Extracts from EMG Report

[1]. The EMG considered four groups of questions around transmission focusing on:

- the relationship between time spent in an environment and risk
- the role of ventilation as a mitigating factor;
- the relationship between the 2m rule and transmission risk;
- the risk of transmission from contact with surfaces

These were considered in terms of published evidence, some early findings from simulations and some simple risk models.

[3] Transmission was considered through airborne (inhalation), droplet and contact routes, and mitigation measures for these; however *it should be noted that the relative importance of these three routes* (as in [3]) *is unknown and may vary with the setting and the infectious person*. The evidence to date suggests *it is highly likely that short range droplet/aerosol and contact transmission dominate in most settings*.

[4]. Transmission risk can be considered using a **Risk = Hazard x Exposure** methodology, where the risk depends on both the amount of virus present and the duration and method of exposure. For *all transmission routes the duration of time a susceptible individual spends in an environment where virus is present will increase the probability of receiving a higher dose and hence an increased transmission risk*.

Short duration contacts even at less than 2m are highly likely to be low risk; a brief (6 sec) conversation at 1m is estimated to be comparable to a 1min exposure at 2m. Many real world close encounters (e.g. passing someone in the street) will be even shorter than this.

[5]. *For all transmission routes the longer an infectious person spends in an environment, the greater the contamination they will leave in that environment for others to come into contact with. Surface contamination could persist for up to 48 hours, contamination in air is unlikely to persist for more than 1 hour unless the ventilation is very poor.* As well as enabling social distancing and hence limiting short range transmission, reducing the number of people in an environment and the time they spend there also reduces viral load on surfaces and in air.

[7, 8]. A combination of environmental and human factors act to influence the three transmission routes (as in [3]) and we suggest that *appropriate mitigation measures should be assessed through a Hazard x Exposure risk matrix approach*…Environmental factors need to consider the physical layout in terms of how this creates or limits interactions, systems such as the ventilation and sanitation which provide environmental connections between people and operational aspects such as cleaning which mitigate risk…"

Ventilation acts to mitigate potential aerosol risk at distances beyond 1-2m. It has very limited effects on short-range and contact transmission, other than to possibly slightly reduce the rate of surface contamination.

[12]. The 2m rule is not an absolute figure; risk decreases with distance and 2m is a distance where risk is considered by many to be sufficiently low. Evidence from modelling studies and simple calculation suggests that *exposure could be 10-20 times higher at 1m compared to 2m. Coughing and sneezing is significantly higher risk than simply talking and hence those who have symptoms should make greater effort to maintain the 2m distance and contain coughs and sneezes appropriately.* The 2m rule is simple and is a good measure of the distance where the direct person-to-person transmission risk drops significantly although should be seen as a ballpark guide to distancing.

[13, 14]. Evidence from previous coronavirus outbreaks, supported by modelling for the SARSCoV-2 outbreak (see Annex 2) suggests that the infection can be transmitted by touching objects and t*here is a realistic possibility that this may be the dominant route*. Recent work (but based upon a single paper) suggests differences in surface survival depending on the material.

The evidence suggests that cleaning with appropriate materials does significantly reduce virus survival.

The Overview of Evidence Summary provides additional information from specific sources, [15] to [42], including:

[18]. The likelihood of any infection can be described through a dose-response relationship for the pathogen, where the probability of infection increases as the exposure increases. This is typically a beta-Poisson or exponential relationship and may vary with route of exposure. *Data do not exist for SARS-CoV-2; however, dose-response for SARS-CoV-1 and HCoV-229E follow these type of relationships*.

[19]. The use of ventilation as a mitigating factor is a precautionary measure for airborne transmission as the role of the airborne route has not yet been established for SARS-CoV-2.

[20]. Exposure to aerosols (beyond 2m) is primarily governed by the generation rate of the aerosol, the ventilation of the environment, the effective breathing rate of the occupant (which can be treated as reduced with appropriate PPE) and the duration of exposure…Evidence for airborne transmission is limited and hard to get, and there is little quantitative data available.

[21]. Occupant density indoors is a key factor in transmission. Higher numbers of occupants increase the likelihood of an infectious individual being present and the number of occupants who may be exposed. Occupant number is also often related to ventilation rate as a result of design guidance for building ventilation…

[30]. Exposure to large droplets (20µm and greater) and short-range aerosol (less than 20 µm) at distances 2m and below is primarily governed by the generation rate from the respiratory activity and the duration of time in proximity to the source. Only a small number of studies have explicitly considered dispersion of respiratory sources and quantitatively explored the relationship with distance; these are all based on chamber experiments with manikins, computational and analytical modelling.

[34]. A face-to-face close exposure will be much greater than side-by-side or someone located behind. Preliminary CFD data suggests cough particles are predominantly within 50cm either side of the source and move with the dominant flow direction, although this has not been modelled for cross-flow conditions.

[35]. *Higher flow rates in outdoor environments can potentially transport larger droplets further than 2m*. Preliminary analysis through CFD modelling shows the increased transport of larger droplets released in a cough scenario at 2m, however the majority of these would deposit on the lower part of the body, and exposure is constrained to a narrow band directly downwind from the source. As discussed above, time will be a significant factor; *a fleeting exposure to a small number of cough droplets outdoors is likely to be far less significant than prolonged exposure in an indoor environment*.