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# The Role of Face Shields in Responding to Covid-19

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## Overview

In recent weeks there has been increased discussion around the potential use of face shields as a tool to help exit lockdown and prevent further spikes in infections of Covid-19.

Face shields are plastic face visors that provide full face protection. This type of face covering can play an important role in tackling the virus, but there are a number of misconceptions about how they work.

Face shields provide a high level of protection for the wearer. Given they cover the whole face – the mouth, nose and eyes – a high percentage of viral particles are prevented from reaching the wearer. Face shields are arguably best at protecting from coughs and sneezes. (As studies have shown, however, viral droplets, particularly small airborne speech particles, can remain in the air for a period of time and these particles can be sucked in around the shield<sup>1</sup>.)

Shields can therefore be very useful tools for those facing very regular contact, at close proximity, with others – for instance in medical settings. They also have great value in professions where nonverbal communication through facial expressions is important, such as teaching. They could be valuable in giving protection and confidence to teachers, enabling them to return to a classroom environment.

For this reason we recommend that face shields are procured and supplied to key groups such as teachers, health-care workers, emergency services staff, transport workers and those working in education.

Their use should also be encouraged in private sector settings such as retail, leisure and hospitality.

In our previous paper on masks, [\*The Role of Masks in Exiting Lockdown\*](#), we recommended the public use a form of face covering when in large groups and where social distancing is not possible. Unlike face shields, which are designed to protect the wearer, masks inhibit the outward transmission of viral particles and therefore help protect others.

For the general public, a normal medical mask is likely to be more effective, therefore, in helping control transmission of the virus.

Speaking to us about this issue, Jeremy Howard, co-founder of Masks4All<sup>2</sup>, said that, “The best masks for source control of speech droplets are absorbent and breathable, for instance, using a combination of cotton and paper towel. However, these masks are not as effective for coughs and sneezes, or heavy breathing during exercise. Therefore, they

should be combined with face shields, to achieve broader protection. Face shields on their own, however, are not effective at protecting the wearer from airborne small speech droplets.”

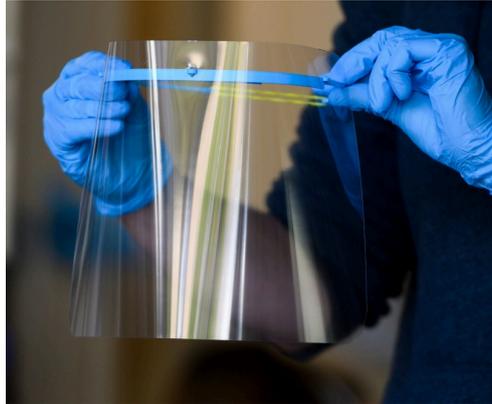
Combining both a mask and face shield would, of course, provide significant protection.

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1 <https://www.pnas.org/content/117/22/11875>

2 <https://masks4all.co/about-us/>

# What Is a Face Shield?



Face shields come in many forms, but all form a clear plastic face covering. They are mainly deployed in health-care settings.

To provide optimal protection, they are designed to cover the full face (from the top of the head to the chin and covering the ears horizontally) and protect the wearer from viral spray particles.

Face shields are generally cheap to produce, easier and more comfortable to wear than masks and can, potentially, be reused indefinitely (as long as they are correctly cleaned).

## The Purpose of a Face Shield

Face shields are valuable in protecting the wearer from inward inhalation of aerosol droplets that may be carrying the virus. While they offer some level of source control, since particles emitted through coughing and sneezing would be somewhat contained, they are less effective than masks when it comes to preventing the wearer from transmitting viral droplets outwards.

With this mind, the main purpose of face shields is to protect the wearer. Their effectiveness in this regard is enhanced because they are more likely than masks to be worn properly, and to be kept on for long periods of time. They are particularly useful, therefore, for those who are likely to have a lot of contact with the public. This is especially the case for those in jobs where nonverbal communication using facial expressions is important, such as teaching young children.

Shield-wearing is not an isolated measure. If the population adopts mask wearing in public places, as recommended in our previous paper [“The Importance of Masks in Exiting Lockdown”](#), then transmission will be reduced. Combined with face shields, we the wearers would have enhanced protection.

Table 1—The role of different types of protective face coverings

Mask/Shield Configuration	Role
Homemade cloth face covering	Protect others; can be cleaned and reused
Disposable masks worn for a short time, e.g. a commute	Protect others
Disposable masks worn for a long time, e.g. bus driver	Limited protection; can become sodden; risk of not being worn properly
Most N95 masks, worn for a short time	Protect wearer and others
Most N95 masks, worn for a long time	Protect wearer and others but become uncomfortable
Face shield	Protect wearer but not others; can be

**Mask/Shield Configuration    Role**

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worn for a long time and reused after cleaning

## How Effective Are Shields?

The data on the efficacy of face shields is more limited than on masks. We include below the key study on shields and some of the recent commentary about their efficacy in responding to Covid-19.

