

# The Covid-19 Crisis and the need for suitable face masks for the general population

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## Abstract

In relation to SARS-CoVid-2 a theoretical gold standard of face mask use is discussed and a similar principle for lockdown. The use of face masks in the general population is debated in relation to the UK public health advice that face masks are not needed in the general population. There is substantial evidence of ability of SARS-CoVid-2 to spread by aerosol which makes the UK Government's public health advice and indeed that of the WHO, that social distancing and hand hygiene alone are required in the general population questionable. The question is not should the general public have mask protection but what degree of mask protection is needed? There is a shortage of suitable masks for health care workers in the UK but the need for this demand is driven by the large numbers of infected people in the community. Once the public health advice is adjusted politicians can start to try and solve the enormous logistical problem of protecting the public.

**Keywords:** Covid-19, SARS-CoVid-2, Pandemic, Face Masks.

## INTRODUCTION

SARS-CoV-2 is a respiratory virus transmitted through air, being airborne or from droplets. Also, infection can occur through contact with eyes, or secondarily from touching contaminated fomites and then the mouth or nose, eye protection and hand hygiene will be effective for these modes including prevention of food being contaminated by touch. Other routes of transmission will be possible such as the faeco-oral, or aerosol especially from those with GI symptoms. Food contaminated by droplet spread or exposure by inhalation would need an additional measure such as wearing a suitable mask.

For decades there has been a mantra in UK hospitals that masks do not work to the extent at one point some surgeons even stopped using them. However, surgical masks protect the patient from sweat, nose drips, hairs, and unseen droplets dispersed when talking and protect the surgeon from blood and fluids. The answer to the blanket statement that masks don't work is, 'Have you ever seen someone dealing with a nerve agent or biological contamination suited up saying, 'I'll not bother with the mask as they don't work?'' Clearly masks do work! The question is not of do they work but what degree of protection is required and how best to apply it?

Imagine a situation such as an astronaut in a space suit or a scuba diver or even a fire fighter, essentially anyone with a full-face mask breathing their own independent air supply. Would anyone suggest that they would be infected with SARS-CoV-2? If everyone in the country used this method continuously for

three weeks it would be reasonable to assume by the end there would be no more new cases given the average incubation period of 5.5 days and most cases occurring within the range 2 to 14 days. This is purely hypothetical as physically it is not possible and clearly not achievable practically but could be considered the gold standard of mask wearing with the other end of the spectrum being no protection at all. Similarly, lockdown can also have the same theoretical gold standard where everyone in country isolates themselves in a room for three weeks. There should be no more new cases but again it would be impossible to carry out. Both scenarios assume no outliers, uncontaminated food and that asymptomatic spreaders are not infectious for longer, and also a closed system i.e. no one else coming into the country such as essential transport etc. The gold standard although hypothetical and unobtainable does not need testing or evidence as it is a logical deduction. The fact that these ideals cannot be achieved does not mean that the best efforts to come as close as reasonably possible should not be made.

In the Cochrane review 2011 [1] concerning physical interventions to interrupt or reduce the spread of respiratory viruses (SARS was excluded) only one randomised controlled trial met all the criteria for a properly conducted study, Loeb 2009 [2]. This is often quoted as showing that there was no difference in infection rates between a surgical mask and an N95 mask for unvaccinated nurses in a flu epidemic (presumably this is why in the UK General Practitioners have been supplied with surgical masks only). However, the authors admit concerning airborne transmission in theory an N95 mask would be preferable and there was no control arm of no mask which would give information on their efficacy. Much of the analysis of

preventative measures is confounded by the fact that many studies took into account other measures such as social distancing, hand hygiene, cleaning, as well as the wearing of masks. Overall, regarding community spread there did appear to be some evidence wearing of masks was beneficial but no firm conclusion was made due to the lack of good quality studies and compliance was seen as an issue. Concerning SARS Seto 3 showed evidence that in the clinical setting masks were protective but that surgical masks were as good as N95, implying that spread was by droplet infection but does not mean aerosol spread does not occur. With regard to MERS for non-aerosol procedures surgical masks were found to be sufficient [4]. However, it appears that Covid19 is more infectious than flu based on one person infecting 3 people compared to 1.4 for flu, evidenced in Wuhan three months ago by the exponential rise in the numbers of reported cases. Only now are asymptomatic and minimally affected super-spreaders being considered, yet some of the first news headlines in the UK were of a "Super Spreader" able to infect 50 people. In Korea at a church gathering of several thousand over two days one person, patient 31 [5] although not completely asymptomatic having a fever, infected more than a hundred people that went on to spread the virus in the country. Considering the other beta coronaviruses in SARS and MERS one difference was the evidence of asymptomatic superspreaders in SARS accounting for its much greater spread [6].

