Personal Protective Equipment for Healthcare Workers

Chinmay Mahatme*
Jawaharlal Nehru medical college, Datta meghe Institute of Medical Sciences, Wardha, Maharashtra, India

Article History:
Received on: 26 Sep 2020
Revised on: 30 Oct 2020
Accepted on: 10 Nov 2020

Keywords:
COVID, prevention, Personal Protective Equipment

ABSTRACT

COVID is a highly contagious viral disease that has caused massive outbreaks throughout the world causing a pandemic. The need to curtail its spread is quite evident in the numbers itself, with over 10.5 million cases worldwide as of today. The healthcare professionals face a multitude of problems in a scenario like this and their protection is of utmost importance. This unprecedented scenario requires them to form new habits that ensure their safety and therefore it is of great importance that information regarding personal safety be reviewed from time to time as knowledge takes time and repetition to get converted into actions and even more so to get converted to habit. A lot of misconceptions also exist regarding the equipment and practices that need to be implemented that require clarification. This article reviews strategies to be used by the healthcare workers and the hospital to tackle cases effectively, provide appropriate care and at the same time ensure their own safety and safety of all other personnel at the hospital as well as patients. An important aspect covered here is personal protective. Information regarding the equipment, it's uses, and protocols are explored with the aim of strengthening the knowledge base of the healthcare force and to reinforce precautionary measures to be taken during these tough times.

*Corresponding Author
Name: Chinmay Mahatme
Phone: 9320308028
Email: chinmay5mahatme@gmail.com

ISSN: 0975-7538
DOI: https://doi.org/10.26452/ijrps.v11iSPL1.3681

INTRODUCTION

nCoV 19 or the novel coronavirus is highly infectious agent that causes coronavirus disease or COVID. Thus, it is of utmost importance that precautions be taken to contain the disease and avoid its spread especially among health care workers who are at a very high risk of coming in contact with cases of COVID. It would be a matter of great sadness of the very person attempting to cure the diseased succumbs to it. Other than that, it is also evident that the sheer volume of patients due to the pandemic has put immense stress on the healthcare system and thus every healthcare professional that has to be isolated due to contact with cases without proper protection leads to an even more overburdened health care system. (WHO, 2020b)

Highest amount of viral load is present in sputum and upper airway secretions. Coronavirus transmission occurs majorly via 2 routes; contact transmission as well as droplet transmission. If the patient’s respiratory activity or certain medical procedures develop aerosols airborne transmission (>1m) may occur. The droplets are larger particles and their spread is usually limited to a 1 metre radius. Contact with the patient or fomites or surfaces may be responsible for infection. The virus is capable of being a potential source of infection for hours or even days. The viral particles enter the healthy individual via the respiratory mucosa and even the con-
The willingness and morale of healthcare professionals to give their best in difficult times like this also depends on how protected they are and the quality of protocol and equipment available.

This article aims at strengthening the response to COVID by reviewing the equipment required and practices of prevention of transmission of COVID amongst healthcare workers.

**METHODS**

Published articles, guidelines and documents have been reviewed and their interpretations combined to create this comprehensive article.

**PERSONAL PROTECTIVE EQUIPMENT**

The items that constitute Personal Protective Equipment or PPE are gloves, mask, eye protection and gown with foot cover. They protect the entry of the viral particles which usually enter via the respiratory mucosa and even the conjunctiva. (*WHO*, 2014)

Depending on the role carried out by the healthcare professional an appropriate level of PPE should be used, which is a combination of the above elements. (*Cook*, 2020)

1. **Gloves**

According to FDA, medical gloves should be used, non-sterile gloves can be used as they are being used for the protection of the healthcare workers and not for the purpose of protection of the patient from infectious agents. The length should be at least 230 mm and the thickness should be 0.5 mm. Nitrile gloves are preferred, latex may be used. (*WHO*, 2020b)

2. **Mask**

Various types of masks can be used which includes

1. FFP 2
2. FFP 3
3. N 95

**FFP**

This stands for filtering facepiece, the number next to it signifies the class of protection provided by it, higher the number more the protection it provides. (*Gawn*, 2008)

Table 1 shows the variants of FFP and their test values to qualify as either FFP 1, 2 or 3.

**N95**

The N95 mask uses several layers of mesh and electromagnetically charged layers to trap particulate matter and thus is effective in blocking droplets that may be carrying the viral particles. The N95 label denotes that under test conditions the mask obstructs a minimum of 95% of solid and liquid aerosol test particles (certified under 42 CFR 84 of National Institute for Occupational Safety and Health and the United States CDC). Masks have different ways of blocking entry of particulate matter ranging from having a small pore size to having a certain electrical charge that traps particles. This must be understood while attempting to try methods of mask sterilization otherwise it may result in reduction in the efficacy of protection that the mask provides.

3. **Eye Protection**

This includes a visor or a face shield. A complete hood with a transparent visor is now considered best.

4. **Gown with foot cover**

The gown should cover the entire length of the arms and should cover mid-calf length of legs at least as the remaining portion will be covered by the foot covers. These are made out of specific materials that meet with the permeability standards set by different country wise authorities. They should have a fluid repellent coat and should be disposable. It is also important to plan what kind of protection might be needed according to the anticipated proximity to patient and the type of procedure to be done. Table 2 shows the guidelines regarding the level of PPE required in some scenarios.

Protocol regarding wearing (Donning) and removing (Doffing) PPE CDC guidelines for,

**Donning**

1. Identify the required PPE items according to the anticipated proximity.
2. Wash hands with soap and water or use a sanitizer
3. Put on the gown first
4. Put on the mask next and perform a seal check

Seal check is performed by blowing out after putting the mask and checking for any points of air exit or fogging of glasses etc.

