Clinical Infection Control - Novel Coronavirus (SARS-CoV-2)

The role of OptiZil (by CleanCert) as an effective skin and surface sanitizer

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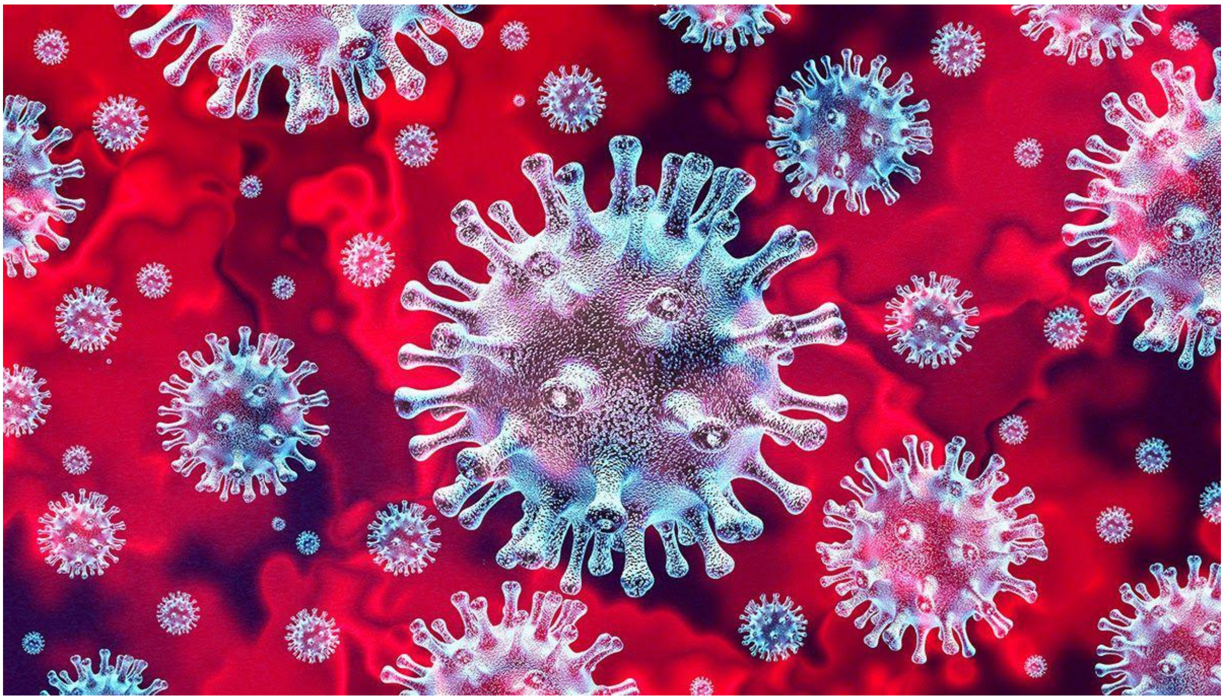

Image of a coronavirus

Introduction

The current outbreak of novel coronavirus (SARS-CoV-2) started in Wuhan, China, on December 31st, 2019. By Monday, March 2nd 2020, China reported 80,026 cases, resulting in 2,912 deaths.

44,541 people in China have recovered from the impact of infection; however, 7,110 remain in a severe or critical condition.

Across the world, SARS-CoV-2 is affecting 68 countries and territories as Infection-related deaths continue to rise: S. Korea (26), Italy (41), Iran (54), Japan (6), Hong Kong (2), France (2), and USA (2). Single deaths have also been recorded in Thailand, Taiwan, Australia, San Marino, and the Philippines.

While the WHO states that the current level of threat does not constitute a pandemic, WHO chief Tedros Adhanom Ghebreyesus stated this week that the number of new cases in recent days in Iran, Italy and South Korea was "deeply concerning".

Mike Ryan, head of WHO's health emergencies programme, went on to claim that now is the time to "do everything you would do to prepare for a pandemic".

Coronaviruses

Coronaviruses, as with hepatitis, influenza, herpes, Newcastle disease and orthopox, are enveloped viruses. Enveloped viruses possess an outer coating that is composed of a lipid layer (a fat-like substance that is water-insoluble). The virus uses the envelope to attach itself to the host cell.

Coronaviruses have crown-like projections on their surfaces giving rise to the Latin name ‘Corona’, meaning halo or crown.

Seven strains of coronaviruses are known to affect humans (See Table 2) and are responsible for 10-15% of common colds.

