The New World of COVID-19 and Disinfection

Introducing a Revolutionary Change

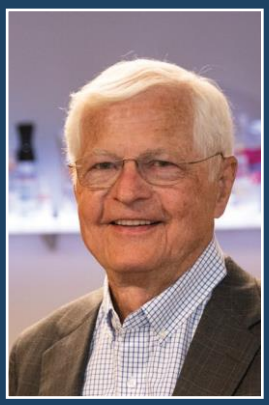
by
Bergein F. Overholt, MD and Chuck Jones, PhD

SETTING THE SCENE

The world is facing a confluence of enormous challenges never before encountered:

- A pandemic caused by a virus that mutated and jumped from animals to humans, wreaking havoc on society.
- Superbugs that are resistant to most, if not all, antibiotics leading to enormous economic and personal losses.
- Misinformation about and misapplication of products that are being used for disinfection and sanitation leading to further human illness.

Addressing these three major societal issues will be explored in this paper. In response to the challenges they present, knowledgeable leadership and advances in technology have joined together to produce a sanitation/disinfection product that is far more effective than bleach, yet is totally safe for humans, pets, and the environment. In fact, as you will see, it also provides promise for protecting us from COVID-19.



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A revolutionary answer to the challenges listed above lies within this paper. When you read it, prepare your mind for change!

EXECUTIVE SUMMARY

This White Paper reports new research-based interventions. It presents practical, real-world solutions to a globally threatening set of human health vulnerabilities:

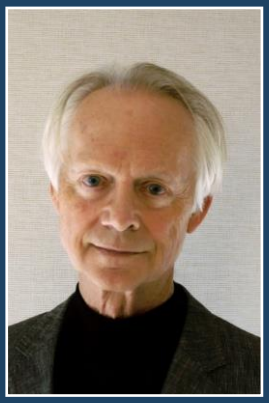
1. The problem of novel mutating pathogens, e.g., diseases without vaccines, like the zoonotic virus causing our current COVID-19 pandemic.

2. The growing threat of Antibiotic Microbial Resistant (AMR) Superbugs that have become immune to known antibiotics.

3. The grave hazards from inadequately addressed toxic side effects associated with the standard disinfectants used as our front-line defense in those two contexts and others.

This paper proposes an innovative approach to resolving all these challenges in the form of a recently engineered, patented process for producing a non-toxic, stable, pH-controlled, concentration-targeted version of Hypochlorous Acid (HOCl), a fast-acting, comprehensively effective, bio-mimicking sanitizing/disinfecting agent; the same substance employed by white blood cells to fight disease in our bodies. Recognition of HOCl's distinct advantages in addressing pathogens (viruses, bacteria, mold, fungi, prions) is not new, however recent innovations for both production and application have overcome serious prior barriers to its broad implementation.

Citing research, this paper proposes a ground-breaking model for sanitization and disinfection, both on surfaces and in the air; one that employs HOCl in aerosolized form, requiring no wiping step, to produce results demonstrablysuperior to traditional sanitizers and disinfectants through a process that is entirely safe for people, animals, and the environment.



Chuck Jones, PhD
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To illustrate the significant implications introduced in this paper: Two independent laboratory studies tested the feasibility of using Ionogen's ultrasonic aerosolizer fogging protocol as a means to kill an EPA-approved SARS-CoV-2 surrogate virus (0C43) contaminating an average-size room in far higher concentrations than one could encounter in everyday life.

The first successfully demonstrated an effective kill of the **airborne** virus and the second study demonstrated a greater than 99.999% kill rate (the maximum possible detection rate for the method) of the virus on **surfaces**.

Again, both results were achieved by simply using Ionogen's ultrasonic fogger to fog the air. And, given the non-toxic nature of the HOCl solution being used, both results can be achieved **with people present** in the room.

That's our proposed revolutionary change in a nutshell.

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THE NEW WORLD OF COVID-19 AND DISINFECTION

THE BIG PROBLEMS

Ours is a challenging new world with both good and bad things happening around the globe. We are facing sectional wars, social upheaval, political turmoil, climate change, and, central to this paper, a biological catastrophe that will bring great disruption and challenges to society as we know it today.

That biological catastrophe is primarily related to a fundamental change evolving in microorganisms – namely, mutation - that has been occurring since inception but is currently unfolding in a more aggressive pattern. Microorganisms, including viruses and bacteria, are, in effect, "smart". As Nature predicts, they adapt and mutate to survive and thrive in the world, often in ways highly unfavorable to humans.

Three Problematic Examples

Mutating Viruses
The COVID-19 pandemic is caused by SARS-CoV-2, which is a newly mutated virus that originated in animals and moved to humans. COVID-19 represents only one of multiple worldwide illnesses caused by mutated pathogens.

People around the globe are facing an alarmingly changing world in which such mutations of viruses are creating human epidemics and pandemics with enormous consequences associated with human morbidity and mortality and resulting in huge societal costs.

We are now dealing with zoonotic viruses that move from animals to humans, e.g. Ebola and others, and viral mutations such as the coronaviruses that include the flu virus, MERS and SARS-CoV-1 and now SARS-CoV-2, the virus causing the current COVID-19 pandemic and which itself appears to be mutating into a more contagious form as this is being written. Humans have little natural defense against these newly introduced pathogens. We are vulnerable.

