

A Review on: Effectiveness of Various Types of Face masks

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ABSTRACT: Face mask is a protective to help covering the face. Face mask helps to prevent infections in patients and treating a person by taking out bacteria shed in liquid droplets and aerosols from person wearing mask mouth and nose. Lately, it is essential to wear mask during covid-19. Face mask is a physical barrier prevent contact transmission. There are various types of face masks surgical mask, cloth mask and FFP1, FFP2 (N95), FFP3(N99) respirator using to protect in recent corona virus. Various materials are used in face mask. In this time face mask is a part of life of whole world. In this review, A main focus is on Effectiveness of various types of important face masks intended for a medical purpose to assist in preventing the spread of infectious materials during the COVID-19 pandemic.

KEYWORDS: Face mask, COVID-19, Respirators, droplets, filtration, infection

I. INTRODUCTION

[1]. At the beginning of the epidemic, many expert doctors advised against the use of facemasks by the public due to a sense that their potential risks, such as self-contamination, could outweigh the potential benefits, and that public use would lead to consumption of the supply needed for healthcare workers. Experts then moved their thinking about potential benefits of masks to include protecting others against infection with SARS-CoV-2 (source control), similar to how surgical masks in the operating room protect patients. However, self-protection is the main reason why infection prevention and control experts suggested health-care workers to wear a facemask when entering a patient's room who may have a viral respiratory infection. With COVID-19, however, facemasks can be beneficial for protection of both health-care workers and the public.

[2]. During this period, it is unknown that how virus is exactly transferred in people. Initial

impression is that It goes through droplets and maybe through aerosol particles. Droplets are large particles of fluid that are usually sneezed or sneezed at. there are VARIOUS types of face mask Surgical face mask, Cloth face mask and Respirators(N95) using to prevent COVID-19. each mask their different level of efficacy.

[3]. In the year 2020, The EUA made a statement which implies this kind of mask is described as "a tool, with or without a face shield, it protects the face of a user and also might meet fluid barrier or filtration efficiency levels. It contains cloth which covers the face. It can be used for various times, and if used multiple times, it can be laundered cleaned. There are various products marketed in America as 'face masks' that offer a range of prevention against potential health issues." FDA, Letter of Authorization for Face Masks (non-surgical) (April 18, 2020), available here. Face mask cover noses and mouths, in accordance with CDC recommendations, to prevent the spread of SARS-CoV-2 during the COVID-19 pandemic."

Scope and purpose

[4]. This review mainly focuses on effectiveness of various types of face mask Surgical Mask, Cloth mask and Respiratory masks(N95) are protective devices covering to face. They are designed to protect both the person who wears them and the immediate surroundings from breathable pollutants (respiratory poisons or Respiratory masks (RM) are protective devices covering a part of the face. They are designed to protect the user and the immediate environment from respiratory contaminants (respiratory toxins or viral / viral pathogens).

[5]. Under different outbreak scenarios and mask usages, the experimenter calculated the total numbers of expected SARS-CoV-2 infections and deaths from COVID-19. Not especially, they found that the total number of deaths and infections declined as the availability and effectiveness of face masks increased.

TYPES OF MASKS

1.SURGICAL MASK

[6]. Initially surgical masks were constructed from layers of cotton gauze. They were first worn by surgery staff in the early 1900s to prevent infection of open surgical wounds. With time their design, function, and use have increased. Today surgical masks are worn in a wide range of healthcare settings to protect patients from the wearers' respiratory discharge. One of the important types of mask which is a surgical mask comes with loosely fitting, disposable characteristics that protects the release of potential elements which is known to be hazardous contaminants from the person in their surrounding environment.

[7]. Loose-fitting, a disposable device made of polypropylene, may be effective in hindering particle droplets, splashes, sprays which may contain germs, keeping them from reaching mouth and nose – does not block small particles in the air that may be spread by nearby coughing or sneezing. This is to be used by person caring for ill people with respiratory infections and also with symptoms like sneezing, cough and fever and health care and those who work in frontline.



Figure.1 Surgical mask

[8]. To safely remove your mask, place it in a plastic bag and put it in the trash. Wash your hands after handling the used facemask.

SURGICAL MASK MATERIALS

[9]. The 3-ply surgical mask is commonly used in the COVID-19 epidemic. The 3-ply surgical mask is made up of 3 distinct layers of nonwoven fabric with each layer having a particular function, as shown in Figure 1 The

outermost layer (typically blue) is water-resistant and helps to repel fluids such as mucosal vary droplets. The middle layer portion is the filter, which prevents particles or pathogens (virus, bacteria) above a certain size from penetrating in either direction. The inner layer is made of absorbent materials to trap mucosal vary droplets from the user. This internal layer portion also absorbs the moisture from exhaled air, thus increase comfort. Together, these 3 layers effectively protect both the user and the nearby people by limiting the penetration of particles and pathogens in both directions. As per standard and recommendation by its name, nonwoven fabric does not include intertwining strands and is made up of bonding a mass of fibres together using heat, chemical, or mechanical means. Felt are the most common examples of nonwoven fabric. Although nonwoven fabric is mechanically weaker than its counterpart, it is low price and fast to manufacture. Therefore, it is an ideal material for the surgical mask.

