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Review Article

Use of face mask in COVID-19 pandemic-a review

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ABSTRACT

The current novel corona virus disease 2019 (COVID-19) is a highly infectious disease of the respiratory tract and rapidly spreading all over the world in short span of time. In current COVID-19 pandemic, use of the face mask is becoming usual and ubiquitous for both health care workers and public individuals. Wearing face mask is one of the non-pharmaceutical interventions which need minimum cost and provide dramatic response for preventing the COVID-19 infection. Limited availability of the vaccine and inadequate supply of therapeutic options, face mask use is an important part for public health measures for restricting the COVID-19 spread. Regardless of the debate among medical community regarding global face mask production shortage, a greater number of countries in the world are moving ahead with recommendations or mandates for using face mask in public. As currently global shortage of N95/FFP2 respirators and surgical masks for use by health care workers in the hospitals, simple cloth masks will act as a pragmatic solution for the use of the public. General public often use the surgical mask or even filtering facepiece (FFP) masks irrespective of their need, resulting unnecessary shortage for needy individuals those are exposed to the patients or those are health care workers. So, this review article will clarify the indication of the different types of masks and their rational use in the current COVID-19 pandemic.

Keywords: COVID-19, Face mask, SARS-CoV-2, Aerosols, N95 mask

INTRODUCTION

COVID-19 is caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2).[1] It is presenting significant challenges to the health care workers, public, policy makers and government. COVID-19 is a global crisis and spreading rapidly to all parts of the world. In early December 2019, the coronavirus disease 2019 (COVID-19) was originated in Wuhan, China.[2] The causative virus, SARS-CoV-2 is spreading from person to person through droplet or airborne and contact. The prevention of the COVID-19 needs vaccination which can protect us from this public health crisis. However, the vaccination is not covering everybody. To reduce the spread of COVID-19 infections, it needs two things: one is to limit contacts of the infected persons via physical distancing and second measure is wearing of the face mask to reduce the transmission probability by contact. [3] Face mask wearing reduces the transmissibility per contact by lowering the transmission of the infected respiratory particles in both clinical and laboratory contexts. Mask wearing is the most effective method for reducing the virus transmission from human to human. There is lack of high-quality research on the face mask for protecting from infectious diseases during pandemic. This review article discusses details about epidemiology, viral transmission in COVID-19 pandemic, types of face mask used in pandemic and its benefits and drawbacks of the face mask.

METHODS OF LITERATURE SEARCH

We conducted an electronic survey of the Scopus, Medline, Google Scholar and Pub Med databases for

searching the research articles. The search terms in the data bases included face mask, COVID-19 pandemic, personal protections of health care workers, surgical mask and N95 mask. The abstracts of the published articles were identified by this search method and other article was identified manually from the citations. This manuscript reviews the epidemiology, mode of SARS-CoV-2 transmission, indications of face mask, types of face mask, advantages of face mask, how to wear proper face mask and don't in face mask. This review article presents a baseline from where further prospective trials for face mask use in COVID-19 pandemic can be designed and helps as a spur for further research in this important protective measure for preventing infection from COVID-19 infection.

EPIDEMIOLOGY

COVID-19 was declared as pandemic by world health organization (WHO) on March 11, 2020 after identification of more than 118000 cases in 114 countries.[4] Government and public health stakeholders were implemented measures for slowing the SARS-CoV-2 where health care workers managing COVID-19 patients are at greatest risk of infection. The ongoing COVID-19 pandemic has already infected millions of the patients worldwide. By July 2020, more than 10 million cases have been reported worldwide, as well as 500,000 deaths with rapid spread in most parts of the world.[5] As the vaccine is not available to all, so personal protection by use of the face mask will be needed urgently to prevent the transmission of the virus. International and national travel restrictions with physical distancing are helpful for limiting the spread of the viral infection. Use of the face mask is still not done by 100 percent population. Face mask can reduce the total infections and death and also delay the peak time of the epidemic.[6] A WHO sponsored systematic review looked at physical distancing, use of face mask and eye protection for preventing human to human transmission of the SARS-Co-V-2.[7] They conclude that use of the face mask could result in large reduction of infection in the community. Currently shortage of the medical masks may require use of the cloth mask, as an effective type of source control, in addition to existing hygiene, social distancing and contact tracing strategies. As several respiratory particles become smaller because of evaporation; wearing mask by infected persons, rather than only use of mask by susceptible persons such as health care workers with focus on individual outcomes.

