

REVIEW ARTICLE

pISSN: 1907-3062 / eISSN: 2407-2230

Mandatory universal use of cloth mask for prevention of coronavirus disease 2019 transmission

Yenny^{*@}, Elly Herwana^{**}, and Raditya Wratsangka^{***}

ABSTRACT

Since the outbreak in Wuhan City, China, in late December 2019, the coronavirus disease 2019 (COVID-19) has spread to nearly the whole world, so that it was declared a pandemic by the World Health Organization. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative organism of COVID-19, is extremely infectious and can adhere to droplet nuclei of < 5 µm diameter and become airborne (aerosol). Since COVID-19 was declared a pandemic, there has been controversy on the use of cloth masks by the public, because of the still inconclusive evidence of the efficacy of cloth masks in protecting against COVID-19 transmission. Universal masking as a healthcare intervention in the community is currently made mandatory by local governments of most countries, since they follow the recent recommendation by the World Health Organization. The issuing of the WHO recommendation on the public use of masks was based on a study demonstrating that COVID-19 transmission does not occur only through droplets but also through aerosols. In addition, there was a study showing that COVID-19 transmission does not only occur from patients with clinical symptoms but also through asymptomatic and pre-symptomatic subjects, so that universal masking is of benefit in providing protection when used by healthy people and as source control to prevent cross-transmission to other people. This review article aims to discuss the mechanism of COVID-19 transmission, the evidence related to the efficacy of cloth masks, and the guidelines related to the selection and use of masks by the general population.

Keywords: COVID-19, prevention, cloth mask, universal masking

*Department of Pharmacology & Clinical Pharmacy, Faculty of Medicine, Trisakti University
**Department of Pharmacology & Clinical Pharmacy, Faculty of Medicine, Trisakti University
***Department of Obstetrics & Gynecology, Faculty of Medicine, Trisakti University

Correspondence :

@Yenny

Department of Pharmacology & Clinical Pharmacy, Faculty of Medicine, Trisakti University
Jl. Kyai Tapa No.260, Grogol JakartaEmail: yennyfarmako@trisakti.ac.id
Orchid id: 0000-0001-9390-5527

Date of first submission, October 18, 2020

Date of final revised submission, January 17, 2021

Date of acceptance, January 19, 2021

This open access article is distributed under a Creative Commons Attribution-Non Commercial-Share Alike 4.0 International License

Cite this article as: Yenny, Herwana E, Wratsangka R. Mandatory universal use of cloth mask for prevents COVID_19 transmission. Univ Med 2021;40:57-68. doi: 10.18051/UnivMed.2021.v40.57-68.



INTRODUCTION

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), the causative organism of coronavirus disease 2019 (COVID-19), is an enveloped RNA beta-coronavirus that is phylogenetically similar to the first severe acute respiratory syndrome coronavirus (SARS-CoV-1) and the Middle East respiratory syndrome coronavirus (MERS-CoV).⁽¹⁾ The severe acute respiratory syndrome coronavirus-2 is spherical in shape, somewhat pleomorphic, and the virion is 85 nm in diameter,⁽²⁾ with a size range of 60–140 nm.⁽³⁾

Coronavirus disease 2019 transmission between humans mainly occurs through exposure to respiratory droplets on exhalation and on close contact with COVID-19 patients (within a distance of 1 meter).⁽⁴⁾ In addition, transmission can also occur on touching contaminated objects used by COVID-19 patients (fomite transmission) and through aerosols (airborne transmission).⁽⁴⁾

Transmission of COVID-19 most frequently occurs via symptomatic patients (those showing symptoms of COVID-19) on close contact (± 1 meter), but may also occur via presymptomatic patients, who do not yet show symptoms of infection because the disease is still in the incubation period (± 14 days) or in asymptomatic patients who do not show clinical symptoms at all but carry the virus that can be transmitted to other people.⁽⁵⁾ The prevalence of asymptomatic COVID-19 infection is 4.0–45.0%.^(6,7)

Since COVID-19 was declared a pandemic by the World Health Organization (WHO) on March 11, 2020,⁽⁸⁾ the President of the Republic of Indonesia has formed the Action Group for Accelerated Management of coronavirus disease 2019 (COVID-19) [*Gugus Tugas Percepatan Penanganan Coronavirus Disease 2019 (COVID-19)*]⁽⁹⁾ that continually socializes the 3M movement, where 3M is an acronym of the three activities of washing the hands with soap, wearing a mask, and physical distancing with other people in order to break the COVID-19 transmission chain.

The use of personal protective equipment in the form of masks is one of the essential pillars of COVID-19 prevention. To date, the use of masks by the general population is made mandatory by local governments in many countries because they follow the recommendation issued by the WHO. The use of cloth masks by the general population (universal masking) remains a matter of debate, because of the still inconclusive evidence for the protective efficacy of cloth masks in the prevention of COVID-19 transmission.^(10,11) In spite of this, several global healthcare organizations have recently issued recommendations in connection with the use of masks by the general population. The United States Centers for Disease Control and Prevention (CDC) recommend the use of cloth masks (face cloths) by the community in public places when social distancing is difficult to maintain.⁽¹²⁾

Similarly, the WHO that initially did not yet recommend the use of masks by the general population, again revised its guidelines on December 1, 2020, and issued recommendations on the use of masks by the general population in areas of known or suspected COVID-19 infection, accompanied by explanations of the types of mask that may be chosen in certain relevant situations and conditions.⁽¹³⁾

