.6	8/8 (100), 3.9 ± 0.5	6/7 (85.7), 3.4 ± 0.9
High-touch surfaces			
≤3 feet from the bed			
Total surfaces	32/55 (58.2), 2.3 ± 0.2	28/45 (62.2), 1.8 ± 0.2	30/39 (76.9), 1.4 ± 0.2
Side bedrail	5/10 (50.0), 2.0 ± 0.3	5/8 (62.5), 1.9 ± 0.3	6/7 (85.7) 1.1 ± 0.2
Call button	5/10 (50.0), 1.2 ± 0.5	5/8 (62.5), 1.6 ± 0.7	5/7 (71.4), 1.6 ± 0.6
Phone	3/10 (30.0), 1.7 ± 0.3	4/8 (50.0), 1.1 ± 0.5	3/7 (42.9) 1.1 ± 0.1
Bed linens	9/10 (90.0) 3.0 ± 0.4	6/8 (75.0) 3.0 ± 0.6	7/7 (100), 1.9 ± 0.3
Foot board	4/5 (80.0), 3.3 ± 0.9	3/5 (60.0), 1.4 ± 0.6	4/4 (100), 1.6 ± 0.8
Tray table	6/10 (60.0), 2.2 ± 0.5	5/8 (62.5), 1.7 ± 0.3	5/7 (71.4), 0.7 ± 0.2
>3 feet from the bed			
Total surfaces	23/58 (39.7), 1.2 ± 0.2	34/50 (68.0), 1.4 ± 0.2	15/44 (34.1), 0.8 ± 0.2
Side table	4/8 (50.0), 1.0 ± 0.2	6/6 (100), 2.0 ± 0.5	5/5 (100), 0.7 ± 0.3
Pulse oximeter	3/7 (42.9), 0.7 ± 0.3	4/6 (66.7), 1.3 ± 0.3	1/7 (14.3), 0.7
IV pole	0/7 (0), 0	2/5 (40.0), 1.1 ± 0.02	1/6 (16.7), 0.3
Chair	5/8 (62.5), 1.3 ± 0.2	7/7 (100), 1.8 ± 0.4	3/5 (60.0), 0.4 ± 0.2
Door knob	4/10 (40.0), 2.0 ± 0.3	5/8 (62.5), 0.9 ± 0.2	2/7 (28.6), 1.2 ± 0.4
Light switch	1/10 (10.0), 0.78	3/8 (37.5), 0.1 ± 0.1	0/7 (0), 0
Sink	6/8 (75.0), 1.2 ± 0.4	7/8 (87.5), 1.4 ± 0.3	3/7 (42.9), 1.3 ± 0.4
Personal items[a]	6/12 (50.0), 1.5 ± 0.5	4/9 (44.4), 1.7 ± 0.3	4/8 (50.0), 1.2 ± 0.4
Portable equipment[b]	1/3 (33.3), 0.8	3/13 (23.1), 1.2 ± 0.5	3/3 (100), 0.7 ± 0.5
Adjacent rooms			
Floor	N/A	5/5 (100), 1.9 ± 0.1	8/10 (80.0), 1.4 ± 0.4
Environment[c]	N/A	2/5 (40.0), 0.9 ± 0.1	1/9 (11.1), 0.7
Nursing stations[d]	9/17 (52.9), 0.5 ± 0.1	15/32 (46.9), 0.2 ± 0.1	17/27 (63.0), 1.0 ± 0.2

NOTE. IV, intravenous; PFU, plaque-forming units; SEM, standard error of the mean.
[a]Personal items included wheelchairs, cell phones, books, and clothing.
[b]Portable equipment included medication cart, glucometer, and phlebotomy cart.
[c]Surfaces included bed rails, bedside table, call button, and telephone.
[d]Surfaces included computer keyboards, computer mouse, and telephones.

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(computer keyboards, computer mouse, telephones) on the same ward. For large surfaces, a 30 × 30 cm area was sampled; for smaller surfaces, such as telephones, the entire surface area was sampled. Swabs were vortexed for 1 minute in sterile water to elute the bacteriophage and serially diluted aliquots were cultured to quantify virus particles.[7] For each set of cultures, a negative control swab opened in the patient room but not placed in contact with surfaces was processed identically.

The Fisher exact test was used to compare the percentages of positive cultures on surfaces less than or equal to 3 feet vs more than 3 feet from the bed and on days 1, 2, and 3. Paired *t* tests were used to compare mean number of plaque-forming units recovered. Data were analyzed with SPSS statistical software, version 10.0 (IBM).

RESULTS

Of the 10 patients on 4 wards, 7 had samples collected for 3 days; 2 patients were discharged after 1 day and 1 was discharged after 2 days. Table 1 provides a summary of the culture results. MS2 was detected on multiple surfaces of all patient rooms by 1 day after inoculation. On days 1 and 3, the concentration of MS2 was higher for surfaces less than or equal to 3 feet vs more than 3 feet from the bed ($P < .02$ for both comparisons) and more sites were contaminated at less than or equal to 3 feet (day 1, $P < .06$; day 3, $P < .0001$). MS2 contamination was not significantly different at less than or equal to 3 feet vs more than 3 feet on day 2.

Contamination was common on high-touch surfaces in adjacent rooms, in the nursing station, and on portable equipment. Portable equipment included wheelchairs, medication carts, vital signs equipment, and pulse oximeters. All negative control swabs were negative for MS2.

DISCUSSION

We found that a nonpathogenic virus inoculated onto floors in hospital rooms disseminated rapidly to the footwear and hands of patients and to high-touch surfaces in the room. The virus was also frequently found on high-touch surfaces in adjacent rooms and at nursing stations. These results suggest that floors in hospital rooms could be an underappreciated source for dissemination of pathogens.

It is likely that both patients and healthcare personnel contributed to dissemination of the virus. MS2 virus present on patients' footwear was probably acquired during direct contact with the contaminated floor site adjacent to the bed. During removal of footwear, patients could easily acquire the virus on their hands, with subsequent transfer to touched surfaces and to other skin sites. The finding of contamination in adjacent rooms and in the nursing station clearly suggests that healthcare personnel contributed to dissemination after acquiring the virus during contact with contaminated surfaces or patients.

Our findings have important implications. Studies are needed to assess the potential for modes of dissemination from floors other than footwear. For example, wheelchairs and other wheeled equipment could disseminate pathogens.[8] If additional evidence demonstrates dissemination from floors, studies will be needed to assess the efficacy of current floor cleaning strategies and to evaluate other methods to interrupt dissemination. Because nonsporicidal disinfectants are often used on floors in rooms of patients with *C. difficile* infection, there is a particular need for data on how effectively the burden of spores is reduced on floors. Finally, studies in nonhospital settings are needed. For example, floors in community households have been shown to be frequently contaminated with *C. difficile* spores.[9]

Our study has some limitations. We studied dissemination of a virus. However, previous studies have demonstrated that transfer efficiency of MS2 and bacteria from fomites to fingers is comparable.[10] The concentration of virus applied to the floors was high, so our results are likely to reflect a worst-case scenario. We cannot exclude the possibility that results might vary with different types of floors. However, we demonstrated similar recovery of MS2 from different types of inoculated dry surfaces (authors' unpublished data).

In summary, we demonstrated that a nonpathogenic virus inoculated onto floors in hospital rooms disseminated rapidly to the hands of patients and to high-touch surfaces inside and outside the room. These findings provide further evidence that benign surrogate markers, such as nonpathogenic viruses, can provide a powerful tool to study routes of pathogen dissemination. Studies are needed to investigate the potential for contaminated hospital floors to contribute to pathogen transmission.

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Why you should be talking about indoor air quality

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Expert Panel Discussion Speaker Bio and Contact information:

Expert Panel Bio's

Bob Dehler, Engineering Program Manager, Minnesota Department of Health

Bob has been with the Minnesota Department of Health for over 12 years. For the last 7 years, Bob has led the Engineering Services Section that enforces construction requirements for healthcare facilities in Minnesota. Bob and his team at the MDH have experience with Life Safety Code (NFPA 101 and NFPA 99), Minnesota rules and statutes regarding state licensure and federal certification of medical facilities and municipal engineering and project management.

Bob graduated from the South Dakota School of Mines and Technology with a degree in civil engineering and is a licensed engineer in the state of Minnesota.

As the manager of the engineering services section, he is responsible for the plan review and inspections of construction in health care facilities throughout the state of Minnesota. The section enforces licensure requirements of the State of Minnesota and federal certification requirements of the Centers for Medicare/Medicaid Services (CMS).

Bob is a member of ASHE (American Society of Healthcare Engineers), NFPA (National Fire Protection Association and the Healthcare Guidelines Revision Committee (HGRC) of The Facility Guidelines Institute (FGI).

