



Brief Evidence Summary:

Efficacy of visors compared with masks in the prevention of transmission of COVID-19 in non-healthcare settings

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SCOPE

The purpose of this document is to provide a brief summary of the current evidence and international guidance regarding the efficacy of visors/face shields (hereafter collectively called visors) compared with masks/face coverings in the prevention of transmission of droplet transmitted infection and specifically COVID-19 in non-healthcare settings. It is not a systematic review of the literature. Please note that these guidelines do not apply to healthcare settings.

RATIONALE

Arising from questions and concerns regarding the widespread use of visors in lieu of face coverings, the National Public Health Emergency Team (NPHE) requested the HPSC to review current evidence and international guidance, including that which has emerged during the course of the COVID-19 pandemic, regarding the effectiveness of visors compared with masks/face coverings.

BACKGROUND

The Statutory Instrument S.I. No 296 of 2020, applies to face coverings in 'certain premises and businesses' and as such applies to 'public settings' only. In S.I. No 296 a face covering is defined as '*a covering of any type which when worn by a person covers the person's nose and mouth*'. Examples of such face coverings used in public settings at present include cloth masks, surgical and non-surgical masks and visors.

COVID-19 MODES OF TRANSMISSION

An infectious person sheds SARS-CoV-2 in liquid particles from the respiratory tract when talking, laughing, coughing or sneezing. Liquid particles are considered as droplets (more than 5 microns in diameter) or aerosols (less than 5 microns in diameter). Droplets generally only travel a relatively short distance through the air. The concentration of droplets declines rapidly with distance from source but some droplets may travel several metres.

SARS-CoV-2 (the virus that causes COVID-19) is transmitted by droplet and contact routes. The virus is shed in respiratory droplets that may carry virus directly to the upper respiratory mucosa (mouth, nose or eye) or indirectly through contamination of

surfaces and subsequent contact transfer to upper respiratory mucosa (typically on hands). (World Health Organization, 2020a). The relative importance of direct (droplet) and indirect (contact) transmission is unclear (Health Information and Quality Authority, 2020a). It is for this reason that the current Public Health recommendations of face mask, social distancing, cough etiquette and regular hand washing are so important in limiting transmission of the virus.

The National Public Health Emergency Team (NPHE) recommends 2m as the distance to manage the risk of direct droplet transmission of COVID-19 in most circumstances (Dr T Holohan, internal communication, 25 June 2020) while the World Health Organization (WHO) considers 1m as the recommended distance to manage the risk of direct droplet transmitted infection (World Health Organization, 2020b).

A recent evidence summary by HIQA noted that while there is limited, low certainty evidence that SARS-CoV-2 may be aerosolised, there is as of yet no conclusive evidence that SARS-CoV-2 remains viable or infective in aerosolised form in real-world situations (Health Information and Quality Authority, 2020b). Aerosols and droplet nuclei (residue from evaporated droplets) can remain suspended in the air for long periods and are readily carried through the air so that they can potentially reach all parts of an enclosed space. Managing the risk of airborne transmission requires avoiding shared airspace, ventilation and the use of close-fitting respirator masks, e.g. FFP2 respirator masks. This is beyond the scope of this paper.

KEY QUESTION AND CHALLENGES

What is the evidence of the relative effectiveness of visors compared with cloth face coverings or masks in preventing droplet transmitted infection, including COVID-19 in public settings?

- A wide variation exists in relation to face coverings that are currently in circulation in Ireland in terms of cloth type, number of layers and type of face

covering including surgical and non-surgical masks, cloth masks and full and partial (covering mouth only) visors.

- Adherence to the appropriate use of face coverings is paramount to ensure the maximum level of protection is rendered to the wearer. If worn incorrectly any type of face covering is likely to be ineffective in providing any protection from COVID-19.

EVIDENCE REGARDING MASK EFFICACY

Chu *et al* (2020), based on their meta-analysis of the available data, noted that the reduction in risk of infection associated with mask use was greater in healthcare settings compared to non-healthcare settings, as adherence to proper face mask usage in health-care settings is likely to be better. They also found evidence to suggest that mask layers play a role in protection, as both N95 respirators and surgical masks were associated with a greater level of protection versus single-layer masks.

