

Duration of Wearing of Face Coverings

EMG-NERVTAG 15/09/2020

Executive Summary

A note on terminology used:

- Respiratory Protective Equipment (RPE) = respirator e.g. FFP2/N95
- Mask = surgical face mask
- Face covering = cloth face mask

SAGE has previously given advice that face coverings are likely to be effective at reducing the emission of respiratory droplets and aerosols containing virus into the environment. This paper focuses specifically on the evidence relating to the duration with which face coverings can be safely worn. The paper only considers face coverings for public/general workplace settings and does not cover respiratory protective equipment (RPE) designed to protect the wearer from aerosols. Although some evidence is drawn from healthcare experiences (including RPE), this paper does not consider the use of face coverings in healthcare as there is already enhanced guidance on this.

- It is very likely that the reduction in transmission risk due to reduced droplet and aerosol emissions from wearing a face covering significantly outweighs any potential for enhanced risk of transmission through inadvertent contact with a contaminated face covering. This is likely to be the case regardless of the duration that the face covering is worn (medium confidence).
- Contamination of face coverings is likely to increase with duration of wearing and therefore the risk of transmission via touching or surface contamination from more heavily contaminated face coverings could increase with time (low confidence). Risks associated with contaminated face coverings can be mitigated by hand hygiene, surface cleaning, and proper disposal or proper washing (high confidence). These recommendations need to be reinforced, made clearer, and facilitated (e.g. by provision of hand sanitiser).
- There is some evidence that extended duration wearing of face masks and face coverings can result in skin conditions such as acne or dermatitis for some people, but there is no data on the frequency or severity of this concern. Regular changing of face coverings and good facial skin hygiene may be able to mitigate this. (medium confidence)
- Performance of face coverings could decline with increased duration of use, but this is not currently supported with good evidence and further research is needed. However, this would still provide more protection to others than an infected person not using a mask (high confidence).
- Issues of tolerability and minor adverse effects (e.g. thermal discomfort, minor skin irritation, glasses steaming) are likely to be the main limiting factors for duration of wearing of face coverings (high confidence), and need to be factored into guidance on duration of use and likely adherence with advice.

- If the use of face coverings is extended to a wider range of settings or the recommended duration of wearing is increased, then equity must be considered. This should ensure that guidance doesn't disadvantage groups who could be adversely affected by greater use of face coverings (e.g. hard of hearing, young children in education settings), and that face coverings are available to those on the lowest incomes.
- Adherence to simple guidance around when and how to use face coverings is likely to be a bigger factor in effectiveness than the duration of wearing (medium confidence).

Evidence Base

The evidence outlined below is based on a brief review of the scientific literature and published guidance and reports relating to face coverings. This is not a comprehensive review and the literature may be incomplete.

It is important to recognise that there are a wide range of designs and materials used for face coverings and no standards covering design and performance. Therefore, any findings from published scientific studies cannot be assumed to hold for all mask and face covering designs

1. How does duration of wearing a face covering impact on transmission risk?

Potential to influence direct transmission

There is increasing evidence about the efficacy of face coverings in reducing emission of droplets and aerosols which is likely to reduce the risk of transmission of SARS-CoV-2; this has previously been set out in the DELVE paper and SAGE-EMG papers. The primary benefit of a face covering is to reduce the emission of infectious droplets and aerosols into the environment. This reduction can be well above 50%, but depends on the design of the mask, its fit to the face and the behaviour of the wearer. There is no data yet for SARS-CoV-2, but evidence from a controlled study measuring viral emissions detected no droplets and aerosols for seasonal coronavirus when participants were wearing surgical facemasks and a significant reduction for influenza (Leung *et al.*, 2020).

As face coverings can reduce both aerosols and droplets they are potentially beneficial for mitigating both close range transmission (less than 2m distance) and aerosol transmission, particularly in poorly ventilated indoor environments. In most settings extended duration of wearing is likely to have the greatest influence on reducing transmission risks relating to aerosol transmission; extended duration will reduce close range transmission for those activities that require prolonged close interaction with another person.

The reduction in droplet emissions has only been measured on fresh face masks and face coverings. It is possible that used face coverings may become wetted through moisture in breath and this may increase resistance across the material. This resistance may cause more exhaled breath to be forced between the face covering and skin over time and hence there could be some degradation in performance with longer duration of wearing. It is likely that different face coverings will be affected by this in different ways, and those made of hydrophobic materials are less likely to be affected. There is no data on this effect currently.