Antibiotic Microbial Resistance (AMR)
Repeated exposure of bacteria to antibiotics has produced bacteria that have become resistant to antibiotics. Similarly, low levels of sanitizing/disinfecting biocides, inadvertently misused during efforts to sanitize the environment, can also lead to potentially lethal pathogen mutations.[1,2] The result: AMR "superbugs" that are killing 99,000 hospitalized patients annually in the United States alone. Unless major changes are made, AMR is projected to be associated with the death of 10 million people around the globe in 2050 with a cumulative cost of over $100 trillion USD.[3] That mortality rate represents the death of one person every three seconds if we do not solve this problem.

What is happening? The cost of developing new antibiotics is so great that new antibiotics are not being generated as rapidly as is needed to address the issues of "superbugs" resistant to all current antibiotics. Unless significant changes occur, the possibility of our society entering an era of "no effective antibiotics" for some deadly infectious diseases is becoming a reality.

Toxic Exposure
Toxic exposure to humans and the environment is resulting from efforts to address these pathogens with current sanitizers and disinfectants. It turns out that many of the chemicals we are currently using in our efforts to sanitize/disinfect our environment are proving poisonous to people, especially to children, to animals including our pets, and to the environment. Ironically, the effort toward cure has become a significant problem in itself. The products we use have, until now, represented the state of the art in cleaning, sanitizing and disinfecting technology but the great majority of these products contain toxic chemicals.

The threat to our society of the toxicity of the chemicals we are exposing our people and children to is likely the greatest threat of all.

Of these three issues, perhaps counter intuitively, the threat to our society of the toxicity of the chemicals we are exposing our people and children to is likely the greatest threat of all.

The worldwide costs in terms of money and of lives lost accruing from mutating pathogenic viruses, from AMR bacteria and from toxic chemicals we use for disinfection and sanitation are staggering. And the threats they pose will increasingly become greater if we fail to find and enact effective interventions to mitigate and resolve these problems. Failing at that task ultimately means eventually even jeopardizing global society itself.

ADDRESSING THESE PROBLEMS

First, consider disinfecting and sanitation products. One recommendation to address these catastrophic diseases is to defeat the pathogens where they originate before they invade our bodies: namely, targeting surfaces of all types, especially in healthcare facilities, in food preparation, in public buildings, in wound care. Essentially everywhere. Including in homes. But doing so requires effective, safe sanitizing/disinfection! However, current sanitizing/disinfection methods and products are fraught with severe problems, including:

- Ineffective results.
- Incomplete or improper use (failure to completely follow instructions or faulty implementation of cleaning procedures)
- Unintentional promotion of AMR due in part to incorrect use
- The toxic effects of cleaning products that cause serious diseases in both adults and children[4-13] and harm to animals as well as toxic harm to the environment.

Most disinfectants are effective in killing bacteria and viruses if used as directed and applied according to instructions for a sufficient period of time. But too often, those directions are not – or cannot – be adequately followed. And, again all too often, the sanitizer/disinfectants contain toxic chemicals.

And, yes, we must also consider the impact of "less than full truth in advertising." We are told the products are safe, in part based on the fact they have been assigned an "EPA registered number." But reviewing the EPA "N" list (https:// www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2) or the product's Safety Data Sheet reveals that many, if not most, of these products include chemicals that are harmful to humans, animals or to the environment - such as quaternary ammonium compounds ("QUATS"), bleach, hydrogen peroxide or ethyl alcohol. We will delve further into the issues of sanitizer/disinfectant toxicity and failures in full disclosure later in this paper.

This report details a positive alternative approach offered through the introduction of a totally non-toxic, highly-effective sanitizer/disinfectant product powered by hypochlorous acid (HOCl).

Beyond surface disinfection, a second area for attacking pathogenic viruses is defeating them in the air we breathe. Recent medical evidence and opinion indicate that viral transmission through the air plays an important role in disease transmission.[14-21] This finding opens many new frontiers to combat viral diseases. We will also discuss this subject in greater detail later in this paper.

PROPOSING A DRAMATIC IMPROVEMENT TO DISINFECTION AND SANITATION

Instead of dwelling on the negative issues in sanitizing/disinfection, this report details a positive alternative approach offered through the introduction of a totally non-toxic, highly-effective sanitizer/disinfectant product powered by hypochlorous acid (HOCl) in a stabilized, near neutral pH Super Mixed Oxidant Solution (HOCl).*

*Super Mixed Oxidant Solution (HOCl) refers to an EPA-certified product (93392-2)

A BRIEF HISTORY OF HOCl

In its simplest description, HOCl is produced during the electrolysis of a saltwater solution. During electrolysis, Free Available Chlorine (FAC) is produced with the chlorine being dissolved in water. The FAC is the active

agent in killing pathogens and its effectiveness is determined in great part by its concentration in solution – the higher the concentration, the greater the effectiveness.

First described by the French chemist Antoine Jérôme Balard in 1834 and then by Michael Faraday, the antibacterial effectiveness of HOCl went unrecognized for decades. Later HOCl was used successfully during WWI for wound care.[22] However, the equipment to produce the HOCl was large and cumbersome, expensive and unreliable. Furthermore, the HOCl product produced by these early machines was unstable resulting in a short shelf-life.

A renewal of interest in HOCl began about 15 years ago. Since that time, product quality has improved but has still suffered from manufacturers' inability to produce more than minimal concentrations of FAC as well a failure to establish long-term product stability. If these difficult problems had not posed such steep challenges, HOCl would have been broadly available and widely used long ago.

SIGNIFICANT TECHNOLOGICAL ADVANCES IN HOCL PRODUCTION

Recently developed and patenting proprietary technology enables production of HOCl:

- in a stable solution
- at a near-neutral pH
- with a broad range of specifically targeted FAC concentrations designed for different applications ranging from 200-2200 parts per million (ppm)

HOCl is a disinfectantthat is stable, is more effective than existing products and also is completely non-toxic to people, animals and to the environment.