The issuing of recommendations on the use of cloth masks by the CDC⁽¹²⁾ and WHO⁽¹³⁾ for the general population was due to existence of several studies showing that COVID-19 transmission can also occur through droplet nuclei (airborne transmission) that are produced upon forceful exhalation such as shouting, singing, or performing physical activities.^(14,15) In addition, there are studies indicating that COVID-19 transmission may also occur through presymptomatic⁽¹⁶⁾ and asymptomatic individuals.⁽¹⁷⁾

The rationale of mandatory universal masking as a public health intervention when social distancing is impossible is to control the source of disease (mask users infected with COVID-19), while universal masking is also of benefit for prevention (protecting healthy users against COVID-19 infection).⁽¹⁸⁾ We searched

Pubmed Central and PubMed on 1 October 2020. This review article aims to provide information in connection with the mechanism of transmission of COVID-19, evidence associated with cloth masks, and guidelines related to the selection and use of masks by the general population.

Droplet vs aerosol transmission

Respiratory droplets are defined as saliva and secretions that are sprayed from the upper respiratory tract through the mouth and nose during exhalation (expelling air from the respiratory tract) such as in coughing, sneezing, laughing, speaking, and even normal breathing.⁽¹⁹⁾ The activity performed determines the diameter of the droplets that are produced. The majority of droplets that are expelled during breathing or clearing the throat are <1 m in diameter, whereas droplets originating during sneezing are larger in size, namely, 74.4–360.1 μm in diameter.⁽²⁰⁾

The size of the produced droplets determines their extent and penetration in the respiratory tract. Based on particle size, several types of droplet are currently recognized: i). small droplet particles (<5 – 10 μm in diameter). Droplet particles of <5 μm in diameter (droplet nuclei) can penetrate the respiratory tract down to the alveolar spaces, whereas droplet particles >5 – 10 μm in diameter are designated as respiratory droplets and penetrate below the glottis; ii). large droplet particles (>20 μm in diameter) cannot follow the respiratory airflow because they rapidly settle due to gravity; iii). intermediate droplet particles (10 – 20 μm in diameter), have the characteristics of both small and large droplets, but disappear more rapidly than droplet particles of <10 μm in diameter and potentially carry a smaller infectious dose than large droplets (>20 μm in diameter).^(21,22)

There are three main methods of transmission of viral infection that cause acute respiratory disease, namely contact (direct/indirect), droplet, and aerosol/airborne transmission. Direct contact transmission occurs when the virus is transmitted directly by contact from the infected patient to another patient,

without the aid of contaminated intermediary objects. Indirect contact transmission occurs via the transfer of a virus through contact with intermediary objects contaminated by infected patients. Droplet transmission occurs when there is a person-to-person transmission of a virus through the air by droplet sprays. The characteristic feature of this mode of transmission is the exposure of mucous membranes to virus-containing droplets. Aerosol or airborne transmission occurs when there is a person-to-person transmission of the virus through the air by the formation of aerosols in the size range of respirable particles or smaller.⁽²²⁾

Viral respiratory tract infection may occur when infected patients produce droplets by breathing, coughing, or sneezing. Transmission between individuals, through large droplets (short-distance) as well as small droplet nuclei (long-distance), may occur depending on the distance to the patients who are the source of infection. Infection may also occur if the droplets deposit onto the surface of objects (fomites) that are subsequently touched and transported by the hands, resulting in self-inoculation into mucosal membranes (ocular, nasal, and oral).⁽²¹⁾

In Figure 1, infected patients are represented by orange-colored heads, while potential recipients have white-colored heads. Airborne transmission may occur by close contact (at talking distance) and at longer distances (several meters). Both types of heads are potential recipients through self-inoculation when touching the surface of contaminated objects (fomite sources). Expiration includes normal breathing exhalation, coughing, and sneezing. Airborne droplets may persist on the surface of objects (fomites) that may subsequently be touched by the hands, so causing self-inoculation.

Transmission through respiratory droplets forms the focus of attention in respiratory infection with droplets of >5 – 10 μm diameter. In general, this has a very low risk of transmission of infection for persons in close contact (1 – 2 meters), because usually the droplets disappear rapidly from the air. Because of gravity, these relatively large