Potential to influence indirect transmission

Face coverings worn by infected people have been shown to become highly contaminated with SARS-CoV-2 even over short periods (Williams et al 2020), with the contamination likely increasing with duration of time worn. This would not pose a risk to the wearer, as they are already infected. This could pose a risk to others if they wore or handled the face covering from the infected person and then touched their eyes/nose, or if the contaminated face covering is placed on surfaces. When users adjust or handle their own contaminated face covering and then touch other surfaces there is a risk this will lead to contamination of frequently touched surfaces, potentially leading to transmission to others who then touch these surfaces. The size of this risk is uncertain and has not been directly investigated. These risks could be mitigated by hand hygiene, surface cleaning, and not sharing masks. Those such as care workers who may have to regularly handle face coverings worn by others may be at a higher risk.

A face covering worn by a susceptible person in the presence of an infected person may become contaminated over time due to viral droplets and aerosols in the environment being deposited on the face covering. This contamination would likely be higher when the person is closer to the infected person, spends a longer period of time in the same room with them, or the infected person is not themselves wearing a face covering. This could pose a risk of infection through hand contamination when the face covering is removed or the face covering is touched during wear, followed by touching eyes or nose. This risk of self-contamination is recognised in healthcare when removing PPE (Tomas *et al.*, 2015; Casanova *et al.*, 2018) after dealing with known infectious patients. A study conducted in China found that 10% of surgical masks worn by 148 participants over a 6-8 hour shift in a high risk hospital ward were positive for a range of respiratory viruses, and there was a significantly higher rate of positivity on masks worn for more than 6 hours (Chughtai *et al.*, 2019). A number of sources (e.g. ECDC, 2020) state that the handling of the mask could increase infection risk, however this does not appear to be based on any evidence. NIOSH guidance on respirators indicates that although surfaces can become contaminated more than 99% of the contamination remains on the respirator even when handled (NIOSH 2020). In a public or workplace setting this risk is likely to be low if wearers take care when removing and practice good hand hygiene. There is no data on SARS-CoV-2, but modelling of influenza transmission from surface-hand-nose suggests around 2% of viral particles may be transferred by a touch. This is likely to be a lower exposure than inhaling the same viral load directly over the period of time in the presence of the infectious person. However this has not been directly compared and it is not known whether equivalent virus inoculation by inhalation or contact poses the same risk.

Disposal of single-use face coverings could theoretically pose a risk of transmission for those who have to handle waste or deal with inappropriately discarded face coverings. This risk can be significantly reduced by safe waste handling and good hand hygiene. Guidance on washing reusable cotton face coverings recommends washing with normal laundry, ideally at 60°C. However, a public survey in Aug 2020 indicated that only 1 in 8 people are washing reusable masks correctly (YouGov 2020). The survey data suggests that 56% of people using single use masks reuse them and 34% of people wearing reusable masks wear them 4+ times before washing them. There does not seem to be any specific evidence on how effectively washing removes virus from masks. However a study has shown a 100 fold natural decay on cloth in 30 min and that the virus is readily inactivated by soap and water (Chin *et al.*, 2020).

A number of reports and opinion pieces (e.g. (ECDC, 2020; Martin et al 2020; WHO 2020) have suggested that wearing face coverings could lead people to forgo other protective behaviours. Although evidence is limited, studies to date considering hand hygiene, physical distancing, not touching faces provide no support for these claims (Chen *et al.*, 2020; Mantzari, Rubin and Marteau, 2020; Liebst et al 2020). There is a contrary hypothesis, that wearing a mask increases the likelihood of the wearer and observers engaging in other hygiene behaviours, because it is a visual reminder of the risk. Face coverings are likely to be influencing other behaviours. Analysis from the Behavioural Insights Team (July 2020) indicated that 56% of people were willing to visit a restaurant when face coverings were worn by waiters compared to 36% of people who were willing to visit when face coverings were not worn. Tolerability of face covering wearing over extended duration could impact on the potential for direct or indirect transmission of the virus through people adjusting or partially removing the mask due to discomfort. Policy makers have used the wearing of face masks as a measure to allow the 2 metre social distancing rule to be relaxed.