It appears clear that face shields offer a high degree of protection to the wearer from close range exposure to viral particles emitted through coughing and sneezing.

They do, however, allow particles – particularly small airborne speech droplets that hang in the air – to be sucked in around the shield. And, while they offer some level of source control, face shields are not as effective as masks in preventing the outward transmission of particles.

## National Institute for Occupational Safety and Health

A 2014 study on face shields titled “Efficacy of Face Shields Against Cough Aerosol Droplets From a Cough Simulator” has been cited in many places as the core evidence available.

The study used a coughing-patient simulator and a breathing-worker simulator to investigate the exposure of health-care workers to cough droplets and examine the efficacy of face shields in reducing the level of exposure.

The results of the study found the following:

- 9 per cent of the initial burst of aerosol from a cough can be inhaled by a worker 46 cm (18 inches) from the patient.
- During testing of an influenza-laden cough aerosol with a volume median diameter (VMD) of 8.5  $\mu\text{m}$ , wearing a face shield reduced the inhalational exposure of the worker by 96 per cent in the period immediately after a cough.
- The face shield also reduced the surface contamination of a respirator by 97 per cent.
- When a smaller cough aerosol was used (VMD = 3.4  $\mu\text{m}$ ), the face shield was less effective, blocking only 68 per cent of the cough and 76 per cent of the surface contamination. In the period from one to 30 minutes after a cough, during which the aerosol had dispersed

throughout the room and larger particles had settled, the face shield reduced aerosol inhalation by only 23 per cent.

- Increasing the distance between the patient and worker to 183 cm (72 inches) reduced the exposure to influenza that occurred immediately after a cough by 92 per cent.

The authors conclude that their “...results show that health care workers can inhale infectious airborne particles while treating a coughing patient. Face shields can substantially reduce the short-term exposure of health care workers to large infectious aerosol particles, but smaller particles can remain airborne longer and flow around the face shield more easily to be inhaled. Thus, face shields provide a useful adjunct to respiratory protection for workers caring for patients with respiratory infections. However, they cannot be used as a substitute for respiratory protection when it is needed.”<sup>3</sup>

## Journal of the American Medical Association

A *Viewpoint* piece in the *Journal of the American Medical Association* (JAMA) titled “Moving Personal Protective Equipment Into the Community: Face Shields and Containment of COVID-19” also looked at this issue.

The authors argue:

- “Face shields offer a number of advantages. While medical masks have limited durability and little potential for reprocessing, face shields can be reused indefinitely and are easily cleaned with soap and water, or common household disinfectants.”
- “They are comfortable to wear, protect the portals of viral entry, and reduce the potential for autoinoculation by preventing the wearer from touching their face.”
- “People wearing medical masks often have to remove them to communicate with others around them; this is not necessary with face shields. The use of a face shield is also a reminder to maintain social distancing, but allows visibility of facial expressions and lip movements for speech perception.”
- “Most important, face shields appear to significantly reduce the amount of inhalation exposure to influenza virus, another droplet-spread respiratory virus.”<sup>4</sup>

## Laura Bauld, Professor of Public Health (University of Edinburgh)

Professor Bauld has said recently that, “The reason for having a visor which would cover the upper half of your face would be if you’re regularly coming into contact with the public at closer range, and you might be exposed to somebody who is emitting those small droplets that we’re all aware are very efficient at carrying the virus.”

In terms of their use, she suggests she could see “...how in some retail settings and other environments they [may be useful], but I don’t think there’s any strong evidence that they’re something the public should be wearing on a routine basis. The key thing is to cover the mouth and the nose.”<sup>5</sup>

## Dr William G Lindsley, National Institute for Occupational Safety & Health

Dr Lindsley, who worked on the large 2014 study described above, sets out some of the ways that face shields are less effective than masks that create a seal around the wearer’s face: “If you’re facing sideways, or I’m behind you, maybe you’re sitting at a desk and I’m standing, there’s other scenarios you can imagine where droplets can come around a face shield.”<sup>6</sup>

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3 Lindsley WG, Noti JD, Blachere FM, Szalajda JV, Beezhold DH. “Efficacy of face shields against cough aerosol droplets from a cough simulator”. *J Occup Environ Hyg.* 2014;11(8):509-518. doi:[10.1080/15459624.2013.877591](https://doi.org/10.1080/15459624.2013.877591)

4 <https://jamanetwork.com/journals/jama/fullarticle/2765525>

5 <https://www.theguardian.com/world/2020/may/18/face-visors-may-protect-wearer-but-not-other-people-against-covid-19>

6 <https://www.nytimes.com/2020/05/24/health/coronavirus-face-shields.html>

## What's Out There?

Face shields are produced by a number of major manufacturers.

