



Enhancing Indoor Environmental Standards In Your Fight Against HAI's

A Unique Time in History

The 2020 pandemic created infection control challenges in healthcare with the related rise in Healthcare Associated Infections (HAI).

According to the National and State Healthcare Associated Infections Progress Report, CDC, October 2021, Healthcare Associated Infections have increased across the board in acute care hospitals.ⁱ

- Central Line-Associated Infections (CLABSI) - 24%
- Ventilator-Associated Events (VAE) - 35%
- Methicillin Resistant Staphylococcus Aureus (MRSA) - 15%

Many Variables to Address

Implementing an effective and economical strategy for your organization can be onerous and requires consideration of many factors:

- Personal Hygiene
- Ventilation/Filtration/Air Return Times
- Temperature/Humidity
- Surface Types
- Maintenance
- Building and/or Room Design
- Layout of Equipment/Furniture
- Proper use of Personal Protective Equipment (PPE)
- Water (WASH)
- Cross-Contamination Factors

Disinfection Done Right (DDR) will be introducing a two-pronged tool for indoor environmental air and surfaces that has proven in our experience to be effective in the reduction of a broad spectrum of pathogens.

The DDR system is integrated as a supplement to any effective cleaning and infection control protocol.

As an adjunctive support, the system requires little to no downtime, leaves zero biofilms, and is safe for day-to-day use.

Step One

Applying Ionized Chlorine Dioxide (ClO₂) to High Touch and Cross Contaminated Areas or as an Adjunct to Terminal Cleaning.

One study has shown that the overuse of bleach (Sodium Hypochlorite - ClO) has created a chlorine resistant pathogen in the agricultural industryⁱⁱ and while studies have not been found regarding the same development in healthcare, reports in contemporary literature suggests that bacteria are becoming resistant to alcohol-based products in healthcare settings.ⁱⁱⁱ

- The Environmental Protection Agency (EPA) recognizes chlorine dioxide (ClO₂) as a disinfectant^{iv}. The World Health Organization and Food and Drug Administration (FDA) recognize chlorine dioxide (ClO₂) as a viable and commonly used solution for decontaminating drinking water.^v
- ClO₂ is also used as a biocide in dentistry.^{vi} ClO₂ is a strong oxidizer that effectively kills pathogenic microorganisms such as fungi, bacteria, and virus which cause sickness, property destruction, and decreased economic efficiency.
- The ClO₂ molecule has 5 negative electrons compared to the sodium hypochlorite molecule (bleach) which has only 2 negative electrons, so the oxidative reaction is 2.5 times greater than bleach yet is less corrosive due to the size of its molecule.

When we look at molecular weight, ClO₂ contains 263 % more available chlorine, creating more than 2.5 times the oxidation capacity of chlorine in bleach.

Applying ClO₂ with Advanced Technology

An emerging strategy to reduce harmful pathogens is to apply the disinfectant with an ionizing sprayer^{vii} at a low concentration, which allows for no touch application, to cross-contaminated and high touch areas.

- ClO₂ leaves little to no residue or biofilm after application.
- With proper dwell times per labeling instructions, reaction times are within seconds to minutes and can react with the smallest particulate.
- ClO₂ produces fewer offending byproducts than oxidizing agents such as chlorine.
- Unlike Ozone (O₃), ClO₂ does not convert Bromide ions into Bromate ions (BrO₃⁻).
- ClO₂ does not produce large amounts of aldehydes, ketones, ketone acids or other disinfection byproducts that originate from the ozonation of organic substances.
- Another benefit is its ability to mix well with water of varying PH levels from 4 to 11.

In less technical speak, and in our opinion, ionized ClO₂ works faster, is more effective and is less caustic and damaging to surfaces and materials.

Step Two

Inhibiting Regrowth of Bacterial Colonies – Denaturing the Bacterial Cell Wall with Active Air Purification.

Ionized ClO₂ is supplemented with portable hydroxyl air and surface cleaning units that first process air with HEPA filtration, and then emits high energy cluster hydroxyls to reduce viral pathogens, bacteria, fungi, dust, and VOC in the ambient air and on surfaces.

The synergistic effect of utilizing ionized ClO₂ concurrent with the operation of hydroxyl emitting air purifiers is pronounced, internally we have found virtually undetectable ATP counts in 72 hours.^{viii}

Why Hydroxyl Air Purification?

Hydroxyl Systems have been utilized in the restoration industry for decades in the most germ infested, odorous, and mold ridden locations.

They are intended to help purify the surfaces and air of a compromised site for both the remediation of property and the safety of the workers.

