Increasing Temperature and Relative Humidity Accelerates Inactivation of SARS-CoV-2 on Surfaces

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Summary

Methods

- The study was conducted at the National Biodefense Analysis and Countermeasures Centre for the US Department of Homeland Security Science and Technology Directorate, Maryland
- Environmental contamination and fomite transmission is a cause of concern with SARS-CoV-2.Commonly contaminated items include office equipment, e.g. mouse, keyboards and metal furnishing such as doorknobs and handrails.The study was done to determine the stability of SARS-CoV-2 on non-porous surfaces.
- The virus was diluted 1:10 in simulated saliva.
- Droplets of various sizes (1 to 50 μl) were deposited onto stainless steel, acrylonitrile butadiene styrene (ABS) plastic or nitrile rubber glove coupons, which represent common sources of fomite transmission
- Virus stability was measured using multiple relative humidity (RH) and temperature set points over a total of 32 trials
- Virus was recovered from three randomized coupons into culture medium at predetermined time points over a period of 48 hours.
- Simultaneously, a fluorescent labelled latex microsphere was also recovered as control to check for physical efficiency
- The amount of infectious virus remaining was determined using a quantitative cell-based infection assay
- Virus infectivity data were fitted to statistical models to estimate the infectivity decay rate and half-life
- Viral RNA estimation by RT-PCR was also done in six trials

Results:

- Droplet size (1 to 50μl) was not a significant factor influencing the half-life ($t_{1/2}$) of SARS-CoV-2
- There was no significant difference in half-lifeestimates between virus deposited on stainless steel, ABS plastic or nitrile glove
- The effects of changing temperature and RH on virus survival ($t_{1/2}$ in hours) are shown below:

Temperature (1)	RH-20% (2)	RH-40% (3)	RH-60% (4)	RH-80% (5)	P value 2 vs 4	P value 2 vs 5

24°C	15.33±2.75	11.52±1.72	9.15±3.39	8.33±1.8	0.0038	0.0023
35°C	7.33±1.33	7.52±1.22	2.26±1.42	-		
	P=0.0016	P = 0.0327	P = 0.0170			

- Virus at ambient indoor temperature is most stable at relatively low RH.
- Higher temperature resulted in faster virus decay.
- They were also able to fit a linear regression equation (adjusted R^2=0.71) that modelled the half-life of SARS-CoV-2 in simulated saliva on non-porous surfaces. Trials performed at 80% RHat 35°Cwere not included in the model
- Viral RNA estimation was not useful for contamination surveillance

Conclusion

- These findings suggest that a potential for fomite transmission may persist for hours to days in indoor environments
- Both temperature and RH were significant factors influencing virus decay.
- The linear regression equation can be used to estimate mean viral persistence at any combination of temperature and RH conditions within the study design (temperature 24–35°C and RH 20-60%)

Appraisal:

- Strength
  - First study evaluating the effects of increasing temperature and RH on survival of SARS-CoV-2 on commonly used non-porous materials.
  - The results are based on actual viral culture
- Weakness
  - The effects of temperature and RH on virus survival on porous surfaces eg. clothing, mask, cardboard packaging has not been studied
  - The data is not applicable to outdoor conditions

Opinion:

Mitigating the transmission of SARS-CoV-2 in clinical settings and public spaces is important to reduce the number of COVID-19 cases till a successful vaccination programme is in place. This study can influence public health measures to cut the transmission of SARS-CoV-2.These data are most relevant for indoor conditions and can help decide post-usage disinfection protocols for hospitals, offices, schools and public transport vehicles.Temporarily increasing temperature and/or RH in these spaces, once they are vacated, may complement cleaning with chemical disinfectants to reduce potential fomite transmission. Also, PPE when used inappropriately can be a source of possible fomite transmission.

Appraisers

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