These products, with HOCl as active ingredient, meet or exceed the major criteria of the"ideal disinfectant" as characterized by the Center for Disease Control and Prevention (CDC)[23] in that they:

- rapidly and effectively kill offending pathogens including bacteria, viruses, fungi and molds
- are completely non-toxic to humans and pets
- are completely non-toxic to the environment

In fact, HOCl establishes a new industry standard for disinfection and sanitation. To reiterate and underscore, HOCl is a sanitizer/disinfectant that is stable, is more effective than existing products, and also is completely non-toxic to people, animals, and to the environment.

MORE ON THE ISSUE OF TOXICITY OF SANITIZERS AND DISINFECTANTS

As stated earlier, even with the two major issues of mutating viruses and AMR, the threat to our society of the toxicity of the chemicals we are exposing our people and especially our children to with the use of standard sanitizers and disinfectants may be the greatest threat of the three.

Consider the following:

Increasingly, recognition of the toxicity of current cleaning, sanitizing, and disinfection products on both the environment and to adult humans is occurring, to say nothing of the amplified negative effects on children.

Examples of toxic chemicals in household and commercial cleaning, sanitizing, and disinfecting products are numerous. Many Lysol® products, such as disinfecting wipes, sprays, and laundry sanitizers, contain QUATS. All-purpose cleaner and Kitchen Pro Antibacterial Cleaner also contain QUATS, as does Clorox® Everest and Disinfecting Bathroom Cleaner.

Other Clorox compounds contain sodium hypochlorite (bleach). Purell® Wipes and Hand Cleaner contain Ethanol (Ethyl alcohol), which is very drying to the skin and is unsafe for young children. Add to this the recent FDA warning against using hand sanitizers imported from Mexico that are or could be contaminated with methanol or 1-propanol.

This list is simply offered as a series of examples, inviting the reader to explore further. All a consumer has to do to "check out" a product is to use the internet to review the Safety Data Sheet for the product in question.

The results are extremely concerning as most - if not all - commonly used household and commercial cleaning/ sanitizing/disinfection products contain chemicals with potential significant, deleterious side effects that are often overlooked, unrecognized, or unappreciated by the user – since, often, the damage is not immediately noticeable because it builds slowly over time.

QUATS, hypochlorite (bleach), hydrogen peroxide in high percentage, and phenol compounds all have toxicity concerns:

- irritation or injury to eyes and skin (very common)
- a strong association with development of childhood asthma[4]
- a cause of adult onset asthma[4-8]
- a cause of development of COPD (chronic obstructive pulmonary disease).[9,10] In fact, one investigator stated that "the effect of occupational cleaning (ed.: use of sprays and other cleaners) was comparable to smoking just less than 20 pack-years." (ed: 1 pack year equals one pack of cigarettes a day).[10]
- a cause of thyroid cancer.[11]
- a cause of "endocrine disruption" with a reduction in fertility in mice.[12]
- an increase in defects in neural tube (brain) developments in mice.[13]

All this paints a rather grim picture of the current state of sanitization and disinfection.

COMPARING TOXICITY: HOCL IS NON-TOXIC ANDHAS NO ADVERSE EFFECT ON HUMANS

HOCl is naturally produced by white blood cells of all mammals for the purpose of killing invading bacteria, viruses and other pathogens.

HOCL is non- toxic to people. In fact, HOCl already exists in the human body, being naturallyproduced by white blood cells of all mammals for the purpose of killing invading bacteria, viruses and other pathogens.

Clinical observations over decades have shown no negative effects from using HOCl for wound care or for treatment of ocular disease. HOCl has been substituted for drinking water with mice which incurred no deleterious effects. Multiple studies further substantiate the non-toxicity of HOCl to humans. However, clinical observation is often anecdotal. True, scientific, peer-reviewed data is required when stating a product used in treating humans is non-toxic and not harmful.

Scientific studies at the cellular level are extremely important in evaluating toxicity to humans. Independent cytotoxicity studies performed by e.g. an independent lab in four different studies have demonstrated no toxicity to lung cells (A549 cell line) when heavily exposed or fogged with HOCl. In addition, *Ionogen LLC* is currently undertaking detailed cellular metabolic toxicity studies performed by an independent, certified lab to scientifically determine if there is any acute or chronic human lung cell toxic effects from exposure to HOCL. Given the four previous studies on lung cell viability, no concerns are anticipated. Results are expected to be available by the end of 2020 and will be reported as an addendum to thispaper.

Furthermore, *Ionogen LLC* is initiating the processes for a human clinical trial to further study the safety andeffectiveness of HOCl in fogging and misting of patients with and without COVID-19.

HOCL TESTING RESULTS WITH THREE TARGET PATHOGENS: SUPERBUGS, BACTERIA, AND VIRUSES

Ionogen LLC has engaged an independent laboratory to study the effectiveness of using HOCl with a range of three main pathogen categories: superbugs, bacteria, and viruses.

