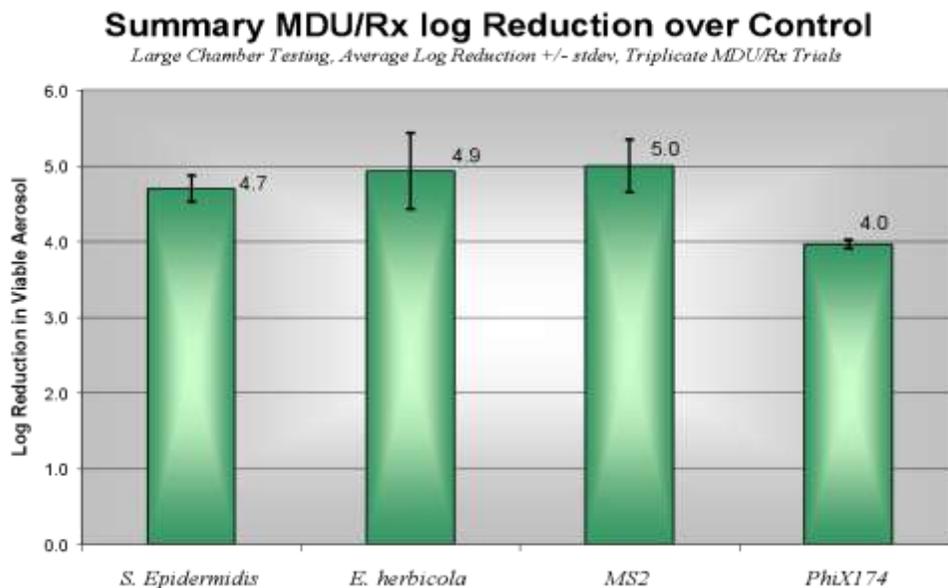


## Can HGI Prove Odorox® Technology Kills the Wuhan Coronavirus?

Testing a new, virulent virus like the Wuhan coronavirus that is spreading across China is not possible for several reasons. First, only major national labs like the Centers for Disease Control and Prevention (CDC) and National Institutes of Health (NIH) get samples so soon after the emergence of the virus. Second, commercial labs are not equipped to test such a virulent virus as it would require biosafety containment facilities and protocols beyond their capability. Commercial testing labs usually deal with viruses, bacteria and mold with virulence levels of Bio Safety Level (BSL) 1 or 2. A virus like the Wuhan coronavirus would be categorized for testing as a BSL 4 or 5, requiring full Hazmat protection, given its high rate of infection and unknown mortality rate. The Middle East Respiratory syndrome (MERS) coronavirus in 2012 had a high rate and the Wuhan coronavirus could be as lethal according to sources at the World Health Association and the Wall Street Journal (January 30, 31 2020).

A proven alternative approach – and one adopted by the Food and Drug Administration (FDA) – is to test recognized surrogate viruses in studies where they are aerosolized to mimic the most important transmission mode. HGI conducted such studies at the Aerosol Research & Engineering Laboratories (ARE Labs) for the two virus types shown below. These kill rates were measured to obtain FDA approval for the Odorox® MDU/Rx™ (FDA 510k #133800, 2014). ARE Labs, a company specializing in the study of aerosolized microorganisms, conducted an FDA approved comprehensive evaluation of the kill rates of two representative bacteria, two representative viruses and a mold as part of the approval process for the use of the MDU/RX™ in occupied spaces in medical facilities. **All five kill rates were between 4 and 5 log reductions (99.99% and 99.999%) within two hours, an exceptionally high, fast kill rate.**



The FDA selected the MS2 and Phi-X174 viruses for this study because they had different viral sheaths and were representative of the two main type of virus as explained below.

“Two representative BSL1 viruses were chosen to evaluate the MDU/RX™’s performance against both RNA and DNA based viruses.