CLOTH MASK (HOME MADE MASK)

[10]. In the early 20th century, American hospitals used a variety of cloth masks (made from cotton, cotton, or silk, and other fabrics). Health services using masks made of 2-3 layers of gauze reduce the incidence of respiratory infections.

In the mid-20th century, the use of clothing masks decreased as disposable medical masks were developed; However, the use of clothing masks is still widespread in many Asian countries.

Cotton masks were widely used by healthcare workers and the general public during the acute respiratory syndrome outbreak in China, and observational studies have shown them to be effective. Ordinary people can wear cloth masks to prevent the spread of infections in society.

The masks can be used in 2 ways in community settings. First, they can be used to prevent the spread of disease-causing infections (resource control) and many health organizations (including the WHO and CDC) recommend such uses.

Some research suggests that, approximately 25%-50% of people infected with Corona have mild cases or are not symptomatic and also can potentially infect others.

Therefore, in high transmission areas, wearing a mask as source control can prevent the spread of infection to people with asymptomatic, presymptomatic, or mild infections. If healthcare

workers prefer medical masks, the general public can use cloth masks as an alternative.

The filtration process, efficacy, fitness and performance of clothing masks are inferior to those of medical masks and respirators. The use of cloth masks should not be mandatory for healthcare professionals, who should prioritize respiratory protection.

When medical masks are not available, cloth masks are a more suitable option for community use. The protection provided by the fabric mask can be enhanced by selecting the appropriate material, increasing the number of mask layers, and using filtration procedures or methods and designs that provide a fit.

Clothing masks should be washed daily and after use with high exposure with soap and water or other suitable methods.



Figure.2 Cloth mask (Homemade mask)

CLOTH MASK MATERIALS

[11]. Mask covers need to filter out particles, but are still easy to breathe. Experts recommend using 100 percent cotton fabric or cotton blend fabric. T-shirts and pillowcases are examples of cotton or cotton blend garments.

[12]. Table1 showing different materials using in cloth mask.

Material	Source	Brand	Fiber composition
T-shirt	Mall	Uniqlo	100% cotton
Fleece sweater	Mall	Uniqlo	100% cotton
Outdoor jacket	Mall	Decathlon	100% polyurethane
Down jacket	Mall	Decathlon	100% polyurethane
Sun-protective clothing	Mall	Decathlon	100% polyester
Jeans	Mall	Uniqlo	98% cotton/2% polyurethane
Hairy tea towel	Supermarket	Maryya	80% polyester/20% nylon
Granular tea towel	Supermarket	Maryya	80% polyester/20% nylon
Non-woven shopping bag	Mall	Eosu	100% polypropylene
Vacuum cleaner bag	Electronic business platform (Jingdong)	Dmy	100% polyethylene-vinyl acetate
Diaper	Supermarket	Elderjoy	Non-woven etc
Sanitary pad	Supermarket	Whisper	Non-woven etc
Pillowcase A	Hospital	Nantong Aokai	40s×40s Air-jet down-proof fabric
Pillowcase B	Hospital	Nantong Aokai	60s × 60s Jet satin
Pillowcase C	Hospital	Nantong Aokai	80s×60s Jet satin
Medical non-woven fabric	Hospital	An Ruiheng	2 Layers of spunbond + 3 layers of meltblown cloth
Medical gauze	Hospital	Rong Wei	Absorbent cotton

homemade mask materials under the epidemic of H5N1 and SARS, COVID-19 including T-shirts, scarves, tea towels, pillowcases, antibacterial pillowcases, vacuum cleaner dust bags, linen, silk, etc. Then an expert consensus meeting decided to include 8 experts in the relevant field (2 people), nursing notation (2 people), evidence-based medicine and clinical epidemiology (2 people), and hospital infection management (2 people). Content of candidates for laboratory tests. Eventually, seventeen candidates were selected for laboratory testing, including T-shirts, Fleece Sweaters, Outdoor Jackets, Down Jackets, Sun Protection Clothing, Jeans, Hair Dishcloths, Grainy Dishcloths, Non-woven Fabric Shopping Bags, Vacuum Bags, Diapers, Towels sanitary, non-woven shopping bags, Vacuum bag, pillowcase A (40s× 40s air jet feather proof fabric), pillowcase B (jet satin 60s × 60s), pillowcase C (jet satin 80s × 60s), medical non-woven fabric, and medical gauze. Table1 showing different materials using in cloth mask.

