

Sustainability of Coronavirus on Different Surfaces

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Coronavirus disease 2019 (COVID-19) is the name of the disease supposedly manifested in December 2019 from Wuhan, from the virus named SARS-CoV-2. Now, this disease has spread to almost all other parts of the world. COVID-19 pandemic has various reasons for its dramatic worldwide increase. Here, we have studied coronavirus sustainability on various surfaces. Various disinfectants and their roles are discussed from the available literature. The infection capabilities of SARS-CoV-1 and SARS-CoV-2 for different materials and finally studies on infection decay for SARS-CoV-1 and SARS-CoV-2 are discussed. (J CLIN EXP HEPATOL xxxx;xxx:xxx)

The global disaster COVID-19 pandemic has various reasons for its dramatic increase worldwide. Some researchers opine that the SARS-CoV has its origin from bats and the prevalence of this virus to humans was through palm civets: the intermediate source between bats and human population.^{1,2} The most responsible reasons for it include the large human population gathering and human intervention which have violated the ecosystem globally. The population of the world intrudes the various untouched ecologies and put themselves before the unknown viruses and bacteria without knowing their threat or impact of exposure to humankind.^{3,4}

The coronavirus can travel beyond species boundaries. The earliest infection of SARS-CoV-2 was in Wuhan (China), and the World Health Organization (WHO) has called this pandemic as Coronavirus disease 2019 (COVID-19). Initially, it was thought that this virus also has its origin from the animals to humans, as some of the infected people were from a wholesale seafood market in Wuhan. At a later stage, infections were found in humans, those who have not even visited that particular market, thus making it clear that this virus can also spread by human-to-human exposure.⁵⁻⁷

There can be various ways of transmission for this virus to infect the human population. Spreading or transmission of COVID-19 can be through close contact of human beings or by touch or the aerosol spreading of the virus.⁸⁻¹⁰ The most common way of spreading of this virus is through respiratory droplets as the infected one coughs or sneezes. These microdroplets containing the virus can infect a healthy human by settling on the face (mouth,

nose, ears, eyes) or hands.¹¹ This virus can sustain for a long time on various surfaces which is also considered as a significant reason for its transmission. Frequent touching of the facial area, handshake and unavoidable touch to different surfaces while travelling (through various transport means) are also a significant threat to humans. In addition, the transmission is known as “hidden transmission” as the carrier unknowingly spreading the infection to other population exists.¹²

CORONAVIRUS SUSTAINABILITY ON VARIOUS SURFACES

Coronavirus can last for long durations on different metal surfaces, ranging from hours to days.^{13,14} Recent studies show that the coronavirus can last about three days on a plastic surface as well as on stainless steel surface, it can also sustain for a period of whole one day on cardboard, while it can only sustain only for about four hours on a copper surface.¹⁵

DISINFECTANTS/SANITISERS AND THEIR ROLE

The use of disinfectants decimates microorganisms such as virus or bacteria on inner layers or inert surfaces by acting as an antimicrobial agent. Disinfectants are not always impressive against all kinds of microorganism such as bacterial spores unlike sterilisation, which kills all types of microorganisms by the use of extreme physical or chemical procedures.¹⁶ Disinfectants play a critical role in decimating microorganisms outside the human body or on various surfaces. This fact distinguishes disinfectants from antibiotics and antiseptics, which act inside the human body or on living tissues, respectively. The mechanism of disinfection involves the destroying of the cell wall of microbes and the disinfectant enters into their metabolism to destroy or inactivate them.

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There are many sanitisers available in the market to disinfect different metal surfaces. These were composed of chemical substances capable of disinfecting microorganisms which may be suspended in various media such as air, alcohol and alcohol plus quaternary ammonium cation-based compounds, aldehydes, oxidising agents, the biguanide polymer polyaminopropyl biguanide, and so forth. Table 1 shows various disinfectants and their role.

Sanitisers are the substances that disinfect and clean simultaneously, and these kill more germs than the sanitisers.^{24,25} Disinfectants are frequently used in hospitals, clinics and also in the bathrooms and kitchens to kill infective organisms. From the Table 1, we can decide the role of disinfectants in human life.

