

A Review of Available Literature on the Use of Face Mask vs Face Shield during the Pandemic

Michael Duque

Philippine Nurses Association of United Kingdom

mduque.pnauk@gmail.com

Abstract— The public and healthcare personnel faced a dilemma when the COVID-19 infection became global. There are conflicting articles, guidance and policies on which type of face covering, either face mask, face shield, or both can be effectively used in a global health crisis such as this pandemic. The general public and the non-healthcare policy makers were the ones most affected by this confusion. The COVID-19 Pandemic has triggered the extensive use of face coverings both for healthcare personnel and the general public. Previous studies were conflicting and have no definitive and conclusive findings on which is more efficient in minimizing the risk of respiratory infection during a pandemic. This study aims to extensively determine which face covering can provide more effective in diminishing the possibility of becoming infected with the virus. Building on previous research and available literature materials on face coverings, it hopes to provide an answer to which specific face covering is more able to protect and minimize the risk of the wearer from getting infected. In this context, the face covering would be either a face mask or face shield, both of which are readily available. The study critically analysed the available information based on an extensive review of the literature ranging from the 1918 Pandemic to the present. Analysis of the reviewed material demonstrated a significant lack of single conclusive result which was associated with various influencing factors. The results indicate that neither the face mask nor the face shield are effective in minimizing the risk of infection on its own, but one is more likely better than the other and that using a combination is best. The best type of face covering to use also depends on various factors and it would be beneficial to conduct further research to identify other factors and arrive at a more conclusive finding.

Keywords— COVID-19, Coronavirus, pandemic, face mask, face shield.

1. INTRODUCTION

Prior to the Covid19 Pandemic, the use of Face Masks (masks) and Face Shield (shields) by the general public was minimal, except in China where face mask is observed to be used daily by a significant portion of the population following the H5N1 outbreak in 1997. The use of a face mask became prominently necessary albeit

voluntarily, it started in the aftermath of the Severe Acute Respiratory Syndrome (SARS), which emerged in 2002 in the Southern province of Guangdong. Formally identified in early 2003, it quickly became an epidemic in the region. Its transmission was identified to be from person-to-person with viral infection from respiratory secretions. This paper reviews as much available literature on the efficacy of face masks and face shields in respiratory infection as presented during the COVID-19 Pandemic. The paper independently concludes with its relevant findings based on the best information gathered.

AIMS

The aim of the paper is to provide sufficient and practical advice on the effective use of face mask and face shield in decreasing the risk of infection brought about by the respiratory transmission of the Novel Corona-Virus-19. While this paper references to authoritative and reliable resources, it does not aim to replace national and international accepted standards of clinical practice as well as local workplace regulations and policies.

This paper is not meant to replace clinical practice manuals not is prescriptive in its findings. This is further aimed as adjunct information on the topic for anyone with an interest in the comparative efficacy of face mask and face shields.

METHODS

An extensive literature research was conducted using the keywords face masks; face shields; face mask vs face shields; efficiency of face masks and face shields; and respiratory infection guidelines to identify previous researches in relation to face masks and face shields use during a pandemic. The most recent available documents and literature about the topic were used and refer to. The paper is structured by initially giving a background on the issue, discussing the available evidences on face masks and face shields independently and collectively and finally concluding with best information.

RESULTS

As there are no significant clinical studies to prove the efficiency of using face shields to bring infections to

more manageable levels, as opposed to the well-studied results of using face masks in minimizing infections, a major recommendation is to evaluate their effectiveness individually and in combination. The overall general advice as part of the multilayered approach is that a mask alone (or face covering in England) is appropriate as long as social distancing is maintained in public places.

This further recognizes the advice endorsed in England by the Public Health England authorities. The mask will help contain and/or minimize the risk any airborne particles entering the person's system and infecting. The use of face shields alone, both publicly and in the healthcare setting, is discouraged in view of the higher risk it poses for the user with the premise that fine infective aerosolized particles can be drawn to the wearer's nose and mouth through the open top, sides and bottom of the shield. Prolonged close contact with an active droplet source is best mitigated with a combination of mask and shield worn properly and in accordance to guidance. This combined use of adjunct personal protective equipment is best reserve for healthcare facilities.