2. Are there other health risks of wearing a face covering from extended periods?

There is no good evidence that face coverings significantly impact on normal breathing or oxygen levels, although there are some studies that suggest a small effect during exercise. Measurements of heart rate during activity showed significantly lower rates with a surgical mask compared to N95 (Li *et al.*, 2005). In a study of healthy young male volunteers surgical masks and FFP2/N95 respirators, both had a significantly marked negative impact on pulmonary capacity (FEV, PEV and PEF) while wearing the mask (with a spirometry mask) during exercise (Fikenzer *et al.*, 2020). We have not identified any evidence relating to impacts on breathing for those who are not exercising, although there are already a number of people with health conditions who are exempt from mask wearing.

Neither surgical masks nor face coverings are designed for use for extended periods. Wearing a face covering for an extended period can maintain a higher moisture level around the face which can be uncomfortable for some people and may increase the likelihood of skin complaints. Masks will become highly contaminated with upper respiratory tract and skin micro-organisms. A review of the downsides of face masks and face coverings (Bakhit et al 2020) found 20 studies reporting irritation and discomfort from using masks. Participants in studies with surgical or cloth masks reported difficulty breathing (12%-34%), facial irritation and discomfort (11-35%). More serious symptoms of headache, acne, rashes were associated with use of N95 and goggles. A study among healthcare workers associates acne with extended duration of wearing (Han *et al.*, 2020). This study recommended replacing surgical masks every 4 hours and highlighted hygiene measures including regular cleaning and moisturising the face. Retroauricular dermatitis has also been reported in 14 patients due to the use of ear loop type face masks; three patients were wearing home-made face coverings (Bothra *et al.*, 2020). There are a number of anecdotal reports of acne associated to public use of face coverings, however there is limited scientific evidence to support this yet.

3. What other factors will influence the duration of wearing of face coverings and the settings in which they are worn?

Tolerability relating to comfort is likely to be the primary concern that will affect duration of wearing. Most studies of tolerance focus on Respiratory Protective Equipment (RPE) and show that people cannot wear them for long. A comparison of surgical face masks with N95 respirators during intermittent exercise highlights that reported discomfort is significantly lower with the surgical mask

rather than RPE ; these perceptions increase over time between 30-90 minutes of wearing surgical masks while undertaking exercise (walking)(Li *et al.*, 2005). This is consistent with (Fikenzer *et al.*, 2020) who reported breathing resistance, heat, tightness and overall discomfort are the items with the greatest influence on subjective perception; however, participants were also wearing a spirometry mask, which will have changed the fit of the surgical mask. In a clinical study of extended wearing, 124/148 participants reported at least one problem associated with mask use including pressure on face, breathing difficulty, discomfort, trouble communicating with the patient and headache (Chughtai *et al.*, 2019). A number of studies consider skin temperature, and highlight respirators result in more issues with heat related discomfort than surgical masks (Scarano et al 2020); tolerance in higher temperature environmental conditions may be worse than in cooler conditions. Across all studies FFP respirators performed worse than surgical masks.

Evidence to support other tolerance issues is limited, however factors that have been mentioned which could affect tolerability including fogging for people who wear glasses and impairment of downward vision which may be important for people who are less steady on their feet. There are already some environments where face coverings are required to be worn for extended periods including long distance rail and air travel, and surgical face masks are now mandatory in healthcare settings. It would be beneficial to collect evidence from some of these settings on tolerability, behaviours and face covering performance.

Equity is an important consideration in determining whether face covering use could be extended to a wider range of settings or recommended for longer periods of time. This includes ensuring that any recommendation does not significantly disadvantage any groups, with a particular focus on those who may such as the hard of hearing or children learning to read who could be significantly affected by the use of face coverings in certain settings. There is also a need to ensure that those on the lowest incomes are able to access suitable face coverings (and replace or wash them frequently) to avoid inequalities of access to protective measures and access to spaces requiring the use of a face covering.

4. Research gaps

There is a lack of good evidence relating to the wearing of face coverings, with very little data relating to duration of wearing. In particular we suggest that the following aspects would benefit from further research:

- Effectiveness of face coverings as a source control after longer duration wearing, including analysis of the influence of moisture on the performance of different types of face coverings.
- Analysis of the potential risk of transmission due to contaminated face coverings (during and after removal).
- Assessment of the prevalence of skin complaints associated with face coverings, including an understanding of the factors that contribute and potential mitigation.
- Analysis of user acceptability of face coverings for long duration use in different settings.