Konda *et al* (2020) found that not only did the number of layers play a role in efficacy of home-made cloth face coverings, but the material and weave of the cloth itself also influenced efficacy. They point out that an incorrect fit can degrade this efficacy by up to 50% due to leakage around the mask edges. Shakya *et al* (2017) drew the same conclusion about fit, when they noted that the shape of the cloth mask played a role in its efficacy in protecting the wearer from nanometre particles (1,000 nanometres is equal to 1 micron).

While there is evidence to indicate that the efficacy of masks is dependent on several parameters related to the mask, there is currently limited evidence on the effectiveness of facemasks worn in public settings on reducing the transmission of SARS-CoV-2 in such settings. A recent pre-print rapid review by Rohde *et al* (2020) identified seven studies specific to COVID-19, and concluded that there is currently limited evidence to suggest that wearing a face mask reduces the risk of SARS-CoV-2 transmission in non-healthcare settings. However, the authors do note that the

studies included in their review were of low quality with high risk of bias, and recommend further well-designed studies that compare the outcome of different mask types and adherence on COVID-19 transmission in non-healthcare settings.

EVIDENCE REGARDING VISOR EFFICACY

The following section presents primary evidence first, followed by literature reviews, and concludes with the current international guidance from authoritative sources.

Primary Evidence

While evidence examining the efficacy of visors in non-healthcare settings is limited (Chu *et al*, 2020), there is a large body of evidence to draw on from healthcare and simulated laboratory settings.

Lindsley *et al* (2014) is one of the key papers in this area. The authors of this study set out to determine the efficacy of visors in protecting the wearer from transmission of viral respiratory diseases. They used a cough simulator in a laboratory setting to emulate the large droplets (8.5 microns) and small droplets (3.4 microns) associated with transmission of the flu virus. These droplet sizes are in the same range as those associated with SARS-CoV-2 transmission.

The researchers placed devices at the point of inhalation of the visor-wearing manikin to measure concentration of inhaled aerosol. The effect of several parameters on visor efficacy were evaluated in this experiment, including the distance between simulated cougher and inhaler, and the size of the simulated cough aerosol particle. When the researchers evaluated the effect of distancing, they noted that the presence of a visor made no difference to the amount of inhaled virus at a distance of 183cm between simulated cougher and inhaler.

In terms of droplet size, the authors found that, compared to no visor, a visor reduced the amount of large droplet inhaled influenza virus at 46cm by 96%. The average size of the influenza-carrying droplets was 9.5 microns (droplet), within the range associated with SARS-CoV-2 transmission. The efficacy of the visor for large droplets fell to 81% after 30mins of the simulated cough, suggesting that visors offer less protection over time. However, when compared with small droplet cough aerosol

with an average diameter of 2.1 microns (aerosol), a visor only reduced inhaled influenza virus content by 68%. The authors posited that this was due to the smaller particles being suspended for longer, and having the ability to flow around the edges of the unsealed visor. The relevance of this point regarding aerosols and how it relates to SARS-CoV-2 should be considered in the context that COVID-19 is primarily transmitted by droplets and contact spread (Health Information and Quality Authority, 2020b).

Lindsley *et al* (2014) concluded that while visors may offer additional protection when working closely with respiratory patients in healthcare settings, they should not be used as a substitute for respiratory protection (i.e. masks) when it is needed. It is generally acknowledged that when respiratory protection is required in healthcare settings, a close-fitting respirator mask or equivalent is required.

A preprint by Ronen *et al* (2020) came to a different conclusion. The authors of this study aimed to identify the potential of visors as an alternative to masks in the context of the current COVID-19 pandemic. They compared masks versus visors in a laboratory setting using a cough simulator, aerosol concentration meter and water sensitive paper placed at a fixed distance of 60cm from the cough simulator. They found that for particles of size less than 2.2 microns (aerosols), visors were superior to masks in preventing inhalation of particles. Above this size (droplets), there was no discernible difference between masks and visors.

This is in contrast to the publication by Lindsley *et al* (2014) above, who found that particles with average size of 2.1 microns (aerosol) were more likely to be inhaled than larger particles of average size 9.5 microns (droplet) when wearing a visor only. The difference between these two studies may be explained by distance and time. In the study by Lindsley *et al* (2014), the researchers noted that the long-term exposure to cough aerosol particles was higher in the breathing simulator placed at 183cm versus that placed at 46cm from the cough simulator over time. They reasoned that this was due to the fact that during the first minute of a cough, the fast-moving plume of expelled air moves rapidly past the visor at 46cm to be replaced by clean air from the surrounding environment. In contrast, when the visor is placed 183cm distant, the fast-moving plume broadens and slows over the increased distance, and remains

in the vicinity for longer, increasing exposure to the aerosol. In the case of Ronen *et al* (2020), the researchers only measured exposure at a fixed distance of 60cm over the first 1 minute only. This may explain the conflicting findings between Lindsley *et al* (2014) publication and Ronen *et al* (2020) pre-print.