RESPIRATORS

[13]. While current COVID-19 pandemic going on, healthcare professionals are working in the very frontline in fighting and managing the highly contagious COVID-19. Since the most common route of transmission is through aerosols and droplets, it is important that healthcare workers have the appropriate personal protective equipment (PPE) including gowns, masks and goggles. Respirator are giving positive results in preventing SARS and influenza, so it is not likely that they can protect contaminated aerosols from infecting the respiratory system. Therefore, it is important to wear respirators that have been shown to provide better protection against the ingress of droplets, aerosols, and fluids and that a tight seal around the mouth and nose. Various types of respirators are used in healthcare setting, FFP1, FFP2/N95/KN95, FFP3/N99/EN149/P3.

[14]. Respirators are a form of personal protection equipment (PPE) and are therefore subject to the legal requirement of European Union PPE Regulation 2016/425.

TPES OF RESPIRATORS

FFP1

[15]. Although FFP1 protection level masks, are still superior to surgical masks, they do not provide the desired protection against the virus. They are intended for carpenters, for example, who work on band saws with vacuum extraction

systems. Builders can use them to trap thick dust and plug vacuums.



Fig.3 FFP1 Respirator

FFP2/N95/KN95

[15]. FFP2 masks (similar to other international standards known as N95, KN95 and P2 masks) are becoming more and more prevalent in nursing homes and nursing homes. They provide the people who use it with a specific level of protection for the virus, but with a condition that when in contact with very highly infectious patients, that should not be used. Given the temporary shortage of sanitary supplies during the first wave of coronavirus in 2020, the Robert Koch Institute in Germany announced that if FFP3 is not available, medical personnel can wear FFP2 masks instead of standard FFP3 masks in infectious conditions. Now there is no shortage of high-quality masks for such serious workers.

[16]. N95 filtering facepiece respirators and surgical masks are commonly used to protect the human respiratory system from particulate airborne particles known to be linked to respiration and heart disease. Aerosol particles of biological origin, for example viruses, bacterial cells, bacterial and fungal spores, fragments and pollen, can have significant health effects, including infectious diseases. Viral particles or viruses are one of the smallest bioaerosol agents known, with particle diameters ranging from 20 to 300 nm. Due to their small size, viruses can easily enter the human respiratory system and cause illnesses such as colds. Flu, measles, mumps, pneumonia, rubella, or chickenpox. Respiratory protective tools are usually tested as challenge aerosols using non-biological particles, however it's use is frequently intended to minimize exposure to biological particles. FFP2 masks (similar to other international standards known as N95, KN95.



Fig.4 FFP2 Respirator

FFP3/N99/EN149/P3

[15]. Only FFP3 masks (similar to international standards such as N99, EN149 and P3) effectively protect the user from extremely dangerous shocks such as aerosol droplets, protein molecules, viruses, bacteria, fungi and spores and even asbestos fibres.

[17]. Respirator's label 'FFP' signify facepiece filtering. They are designed to filter out dust, particulates, and aerosols, while providing protection against viral and bacterial infections from coughing or sneezing. "3" is the level of protection offered by the respirator (3 highest FFP rating). It is essential that the FFP3 respirator fits correctly and provides proper seal to protect against airborne transmission of COVID-19. If the respiratory system is not properly sealed, the air containing the virus can leak through the filter. FFP3 respirators are required when making aerosol Generator Processors (AGP). This is because the AGP process produces aerosols that can come into contact with viral particles. First-line caregivers should use them even when they encounter Covid-19 patients or have symptoms.



Fig.5 FFP3 Respirator

MATERIALS-

[18]. Those masks generally consist of four layers:

- First layer is an outer layer;
- second layer is a non-woven filter layer, generally made of polypropylene microfiber to capture the virus,
- third layer is an acrylic backing for mask support;
- and an inner layer for facial comfort.

Respirators can be insulating and filtering. The filtering respirator consists of a Facepiece and a filtering device. Depending on the type of filter, the mask will be effective against particles only, only against specific gases and Vapours or against particles, gases and vapours. The filter respirator can sometimes be equipped with a breathing valve to improve user comfort.

Efficacy of medical mask (Respiratory mask) in preventing spread of COVID-19

[19]. Face masks and respiratory function against coronavirus and other respiratory viruses for the community, health workers and sick patients found that the use of face masks for health workers and community members has benefits. Due to their lack of supply, the WHO suggests that professional respirators for direct contact with COVID-19 patients be reserved for healthcare workers only, and surgical mask for healthcare workers, not in direct contact with corona patients.

Table 2 showing the efficacy of Medical Masks (Surgical and respirators) against COVID 19 Compared to that of Non-Medical (cloth mask) Face Masks.

