

Technical Report 12



Can face masks protect you from COVID-19?

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Highlights

- Facemasks are used worldwide in the prevention of transmission in COVID-19, causing a shortage during the pandemic.
- A plethora of controversial evidence on the effectivity of using different types of facemasks exists.
- If used irrationally/inappropriately, facemasks could cause more harm than providing protection from COVID-19.

Introduction

Face masks are a sub-category of respiratory protective equipment (RPE) used in the prevention and control of infections transmitted via aerosol (1-3). Face masks act as physical barriers (4) between the wearer and the environment. The transmission of COVID-19 can occur via expulsion of infected respiratory droplets, emitted via coughing, sneezing, etc. (5). In the light of growing evidence on pre-symptomatic and asymptomatic disease status (6) and the uncertainty of aerosol transmission of COVID-19 (7-8), academics and the general public are debating on the use of facemasks as a mechanism for prevention and control of the novel disease. This report attempts to answer the frequently asked

question, “can face masks protect oneself from transmission of COVID-19?”

Face masks and respirators

Facemasks offer protection combining the following mechanisms (9) :

- Filtration
- Fit of the mask (seal between the face and the mask)

The filtration efficiency of the facemask relies on factors such as structure and composition of the material used to manufacture the mask and properties of the aerosol particle (size, shape, velocity) (9-10).

Considering these properties, the facemasks can be categorized as follows:

- **Face masks**
 - Medical masks (e.g. surgical masks, dental masks, procedural masks, isolation masks)
 - Cloth masks
- **Respirators** (e.g. N95 masks)

Face masks and respirators perform separate roles. The medical face masks are designed to protect the sterile field from exhaled pathogens of the wearer while protecting the wearer from fluid splashes originating from outside (11-12). Use of these medical face masks does not require any special training and can be used by the general public.

Medical face masks have three layers of polypropylene. The outermost layer has liquid repellent properties; the middle layer is a nonwoven layer which acts as the filter; and the innermost layer is water absorbent. The usual filtration efficiency of a medical face mask is 95% at the 3 micron particle size (13). It is recommended to change a medical mask at the end of each procedure or when it gets damp, whichever comes first (14). The medical face masks are single use only (14).

When a medical face mask is worn, due to the lack of fit in its edges and the face, air leakage may occur at the edges of the mask. Hence, the wearer may get exposed to the pathogens circulating in the environment in aerosol form.

Cloth face masks are very similar in the way it is being used when compared to medical face masks

(12), however the filtration efficiency may vary greatly (11-60%) depending on the material used (Table 1). Cloth face masks can be home-made or manufactured commercially.

Respirators are protective devices that cover the nose and mouth or the entire face or whole head, to guard the wearer against hazardous atmospheres. Respirators are generally recommended only for professional use. There are several gradings of respirators according to filtration efficiency of particulate matter and ability to withstand oily environments (12,15). It is recommended that users are properly trained in wearing the unit correctly (15) and undergo a fit test when using respirators to assure no air leakage occurs while wearing it (15). Though respirators are single use devices due to the recent increase in demand, reusability was tested after disinfection. Researchers found that respirators can be disinfected up to 3 times without significant loss of efficiency (16-17). N95 respirators are popular in the medical field and can filter 0.3 μm particles with 95% efficiency in normal environmental conditions (15).

A study on the effectiveness of facemasks in the reduction of respiratory infection revealed that there is no significant reduction in the transmission of respiratory illness with the use of facemasks. It added that improper use in fact might increase the risk of transmission (18).

Understanding the unique properties of face masks may help to determine the usability of them in prevention and controlling COVID-19 effectively. We propose the following adaptation of face masks and respirators as of current evidence on its effectiveness.