Three strains, SARS-CoV (first reported in China, 2002), MERS-CoV (first reported in Saudi Arabia, 2012), and SARS-CoV-2 (Wuhan, China, December 2019) pose a significant threat to human life.

SARS-CoV-2 Symptoms vary from person to person but typically include

- fever,
- breathlessness, and
- coughing.

Contracting SARS-CoV-2 can quickly lead to severe acute respiratory syndrome (COVID-19).

Infection Control

Genetically, SARS-CoV-2 is more closely related to the 2002 SARS (SARS-CoV) coronavirus than it is to influenza.

The WHO reports that 25% of 2002 SARS coronavirus cases were seen in health care professionals due to the highly contagious nature of the virus.

Inanimate surfaces can be as infectious as people, so the correct use of disinfectants is a critical step in environmental control.

SARS-CoV-2, like other enveloped viruses, is transmitted by direct or indirect contact with infectious virus particles through

- droplets dispersed into the air by coughing or sneezing,
- touching or shaking hands with an infected person, or
- making contact with an infected surface and then touching the eyes, nose, or mouth.

Reports into the effect of several virucidal agents on enveloped viruses show the viral genome becomes inactive when the agent destroys the protective envelope.

OptiZil is a non-toxic, biodegradable disinfectant proven effective against enveloped viruses including HIV, influenza, hepatitis B & C, and coronaviruses.

Treatments with ultraviolet (UV) radiation also usually destroy the viral genome, while chlorine dioxide and heat interrupt the process of host cell recognition for virus binding (Wigginton, 2012).

Published work (Clark et al., 2006) has demonstrated excellent log reductions of up to 10^7against MRSA (on ceramic tiles) using OptiZil. Independent studies have repeatedly demonstrated that CleanCert’s products are effective against bacteria and viruses in a wide range of applications (e.g. food safety, animal production, health care) and methods of use (e.g. spray, dip, fog).

Precautions

SARS-CoV can be inactivated (4 log reduction) easily with many commonly used disinfectants.

In Rabenau et al., 2005, workers reported a 30-60 minute contact time with concentrations of disinfectants based on glutaraldehyde and benzalkonium chloride. They did not test chlorine-based products.

Dellano et al. (2009) tested a range of household disinfectants against Murine hepatitis virus (a SARS-CoV surrogate), including sodium hypochlorite. They found that a 30 second contact time was sufficient to achieve a 4.5 log reduction of MHV dried onto stainless steel coupons.

Fogging has also been tested as a virucidal vehicle for disinfectants: Knotzer and workers (2015) fogged stainless steel coupons with a dry residue of a range of viruses (enveloped and non-enveloped).

The study demonstrated that 5 minutes fogging with hydrogen peroxide/peracetic acid (at a rate of 0.4ml/m^3) was sufficient to achieve inactivation.

However, hydrogen peroxide/peracetic acid is aggressive and can be highly dangerous to humans if not used in the correct quantity.

By comparison, the active ingredient in OptiZil is hypochlorous acid: the same chemical produced by the human defence system to kill bacteria and fight infection.

One of the most commonly studied viruses is Feline calicivirus (FCV) as it is relatively easy and safe to work with under laboratory conditions. It is also used as a surrogate for norovirus.

Norovirus and FCV are non-enveloped viruses which are harder to kill than enveloped viruses such as coronaviruses.

Many studies have reported on various compounds used for the inactivation of FCV, including acids and alcohols (Whitehead and McCue, 2010), ozone gas (Hudson et al., 2007), H2O2 vapours, and chlorine dioxide gas (ClO2) (Morino et al., 2009).

Whitehead and McCue (2010) showed that bleach and acid-based disinfectants could inactivate FCV within 1 min (>4 log10 reduction). The use of ClO2 has been shown to reduce FCV titers by >3 log10 within 10 h (Morino et al., 2009), and ozone can inactivate FCV in less than 1 h (Hudson et al., 2007).

However, some of these compounds are toxic, some expensive, and most require an extended time for virus inactivation. OptiZil achieved >5 log reduction in FCV titres in less than a minute (Chander et al., 2012), without toxic risk.

Various virucides are commonly used to disinfect environmental contact surfaces implicated in viral outbreaks. The material safety data sheets and labels for these virucidal compounds rarely allow for their aerosolization, spraying, or fogging due to their toxicity and adverse health effects for given exposure durations and concentrations.

Many of these chemical compounds, including sodium hypochlorite, chlorine gas, and glutaraldehyde, are associated with occupational illnesses.

For example, exposure to glutaraldehyde is associated with contact dermatitis in health workers, and the use of quaternary ammonium compounds has been found to cause occupational asthma in users (Purohit et al., 2000; Ravis et al., 2003).