INFECTION CAPABILITY OF CORONAVIRUSES

A comparative study of SARS-CoV-2 and SARS-CoV-1 viruses is conducted to estimate their decay rate on different metal surfaces and in an aerosol. They have used a Bayesian regression model to study the decay rate of the virus on different surfaces. Approximately ten experiments with different conditions involving the aforementioned two viruses were conducted for five different environmental conditions. These include four metal surfaces and aerosol. Plastic, stainless steel, copper and cardboard were the four metal surfaces taken into consideration. The reason behind taking these metal surfaces was the use of these materials in our day-to-day life, whether the population

is travelling, shopping, or doing work in the office. Study on the aerosol showed that SARS-CoV-2 could sustain in it for up to three hours. One important observation was that during that time, the virus reduces its infecting capability, from 103.5 to 102.7 Tissue Culture Infective Dose (TCID)₅₀ per litre of air. A similar tendency of SARS-CoV-1 is also observed in this study, and it was identified that the infection capability of the COVID-19 virus has reduced from 104.3 to 103.5 TCID₅₀ per millilitre.²⁶ Table 2 gives a comparative study of both viruses and shows that SARS-CoV-2 and SARS-CoV-1 have significant sustaining time on different surfaces.

Although the behaviour of both the viruses is almost similar on some metal surfaces as in the first three environmental conditions, they show linear decay in infection capability.^{27–30} However, in aerosol, plastic and stainless steel, the concentration of virus on the medium is different, but the differences are insignificant. Under the tested experimental conditions, SARS-CoV-2 was similar to SARS-CoV-1. These viruses include high viral load having the potential to infect the people, and before spreading, the affected person may be asymptomatic.^{31–35}

INFECTION DECAY

From the available data, an analysis is made on the infection capability and duration for which a particular virus can sustain in a medium or on a surface to depict the trend of decreasing infection tendency of the virus (Figures 1 and 2). Thus, to make these two graphs, the lower

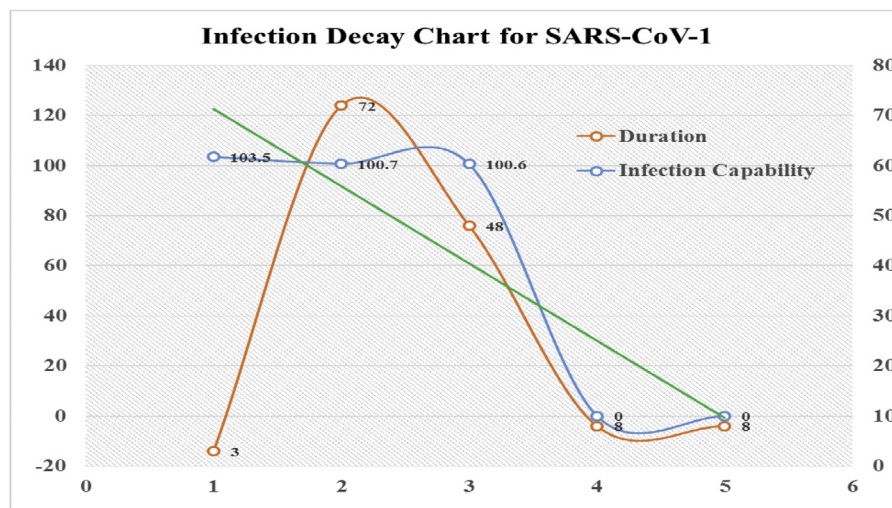
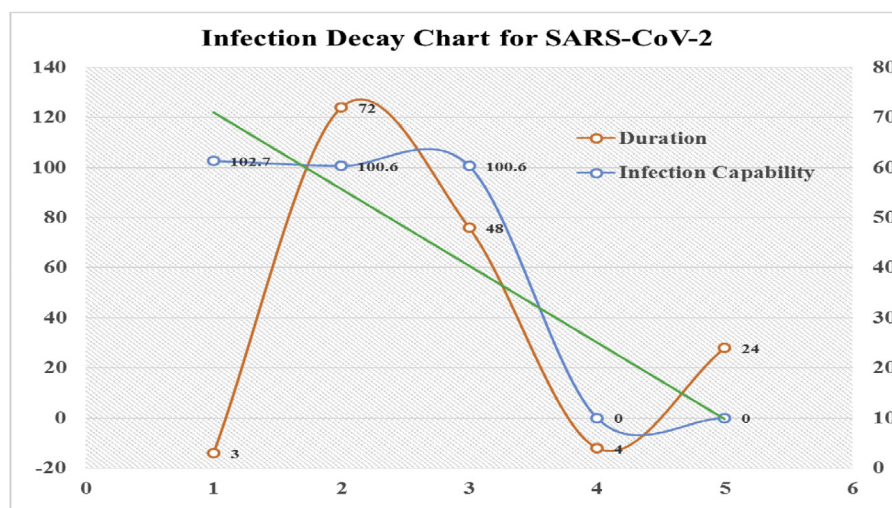
Table 1 Various Disinfectants and Their Role.