*MS2 bacteriophage*

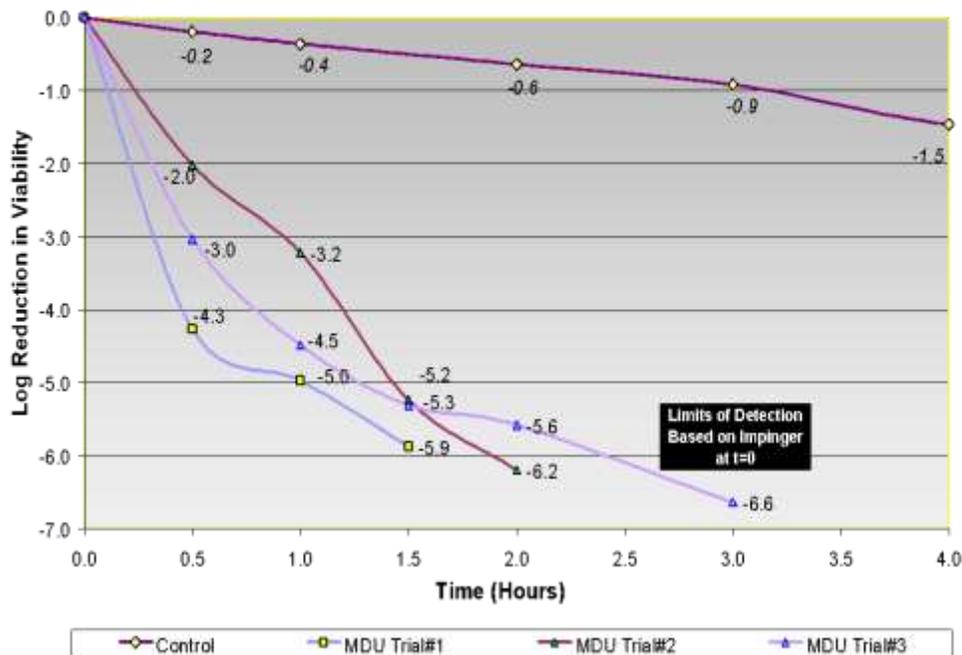
(ATCC 15597-B1) is positive-sense, single-stranded RNA virus that infects the bacterium *Escherichia coli* and other members of the Enterobacteriaceae family. MS2 is routinely used as a simulant for pathogenic RNA viruses.

*Phi-X174* (ATCC 13706-B1) *bacteriophage* is a circular single stranded DNA based virus that infects the bacterium *Escherichia coli*. Phi-X174 was selected as a simulant for DNA based pathogenic viruses.”

The kill rate profiles for these viruses are shown below. It is notable that the baselines remain very stable during the trial and the rates of viral decline are similar and rapid, and achieve the FDA minimum level of efficacy of 99% (2 log reduction) within 15 to 30 minutes.

## MS2 - Reduction in Viable Concentration vs. Time

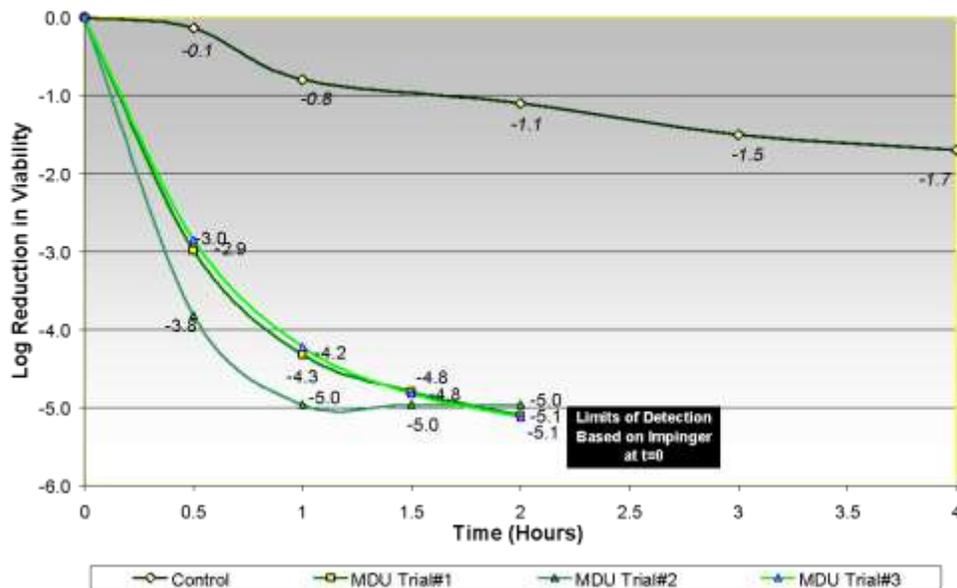
Control + Triplicate MDU Decon Runs, Collision Nebulizer, AGI-30 Impinger Enumeration