Tom Holm, President of Green Science Solutions

With more than 30 years of experience in science and technology, Tom's expertise with effective sustainable cleaning and disinfecting products allows him to provide his clients with products that fit their needs. Tom has science-based start-up experience and a wealth of knowledge to inform organizations or consumers looking to create safe and healthy indoor environments. Green Science Solution's core vertical focus is schools, athletic programs, long-term care facilities, transportation services, community, and faith-based organizations.

Brian Evan, PE, Mechanical Engineer at Wold Architects and Engineers

Bachelor of Science in Mechanical Engineering from University of Minnesota - Duluth.

Brian's passion for design started when he was a kid, designing and building all kinds of contraptions in his grandfather's woodshop. He has taken that passion and channeled it over the past 10+ years to partner with clients to create efficient and cost-effective facilities to meet the needs of their community best. Brian's experience gives him a deep understanding of sustainable and seamless mechanical systems' high-level expectations. His healthcare knowledge leads to the design of efficient and reliable systems that create comfortable environments for patients, their families, and staff. Healthcare is a universal need, and he aims to design state-of-the-art healthcare facilities where he would feel very comfortable sending his own family members for care.

Eric Krause-CHFM,CHC, Regional Manager-Facilities Engineering, Allina Health

Eric Krause serves as the Regional Facilities and Engineering Manager, providing day-to-day Facilities and Engineering support for United, Mercy, Unity Hospitals as well as Children's Hospital of St Paul. His primary responsibilities include leadership of Facilities, Regulatory Compliance, and Construction for the previously mentioned sites, which have a combined total of over 2.6 million square feet in size and licensed for 1,213 patient beds. Eric has a Master Plumbing and a 1B boiler Operators license. He is also a Certified Healthcare Facilities Manager (CHFM), Certified Healthcare Constructor (CHC) and serves as the President Elect for the Minnesota Healthcare Engineers Association and is the current President for the Twin City Healthcare Engineering Association.

Michael Puncochar, Senior Project Manager, Healthcare Facility Construction Expert, LS Black Constructors

Mike has been in the construction industry for more than 19 years, 7 of which have been in the healthcare sector. He was vast experience managing the construction of specialty healthcare clinics across the Minneapolis/St. Paul metro area. Michael is a Certified Healthcare Constructor, LEED Green Associate and is currently the Secretary of the Twin City Healthcare Engineering Association (TCHEA).

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Green Science Solutions
www.greensciencesolutions.com
(651) 646-5339

Stabilized Aqueous Ozone™

Who We Are: **Green Science Solutions** is a Minnesota-based, woman/minority-owned company that distributes safe, healthy, and green cleaning, sanitizing and disinfecting products.

What is SAO? Stabilized Aqueous Ozone™ is a powerful oxidizing cleaner and disinfectant that is generated onsite from water and oxygen. SAO is patented technology from Tersano. SAO is:

- **Easy to Use** – One product that cleans, sanitizes, disinfects, and deodorizes on all types of surfaces, glass, metal, rubber, carpet, porcelain, wood, etc. SAO can be applied using mop & bucket, backpack sprayers, spray bottles, electrostatic sprayers.
- **Safe** – **Contains no chemicals**. SAO has an SDS rating of 0-0-0-A. No PPE required means it's safe for staff; safe for visitors, animals, and pets; safe for the environment; and safe for equipment.
- **Powerful** - 1.5x more powerful than traditional chlorine bleach. Cleans, kills molds, fungi, bacteria, and viruses. Eliminates odors.
- **Effective against SARS-CoV-2 virus**. Tests against surrogate virus showed 99.99% reduction @ 1 minute.
- **EPA Approved** as a registered pest device with efficacy tests supporting pathogen reduction claims.
- **Environment Friendly –** Because it is generated on-site with cold water, it eliminates plastic containers, transportation pollution, hot water usage, and supply chain concerns.

Where is SAO Used: Aqueous ozone is proven technology that has been in use in the United States and other countries for over 50 years. Aqueous ozone is used in the food and drug industry to clean and sanitize equipment; water and wastewater treatment industry to kill bacteria and viruses; swimming pools to sanitize water; athletic and fitness centers to clean and disinfect; schools and universities to clean and disinfect classrooms and dormitories; restaurants and food service establishments to clean and sanitize surfaces; athletic arenas to clean restrooms and public spaces; and many more…

How much does SAO Cost: The initial equipment investment for a Dispenser and 2 filter cartridges costs around $2,000. After that, SAO costs between $0.30 - $045 per gallon of SAO generated. Most users find this to be as savings of 40%-80% over current chemical costs.

Ozone Facts and *Fallacies*

- ***Fallacy:*** ***Ozone is dangerous, corrosive and off-gasses***
- **Fact:** **Ozone has been safely used in thousands and thousands of applications with no danger to humans or facilities**
- ***Fallacy:*** ***Ozone is cost-prohibitive or expensive***
- **Fact:** **Ozone can provide a return on investment often in 1-2 years; after which, it provides a significant savings (labor, chemicals, energy, sewage); this in addition to product safety**
- ***Fallacy:*** ***Ozone is an oxidizer only***
- **Fact:** **Ozone is a highly efficacious sanitizer, disinfectant and purifier; these provided by its strong oxidation capabilities**
- ***Fallacy:*** ***Ozone is not as strong as traditional sanitizing chemicals***
- **Fact:** **Ozone is exponentially stronger and more efficacious than all standard sanitizers**
- ***Fallacy*** ***Ozone is a new product***
- **Fact:** **Ozone has been in commercial use since 1906**

CLEANING AND DISINFECTION FOR ASTHMA SAFE SCHOOLS

Nancy P. Bernard, MPH, REHS

Fall 2019 School EHS Workshops

Washington State Department of Health
School Environmental Health & Safety Program

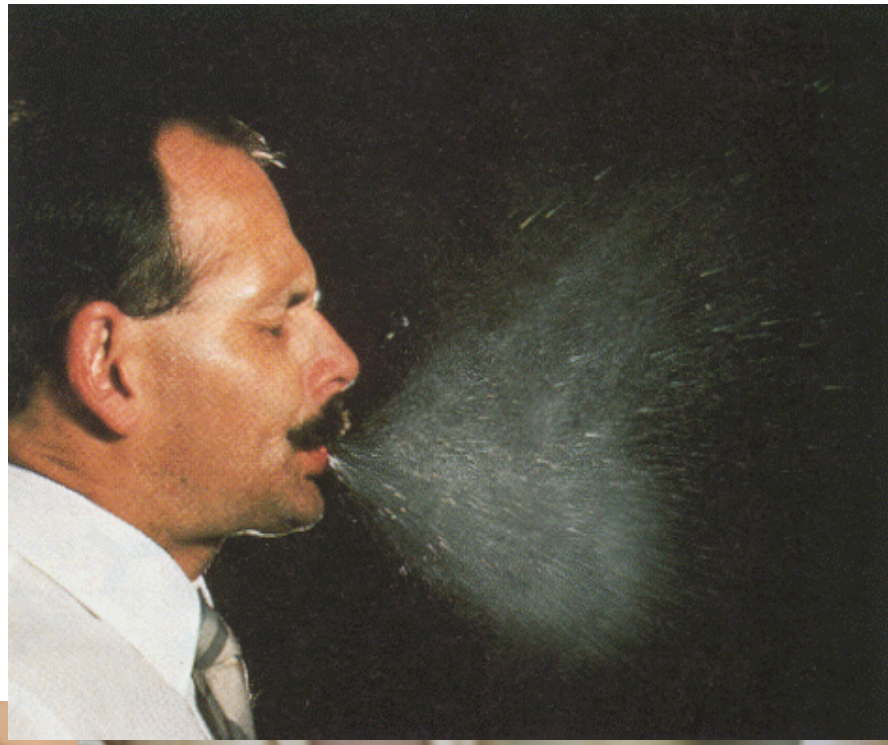
Our Mission

To protect and improve the Environmental Health and Safety condition of schools in Washington state.



Spreading Germs

- Foodborne
- Waterborne
- Person-to-Person
- Airborne
- Contaminated surfaces



Prevention – Everyone's Job!