S No	Disinfectant	Role
1.	Air disinfectants	A disinfectant can be used as an aerosol or vapour with sufficient concentration to kill airborne microorganisms. ¹⁷
2.	Alcohols	Alcohol and alcohol-based compounds are hospital-grade disinfectants approved by the Centers for Disease Control (CDC) and Environment Protection Agency (EPA). ¹⁸ It is found that high-concentration mixture of ethanol (80%) and isopropanol (5%) are very effective against viruses such as human immunodeficiency virus (HIV), hepatitis B, and hepatitis C. ^{19–22}
3.	Aldehydes	These are sporicidal and fungicidal and inactivate the organic matter partially.
4.	Oxidising agents	The mechanism involves the oxidising of the cell membrane, which leads to the death or the inactivation of the virus. Chlorine and oxygen are powerful oxidisers.
5.	Peroxy and peroxo acids	These are also very good oxidants and effective in disinfection of viruses and bacteria.
6.	Phenolic agents	These are the ingredients of disinfectants and found in mouth wash, soap and hand wash.
7.	Quaternary ammonium compounds	Also known as “quats” and shows a very high tendency with alcohol to kill viruses such as norovirus, rotavirus or poliovirus, which are nonenveloped.

Table 2 Infection Capability of SARS-CoV-1 and SARS-CoV-2 for Different Materials.

Materials	SARS-CoV-1		SARS-CoV-2	
	Infection capability	Duration	Infection capability	Duration
Aerosol	104.3 to 103.5 TCID ₅₀	3 h	103.5 to 102.7 TCID ₅₀	3 h
Plastic	103.4 to 100.7 TCID ₅₀	72 h	103.7 to 100.6 TCID ₅₀	72 h
Stainless steel	103.6 to 100.6 TCID ₅₀	48 h	103.7 to 100.6 TCID ₅₀	48 h
Copper	no viability	8 h	no viability	4 h
Cardboard	no viability	8 h	no viability	24 h

TCID, Tissue Culture Infective Dose.

**Figure 1** Infection decay chart for SARS-CoV-1.**Figure 2** Infection decay chart for SARS-CoV-2.

concentration values were taken from Table 1, as those are the correct values of concentration at the end of sustaining time of virus on different metal surfaces.

It can be derived from Figures 1 and 2 that the sustainability of SARS-CoV-2 is more or less similar to

that of SARS-CoV-1 for the given environmental conditions. We see a linear decrease in the infection capability of this virus, with respect to time, and the same varies in accordance with the medium (surface). This linear decrease shows the exponential decay in virus titre per litre of air or

millilitre of medium with time. The green line shows the linear decay of infection capability in the graphs. Graphs for both SARS-CoV-2 and SARS-CoV-1 are confined from 1 to 5 digits; these digits depict the five environmental conditions, namely, (1) aerosol, (2) plastic, (3) stainless steel, (4) copper and (5) cardboard.

CONCLUSION

Coronavirus can sustain for a long time on various surfaces which is a major reason for its transmission. This virus can contaminate on different metal surfaces and stay on them from hours to days, with a maximum span on plastic and stainless and least on the copper surface. The alcohol-based disinfectants can significantly reduce the survival and decay time of the virus. The two important coronaviruses (SARS-CoV-2 and SARS-CoV-1) have significant sustaining time on different metal surfaces, and their behaviour is almost similar on various metal surfaces and in aerosols.

CREDIT AUTHOR STATEMENT

Dr Rajiv Suman: Concept, writing some part and revision of the paper. **Dr Mohd Javaid:** Concept and writing some part of the paper. **Prof. Abid Haleem:** Writing some part and checked whole paper. **Prof. Raju Vaishya:** Writing some part and checked whole paper. **Dr Shashi Bahl:** Writing some part of the paper. **Devaki Nandan:** Revision of the paper.

CONFLICTS OF INTEREST

The authors have none to declare.

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