

# Adverse effects due to use of personal protective equipment (PPE) in health care workers in COVID-19.

Pratibha Dawande\*

Department of Pathology Datta Meghe Medical College, Shalinitai Meghe Hospital and Research centre, Nagpur, India

## Abstract

**In December 2019, a new coronavirus was found in Wuhan, China which spread rapidly across other countries including India. It is an highly infectious disease which was labelled as pandemic on 11th March 2020. And to cope up with this pandemic, the first line workers i.e. the health care workers were volunteered to work for the same. Due to the high infectivity of SARS CoV-2, and the close contact of the health care workers with the patients, the health care workers (HCW) needed to do frequent hand wash and wear personal protective equipment (PPE) in the form of triple layered masks, hand gloves, gowns, goggles, face shields, shoes and etc to protect them from infection while treating the patients and thus securing a safe working condition for better management of the outbreak. But the use of the PPE kits for a long duration of time was not that easy and lead to some psychological and physiological effects including respiratory problems and in many cases skin related issues ranging from mild to severe. The skin related issues included side effects like dryness, itching which most commonly were found, besides this pain, redness, ulcers, acne in concordance with several adverse skin reactions were also present. The main affected sites include nose, cheeks, chin, hand, trunk and in very few instances axilla and groin. In this review article we will mainly discuss about the skin related reactions and adverse effects seen in Health Care workers (HCW) by the use of PPE kits during the pandemic.**

**Keywords:** COVID-19, PPE (Personal protective equipment), Mask, Gloves, Adverse skin reactions, HCW (Healthcare worker).

## Introduction

Right from the beginning of this century, numerous serious losses to the society has brought due to the outbreak of coronavirus, out of which the most serious is the severe acute respiratory syndrome coronavirus (SARS). In December 2019, a new coronavirus was found in Wuhan, China, in December 2019 [1]. Attracting global attention which started spreading across other countries including India. (1) According to the available data the transmission speed of COVID-19 is significantly higher than SARS [1] but ability of the virus to cause disease i.e. pathogenicity is comparatively weaker when compared with SARS. Therefore large number of people is affected (2). To fight against the COVID-19 and control this epidemic the government of India have taken certain measures such as social distancing, wearing of mask, no social gathering, lockdown, restriction to travel in the area where number of cases are high and strict quarantine policy. Due to high transmission of COVID-19 and uncertainty of patient regarding COVID-19 status, the Health care worker including doctors, nurses, ward attendant and others are at risk of transmission because of which the health care worker are provided with personal protective kit which includes N95

mask, gloves, personal protective equipment (PPE) which are being worn for hours (3). However the use personal protective kit has resulted in adverse skin reactions such as itching, rash, dryness, erythema, pustules, pigmentation, wheals, pressure related symptoms, allergic skin reactions etc. (4). At present there is limited data on various skin reaction associated with use of personal protective equipment, so the aim of this study is to determine and collect the data regarding skin reactions in health care worker using mask, gloves, PPE for longer duration. By combining this result we can identify the prevalence and various characteristics of adverse skin reactions in the health care worker. Also the result of the study will guide us to determine whether the long term use of mask, gloves, personal protective equipment, hand sanitizer and frequent hand washing poses any remarkable occupational health risk and suggestions for the possible solution.

The coronavirus outbreak during December 2019 has brought some serious losses to the society due to its highly infectious nature. It has caused a severe strain on the health care system as well as health care worker to ensure their safety while treating the infected person. To fight against and control this epidemic the government of India have taken certain measures

\*Correspondence to: Pratibha Dawande, Department of Pathology Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Nagpur, India, E-mail: dpratibha99@gmail.com

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such as social distancing, no social gathering, lockdown and strict quarantine policy and beside this PPE for health care workers including doctors, nurses and ward attendants and other at risk of transmission.

### Mode of transmission

Coronavirus is transmitted from person to person through the direct transmission, contact transmission and aerosol transmission via aerosol. The virus can spread by any infected individual either symptomatic or asymptomatic however it has found that, symptomatic individuals are more commonly associated with the spread of the infection when compared to the asymptomatic individuals, since coughing and sneezing releases number of droplets which when come in contact with the nasal or oral mucous of any healthy individual can lead to infection. Also severe patients show a high viral load for long duration of time and hence are more likely to spread the disease. Since the health care workers remains in close contact with the patients, they are at higher risk of accruing the infection when compared with the general population. Due to highly infectious droplets nuclei and bodily fluid in the working environment they need to ensure definite measures for their safety like use of PPE and frequent hand washing.