COVID-19 VIRUS

The COVID-19 infection is caused by a virus called as SARS-CoV-2 which is an encapsulated or enveloped positive strand RNA virus and w classified into four genera such as alpha, beta, delta and gamma.[8] Out of these four types, alpha and beta are known to infect human beings.[8] The corona virus is ranging from 60 nm to 140 nm with spike like projection from the surface as a crown like appearance under electron microscope, so the name corona virus.[9] The spikes over surface of the virus are made up of glycoprotein which act as critical for binding to the host cell receptors and play a vital role in severity of the infections of the host.[8] The majority of the human receptors for glycoprotein of this virus, human angiotensin converting enzyme 2 (ACE2) is seen mainly in the lower respiratory tract rather than upper respiratory tract.[10] So scarcity of the receptors in the upper respiratory tract, the clinical symptoms related to upper airway is less. The incubation period of Covid-19 ranges from 1 to 14 days with a median of 5-6 days. [11] Although recent study document that the incubation period may extend to 24 days.[11] A longer incubation has implication in quarantine policies and prevention of the spread of the disease. This virus primarily transmitted via droplets but also it is seen in blood and stool, so raising question regarding mode of transmission.[12] The lipid rich envelope is critical for spread of the virus, but may be eliminated via physical or chemical means.[13] Airborne virus containing droplets have been found on different surfaces up to three days following exposure, with indications of half-life of several hours.[14] Currently airborne transmissions are considered as the major cause for spread of infection from human to human and resulting community spread of this infection. The rapid transmission of the SARS-CoV-2 raised concerns protective measures. Lack of protective measures such as appropriate face mask or personal protective equipment may result in increased morbidity and mortality.[15] So, there is urgent need for effective intervention to stop the spread of the virus, especially in the context of limited resources.

VIRAL TRANSMISSION

The rapid spread of the SARS-CoV-2 virus has increased concerned for public and health care workers because of lack of sufficient resource in all parts of the world. Rapid spread of infection results in significant increase of morbidity and mortality. There thought to be three modes of human-to-human transmission of COVID-19 infection such as large drop transmission from mouth of an infected person to the mouth, nose or eye of the recipient; direct physical contact with droplets deposited on the surfaces and subsequently goes to the respiratory mucosa and inhalation of the micro-droplets ejected from an infected person and held aloft with ambient air currents.[16] The transmission of the COVID-19 commonly occurs via the upper respiratory tract such as nose, nasopharynx, oral cavity, pharynx and larynx with high levels of viral shedding.[17] It rapidly spread through droplets and airborne but the aerosols generating procedures are more responsible for transmission of the virus and enhance the spread to the surrounding health care workers and other persons.[18] Airborne transmissions occur through the inhalation of the aerosol droplets which exhaled from infected person and currently thought to be the primary transmission route of COVID-19.[19]

HISTORY OF FACE MASK

The use of the face mask and respirators to protect the health care workers and general public got renewed interest following 2009 influenza pandemic.[20] The use of face mask was got more importance in emerging infectious disease such as avian influenza, Middle East respiratory syndrome coronavirus (MERS-coronavirus) and Ebola virus.[21] Historically, different types of cloth/cotton mask have been used for protecting health care professionals. Disposable medical or surgical masks were introduced in health care system in mid-19th century followed by respirators.[22] In comparison to other regions of the worlds, use of the face mask is more prevalent in Asian countries like China and Vietnam.[23] In developed countries where resource setting is high, disposable medical masks and respirators are replacing the use of cloth masks in the hospital. However, the cloth masks are widely used globally particular more in Asian countries which have historically been affected by emerging infectious diseases and also in West Africa in context to shortage of personal protective equipment.[24]

FACE MASK

Face mask provide high levels of containment and achieve to limit the transmission of the infection which reduce the total number of positive cases and also decrease the number of deaths.[25] The key factors for providing effectiveness or quality of the mask in reducing the transmission of infection include the aerosol reduction rate, face mask coverage in population and availability of the mask. Face masks usually protect against coarse droplet and finer aerosol transmission. There are different varieties of the face masks available to protect the persons for getting infections. Other than cloth masks and surgical masks, N95 respirators are more effective against finer aerosols and also superior to prevent droplet transmission.[25] The virus can stay active on the outer surface of the face mask and so touching the outer surface of the mask is a dreaded habit for self-contamination and get infection to the own body. All the face mask wearers should not adjust the mask frequently. If urgently you need to adjust the mask, wash the hand with soap and sanitize hand properly after touching it.