With regards to droplet prevention, Ronen *et al* (2020) noted that while masks provided almost 100% blocking of areas covered by the mask, visors had evidence of droplets landing on the cheeks and neck of the test manikin. This was dramatically worsened when the setting was changed to include vertical difference (cougher higher/lower than breather), with a visor only offering 40-60% droplet prevention. The authors posit that extending the visor inferiorly and laterally may improve this. This is in keeping with the conclusions of Roberge (2016) regarding effective visor design in healthcare settings.

Ronen *et al* (2020) also evaluated the potential of a visor to act as source control (i.e. prevention of transmission when the visor is worn by an infected individual), and stated that there was no indication of droplet spread beyond the visor when used for source control. The authors concluded that a visor offers similar blocking efficacy to a mask, and is superior to masks with regards to fine (<2.2 micron) particles.

The study by Ronen *et al* (2020) has several limitations not expressed by the authors and in addition to those mentioned earlier regarding distance and time. Firstly, the findings are unlikely to have real-world application. The efficacy of the visor for protection reduced considerably when moved vertically only 30cm from an infective source. In real-world situations, people are unlikely to remain stationary facing another person at all times, and it is likely that the true contamination when wearing a visor is higher than that reported in this study. Secondly, while the visor may prevent forward flow of particles when used as source control, the authors did not consider or measure inferior and lateral flow of particles around the visor edges.

Viola *et al* (2020) specifically addressed this in their pre-print article where they evaluated the efficacy of face coverings as source control for respiratory diseases such as COVID-19 in a simulated laboratory setting. Using an optical technique to visualise airflow density, they found that while both masks and visors reduced front

flow of air with coughing by more than 90%, visors produce significantly more intense leakage jets laterally and inferiorly compared to masks. This is a significant hazard in situations where the wearer is standing near a seated person, and would suggest that visors are less effective than masks at limiting spread of droplets contained in exhaled air. The authors advised that visors should be curved below the chin to prevent significant downward flow and risk of viral transmission.

Verma, Dhanak and Frankenfield (2020) came to a similar conclusion. They noted an increasing trend of people substituting visors for masks during the COVID-19 pandemic, and in light of the noticeable gaps around a visor, they sought to evaluate the efficacy of various face coverings in preventing the spread of droplets. Using laser sheets to visualise droplet dispersal, they evaluated visors in a simulated laboratory setting. While they also determined that face shields diverted the initial forward motion of the expelled air jet downwards, they added that aerosolised droplets less than 10microns in diameter remained suspended near the bottom opening of the shield, and gradually dispersed over a wide area over time. The authors also evaluated the efficacy of masks using the same experimental setup, and concluded that visors may not be as effective as regular face masks in restricting droplet spread. They caution that the widespread substitution of masks with visors could adversely affect the ongoing COVID-19 mitigation efforts.

No peer reviewed study evaluating real world evidence on the efficacy of masks versus visors in non-healthcare settings was found. There was a single news item that reported on an outbreak of COVID-19 in a Swiss hotel (The Local, 2020). In this particular case, all confirmed cases of COVID-19 had used visors, while none of the residents who wore masks became infected.

Literature Reviews

A scoping review evaluating medical-grade facial protection for healthcare workers (HCW's) (Godoy *et al*, 2020) identified a single study that evaluated face shields for respiratory protection, namely the study by Lindsley *et al* (2014) described above. Godoy and colleagues conclude that "*Because they lack a peripheral seal, face shields should not be used as primary protection for preventing respiratory disease*

transmission, but can be used as an adjunct to other facial protection.” (Godoy et al, 2020; pg 5)

The conclusions of Godoy and colleagues was echoed by a scoping review of face coverings in the context of dentistry (Smith, Agostini and Mitchell, 2020). The authors found limited evidence examining the extent of protection offered by visors during dental procedures, particularly regarding viral agents, and present no additional primary evidence beyond that identified by Godoy *et al* (2020). They similarly concluded that visors should not be used in isolation as they do not offer sufficient protection on their own. They recommended that where used, visors should be large enough to protect around the side of the face, and only be used in conjunction with a facemask.

