Coronavirus Stays in Aerosols for Hours, on Surfaces for Days

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The novel coronavirus, SARS-CoV-2, remains viable in aerosols for hours and on surfaces for days, according to a new study.

The data indicate that the stability of the new virus is similar to that of SARS-CoV-1, which caused the SARS epidemic, researchers report in an article published on the medRxivpreprint server. (A version of the article has been published online by the *New England Journal of Medicine*.)

Transmission of SARS-CoV-2, which causes COVID-19, has quickly outstripped the pace of the 2003 SARS epidemic. "Superspread" of the earlier disease arose from infection during medical procedures, in which a single infected individual seeded many secondary cases. In contrast, the novel coronavirus appears to be spread more through human-to-human transmission in a variety of settings.

However, it's not yet known the extent to which asymptomatic or presymptomatic individuals spread the new virus through daily routine.

To investigate how long SARS-CoV-2 remains infective in the environment, Neeltje van Doremalen, PhD, of the Laboratory of Virology, Division of Intramural Research, National Institute of Allergy and Infectious Diseases, in Hamilton, Montana, and colleagues conducted simulation experiments in which they compared the viability of SARS-CoV-2 with that of SARS-CoV-1 in aerosols and on surfaces.

Among patients infected with SARS-CoV-2, viral loads in the upper respiratory tract are high; as a consequence, respiratory secretion in the form of aerosols (<5 µm) or droplets (>5 µm) is likely, the authors note.

van Doremalen and colleagues used nebulizers to generate aerosols. Samples of SARS-CoV-1 and SARS-CoV-2 were collecting at 0, 30, 60, 120, and 180 minutes on a gelatin filter. The researchers then tested the infectivity of the viruses on Vero cells grown in culture.

They found that SARS-CoV-2 was largely stable through the full 180-minute test, with only a slight decline at 3 hours. This time course is similar to that of SARS-CoV-1; both viruses have a median half-life in aerosols of 2.7 hours (range, 1.65 hr for SARS-CoV-1, vs 7.24 hr for SARS-CoV-2).

The researchers then tested the viruses on a variety of surfaces for up to 7 days, using humidty values and temperatures designed to mimic "a variety of household and hospital situations." The volumes of viral exposures that the team used were consistent with amounts found in the human upper and lower respiratory tracts.

For example, they applied 50 µL of virus-containing solution to a piece of cardboard and then swabbed the surface, at different times, with an additional 1 µL of medium. Each surface assay was replicated three times.

The novel coronavirus was most stable on plastic and stainless steel, with some virus remaining viable up to 72 hours. However, by that time the viral load had fallen by about three orders of magnitude, indicating exponential decay. This profile was remarkably similar to that of SARS-CoV-1, according to the authors.

However, the two viruses differed in staying power on copper and cardboard. No viable SARS-CoV-2 was detectable on copper after 4 hours or on cardboard after 24 hours. In contrast, SARS-CoV-1 was not viable beyond 8 hours for either copper or cardboard.

Table. Median Half-Life on Surfaces

Surface	SARS-CoV-2 (hr)	SARS-CoV-1 (hr)
Copper	3.4	3.76
Cardboard	8.45	1.74
Steel	13.1	9.77
Plastic	15.9	17.7

"Taken together, our results indicate that aerosol and fomite transmission of HCoV-19 [SARS-CoV-2] are plausible, as the virus can remain viable in aerosols for multiple hours and on surfaces up to days," the authors conclude.

Andrew Pekosz, PhD, codirector of the Center of Excellence in Influenza Research and Surveillance and director of the Center for Emerging Viruses and Infectious Diseases at the Johns Hopkins Center for Global Health, Baltimore, Maryland, applauds the real-world value of the experiments.

"The PCR [polymerase chain reaction] test used [in other studies] to detect SARS-CoV-2 just detects the virus genome. It doesn't tell you if the virus was still infectious, or 'viable.' That's why this study is interesting," Pekosz said. "It focuses on infectious virus, which is the virus that has the potential to transmit and infect another person. What we don't know yet is how much infectious (viable) virus is needed to initiate infection in another person."

He suggests that further investigations evaluate other types of environmental surfaces, including lacquered wood that is made into desks and ceramic tiles found in bathrooms and kitchens.

One limitation of the study is that the data for experiments on cardboard were more variable than the data for other surfaces tested.

The investigators and Pekosz have disclosed no relevant financial relationships.

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