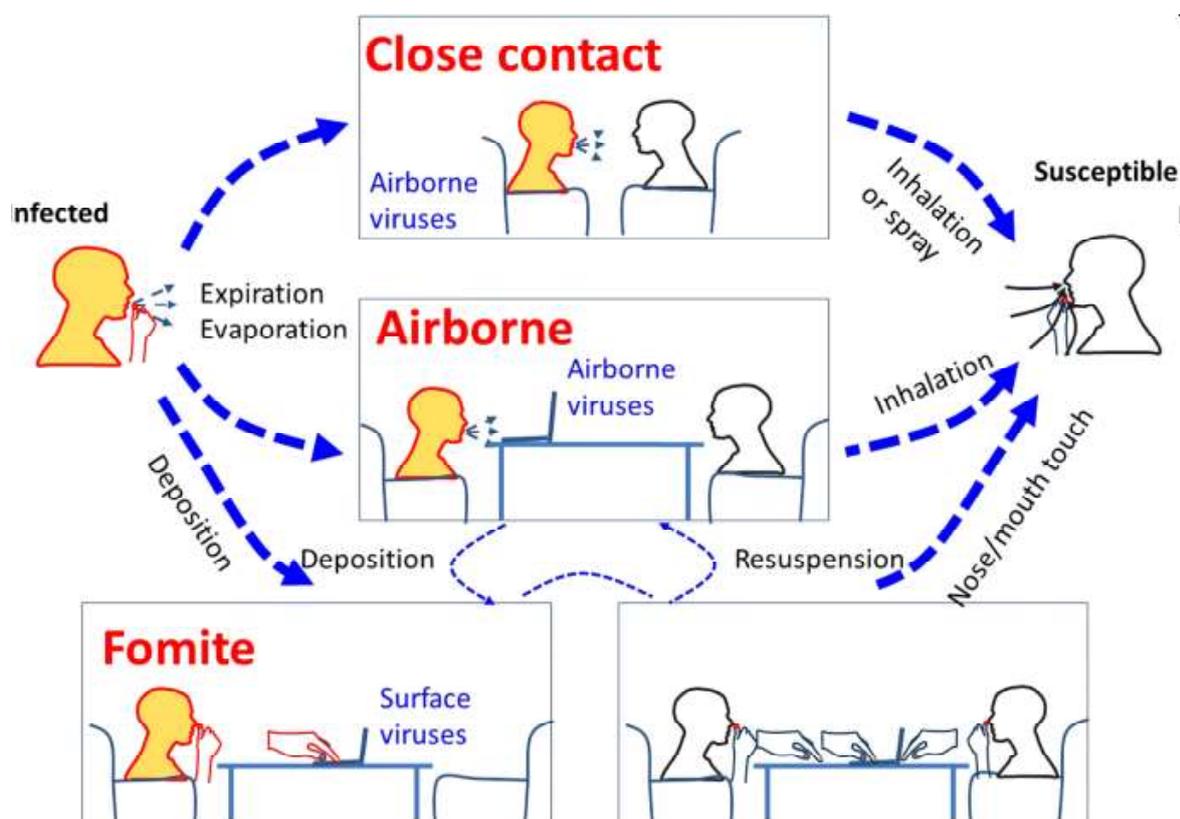


Figure 1. Several possible mechanisms of transmission of respiratory infections. ⁽²¹⁾

droplets deposit onto the floor or other surfaces within a few seconds.⁽²¹⁾

Environmental factors, in this case the airflow, also play a role in determining the droplet transmission distance. Large droplets may persist in the air if the airflow in the environment can maintain the droplet suspension for a long enough time, such as strong cross-flows or ventilation that induces air flows.⁽²¹⁾ Aerosol or airborne transmission may occur through large or small particles that may persist for a considerable time in the air at transmission distances of more than 2 meters.⁽²²⁾

Several studies conducted to identify the presence of COVID-19 virus in respiratory air or by aerosol transmission yielded inconsistent results. A study conducted by Chia et al.⁽²³⁾ showed positive air samples in two out of three isolation rooms of patients with COVID-19, with viral particle sizes of around 1-4 μm and $>4 \mu\text{m}$ (total concentration of SARS-COV-2 in the air samples ranging from 1.84×10^3 to 3.38×10^3

RNA copies per m^3 of sampled air). The study of Santarpia et al.⁽²⁴⁾ showed that 63.2% of air samples were positive, with mean viral load of 2.42 copies/L air. Samples taken from around the beds of the patients and those from a distance of more than 2 meters, had COVID-19 viral RNA copies of 4.07 and 2.48 per L air, respectively. This study supports the opinion that COVID-19 may be directly transmitted (droplet and person-to-person transmission) as well as indirectly (by contaminated objects and airborne transmission). Liu et al.⁽²⁵⁾ showed that more than half of the viral RNA in the air samples had a size of $<2.5 \mu\text{m}$ and were therefore associated with aerosol transmission.

The above studies show the occurrence of air samples that are positive for the SARS-CoV-2 genome, which supports the notion of airborne COVID-19 transmission. In contrast, several studies were showing contradictory results in connection with airborne COVID-19 transmission, such as the Singaporean study of

Ong et al.,⁽²⁶⁾ who did not find positive air samples from the isolation rooms of three patients. The study by Alsvéd et al.⁽²⁷⁾ conducted on 12 choir singers and two patients with confirmed COVID-19 showed significant differences in particle emission between breathing, talking, and singing, but failed to detect the virus in the respiratory air of patients with confirmed COVID-19. According to the investigators, the latter may have been caused by several factors, such as low viral concentrations in the air, differences in viral loads in the droplet-producing respiratory tract regions, or the dilution steps in preparing the samples.

Airborne transmission of COVID-19 may occur when a person is exposed to droplet nuclei and is frequently found in healthcare personnel when performing medical procedures in hospital, resulting in the mechanical formation and dispersion of aerosols or triggering an aerosol-generating procedure, such as when performing bronchoscopy, cardiopulmonary resuscitation, tracheal intubation, mechanical ventilation, oral-maxillofacial surgery, etc.⁽⁴⁾

Cloth masks

Cloth masks (cloth/fabric/homemade masks) are defined as masks that are made of any fabric such as cotton, gauze, silk or muslin.⁽²⁸⁾ The use of cloth or non-medical masks by the community is currently made mandatory by local governments in several countries, including Indonesia. Up to the present, there are still doubts arising, both from medical personnel and the general population, with regard to the efficacy of cloth masks in protecting against COVID-19 transmission.