### Personal protective equipment (PPE)

PPE denotes personal protective equipment used to decrease the risk of accidental injuries and occupation associated hazards by protecting against various factors like physical, chemical and biological in the working environment. The PPE consist of mask, gloves, gown, goggles face shield, shoes and head covers which when worn properly acts as a barrier and prevents the spread of the infection. The mask can cover the whole nose and mouth of the patient and can effectively prevent the transmission of the infection via the respiratory route. Similarly gloves, gown, shoes, head covers when used properly can prevent the direct contact of the infected person and the wearer, thus preventing the transmission of infection. However the long duration of the work and daily use of PPE by the health care workers has lead to some serious physiological and psychological effects, like headache, adverse skin reactions, dizziness, pressure related symptoms, reduced cognition, etc. the most common being the cutaneous manifestation.

### Risk factors and skin reactions

As per various researches the most common risk factor associated with use of PPE is wearing a PPE for long duration of time. Other risk factors identified were non- use of moisturize, previous history of dermatitis, use of N- 95 rather than surgical mask. The common adverse skin reaction overall includes itching, dryness, allergic dermatitis, redness

and facial pain. And the most commonly affected areas due to use of PPE is nose, cheeks, chin, hands, trunk and less commonly groin and axilla. These adverse skin reactions should be recognized early and minimized to reduce the stress and provide a better working environment to the health care workers (Table 1).

### Masks

The major transmission route for COVID-19 is via the respiratory droplets and aerosols, the respiratory tract infections can be prevented by the use of mask. Mask when worn properly can effectively cover the nose and mouth of the wearer and can stop the transmission of virus [2]. It acts as barrier between the infected and healthy individual preventing contact of the virus against the nasal and oral mucosa of the wearer thereby preventing the infection. Adverse reactions following use of the mask depends upon its type, composition and the duration for which it is worn along with underlying skin conditions. Different types of face mask are available like surgical mask, cloth mask, N- 95, surgical mask which are covered by a piece of cloth [3]. Both the surgical mask and N-85 was associated with skin reaction when used for a long duration of time however because of their efficacy were highly used. The National Institute of Occupational Safety and Health recommends using the mask that meets its certification. "N" refers to the National Institute of Occupational Safety and Health, and "95" denotes its filtering efficiency that is it can effectively block 95% of the particles less than 300 nm. N-95 mask are used to prevent the spread of disease like tuberculosis, chicken pox, SARS, and measles [4]. The size of SARS-CoV-2 is between 80 and 120 nm, but it comes out as a large droplets when excreted from the infected as it is wrapped in the saliva.

The particles  $\geq 300$  nm in size, can be effectively filtered out by the use of N-95 mask, hence it can easily block the transmission of the SARS-CoV-2 [5]. HCWs remains in contact with the patients for a longer duration and therefore they have to wear the masks for a long duration of time because of the highly infectious nature of COVID-19. It is essential to determine various skin reactions using the N95 mask. Number of researches conducted across, have potential explored various adverse reactions to the HCWs wearing N95 mask. The common skin reaction associated prolonged use of were facial itching, scarring, dry skin, papules, pigmentation and rashes particularly along the area of contact [6]. Because the health care workers were at high risk of acquiring the infection due to high exposure they have to observe adequate personal protection, because of which to ensure the tightness of mask they wear the mask tightly and squeeze the metal clip hard, following which the scar develops on the bridge of nose, due to the hardness of the metal clip and the excessive pressure

Table 1. Side effects associated with different equipment.

SR.NO.	PROTECTIVE EQUIPMENT	ADVERSE SKIN REACTIONS
1	Mask	Dryness, erythema, rashes, acne
2	Gloves	Dry skin , itching, rashes
3	Gown, goggles, face sheild	Skin tear, pressure related skin changes, moist related skin disease
4	Hand washing	Dry skin, rashes

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applied to ensure tightness. Rashes particularly located behind the ears and on the cheek occur due to skin breakdown by the ear straps and the edges of the mask. Wearing a mask for a long duration of time in such a humid climate along with sweating is one the cause of itching; it may also result from irritating contact dermatitis occurring due to allergy to the mask material. The rise in temperature also makes the condition favorable for the growth of propionic bacterium acne and thus leads to development of acne, irritation while wearing a face mask which increases the risk of pilosebaceous gland occlusion [3]. The rise of temperature may probably be due to sealing effect of mask and increasing exposure to one's own hot breath. This skin reactions can be limited by pinching the metal clip gently at the bridge of the nose and achieving moderate tightness of the mask, adding a surgical mask or cloth mask lining inside of the N-95 also help to prevent the adverse skin reactions, using mask of a different material in case of allergic contact dermatitis. The acne can be avoided by washing the face with non- comedogenic cleanser.