- The hydroxyl radical was first discovered by NASA scientists in 1963 and was referred to as the “detergent” of the troposphere. It reacts with pollutants and helps destroy them.
- Active technology was developed in 1985 using Corona/Remote Ionization. This germ fighting process was identified as viable and safe for commercial implementation.
- In 1994 NASA developed Photo Ionization giving us the ability to ionize, and most notably, in 1999, Photo-Hydro-Ionization was discovered and used to produce friendly oxidizers.

Hydroxyl radicals are produced by the interaction of H₂O, precious metal catalysts, and specific UV waves/frequencies that induce photolysis of ozone to generate hydroxyls (H₂O₂)-.

The hydroxyl molecule is short-lived and reacts immediately with contaminants in its near vicinity.

How do Hydroxyls Inactivate Bacteria?

A random bacterial cell may contain peptidoglycan, amino acids, lipids, and polysaccharides that make up one or more layers of the bacterial cell wall.

The high energy cluster hydroxyl primarily reacts with the cell wall, ultimately inflicting multiple damage areas to the cell wall resulting in a “pin cushion effect”.

These pin pricks shrivel and denature the affected bacterial cell making replication impossible and thus reduces the growth of a potential colony forming unit.

Effective hydroxyl air purifiers should intake and filter ambient air with HEPA air filtration while creating and distributing high-energy-cluster hydroxyls - providing air and surface coverage to a compromised area or to inhibit the speed of regrowth to a terminally cleaned area.

Air Purifier Safety

A helpful benefit of today's hydroxyl air purifiers is safe operation while team members and patients are present.

Many models that are EPA registered are university validated for safety, while others that are intended to be used for medical purposes are cleared by the FDA as a Class II medical device.*

Team members working in the healthcare industry are constantly exposed to contaminants. Hydroxyl Air Purification can potentially lessen this burden by safely purifying air and surfaces 24/7.

When deployed tactically, the effectiveness of ionized ClO₂ is measured in seconds to minutes and supplemental hydroxyl air purification requires minimal human involvement.

Why we believe the Marriage of Ionized ClO₂ & Hydroxyl Air Purification Makes Sense

- The bactericidal properties of ionized ClO₂ work in seconds to minutes in the reduction of offending pathogens.
- Hydroxyl radicals are bacteriostatic as well as bactericidal and have shown to reduce other microscopic pathogens and agents of various nature and size.

DDR has found that combining the unique properties of each method as an adjunct to an indoor environmental cleaning plan results in virtually undetectable pathogen counts within the areas serviced.^{ix}

Anticipated Potential Outcomes When Used to Enhance Current Protocols:

- Potentially fewer Healthcare Associated Infections.
- Reduced inpatient days.
- Release of Isolation Rooms.
- Swifter room turn-around times.
- Portability with zero HVAC retrofitting.
- Safety in occupied areas.
- Ease of use, training and implementation.
- Enhanced air hygiene and environmental wellness, and visitor experience.
- Potentially fewer reimbursement penalties.

Supporting Research

In one four-year surveillance study at the 426-bed Europe General Hospital – Antrim, the use of 275 ppm of a ClO₂ based disinfecting agent was studied to measure its effectiveness against MRSA and Clostridium Difficile (C-Diff).

- The study was conducted from November 2009 through Sept 2013.
- From November 2009 to October 2011, sodium dichloroisocyanurate (NaDCC) at a 1,000 ppm was used for routine environmental disinfection.
- During that time prior to the introduction of ClO₂, a significant increase in a HAI-MRSA trend upward of 0.004 cases/100 bed days (p<0.01) was observed using NaDCC.

Results

From Nov 2009 to Sept 2013, 423 cases of MRSA and 120 cases of C-Diff were identified in the hospital.

The average monthly incidence rate was nine cases for MRSA and three cases for C-Diff.

*There was a significant decrease in MRSA.**

Following the introduction of the ClO₂ disinfecting agent, there was a significant decrease in HAIs to an average of four cases per month after 12 months. The level effect of the intervention after 12 months was a decrease in the incidence of HAI-MRSA by 0.095 cases/100 bed-days/month.

Statistical Analysis

Effect of ClO₂ disinfectant (275ppm) on MRSA and C-DIFF was assessed using segmented regression analysis of interrupted time series to allow for estimation of changes in the incidence of MRSA and C-DIFF during the period of routine use of NaDCC (Nov 2009 to Oct 2011) compared with the use of ClO₂ (Nov 2011 to Sept 2013).

Economic Impact

Total cost of the intervention for one year was £52,000 (approx. USD\$70,000).

