



REVIEW ARTICLE

Personal Protection Equipment Utilization and Hand Hygiene Practice during COVID-19 Pandemic: A Narrative Review

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Abstract

Background and objectives: Personal protective equipment and instant hand hygiene found the most effective preventive measures during coronavirus disease-19 and their utilization should depend upon contact-droplet exposure. The aim of the review was to evaluate when, where, and how the personal protective equipment utilized and hand hygiene practiced during SARS-CoV-2 infection.

Evidence acquisition: The following databases were searched using keywords and related browsing terms: PubMed Central, Ovid Medline via PubMed, Cochrane database, WHO coronavirus databases, CDC coronavirus database, and MDPI. Where duplicates were removed, records screened and full-text articles evaluated, so results from relevant articles were reported.

Result: The result showed that the claim on mass mask-wearing, and also another claim between United States center for disease control and the world health organization whether preferred to use surgical masks or N95 respirators to inhibit viral droplet transmission so that N95 preferably recommended towards aerosol transmission prevention.

Conclusion: The majority of the studies recommended that surgical masks for low-level protection than respirators and both consumed irrespective of their specific purposes.

Keywords

SARS-CoV-2, COVID-19, PPE, Viruses, Hand hygiene

Abbreviations

CDC: Center for Disease Control; COVID-19: Corona Virus Disease 19; PPE: Personal Protective Equipment; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2

Introduction

The pandemic severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), caused coronavirus disease-19 (COVID-19), first reported in Wuhan city, China [1]. The most likely route for spreading the virus was a person-to-person transmission and the primary transmission was supposed to be direct contact or droplets of an infected individual [2-4] but no evidence ascertains the virus is air-borne [5]. The pandemic increases the burden of the global health care system and encountered deaths. Thus, in mid-2019, the world health organization (WHO) endorsed personal protective equipment (PPE) use and instant hand hygiene practice, at any point of risk, for contact prevention [6-8].

Thus, WHO identified the following PPE includes, yet not limited, gloves, covers, goggles, face shields, respirators, gowns, boots or closed shoes, and liquid safe aprons [9-11] accompanied with physical distancing 1-2 meter [7] including reusable easy breath decahlons mask [12]. So far, many studies conducted elsewhere in the world but still, there is a need to reward information when, where, and how the personal protective equipment utilized and hand hygiene practiced in attempted to acquire some relevant information ahead of, no vaccine, SARS-CoV-2 infection.

Preventive features of personal protective equipment and hand hygiene practice

Masks: Mask is one of the effective globally prescribed personal protective equipment used as the last resort of physical protection against SARS-CoV-2 and comprises of respirators, medical masks, and non-medical/cloth masks [13,14], which was designed in different sizes for different purposes. For instance, filtering face piece 2 (FFP 2) protects health care workers (HCWs) against aerosols while surgical masks found effectively to protect patients from droplets of HCWs, preferred to use it in adjunct to other personal protections [15]. The filtering rate of masks depends on the particle size of the virus. In a given demonstration of challenge tests with 0.02 μm , surgical and cloth masks had filtration rates of 89% and 60% respectively where N95 was ahead of them by more than 6% and 35%, towards airborne particles > 0.3 μm , respectively [16]. In regards to cloth masks, the more the layers of cloth masks, the more filtering performance of the virus [17].

There was a claim about the inferiority of medical mask against the respiratory virus than N95 on top of high-risk situations where N95 is preferably recommended [18]. In this regard, FFP respirators were 12 to 16 times more protective than surgical masks [19], therefore, FFP (1-3) able to filter 80%, 94%, and 99% respectively [20,21]. Again, FFPs highly filtered fine solid particles of 0.07 to 3-micrometers droplets than medical masks [22]. In essence, the use of masks having exhalation valves was not recommended. Onwards, cloth masks or community masks, advised for use by the general public when physical distancing cannot be maintained as part of a comprehensive approach, was 15% less effective than surgical masks and five times more effective than not wearing masks to halt the viral infections [23] but not preferred to use by them HCWs or medical purposes [24]. Again, the effectiveness of cloth masks increased when worn them with coveralls than with gown [11].