### **Gloves and hand washing**

It has been documented that close contact with the infected person or object is also a risk factor of acquiring infection since the infected hands when touched to the face may transfer the virus directly to the respiratory tract. Therefore hand protection is also very important to prevent the infection [7]. For this the health care workers should use the gloves and frequently sanitize or wash their hands to prevent the infection. The most commonly used gloves are latex gloves. As per various researches the different skin reactions associated with the use of latex gloves are dry skin, itching and rashes. Potentially there may be three reasons for this: One is hypersensitivity reaction to latex which is immunoglobulin E-mediated [8]. The second is allergy to latex [9] and the third may be due to incompletely drying the hands after repeated hand washing with soap and detergent leading to irritant contact dermatitis [10]. The absorption of air inside the gloves is affected resulting in irritation. A dry powered gloves consist of talcum powder inside therefore it is essential that one should completely dry the hand and rinse off the soap or detergent before wearing gloves. Also there should not be excessive talcum powder inside the gloves which would further stimulate irritation. Beside this a plastic glove can be worn inside the latex glove, this will prevent the occurrence of dermatitis. Continuous exposure of the allergen may worsen the condition and may lead to inappropriate wear of the equipment which will significantly increase the chances of acquiring COVID-19. If the condition still does not resolve latex allergy testing should be done and latex gloves should be avoided [11]. Beside this repeated hand washing with soap, detergent or antiseptic material may affect the structural integrity of the skin destroying the lipid barrier in the stratum corneum, which allows entry of irritant and allergen in the epidermis increasing the risk of irritant and allergic hand dermatitis. The use of moisturizer should be appreciated particularly after washing the hands to prevent dry skin and eczematous changes.

### **Surface disinfectant**

Due to risk of transmission of COVID-19 indirectly from the infected surface, the surfaces are frequently disinfected. The repeated use of chemical disinfectant may cause damage to the skin leading to dermatitis. Therefore adequate measures like use of the gloves while dealing with chemical should be taken into consideration.

### **Gowns, Face shields and goggles**

Also the HCW should use the protective equipment in the form of gown, face shield, goggles, and shoes for their safety to avoid direct contact with the infected person. However this is also associated with certain adverse reactions. According to a Multicentric Chinese study conducted during COVID-19 pandemic approximately 42% of the medical staff suffers from the three major skin injuries:

Device related pressure ulcer

Moist associated skin disease and

Skin tears. Pressure related skin reactions presents as pain.

This occurs through a series of steps which initially involves damage to the tissues following which inflammation and ischemia eventually leading death of the tissue. Therefore the pain should be interpreted as the first sign of tissue damage and prompt measures like removing the protective tools and application of the facial dressing to prevent severe complication should be taken into consideration. Gowns also act as a barrier for the health care workers and protects against the disease. However the long term use if this led to development of irritant contact dermatitis particularly in area like axilla, below the breast, groin region and skin folds. Because of the close proximity and strict adherence of the protective equipment against the skin and also the Protective clothing being muggy and the need of it to wear for a long period of time leads to increase in friction, warmth and moisture would have triggered this side effects. Face shield and goggle involves the nasal bridge, ears and per orbital region and use for a long duration of time may lead to pressure injuries and erosion of skin in the forehead, zygoma and nasal bridge. Along with this the use of goggles often led to restricted vision due to fogging of the goggles, probably because of the hot breath of the wearer. In addition to this, certain health care workers also suffered due to the inappropriate size of the PPE. Excessively long PPE hindered the workers from performing the procedures with ease and also led to difficulty in walking hence overall reducing the productivity of the work, also the excess of material while performing activities drag here and there and increases the risk of contamination [12-18]. Therefore the PPE should be of adequate size.

The long duration of wearing PPE combined with humid climate leads to profuse sweating which was associated with giddiness, headache, restlessness which ultimately reduces the efficacy of the work. The overall most common reason associated with all the physical and psychological manifestation was the long duration of use of the PPE by the health care workers, therefore frequent replacement of protective clothing, reducing the duration and adding a

thin dressing as a barrier between facial PPE and skin may reduce the damage to the skin and can effectively decrease the incidence of the above symptoms.

### Conclusion

The rapid spread of COVID-19 due to its highly infectious nature has a severe strain on health care workers because of their close contact with the patients and thus has given paramount importance to use of the personal protective equipment to ensure the safety from the infection. However the long term use of PPE is associated with certain side effects ranging from mild to moderate grade including dryness, itching, allergic dermatitis, contact dermatitis, nasal bridge scarring and pressure related symptoms. And the prevention of the same can be achieved by reducing the wearing time and avoiding overtime, applying thin dressing between skin and PPE, use of moisturizer in itching, in cases of allergy a substitute material can be worn and thus minimizing the adverse effects and ensuring the secure working condition for HCWs, leading to better management of the outbreak.

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