- **Wash your hands with plain soap and water – often!**
- **Cover your cough or sneeze.**
- **Avoid touching your eyes, nose, or mouth.**
- **Stay out of spit zones.**
- **Get vaccinations.**
- **Good ventilation.**
- **Stay home when ill.**
- **Support Public Health.**

Hand Antiseptics

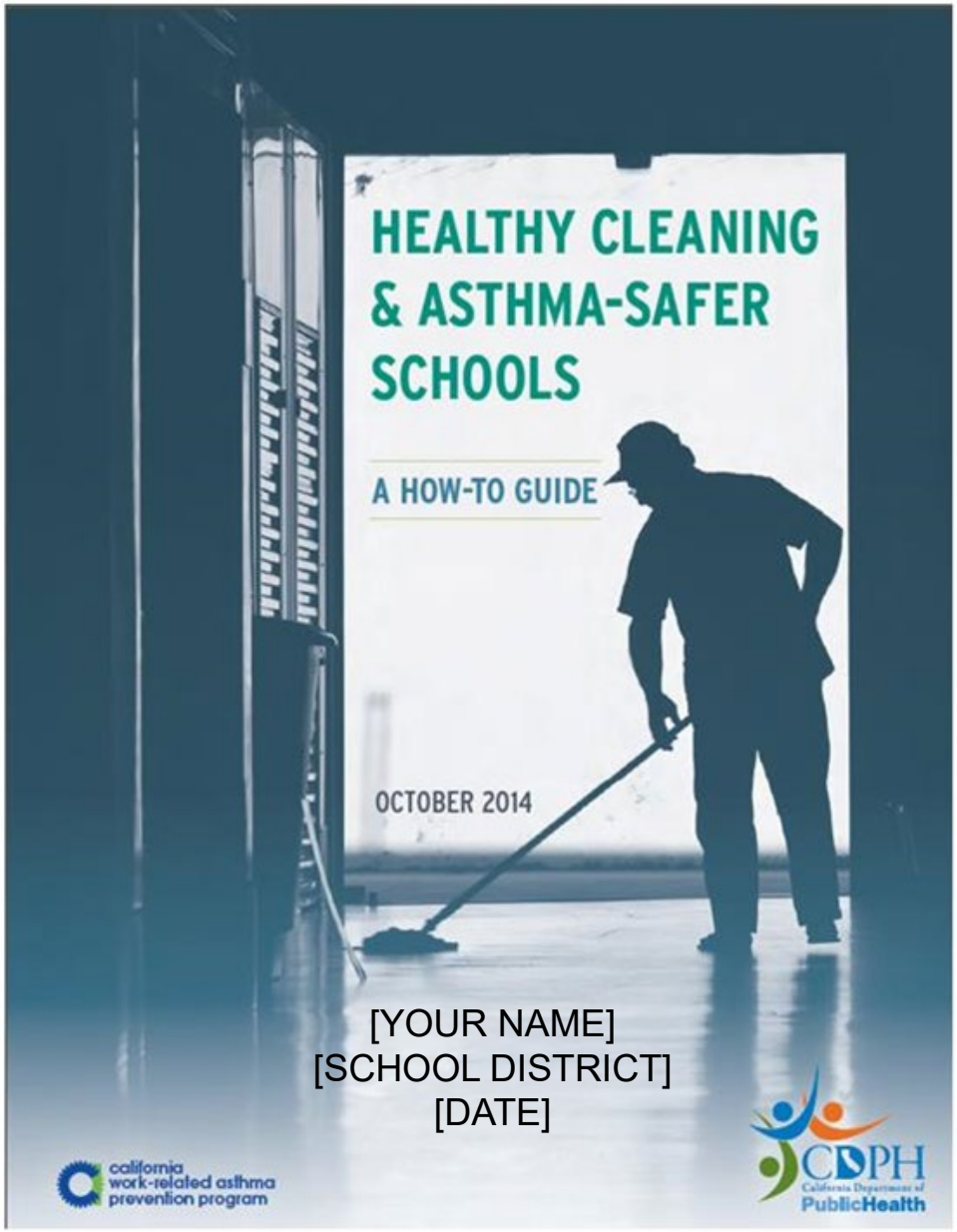
- Not a substitute for hand washing
- Not effective on dirty hands
- At least 60% alcohol
- Hands should stay wet for 10-15 seconds
- Not considered effective on non-enveloped viruses or spores
- Flammable / poison
- Fragrance free
- Not recommended:
  - Benzalkonium chloride / “quat” based / non-alcohol / “natural”

CDC: Show Me the Science:
http://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html

Schools Need An Infection Control Plan

- **Clear Protocol**
- **Independent third party certified cleaning products**
  - **Ingredients not known to contribute to asthma, cancer, respiratory irritation, liver and kidney disease**
- **EPA registered sanitizers-disinfectants**
- **Best practices & procedures**
- **Cleaning equipment designed to reduce the amount of chemicals required**
  - **Walk-off mats, HEPA filters, microfiber, etc.**
- **Training programs**

Staff and students deserve to work and learn in a safe and healthy school environment, and they can, since safer cleaning products and methods exist.

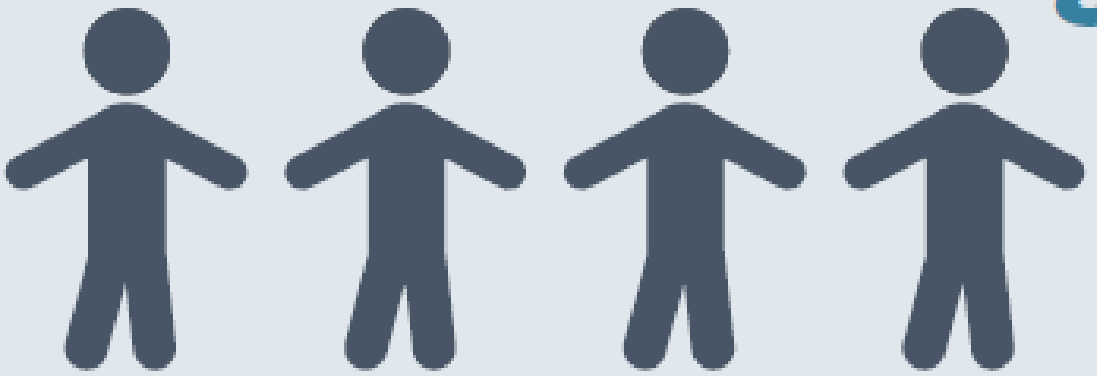


Work-Related Asthma in California

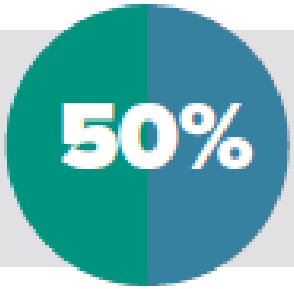
20%

1 in 5 worked as a cleaner.

80%



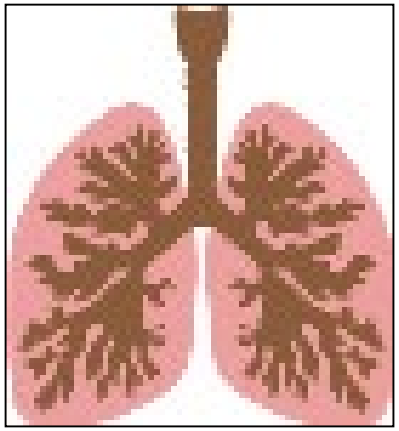
4 of 5 of workers did not clean but were around during cleaning or after cleaning just happened.



Half had new asthma that started after they began work. On-the-job exposures likely caused their asthma.

Health Hazards of Cleaning Products

- Causing asthma and making it worse
- Irritating skin, eyes, nose, throat, causing headaches
- Disrupting or acting like hormones
- Causing cancer



Asthma: significant problem in schools

Poor indoor air quality makes it worse

Work -Related Asthma

New asthma from work

or

Asthma gets worse while at work

New Asthma

People may get asthma as adults
from exposures at work

Asthmagens:
Ingredients that may cause asthma

Small amounts
⟶ lifetime impact

Safer Products Might Have Prevented Illness and Saved Custodian's Job

Work-Aggravated Asthma

Substances including asthmagens that may make asthma worse at work:

- Strong odors
- Irritating chemicals
- Dust
- Cold air
- Animal dander
- Mold
- Plant materials

Agricultural dust near school

Mold on wall

WRA + Cleaning Products

Many with WRA didn't know specific ingredients.
Those who knew reported:

- Bleach
- Acid cleaners
- Disinfectants
- Carpet cleaner
- Floor stripper
- Ammonia
- Graffiti removers
- Mixing cleaning products, etc.

Learning and Productivity

Asthma: leading cause of school absences for a chronic illness

Hospital care cost $193 million for asthma in 2005-2007 in California

Schools lose money each day a student is absent

Lower academic achievement

Lower productivity among workers, more sick days

Solution: Cleaning for Asthma-Safe Schools

Protects custodians, staff, children's health

Improves indoor air quality

Reduces environmental harm

Successes

Cost-savings

New equipment

Healthier environments

Reduced absenteeism

Fewer injuries

"Green products can clean just as well or better than some of the products we used that were not labeled or considered "green." –Livermore School District

Green Saves Green

School District Example:

Reduced cleaning chemicals

+

Changed cleaning procedures

=

28% cost savings

Green Saves Green

"By switching to greener cleaners, my custodians could see that we could save the district money and that could save their jobs." – Alameda Unified School District, California

"Financially, it's a wash, and the benefits are huge. Why would you not switch to green when it benefits everyone's health? It's a no-brainer." –Livermore Joint Valley Unified School District, California

Green Cleaning

Definition: Products and services that reduce health and environmental impact compared to other products and services used for the same purpose.

