Facemasks for Public Use

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COVID-19 Actuaries Response Group – Learn. Share. Educate. Influence.

Summary

The use of face masks by the general public for personal and wider protection has been recommended in many countries, to the extent that in some, fines are imposed for non-compliance.

This bulletin reviews the current evidence-base for mask wearing by the public in an effort to keep R below 1.

Most of the evidence points in the same direction: mask wearing reduces person-to-person transmission and could form part of a strategy that reduces the risk of transmission from asymptomatic carriers and potentially reducing viral load on the uninfected.

Introduction

The question of whether to protect yourself from becoming infected with the SARS-CoV-2 virus by wearing a mask in public places is one that has been vigorously debated. The counter-argument to mask use is that it will produce a false sense of security in the wearer who will then take other protective measures, such as physical distancing, less seriously.

Types of face mask include:

- Cloth;
- Medical (non-surgical);
- Surgical
- Filtering facepiece respirators such as N95 masks and FFP masks.

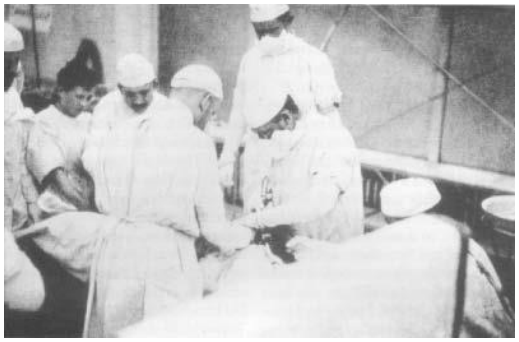
In this bulletin, we will explore the evidence on mask efficacy and benefits of use by the general public.

History

Jan Mikulicz-Radecki, a Polish surgeon born in 1850, is the first doctor to record the wearing of surgical face masks during surgery in around 1897. In addition, it is worth noting that he was a pioneer in infection control as well as in what were considered ground-breaking surgical techniques and an inventor of surgical tools that have been permanently assimilated in the world's surgery[1].

His practice of mask wearing was initially met with scepticism; however, a study of more than 1000 photographs of surgeons in operating rooms in US and European hospitals between 1863 and 1969 indicated that by 1923 over two-thirds of them wore masks and by 1935 most of them were using masks[2].

[1] https://pubmed.ncbi.nlm.nih.gov/15832074/
[2] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31207-1/fulltext



Professor Jan Mikulicz-Radecki at work, complete with gown, mask and gloves.

He described the mask thus:

"a piece of gauze tied by two strings to the cap, and sweeping across the face so as to cover the nose and mouth and beard".

Face mask wearing to protect the wearer is likely to have emerged during the 1918 influenza pandemic with the US mandating police officers, health workers and some residents to wear them. This signalled a shift in the concept that the mask could protect the wearer, rather than protect the vulnerable surgical patient.

The two other corona-virus outbreaks in this century (SARS 2003, MERS CoV 2012) witnessed the widespread adoption of mask wearing by the general public in the affected countries as a means of personal protection.

Evidence of Effectiveness for Personal Protection

Generally, when guidance is issued for health-related purposes, the issuing body will carefully weigh up the evidence, the risks versus the benefits, and may rely on controlled trials of the intervention in order to reach an evidence-based conclusion. In normal contexts this is essential to protect us from the potential harms of an intervention, such as new pharmaceuticals, or surgical procedures.

One of the arguments against the use of face masks for personal protection by the public is that there is a lack of such evidence. However, we do know that the particulates expelled during a cough or a sneeze have the ability to spread several metres and to linger in the air for many minutes. For a cough, the distance travelled is up to 6 metres and for a sneeze, 8 metres[3].

Additionally, we now have insights into contaminants expelled during normal exhaled breath[4] (**figure one**). This analysis suggests that in addition to droplets, SARS-CoV-2 may also be transmitted as aerosols.

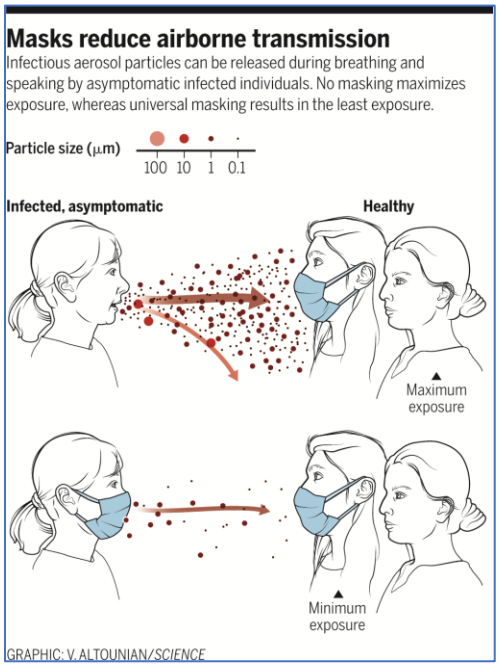


Figure One: Reduction of airborne transmission through mask use

https://science.sciencemag.org/content/early/2020/0

[3] https://www.nature.com/news/polopoly_fs/1.19996!/menu/main/topColumns/topLeftColumn/pdf/534024a.pdf?origin=ppub

[4] https://science.sciencemag.org/content/early/2020/05/27/science.abc6197

Owing to their smaller size, aerosols may lead to higher severity of COVID-19 because virus-containing aerosols penetrate more deeply into the lungs.