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## PhiX174 - Reduction in Viable Concentration vs. Time

Control + Triplicate MDU Decon Runs, Collision Nebulizer, AGI-30 Impinger Enumeration



Considering that the FDA threshold for “efficacy” is a 2-3 log kill rate within 8 hours, the MDU/Rx™ kill rate reductions of over 99.99% within one to two hours are exceptional. This reflects the fact that hydroxyls and the secondary organic oxidants they generate kill microorganisms by the physical process of attacking the chemicals in their cell walls. It does not matter if they are protected by protein, lipid or carbohydrate sheaths.

The full ARE Labs study is available upon request and includes all testing protocols and results. The FDA only required testing of the two types of bacteria and viruses that they considered representative of their classes to approve the MDU/Rx™.

Based on extensive microbiological testing done by HGI on surface bound microorganisms and the high, rapid kill rate for the aerosolized, surrogate MS2 virus tested at ARE, HGI believes its proprietary technology should effectively kill the Wuhan coronavirus. The MS2 virus tested at ARE Labs is an excellent surrogate for the coronavirus as they are both positive-sense, single-stranded RNA viruses. Note that the FDA considers the MS2 to be “a simulant for pathogenic RNA viruses”.

HGI has developed a range of products that incorporate the same technology found in the FDA approved MDU/Rx™. HGI can deliver turnkey solutions to treat spaces as small as a few hundred square feet to very large spaces of over a million square feet.

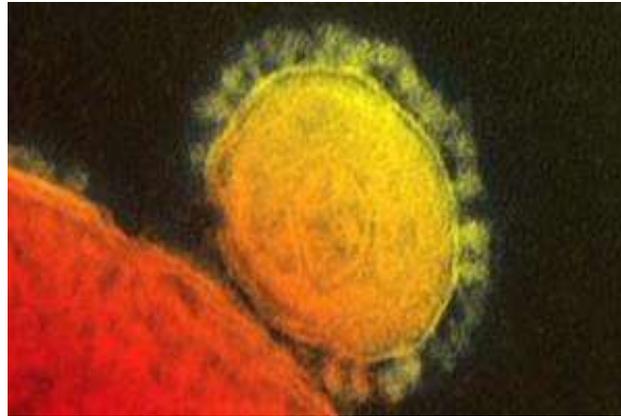
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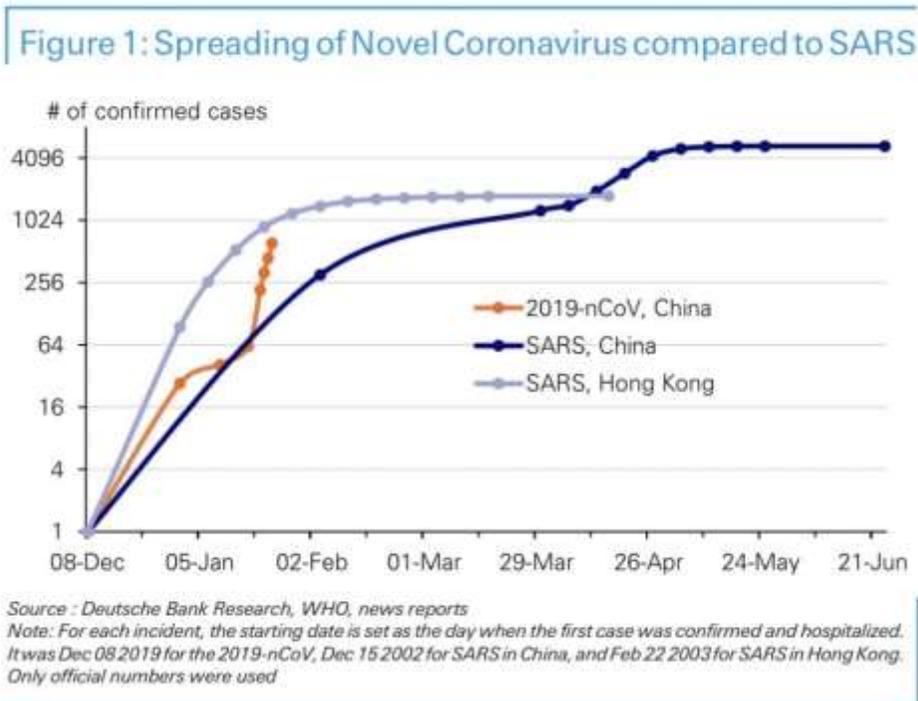