Green Cleaners

Won't cause cancer, impact reproductive health. Some are safer for asthma.

Green Cleaners

Improved air quality

Won’t pollute air or harm fish

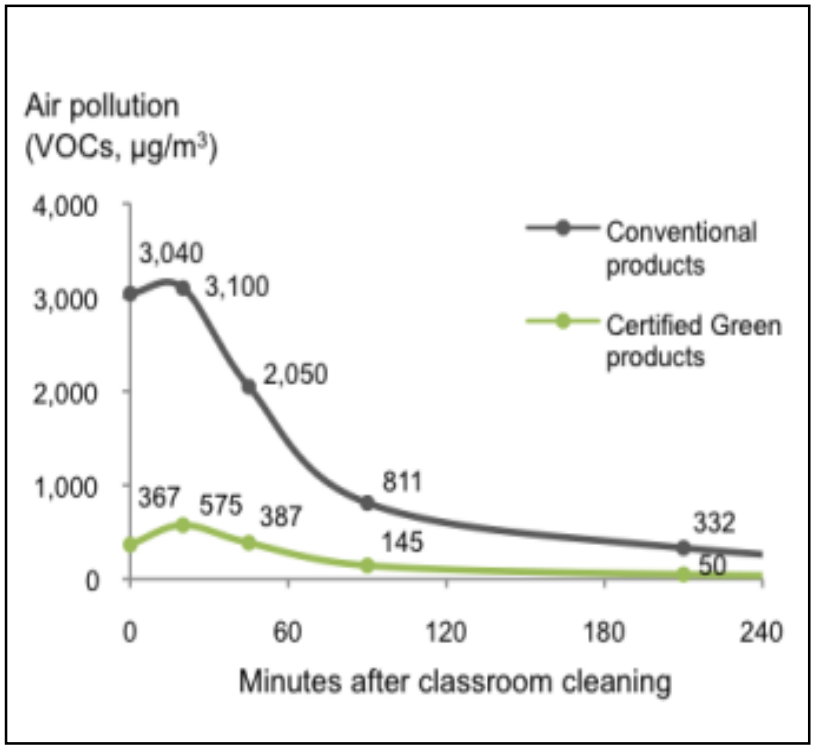
Certification Programs

Green Seal Industrial and Institutional Cleaners Standard (GS-37)

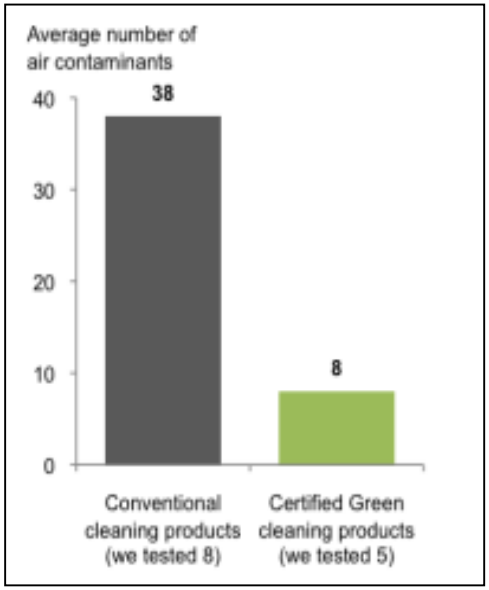
UL ECOLOGO Hard Surface Cleaners Standard (UL 2759)

Consider settings with vulnerable populations

Greener School Cleaning Supplies = Fresh Air + Healthier Schools



Green cleaning releases less air pollution



Green general purpose cleaners had fewer air contaminants

Greenwashing

- Selling you a “green” product that isn’t actually green.

- Third-party certified groups make sure products meet criteria to reduce risks to health and the environment.

Advertising and labels not always reliable

Greenwashing

Front of Bottle

Back of Bottle

Company's self-declared green products may not be safer or healthier

Microfiber

Important cleaning tools

- Little to no cleaning chemicals
- Less effort, absorbent, durable
- Prevent injuries, illnesses
- Avoid cross-contamination
- Simple to clean

Asthma-Safer Cleaning

- Update and maintain equipment
- Ventilate adequately and regularly change air filters
- Air fresheners not asthma-safer
- Clean has no scent

Asthma-Safer Cleaning

- Disinfect only when necessary
- Don't disinfect floors--no greater health protection
- High-risk areas to possibly disinfect: athletic departments, bathrooms, cafeterias, child care areas, kitchens, nurse health rooms

Steps

1. Create team
2. Train team on asthma-safer cleaning
3. Inventory products
4. Select certified products to test
5. Arrange vendor presentations, select vendors
6. Test and evaluate products
7. Share your successes, set district policies

Outcomes

- Custodians: experts in district
- Leaders become knowledgeable about healthier products

  "Let's pick a different product. This one has asthmagens."
- Less absenteeism
- Reduce cleaning budgets
- Serve as a model of success

Clean – Sanitize – Disinfect?

- **Cleaners**, **Soaps**, **Detergents**
  - Remove dirt/organics.
- **Sanitizers**
  - Reduce germs from surfaces – 99.9%.
- **Disinfectants**
  - Destroy or inactivate germs and prevent them from growing.

Cleaning and/or Disinfecting ?

- High touch surfaces
  - Door handles
  - Faucets
  - Keyboards
  - Railings
  - Phones
  - Drinking Fountains
- Bathrooms
- Drinking Fountains
- Where someone is ill

Restrooms

- Clean/disinfect bathroom at least daily.
- Soap and paper towel dispensers full.
- Tempered (85^{o}-105^{o}F) water.
- WAC 246-366-060: “Adequate, conveniently located toilet and handwashing facilities shall be provided for students and employees.

