## EMG-Survival of SARS-CoV-2 in the Environment

### Executive summary

- New data is presented that has been shared by the US Department of Homeland Security on virus survival on surfaces and in aerosol. The data is not yet peer reviewed but is from a laboratory with a strong international reputation.
- Data adds to the evidence that the virus is likely to be stable for long periods of time on indoor surfaces and in air.
- Decay rate on surfaces increases with higher temperature and humidity. There may likely be small benefits in operating buildings at a higher temperature and/or humidity where this doesn't cause significant thermal discomfort to occupants. Ventilation rates should not be reduced to achieve this.
- The virus is very likely to decay very quickly (a few minutes) in air and on surfaces when exposed to sunlight. This adds to the evidence that outdoor environments are highly likely to be a lower risk for transmission.

### Evidence summary

1. *Background*. The US Department of Homeland Security has been funding a study of survival of SARS-CoV-2 on surfaces and in the small aerosol state. The study has been carried out by the National Biodefense Analysis and Countermeasures Center (NBACC), a Department of Homeland Security federal laboratory (DHS) sponsored by the DHS Science and Technology Directorate and operated by the Battelle National Biodefense Institute. A slide set of the results of this study have been supplied to the UK through 5RD. The results in the slideset are précised in this note. While the data is not peer reviewed, manuscripts are being prepared and the laboratories have an international reputation, so we have confidence in this data.

2. *Survival on indoor surfaces*. At 24$^{o}$ C the half-life for SARS-CoV-2 dried onto stainless steel in simulated saliva was 14.5 hours at 20% relative humidity (RH), 7.1 hours at 60% RH and 8.3 hours at 80% RH demonstrating the stability of the virus in indoor environments. Increasing temperature and RH decreased the half-life (1.1 hours at 35$^{o}$ C and 65% RH). SARS-CoV-2 is stable on surfaces in indoor environments not exposed to sunlight.

3. A model within the report suggests linear relationships with temperature and humidity in the range 20-35$^{o}$C. There may likely be some small benefits in maintaining buildings at a warmer temperature (e.g. increasing from 20-22$^{o}$C to around 26$^{o}$C) where this doesn't cause significant thermal discomfort. However ventilation rates should not be reduced to achieve this. EMG believe that the evidence for improving ventilation in poorly ventilated buildings in order to dilute and remove bioaerosols is stronger than that for altering temperature and humidity. Hence changing building temperatures or humidity should only be considered where it can be achieved while still maximising the fresh air ventilation.

4. *Survival on surfaces exposed to artificial sunlight* - Solar radiation rapidly reduced viral stability on stainless steel surfaces with virus half-lives of 2 minutes in high intensity full sunlight, 3 minutes in half sunlight and 4 minutes in quarter sunlight compared to ca10 hours in the indoor environment. Outdoor surfaces exposed to sunlight are lower risk for

virus transmission and sunlight may be effective as a disinfectant for potentially contaminated non-porous surfaces.

5. *Survival in indoor aerosols.* No decay within an hour at 20° C at a range of relative humidities in the dark. Some evidence for increased decay at 30°C and 70% RH. Dstl have also generated limited data under dark conditions showing similar behaviour. SARS-CoV-2 is stable in the aerosol state in indoor environments

6. *Survival in outdoor aerosols.* Full intensity sunlight rapidly inactivated SARS-CoV-2 in aerosols (half-life 2-3 minutes). Moderate intensity sunlight also rapidly inactivated viral aerosols with slightly longer half-lives (4-6 minutes). This shows that the outdoor environment will be a lower risk for aerosol transmission, although it should be noted that this timescale will not significantly influence close range (less than 2m) risk. Outdoor SARS-CoV-2 aerosols exposed to sunlight are rapidly inactivated. The outdoor environment presents a far lower risk for long range viral aerosol transmission due to rapid inactivation and dilution of the virus.

7. *Intensity of sunlight.* No data is provided on the UV levels used for moderate and high intensity sunlight. It is assumed that these values correspond with the UV intensity scales used in weather forecasting where moderate intensity is defined as a UV index reading of 3 to 5 (meaning moderate risk of harm from unprotected Sun exposure) and full intensity is a UV index reading of 6 to 7 (meaning s high risk of harm from unprotected Sun exposure).

**PHIA probability yardstick – to be used when expressing likelihood or confidence**