



# The viability of SARS-CoV-2 on solid surfaces

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## Abstract

The COVID-19 pandemic had a major impact on life in 2020 and 2021. One method of transmission occurs when the causative virus, SARS-CoV-2, contaminates solids. Understanding and controlling the interaction with solids is thus potentially important for limiting the spread of the disease. We review work that describes the prevalence of the virus on common objects, the longevity of the virus on solids, and surface coatings that are designed to inactivate the virus. Engineered coatings have already succeeded in producing a large reduction in viral infectivity from surfaces. We also review work describing inactivation on facemasks and clothing and discuss probable mechanisms of inactivation of the virus at surfaces.

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## Introduction

Severe acute respiratory coronavirus-2 (SARS-CoV-2) is the virus that causes COVID-19 and has been responsible for more than 100 million cases and 2 million deaths as of February 2021 (COVID-19 Dashboard by the Center for Systems Science and Engineering at Johns Hopkins University, <https://coronavirus.jhu.edu/map.html>). SARS-CoV-2 is transmitted through infected respiratory droplets and aerosols generated by a diseased person [1,2]. Respiratory droplets and aerosols can be generated when a person sneezes, coughs, speaks, or breathes [3]. An individual is infected by the virus through nasal or oral inhalation of the infected droplets or aerosols and then attachment of the virus to the epithelial membrane [2]. The pathway to infection is not fully understood but is

thought to be via inhalation of either respiratory droplets or aerosolized virus (WHO Transmission of SARS-CoV-2: implications for infection prevention precautions, <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>). For this reason, health officials have advised that individuals should avoid poorly ventilated public places [4], wear a mask in public places, and increase distance between other individuals [3,5].

The possibility of infection via solid surfaces has also been considered. In this scenario, a droplet that contains virus lands on and contaminates an inanimate object. The contaminated object is called a fomite. The next user touches the fomite, and the virus is transferred from the fomite to the user's hand. Infection can occur if the person then touches their nose, mouth, eyes, or ears (Figure 1). A preprint (Behzadinasab et al., medRxiv doi: [10.1101/2021.04.24.21256044](https://doi.org/10.1101/2021.04.24.21256044)) confirmed that SARS-CoV-2 can be transferred from fomites to artificial skin.

A study on Golden Hamsters showed that the virus can be indirectly transmitted through fomites [6], but we are unaware of a study directly showing fomite transmission in humans. The WHO not only states that “fomite transmission is considered a likely mode of transmission for SARS-CoV-2” (WHO Transmission of SARS-CoV-2: implications for infection prevention precautions, <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>), but also notes that “People who come into contact with potentially infectious surfaces often also have close contact with the infectious person, making the distinction between respiratory droplet and fomite transmission difficult to discern” (WHO Transmission of SARS-CoV-2: implications for infection prevention precautions, <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>). Modeling of outbreaks suggests that transmission via fomites may contribute up to 25% of deaths during periods of lockdown [7].

Infection via fomites depends on the longevity of SARS-CoV-2 on a solid because an infectious dose clearly must survive until following users contact the solid. The longevity of SARS-CoV-2 depends on the solid material,