Several studies have been conducted to determine the efficacy of cloth masks in reducing the spread of respiratory infection in the community. The study conducted by Davies et al.⁽²⁹⁾ aimed to evaluate the capacity of home-made masks (made of several types of textile) as alternatives to surgical masks as a physical barrier against bacteria and viral aerosols. This study determined the filtration efficiency of

various types of cloth, such as cotton T-shirt fabric, linen, silk, and scarfs in comparison with surgical masks against two types of organism, namely *Bacillus atrophaeus* (0.95–1.25 µm in diameter) and bacteriophage MS2 (23 nm in diameter). The results showed that the mean filtration efficiency of surgical masks (89.52%) was higher than that of tea towel (72%), cotton mix (70.24%), linen (61.67%), silk (54.32%), cotton T-shirt fabric (50.85%), and scarf (48.87%). These study results also showed that the use of home-made masks was better than not wearing any mask at all.⁽²⁹⁾

The study conducted by Jung et al.⁽³⁰⁾ aimed to evaluate the filtration capacity of various types of masks, using the protocols of the Korean Food and Drug Administration (KFDA) and the US National Institute for Occupational Safety and Health (NIOSH). Cloth masks made from cotton handkerchiefs consisting of minimally four layers, had a filtration efficiency of only 13%, whereas extremely porous textiles such as gauze, had a filtration efficiency of merely 3%, even though consisting of several layers.

The study conducted by Jang et al.⁽³¹⁾ aimed to evaluate the filtration efficiency, the number of layers, and the effect of washing of commercial cloth masks as compared to respirators. The results of this study showed that the filtration capacity of cloth masks increased 1.7–4.6 times and 2.3–6.8 times when the cloth masks were folded into two and four layers, respectively, as compared with masks consisting only of one layer. After a single washing, the filtration efficiency of the cloth masks decreased 1.04–4.0 times as compared with the products before washing.

A cluster randomized controlled trial conducted by MacIntyre et al.⁽³²⁾ aimed to compare the efficacy of cloth masks to that of medical masks used to protect healthcare personnel from respiratory infection. The study results showed that particle invasion through cloth masks was very high (97.0%) when compared with that of medical masks (44.0%). Workers using cloth masks had a 6.64 times higher risk of acquiring an influenza-like infection (RR=6.64;

95%CI=1.45-28.65) and had a 1.72 times higher risk of acquiring laboratory-confirmed viral infection (RR=1.72; 95%CI=1.01–2.94) as compared with those using surgical masks. The investigators concluded that cloth masks did not provide protection equal to that of medical masks so that they should not be recommended for healthcare personnel.

The study conducted by Neupane et al.⁽³³⁾ aimed to evaluate the filtration efficiency of cloth masks and surgical masks against aerosol-sized particles, and to determine the effects of washing, drying, and stretching on filtration efficiency. The study results showed that the filtration efficiency of cloth masks was variable (63.0–84.0%), while the efficiency of surgical masks was 94.0%. These results also showed that the filtration efficiency of cloth masks decreased by 20.0% after four times washing and drying as a result of changes in pore size and shape, and decreased microfiber in the textile pores due to washing.

The study conducted by Ma et al.⁽³⁴⁾ aimed to evaluate the efficiency of three types of mask (home-made, N95, and medical masks) to prevent infection with avian influenza virus. The study results showed that home-made masks consisting of one layer of polyester cloth and four layers of kitchen paper towels were able to inhibit viral aerosol particles by 95.15%, while N95 and surgical masks inhibited by 99.98% and 97.14%, respectively. The investigators stated that cloth masks were more breathable than N95 masks, and that kitchen paper towels could be replaced frequently. The study conducted by Konda et al.⁽³⁵⁾ aimed to evaluate the filtration efficiency of cloth masks made from various types of fabric, namely cotton, silk, chiffon, flannel, synthetics, and combinations of these various types of cloth, and to determine their function in the filtration of aerosol-sized particles (10 nm–10 µm). The study results showed that the filtration efficiency of various types of single-layer cloth varied widely for particles of <300nm and >300 nm in diameter, namely 5–80% and 5-95%, respectively. The use of combination cloth (cotton-silk, cotton-chiffon,

cotton – flannel) in the manufacture of cloth masks increased the filtration efficiency of the masks by more than 80% (<300 nm) and 90% (>300 nm), respectively. The increased filtration efficiency of combination cloth masks was due to the combined mechanical and electrostatic effects of the cloth. The study results of Konda et al.⁽³⁵⁾ confirm the possibility of using cloth masks for filtration of aerosol-sized particles (100 nm–1000 nm). Table 1 may be seen as a summary of studies that determined the efficacy of cloth masks for the prevention of viral infection transmission.

A systematic review conducted by Jain et al.⁽³⁶⁾ showed that cloth masks have protective efficacy, but that penetration of cloth masks is higher than that of surgical masks and N95 respirators N95. Cloth masks may be used in low risk areas and by the community if there are no surgical masks available. A systematic review and meta-analysis by Sharma et al.⁽³⁷⁾ showed several factors that play a role in the filtration capacity of cloth masks, such as type of cloth used (thread count of the cloth), number of layers, degree of humidity, and compatibility of the masks with the face. Cotton cloth masks consisting of three layers or more in combination with silk, chiffon, and flannel, that fit on the face with no or minimal leakage of air around the masks, and are not moist, provide the best protection in preventing viral infection.