Research Results from a Tough Challenge - A Representative Superbug

The Center for Disease Control (CDC) has identified Chloridoids difficile (C. diff) as one of its current top three superbugs. One of their press-release summaries indicates C. diff causes roughly half a million intestinal infections yearly, manifested by persistent diarrhea, with almost 30,000 patients in the United States dying within 30 days of diagnosis of C. diff and with 15,000 of those being directly attributable. It has been noted as the most common microbial cause of healthcare-associated infections in U.S. hospitals, resulting in upwards of $4.8 billion every year in excess health care costs for acute care facilities alone.[24]

C. diff is exceptionally hard to kill as it forms spores for protection when attacked by an antibiotic. The spores can enable it to survive in the absence of air for two years. This 2020 article title says it all:

> *Hospital disinfectants struggling to kill C. diff bacteria colonies: Clorox comes close, but none completely eliminates superbug.*[25]

In tests performed by an independent, certified laboratory, HOCl (Ionopure™ Disinfecting Spray) achieves a remarkable log-6 (99.99996%) kill of Chloridoids Difficile spores in 1 minute (table 1). Again, C. diff is the most difficult of bacteria to kill as it forms resistant spores when "attacked." No other disinfectant hasachieved this level of C. diff kill in 1 minute in a safe, non-toxic, and effective way.

Below is a table depicting the difference on C. diff survival between untreated surfaces and HOCl-treated surfaces, measured as Colony Forming Units (CFUs), which is a microbiological term referring to the number of viable cells. Moving from over a million CFUs to less than .23 CFUs is what results in that 99.99996% rate of effectiveness.

Table 1 - Use of HOCl on Clostridioides Difficile

On-Site Generating (OSG) Technology & Wipe System for the Remidiation of *Claustridium difficile* (ATCC: 43958) on Stainless Steel Surface Using 2,200 ppm of Free Available Chlorine (FAC) Surfactant-Enhanced Solution				
Treatment System	**Exposure Time (Min)**	**Average recovery from untreated surface** *(avg. of 2 sq. analysis; CFU/sq.)**	**Recovery from Treated Surface (CFU/sq.)**	**Average Percent Reduction**
HOCL Disinfecting Spray(2200 ppm)	1	1,040,000 CFUs	<0.23 CFUs	>99.99996%
	2	1,050,000 CFUs	<0.23 CFUs	>99.99997%
	5	1,050,000 CFUs	<0.23 CFUs	>99.99997%

**CFU refers to Colony-Forming Units, a standard microbiology measurement. All testing done under ASTM GCLP standards.*

A log-6 reduction of the presence of a pathogen is a difficult milestone to fathom, even when it is cast in simple numbers as a 99.9999% (six 9's) kill rate. On the following page is a graphic (fig. 1) designed to make the idea more comprehensible, even if it is still challenging to grasp.

Figure 1
Log-6 Reduction

Log Reduction	Number of CFUs Remaining	% Reduction of Bacteria
0	1,000,000	0
1	100,000	90
2	10,000	99
3	1,000	99.9
4	100	99.99
5	10	99.999
6	1	99.9999

Visualizing a **Log-6 Reduction**

A stack of one million pennies reaches approximately 4,986 feet tall, or about the height of five Eiffel Towers.

A log-6 reduction of that stack would leave you with **just one penny.**

OTHER HOCL BACTERIOLOGY / VIRAL STUDIES USING AEROSOL HOCL

Testing results against other viruses and bacteria is equally important and demonstrates a broad spectrum of pathogen kill by fogged HOCl. Table 2 details results of the use of aerosolized HOCL at various concentrations on bacteria that cause many of the hospital-acquired bacterial illnesses.

Table 2
Pathogen Kill Rates Following Exposure to Aerosolized HOCl (Dry-Fogging)

Bacteria	Results
Klebsiella pneumoniae (best known for respiratory infections)	>99.99% Reduction
Staphylococcus aureus (skin infections)	>99.99% Reduction
Pseudomonas aeruginosa (common UTI/kidney infections)	>99.99% Reduction

Norovirus is another virus of particular interest. It is highly infectious and is one of the most common causes of outbreaks of gastroenteritis with vomiting and diarrhea. It is particularly notorious for rampant gastrointestinal illness on cruise ships and in schools. Transmission can be by hand to mouth but also vomiting can result in aerosolized norovirus that can "travel" across a room in the air. Once established, the virus is difficult to completely eliminate so attempts at cleaning facilities exposed to norovirus require very strong chemicals including bleach (1.5 – 7.5%) in water.

HOCL when aerosolized in an aerosolizeris an ideal product to tackle the idea of safely sanitizing/ disinfecting the air atthe same time peopleare present.

Since human norovirus cannot be grown in a laboratory environment, HOCl was previously tested against surrogate viruses for human norovirus (Bacteriophage and Murine Norovirus) and was found to readily kill those viruses on surfaces, thereby potentially slowing down and perhaps even preventing norovirus outbreaks of gastroenteritis. Further studies on the use of aerosolized HOCL against norovirus surrogates are in process.

Based on these results, HOCl demonstrates and establishes a baselinefor new industry-wide disinfection standards. And, like the ability to safely destroy the most difficult-to-kill C. diff so effectively, HOCl can kill essentially any bacteria, virus, fungus or mold on surfaces in a timely manner, generally in a matter of seconds while remaining completely safe for humans.

These studies, and those described below, combined with clinical experience, provide a solid scientific foundation for treatment of and prevention strategies for human diseases with HOCL, including (norovirus) gastroenteritis and, possibly,pulmonary diseases like COVID-19.

HOCL DRY-FOGGING KILLS CORONAVIRUS BOTH IN THE AIR AND ON SURFACES

HOCL solutions administered via a free-standing, portable ultrasonic aerosolizer produces a light fog covering up to 5,000 square feet. The mist consists of aerosolized particles, 2-4 microns in size, which hang inthe air, creating a very slight haze, while also effectively coating surfaces without wetting ("dry-fogging").