DISCUSSION

Further down in history, four influenza-related Pandemic have been documented. These are the 1918 (H1N1), 1957 (H2N2), 1968 (H3N2) and the 2009 (H1N1-pdm09) influenza outbreaks. All four pandemics were associated with influenza infections which during those times were managed with non-pharmaceutical methods such as isolation, quarantine, personal hygiene and limitations of social gatherings in conjunction at a later stage with pharmaceutical intervention. The 1918 outbreak was the most devastating with its dubious origins and with no previous knowledge of it. One most prominent non-pharmaceutical intervention implemented during the 1918 Pandemic was the use of face mask. Local governments made it a lawful obligation to wear mask in public and while majority of the population complied with it, there were still some who rallied against it, even when the casualties of the pandemic was getting to be far greater than the causalities of World War 1.

FACE MASKS

Although the general public's compliance to use mask was high, those who did not follow were called "slackers." The use of mask then as today was uncomfortable, suffocating and unpleasant. To encourage the general population to use mask, people were allowed to make and wear any type of masks they like. This led to the use of masks made of fine mesh

gauze and followed the fashion at the time. However, the effectiveness of the use of these non-medical masks were questioned and debated regularly by the authorities. As the war wrapped to an end, the use of mask subsequently declined as people no longer felt the need to use it. Nancy Tomes concludes that the effectiveness of using masks during the 1918 Pandemic was essentially difficult to prove, and it is the clear fact that those communities that implemented health measures were better than those communities that did not. Contrary to a study published in 1919 by the California State Department of Health, it presents evidence that there is almost no difference to the number of deaths between wearing masks and not. They identified possible reasons for this little difference in death rates. Authorities strongly felt that masks were not being used properly. Medical authorities at the time also advised using fine medical gauze but as such materials were limited to the healthcare setting, the general population resorted to using daily regular materials for mask. The use of sub-standard material effectively was ineffective. William T. Vaughan summarizes the overall sentiments of the time with regards to the proper use of mask.

"One difficulty in the use of the face mask is the failure of cooperation on the part of the public. When, in pneumonia and influence wards, it has been nearly impossible to force the orderlies or even some of the physicians and nurses to wear their masks as prescribed, it is difficult to see how a general measure of this nature could be enforced in the community at large." The Surgeon General of the US Navy formally identified that "...Masks of improper design, made of wide-mesh gauze, which rest against the mouth and nose, become wet with saliva, soiled with the fingers, and are changed infrequently, may lead to infection rather than prevent it, especially when worn by persons who have not even a rudimentary knowledge of the modes of transmission of the causative agents of communicable diseases" in his 1919 report. The use of substandard material for masks during the early days was echoed by W.H. Kellogg when he identified five key reasons why the gauze-masks did not help lower the risks of infection.

Overall, those who implemented non-pharmaceutical interventions had better results than those who either did not recommend non-pharmaceutical intervention or implemented it at a later stage. The death rates of the early implementers were less compared to the late starters. The single most reasonable cause of failure of the management of the 1918 Pandemic is the lack of a coordinated response to the situation. This lack of

coordination filtered out to the national, local and state levels. There was no centralized response from all levels which contributed to the rapid increase of infection rates.

The effectiveness of the mask eventually falls on a handful of important factors such as design, material, construction, supply and use. The person wearing the mask needs to use a mask which satisfies certain levels protection and should change it as frequently as possible. During the 1918 Pandemic, the use of mask was entirely ineffective due to the mask material itself and the behaviour patterns of the wearer. The advent of technology and recent advances in health sciences, the use of mask recently has been proven to be more efficient than before. In addition, the strong advice that additional non-pharmaceutical intervention should be part of this "layered" protection techniques in order to effectively control the spread of the disease is sensible and more logical.