They are also manufacturable via the use of 3D printers and a number of UK universities have been producing them.

In the US a number of companies have repurposed to produce face shields, they include: Amazon, Apple, Nike and General Motors.<sup>7</sup>

In terms of the main manufacturers the website *Medical Expo* lists the 33 firms.<sup>8</sup>

## Repurposing Manufacturing in the UK to Make Face Shields

Across the range of PPE, face shields stand out for their simplicity in design and manufacture. This lends itself to the repurposing of existing manufacturing in the UK to mass produce face shields. A study from late April<sup>9</sup> that included input from Royal United Hospital in Bath shows the ease with which these shields can be made in the UK using commonly available materials:

- A3 clear polyvinylchloride/acetate sheets for the visor – available via printing services
- Medium-density polyurethane foam for the facial support – available via furniture manufacturers
- Woven waistband elastic for the head strap – available via haberdashers
- Staples & staplers to attach the strap – available via office-supply companies
- Glue/adhesives to adhere the foam to the visor – available via home-improvement stores<sup>10</sup>

A simplified medical face shield design is presented in the study, which repurposes an assortment of existing alternative supply chains. The device is easy to produce with minimal equipment and training.

Already, we have seen examples of small firms repurposing their manufacturing to develop face shields in the UK. This includes Plastic-IT in Shrewsbury,<sup>11</sup> which has developed the Saludem face shield, following a government grant via Innovate UK.

The potential for UK-based manufacture of face shields is clear. Easier to mass produce compared to masks, the government should coordinate potential manufacturers and support them through focused grants, advanced purchase contracts and access to manufacturing facilities. Simultaneously, government should engage with global manufacturers of face shields with a view to onshoring mass production of face shields (and face masks) in the medium term.

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7 <https://www.theguardian.com/world/2020/may/18/face-visors-may-protect-wearer-but-not-other-people-against-covid-19>

8 <https://www.medicalexpo.com/medical-manufacturer/face-shield-49829.html>

9 Shokrani A, Loukaides EG, Elias E, Lunt AJG. "Exploration of alternative supply chains and distributed manufacturing in response to COVID-19; a case study of medical face shields" [published online ahead of print, 2020 Apr 25]. *Mater Des.* 2020;192:108749. doi:10.1016/j.matdes.2020.108749

10 Ibid.

11 <https://www.shropshirestar.com/news/business/2020/06/09/firm-develops-face-shields-to-aid-return-to-work/>

## Recommendations

Face shields are useful tools in protecting wearers who are regularly exposed, at close proximity, to others potentially carrying the virus.

For example, transport workers, emergency services workers, care-home workers, those working in schools and those working in retail sectors.

Given how easy they are to wear compared to masks and that they are cost-effective and reusable, we recommend the following:

### Face Shields for Specific Professions

- Face shields should be procured and supplied for use by the following groups:
  - Teachers
  - Workers in care homes
  - Workers on public transport
  - Emergency services staff
  - Education staff
  - Any other public worker exposed to a large volume of people on a daily basis
- The government should also encourage private sector companies, including retailers and those in leisure and hospitality, to equip their workers with shields.
- Guidance should be produced and clearly communicated to advise on the appropriate wearing of shields, including how often they can be reused and in what situations they should be worn with a mask.

### Face Shields for the General Public

- As our paper [“The Importance of Masks in Exiting Lockdown”](#) makes clear, the principle value of masks is in inhibiting the outward transmission of viral droplets. In that paper we set out how the use of masks by the general public can play a vital role in keeping the rate of infection at manageable levels.

- For members of the public we therefore recommend the usage, at a minimum, of a basic face covering where they are in groups, in public, and normal social distancing is not possible. Where the wearer is coming into contact with large numbers of people at close range, then a face shield is a helpful addition to, but not a replacement for, a mask.

## Manufacturing of Face Shields

### Short-term

- The government should support the repurposing of manufacturing to mass produce shields in the UK through grants and access to production facilities.

### Medium- to long-term

- The government should continue to coordinate the manufacturing of face shields in the UK, bringing together repurposed UK-based manufacturers while onshoring mass-manufacturing by engaging with large global manufacturers.



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