It is therefore logical that placing a barrier over your mouth and nose will reduce the emission of contaminants to other people and your environment. The Mayo Clinic in the US states clearly that face masks combined with other preventive measures, such as frequent hand-washing and social distancing, help slow the spread of the virus[5]. The ECDC suggest that due to increasing evidence that persons with mild or no symptoms can contribute to the spread of COVID-19, face masks and other face covers may be considered a means of source control complementary to other measures already in place to reduce the transmission of COVID-19[6].

One key analysis published in *Nature* on respiratory viral shedding and the efficacy of face masks provides additional evidence on using face masks to prevent transmission of the virus[7]. A key finding relates to the earlier point on aerosol transmission. This study sought to quantify the amount of respiratory virus in exhaled breath of participants who had medical attention for acute respiratory virus illnesses (ARIs) and to determine the potential efficacy of surgical face masks to prevent respiratory virus transmission.

Figure two shows the results of viral shedding (in terms of viral copies per sample) identified in nasal swabs, throat swabs, respiratory droplet samples and aerosol samples with a comparison of the latter two between samples collected with or without a face mask. The results indicate that surgical face masks could prevent transmission of human coronaviruses and influenza viruses from symptomatic individuals.

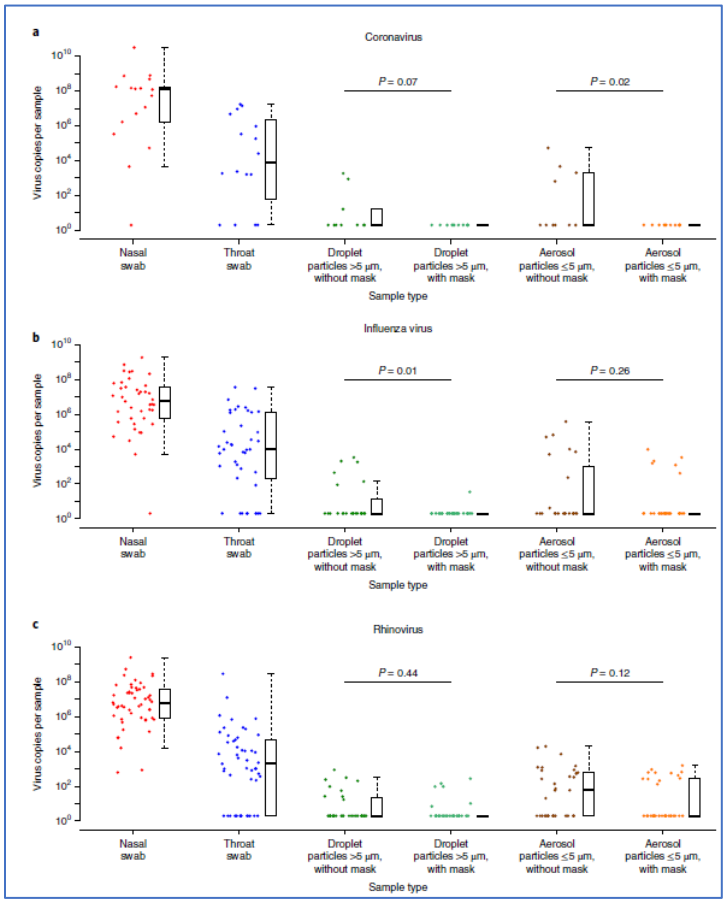


Figure Two: Efficacy of surgical face masks in reducing respiratory virus shedding in respiratory droplets and aerosols of symptomatic individuals with coronavirus, influenza virus or rhinovirus infection.

https://www.nature.com/articles/s41591-020-0843-2

Virus copies per sample collected in nasal swab (red), throat swab (blue) and respiratory droplets collected for 30min while not wearing (dark green) or wearing (light green) a surgical face mask, and aerosols collected for 30min while not wearing (brown) or wearing (orange) a face mask, collected from individuals with acute respiratory symptoms who were positive for coronavirus (a), influenza virus (b) and rhinovirus (c), as determined by RT–PCR in any samples.