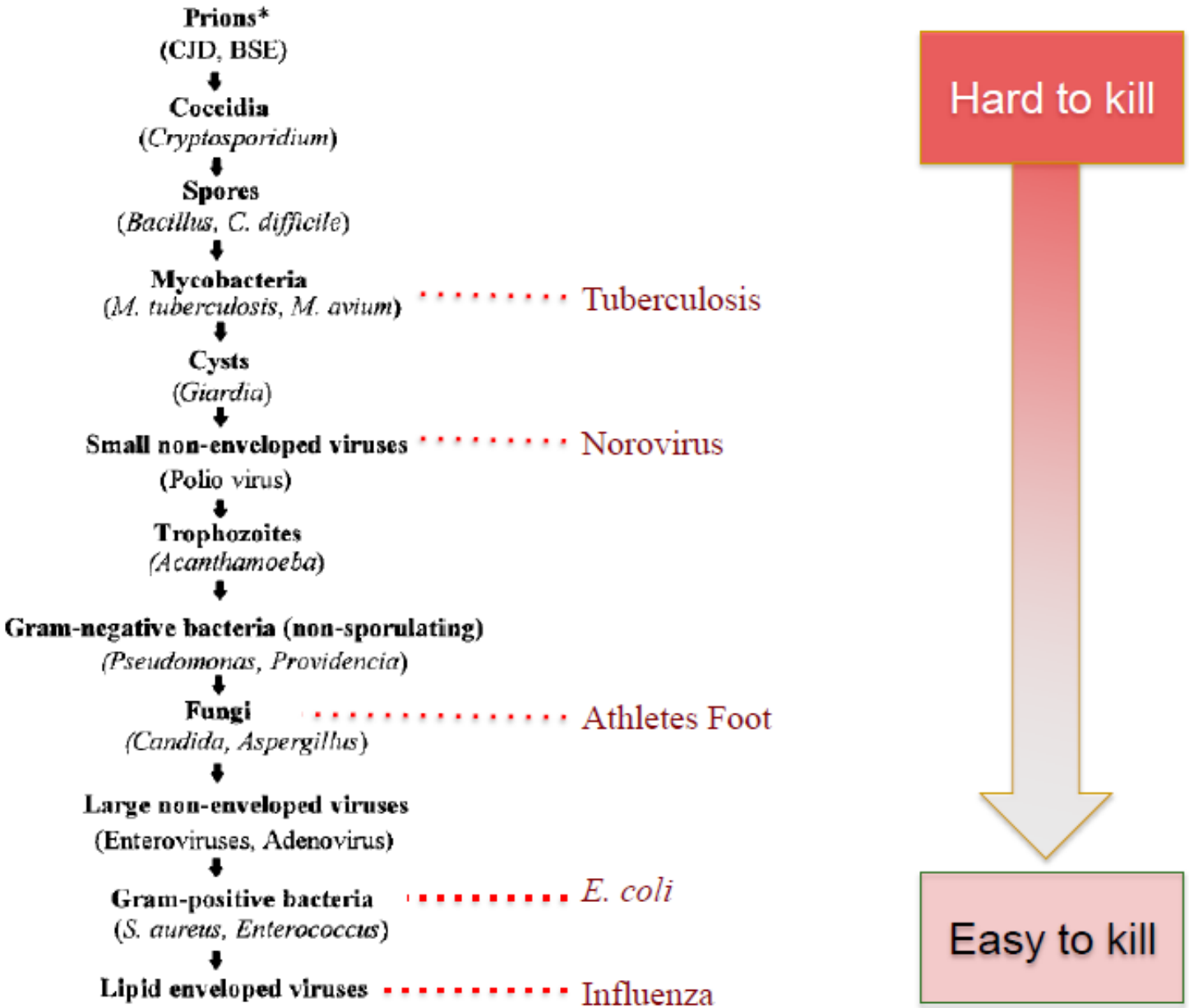


FIG. 1. Descending order of resistance to antiseptics and disinfectants. The asterisk indicates that the conclusions are not yet universally agreed upon.

Source: McDonnell & Russell, 1999

Characteristics of Selected Disinfectants

For More Information, see the 'Disinfection 101' document at www.cfsph.iastate.edu

Disinfectant Category	Alcohols	Aldehydes	Biguanides	Halogens: Hypochlorites	Halogens: Iodine Compounds	Oxidizing Agents	Phenols	Quaternary Ammonium Compounds (QAC)
Sample Trade Names	Ethyl alcohol Isopropyl alcohol	Formaldehyde Glutaraldehyde	Chlorhexidine Nolvasan® Virosan®	Bleach	Betadyne® Providone®	Hydrogen peroxide Peracetic acid Virkon S® Oxy-Sept 333®	One-Stroke Environ® Pheno-Tek II® Tek-Trol®	Roccal® DiQuat® D-256®
Mechanism of Action	•Precipitates proteins •Denatures lipids	•Denatures proteins •Alkylates nucleic acids	•Alters membrane permeability	•Denatures proteins	•Denatures proteins	•Denature proteins and lipids	• Denatures proteins • Alters cell wall permeability	• Denatures proteins • Binds phospholipids of cell membrane
Advantages	•Fast acting •Leaves no residue	•Broad spectrum	•Broad spectrum	•Broad spectrum •Short contact time •Inexpensive	•Stable in storage •Relatively safe	•Broad spectrum	• Good efficacy with organic material • Non-corrosive • Stable in storage	• Stable in storage • Non-irritating to skin • Effective at high temperatures and high pH (9-10)
Disadvantages	•Rapid evaporation •Flammable	•Carcinogenic •Mucous membranes and tissue irritation •Only use in well ventilated areas	•Only functions in limited pH range (5–7) •Toxic to fish (environmental concern)	•Inactivated by sunlight •Requires frequent application •Corrodes metals •Mucous membrane and tissue irritation	•Inactivated by QACs •Requires frequent application •Corrosive •Stains clothes and treated surfaces	•Damaging to some metals	• Can cause skin and eye irritation	
Precautions	Flammable	Carcinogenic		Never mix with acids; toxic chlorine gas will be released			May be toxic to animals, especially cats and pigs	
Vegetative Bacteria	Effective	Effective	Effective	Effective	Effective	Effective	Effective	YES—Gram Positive Limited—Gram Negative
Mycobacteria	Effective	Effective	Variable	Effective	Limited	Effective	Variable	Variable
Enveloped Viruses	Effective	Effective	Limited	Effective	Effective	Effective	Effective	Variable
Non-enveloped Viruses	Variable	Effective	Limited	Effective	Limited	Effective	Variable	Not Effective
Spores	Not Effective	Effective	Not Effective	Variable	Limited	Variable	Not Effective	Not Effective
Fungi	Effective	Effective	Limited	Effective	Effective	Variable	Variable	Variable
Efficacy with Organic Matter	Reduced	Reduced	?	Rapidly reduced	Rapidly reduced	Variable	Effective	Inactivated
Efficacy with Hard Water	?	Reduced	?	Effective	?	?	Effective	Inactivated
Efficacy with Soap/ Detergents	?	Reduced	Inactivated	Inactivated	Effective	?	Effective	Inactivated

? Information not found

Disclaimer: The use of trade names does not in any way signify endorsement of a particular product. For additional product names, please consult the most recent Compendium of Veterinary Products.

References: Linton AH, Hugo WB, Russel AD. Disinfection in Veterinary and Farm Practice. 1987. Blackwell Scientific Publications; Oxford, England; Quinn PJ, Markey BK. Disinfection and Disease Prevention in Veterinary Medicine, In: Block SS, ed., Disinfection, Sterilization and Preservation. 5th edition. 2001. Lippincott, Williams and Wilkins: Philadelphia.

the Center for Food Security & Public Health
Iowa State University
www.cfsph.iastate.edu

Disinfectants

Considered pesticides by Environmental Protection Agency (EPA)

Cannot be third-party certified by Green Seal or UL ECOLOGO

EPA's Design for the Environment has a safer disinfectants program

EPA's Design for the Environment

- **Antimicrobial Pesticide Pilot Project**
- **The DfE logo on an EPA-authorized antimicrobial pesticide label means that the product:**
  - **Is in the least-hazardous classes (III & IV) of EPA's acute toxicity)**
  - **Is unlikely to have carcinogenic or endocrine disruptor properties**
  - **Is unlikely to cause developmental, reproductive, mutagenic, or neurotoxicity issues**
  - **All ingredients reviewed**
  - **Does not require the use of agency mandated PPE**
  - **Has no unresolved efficacy failures**
  - **Has no unresolved compliance/enforcement action**

Disinfectants

Asthma-Safer Ingredients	Ingredients that may Cause Asthma
• Hydrogen Peroxide • Lactic Acid • Citric Acid • Alcohol-ethyl alcohol, isopropyl alcohol	• Quaternary ammonium compounds include alkyl dimethyl benzyl ammonium chloride, benzalkonium chloride, lauryl dimethyl benzyl ammonium chloride, didecyl dimethyl ammonium chloride • Bleach (sodium hypochlorite) • Acetic acid (found in vinegar) • Thymol (skin sensitizer, suspected asthmagen) • Glutaraldehyde • Peracetic acid (peroxyacetic acid)

Safer Products and Practices for Disinfecting and Sanitizing Surfaces

San Francisco Department of the Environment

Table 1. Summary of Health and Environmental Attributes of 11 Active Ingredients Commonly Found in Surface Disinfectants and Non-food Contact Sanitizers

ACTIVE INGREDIENT	CANCER	REPRODUCTIVE TOXICITY	ASTHMA	SKIN SENSITI-ZATION	AQUATIC TOXICITY	PERSISTENCE
Caprylic Acid	No	No	No	No	Med acute	Low
Citric Acid	No	No	No	No	None	Low
Hydrogen Peroxide	No[1]	No	No	No	High acute	Low
Lactic Acid	No	No	No	No	None	Low
Ortho-Phenylphenol (OPP)	Known	Suspected	No	No	Very high acute	Low
Peroxyacetic Acid (PAA)	No	No	Yes	No	Very high acute	Low
Pine Oil	No[2]	No	No[3]	Yes	None	Low
Quaternary Ammonium Chloride Compounds (Quats)	No	Suspected	Yes	One compound[4]	High acute, med	Very High
Silver	No	No	No	No	High acute	Very High
Sodium Hypochlorite (Chlorine Bleach)	No	No	Yes	No	Very high acute	Low
Thymol	No	No[5]	No	Yes	High acute	Low

Chlorine Chemistry

$XCl + H_2O \rightarrow HOCl$ + By-product (specific to the type of chlorine)

HOCl (hypochlorous acid) $\xrightarrow{pH}$ $H^+ + OCl^-$ (hypochlorite ion)

HOCl + OCl^- = Free Chlorine $\rightarrow$ Active Available Disinfectants

At pH 6.0: ~97% HOCl

pH 7.5: ~50% of each

pH 8.5: ~9% HOCl

HOCl~60x-100x more effective than OCl^- at killing microorganisms

NaOCL – Sodium Hypochlorite (Bleach – 10-12% available chlorine)

$NaOCl + H_2O \rightarrow HOCl + Na^+ + OH^-$ (pH ~9-14)

Sodium Dichloroiso-cyanurate (organic stabilized chlorine form)

- 50% of the "total" available chlorine is present as "free" available chlorine
- The remainder is "combined" in the form of mono – or dichloroiso-cyanurate
- pH 6-7

On-site Generation – from NaCl or Sodium Dichlor tablets

Bleach

- Disinfectant, NOT a cleaner
- Make a fresh solution daily
- Never mix with ammonia or acid products
- Use gloves, ventilation, eye protection
- Emergency Eye Wash
  - DOSH Directive 13.0 July 15, 2011

http://www.lni.wa.gov/Safety/Rules/Policies/PDFs/DD1300.pdf

Washington State Department of Health

DOH 970-216 January 2015

Disinfecting and Sanitizing with Bleach
Guidelines for Mixing Bleach Solutions for Child Care and Similar Environments

Preparation Tips

- **Prepare** a fresh bleach solution each day in a well-ventilated area that is separate from children.
- **Label** bottles of bleach solution with contents, ratio and date mixed.
- **Use cool water. Always add bleach to cool water, NOT water to bleach.**
- **Wear** gloves and eye protection.
- **Prepare** solution in an area with an eye wash.

