Role of Screens and Barriers in Mitigating COVID-19 transmission

This is a rapid note put together to summarise known evidence relating to the use of screens and barriers as an infection control measure. This is predominantly based on evidence presented in previous SAGE EMG papers and a very rapid review for any new evidence.

- There is very little data on the effectiveness of screens and barriers at reducing infection transmission from epidemiological, modelling or laboratory studies
- Screens and barriers are likely to have benefits in reducing the risk of exposure to larger aerosols and droplets from exhaled breath when people are face to face and close together (less than 2m) (high confidence).
- Screens could also reduce surface contamination in some settings which could impact on fomite transmission risk however there is limited evidence currently to quantify the magnitude of this effect (medium confidence).
- Screens are unlikely to provide any direct benefit in reducing exposure to the virus from droplets or aerosols when people are already located at 2m or greater or where they are not face to face (high confidence).
- Unless they are designed to work with the airflow, screens are unlikely to reduce exposure to virus in smaller aerosols as they can easily pass around a screen with the airflow in a short period of time (high confidence).
- There is some epidemiological and mechanistic evidence that suggests that screens could increase risks of aerosol transmission due to blocking/changing airflow patterns or creating zones of poor air circulation behind screens. This effect will depend on the local airflow patterns (medium confidence).
- In some locations it is possible that screens or barriers could act as reminders to people to maintain social distance or help organisations manage the layout in their environments. However, there is currently no evidence that we are aware of to support this benefit (low confidence).
- The effectiveness of screens is likely to be environment and activity specific and will depend on the layout of the space, the ventilation, the size and design of the screen and the interactions that happen in the environment. There are large numbers of screens that are unlikely to be effective due to their design or positioning (medium confidence).
- The use of screens as part of a “COVID-secure” risk assessment should be informed by both an understanding of the activity involved and the ability of the screen to reduce the identified transmission risk, based on our current understanding of their efficacy as outlined in this paper (high confidence).
- There remains a need for further research to look at the effectiveness of screens and barriers in real-world settings both from the perspective of direct mitigation of the virus in exhaled breath or managing behaviour.

Rationale for the Use of Screens and Barriers

Exposure to the virus indoors increases as distance between people decreases, particularly at distances below 2m. Previous EMG papers indicate the exposure at 1m may be 2-10x greater than at 2m (EMG 2021). This is also born out in UK contact tracing data which shows that infection rate for reported contacts is almost double for “direct” contact compared to “close” contact[1]. At close range

[1] Direct: face to face contact (e.g. a conversation within 1 metre); skin to skin contact (including sexual contact); coughed on, sneezed on or spat on

it is possible to be exposed to all sizes of droplets and aerosols in a concentrated plume, whereas beyond 2m exposure is predominately the small aerosols which remain airborne and are more dispersed through a space. Screens are a mitigation measure that can potentially reduce part of the close-range transmission through blocking larger aerosols and droplets. Their use is likely to be most effective in scenarios which require people to be face to face in close proximity for short periods of time.

Epidemiological Evidence for the Impact of Screens and Barriers

There are very few studies that consider the impact of screens and barriers on the risk of disease. A study looking at schools in Georgia, US suggested that the impact of distancing between desks and use of barriers have a very minimal effect compared to measures such as ventilation or masks (Gettings et al 2021). Analysis from a very large US online survey of self-reported school-based mitigations in the US suggests that desk screens are associated with an increase in COVID-19 risk (Lessler et al 2021). A small amount of data from the NHS suggests that screens placed between beds increased nosocomial transmission compared to increasing spacing between beds (HOCI/EMG paper).

Pre-pandemic, Bagherirad et al. (2014) reviewed a cluster of tuberculosis cases in a commercial office in Australia and noted cubicle dividers as one of the factors that may have contributed to transmission. Studies of other respiratory diseases suggest higher rates of transmission in open-plan offices, but do not comment specifically on screens and dividers (Zivich et al 2018, Richardson et al. 2017)

Mechanistic Evidence on the Effect of Screens and Barriers

Evidence from modelling applications on buses suggests that screens which completely separate one person from others in the environment may be effective at reducing their risk of exposure to virus (UCL, 2020). However, it should be noted that this separates off a space for a single occupant (driver) and the effect of a full height screen may be different where there is more than one person enclosed by the screen.

There remains very little data on the effect of partial screens on transmission risk, with only a small number of experimental (inert tracer) and computational studies prior to and during the pandemic (Ching *et al.*, 2008; Gilkeson *et al.*, 2013; Abuhegazy *et al.*, 2020)). These studies highlight that the effect of screens on small aerosols depends significantly on the design relative to room airflows; there may be a reduction in exposure for some designs and an increase for others (Gilkeson *et al.*, 2013; Abuhegazy *et al.*, 2020)).

Studies from the health and safety workplace sector show that screens are effective at reducing exposure to large droplet splatter, however it is not clear how this data translates to the sizes of aerosols and droplets from a respiratory source. Visualisation techniques such as those in Newsom et al (2021) may be beneficial for exploring the impact of screens on large droplet dispersion and surface contamination. An experimental study by Wang et al (2020) exploring deposition onto a solid surface placed in front of a cough simulator also suggests protection for those behind the surface from the larger spray droplets. They indicate that the size of partition needs to be large enough to

---

Close: within 1 metre for 1 minute or more (not necessarily face to face); within 1-2 metres for 15 mins or more (could be total 15 mins over 24 hours); travelling in a small vehicle; travelling in a large vehicle or plane (1 metre for 1 min and 1-2 metres for 15 mins) block the spray droplets and the height above the mouth of the infectious person depends on distance. It is also likely that screens with gaps close to breathing height (e.g. to enable payment in shops) are likely to be less effective at providing this protection against spray droplets and surface contamination.