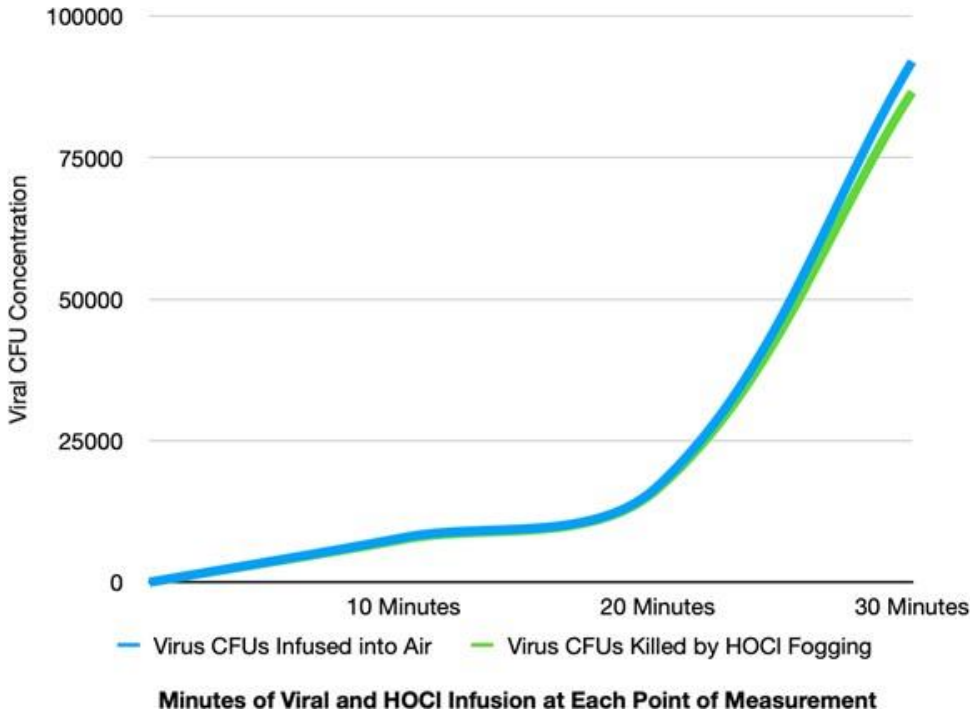
The EPA has protocols for determining pathogen kill rates on surfaces but none for the efficacy of sanitizing/ disinfecting the air, because, until now, standard cleaning solutions were too toxic to continually aerosolize into our rooms while we were living in them, so why would anyone trying to measure the results of what we are proposing?

In an initial fogging experiment, an EPA-approved surrogate for the COVID virus(Human Coronavirus OC43) was continuously injected along with a fogged HOCl solution. After infusion was begun, viral concentration measurements were taken at 10, 20 and 30 minutes. This means fresh virus constantly replaced what was killed. Thus, the air in the room was never completely without live virus.

Second, HOCl quickly dispatches pathogens more difficult to kill than Coronavirus. So, in order to seriously test the effectiveness of the fogging process, an enormous viral concentration of about 33,000,000 times that of a sneeze from a SARS-CoV-2-infected person was injected into the air on a continuous basis.

Even with those two extreme challenges, before the first measurement at 10 minutes, the misting procedure was established and an average equilibrium point of almost 95.6% kill was maintained throughout the 30-minute trial, effectively counterbalancing an exponentially increasing virus load in the room. Further research into efficacy of viral kill is in process. Below (fig. 2) is a graph of the balanced equilibrium with the blue line tracking the viral injection and the green line tracking the kill rate.

Figure 2
Comparing Viral Infusion into Chamber Air vs. Virus Colony-Forming Units (CFUs) Killed by Purity HOCl Fogging - Across Time



In the context of the pandemic health crisis, these results offer a promising advance in mitigation strategy, available while people are congregating together in a room.

In a second fogging experiment, the virus (again, Human Coronavirus OC43) was placed on a glass plates surface and the room was continuously fogged in a manner simulating a standard workday, resulting in a >99.999%* reduction of the virus.

Table 3
Surface Viral Kill Rates Following Exposure to Aerosolized HOCl (Dry-Fogging)

Virus	Results
Human Coronavirus 0C43	99.999% Reduction*

**Value represents the method's detection limit.*

HIGHLIGHTING A MAJOR NEW TREATMENT IMPLICATION:

- Vaporized HOCl dry-fogging will attack and kill viruses both in the air and on surfaces.

- The CDC has acknowledged spread of the virus both through surface contact and from transmission through the air, so talking could result in droplets staying airborne for 5-10 minutes, thereby resulting in viral transmission.[14-21] Smaller, aerosol sized droplets have been shown to stay suspended for several hours and can carry viruses such as SARS-CoV-2. But vaporized HOCL, when used in dry fogging, effectively attacks and kills viruses both in the air (droplets or aerosolized) and on surfaces within seconds to minutes.

HOCL MISTING ALSO REDUCES BIOFILM – AND IMPROVES CLEANINGAND DISINFECTION

Biofilm is defined as a thin, microscopic layer of microorganisms, both dead and alive, that bind together and accumulate on essentially any surface, forming a mat of organic and inorganic material. This mat is primarily composed of polysaccharides and provides a material matrix for bacteria to accumulate, grow and multiply. The bacteria are also partially "protected" by the matrix, thereby becoming more difficult to access, a factor which, in turn, provides opportunities for development of resistance to antibacterial treatments and disinfectants. These opportunities are likely enhanced if antibacterial treatments and disinfectants are applied incorrectly.