	Surgical Masks	Respirators (N95, FFP)	Cloths Masks
Testing and Approval	Classified by ASTM	Evaluated and certified by NIOSH	Have not been evaluated or tested to recognized standards.
Purpose	-Also known as FRSM. -Provide a barrier to splashes and large droplets impacting the wearer's mouth, nose, and respiratory tract. -Do not protect against smaller droplets.	- Type of respirator - FFP: UK equivalent of N95 (in the USA). 3 categories: FF1, FFP2, FF3 - Provide more protection than surgical masks. - Can filter out both large and small particles when the wearer inhales.	- Sewn and non-sewn types - Intended to trap droplets that are released when the wearer talks, coughs, or sneezes. - Can use pillowcases, t-shirts, bandanas, scarves to make them. - Thicker, tightly woven cotton fabrics are preferred.
Fit (Face Seal)	Loose-fitting	Tightly fitted to the face	Fits against face
Fit testing requirement	No	Yes	No
Filtration	75%	Filters out 95% of airborne particles (large and small)	- 3-60% - High thread-count fabric combined with a high-electrostatic fabric filter aerosol most effectively
Use limitations	Disposable, meant for one-time use.	Generally, for a single-time use	-May be difficult to breathe through the fabric -Wash between uses
Intended Users	- Healthcare workers, and patients in healthcare settings.	Health care workers.	General public
When to wear	- During single or multiple patients' interactions or routine health procedures. - Surgical masks are also recommended when N95s are not available.	Recommended for use by healthcare workers providing care for patients with Covid-19, and performing procedures putting them more at risk of virus exposure.	Recommended for persons who cannot perform social distancing: -When coughing or sneezing. - In public transportations, grocery stores, pharmacies, and other essential businesses...

The Efficacy of surgical mask (Medical mask) against COVID-19 Compare to cloth mask (Non-Medical mask)

The comparison of surgical and homemade masks against bacterial and viral aerosols showed that “the average fit factor of homemade masks was half that of surgical masks. That is, both surgical and homemade masks reduced the number of microorganisms expelled by

test subjects, but surgical masks were 3 times more effective.

Efficacy of cloth mask (Non-Medical mask) in preventing to spread of COVID-19-

The use of non-medical face masks outside of healthcare settings is recommended, but may be insufficient to prevent the spread of coronavirus, according to an evidence-based study conducted by the COVID-19 Task Force from the Faculty of Medicine of Public health. He noted that there was not much evidence related to the

effectiveness of the cloth mask compared to its medical parts.

The efficacy percentage of some homemade non-medical masks has been stated by one preprint article to be “between a 49% and 86% filtration rate for 0.02 μm exhaled particles whereas surgical masks filtered 89% of those particles. In addition, he cited laboratory tests that showed that "particles in the corresponding size range had a leakage rate of 3% to 60% in household materials, comparable to some surgical masks.

- Aerosol particle sizes operate from 10 nm to 10 μm .
- Single layer filter efficiency: 5-80% and 5-95% for particles size less than 300 nm & more than 300 nm.
- Hybrids filter efficiency (cotton-silk, cotton-chiffon, cotton-flannel): > 80% (for particles < 300nm); and > 90% (for particles > 300nm).
- The improved efficiency is due to the combined effect of mechanical and electrostatic filtration.

Finally, the WHO recommends using a fabric mask of three or more layers of linen or cotton. Additional global recommendations include frequent mask washing, a comfortable physical condition, and proper removal techniques

While the struggle to maintain the benefits of non-medical masks continues, some difficulties remain. Many versions of non-medical masks provide an inadequate seal of the mouth and nose, have poor fluid resistance, and require frequent redistribution. Low compliance and misinformation about its efficiency are also causative factors. Ignoring these factors, they are more effective in reducing the number of scattered drops than wearing no mask.

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III. CONCLUSION-

This review highlights the impact various types of face mask use in preventing respiratory virus transmission among healthcare workers,

patients and the general population. The findings show that regardless of the type, environment or who uses the mask, it mainly has a dual preventive purpose; How to protect yourself and others from viral infections. Therefore, if everyone wears a mask in public, it creates a double barrier against the transmission of Covid-19.

Face mask and respirators can be used as personal protective equipment (PPE) or to prevent infectious droplets produced by the users.

wearing face masks at the community level and in medical settings will decrease the spread of Corona infection by:

- Prevent Sars-Covid-19 droplets from releasing infected users and entering the environment.
- Prevent Sars-Covid-19 droplets from entering the respiratory tract of the uninfected users.

Concerning healthcare Workers, they should use surgical mask and N95 respirators to be get protected against viral infection.

The cloth mask will protect the public from the infected users but offer less protection from the infectious public.

In summation, we have determined that the use of face masks will greatly reduce the spread of the SARS-COVID-19 virus and other respiratory infections.

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