Disinfecting Solutions

For use on diaper change tables, hand washing sinks, bathrooms (including toilet bowls, toilet seats, training rings, soap dispensers, potty chairs), door and cabinet handles, etc.

Water	Bleach Strength* 2.75%	Bleach Strength* 5.25-6.25%	Bleach Strength* 8.25%
1 Gallon	1/3 Cup, plus 1 Tablespoon	3 Tablespoons	2 Tablespoons
1 Quart	1½ Tablespoons	2¼ Teaspoons	1½ Teaspoons

Sanitizing Solutions

For use on eating utensils, food use contact surfaces, mixed use tables, high chair trays, crib frames and mattresses, toys, pacifiers, floors, sleep mats, etc.

1 Gallon	1 Tablespoon	2 Teaspoons	1 Teaspoon
1 Quart	1 Teaspoon	½ Teaspoon	¼ Teaspoon

Disinfection of non-porous non-food contact surfaces can be achieved with 600 parts per million (ppm) of chlorine bleach. To make measuring easier, the strengths listed in this table represent approximately 600-800 ppm of bleach for disinfecting, and approximately 100 ppm for sanitizing. Chlorine test strips with a measuring range of 0–800 ppm or higher can also be used to determine the strength of the solution.

Contact your local health jurisdiction for further instructions on cleaning and disinfecting if specific disease or organisms are identified as causing illness in your program.

*Use only plain unscented bleach that lists the percent (%) strength on the manufacturer's label. Read the label on the bleach bottle to determine the bleach strength. For example, Sodium Hypochlorite…6.25% or 8.25%.

Steps to Follow

- **Clean** the surface with soap and water before disinfecting or sanitizing.
- **Rinse** with clean water and dry with paper towel.
- **Apply** chlorine bleach and water solution to the entire area to be disinfected or sanitized.
- **Air dry** for at least 2 minutes.

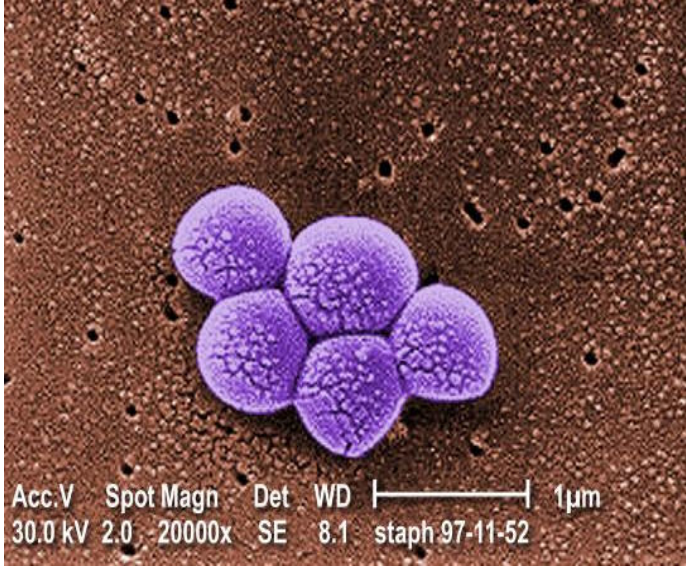
This chart was created by the Disinfection Workgroup led by the Washington State Department of Health. Workgroup members consist of staff from the Department of Early Learning, Snohomish Health District, Local Hazardous Waste Management Program in King County, Washington State Department of Ecology, the Coalition for Safety and Health in Early Learning, and the Washington State Department of Health.

Special Concerns

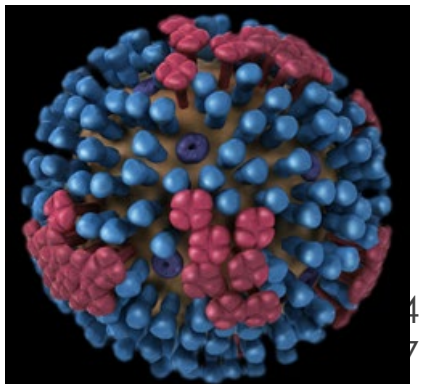
- Cake toilet deodorizers
  - paradicholorobenzene
- Citrus & Terpene Solvents
  - D-Limonene
- Nano Technology
  - nano-silver
- "Air Fresheners"
- Ozone generators
- Fragrances
- Anti-microbial soaps
  - Triclosan / Triclocarban

No Foggers

Specifics



- **Influenza**
- **Measles**
- ***Pertussis* (Whooping Cough)**
- **MRSA**
  Methicillin Resistant Staphylococcus aureus
- **Norovirus**
- ***Clostridium difficile* (C. diff)**



Norovirus

- **24-48 hour incubation period**
- **Sudden onset vomiting, diarrhea , cramping**
- **Low-grade fever**
- **Symptoms last 1-2 days**
- **Viruses in stool and vomit**
- **Can shed virus for days to 2 weeks after symptoms gone**
- **Highly contagious (as little as10 virus particles can cause illness)**
- **Lives for days on surfaces, where it can be "picked up" by others**

Vomit Events in School

Preparedness

- Identify disinfection products sufficient to inactivate norovirus, consider hard and soft surfaces
- Include a training program for clean-up employees, building maintenance, janitorial, and other affected staff.
- Ready personal protective equipment (PPE).

25' Radius

- People are kept out of the actual "spill' area
- Initial cleaning of gross visible contamination to minimize spread (including disinfectant and/or absorbent).
- Any uncovered food in the immediate area must be discarded.

Report & Monitor

- Notify local health of absenteeism and/or if possibly linked to kitchen service
- Cleaning and disinfection tools and equipment from food preparation, storage and handling areas.
- Monitor clean-up employees for symptoms for 72 hours.

Sporicide / Noro / EV D68 / Hanta

- Blood spills, diarrheal stools, rodent droppings 5000 ppm bleach
- Surfaces must be cleaned with soap and water first
- Usual 1:10 solution - 1 part bleach to 9 parts water
  - 6.25 %: 1 1/2 cups bleach/1 gallon water
  - 8.25 % bleach, (1:9) - 1 1/4 cups bleach/1 gallon water
  - Wet contact time - diarrheal stools: 5+ minutes
  - Wet contact time - Noroviruses: 1+ minute
  - Wet contact time - rodent droppings: 10 minutes
    - See WSDOH Hantavirus webpage for specifics.

➢ This is an extremely concentrated bleach solution. Protect eyes, skin, and clothing during preparation and use. Keep the area well ventilated.

Fungi/Ringworm/Athlete's Foot

- **1) Clean thoroughly with soap and water to remove all organic material.**
- **2) Apply chlorine bleach solution with a concentration of 2400 ppm (see below), leaving the surface wet for ten minutes or a 3600 ppm bleach solution staying wet for five minutes.**
- **3) Rinse with clean water.**
- **Fungus can be difficult to eliminate. Where persistent, multiple applications of bleach at a concentration of 5000 ppm, with drying in between, may be necessary to kill.**

OR

- **Use an EPA registered disinfectant where the label indicates it is effective against fungi.**

http://www.cdc.gov/fungal/diseases/ringworm/index.html

MRSA

(Methicillin-Resistant *Staphylococcus aureus*)

- Type of "staph" infection
- Often causes skin infections
- Resistant to (not killed by) penicillin
- Treatable with appropriate antibiotic
- Lives on surfaces for days – at least 70!