Gown: The gown is one of the personal protective equipment that has been used to halt contact exposure from SARS-CoV-2 and prevent users from contamination of aprons [11] includes surgical gowns, isolation gowns, surgical isolation gowns, non-surgical gowns, procedural gowns, and operating room gowns. Users should select them based on their risk level ranged from minimal to high risk [25]; therefore, users should aware of their performance difference, so they perform differently with different risk conditions. For instance, level-4 (preferred for higher risk) gown can provide more protection than level-1 (preferred for low-risk condition) against viruses [26].

Study findings showed that uninfected HCWs wore gown more than the infected one [27] and a clean isolation gown can be used when caring for a patient with known or suspected COVID-19 [28]. However, there was a lack of comparative evidence to show whether coveralls or gowns are more effective than the other in reduc-

ing transmission of SARS-CoV-2 to health workers [29].

Glove: Medical glove, without considering their shelf life, has been used as barriers against viruses and could offer some protection [29]; therefore, the world health organization recommended using them in public places, such as supermarkets or public/private buildings accompanied by instant hand hygiene. Nevertheless, the food and drug authority of the United States of America didn't approve any medical glove for use and reuse to protect the wearer from SARS-CoV-2 infection [25] and nitrile gloves have been preferred over latex. According to the center for disease control, gloves were recommended when caring for a patient known or suspected of COVID-19 [30]; they should not be washed and reused [31].

Hand hygiene practice: Hand hygiene found the single most important protective measure to prevent infection including SARS-CoV-2, so important and practical than mask use [32,33]; however, the value of hand hygiene affected by unwise use of PPE [34]. Therefore, gloves could not replace hand hygiene [24]. Appropriate hands washing using both soap and water for at least 20 seconds or full cover hand rubbing using with a minimum of 60% alcohol, never in an open wound, have been helpful to reduce the chance of viral contamination [35,36]. In this regard, HCWs recommended performing hand hygiene everywhere in contact or cross-contact and similarly important for non-health-care workers using qualified cleansing products [37,38].

Review questions

- Who wore what type of equipment in which type of setting?
- How and when instant hand hygiene practiced elsewhere in contact?

Evidence Acquisition

Selection of studies

This review was conducted by considering the scale for the quality assessment of narrative review articles. The relevant studies attempted to prevent SARS-CoV-2 infection were included in the study. In doing so, the studies with epidemiological, clinical, or laboratory-based studies were conducted in any part or any setting of the world and published in English. Instead, meeting abstracts and letters to the editors were excluded.

Search strategy

An initial limited search of PubMed and Google scholar was done to identify articles on the topic. Furthermore, the following databases were searched using keywords and related browsing terms: PubMed Central, Ovid Medline via PubMed, Cochrane database, WHO coronavirus databases, CDC coronavirus database, and MDPI. A combination of keywords was used, and the

quest was made on Google scholar without data restriction.

Evidence and quality appraisal

After the database searching of records for titles and abstracts, duplicates removed, records screened, and full-text articles assessed, most relevant articles were studied and summarized.

Results

Coronavirus disease-2 is spreading; therefore, equipment and hand hygiene should be rationally utilized with realized to the risk of disclosure and transmission nature of the virus [39,40]. Health care workers involved in intubation, ventilation, and resuscitation procedures, therefore, use respirators [41] or equivalent, goggles or face shields, gloves, and fluid-resistant gowns or aprons, so properly [11]. There should be clear and understandable information about PPE use to maintain safe and effective control of SARS-CoV-2 infection [10,40]. For example, cleaners entering rooms where patients with suspected or confirmed COVID-19 should use gowns, heavy-duty gloves, medical masks, goggles or face shields, boots, or closed work shoes [42,43]. While full body cover with PPE could offer better protection unless difficult of doffing, donning, and secondary contamination [11] indicated based on contact and droplet exposure to who uses what and when [33,44-46].