There are several limitations of cloth masks, namely that the physical features of cloth masks result in a lower filtration capacity in comparison with medical masks or N95 respirators, causing the virus to penetrate and spread through the mask by the capillary diffusion of liquids, particularly because the expelled air frequently causes the masks to become wet. The high humidity and temperature of the expelled air may result in dew precipitation within the mask as a result of the different temperatures within the mask and the outside air. The droplets expelled during speech increase the humidity of the mask, and additionally the

Table 1. Summary of studies that determined the efficacy of cloth versus surgical masks for the prevention of viral respiratory infection transmission

Investigators	Aim of the study	Study design/ subjects	Type of mask	Outcome
Davies et al. ⁽²⁹⁾	To evaluate the potential of home-made mask as surgical mask alternative	Non-randomized study on 21 volunteers	No mask, homemade mask (100% T-shirt cotton) vs surgical mask	Mean filtration efficiency of surgical mask (89.52%) vs tea towel (72%), cotton combination (70.24%), linen (61.67%), silk (54.32%), T-shirt cotton, and scarf (48.87%). Home-made mask better than no mask.
Jung et al. ⁽³⁰⁾	To evaluate the filtration capacity of various types of mask using protocols of the Korean Food and Drug Administration (KFDA) and the National Institute for Occupational Safety and Health (NIOSH).	Laboratory study	44 brands of 4 types of mask and handkerchiefs	Cloth masks made from cotton handkerchiefs consisting of minimally 4 layers had a filtration efficiency of only 13%, while very porous cloth such as gauze had a filtration efficiency of merely 3% although consisting of several layers.
Jang et al. ⁽³¹⁾	To evaluate filtration efficiency, number of layers, and washing of commercial cloth masks	Laboratory study	5 commercial cloth masks vs respirator	The filtration capacity of cloth masks increased 1.7–4.6 times and 2.3–6.8 times, respectively, if cloth masks were folded into two and four layers vs single layer masks. Filtration efficiency of cloth masks decreased significantly 1.04–4.0 times after washing.
MacIntyre et al. ⁽³²⁾	Comparison of efficacy of cloth masks vs medical masks in hospital healthcare personnel	Cluster randomized clinical trial on 1607 healthcare personnel	Local medical masks (3 layers of nonwoven material) vs. cloth masks (2 layers of cotton material)	Particle invasion through cloth masks (97%) vs medical masks (44%). Cloth mask user has 6.64 times higher risk of influenza-like infection (RR=6.64; 95%CI=1.45–28.65) and 1.72 times higher risk of laboratory-confirmed viral infection (RR=1.72; 95%CI= 1.01–2.94) vs surgical mask user

Table 1 (continued).

Neupane et al. ⁽³³⁾	Filtration efficiency against aerosol-sized particles; Effects of washing, drying, and stretching on filtration efficiency	Laboratory study	Double-layered cloth masks vs. surgical masks	Filtration efficiency of cloth masks (63–84%) lower than surgical masks (94%). Filtration efficiency of cloth masks decreased by 20% after four times washing and drying due to changes in pore size and shape and reduction in microfiber in pores of the cloth due to washing.
Ma et al. ⁽³⁴⁾	Comparison of filtration efficiency of 3 types of mask on prevention of avian influenza virus	Laboratory study	Cloth masks, surgical masks, N95 respirators	All three types of masks could effectively inhibit avian influenza virus. Home-made masks consisting of one layer of polyester cloth and four layers of kitchen paper towels could inhibit aerosol-sized viral particles (95.15%), N95 masks (99.98%), and surgical masks (97.14%).
Konda et al. ⁽³⁵⁾	To assess the filtration efficiency of masks made of various materials and/or combinations	Laboratory study	Masks made of silk, cotton, flannel, chiffon, various synthetics, and their combinations	Filtration efficiency of cloth masks increased up to 80% (particles of <300 nm) and 90% (>300 nm) when multiple layers were used in mask fabrication, using combinations of cotton cloth with silk, chiffon, and flannel, respectively.

breathing process will mechanically increase viral penetration on the surface as well as within the mask.⁽³⁸⁾ The presence of gaps at the sides of the mask (due to incompatibility of mask and face) may reduce the filtration efficiency of cloth masks by 60.0%.⁽³⁵⁾ The physical features of cloth masks (poor filtration), reuse, cleaning frequency, and moisture retention, may cause the virus to persist on the surface of the masks, thereby increasing the risk of infection.^(32,39)

Apart from the variable filtration capacity of cloth masks, there are several advantages of cloth masks, namely cloth masks can be made at home by the user and adapted to the user's face, therefore being able to cover the gaps that are usually found around medical masks, and cloth masks can also be reused after having been washed and subjected to decontamination measures.^(32,40)

Potential benefits and risks of instituting universal masking

The recognition of droplet and airborne COVID-19 transmission and the discovery of asymptomatic transmission as source of infection has resulted in the wearing of masks becoming one of the methods of preventing COVID-19 transmission. The use of masks by the general population has the potential of the occurrence of "variolation", which was the process in which an individual who was susceptible to smallpox was inoculated with material taken from the vesicles of patients with smallpox, in order to trigger a mild infection that eventually resulted in immunity.⁽⁴¹⁾ The study conducted by Sekine et al.⁽⁴²⁾ shows that cellular immunity results from mild as well as from asymptomatic COVID-19 infection. A high prevalence of asymptomatic COVID-19 may increase the immunity of the

community⁽⁴³⁾ and reduce transmission while waiting for the availability of vaccines, even though the effective antibody concentration and the T cell immune response resulting from various manifestations of COVID-19 have not yet been determined.⁽⁴¹⁾

The more individuals are using masks in public places, where they are in close contact with one another, the more the whole community is protected because of the emergence of immunity such as occurs with vaccination.⁽⁴⁴⁾ The use of any type of mask can partially filter the viruses present in the droplets (with the filtration capacity depending on the type of mask used).⁽⁴⁵⁾ Universal masking is of benefit in reducing the “inoculum” or viral dose for mask users.⁽⁴⁶⁾ Exposure to a lower dose of inoculum may reduce the frequency of severe cases and constitutes the basic principle in vaccine development.⁽⁴⁷⁾