Conservative estimates of MRSA infection rate reduction with the test protocol were 48 cases annually, at a cost estimated to be £6,845 (Approx. USD\$9,000) per MRSA case, thus amounting to a total cost reduction of £276,000 (£6,845 x 48 cases). (approx. USD\$370,000)

Methods and Settings

- With the phased introduction of ClO₂ in April 2011, training was delivered to nursing, auxiliary nursing, and hospital services staff in each ward and repeated until 75% of the staff were trained.
- Routine cleaning of the environment, clinical, and patient care equipment was carried out once daily.
- All areas and pieces of equipment associated with patients with C-Diff were cleaned using detergent and water, followed by either disinfectant agent twice daily.
- Environmental cleaning was performed in patient occupied areas using either disinfectant between patients.
- Monthly incidence of MRSA and C-DIFF was obtained from the clinical microbiology information system.
- Monthly quantity of high-risk antibiotics associated with MRSA were obtained from the Pharmacy Information System.

Distribution records of alcohol-based hand rub, NaDCC-based agents, and ClO₂ based agents supplied to each adult inpatient ward were obtained from the Pharmacy Information System.

The lack of effect of the 275 ppm ClO₂ application on C-Diff was in part attributable to the low baseline of this infection with an average of only three cases per month compared to nine MRSA cases.

Cost Benefit Potential

- Many thousands to millions are spent annually by healthcare facilities to reduce the chance of HAI's.
- This suggested protocol is a relatively inexpensive process that assists in managing harmful pathogens for the environmental services and infection control toolbox.^x

Should Your Office or Facility Request a Consultation?

Disinfection Done Right is a cleaning company that specializes in the implementation of our preferred methods to all types of facilities including Hospitals, Nursing Homes, Ambulatory Surgery Centers, and Medical/Dental offices.

We maintain credentials to enter restricted and semi-restricted areas in various types of facilities to provide service if there is a need, however we also consult, install, train, and continuously improve all aspects of the system for our facility partners.

Every biome is unique. Our executive team offers a combined over one hundred years of experience with the objective to customize specifications appropriate for each individual facility through a guided trial period which includes a product demonstration for a reasonable and necessary time frame, staff education, and surveillance.

Call 855-777-3088 or visit our website for an introduction packet or video consultation to achieve better health through a cleaner indoor environment!

Dissemination of Information and Opinion on Cleaning Methods in the Healthcare Setting in this Whitepaper Deferred to the Following Sources.

- i <https://www.cdc.gov/hai/data/portal/progress-report.html>
- i A) Clean results: U-M researchers learn how bleach kills bacteria | University of Michigan News (umich.edu)
- B) Chlorine dioxide vs. chlorine bleach: A battle of misconceptions | NEOGEN
- C) Bleach vs. Bacteria (nih.gov)
- D) Surviving Reactive Chlorine Stress: Responses of Gram-Negative Bacteria to Hypochlorous Acid (nih.gov)
- E) How Household Bleach Kills Bacteria - ScienceDaily

- A) <https://www.npr.org/sections/goatsandsoda/2018/08/02/635017716/some-bacteria-are-becoming-more-tolerant-of-hand-sanitizers-study-finds>
- B) Increasing tolerance of hospital *Enterococcus faecium* to handwash alcohols Sacha J. Pidot, Wei Gao, Andrew, H. Buultjens, Ian R. Monk, Romain Guerillot, Glen P. Carter, Jean Y. H. Lee, Margaret M. C. Lam, M. Lindsay Grayson, Susan A. Ballard, Andrew A. Mahony, Elizabeth A. Grabsch, Despina Kotsanas, Tony M Korman, Geoffrey W. Coombs, J. Owen Robinson, Anders Gonçalves da Silva, Torsten Seemann, Benjamin P. Howden, Paul D. R. Johnson*, Timothy P. Stinear*
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- i A) [www.chemicalsafetyfacts.org/Chlorine Dioxide](http://www.chemicalsafetyfacts.org/Chlorine-Dioxide)
- B) United States Environmental Protection Agency System of Registries | US EPA

- i A) <https://www.who.int/ipcs/publications/cicad/en/cicad37.pdf>
- B) <https://www.ars.usda.gov/research/publications/publication/?seqNo115=219006>
- C) [Statement-of-Chlorine-Dioxide.pdf](#) (whnt.com)
- D) CFR - Code of Federal Regulations Title 21 (fda.gov), CFR - Code of Federal Regulations Title 21

- i Effects of Chlorine Dioxide on Oral Hygiene - Design Effects of Chlorine Dioxide on Oral Hygiene - A Systematic Review and Meta-analysis (nih.gov)
- i PowerPoint Presentation (epa.gov)
- i Proprietary record of event on file with Air Systems Done Right
- i <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6451552/>

- * This study used ClO₂ without ionization. (ClO₂ has been known to be effective at concentrations as low as 100 ppm)
- * C-diff transmission is usually attributed to poor hygiene (handwashing), person-to-person physical contact, and antibiotic stewardship.
- * Any or all components of the DDR system is not a medical device

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