[5] https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-mask/art-20485449
[6] https://www.ecdc.europa.eu/en/publications-data/using-face-masks-community-reducing-covid-19-transmission
[7] https://www.nature.com/articles/s41591-020-0843-2

Cloth Masks?

However, given the concern regarding the supply of surgical face masks to healthcare workers, what about the efficacy of cloth masks? Testing of various fabrics to examine their filtration efficiency finds that multiple layers of fabrics with different properties can be effective. In particular, if the combination of fabrics can offer mechanical and electrostatic filtration as illustrated in **figure three.**

Combinations of fabric (such as cotton–silk, cotton–chiffon, cotton–flannel) achieved the ideal mechanical/electrostatic effect, but, it is worth noting **that correct fitting of any mask will affect its efficacy.** Improper fitting can result in a more than 60% decrease in filtration efficacy.

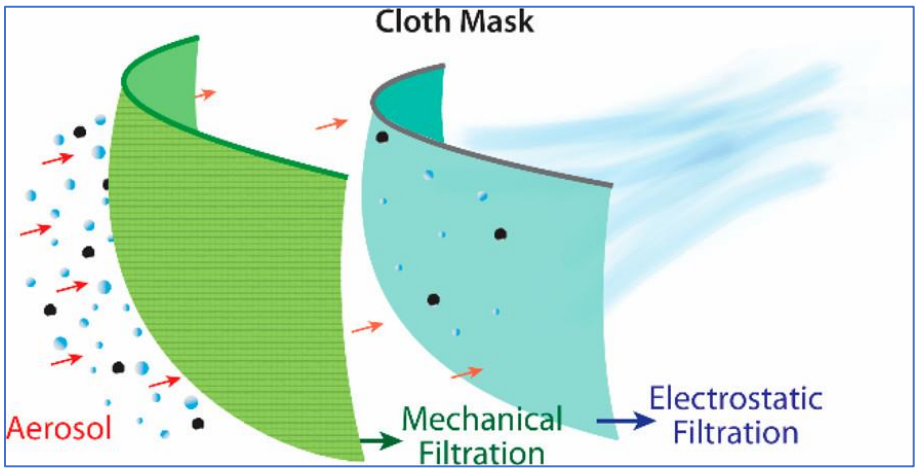


Figure Three. *https://pubs.acs.org/doi/10.1021/acsnano.0c03252?fig=tgr1&ref=pdf*

Impact of Masks on R0

A pre-print evidence review published 12 May 2020 [8] finds in favour of the wearing of face masks by the general public. This review identified the following key questions to consider:

1. Do asymptomatic or pre-symptomatic patients pose a risk of infecting others?
2. Would a face mask likely decrease the number of people infected by an infectious mask wearer?
3. Are there face covers that will not disrupt the medical supply chain, e.g. homemade cloth masks?
4. Will wearing a mask affect the probability of the wearer becoming infected themselves?
5. Does mask use reduce compliance with other recommended strategies, such as physical distancing and quarantine?

Figure four shows the impact of public mask wearing under the full range of mask adherence and efficacy scenarios. Clearly, compliance needs to be high to be most effective at reducing spread of the virus. Recommendations from this review include that mask use be mandated by governments. When governments do not, then by organizations that provide public-facing services, such as public transport providers or shops, as "no mask, no service" rules. Such mandates must be accompanied by measures to ensure access to masks.

[8] https://www.preprints.org/manuscript/202004.0203/v2

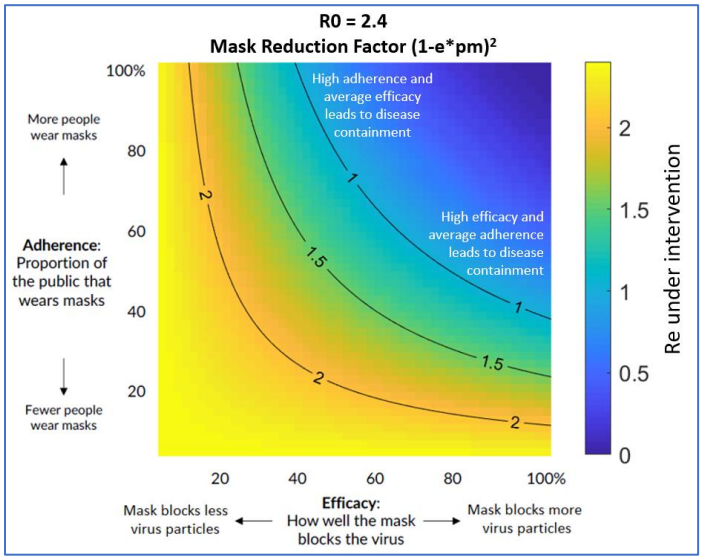


Figure Four. Impact of public mask wearing under the full range of mask adherence and efficacy scenarios

The colour indicates the resulting reproduction number R from an initial R0 of 2.4

Recent meta-analysis published in *The Lancet* (**link**) which investigated the effects of physical distance, face masks, and eye protection on virus transmission in health-care and non-health-care (e.g., community) settings finds that a combination of the three approaches provides the most effective protection.