The recommendation with regard to the use of masks in the community for the prevention of COVID-19 transmission, particularly in Indonesia, is acceptable in view of the daily increase in the number of COVID-19 cases in Indonesia.⁽⁴⁸⁾ This shows that physical distancing cannot be sufficiently effective in preventing COVID-19 virus transmission. Universal masking is of benefit in protecting the individual against cross-transmission and reduces the risk of increasing COVID-19 transmission upon relaxation of social distancing.⁽¹¹⁾

In connection with COVID-19 transmission it should be kept in mind that droplet transmission is not the sole factor determining whether or not a person will become infected with COVID-19. There are many factors play a role, such as climatic conditions (e.g. temperature and humidity) and population density.⁽⁴⁹⁾ Other factors to be considered are the virus (viability, infective dose), the infected person (viral load), mode of transmission (droplet vs. airborne), aerosol processes (phase transformation and respiratory deposition), medium (building ventilation), and host (immune system, use of personal protective equipment).⁽⁴⁰⁾

Apart from the potential benefits of universal masking for the general population, the mandatory

use of cloth masks by the general population may engender a spurious feeling of security. Because the public feels protected from COVID-19 infection due to the use of masks, this may contribute to lowered compliance for maintaining hand hygiene, to poor coughing etiquette, violations in social distancing, and increased risks of touching the face and nose as a result of adjusting the cloth mask on the face.⁽⁵⁰⁾

Guidelines on the use of masks by the community

According to current guidelines, medical masks and respirators should be prioritized for medical personnel and individuals at high risk of infection, in view of their limited availability and higher cost. The WHO recommends the use of surgical masks for larger-sized droplets ($>5 \mu\text{m}$) and short distances (<2 meters), such as in acute respiratory disease accompanied by fever, in respiratory syncytial virus and adenovirus infections, and influenza. The N95 respirator is used for aerosol infections ($<5 \mu\text{m}$) at longer distances (>2 meters), such as in tuberculosis, measles, SARS, and acute respiratory tract infections by new or unknown organisms.⁽⁵¹⁾

On October 5, 2020, the US Centers for Disease Control and Prevention (CDC) again revised the guideline related to the potential of airborne transmission of COVID-19. According to the CDC, airborne transmission may occur at distances of more than 6 feet (1.8 meters) and persist for several hours after a COVID-19 patient or an asymptomatic person has left the room, if the room is closed and inadequately ventilated, or at the moment that the infected patient breathes out forcibly such as when singing or performing physical exercise that results in the production of smaller droplets at relatively high concentrations, thereby spreading the virus to others.⁽⁵²⁾

In connection with the recommendation on the use of masks by the general population, the CDC recommends the use of cloth masks in public and when being around persons who are not living in our household, particularly when physical distancing is difficult to maintain.⁽⁵³⁾

On December 1, 2020, the WHO again revised its guidelines and recommended that the general population use fabric masks when being indoors (such as in shops, workplaces, schools, etc.) or outdoors when physical distancing of minimally 1 meter cannot be maintained. The use of medical masks is recommended for vulnerable subjects who may be at high risk of complications when infected with COVID-19 (elderly aged ≥ 60 years, persons with comorbidities such as cardiovascular disease, diabetes mellitus, chronic lung disease, cancer, cerebrovascular disease, or on immunosuppressants) and in persons with suspected or confirmed COVID-19, irrespective of the presence of symptoms.⁽¹³⁾

Currently there are guidelines issued by the WHO in connection with the types of masks that can be used by the general population in areas with known or suspected transmission of COVID-19.⁽⁵⁾ In the selection of non-medical masks it is recommended to pay attention to the following: filtration efficiency, breathability, a combination of materials used, mask shape and coatings, and care of masks. Masks should preferably be used by one person only, not shared with others, and should be frequently washed using warm water (60°C) and soap or detergent. If no warm water is available, the masks may be washed with soap or detergent using clean water followed by boiling the masks for one minute or immersing the masks in 1% chlorine solution for one minute, then rinsed to remove residual chlorine.⁽⁵⁾

CONCLUSIONS

To date, there has been no clinically tested drug that can cure patients with COVID-19, so that the best way for breaking the COVID-19 transmission chain is by taking measures for preventing viral exposure. Based on the currently existing evidence, the filtration efficiency of cloth masks in the prevention of respiratory virus transmission is lower than that of surgical masks. However, there are studies demonstrating that the filtration efficiency of cloth masks may be enhanced by the selection of the textile material

and the number of layers used. There is a need for standardization in the fabrication of cloth masks, so that they may give maximal effects to the wearer. Universal masking in conjunction with social distancing and hand hygiene are the health interventions that can be instituted at present for the prevention of COVID-19 transmission, while waiting for the discovery of definitive treatment for COVID-19.

CONFLICT OF INTEREST

All authors declare that they have no competing interests and have no non-financial interests that may be relevant to the submitted work.

ACKNOWLEDGMENTS

The authors are grateful to the Faculty of Medicine, Trisakti University, for financial support.

CONTRIBUTORS

Y contributed to writing the draft of the manuscript. EH and RW contributed to editing and revising the manuscripts. All authors have read and approved the final manuscript. 