TYPES OF FACE MASK

Mask is a type of personal protective equipment used for preventing the spread of respiratory infections. It is effective for preventing transmission of the respiratory viruses and bacteria.[26] There are different face masks available during COVID-19 pandemic for preventing the transmission of SARS-CoV-2 infections in community. There a great debate that which type of mask provides the best possible protection against the virus. WHO recommended that surgical masks should be used during treatment of COVID-19 patients whereas N95 masks/respirators or PAPRS should be used only in case of aerosol generating procedure.[27] Face mask act as the best shield to protect against the virus causing COVID-19 infection. Without use of the mask by an individual in current pandemic, there is maximum risk for being infected. There are various types of face mask (Table 1) available for general public and health care workers.

Table 1: Various types of face mask used in current COVID-19 pandemic.

Types	Special features	Benefits	Drawbacks
Cloth masks	-Loose fitting, made of polyster or cotton -Can be layered by filter paper -For use by general public	-Can be made in home, washed and reused -Use of this mask can prevent hoarding of medical masks	-Insufficient protection from the aerosols
Surgical masks	-Loose fitting, provides physical barriers -Used by health care workers	-Cheaper -Easily available -Can be layered over N95 mask	-Air leakage -Cannot be used during aerosol generating procedure -Disposable and meant for one time use
N95 masks	-Tight fitting (Filtration rate>95%) -Used by health care workers	-Provide greater protection against aerosols and droplets	-Need regular fit testing and seal check -Diminishing supplies -Higher cost than surgical mask
Powered air-purifying respirators (PAPRs)	-Loose head-top with battery powered blower to filter air -For use during aerosol generating procedures	-Provide greater protection compared to N95 mask -Does not require fit testing and can be worn with facial hairs -More comfortable	-Expensive -Limited availability -Difficulty in maintenance

Cloth mask/ homemade mask

The use of the cloth masks ensuring COVID-19 pandemic is under debate. The filtration effectiveness of

the cloth mask is usually lower than that of the surgical masks and respirators. However, cloth masks give some protection is well designed and correct method of wearing. Multilayer cloth masks are made to fit around the face and with water resistant fabric with higher number of threads and finer weaves which may provide a reasonable protection.[28] Currently there are no head-to-head studies for effectiveness of the homemade mask or cloth mask versus medical or surgical mask against SARS-CoV-2 infection transmission in the community. Universal use of the cloth mask is helpful to reduce the transmission of SARS-Co-2.[28] Cloth masks have been found to be effective for stopping small particles in they consist of multiple layers, especially those layers are made with different fabrics. In case community level, cloth masks may be useful to prevent community spread of infections by sick or asymptomatic infected patients and the public should be educated for correct use of the cloth mask. On April 3, 2020, the center for disease control (CDC) produced an advisory for general public to wear cloth face mask when going outside, particularly those are staying in COVID-19 pandemic affected areas to prevent the community transmission.[29]

Surgical mask

Medical or surgical masks are used for health care workers and community settings for protecting from droplet infections. Surgical masks are made of three layers such as a middle layer of extra fine glass fibers or synthetic microfibers covered both sides by acrylic bonded parallel laid wet laid nonwoven.[30] These are useful to prevent spread of infection from asymptomatic persons or sick persons.[30] Respirators are usually fit around the face, designed to protect respiratory system and useful mostly for health care settings. In context to COVID-19 pandemic, the surgical mask must be reserved for the persons with symptoms of the respiratory infections suggestive of confirmed COVID-19. Health care workers, first aid persons and medical transport persons should wear surgical mask (Figure 1). Health professionals in contact with features of the respiratory infection and in absence of invasive procedures on the respiratory tract can use surgical masks.[31]

Figure 1: Health care worker wearing surgical mask.

