Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Emerging Results:

SARS-CoV-2 Surface Contamination is Rapidly Inactivated at High Temperature (130°F/ 54°C)

Homeland Security
Science and Technology

PREDICTING THE DECAY OF SARS-COV-2 ON SURFACES AT HIGH TEMPERATURES

In the absence of a therapeutic or vaccine, preventing person-to-person spread of SARS-CoV-2 is the primary means to reduce the impact of COVID-19. While transmission occurs mainly through respiratory droplets generated by talking, coughing, and sneezing, contact with contaminated surfaces may play a role in spread. As a result, DHS S&T is executing laboratory studies at the National Biodefense Analysis and Countermeasures Center (NBACC) to evaluate the indoor stability of SARS-CoV-2 on nonporous surfaces under multiple environmental conditions (temperature, relative humidity [RH]). In these studies, NBACC has demonstrated that increasing temperature and/or RH accelerates the decay of SARS-CoV-2. These data were used to develop a web-based tool that can estimate virus stability under conditions that were experimentally confirmed (https://www.dhs.gov/science-and-technology/sars-calculator). These initial results have been expanded to include evaluation of virus decay at a higher temperature that could occur in the interiors of vehicles parked outside in direct sunlight during the summer months to evaluate how long SARS-CoV-2 survives on surfaces under these conditions. Prior testing on multiple nonporous surfaces (stainless steel, ABS plastic, and nitrile rubber) demonstrated that there was no difference in surface decay on these nonporous surfaces. The results provide evidence that high temperature (≥ 130°F) is detrimental to virus stability on nonporous surfaces.

EMERGING RESULTS

SARS-CoV-2 stability in simulated saliva (saliva) on stainless steel (a representative nonporous surface) at high temperature (130°F) and 20% RH was tested. Saliva was utilized to represent contamination originating from the mouth/throat as a result of sneezing and coughing. Table 1 shows the time required to achieve a 50, 90, 99, and 99.9% reduction in virus infectivity at 130°F.

Table 1: Time required to achieve the indicated reduction in SARS-CoV-2 infectivity on surfaces at 130°F and 20% RH in saliva.

% Virus Decay	Saliva	
	Minutes	Hours
50% (half-life)	10.7	0.2
90%	35.5	0.6
99%	71.1	1.2
99.9%	106.6	1.8

Additionally, these data were combined with previous results for half-lives of virus in saliva at 20% RH and at temperatures ranging from 74 – 95°F. An equation was developed to estimate the half-life of SARS-CoV-2 in saliva over the temperature range 74 – 130°F at

20% RH (Figure 1). This equation should not be used to estimate the decay of SARS-CoV-2 at temperatures outside this range (below 74ºC and above 130°F), as the results would be invalid.

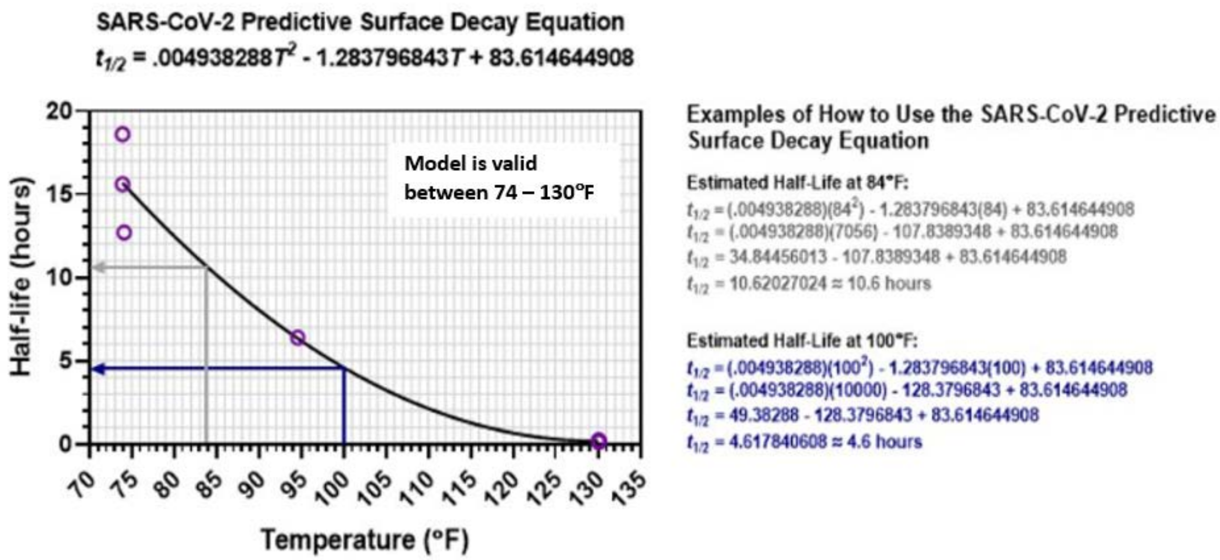

Figure 1: Surface stability of SARS-CoV-2 in saliva. Experimentally-determined half-lives for SARS-CoV-2 at 74°F (3 tests), 95°F (1 test), and 130°F (4 tests) were used to develop an equation that can be used to estimate the half-life of SARS-CoV-2 in saliva for any temperature between 74 – 130°F at 20% RH. Based upon prior results, we have demonstrated that the virus is most stable at lower RH conditions and thus the equation's estimates likely represent a worst case (*e.g.,* decay would be faster at higher RH).

In order to fully assess the hazard posed by SARS-CoV-2 surface contamination, additional information is needed, including how much infectious virus is shed by infected individuals onto surfaces, how much virus is transferred when touching a contaminated surface, and the amount of virus required to make a person sick.

APPLICATIONS OF FINDINGS

In summary, these results provide evidence that high temperature (≥ 130°F) is detrimental to virus stability in saliva on nonporous surfaces. As normal operations resume, these data suggest that, in addition to normal disinfection processes, further sanitization of unoccupied interior spaces, such as vehicles (*e.g.,* ambulances, police cars, buses) or rail cars, through either passive or active heating could be utilized to further reduce the risk of fomite transmission of SARS-CoV-2.