Environmental Contamination

SARS-CoV persists on hard surfaces for up to 96 hours (Duan et al., 2003) and up to 5 days if dry (Rabenau et al., 2005b).

MERS-CoV persists for at least 48 hours on surfaces (Hui et al., 2018).

Environmental contamination is considered a serious method of infection in hotels, public places and health care settings (Radun et al., 2003).

Contamination by MERS-CoV in patients' rooms has been reported in South Korea, with positive MERS-CoV RT-PCR results for cultures from environmental swabs taken from bed sheets, bed rails, intravenous fluid hangers and tables (Bin et al., 2016).

In the same study, MERS-CoV viruses could still be isolated from three of the four enrolled patients studied on days 18–25 after the onset of symptoms.

Another study (Cho et al., 2016) detected the presence of MERS-CoV by RT-PCR in viral cultures from four of seven air samples taken from two patients' rooms, one patient's bathroom, and one common corridor. MERS-CoV was also detected in the viral cultures for 15 of 68 surface swabs.

A third study showed low concentrations of MERS-CoV RNA for environmental swabs taken from bed guardrails and monitors. Even after cleaning the monitors with 70% alcohol-based disinfectant, RT-PCR showed low concentrations of MERS-CoV RNA remained: the samples only became negative for MERS-CoV after the monitors were wiped with diluted sodium hypochlorite (Song et al., 2015).

The results are consistent with the findings of other researchers, e.g. Rabenau et al. (2005) found that (under laboratory conditions) alcohol gels were effective against feline calicivirus in the presence of fetal calf serum but not effective in the presence of sheep erythrocytes or serum albumin: alcohol gels are not efficacious under all “dirty” conditions.

Rutala and Weber (2014) proposed a hierarchy approach to effectiveness based on the general resistance to disinfection of various microorganisms. (Table 1.)

In the table, enveloped viruses at the bottom of the table in the most susceptible group and the easiest class of microorganisms to kill.

SARS-CoV-2 is an enveloped virus and falls into this group: therefore, disinfectants proven effective against HIV, influenza and other coronaviruses should also be effective against SARS-CoV-2.

Table 1: Hierarchy of Microbial Resistance to Disinfectants and Sterilants

Most Resistant	**Microorganism**	**OptiZil BS EN Tests**
	Spores (e.g. C. difficile)	BS EN 13704:2002; BS EN 13727:2003
	Mycobacteria (e.g. M. tuberculosis)	BS EN 14204:2012; BS EN 14348:2005
	Non-enveloped viruses (e.g. norovirus, polio)	BS EN 14476:2013
	Fungi (e.g. Candida albicans)	BS EN 13697:2001; BS EN 1275:1997
	Bacteria (e.g. MRSA, VRE, Acinetobacter)	BS EN 1040:2005; BS EN 276:2009; BS EN 13697:2001 BS EN 1656:2009
Most Susceptible	Enveloped viruses (e.g. HIV, influenza)	BS EN 14476:2013

Source: Adapted from Spaulding, 1957 and Rutala and Weber, 2014

Background

Coronaviruses belong to one of two subfamilies: Coronavirinae and Torovirinae: they are enveloped viruses typically 120-160µ in diameter. They were first isolated in the 1960s from the nasal cavities of patients suffering from colds.

Coronaviruses have a seasonal pattern (the R0 value for seasonal influenza is said to be 1.3). They primarily affect the upper respiratory tract of mammals and birds. They cause direct (viral) and secondary (bacterial) pneumonia and bronchitis. The strains of coronavirus known to affect humans are shown in Table 2.

Table 2: The Seven Strains of Coronavirus Known to Affect Humans

Variant	**Genus**	**First reported**	**Reported number of cases / deaths / mortality rate**
Human CoV 229E	AlphaCoronavirus	**-**	-
Human CoV OC43	BetaCoronavirus	-	-
SARS-CoV	BetaCoronavirus	2003	8098 / 774 / 9.6%
Human CoV NL63	AlphaCoronavirus	2004	-
Human CoV HKU1	BetaCoronavirus	2005	-
MERS-CoV	BetaCoronavirus	2012	2182 /779 / 36%
SARS-CoV-2	BetaCoronavirus	2019	89083 / 3057 / 3.4% (as of March 2nd, 2020)

For many years, epidemiologists were only aware of two strains of coronavirus (Human CoV 229E and Human CoV OC43). Resultant illness is fairly mild, affecting just the upper airway. The discovery of SARS-CoV in China added a third. By the end of 2005, two more (mild illness) strains had been identified (Human CoV NL63 and Human CoV HKU1).