FACE SHIELDS

The introduction of the use of Face Shields (shield) came about only during the Covid-19 Pandemic. Contrary to a mask which is often a flexible cloth-like material which is fastened to cover the mouth and nose, shields are plastic covering that provide a transparent unconstructive full face protection. Unlike full face and head respirators which are commonly used in infectious communicable disease setting and are often self-contained, face shields can be seen as a poor-man's face protector. Shields more often than not cover only the front part of the head or the whole face from the forehead, eyes, nose and mouth. Shields are secured either with straps or hooks on the sides. Face shields are often open on the top, bottom and sides. Unlike masks which are suggested to be changed as regularly as possible and are disposable, shields offer more cost effectiveness as it can be reused after it has been thoroughly cleaned and disinfected.

Arguably, shields are the best protection from large molecular particles of the virus which is known to spread by airborne droplet transmission. Apart from the droplet particles, the virus is also known to be transmission to much smaller aerosol particles which can remain in the air for a period of time. It is therefore logical that shields are very useful tools for those constantly exposed and with regular close proximity to persons who generate regular infective droplet particles.

Face shields can also be worn for longer periods without strain on the user. It also provides the transparency it needs when facial expression or lip-reading is required

of the healthcare professional or the wearer where a covered mouth and nose is unacceptable. While it offers more convenience to the user, its protective capabilities are limited to close range exposure to droplet particles which are discharged through active coughing or sneezing. Face shields allow small finely aerosolized particles which float in the air longer to be sucked through the open top, sides and bottom and eventually to the susceptible host's nose and mouth.

There are no clear findings on the relationship between the exposures of health care personnel to droplet particles while caring to respiratory infective patients. Furthermore, the efficacy of various types of PPE against respiratory infection is also unclear. In a landmark study published in the Journal of Occupational and Environmental Hygiene, it was concluded that face shield offer reduced exposure to small aerosol particles that are airborne longer and which can be easily inhaled. Professor Laura Bauld summarizes that shields should be used if the wearer will regularly come in close contact with somebody who is constantly emitting droplets (i.e. cough). She further adds that there is no evidence that wearing a face shield by the general public can prevent the same level of protection as the mask. Bauld expresses her thoughts that there is no conclusive evidence that shields are to be worn by the public and that she believes that appropriate cover for the mouth and nose is more efficient. Her finding was supported by Dr William G Lindsley, National Institute for Occupational Safety & Health who also worked with the landmark research of 2014.

Offset from the findings of the study, Iowa City Epidemiologist Michael Edmond advocates that face shields offer more effective protection than masks and has equally encouraged the public to use it.

What the email interview with him forgets to highlight is the fine aerosol particles that can remain airborne longer than the large droplet particles. No consideration was given that while face shield are required to be tight on the top and should extend further below the chin, the "open" structured design of the shield is its own design vulnerability.

Using information from the 2009 H1N1 Influenza pandemic, the Center for Disease Control and Prevention (CDC) has reiterated that the effectiveness of the use of facemasks and respirator is very limited to make any substantial conclusion. In view of the absence of clear information, the CDC have provided some recommendations which if looked at carefully mimics the non-pharmaceutical interventions done during the

1918 pandemic and the "layered" approach to intervention.

Like masks, face shields are loosely classified as personal protective equipment (ppe) and are used to protect the wearer from splashes and sprays of body fluids into the wearer's facial area and mucosal membranes. As they are not used solely alone but more efficiently with other equipment's, they are called adjunct PPE equipment's. It is clear that there are numerous advantages and disadvantages on the use of face shields. One clear setback on the use of face shield is the inability to protect the wearer from fine aerosol infective particles that have been proved to float longer in the air. This is primarily due to the open design of the shield primarily on the top, sides and bottom. This weakness in the total effectiveness of the shield was highlighted in the Institute of Medicine study.