Table 1: Filtration efficiencies of different face masks and respirators (13, 19)

Type of mask	Material (common name)	Material composition	Particle size used for testing	Filtration efficiency (# number of layers)
Medical masks	Polypropylene	Three layers +	5 μm	>99%
		Outer: Repel fluids Middle: Filter Inner: Absorb moisture	3 μm	>95%

Cloth masks	Handkerchief	100% cotton 66 x 58 inches thread count	1.8 μm	32% (4)
	Washcloth	Terry Weave (88% cotton, 12% dacron polyester)	1.8 μm	40%
	Shirt material	65% fortel polyester 35% cotton 46 x 46 inches thread count	1.8 m μm	26% (4)
	Sweatshirt	60-80% cotton 15-40% polyester	20-1000 nm* (0.02-1 μm)	20 - 60%
	T-shirt	60-100% cotton 0-40% polyester	20-1000 nm* (0.02-1 μm)	<14%
	Towel	80-100% cotton 0-20% polyester	20-1000 nm* (0.02-1 μm)	34%
	Scarf	0-100% cotton 0-100% polyester	20-1000 nm* (0.02-1 μm)	11%
	Branded cloth masks	Not available	20-1000 nm* (0.02-1 μm)	10-26%
	N95 (as control)		20-1000 nm* (0.02-1 μm)	>95%
Respirators**	N95, N99, N100 P95, P99, P100 R95, R99, R100		0.3 μm	95%, 99% and 99.97%

* It is observed that the filtration efficiency is decreased when particle size increases from 20nm to 100nm. Thereafter, the efficiency plateaus up to 400nm. After that, slight decrease of efficiency is noted up to 1000nm

** European standard categorizes respirators as FFP1, FFP2, FFP3 with filtration efficiency of 80%, 94% and 99%. Therefore, US N95 is approximately equivalent to European FFP2

+ Any face mask without this structural arrangement cannot provide adequate protection (4)

Public health application

The face masks can act as a physical barrier to prevent droplets being expelled. It also limits the exposure to airborne droplets. Masks do not require special training to wear. Each type of mask has its own filtration efficiency. Therefore, masks may be useful in airborne disease transmission in places where physical distancing cannot be maintained or in places where adequate air circulation cannot be maintained. Hence, it could be proposed as a useful strategy to control and prevent COVID-19 infection.

Respirators have high filtration efficiency but are costly. Wearers of respirators need special training and may need to undergo a fit test frequently. As such, it is logical to limit its use for frontline healthcare staff dealing with COVID-19 patients. In contrast, medical face masks can be used by both medical personnel and the general public to protect from possible aerosol transmission of the COVID-19. However, with the global pandemic of COVID-19, the demand for medical face masks has risen and stockpiling has become a problem. Therefore, until adequate supplies of medical face masks are

established, its use should be limited to personnel caring for patients of COVID-19. On the other hand, even though cloth face masks have very limited filtration efficiency, it may help to reduce the infective dose of the pathogen being expelled as a large droplet, which is the main method of COVID-19 transmission as of today (20-21). It may also provide a certain degree of protection in inhaling airborne droplets within close proximity and in areas of established community transmission (22-23).

Application of medical and cloth face masks must be coupled with proper wearing technique to reduce the air leakage. Outer surface of the face mask should not be touched which could easily lead to hand contamination. It should also be noted that proper disposal of face masks must be done to reduce the exposure of others to the disease-causing pathogens that might be collected in the layers of the masks. Timely change of masks is mandatory to limit excess pathogen growth on the masks endangering the wearer. On the other, reuse and extended use of N95 respirators as well as medical facemasks might be done based on the risk of exposure to the wearer while using extreme precaution (17). It should however be exchanged between users.

Currently, wearing facemasks is not recommended for children below 2 years due to the danger of suffocation. Older children can use facemasks as long as proper fit of the mask can be ensured (24). Personalization of masks may increase the use of face masks.

Recommendation

In the light of current knowledge, control and prevention of COVID-19 can be done by strict adherence to physical distancing and practising hand hygiene. Wearing a face mask should be a complementary protective method while strict adherence to proper wearing technique and disposal is maintained.

Author Declaration

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