# Global Coronavirus Outbreak 2020

The outbreak and rapid spread of a new coronavirus from China has caused great concern worldwide as the virus is highly contagious and spread in air, from contaminated surfaces and via personal contact.



Early data indicates that the infection rate is higher than that measured for another virulent coronavirus called SARS in 2002 and 2019.



Epidemiologists have confirmed the source of the new coronavirus as a wild animal market in the Chinese city of Wuhan where vendors sell dozens of carcasses and live animals including bats, rats, ostriches, crocodiles and hedgehogs. The Wuhan Institute of Virology has determined from patient samples that there is a 96% match to bat coronavirus. The SARS coronavirus outbreaks of 2002 also originated in bats and spread to humans via palm civets, cat-sized mammals sold in Chinese markets.

This latest form of the coronavirus causes severe acute respiratory illness manifested as coughing, fever and pneumonia similar to that caused by the variant of the coronavirus called "Middle East Respiratory Syndrome Coronavirus" (MERS-CoV) that was first described in September 2012. The MERS coronavirus epidemic resulted in a fatality rate of 49%. There is concern that, given the high infection rate, the new virus may have a similarly high fatality rate, particularly among those with compromised immune systems.

Dozens of people in several US cities have been infected principally by exposure to travelers from Asia. Health authorities in major cities like Los Angeles, San Francisco, Atlanta, Seattle, New York are screening airline travelers. Over 100 people in 26 states have been investigated and are being monitored for the virus. The expanding outbreak has sparked concerns at schools and universities across the country that have exchange programs with China. The CDC confirms that there is no vaccine available and recommends routine sanitary precautions to minimize the risk of infection.

Risk of infection is highest in densely populated cities, public areas and transportation centers where the airborne virus can become concentrated. Of particular risk are public rest rooms. MERS transmission has been confirmed by inhaling aerosolized contaminated stool when flushing an open toilet. Aerosols persist in air for extended periods of time. Travelers and health care workers are at the highest risk.