N95 mask

In case of aerosol generating procedures, N95 respirators are unanimously recommended by international and national guidelines.[32] However the use of the N95 mask (Figure 2) is inconsistency for recommending for routine care and non-aerosol generating procedures of COVID-19 patients.[32] Currently WHO and public health agency of Canada are recommending to use of medical/surgical masks for non-aerosol generating procedures at the time of caring COVID-19 patients whereas the the U.S Centre for disease control and prevention (CDC) and European centre for disease and prevention (ECDC) are recommending the use if N95 respirators for non-aerosol generating procedures over less expensive and readily available surgical or medical masks. N95 masks (equivalent to FFP/P2 in European countries) are made up of electrostatically charged polypropylene microfibers designed to filter the particles of size 100 to 300 nm in diameter with 95% efficacy. N99 (FFP3) and N100 (P3) masks are available but not widely used with 99% and 99.7% efficacy respectively for same range of particle.[33]

Figure 2: N95 mask.

INDICATIONS FOR FFP2/N95 MASK

The filtering face piece 2 (FFP-2) type of mask is usually reserved exclusively for health care workers when doing different invasive medical procedures or dealing with respiratory tract which usually generate an aerosol such as intubation/extubation/laryngeal mask, invasive ventilation with open-expiratory circuit, non-invasive ventilation (NIV), endotracheal aspiration, bronchoscopy, aerosol therapy, aerosol generating chest physiotherapy, nasopharyngeal sampling, dental surgery. functional respiratory explorations, autopsy or any other procedures at risk of aerosol.[33] Both surgical and FFP masks are single-use devices, intended to be worn while caring for one patient and to be changed between patients. Currently general public is wearing surgical or FFP masks irrespective of their need, resulting to shortage for health care workers those are exposed to COVID-19 patients. Both surgical and FFP masks are single use devices and usually worn while caring of patient and to be changes between the patients.

TECHNIQUE TO WEAR FACE MASK

The face mask must cover the nose and mouth with any leakage in any side. The upper part of the mask should come all the way up, close to the bridge of the nose whereas the lower part goes down under the chin. The face mask should snug to the face. The degrees of the surgical mask are not deigned to form seal around the nose and mouth. But N95 mask is designed to achieve a very close facial fit and filter 95% of the particles.[33] So, N95 provide an extra protection. Everybody knows that SARS-Co-V2 enters the body through nose, mouth and eyes. But many people still uncover the nose and even mouth when wearing the mask and so easily get infected and also spread the virus to others. Wearing the mask around the neck or on chin is a dangerous practice. Knotting the ear loops of the surgical mask and tucking in and flattening the material close to the face will stop the leakage around the face mask.

ADVANTAGES OF THE FACE MASK

Face mask have been proven to prevent a person from getting infection and spreading SARS-CoV-2 to others. Everyone should wear proper mask in proper way to keep the virus at bay. As COVID-19 infection is airborne, wearing proper face mask at the right ways is utmost importance in current pandemic.

DON'T TOUCH FACE MASK

Person wearing the face mask should not touch the mask and if touched accidentally, he or she should wash the hand with soap or sanitizer. One should not wear a dirty or soiled face mask. Never expose the nose or mouth when wearing the face mask. One should not use mask below the nose. Don't allow others to touch someone's face mask. Nobody should remove the mask to talk with other. Nobody should bring down the mask below the chin. When somebody needs to eat, drink or do any activity, he or she should remove the mask completely after washing /sanitizing the hands. The person who is wearing face mask should not allow his or her colleagues, friends and relatives to remove the face mask.[19]

DOUBLE MASK

In current COVID-19 pandemic, there is widespread shortage of N95 respirators. Although surgical/medical face masks are usually available, their efficacy is limited because of their poor face seal. The absence of the seal increases the exposure to the aerosolized droplets. This leakage can be replaced by use of the double mask which substantially improve the facial seal and so substitute N95 respirators in times of the shortage.[34,35] Double mask is very helpful to protect the infection to enter into the nose, mouth and eye. In case of double masking, a cloth mask is kept on the top of a medical/surgical mask.

CONCLUSION

Use of face mask intervene the viral transmission in current COVID-19 pandemic which has impact on the epidemic curve. Along with vaccination, use of the face mask potentially reduces the virus transmission. As vaccination is not available to everybody till now, use of the face mask plays crucial role for preventing the viral transmission. Increase use of the face mask need adequate awareness and availability of the mask also needed. Face mask use should be universal and implemented everywhere without delay. The compulsory use of the face mask in proper way will greatly control the COVID-19 pandemic by preventing the community transmission of the virus. Because of its less cost, potential for benefit and lack of any obvious harm, the face mask is strongly recommended for universal use of the medical mask by general public.

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