1. Put on the face shield or visor
2. Put on gloves last.
Figure 1: Beak Method

Table 1: Grades of FFP and their characteristics

| Class | Maximum allowed inward leakage | Maximum allowed filter penetration | Minimum filter efficacy | Normal Protection Factor | Assigned Protection Factor |
|-------|--------------------------------|-----------------------------------|-------------------------|--------------------------|---------------------------|
| FFP 1 | 22%                            | 20%                               | 80%                     | 4.5                      | 4                         |
| FFP 2 | 8%                             | 6%                                | 94%                     | 12.5                     | 10                        |
| FFP 3 | 2%                             | 1%                                | 99%                     | 50                       | 20                        |
Figure 2: Glove in glove method

Figure 3: Method for gown removal
**Table 2: Scenarios and appropriate PPE**

| Mode                  | Proximity                             | PPE                                      |
|-----------------------|---------------------------------------|------------------------------------------|
| Contact               | >2 m                                  | Gloves, Apron                           |
| Droplet               | <2 m                                  | Gloves, Apron, Fluid Resistant Surgical Mask, Eye Protection |
| Airborne              | Procedure involving generation of aerosols | Gloves, Fluid repellent long sleeved gown, Eye protection, FFP 3 Mask |

**Doffing**

1. Remove gloves first (ensure it does not cause contamination of hands). Gloves can be removed using the glove in glove technique or the bird beak technique.
2. Next the gown is removed ensuring that the exterior of the gown does not come in contact with the health care personnel. This can be ensured by rolling the gown as it is being removed.
3. Perform hand hygiene
4. Remove face shield or visor
5. Remove face mask at last
6. Perform hand hygiene again ([CDC, 2020b](https://www.cdc.gov))

Figure 1 shows the ([Beak Method, 2015](https://beakmethod.com)) for glove removal. The glove in glove method ([Shale and The Hand Protection Blog, 2015](https://shale-handprotectionblog.com)) of removal is shown in Figure 2.

The method of gown removal should be such that the exposed part of the gown does not touch the healthcare workers clothing ([CDC, 2020a](https://www.cdc.gov)) (Department of Health & Human Services, USA and Centres for Disease Control & Prevention, 2020). This is shown in Figure 3.

**Important considerations**

PPE is only a part of the system employed to prevent cross infection. Equal importance must be given to taking general measures to avoid infection like,

1. Avoidance of unnecessary contact with visitors or relatives of patients who might have been exposed to COVID
2. Proper hand washing and personal hygiene
3. Maintaining proper isolation within the hospital
4. Cleaning regimens for surface disinfection at least twice a day
5. Proper communication of health information via posters and so on
6. Appropriate waste management

**PPE misuse and overuse**

PPE is expensive and limited stocks are available in India. Thus, judicious use of PPE is very essential as the battle against COVID is a long one.

**Reusing of PPE**

Reusing of PPE after decontamination should only be practiced in case of shortage. FFR masks are not authorized for reuse after decontamination due to factors like improper fit later, reduced filtration efficiency and so on.

Methods that can be used for decontamination include,

1. Ultraviolet Germicidal Irradiation (UVGI)
2. Microwave generated steam
3. Liquid Hydrogen Peroxide
4. Vaporous Hydrogen Peroxide (VHP)
5. Ethylene Oxide (ETO)
6. Moist Heat

**Appropriate allocation of resources**

An inventory of PPE should be maintained, and calculated usage should be permitted. The burn rate of PPE should be calculated, and further orders should be placed accordingly.
CONCLUSIONS

The COVID pandemic has presented with unprecedented challenges regarding containment of communicable diseases making standard protocols and guidelines very essential. Proper care in handling of cases and measures taken for self-protection can halt the propagation of this disease. Proper equipment and facilities are undoubtedly importance but what is equally important is the judicious use of resources, strict adherence to protocols and enforcement of guidelines provided by reliable sources. Overuse of resources is also a form of misuse is what must be understood and therefore policy decisions must be made about when and how the protection equipment should be used.

In developing countries especially where there is a shortage of resources, decontamination and reuse of PPE may be done using standardized protocols and procedures of decontamination. This may make the financial challenge of tackling this crisis seem less challenging. Proper communication of the guidelines and protocols is also of immense importance. Schematic diagrams, images, posters and other means of communication should be used at various points in the facility to ensure compliance.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

Funding Support

The authors declare that they have no funding support for this study.

REFERENCES

Beak Method 2015. Glove Removal Technique. [Accessed On January 1, 2015]. Emory Research Administration News.

CDC 2020a. Department of Health & Human Services, USA and Centres for Disease Control & Prevention, 2020. Auckland Regional Public Health Service.

CDC 2020b. Use Personal Protective Equipment (PPE) When Caring for Patients with Confirmed or Suspected COVID-19. Centers for Disease Control and Prevention.

Cook, T. 2020. Personal protective equipment during the coronavirus disease (COVID) 2019 pandemic - A narrative review. Association of Anaesthetists, 75(7):920–927.

Gawn, J. 2008. Evaluating the protection afforded by surgical masks against influenza bioaerosols. Health and Safety Executive.

Shale, S., The Hand Protection Blog 2015. How to Safely Remove Disposable Gloves. [Accessed on 29 July 15]. Globus Group.

WHO 2014. Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care, Geneva. World Health Organization.

WHO 2020a. Modes of transmission of virus causing COVID-19: implications for IPC precaution. World Health Organization.

WHO 2020b. Personal protective equipment for COVID-19. World Health Organization.