### **Disruptive, FDA Approved Technology Can Help Minimize Viral Infection Risk**

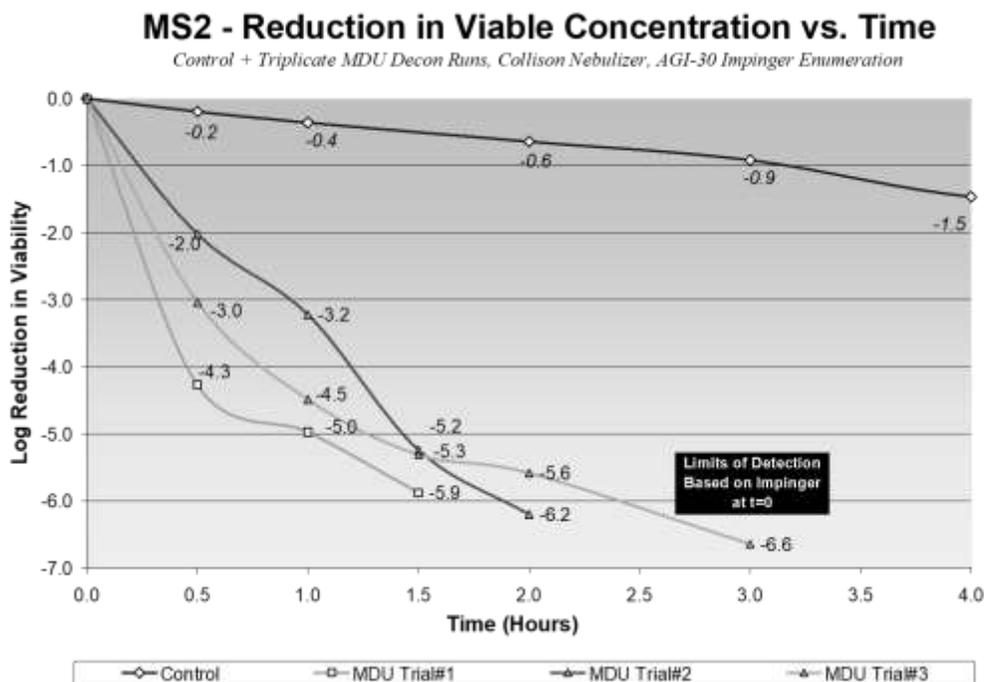
HGI Industries has developed a range of innovative sanitizing devices (Odorox® line of products) that are powered by high energy ultraviolet photochemistry, just like the action of the sun. These devices kill 99.99% of viruses, bacteria, mold and other pathogens in air, on surfaces and fabrics safely, in areas as small as an office or as large as hundreds of thousands of square meters (millions of square feet). HGI's proprietary technology sanitizes by generating effective levels of atmospheric hydroxyl radicals, nature's powerful atmospheric sanitizing oxidant.

Airborne hydroxyls are the perfect sanitizing agent. They react with a broader range of chemicals and are over one million times faster than ozone, bleach or other sanitizing agents. They react so fast that they are consumed within a few seconds, so they never accumulate. The cascade of organic peroxy and oxy sanitizing compounds formed also react very rapidly. Volatile organic by-products are rapidly decomposed as they are recycled through the device. Indoor environments are rapidly depleted of natural hydroxyls and build up unhealthy levels of chemicals, bacteria and viruses. Odorox® technology eliminates this build-up and restores nature's safe balance indoors.