References

Bahkit et al (2020) [https://www.medrxiv.org/content/10.1101/2020.06.16.20133207v1.full.pdf\(B](https://www.medrxiv.org/content/10.1101/2020.06.16.20133207v1.full.pdf(B)

Bothra, A. *et al.* (2020) 'Retroauricular dermatitis with vehement use of ear loop face masks during COVID-19 pandemic', *Journal of the European Academy of Dermatology and Venereology*. doi: 10.1111/jdv.16692.

Casanova, L. M. *et al.* (2018) 'Assessing Viral Transfer during Doffing of Ebola-Level Personal Protective Equipment in a Biocontainment Unit', *Clinical Infectious Diseases*, 66(6), pp. 945–949. doi: 10.1093/cid/cix956.

Chen, Y. J. *et al.* (2020) 'Comparison of Face-Touching Behaviors Before and During the Coronavirus Disease 2019 Pandemic', *JAMA network open*, 3(7), p. e2016924. doi: 10.1001/jamanetworkopen.2020.16924.

Chin, A. W. H. *et al.* (2020) 'Stability of SARS-CoV-2 in different environmental conditions', *The Lancet Microbe*. Elsevier Ltd, 1(1), p. e10. doi: 10.1016/s2666-5247(20)30003-3.

Chughtai, A. A. *et al.* (2019) 'Contamination by respiratory viruses on outer surface of medical masks used by hospital healthcare workers', *BMC Infectious Diseases*. BMC Infectious Diseases, 19(1), pp. 1–8. doi: 10.1186/s12879-019-4109-x.

ECDC (2020) 'Using face masks in the community', *European Centre for Disease Prevention and Control*, (April), pp. 1–6.

Fikenzer, S. *et al.* (2020) 'Effects of surgical and FFP2/N95 face masks on cardiopulmonary exercise capacity', *Clinical Research in Cardiology*. Springer Berlin Heidelberg, (0123456789). doi: 10.1007/s00392-020-01704-y.

Han, C. *et al.* (2020) 'Increased flare of acne caused by long-time mask wearing during COVID-19 pandemic among general population', *Dermatologic Therapy*. doi: 10.1111/dth.13704.

Leung, N. H. L. *et al.* (2020) 'Respiratory virus shedding in exhaled breath and efficacy of face masks', *Nature Medicine* 2020. Springer US, pp. 1–5. doi: 10.1038/s41591-020-0843-2.

Li, Y. *et al.* (2005) 'Effects of wearing N95 and surgical facemasks on heart rate, thermal stress and subjective sensations', *International Archives of Occupational and Environmental Health*, 78(6), pp. 501–509. doi: 10.1007/s00420-004-0584-4.

Liebst LS, Lindegaard MR et al (2020) Face-touching as a possible correlate of mask-wearing: A video observational study of public place behavior during the COVID-19 pandemic. <https://psyarxiv.com/u6wcp/>

Mantzari, E., Rubin, G. J. and Marteau, T. M. (2020) 'Is risk compensation threatening public health in the covid-19 pandemic?', *BMJ (Clinical research ed.)*, 370, p. m2913. doi: 10.1136/bmj.m2913.

Martin, G., Hanna, E., Dingwall R. (2020) Face masks for the public during Covid-19: an appeal for caution in policy <https://osf.io/preprints/socarxiv/uyzxe/>

NIOSH (2020) <https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html>

Scarano, A.; Inchingolo, F.; Lorusso, F. Facial Skin Temperature and Discomfort When Wearing Protective Face Masks: Thermal Infrared Imaging Evaluation and Hands Moving the Mask. *Int. J. Environ. Res. Public Health* 2020, 17, 4624.

<https://www.mdpi.com/1660-4601/17/13/4624>

Tomas, M. E. *et al.* (2015) 'Contamination of health care personnel during removal of personal protective equipment', *JAMA Internal Medicine*, 175(12), pp. 1904–1910. doi: 10.1001/jamainternmed.2015.4535.

YouGov (2020) <https://yougov.co.uk/topics/health/articles-reports/2020/08/31/just-13-reusable-mask-wearers-are-washing-them-fre>

Williams C, Pan D et al (2020) COVID-19: Exhaled virus detected by Face Mask Sampling provides new links to disease severity and potential infectivity <https://www.medrxiv.org/content/10.1101/2020.08.18.20176693v1>