Athletic Areas / MRSA

- **Intact surfaces.**
- **Routine schedules for cleaning & disinfecting.**
- **All hard surfaces that may contact skin at least daily.**
- **EPA-approved disinfectant.**
- **Keep soap dispensers full – fragrance free, NOT antibiotic soap.**
- **Have separate cleaning mops (preferably micro-fiber) and buckets for athletic areas.**

Resources

- Cleaning for Asthma-Safe Schools (CLASS), *CDPH*
  - *https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/WRAPP/Pages/CLASS.aspx*
- *Cleaning for Healthier Schools – Infection Control Handbook 2010*
  - https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/eoha/pdf/CleaningforHealthierSchoolsFINAL2411pdf.pdf?la=en
- Green Clean Schools, Healthy Schools Campaign, The Quick & Easy Guide to Green Cleaning in Schools
  - https://healthyschoolscampaign.org/programs/green-clean-schools/
- Cleaning For Healthy Schools Toolkit
  - http://healthyschools.org/Cleaning-For-Healthy-Schools/
- Informed Green Solutions
  - http://www.informedgreensolutions.org/
- Characteristics of Selected Disinfectants
  - http://www.cfsph.iastate.edu/Disinfection/Assets/CharacteristicsSelectedDisinfectants.pdf
- *Safer Products and Practices for Disinfecting*, 2014, SFDE, RPN
  - http://www.sfenvironment.org/sites/default/files/fliers/files/sfe_th_safer_products_and_practices_for_disinfecting.pdf

Classroom Cleaning - Tips for Teachers

Cleaning for Health in the Classroom
Best Practices for Teachers

School Environmental Health and Safety Program

Washington State Department of Health

School custodial staff is responsible for cleaning schools. Some teachers choose to do additional cleaning. Here is how to ensure those efforts tackle dirt and germs safely and effectively.

Teach good handwashing habits - the #1 way to keep germs from spreading.

Use plain soap and water for handwashing – before eating, after using the bathroom, after recess, etc. Antibacterial soap is not recommended. Use plain fragrance-free soap. When there is no access to a sink, as on a field trip, alcohol-based (at least 60% alcohol, dye-free and fragrance-free) hand sanitizer or alcohol-based sanitizer wipes can be used. Hand sanitizers are not a substitute for handwashing. They are not effective when hands are dirty or greasy.

Cleaning for Health benefits all
- Lowers absenteeism
- Increases productivity
- Improves indoor air quality
- Reduces asthma and allergy triggers

Good to know:
- Kids are more vulnerable to chemical exposures.
- Many common cleaning products have ingredients that can harm health, especially the lungs.

Know the difference between Cleaning, Sanitizing, and Disinfecting.

Use the right product for the task:

- **CLEANING** removes dirt and most germs. Use soap and water. A third party certified green cleaner is preferred. **In the classroom, cleaning is the focus.**
- **SANITIZING** reduces germs to safe levels, for example in food service environments. Food code regulations have specific requirements for sanitizers in the cafeteria and kitchen.
- **DISINFECTING** kills most germs, depending on the type of chemical, and only when used as directed on the label.

- **In schools, custodial staff use disinfectants and sanitizers regularly only in high-risk areas** – nurse's office, bathrooms, cafeterias, kitchens, drinking fountains, sink and door handles, and athletic facilities; preferably, when students are not present. Overuse does not provide any additional protection and can expose students and staff to harmful chemicals.

Teachers can rely on basic *cleaning* to remove dirt and germs in the classroom.

If staff, besides trained custodial staff, needs to assist with classroom cleaning, they should use a school or district provided basic cleaner. A third party certified green cleaner is preferred.

- Custodial staff can **make a simple all-purpose cleaner for classrooms**. Mix one teaspoon of fragrance-free dish soap in a spray bottle filled with water. Spray on surface and scrub with paper towels or a microfiber cloth. Rinse and wipe dry to remove any residue.
- **Microfiber cleaning cloths improve cleaning** – the removal of dirt and germs. Dampened with water they are great dust removers. With soap and water, they remove most germs.
- **Disinfecting is the responsibility of school custodial staff**. They are trained to use disinfectants in a safe and effective manner and to clean up potentially infectious materials and body fluid spills – blood, vomit, feces, and urine. Contact your custodian or school nurse if students are ill and your classroom needs cleaning and disinfection. IF teachers use disinfectants, the district must provide training and supply the appropriate cleaner and sanitizer or disinfectant.

Students should never use disinfectants. Disinfectant wipes should not be used to clean hands. This includes Clorox wipes.

If students are helping:
- They should only use soap and water.
- Fragrance-free baby wipes could be used for quick cleaning.
- Most store-bought cleaning products are not safe for children to use.

Cleaning for Health in the Classroom
Frequently Asked Questions

School and Indoor Air Quality Program

Washington State Department of Health

How does cleaning reduce germs?

Cleaning works by removing dirt and organic matter that contains and protects germs. Soap breaks down oils and allows dirt, contaminants, and germs to be more easily removed. Cleaning with soap, water, and a microfiber cloth will remove most germs.

Why is handwashing better than hand sanitizer?

Soap and rubbing hands together under running water removes oil, dirt, and harmful surface germs. Hand sanitizer does not remove dirt in which germs hide and only kills a few easy-to-kill ones.

Why use plain soap for handwashing?

Antibacterial ingredients, in particular triclosan and quaternary ammonia compounds (quats), only kill a few types of germs and are unnecessary when washing hands. It doesn't matter if germs are alive or dead when they are washed down the drain.

What about non-alcohol hand sanitizers?

The U.S. Centers for Disease Control and Prevention only recommends hand sanitizers with at least 60% alcohol. Non-alcohol ones are even less effective than alcohol hand sanitizers.

How does this guidance affect fall classroom supply request lists?

Okay to Request	DO NOT Request
• Fragrance-free baby wipes.	• Disinfecting wipes.
• Paper towels (recycled content preferred).	• Non-alcohol-based hand sanitizer.

What are the issues with disinfecting wipes?

- Disinfecting wipes are often overused. They are not appropriate for general cleaning when an all-purpose cleaner or soap and water would suffice.
- Disinfecting wipes (e.g. Clorox, Lysol) usually contain quats and fragrance chemicals. These ingredients can trigger asthma and are associated with adverse health effects.
- Disinfectants can give a false sense of security because when they are not used exactly to label instructions, they don't work properly. Most disinfecting wipes require the surface to be cleaned first, and then remain visibly wet 4-10 minutes (dwell time) to be effective, requiring multiple wipes.

Why is it important to use fragrance-free products in school?

Fragrance is one of the most frequently identified allergens, can irritate the respiratory system, cause headaches, and exacerbate asthma.

What's so great about microfiber cloths?

Their split fibers create more surface area and are superior for removing dust, dirt, and germs. They are reusable and can be laundered or washed by hand.

Why should teachers not bring common cleaning products (including bleach) from home into the classroom?

- Some common cleaning products are dangerous when mixed. Never mix bleach with ammonia, acids, or other disinfectants. An example: Comet, containing bleach, would react with Windex, which contains ammonia, to form poisonous vapors.
- Common household cleaners and disinfectants may not be appropriate for schools and may cause allergic reactions or have other health impacts.
- Schools and districts must have a Safety Data Sheet for each chemical used in the school.

Guidelines for Cleaning, Disinfecting, and Handling Body Fluids in School – Appendix 8

OSPI *Infectious Disease Control Guide for School Staff* 2014

A. Standard Precautions
B. General Precautions
C. Hand Washing Procedures
D. Use of Gloves
E. Contaminated Needles, Broken Glass, or Other Sharp Items
F. Cardiopulmonary Resuscitation
G. General Housekeeping Practices
H. Disinfectants
I. Procedures for Cleaning and Disinfection of Hard Surfaces
J. Blood or Body Fluid Spills
K. Cleaning up vomit
L. Athletics
M. Procedures for Cleaning and Disinfection of Carpets/Rugs
N. Disposal of Blood-Containing Materials
O. Procedures for Cleaning and Disinfection of Cleaning Equipment
P. Procedures for Cleaning and Disinfection of Clothing and Linens soiled with Body Fluids
Q. Signs and Labels
R. Cleaning and Disinfecting Musical Mouth Instruments

THANK YOU!

Nancy P Bernard, MPH, REHS, CPSI
Nancy.Bernard@doh.wa.gov
360-236-3072

Resources available:

www.doh.wa.gov/schoolenvironment

Join my list serve for timely information!


Washington State Department of
Health

GREEN SCIENCE SOLUTIONS

Education

Toxic-Free Cleaning and Sanitizing with SAO®

Stronger, Faster, Safer than Bleach

Stabilized Aqueous Ozone (SAO®) is an on-site, on-demand 100% natural solution that sanitizes, disinfects and deodorizes.

TESTIMONIAL

"We do ATP testing on surfaces throughout the school and find it much cleaner and sanitized with using SAO. It does everything from cleaning mirrors and glass to disinfecting student areas. Its economical since we don't have to order other chemicals. It's safe for the kids.
Students don't have their skin touching chemicals that can be toxic such as a quat disinfectant. Our janitors here just love it."