To protect both the person who wears it and those with whom that person comes into contact, PPE should worn, removed, and discarded properly [47] since widely used by HCWs and the communities [32,40,48]. In this regard, the United States CDC argued that FFP2 masks (N95) are recommended in caring for confirmed cases of COVID-19 [45] while WHO preferred to standard surgical masks [46]. They discourage using respirators having exhalation valves in a sterile environment [49] where cotton mask recommended last without respiratory symptoms [32].

A given study that conducted during SARS-CoV-1 identified that hand hygiene, gloves, and face mask were effective to prevent viral transmission of 55%, 57%, and 68% respectively [8]. It was also found effective during COVID-19, however, 26.1% of the global population had no access to hand washing in 2019, which may limit the world to comply protocol-driven hand hygiene [50,51], and the majority of reviewed articles showed that hand and respiratory hygiene has been unequivocally recognized as an important measure to slow contact transmission of the virus where instant hand washing was more often hard to implement than instant hand rubbing [17,44,52] (Table 1).

Effectiveness of reuse versus extended use of personal protective equipment

Following the COVID-19 pandemic, personal pro-

TECTIVE equipment conceded with profound shortages [32,40]. Thus, rational use and either reuse or extended use of PPE were strategic and contemporary solutions respectively [40,54]. Where reuse defined as wearing the same PPE (except gloves) with removal between patients, for a maximum of five donning's [60] whereas extended use is about the continuous wear of the same PPE (except gloves) without removal in between patients when working with multiple patients' [60].

Therefore, extended use of PPE is preferred over reuse expected to involve less touching and then less risk of contact transmission [61,62] while reusable PPE must be properly cleaned, decontaminated, and maintained over and between uses [63]. It was claimed that N95 respirators worn at high-risk procedures should be for extended use only [64], and extended use of FFR has an insignificant risk of decreased protection over limited reuses [65]. Besides, disposable FFRs and N95 were not approved for continuous decontamination as the conventional standard of care while successful reuse of respirators could be helpful during fatal shortages of PPE. To discourage reuse or extended use specific to a sterile environment, therefore, rational use of PPE is highly recommended in maintaining continuous availability [18].

Factors associated with non-compliance to personal protective equipment utilization and hand hygiene practice

Instant hand hygiene and proper use of personal protective equipment challenged by a lack of positive role models, and compliance with hand hygiene caused intensified dryness and soreness of hands. This could deter compliance with hand hygiene, so users experienced negative perceptions [66]. For instance, a given study affirmed that only 36% of hemodialysis staff complied with hand hygiene protocol [67]; therefore, compliance with hand hygiene was influenced by risk perception [68]. Another study conducted somewhere in the world revealed that the overall median compliance rate with hand hygiene in-hospital care was 40% [69]. Similarly, compliance with PPE affected by an adverse reaction such as nearly 95% of healthcare personnel experienced with adverse reactions of various degrees [70,71], compromises rational use.

Discussions

The pandemic, COVID-19, is prominently transmitted via droplets and close contact. Consequently, mask-wearing and instantaneous hand hygiene (MIH) conveyed with physical distancing has taken as non-pharmaceutical preventive measures of severe acute respiratory syndrome coronavirus-2 infection. There have been a global scarcity of PPE and inputs of hand hygiene that push high-level standards towards their least alternative. Where prolonged use or reuse of medical masks, which recommended last when medi-

Table 1: Types of personal protective equipment towards certain activities/settings during COVID-19 disease [53-59].