Biofilm accumulation can be indirectly determined by measuring Adenosine Triphosphate (ATP), the energy molecule found in living cells - thereby providing an indirect measure of organic material and bacterial presence. Sterile swabs are rubbed over a surface and then placed in an ATP-measuring device, yielding a digital readout of ATP quantity. A low readout value indicates a clean surface. A high readout value implies dirtiness, i.e., biological contamination. A reduction in ATP scores following cleaning and disinfection, in part, reflects a reduction in the surface biofilm.

To achieve maximal cleaning and disinfection of a surface, the biofilm must be removed. Classically, any reduction in biofilm for cleaning/disinfection purposes has required two steps - both a manual wiping step with a cleaning agent followed by an application of a true disinfectant for a specified period of time (up to 4-10 minutes). This process is more challenging in practice than it sounds in theory and, therefore, it is seldom successfully followed,[2] a cleaning implementation failure that takes us back to the concern about antibiotic microbial resistance.

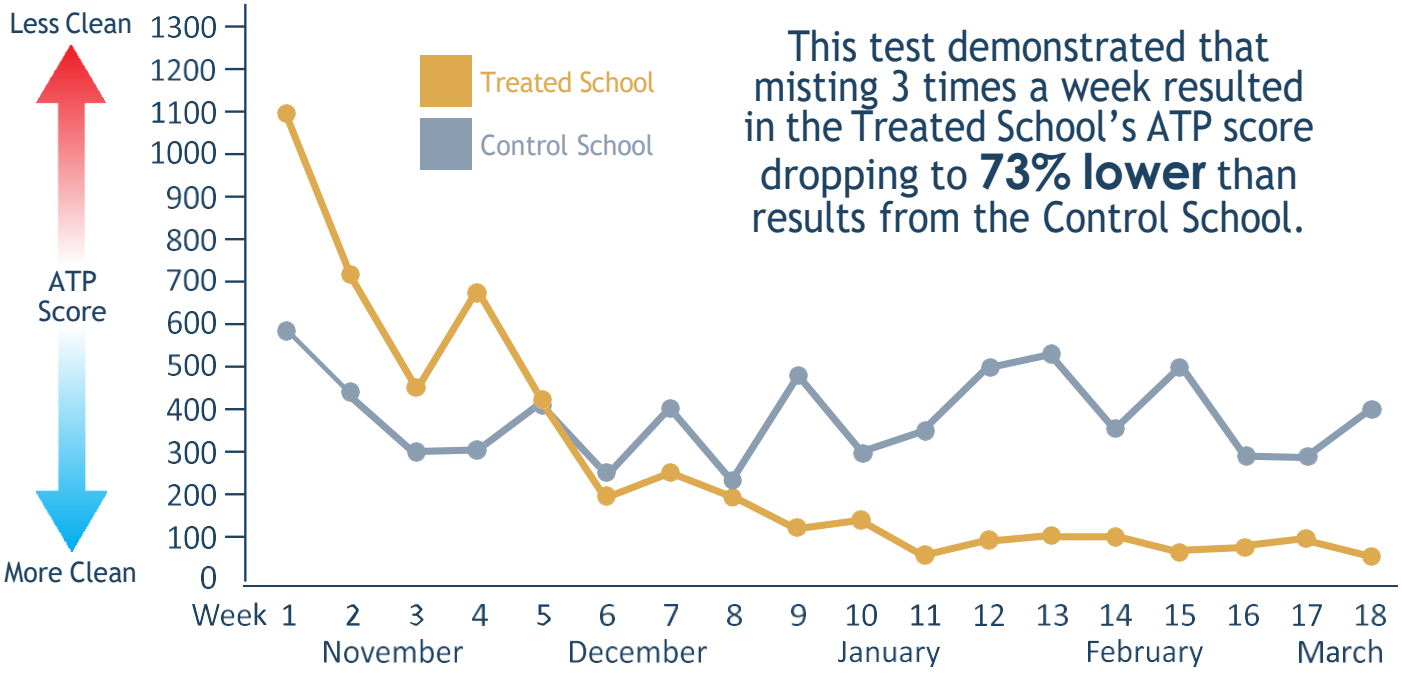
Fortunately, new developments in cleaning and sanitation indicate that if one is using HOCl,the manual wiping step is no longer mandatory to achieve a significant reduction of biofilm.

In addition to the dry-fogging technology mentioned above, the utility of spraying its product by employing a portable, hand-held misting machine has been studied. Study results have demonstrated that an HOCL spraying treatment successfully equates to an additional full cleaning step, without wiping, that significantly reduces biofilm and facilitates deep cleaning. The effectiveness and efficiency of this streamlined protocol has been demonstrated through research projects undertaken both in school buildings and in Ambulatory Surgery Centers (ASCs), each very challenging and crucial environments to clean and disinfect.

In a study of two comparable schools, one serving as a control and the other as the test school. Compared was standard school cleaning methods (control school) versus standard school cleaning methods plus spraying of the school (test school) using an EPA certified disinfectant (93392-2) at the end of the school day, three times weekly.

Both schools started with high ATP (hence, biological contamination) scores but, over the 5-month duration of the study, the HOCl sprayed school's ATP scores dropped significantly and remained at substantially lower levels during the duration of the study, demonstrating a statistically significant improvement in cleaning and disinfection (fig. 3). The only intervention difference involved power misting the entire school with HOCL three times weekly.