REFERENCES

1. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of corona virus disease 2019 in China. *N Engl J Med* 2020;382:1708-20. doi: 10.1056/NEJMoa2002032.
2. Yi Y, Lagniton PNP, Ye S, et al. COVID-19: what has been learned and to be learned about the novel coronavirus disease. *Int J Biol Sci* 2020; 16: 1753–66. doi: 10.7150/ijbs.45134
3. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med* 2020;382:1177–9. doi: 10.1056/NEJMc2001737
4. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. Geneva: World Health Organization;2020.
5. World Health Organization. Coronavirus disease (COVID-19) advice for the public: When and how

- to use masks. Technical guideline Advice on the use of masks in the context of Covid-19. Interim guideline 5 June 2020. Geneva: World Health Organization;2020.
6. Oran DP, Topol EJ. Prevalence of asymptomatic SARS-COV-2 infection: a narrative review. *Ann Intern Med* 2020;173:362-7. doi: 10.7326/M20-3012.
 7. Byambasuren O, Cardona M, Bell K, Clark J, McLaws ML, Glasziou P. Estimating the extent of asymptomatic COVID-19 and its potential for community transmission: systematic review and meta-analysis. *JAMMI* 2020;5. doi:10.3138/jammi-2020-0030.
 8. World Health Organization. Coronavirus disease (COVID-19) pandemic. Copenhagen, Geneva: World Health Organization;2020.
 9. Presiden Republik Indonesia. Keputusan Presiden Republik Indonesia Nomor 7 Tahun 2020 tentang Gugus Tugas Percepatan Penanganan Corona Virus Disease 2019 (COVID-19). Jakarta: Presiden Republik Indonesia;2020.
 10. Mahase E. Covid-19: What is the evidence for cloth masks? *BMJ* 2020;369:m1422. doi:10.1136/bmj.m1422.
 11. Esposito S, Principi N, Leung CC, Migliori GB. Universal use of face masks for success against COVID-19: evidence and implications for prevention policies. *Eur Respir J* 2020;55:2001260. doi: 10.1183/13993003.01260-2020.
 12. Centers for Disease Control and Prevention. Regarding the use of cloth face coverings, especially in areas of significant community-based transmission. Atlanta: Centers for Disease Control and Prevention;2020.
 13. World Health Organization. Mask use in the context of COVID-19. Interim guideline 1 December 2020. Geneva: World Health Organization; 2020.
 14. Hamner L, Dubbel P, Capron I, et al. High SARS-CoV-2 attack rate following exposure at a choir practice – Skagit County, Washington, March 2020. *Morb Mortal Wkly Rep* 2020;69:606-10. doi: 10.15585/mmwr.mm6919e6.
 15. Jang S, Han SH, Rhee JY. Cluster of coronavirus disease associated with fitness dance classes, South Korea. *Emerg Infect Dis* 2020;26:1917-20. doi: 10.3201/eid2608.200633.
 16. Arons MM, Hatfield KM, Reddy SC, et al. Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. *N Engl J Med* 2020;382:2081-90. doi: 10.1056/NEJMoa2008457.
 17. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med* 2020;382:1177-9. doi: 10.1056/NEJMc2001737.
 18. Cheng KK, Lam TH, Leung CC. Wearing face masks in the community during the COVID-19 pandemic: altruism and solidarity. *Lancet* 2020. doi: 10.1016/S0140-6736(20)30918-1.
 19. Morawska L, Johnson GR, Ristovski ZD, et al. Size distribution and sites of origin of droplets expelled from the human respiratory tract during expiratory activities. *Aerosol Science* 2009;40:256-69. doi:10.1016/j.jaerosci.2008.11.002.
 20. Han ZY, Weng WG, Huang QY. Characterizations of particle size distribution of the droplets exhaled by sneeze. *J R Soc Interface* 2013;10:20130560. doi: 10.1098/rsif.2013.0560.
 21. Tellier R, Li Y, Cowling BJ, et al. Recognition of aerosol transmission of infectious agents: a commentary. *BMC Infect Dis* 2019;19:1-9. doi: 10.1186/s12879-019-3707-y.
 22. Larson EL, Liverman CT, editors. Understanding the risk to healthcare personnel. In: Preventing transmission of pandemic influenza and other viral respiratory diseases: personal protective equipment for healthcare personnel: update 2010. Washington, DC: The National Academies Press; 2011.
 23. Chia PY, Coleman KK, Tan YK, et al. for the Singapore 2019 Novel Coronavirus Outbreak Research Team. Detection of air and surface contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in hospital rooms of infected patients. *Nat Commun* 2020;11: 2800. doi: 10.1038/s41467-020-16670-2.
 24. Santarpia, JL, Rivera DN, Herrera VL, et al. Aerosol and surface contamination of SARS-CoV-2 observed in quarantine and isolation care. *Sci Rep* 2020;29;10:12732. doi: 10.1038/s41598-020-69286-3.
 25. Liu Y, Ning Z, Chen Y, et al. Aerodynamic characteristics and RNA concentration of SARS-CoV-2 aerosol in Wuhan hospitals during COVID-19 outbreak. *Nature* 2020;582:557–60. doi: 10.1038/s41586-020-2271-3.
 26. Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA* 2020;323: 1610-2. doi: 10.1001/jama.2020.3227.
 27. Alsved M, Matamis A, Bohlin R, et al. Exhaled respiratory particle during singing and talking. *Aerosol Sci Technol* 2020;54:1245-8. doi: 10.1080/02786826.2020.1812502.
 28. Chughtai AA, Seale H, MacIntyre CR. Use of cloth masks in the practice of infection control-