Even today surprisingly the literature is undecided on how influenza spreads regarding droplets versus airborne transmission. This discussion is remarkable as there is not any doubt that flu is highly infectious and airborne after my own car sharing as a medical student, coming down with the first stages of flu. I did suggest to the two companions that they take a train but they insisted on going in the car. There was no coughing sneezing or even talking, simply breathing the same air for half an hour and both came down with severe flu two days later. So, there will be variable risk depending on time exposed, ventilation of the area, and amount of virus circulating. Without knowing these parameters, the risk of infection could be high or low.

Social distancing seems to be based on the distance that droplets can spread but takes no account of aerosols such as from sneezing. There was a study many years ago that showed the aerosol from a sneeze could spread through a lecture theatre in only a few seconds. However, fine aerosol spread has been demonstrated to occur not only in sneezing or coughing but also speaking and even in normal breathing [7], and there is data from the University of Nebraska analysing the distribution of virus in Covid19 patients' isolation rooms, showing that people entering the room allows dispersal of identifiable virus into the corridor air [8]. In aerosol form SARS-CoV-2 can survive in an unventilated room for up to three hours [9] and has even been identified in ventilation shafts. SARS-CoV-1 was demonstrated to be infectious in aerosol form notably in the Amoy Building where aerosol from a toilet spread through the plumbing system into apartment bathrooms infecting multiple people [10].

In the UK it is acknowledged that high grade protection is required for frontline workers [11] but has not been considered necessary for the general population. This is based on a flawed premise that because there is no suitable evidence base for the use of masks in the general population there is a reason for no action, where equally there is no suitable evidence base that the use of masks especially in Covid-19 is not beneficial. This has been referred to as the precautionary principle when there is no evidence for an action but the risk of inaction risks considerable harm [12]. The strategy might be satisfactory for an influenza epidemic with relatively small numbers of hospital admissions

but makes no sense concerning Covid 19, unless it is mistakenly postulated that almost all infections out with hospitals occur because of inadequate hand hygiene. Even at the modest estimate of some reviewed studies of a 10 percent reduction in cases from using masks if there are 600 deaths per day a ten per cent reduction is 60, and the less people that are infected in the community the less patients that are in hospital and the less health workers will be exposed. Unless social distancing halts the spread of the virus more or less completely, of which there is no evidence at present in Spain or Italy, then more proactive measures are needed urgently. Without robust evidence to the contrary the default position must be that SARS-CoV-2 is a highly infectious airborne virus. The general risk is much less compared to those in close proximity to infected patients but there is risk evidenced by the large numbers of patients in hospital coming from the community which makes this outbreak completely different from any in recent studies.

One issue raised is that vulnerable people with respiratory problems cannot tolerate masks due to the need for the increased respiratory effort, however, the more people that are wearing a mask will give more protection to that group providing the mask does not have an unfiltered exhalation valve. In extreme cases there are portable powered respirators with positive airflow that require no additional effort to breathe. Instruction on fitting a mask properly can be given with little instruction or know-how. Compliance has been an issue in some studies but one study regarding SARS noted when people's livelihoods were affected their compliance increased dramatically [13] and in China currently it is illegal to go outside without a mask. Even the most sceptical acknowledge there is evidence that masks help to reduce transmission and if everyone is wearing a mask then there is double protection. Masks can also stop people touching their nose and mouth directly.

In laser surgery on papillomas, a situation where active virus has been confirmed in the laser smoke plume and there are recorded cases of surgeons being infected with the papilloma virus [14]. For laser surgery specific masks with 0.1-micron filter are used. N95 means 95% filtration of non-oil-based aerosol particles at 0.3 microns, with SARS-CoV-2 virus particles being 0.06 to 0.14 microns in diameter [15]. There is evidence that the biological aerosol particles that virus can travel in are larger than 0.5 microns and most likely in the range 5 to 20 microns, therefore in theory N95 protection may be suitable if used for low risk situations and for a short time. As Weiss [16] pointed out N95 means 5% inefficiency and recommended N100 but conceding that these are more expensive. However, it would seem prudent in high risk areas masks with at least 99% filtering at 0.1 microns are used and even considering an independent air supply such as used for spray painters, for very high risk situations such as CPAP, which if in used in an open circuit may be much more infectious to health workers [17], or aerosol generating procedure such as intubation, suctioning airways, and tracheostomies.