Figure 3
Adenosine Triphosphate (ATP) Readings in a HOCL-Treated School vs. the Control School



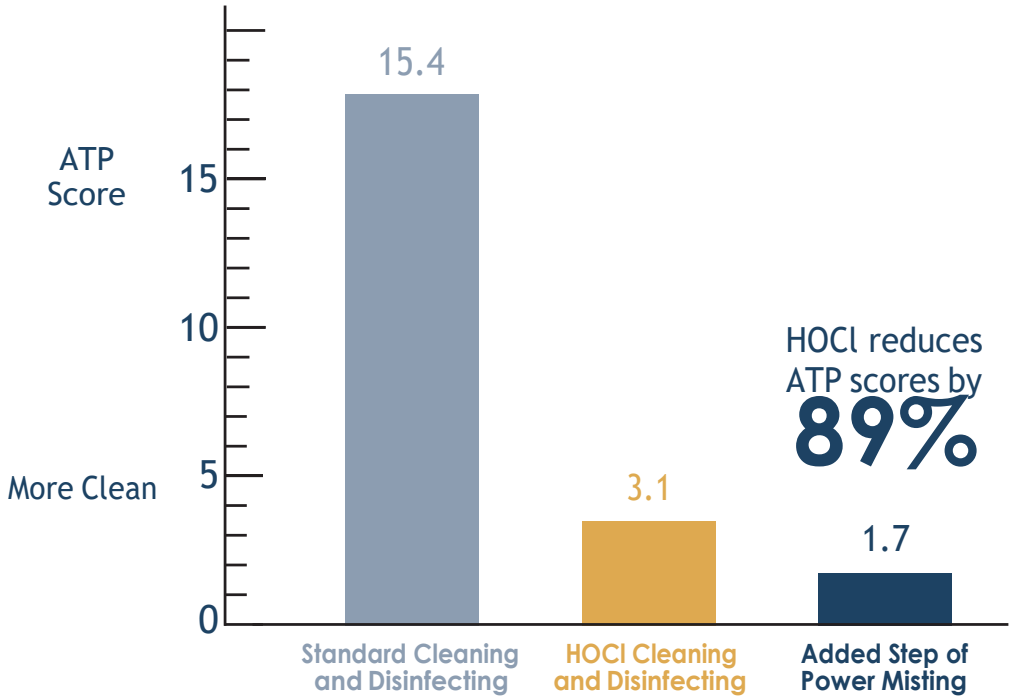
Likewise, in our study of Ambulatory Surgery Centers (ASCs), we used two comparable ASCs. The control ASC underwent standard cleaning with Cavicide wipes* between procedures and a terminal cleaning with both wipes and a Lysol disinfectant* spray at the end of the day. The test ASC underwent the same cleaning process but used HOCl solutions and wipes. Also, an additional step of power misting of the rooms with HOCl was done after the terminal cleaning at the end of the day. The misting required an additional 1-2 minutesper room.

**Both Cavicide wipes and Lysol Disinfecting Spray contain Quaternary ammonium compounds (QUATS), which are known toxic chemicals.*

At the end of the regular terminal cleaning, the control ASC rooms were very clean, averaging an ATP score of 15.4. The HOCl-cleaned rooms were even cleaner, producing an average ATP score of 3.1. Adding the power misting of HOCl to these rooms as a last step yielded a further statistically significant drop in ATP values to 1.7 (fig. 4). In the words of the non-medical bio-statistician reviewing these results, "The improvement (3.1 to 1.7) was comparable to an additional manual wiping step."

Bottom line: cleaning and sanitizing/disinfecting with HOCl produced significantly improved results in reducing ATP scores in endoscopic ASCs.

Figure 4
ATP Results Comparing Standard-Treated Rooms and HOCL-Treated Rooms
Ambulatory Surgery Center



PROPOSING A NEW CLEANING AND SANITIZING/DISINFECTINGPARADIGM

- Power misting and dry-fogging with vaporized HOCl reduces biofilm without manual wiping and also effectively kills bacteria and viruses, molds and fungi, quickly and thoroughly on surfaces. This remarkable finding literally changes the way we think about cleaning, sanitizing, and disinfecting of those surfaces.

- Dry-fogging with vaporized HOCl attacks and kills viruses in the air as well as on surfaces creating a new modality for treating and preventing airborne viral infections such as the common cold, flu, SARS-CoV-2 and others.

- Dry-fogging and misting with vaporized HOCl provides these powerful effects safely so that sanitizing/disinfecting a space can occur with no ill effects while people (e.g., patients or families at home or children and teachers and administrators in schools) remain present.

HOCL ALSO PROVIDES A MEANS TO ADDRESS BOTH "SUPERBUGS" ANDMUTATING VIRUSES

One approach to addressing the daunting challenges of "superbugs" and mutating viruses is to use a non-toxic, highly effective disinfectant at the source where the pathogens exist – namely the environment.[3] In essence, the aim is to kill the pathogen before it has the opportunity to invade the human body – and to do it in a way that is both safe for humans and for that environment.

HOCl does just this: it is a non-toxic product which is a highly effective sanitizer/disinfectant that kills all pathogens without producing any adverse effects on humans.

A SPECULATIVE IDEA CALLING FOR FURTHER RESEARCH: THIS SECTION IS NOT INTENDED TO ADVOCATE A MEDICAL POSITION, RATHER, SIMPLY TO INTRODUCE A PROSPECTIVE RESEARCH AREA.

