DHS Science and Technology Factors Affecting the Stability of SARS-CoV-2 on Surfaces

Homeland Security
Science and Technology

PROBLEM ADDRESSED

While most data suggest that droplets or aerosols are the predominant modes for SARS-CoV-2 transmission, infection may also occur after touching contaminated surfaces and transferring virus to the nose, mouth or eyes. As a result, elevated hygiene and disinfection practices are in place to mitigate the potential for such contact transmission. At the onset of the pandemic, it was shown that SARS-CoV-2, the virus that causes COVID-19, could remain infectious on surfaces for several days under a limited set of environmental conditions. However, the effects of a wide range of environmental conditions (e.g., temperature, relative humidity, and sunlight), droplet size, and surface type on how long the virus survives on surfaces were largely unknown. To better understand the stability of SARS-CoV-2 on surfaces and to inform the potential for contact transmission, NBACC conducted a series of studies to identify the environmental factors that influence how long infectious SARS-CoV-2 remains on nonporous surfaces.

KEY RESULTS

- Temperature, relative humidity, and simulated sunlight all affect how long SARS-CoV-2 remains infectious on surfaces, with simulated sunlight causing the most rapid decrease in infectivity.
- Under conditions representative of indoor climate-controlled environments, virus remained infectious for several days with the time required to kill 90% of the virus under cool dry conditions being approximately 51 hours.
- In the absence of simulated sunlight, increasing temperature and/or relative humidity resulted in faster inactivation of virus on surfaces.
- SARS-CoV-2 infectivity decayed rapidly in the presence of simulated sunlight and was dependent on solar intensity. The time required to kill 90% of virus at peak summer solar intensity was 6.8 minutes.
- Decay was not different among three different droplet sizes tested, nor did the type of nonporous surface (stainless steel, ABS plastic, nitrile rubber) onto which the virus was deposited affect its stability.
- Using these data, a mathematical model was developed to allow a user to predict how long SARS-CoV-2 will remain infectious on indoor surfaces under different environmental conditions.

SIGNIFICANCE OF RESULTS

These results suggest that nonporous surfaces contaminated with SARS-CoV-2 may remain infectious for several days under environmental conditions commonly encountered in climate-controlled indoor environments. Consequently, the data suggests that contact transmission may be possible, even though current epidemiological data still point to droplet and aerosol exposure as the primary means of infection. Reduction of potential exposure to contaminated fomites indoors is best mitigated by more frequent cleaning and disinfection of high-touch surfaces, and regular hand washing. Because the potential for encountering infectious virus on surfaces is higher indoors than outdoors, it is also recommended that operations be moved outdoors when possible in addition to employing social distancing and the use of PPE for at-risk individuals.

While increasing temperature and humidity resulted in increased decay of infectious virus on surfaces, this effect would not sufficiently reduce virus infectivity in an operationally relevant time frame that would significantly decrease the potential for exposure. Therefore, these results do not support increasing the temperature and relative humidity of inhabited permanent structures or environments. However, when vacating or re-using a temporary structure that housed infected individuals (e.g., a mobile support tent or trailer), actively increasing temperature and relative humidity (e.g., 95° F and 60% RH) for several days prior to normal cleaning and disinfection practices would have complementary effects by reducing potential exposure to infectious virus, particularly for contaminated hard to reach areas where manual cleaning would be difficult.

Finally, because these results suggest that sunlight rapidly inactivates infectious SARS-CoV-2 on surfaces, placing potentially contaminated nonporous objects (e.g., shopping carts, baskets, folding chairs) outdoors and in direct sunlight in addition to normal disinfection and cleaning may further reduce the potential for transmission of the virus from these contaminated surfaces.

The predictive model developed using droplet deposited virus decay data from this study allows a user to estimate the persistence of SARS-CoV-2 on nonporous indoor surfaces across a range of environmental conditions (74-95 °F and 20-60% RH). This tool can be found at: https://www.dhs.gov/science-and-technology/sars-calculator.

REFERENCES

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