Since there are no universally accepted standards for the proper use of face shields, the Occupational Health and Safety Administration (OSHA) recommendation based on the Blood borne Pathogens standard (1910:1030 subpart (d)(3)(i)) states: "...chin-length face shields, shall be worn whenever splashes, spray, spatter, or droplets of blood or other potentially infectious materials may be generated and eye, nose, or mouth contamination can be reasonably anticipated." As an adjunct personal protective equipment, it is therefore clear from this guidance that face shield should be worn when there is a high risk of exposure to droplet and aerosol sprays of any blood and body-fluids. In the medical healthcare setting, the risk of exposure should be assessed on a case to case basis according to local policies. Outside the medical healthcare setting, it is evident and observable that the risk of exposure to droplet and aerosol sprays of blood and body-fluids is lesser as compared to the healthcare setting unless a person directly comes in contact with an active source of droplet or aerosol spray (i.e. being directly in front or in the immediate surroundings of a person who has a new active cough). In addition, it is arguably understandable that while the risk of droplet and aerosol exposure in general public is less than where patients are already exhibiting signs and symptoms in the healthcare facility, the risk of being exposed to an unknown new infective source is also present. In such cases, it is more likely possible that fine diffused aerosol particles would be carrying the infective virus as it has been proved that fine aerosolized particles float longer in the air than larger droplet particles. In such a case, the use of a shield is much less effective compared to the use of a mask due to the inability of the shield to filter out aerosolized

particles from entering the vulnerable person's respiratory system.

The Chief Scientist of the U.S. Food and Drug Administration, Denise M. Hinton has repeatedly said and clearly stated that face shields are intended to be used by health care personnel (HCP) who are in the healthcare setting and are at a higher risk of being exposed to biological fluid airborne particles. Furthermore, the FDA has issued guidance that shields are to be described as adjunct PPE for medical purposes. Since the availability of data relating to the efficacy of the use of face shields is limited and much less than data available for the efficiency of masks, the potential benefits of the use of the shield as an adjunct PPE outweighs the potential risk of the shield when used as an adjunct equipment.

FACE MASK VS FACE SHIELD

In relation to the general public's use of either mask or shield, there is significant scientific evidence that the layered approach to self-care, when used correctly and properly, provide sufficient protection from infection. Physical distancing, hand hygiene, respiratory hygiene and the use of proper mask are the most important and effective means of reducing the risk of infection. The use of shields outside the medical health care facility is discouraged and is not scientifically considered an alternative to those mentioned earlier. The Infectious Diseases Society of America (IDSA) has recommended the general use of adjunct PPE in the community primarily because, according to its latest report, most infections are acquired in the community where PPE is not worn. IDSA further argued that during this pandemic, healthcare workers rarely acquire infections during patient care. This argument that healthcare workers rarely get infected contradicts the well-known fact that thousands of healthcare workers around the world have died after having been infected. In England, the national advice guidance for face coverings is that, a face covering should be worn when unable to maintain effective social distancing in public. It should be made clear at this time that the Health and Safety Executive have broadly and loosely used the term "face covering" to refer to any material used to cover the user's nose and mouth and is mainly intended to protect others and not the wearer. Face masks are implied to refer to hospital grade face masks intended to be worn in healthcare facilities and not in public.

CONCLUSION

A continuous debate about the specific transmission of Covid-19 is ongoing. While there are evidences that it is spread by direct contact of infectious droplets into the susceptible hosts' mucosal membrane (i.e. eyes, nose,

and mouth), minute airborne particles that remain longer in the air are also being considered to be infectious. The implications of aerosol generating procedures inside the healthcare setting is of utmost importance as the risk is substantially higher than in the public setting.

This implies that in the community setting, a simple and easy to use respiratory barrier, along with other infection control measures, is more beneficial than the benefits provided by a face shield. One way of minimizing the overall risk of transmission is to properly educate the general public on the proper way of using a face mask (or face covering in England) as evidence has proved that the efficiency of face masks is related to the wearing habits and proper use of the wearer. It is important to consider that significant medical, scientific and social advancements are in place now in relation to the situation in the past where various factors have been identified to the failure of face masks to contain the pandemic. We need to recognize that there are a number of evidence based actions we can do now while improving it on a daily basis.

The regular use of face mask and the appropriate use of face shields according to established guidelines based on scientific evidence and evidence-based research can help lessen the impact of the infection on society. The early identification and positive action on this single point of failure will all make the difference.

The unprecedented arrival of Covid-19 found most of us unprepared. Both national and international responses differed slightly and continuing management of the infection further differed between nations. Rapid assessment and adaptation of a coordinated intervention supported by evidence-based adjunct protection would more likely result in a favorable and manageable level of infections in society.

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