BASED ON WHAT IS KNOWN ABOUT PULMONARY MEDICINE, THE RESEARCH CITED IN THIS WHITE PAPER ALONG WITH SUBSTANTIAL ANECDOTAL OBSERVATIONS, SUGGEST THE POSSIBILITY OF IMPROVING TREATMENT OF SELECTED LUNG DISEASES BY USING AEROSOLIZED HOCL AS AN INHALATION THERAPY. FURTHER RESEARCH IS PLANNED TO EVALUATE THIS APPROACH. [26, 27, 28]

Viruses are very small particles (20-400 microns). When they invade the human body, it is typically by way of the respiratory tract: nose and mouth, throat, trachea, bronchi and with some viral particles ending in the smallest lung structures, the acinar sacs lined with alveolar cells, where the transfer of oxygen and carbon dioxide occurs.

The viruses can attach anywhere along that tract, likely first in the nose, throat, and trachea. [26, 27] From there, spread can occur to the lower regions of the lung (bronchioles, alveolae) depending on multiple factors including particle size and shape, humidity, and depth of inspiration. Major and serious infections such as pneumonia occur when alveolar infection occurs in a widespread manner throughout the segments of the lungs. Our laboratory studies have showing that HOCL can be vaporized in aerosolized-sized particles equal to or less than 4 microns, which are small enough to reach the alveolae. Separately, as reported earlier in this paper, our studies have also shown that vaporized HOCL will kill coronavirus in the air (Figure 2, p. 12) and on surfaces (Table 3, p. 12).

Logically and plausibly, albeit speculatively, it follows that vaporized HOCL could be used adjunctively to treat or even prevent lung infections such as COVID-19 pneumonia. Clinical studies arebeing developed to test this hypothesis. Until that time, clinical observations have shown a dramatic improvement in patients with viral sore throats or those with flu-like symptoms through simply using HOCl prepared for use as a nasal spray, gargling and/or dry-fogging in a small room.

HONESTY IN DISINFECTION – HOW MUCH IS LACKING?

As a current standard practice, the proper process of manual wiping of a surface with a cleaning agent followed by application of a disinfectant and, subsequently, allowing that disinfectant time to work (typically 4 -10 min) is recommended by companies selling cleaners and disinfectants. Although effective, in everyday practice that is a process seldom followed correctly by the user.[2]

This is a well-known problem but one that is not addressed adequately either by the companies or by the end users. As pointed out previously, a serious consequence of this failure to follow the proper usage protocol is that bacteria and viruses are exposed to the disinfectants in an attenuated fashion that often proves inadequate for killing the pathogens. The result: some of the pathogens survive with limited exposure to the disinfectant, and, in the process, develop resistance to the intended killing agents. And resistance to disinfectants most likely contributes to more bacteria developing antibiotic resistance, contributing ultimately to the problem of "superbugs."

This is the not-so-secret secret, and it is neither honestly nor openly discussed.

Furthermore, as previously reviewed, most disinfectants that are used today, have toxic chemical ingredients in them that are harmful to the environment and to humans (even more so to children and the infirm). For example, after drying on a surface, "QUATS" (quaternary ammonium compounds) can remain active as a disinfectant on a hard surface for days, a point that is proudly touted in advertisements. Children and adults who touch that surface during that time have varying degrees of transfer of the chemical to their skin – with likely at least some absorption. Over time, levels of the chemical can build up in the body and have their effect on human health.

HOCl solutions provide Free Available Chlorine in precise concentrations previously unobtainable and which have demonstrated effective lethality to bacteria, viruses, molds and fungi – while being entirely safe to humans and the environment.

Add to the not-so-secret secret, the clear reality that the problem of disinfectant toxicity inflicted on the environment, animals and people is also not discussed with forthcoming honesty by the companies producing and distributing these chemicals.

Is this failure to discuss problematic unintended, health-threatening effects of their products directly acknowledged by the companies that make these disinfectants? Do they take even partial responsibility for the serious problems of microbial resistance to disinfectants that is becoming more prominent?

Or to the contribution to the problem of antibiotic microbial resistance? Or the enormous problem of hospital acquired infections? Or to the crisis the world will be facing in one-two decades with superbugs and who knows what else might be arising? And what about the huge issue of toxic disinfectant chemicals that remain on surfaces and expose children, adults and pets to those chemicals resulting in diseases we already know about?

Equally important is collectively determining how to address these questions now that we are realizing and acknowledging them. How do we deal with these issues? The answer requires a logical, science-based, stepwise progression toward achieving solutions. We must start with honesty and truth in recognizing the causes. Then we need to move to actions like those recommended by the World Health Organization and in the report from the United Kingdom.[3]

CONCLUSION

Our new world of pandemics and antibiotic microbial resistance, complicated by the toxicity of existing disinfectants to people and to the environment, requires new preventive measures and new medical therapies if we are to remain a vibrant, progressive society while successfully protecting our citizens from unnecessary diseases and toxic exposure.

One action to take in addressing this burgeoning crisis is to use a truly "ideal" sanitizer/disinfectant – one that is non-toxic while also being highly effective. We propose that sanitizer/disinfectant is HOCl. Pathogenssimply cannot develop resistance to free chlorine. It is too operationally efficient as a pathogen killing agent. HOCl solutions provide Free Available Chlorine in precise concentrations previously unobtainable, and which have demonstrated effective lethality to bacteria, viruses, molds, and fungi – while being entirely safe to humans and the environment.

IN SUMMARY: HOCl sanitizing and disinfectant products provide the revolutionary solution. They are non-toxic, safe and highly effective in eliminating viruses, bacteria, fungusand mold both on surfaces and in the air. Accordingly, they provide the foundation for solving challenges emerging from the deeply concerning evolution of viruses, bacteria, and other problematic microorganisms in our world while preserving our environment and our safety from toxic chemical sanitizers and disinfectants.

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