Mask4all

Finally, a campaign by Professor Trisha Greenhalgh and colleagues point to the precautionary principle, such that a strategy for approaching issues of potential harm when extensive scientific knowledge on the matter is lacking. "As with parachutes for jumping out of aeroplanes, it is time to act without waiting for randomised controlled trial evidence."[9]

Professor Greenhalgh is one of more than 100 health experts to call for cloth mask requirements[10] for the general public based on the following:

- People are most infectious in the initial period of infection, when it is common to have few or no symptoms
- Cloth masks obstruct a high portion of the droplets from the mouth and nose that spread the virus
- Non-medical masks have been effective in reducing transmission of coronavirus
- Cloth masks can be washed in soapy water and re-used
- Places and time periods where mask usage is required or widespread have been shown to substantially lower community transmission
- Public mask wearing is most effective at stopping spread of the virus when the vast majority of the public uses masks
- Laws appear to be highly effective at increasing compliance and slowing or stopping the spread of COVID-19

"Whilst not every piece of scientific evidence supports mask-wearing, most of it points in the same direction. Our assessment of this evidence leads us to a clear conclusion: keep your droplets to yourself – wear a mask." (Professor Trisha Greenhalgh and Jeremy Howard)[11]

[9] https://www.bmj.com/content/369/bmj.m1435
[10] https://masks4all.co/letter-over-100-prominent-health-experts-call-for-cloth-mask-requirements/
[11] https://www.fast.ai/2020/04/13/masks-summary/

Appendix: Guidelines

The table contains a snapshot of the guidelines and advice that have been issued by various governments on face covering either through mask or cloth covering.

Country	Advice/Guidance
Angola	Outside the home
Argentina	Public transport, any one in contact with members of the public (Buenos Aires) (fines for non-compliance)
Austria	Outside the home
Bahrain	Outside the home
Benin	Outside the home
Bosnia & Herzegovina	Outside the home (mask or cloth covering)
Burkina Faso	Outside the home
Cambodia	Shopping and public places
Cameroon	Outside the home
Canada	Where it is not possible to keep enough distance between one person and the other
China	Public places
Colombia	Public transport, shops, outdoor markets and banks
Cuba	Outside the home
Czech Republic	Supermarkets, pharmacies & public transport
Dominican Republic	Public places & the work place
DR Congo	Outside the home (Kinshasa)
Ecuador	Outside the home
Equatorial Guinea	Outside the home
Ethiopia	Outside the home
France	Public transport (fines for non-compliance)
Gabon	Outside the home
Germany	Public transport & shopping
Honduras	Outside the home
Hong Kong	Public transport & crowded places
India	Certain states outside the home (mask or cloth covering)
Indonesia	Outside the home
Ireland	Enclosed public spaces where it's difficult to maintain social distance
Israel	Outside the home
Italy	Outside the home (Lombardy & Tuscany)
Ivory Coast	Shopping
Jamaica	Outside the home
Kenya	Outside the home
Liberia	Outside the home
Lithuania	Public places
Luxembourg	where it is not possible to keep enough distance between one person and the other
Malaysia	With symptoms ((delivered to each household)
Mexico	Metro stations & trains
Mongolia	Public transport
Morocco	Outside the home (fine for non-compliance)
Mozambique	Public transport & large public gatherings
Nigeria	Outside the home
Pakistan	Outside the home
Peru	Outside the home

Philippines	In areas under enhanced community quarantine
Poland	Outside the home (mask or cloth covering)
Qatar	government and private sector employees and clients, shoppers at food and catering stores and workers in the contracting sector (fines and potential prison sentence for violation)
Russia	Outside the home
Rwanda	Outside the home
Sierra Leone	Outside the home
Singapore	Outside the home
South Korea	Public transport & taxis
Spain	Indoor public places & where it is not possible to keep enough distance between one person and the other
Taiwan	Public transport (fine for non-compliance)
Turkey	Shopping and crowded places (free delivery to every citizen)
UAE	Outside the home
Uganda	Outside the home
UK	In enclosed spaces where social distancing is not always possible (mask or cloth covering) & public transport. (Scottish government on all public transport)
USA	Non-medical cloth face coverings when in public places (some state variation)
Venezuela	Outside the home
Vietnam	Public places
Zambia	Outside the home
Zambia	Outside the home

https://www.aljazeera.com/news/2020/04/countries-wearing-face-masks-compulsory-200423094510867.html

[1] https://en.wikipedia.org/wiki/Face_masks_during_the_COVID-19_pandemic#cite_note-152