A systematic review by Samaranayake *et al* (2020) evaluating the efficacy of respiratory protective equipment (RPE) in dentistry found limited primary evidence regarding the efficacy of visors. The authors came to a similar conclusion as above, and stated that a lack of seal around a visor makes them impractical as the sole source of respiratory protection in dental surgeries. They reiterated the stance that visors should be worn as an adjunct to masks in order to offer optimal protection against respiratory diseases in healthcare settings.

Roberge (2016) provided a narrative review on the efficacy of visors for infection control in healthcare settings. He found evidence that visors that extended from head to neck, made three separate contact points with the forehead, and had sides that curved to the point of the ears, protected the eyes, nasal nares and mouth from contamination with a fluorescent dye spray in a simulated setting. Roberge (2016) concluded that a visor alone is insufficient for respiratory protection as aerosols can flow behind the visor, and therefore should only be used in conjunction with a mask.

CURRENT INTERNATIONAL GUIDANCE

CDC

The CDC (CDC, 2020) clearly states that they do not recommend the use of visors as a substitute for a mask. There is currently a lack of evidence on the extent of

protection from visors, both as a primary protection and as source control. They do recognise that in certain situations, a mask may not be feasible, e.g. in people who are deaf. In such circumstances, a visor may be used as an alternative. When used, visors should extend below the chin and wrap around the sides of the face.

Regardless of what face covering is used, it is important to continue public health measures of respiratory etiquette, social distancing and effective hand hygiene, particularly when handling a mask/visor after use.

WHO

The WHO 'Advice on the use of masks in the context of COVID-19' (World Health Organization, 2020c) recommends that visors should only be considered in the following contexts:

“In the context of non-medical mask shortage, face shields may be considered as an alternative noting that they are inferior to mask with respect to prevention of droplet transmission. If face shields are to be used, ensure proper design to cover the sides of the face and below the chin. In addition, they may be easier to wear for individuals with limited compliance with medical masks (such as those with mental health disorders, developmental disabilities, deaf and hard of hearing community and children).” (pg 11)

ECDC

The ECDC's 'Using face masks in the community' document (European Centre for Disease Prevention and Control, 2020) makes no mention of visors or face shields. The authors of this document reiterate that masks are complementary measures, and should not be seen as a replacement for appropriate public health measures such as effective hand hygiene, respiratory etiquette and social distancing. When used, masks should be worn and managed appropriately, regardless of the type of mask used.

CONCLUSIONS

- The conclusions and recommendations that follow relate only to cloth face covering and visors because surgical masks are not currently recommended for use outside of health care settings.
- There is a clear consensus that a surgical mask is generally preferred as a face covering, particularly in high risk situations, but surgical masks are not currently recommended for use outside of the healthcare setting.
- Good quality evidence that allows for the assessment of differences in the degree of protection afforded by surgical masks, cloth face covering and visors against droplet transmitted infection is lacking particularly in public settings.
- There is a general consensus that cloth face coverings are preferred to visors.
- Some authoritative international guidance recommends against use of visors alone.
- There is also a body of evidence and opinion that visors offer a significant degree of protection against droplet exposure compared with no face covering.
- Face coverings are always in addition to and never a substitute for other Public Health measures including limiting social contacts, maintaining social distance, hand hygiene and practising appropriate respiratory etiquette.

RECOMMENDATIONS

- In public settings, when considering the options of cloths face coverings compared with visors, expert opinion and international guidance generally favours cloth face coverings.
- There is a rationale and laboratory evidence in particular for favouring cloth face coverings over visors where the wearer is at a higher level (standing) than those potentially exposed at a lower level (sitting).
- However, there is evidence that visors do reduce exposure to droplets to a certain extent and may be an alternative in certain circumstance including
 - People with breathing difficulties
 - People who are unable to remove masks/face coverings without help
 - Anyone with particular needs who may feel upset or very uncomfortable wearing the mask/face covering

- In settings where people who have learning difficulties or hard of hearing or deaf are present.
- Where cloth face coverings are used, it should be of multiple layers of suitable fabric and correctly applied. Further information on the handling and care of cloth face coverings can be found [here](#).
- Where visors are used they should cover the entire face (above the eyes to below the chin and wrap around from ear to ear) and be correctly applied. Further information on the handling and care of visors can be found [here](#).

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