-Russ Bode, Grounds and Maintenance Supervisor.
Goodridge Public Schools

Benefits

when used as directed, the Tersano SAO system:

- Kills 99.9% of the Coronavirus-2 surrogate, MHV-3
- Uses on-site generation eliminating the need to continually purchase chemical cleaning products
- Increases productivity through an all-in-one solution; less dwell time needed than chemical cleaners.
- Non-corrosive and safe for virtually any surface.
- Offers facility staff a zero-risk alternative to toxi chemical cleaners.
- Reduces slip fall, SAO does not leave a residue.

Multipurpose

SAO can be used within a variety of applications throughout your facilities

EPS Est. No. 089093-CAN-1

Sprayers

Mop Buckets

Floor Scrubbers

Clean with SAO on the go

- The new iClean® PRO has the same leading technology and user-friendly design as the iClean mini but is now bigger and stronger!
- The iClean® PRO turns tap water into a cleaner, sanitizer, and deodorizer that kills up 99.999% of germs.
- Stronger than bleach, yet non-toxic and residue free, the iClean® PRO is tough on dirt, grime and germs.
- Safe, will not harm eyes or skin if accidentally splashed

About GREEN SCIENCE SOLUTIONS

Sustainability, Powered by Technology ™

With over 30 years of experience in science and technology, Green Science Solutions is a local distributor of sustainable products for commercial and residential spaces.

Whether you're in need of air purification or cleaning and disinfecting solutions, GSS carries one of the widest selections of sustainable products, all of which have been vetted by onsite staff.

www.greensciencesolutions.com
Call us at 651-646-5339 or email us at gss@greensciencesolutions.com

GREEN SCIENCE SOLUTIONS

Healthcare
Cleaning & Disinfecting

Toxic-Free Cleaning and Sanitizing in Hospitals

The SAO system creates SAO on-site on-demand. It's compact and fits easily into janitor closets.

The system provides an effective, innovative, and sustainable, cleaning, sanitizing, and deodorizing solution.

SAO technology is patent-protected and revolutionary. It creates an all-in-one solution, approved for sanitizing up to 24 hours and cleaning for 6 days.

Benefits

When used as directed, the Tersano/SAO system.

- Reduces chemicals on surfaces and air.
- Kills 99.99% of SARS-CoV-2, MHV-3 and many other bacteria and viruses in 1 minute.
- Improves Indoor Air Quality
- Reduces slip and falls.
- Does not contribute to antimicrobial resistance
- Is non-corrosive and safe for virtually any surface including steel and metals.
- Increases productivity as an all-in-one solution.
- Reduces supply chain issues, eliminates packaging waste.

Chemical-Free

EPA Est. No. 89093-CAN-1

How SAO Works

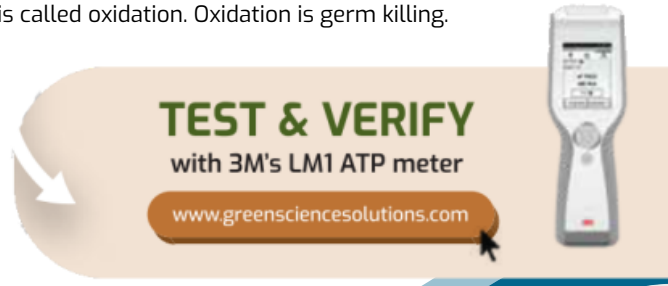
This patent-protected technology creates Stabilized Aqueous Ozone (SAO), an effective, innovative, and sustainable cleaning, deodorizing, and sanitizing solution. SAO attacks organic matter, breaking it down into smaller particles and suspending it in solution.

How SAO Cleans

Ozone reacts with proteins which are large organic compounds and consist of strings in amino acids held together by peptide bonds. Peptide bonds react with the 3rd oxygen atom in ozone and break acids. The base amino acids will continue to react with ozone and break into even more stable/inherit active matter. These minute particles are then readily suspended into solution. Once dirt is surrounded by these ions, it no longer adheres to the surface and becomes suspended int solution.

How SAO Kills

When applied to surfaces, SAO kills the germs that can also cause odors. When ozone molecules make contact with the cell wall of bacteria and viruses, tiny holes are created, This reaction is called oxidation. Oxidation is germ killing.



About

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www.greensciencesolutions.com
Call us at 651-646-5339 or email us at gss@greensciencesolutions.com

FINANCE & COMMERCE

LS BLACK CONSTRUCTORS

Why you should be talking about indoor air quality.

EXPERT FORUM

November 16, 2021 /// www.lsblack.com

Agenda

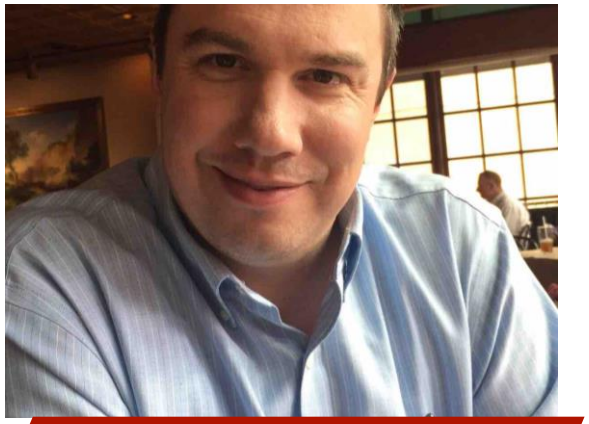
1. Introductions
2. Air quality is under the microscope due to COVID-19
    - Stats about Healthcare acquired infections (HAI's)
3. Current systems and code requirements (Bob/Eric)
    - What are we doing now to combat air quality?
4. Do surface contaminants affect your air quality? (Tom/Brian)
    - Our experts weigh-in
5. Impact of chemical disinfectants on building occupants (Tom)
6. Innovative solutions (Tom/Brian/Eric)
7. Where do we go from here and why you need to start planning now. (all panelists)

PANELISTS

Bob Dehler

Minnesota Dept. of Health

24 years of engineering experience
12 years with the State of Minnesota



Eric Krause

Allina Health

23 years of industry experience
Master Plumbing and Boiler Operators License

Tom Holm

Green Science Solutions

30+ years experience in Science and Technology

PANELISTS

Brian Evan

Wold Architects and Engineers

10+ years of engineering experience
Mechanical systems specialist

Michael Puncochar

LS Black Constructors

19 years of construction experience
7 years in the Healthcare Sector

HVAC AIR QUALITY MEASURES

- **Ventilation** – bring spaces at least up to current minimum code requirements
- **Filtration** – Consider upgrading to minimum MERV 13 filters
- Other considerations if minimum ventilation and filter requirements cannot be met:
  - **In room filtration** – HEPA air recirculation devices – increase air changes within a space

More Is Not Always Better

Stronger May Just Be More Harmful

Prevention Is As Important As Removal

We Can Do Better

We Must Be Smarter

The Power of Oxygen

Oxidant	Oxidation Potential, V
Fluorine	3.0
Hydroxyl radical (-OH)	2.8
Atomic Oxygen (O)	2.4
Aqueous Ozone (H_2O_3)	2.1
Ozone Gas ($O_{3,}$)	2.1
Hydrogen peroxide (H_2O_2)	1.8
Potassium permanganate	1.7
Chlorine dioxide	1.5
Chlorine	1.4

More Powerful – Less Contact/Dwell Time

Less Powerful – Longer Contact/Dwell Time

Ions are the Cleaners
Oxygen, UVC are the Assassins

Better Use of Existing Technology

Surface Cleaning and Disinfecting

- Urethane Floor Coatings
- Aqueous Ozone
- UV Lights
- Shoe Sanitizing (UV light/Ozone)

Indoor Air Purifiers

- Filtration - HEPA
- UV Lights
- Ionization
  - Needle Point (-)
  - Bipolar (+/-)
- Ozone-low dose
- Photocatalytic Oxidation (Hyd. Rad)
  - Advanced PCO
  - Advanced Hydrated PCO

Laundry Systems

- Aqueous Ozone
- Hydroxyl Radicals

Monitoring & Testing

- ATP Meters
- IAQ Sensors

INNOVATIVE SOLUTIONS & CONTROL STRATEGIES

- **Ultraviolet Lights** – coil disinfection and airstream disinfection
- **Bi-polar Ionization** – newer technology, not much data regarding effectiveness outside of lab conditions.
- **Aqueous Ozone**
- **Air Quality Monitoring**

- **Control Strategies**
  - Time of day scheduling – 2-hour pre and post occupancy flush
  - CO2 reset – disable so as not to reduce ventilation during light occupancy conditions
  - Occupancy sensor ventilation reset – disable occupancy sensor control that limits ventilation

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