Activities/Settings		PPE to be worn		Level of Evidence ^f
Aerosol generating procures (AGP) ^a		FFP3 respirator, long-sleeved disposable gown, gloves, disposable eye protections	Hand hygiene	IB
		Gloves, fluid-repellent-long sleeved gown, goggles or a visor, FFP3 mask		
Cleaning Activities		Gowns, heavy-duty gloves, surgical face mask, goggles or face shields, boots or closed work shoes,	Hand hygiene	NA*
Cleaning where the person with suspected or positive COVID-19		Disposable plastic apron, surgical face mask, disposable single-use glove, gown FFP2 mask, gloves, gown, goggles or face shield, boots or closed work shoes		
Providing patient care ^b		Surgical face mask, goggles or face shields, apron, gloves	Hand hygiene	IA/IC** IB**
Patient's Room: Droplet and contact precautions		Medical mask, apron or gown, gloves, goggles, or full-face screen	Hand hygiene	NA*
Transporting suspected COVID-19 patients		FFP2 masks, double non-sterile gloves, long-sleeved water-resistant gown, goggles or face shield	Hand hygiene	
Outpatient facilities		Surgical mask, gloves, gown, boots, or closed work shoes	Hand hygiene	
Waiting room		Medical mask, and/or physical distance(1meter)		
Working with a respiratory sample		FFP2 masks, double non-sterile gloves, long-sleeved water-resistant gown, goggles, or face shield	Hand hygiene	
		Disposable single-use Nitrile glove ^c , disposable plastic apron, surgical facemask ^d eye protection ^e		
Community settings	Indoor environment	Cloth masks, physical distancing	Instant hand hygiene	NA*
	Outdoor environment	Maintain physical distance No mask is required.		

*Not Available

^aIntubation, manual ventilation, open suctioning, tracheotomy/tracheostomy procedures, bronchoscopy, surgery and post mortem procedure, dental procedures, non-invasive ventilation, airway pressure ventilation, induction of sputum, nasal oxygenation

^bDiagnostic imaging, phlebotomy services, physiotherapy, [Flexible laryngoscopy or nasal endoscopy without additional instrumentation]**

^cGloves must be changed between service users and hand hygiene must be performed before and after putting on gloves.

^dOptions may include the use of FFP2 masks in situations in which they are not strictly required or the use of any surgical mask that is fluid repellent

^eEye protection is required to be worn as part of standard infection control precautions when there is a risk of blood, body fluids, excretions, or secretions splashing into the eyes.

^fEvidence levels contained herein were designated by the CDC.

cal-grade masks are available, were beyond no protection [63]; however, reuse of a medical glove was not invincible due to lack of validated, and low-cost procedure for safe decontamination.

To use masks, identify their protective performance towards the different sizes of a viral particle is invincible. In this sense, the performance of a cloth mask is lower by 29% than a surgical mask with the same particle size, and five times more protective than no protection so that its filtering performance could increase by increasing its layer [23,24], which could vary when the particle size of the infectious agent varied. Studies contended that the N95 respirator is superior to surgical mask while others didn't show the inferiority of medical masks [18]. Some others offered that a surgical mask is more effective than an N95 respirator in preventing

viral droplet transmission where N95 is better towards aerosol exposure, then R95 and P100 prescribed for high-level protection [51]. These arguments go to FFP respirators supposed to be more effective than cloth masks, surgical masks, and N95 respirators, although, the particle size of infectious agent matters [19].

Noted that high-risk activities like aerosol-generating procedures demand high-level personal protective equipment rather than extended use. Hand washing has unequivocal importance to slow contact transmission, whether using or not using personal protective equipment in all settings [52] so that the majority of study findings decided to have hand and respiratory hygiene during COVID-19.

The challenge behind compliance with hand hygiene

protocols is due to a lack of positive role models and adverse reactions following hand hygiene practice and PPE utilization [70,71]. To this end, the current study was tried to show and addressed claims regarding how, when, and what types of personal protective equipment in which type of activities or settings were effective during the time of, no vaccine, COVID-19. The current study addressed and showed claims regarding when and what types of PPE are effective in which type of activities or settings. Limitation: Formal critical appraisal of the quality of individual sources was not performed.

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Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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