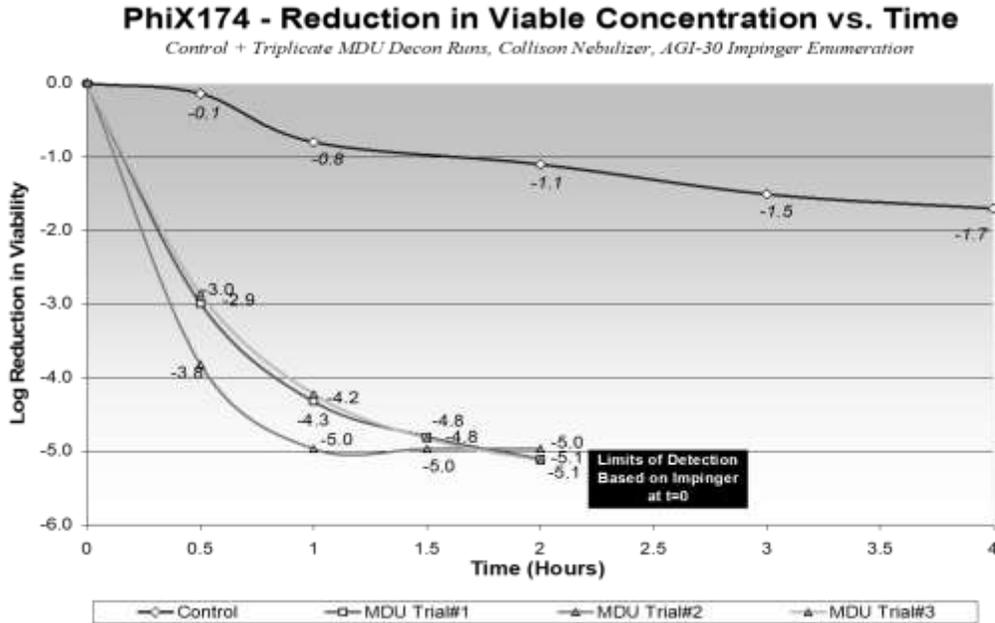
Atmospheric hydroxyl radicals (hydroxyls) are continuously produced by the action of the sun's ultraviolet energy on oxygen and water in our atmosphere. There are, on average, two (2) million hydroxyls in each cubic centimeter of ambient outdoor air during daylight hours.

(D. E. Heard, "Analytical Techniques for Atmospheric Measurement", Blackwell Publishing, 2006 – professor at the University of Leeds, UK). They keep air safe to breathe by decomposing natural and man-made pollutants and killing microorganisms. They sanitize air and surfaces by a natural process called lysing, where the hydroxyls react chemically with the lipids, protein carbohydrates and other organic chemicals in the cell wall and membranes of bacteria, viruses and other pathogens and disrupt their structure. The interior contents of the cells leak and the organism is destroyed. The mechanism for killing microorganisms is not biological, so the bacteria or viruses cannot develop any form of immunity.

Odorox® measured kill rates across a broad range of microorganisms on hard and porous surfaces and in air are consistently over 99.9%. Kill rates for aerosolized microorganisms are exceptionally high in the measured range of 4-5 log (99.99 to 99.999%) within several hours, as shown below from a study of the Odorox® MDU/Rx™ device presented to the FDA. This is particularly effective for the spread of viral disease as the main vector for transmission is inhalation of aerosolized virus.



**Figure 8:** Bacteriophage MS2 Control and MDU/RX trial Log Reduction in Viable Concentration.



Germicidal ultraviolet (UV-C) lights have been used for years to sanitize surfaces. UV-C lights have insufficient power to generate hydroxyls, whose formation requires higher energy UV energy. UV-C lights are only able to sanitize surfaces and biologicals within a few inches of their source and only when there is sufficient exposure time achieved by low flow rates. They are ineffective sanitizing air that circulates rapidly past their source and do not sanitize surfaces.

HGI's Odorox® UV technology is unique: it is completely different from germicidal UV-C technology. Odorox® devices generate more intense and high energy UV radiation within a patented reflection chamber. Different models are customized for specified applications and volumes of space to ensure that hydroxyl levels match safe levels found in nature. Odorox® devices have received the ETL safety mark and the MDU/Rx™ model has been approved by the FDA for use in occupied spaces in medical facilities (510k #133800, 2014).

Odorox® portable devices can treat rooms from 27 to 540 square meters (300 to 6,000 square feet), either as standalone units or by integrating into existing heating and ventilation systems. Odorox® commercial devices are designed to treat large spaces - up to thousands of cubic feet - and feature integrated, interactive process controls and sensors that measure and control the levels of sanitizing oxidants ensuring consistent, safe levels.

HGI's Odorox® devices are manufactured in the United States. HGI can rapidly design and implement custom solutions that effectively treat public places at risk of coronavirus contamination and propagation. HGI can help authorities to rapidly put in place solutions that sanitize the air and surfaces in hospitals, airports, train stations, schools, universities, health clinics and other public places.

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 President Prometheus Strategies, LLC  
 Chair, HGI Scientific Advisory Board

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