- evidence and policy gaps. *Int J Infect Control* 2013;9:1–12. doi: 10.3396/IJIC.v9i3.020.13.
29. Davies A, Thompson KA, Giri K, Kafatos G, Walker J, Bennett A. Testing the efficacy of homemade masks: would they protect in an influenza pandemic? *Disaster Med Public Health Prep* 2013;7:413-8. doi: 10.1017/dmp.2013.43.
 30. Jung H, Kim JK, Lee S, et al. Comparison of filtration efficiency and pressure drop in anti-yellow sand masks, quarantine masks, medical masks, general masks, and handkerchiefs. *Aerosol Air Qual Res* 2014;14:991-1002. doi: 10.4209/aaqr.2013.06.0201.
 31. Jang JY, Kim SW. Evaluation of filtration performance efficiency of commercial cloth masks. *J Environ Health Sci* 2015;41:203-15. doi: 10.5668/JEHS.2015.41.3.203.
 32. MacIntyre CR, Seale H, Dung TC, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open* 2015;5:e006577. doi: 10.1136/bmjopen-2014-006577.
 33. Neupane BB, Mainali S, Sharma A, Giri B. Optical microscopic study of surface morphology and filtering efficiency of face masks. *Peer J* 2019;7:e7142. doi: 10.7717/peerj.7142.
 34. Ma QX, Shan H, Zhang HL, Li GM, Yang RM, Chen JM. Potential utilities of mask-wearing and instant hand hygiene for fighting SARS-CoV-2. *J Med Virol* 2020;92:1567-71. doi: 10.1002/jmv.25805.
 35. Konda A, Prakash A, Moss GA, Schmoldt M, Grant GD, Guha S. Aerosol filtration efficiency of common fabrics used in respiratory cloth masks. *ACS Nano* 2020;14:6339-47. doi: 10.1021/acsnano.0c03252.
 36. Jain M, Kim ST, Xu C, Li H, Rose G. Efficacy and use of cloth masks: a scoping review. *Cureus* 2020;12:e10423. doi: 10.7759/cureus.10423.
 37. Sharma SK, Mishra M, Mudgal SK. Efficacy of cloth face mask in prevention of novel coronavirus infection transmission: a systematic review and meta-analysis. *J Educ Health Promot* 2020;9:92. doi: 10.4103/jehp.jehp_533_20.
 38. Li Y, Wong T, Chung J, et al. In vivo protective performance of N95 respirator and surgical facemask. *Am J Ind Med* 2006;49:1056-65. doi: 10.1002/ajim.20395.
 39. Osterholm M, Moore K, Kelley N, et al. Transmission of Ebola viruses: what we know and what we do not know. *mBio* 2015;6:e00137. doi: 10.1128/mbio.00137-15.
 40. Hsiao TC, Chuang HC, Griffith SM, Chen SJ, Young LH. COVID-19: an aerosol's point of view from expiration to transmission to viral-mechanism. *Aerosol Air Qual Res* 2020;20:905-10. doi: 10.4209/aaqr.2020.04.0154.
 41. Gandhi M, Rutherford GW. Facial masking for Covid-19 -potential for “variolation” as we await a vaccine. *N Engl J Med* 2020;383:21. doi: 10.1056/NEJMp2026913.
 42. Sekine T, Perez-Potti A, Rivera-Ballesteros O, et al. Robust T cell immunity in convalescent individuals with asymptomatic or mild COVID-19. *Cell* 2020;183: 158-68.e14. doi: 10.1016/j.cell.2020.08.017.
 43. Leslie M. T cells found in COVID-19 patients ‘bode well’ for long-term immunity. *Science* 2020;368:809-10. doi: 10.1126/science.abc8120.
 44. Brooks JT, Butler JC, Redfield RR, et al. Universal masking to prevent SARS-CoV-2 transmission-the time is now. *JAMA* 2020;324:635-7. doi: 10.1001/jama.2020.13107.
 45. Lai ACK, Poon CKM, Cheung ACT. Effectiveness of facemasks to reduce exposure hazards for airborne infections among general populations. *J R Soc Interface* 2012;9:938-48. doi: 10.1098/rsif.2011.0537.
 46. Gandhi M, Beyrer C, Goosby E. Masks do more than protect others during COVID-19: reducing the inoculum of SARS-CoV-2 to protect the wearer. *J Gen Intern Med* 2020;35:1-4. doi: 10.1007/s11606-020-06067-8.
 47. Handel A, Li Y, McKay B, et al. Exploring the impact of inoculum dose on host immunity and morbidity to inform model-based vaccine design. *PLoS Comput Biol*. 2018;14:e1006505. doi: 10.1371/journal.pcbi.1006505.
 48. Kementerian Kesehatan Republik Indonesia. Covid-19 updated 08 October 2020. Jakarta: Kementerian Kesehatan Republik Indonesia;2020.
 49. Dalziel BD, Kissler S, Gog JR, et al. Urbanization and humidity shape the intensity of influenza epidemics in US cities. *Science* 2018;362:75-9. doi: 10.1126/science.aat6030.
 50. Greenhalgh T, Schmid MB, Czypionka T, Bassler D, Gruer L. Face masks for the public during the covid-19 crisis. *BMJ* 2020;369:m1435. doi: 10.1136/bmj.m1435.
 51. World Health Organization. Infection prevention and control of epidemic- and pandemic- prone acute respiratory infections in health care. Geneva: World Health Organization;2014.
 52. Centers for Disease Control and Prevention. Coronavirus disease 2019 (Covid-19): how COVID-19 spread. Atlanta: Centers for Disease Control and Prevention;2020.
 53. Centers for Disease Control and Prevention. Considerations for wearing masks: help slow the spread of COVID-19. Atlanta: Centers for Disease Control and Prevention;2020.