Middle Eastern respiratory syndrome coronavirus (MERS-CoV) was identified in 2012 and the new variant (SARS-CoV-2) was first observed in Wuhan, China in late 2019.

Coronaviruses cause a wide range of disease in farm animals and domesticated pets: porcine CoV, bovine CoV (both cause diarrhoea in young animals), avian CoV (respiratory tract), Canine CoV (two types), Feline CoV (two types, both associated with high mortality rates), ferret CoV (two types) and murine CoV (high mortality rate).

Coronaviruses are also present in wild animal species including bats, camels, and snakes. Some CoV has effective vaccinations, and IBV vaccines are widely used in the commercial poultry industry.

CoV diseases in animals are zoonotic and freely mutate. So new viral pandemics pose a genuine threat to humans and animals.

The term “emerging viruses” is used to describe the appearance of viruses whose presence has increased over the past twenty years or whose presence threatens to increase in the years to come (Artika and Ma’roef, 2017).

High profile viruses that meet this definition include the highly pathogenic avian influenza (HPAI) virus of subtype H5N1, severe acute respiratory syndrome (SARS-CoV), Ebola, the Middle East respiratory syndrome coronavirus (MERS-CoV), Zika and most recently the new variant Wuhan Coronavirus (SARS-CoV-2).

Their appearance is believed to be driven by many factors such as socio-economic, environmental and ecological changes (Jones et al., 2008).

Local interaction with wildlife in undeveloped countries, higher levels of global travel and trade, and different land use are known to be contributing factors for their rapid emergence.

Additional factors, including a substantial increase in the human population over the past five decades, and urbanisation in developing countries have contributed to the increased chance of viral diseases emergence and re-emergence.

Of the six previously known strains, two have been associated with severe outbreaks: SARS and MERS.

SARS-CoV caused severe illness (muscle ache, headache, fever followed by respiratory symptoms, including pneumonia). The WHO state that approximately 25% of cases were seen in health care professionals due to the highly contagious nature of the virus.

While most of the cases arose in China, 30 other countries were also affected. No new outbreaks have been reported since 2014.

MERS-CoV was first discovered in 2012 in Saudi Arabia. Although it has been reported in 27 countries, 85% of the cases have been in Saudi Arabia. Infected patients present with a range of symptoms including fever, shortness of breath, cough, nausea, headache, vomiting and diarrhoea. Epidemiological data suggest that those affected are predominantly males who also suffer from a co-morbid disease (e.g. diabetes) (Hui et al., 2018).

OptiZil by CleanCert

Weare not currently able to test OptiZil against novel coronavirus SARS-CoV-2 as the strain is not available for laboratory testing. Moreover, if samples were available, it is not possible to make any definitive claims until regulators review and approve those claims.

However, CleanCert's products have passed British Standards tests for virus efficacy and our in-house tests against a wide range of enveloped and non-enveloped viruses, delivered positive results.

CleanCert passed all the BS EN tests highlighted in Table 1, and we have also carried out tests on a wide range of other organisms to satisfy the very vigorous demands of the Biocidal Products Regulation (BPR). Our active substance is approved for use in which we own the dossiers submitted to ECHA regulating CleanCert OptiZil throughout the European Union.

Findings demonstrate that OptiZil consistently performs well under laboratory and field conditions. >3 log reductions in viral loads both under laboratory and commercial "real life" conditions have been achieved.

In comparison, Alcohol-based sanitizers and disinfectants are effective against viruses in laboratory-based tests, but they do not always appear to be useful in "real life" situations.

Similarly, the glutaraldehydes tested by Rabenau and workers (2005) achieved good log reductions of viral loading on surfaces. However, their very long contact times (30 -60 minutes) mean that they may be of limited "real world" use.

OptiZil achieves >5 log viral reductions in less than a minute, demonstrating effectiveness as a spray, wipe or bottled solution.

OptiZil can be misted into the environment when people and animals are present with no deleterious effects.

It can be sprayed onto a surface and left with no fear of toxic residues. Workers do not need any PPE to handle it.

OptiZil does not lose efficacy at low temperatures and has a 12-month shelf.

CleanCert Innovations Ltd

For over 10 years, CleanCert Innovations has operated at the forefront of high-performance clinical infection control and water management.

We help clinical practices manage infection risks without the need for toxic chemicals; we produce pre-mixed solutions to save time and provide one-step applications to reduce the downtime associated with multi-step processes.

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OptiZil | Powerful non-toxic clinical disinfectant

CleanCert | Effective clinical infection control

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