Ongoing work as part of PROTECT NCS has developed a computational fluid dynamics simulation of exhaled particles resulting from speaking and coughing, which are being applied to a simulated small room containing a screen under different ventilation conditions. Preliminary results for a displacement ventilation case when the infected person is facing the screen at 0.5m distance suggests that the screen can disrupt the initial exhalation and larger particles either hit the screen or fall to the ground. As well as reducing direct exposure this may reduce the contamination of surfaces beyond the screen. However small aerosols are likely to be carried by the air around the screen by around 30s after being exhaled and are mixed throughout the room by around 5 minutes. There is a dependence on the exhalation, with the screen likely to be more effective against the exposure to an uncovered direct cough which has a greater momentum compared to speaking which releases particles at a lower velocity. Work is ongoing to look at the effect of the screen in other ventilation conditions and to quantify the effect on different particle sizes.

Influence of Screens and Barriers on Behaviour

There seems to be an absence of evidence on the role of screens and barriers on behaviour, however it is possible that there are studies that we have not been able to identify in this very rapid timescale. It is possible that screens could act to improve compliance with social distancing by enforcing the layout of a space and reminding people to maintain a distance. It is also possible that screens could provide false assurance, although studies have shown that there is very little evidence of risk compensation behaviour (Mantzari et al 2020). Further research is needed to understand whether there are any behavioural influences of screens and barriers.

Screens as part of a risk assessment process

The "COVID-secure" risk assessment process should identify all work activities where transmission via the three main routes (air, surface, person-to-person) is possible. It should then identify the most appropriate suite of control measures to reduce the risk to as low as reasonably practicable based on the available evidence base. The choice of risk reduction measures will depend on the specific workplace, and the suitability of the control measure to reduce transmission by the specific work activity. The use of appropriately sized and located screens should be considered in the context of the evidence presented above; in particular, if there is a risk of close contact transmission of large droplets where individuals may be in face-face contact for short periods of time. It is also important that risk assessment approaches are monitored and reviewed in the light of new evidence.

References

1. Abuhegazy, M. *et al.* (2020) 'Numerical investigation of aerosol transport in a classroom with relevance to COVID-19', *Physics of Fluids*. AIP Publishing, LLC, 32(10). doi: 10.1063/5.0029118.
2. Bagherirad, M., Trevan, P., Globan, M., Tay, E., Stephens, N., & Athan, E. (2014). Transmission of tuberculosis infection in a commercial office. *Medical Journal of Australia, 200*(3), 177-179. doi:10.5694/mja12.11750
3. Ching, W. H. *et al.* (2008) 'Reducing risk of airborne transmitted infection in hospitals by use of hospital curtains', *Indoor and Built Environment*, 17(3), pp. 252–259. doi: 10.1177/1420326X08091957.
4. EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021

5. Gilkeson, C. A. *et al.* (2013) 'Measurement of ventilation and airborne infection risk in large naturally ventilated hospital wards', *Building and Environment*. Elsevier Ltd, 65, pp. 35–48. doi: 10.1016/j.buildenv.2013.03.006

6. Gettings J, Czarnik M, Morris E, et al. Mask Use and Ventilation Improvements to Reduce COVID-19 Incidence in Elementary Schools — Georgia, November 16–December 11, 2020. MMWR Morb Mortal Wkly Rep 2021;70:779–784

7. HOCI/EMG Masks for healthcare workers to mitigate airborne transmission of SARS-CoV-2, 25 March 2021

8. Lessler J, Grabowski M.K. et al (2021) Household COVID-19 risk and in-person schooling, Science: 372: 1092-1097

9. Mantzari E et al. Is risk compensation threatening public health in the covid-19 pandemic? BMJ 2020; 370 doi: https://doi.org/10.1136/bmj.m2913 (Published 26 July 2020).

10. Newsom RB et al (2021) Comparison of droplet spread in standard and laminar flow operating theatres: SPRAY study group, Journal of Hospital Infection: 110: 194-200

11. Richardson, A., Potter, J., Paterson, M., Harding, T., Tyler-Merrick, G., Kirk, R., . . . McChesney, J. (2017). Office design and health: A systematic review. *New Zealand Medical Journal, 130*(1467), 39

12. UCL 2020, Covering screen gaps minimises Covid-19 risk for bus drivers https://www.ucl.ac.uk/news/2020/oct/covering-screen-gaps-minimises-covid-19-risk-bus-drivers#:~:text=Covering%20up%20gaps%20around%20the,commissioned%20by%20Transport%20for%20London.

13. Zivich, P. N., Gancz, A. S., & Aiello, A. E. (2018). Effect of hand hygiene on infectious diseases in the office workplace: A systematic review. *American Journal of Infection Control, 46*(4), 448-455. doi:https://doi.org/10.1016/j.ajic.2017.10.006