Any debate should be concerned with which protection is the best for the general population and indeed general practitioners as simple surgical masks are inadequate for airborne virus. Surgical masks which are looser fitting from a health and safety study showed that a surgical mask reduced bioaerosol six-fold compared to the predicted of 100-fold for FFP3 [18]. It is a question of risk but when this is unquantified then an over estimate is essential. Should the general public have N95 or full antiviral masks such 0.1-micron filters with at least 99% efficiency, could they be tolerated if needed for long periods or would some have to settle for more inferior surgical masks?

Regarding cost the retail value of an FFP3 mask with 0.1-micron filter before the crisis was approximately 1.25 Euros before the crisis per mask and wholesale cost would be significantly lower. The cost of supplying everyone with mask protection and an eyeshield would not be small but a fraction of the cost of the outbreak so far.

In World War II in the UK everyone in the country was supplied with a gas mask [17], there could be arguments about potential effectiveness, quality, and the fact they contained asbestos with many factory workers developing asbestos related cancers, nevertheless the protection was made available. The strategy that is most likely to be successful is a supply for everyone that is able to use a mask. There are logistical considerations such as how long can a mask be used and reused in a low risk situation. For the general population limitations in supply would necessitate reuse and use for longer periods where infectious aerosol might in theory dry out on the filter and then release virus, so therefore again a 0.1 micron filter would be more desirable, especially if there is some reduction in efficiency with time; it should be noted if considering this as a negative point having no mask and inhaling the aerosol could only be worse. It can be difficult for some to wear a more efficient mask for a long time whereas a surgical mask could be worn by most people easily for long periods at risk of being much less efficient. Weiss pointed out that most masks are disposable and there is little if any information on reusability but manufacturers have a financial incentive to make masks disposable. As SARS-CoV-2 is unlikely to survive on any surface for more than three days [9], (one article suggested seven days on a mask but contradictorily only 2 days on cloth [20]), then concerning general use daily rotation using three masks might be useful as long as they remain clean and intact. There are more advanced industrial and DIY reusable respirators with filters that can last for six months although generally these have exhalation valves and as mentioned will not protect others, only the wearer.

Sourcing and manufacture would be extremely difficult in a short space of time, however, once politicians are given advice concerning the need for suitable masks for everyone they can then take measures to apply it in the best way possible, such as help from China which makes over 100 million masks per day and has a large capability. A solution is needed to the mask shortage problem not incorrect advice that the general public do not need masks or even the WHO [21] advice that medical masks are only needed for those with symptoms. There is a shortage of masks for health professionals but their need is driven by the general population becoming sick so the source needs to be tackled. Ideally there would be large-scale trials such as in the catchment areas of overwhelmed hospitals but as the UK is two months behind where it should be regarding supply of masks to the general population it seems trials may not be feasible. Given the delay the need is at first for selectivity, aided by lockdown. Key workers, those still using trains, planes, buses, subways, work places such as shops and especially care homes (patients and staff), cleaners, particularly of toilets. Essentially anyone in near contact with people out with their household potentially rebreathing the same air. At some point people will have to go to shops for food once inside there will be some risk depending on the ventilation of the building and time spent, but for a weekly shop potentially one mask could last a very long time if kept clean and dry. More measures will be needed especially when lockdown is released unless by then there are no more new cases at all and without reliable testing for the whole population it is not known who is immune and in less need of protection.

Concerning the increasing frequency of beta corona virus

infections then preparedness in the future will be necessary, for instance stock piling masks and or manufacturing capability that can change from a thousand a day capacity to a hundred of thousands. Public health measures will be of extreme importance especially in countries such as China to disrupt the bat – intermediary- human pathway for any new virus transmission.

When there is inadequate evidence base or no protocol it is necessary to take a logical approach based on experience and at present the experience is in China, Hong Kong, South Korea, and Japan. It is preferable in a crisis to say we did too much and look back at how procedures can be made more efficient rather than to have to say we could have done better.

### Conflict of Interest

We declare that we have no conflict of interest.

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