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## **Safely Reopening Healthcare and Public Spaces: *Preparing your environment to instill public confidence***

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### **The Crisis**

The novel SARS-CoV-2 coronavirus pandemic resulted in world-wide shelter-in-place orders intended to slow the spread of the virus, reduce the burden on healthcare providers and minimize the global death toll by ‘flattening the curve’ (1). In the United States, this order began in mid-March 2020, when non-essential businesses in most states were closed and residents in non-essential jobs were ordered to remain home and promote physical distancing. These closures included non-emergent healthcare, such as elective surgeries, dentistry, optometry and other outpatient practices, as well as general industry, most public spaces, gyms, salons, retail spaces and schools. Other public spaces such as airports, busses and train stations were not closed, but have seen substantial decreases in use.

A month after the closures, agencies such as the Association of peri-Operative Registered Nurses (AORN), American College of Surgeons (ACS), American Society of Anesthesiologists (ASA), American Hospital Association (AHA), and the Centers for Medicare and Medicaid Services (CMS) began issuing guidance for re-opening non-emergent medical services (2,3). In late April, news headlines started reporting the re-opening of states, including non-essential business and public spaces, and the World Health Organization (WHO) announced that it will be providing updated guidance on the safe opening of the world (4).

On April 3, 2020 REHVA, the European heating, ventilation and air conditioning association, released the latest updates on guidance for operating and using building services to prevent the spread of coronavirus in the workplace (5). Although the spread of this novel virus has been effectively slowed and to date, the surge of critically sick patients has been minimized by the widespread national shutdown, the threat of the virus has not been removed. There are few proven treatments and no vaccine yet exists. Worse yet, WHO recently suggested that there is no evidence that those who have been infected and recovered, are protected from becoming infected again (4). This is further complicated by the uncertain evidence suggesting the virus is easily transmissible by asymptomatic, pre-symptomatic or mildly symptomatic individuals (6-10).

As the nation and the world begin to reopen public facilities, safety will be paramount for all individuals. Consumer and employee confidence will also need to be restored using evidence-based science rather than unproven opinion. And as these spaces prepare to reopen, management will need methods to assess and improve the microbial safety of these environments.

## The Science



SARS-CoV-2 is an enveloped, RNA virus that uses a specific 'spike' protein on its envelope to gain entry into human cells (11). When the envelope is denatured, or disrupted, the virus is inactivated and cannot infect cells. Therefore, soap and water, bleach, hydrogen peroxide, Isopropyl alcohol, quaternary ammonia cleaning agents, and other hospital-grade disinfectants are effective at inactivating the virus (12).

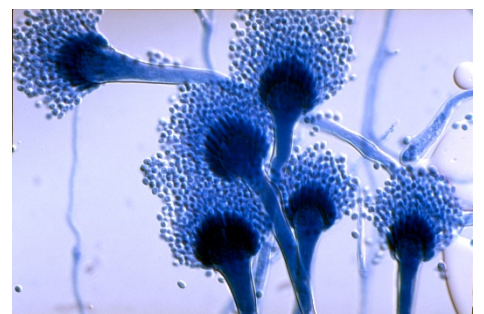
The virus is also susceptible to ultraviolet radiation and heat (13, 14). The primary means of infection are inhaling liquid droplets containing viral particles, close contact with an infected individual, and contact with contaminated surfaces (14). The virus can survive on non-porous surfaces, such as plastic and metal for longer periods of time than on porous surfaces, such as cardboard or clothing (15). This is because dehydration, or removal of moisture, will also denature the envelope, rendering the virus inactive.



Furthermore, there is some evidence that this virus' RNA can exist in an aerosol (16) that could linger in the air and possibly in ventilation systems, but whether this detected viral nucleic acid is infective is still unknown. This coronavirus may have a similar aerobiological property to other viruses such as measles and chickenpox.

There is also increasing evidence of a fecal-oral mode of transmission, implicating aerosols from toilets and other contaminated water sources in the spread of the virus, according to WHO (4). Though there is still much to learn about SARS-CoV-2, we can use the information we do have to assess the safety of our healthcare and other public spaces as we resume everyday life.

In addition to the virus itself, there are equally important environmental threats that must be addressed as repurposed spaces return to their intended uses and shuttered spaces reopen. Because these spaces will have to be returned to their original intended function or reopened after halted operation, staff must evaluate environmental performance to ensure proper pressure, air flow, humidity, temperature, air change rates, and cleanliness (virus, mold, bacteria). Effective ways to clean the air include ultraviolet radiation, HEPA filtration (17), electrostatic filtration (not ionization), increased ventilation, increased outside air supply with minimized recirculation, and directional and controlled supply and exhaust are effective ways to clean the air (5, 18). According to RHEVA, duct cleaning, humidification and temperature are not practically effective means to control this coronavirus' spread (5).



*Aspergillus sp.*

In addition to air quality, surface decontamination and water quality are equally important. In critical spaces, surfaces should be disinfected with a hospital-grade product approved by the EPA as effective against emerging viral pathogens (12). Surface disinfection and air quality can be verified by swabbing surfaces to measure total aerobic bacteria colony counts after disinfection and before returning the

space to the original purpose. Since coronaviruses are more susceptible to disinfection processes than vegetative bacteria (18), microbiological testing for efficacy against aerobic bacteria is a good proxy method to provide reliable, affordable evidence of SARS-CoV-2 removal from critical spaces such as airborne isolation rooms, operating rooms and other healthcare and general public spaces. Direct detection of viral RNA on surfaces and in the air is achievable, but it's expensive and prone to false positives because nucleic acid may be detected even when the viral envelope has been disrupted and the virus is not infective.

As for water, SARS-CoV-2 is not a waterborne pathogen, but there is some evidence that it can be carried in droplets and droplet residue from contaminated water (19, 20). The WHO recommends that all toilets should be equipped with a lid and water seals should work at all times. Building occupants, healthcare or otherwise, should be instructed to flush toilets with the lids down. Furthermore, as with surfaces and air, the novel coronavirus is not the only concern when recommissioning or reopening public places. When shut down for an extended period, both utility and critical water systems should be restarted in a controlled manner to protect key system components and ensure proper water quality before starting sterilization operations. It's likely that there has been some bacteria growth in all vessels and water systems if these critical systems were stagnant. In addition to being of a concern in sterilization operations, biofilms can become foulants downstream in reverse osmosis (RO) membranes and filters. Restart recommendations include: forcing a water softener regeneration of each cell to purge the water in the softener tank(s); dumping any reverse osmosis (RO) water that was left in storage tanks during shutdown; visually inspecting tanks to ensure no visible biofilm is present; restarting the RO and refilling the tank with the discharge pumps off; replacing filter media when appropriate; and flushing the system to drain until appropriate test levels have been met. (21)

Validation that these recommissioned and reopened public spaces are functioning optimally could play a big part in restoring consumer and employee confidence in healthcare providers and business owners. Accurate data and analysis can provide evidence that they have restored safe environments for their patients, visitors, customers and staff.



The BEACON™ Surgical Patient Safety and Quality Improvement Program (OnSite LLC, Indianapolis, IN) provides comprehensive environmental quality indicators that can be used for recommissioning and reopening a variety of spaces such as hospitals and surgery centers, dental offices, general office spaces and airports, to name a few.

Additional details are available at [www.onsite-llc.com](http://www.onsite-llc.com).

\*Handwashing and cleaning images from CDC.gov; Aspergillus image from Wikipedia.

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