

Optimal Personal Protective Equipment Use in Healthcare Workers during Corona Virus Disease (COVID-19) Outbreak

Corona Virüsü Hastalığı (COVID-19) Salgını Sırasında Sağlık Çalışanlarında Optimal Kişisel Koruyucu Donanım Kullanımı

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ABSTRACT

COVID-19 infection is mainly spread by droplets and contact routes. In aerosol generating processes such as intubation and mask ventilation, the contamination risk of COVID-19 is greatly increased. It is important to use PPE during hospital care or outpatient services in the COVID-19 pandemic. Due to its frequent and necessary use during pandemic, PPE deficiency is an important problem worldwide. To prevent this problem, current information about optimal PPE use in hospitals has been evaluated. In this review, the correct use of PPE and reuse conditions of the same PPE are discussed. In addition, about the requirements and conditions of use of PPE health practices in Turkey were compiled.

Key Words: Occupational health, personal protective equipment, healthcare workers, COVID-19 pandemic

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ÖZET

COVID-19 enfeksiyonu ağırlıklı olarak damlacık ve temas yollarıyla yayılır. Entübasyon ve maske ventilasyon gibi aerosol üreten işlemler ise hastadan sağlık çalışanına enfeksiyon bulaşma riski çok artmıştır. COVID-19 pandemisinde hastanede bakım işlemleri veya poliklinik hizmetleri sırasında KKD kullanmak önemlidir. Pandemi nedeniyle yoğun ve sık kullanılması nedeniyle KKD yetersizliği tüm dünyada önemli bir sorundur. Bu sorunun önüne geçebilmek hastanelerde optimal KKD kullanımı hakkında güncel bilgiler incelenmiştir. Bu derlemede KKD doğru kullanımı ve aynı KKD tekrar kullanım koşulları ele alınmıştır. Buna ek olarak, KKD kullanımının gereklilikleri ve koşulları hakkında Türkiye’de yapılan sağlık uygulamaları derlenmiştir.

Anahtar Sözcükler: İş sağlığı, kişisel koruyucu donanım, sağlık çalışanları, COVID-19 salgını

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INTRODUCTION

The highest viral load in COVID-19 infection is in sputum and upper respiratory tract secretions. Although viremia has occurred, blood-borne transmission has not been detected (1). The virus spreads predominantly through droplets and contact routes (2). The droplet size is generally over 5 µm and cannot be moved more than 1 meter since it is subject to gravity. In contact transmission, the virus is on a surface and is a potential source of infection for hours or even days (3). Airborne contamination, smaller breathing particles (usually <5µm) occur for long periods of air circulation. Viral particles are absorbed through the respiratory mucosa and potentially along the conjunctiva. Particles smaller than 10 µm are likely to penetrate deep into the lung and cause infection (4). Certain procedures can create virus-containing aerosols that remain in the air and thus carry the risk of transmission at distances above 2 m. Major aerosol generation procedures; Tracheal intubation, extubation and related procedures; Non-invasive ventilation; Tracheostomy; Face mask ventilation; Open tracheal aspiration; Bronchoscopy and bronchoalveolar lavage; Sputum induction; High flow nasal oxygen; Certain dental procedures; Nasogastric tube placement; Chest compressions and / or cardiopulmonary resuscitation can be ordered. It is recommended to use special personal protective equipment (PPE) to prevent airborne contamination during these processes (5). Procedures that produce aerosol increase the risk of healthcare workers infection and should only be done when necessary. Wherever possible, aerosol generating procedures should be performed in a well-ventilated single negative chamber with closed doors.

Aerosol Generating Processes

Intubation and mask ventilation are seen as the highest risk procedures (6). PPE that prevents airborne contamination is recommended for all personnel in the room during airway management (2). High levels of nasal oxygen can prevent or delay tracheal intubation in patients with COVID-19, but there is no consensus on whether it reliably reduces mortality in acute respiratory failure (7). When high-flow nasal oxygen is used, PPE is currently recommended for airborne contamination. Low flow nasal oxygen (ie <5 l.min⁻¹ through normal nasal cannula) is at lower risk and is not considered an aerosol generating procedure (2).

Personal Protective Equipment in Healthcare Professionals**1) Eye Protectors****Goggles**

The glasses provide barrier protection for the eyes. It should sit tightly on and around the eyes or personal prescription lenses, indirectly ventilated (to prevent penetration of splashes or sprays), and have an anti-fog coating to maintain clarity of vision. The lens is made of plastic, usually polycarbonate, and has an adjustable elastic strap to ensure a perfect fit around the eyes. Glasses used for healthcare applications can often be reused (8).

Face Shield

It provides barrier protection to the face area and related mucous membranes (eyes, nose, lips) and is considered an alternative to glasses. Face shield should be used if the aerosol generating procedure is followed. The face shield should cover the forehead, lie under the chin and cover the edge of the face. Both disposable and reusable options are available (8).

2) Medical masks / Filtered Masks

Liquid-resistant (Type-IIR) surgical face masks are used to protect against droplets. If worn by the patient, it will minimize disintegration of large respiratory droplets that will protect staff from both droplet and contact contamination (9). If the surgical mask is worn by the healthcare professional, it protects against droplet transmission when the patient is within 1-2 m. The risk is estimated to decrease by at least 80% (5).

The terms FFP2, FFP3 and N95 are used for high-performance filtering masks. The filtration is carried out by a combination of a polypropylene micronet and electrostatic charge.

According to the European standard EN 149 + A1: 2009, there are three classes of protection, each with a protection factor that indicates how much the mask will reduce the concentration of the hazardous substance. Accordingly, FFP1 protects 4 times, FFP2 protects 10 times and FFP3 20 times (10).

The definition of N95 means that under test conditions (National Institute of Occupational Health and Safety), the respirator blocks at least 95% of solid and liquid aerosol test particles (11). FFP2 / 3 and N95 masks should be checked before each use.

There is insufficient evidence to consider home-made masks or cloth masks in health and care settings (8).

3) Aprons and overalls

Liquid-resistant hospital gowns or overalls are indicated for the care of patients in high-risk areas where aerosol-producing procedures are applied. If the apron or coverall is visibly dirty, it should be disposed of as an infectious waste. Protective gowns are indicated for use when aprons are not liquid resistant (8).

4) Gloves

These gloves are available from a variety of materials, are disposable and must be discarded after each use. Powder-free, nitrile gloves are the most recommended for healthcare. It is not recommended to use double gloves for the care of suspected or approved COVID-19 patients. Re-use examination gloves for clinical care should be avoided (8).

Efficient Use of Personal Protective Equipment (PPE) and Alternative Methods**a) Eye Protectors**

Long-term use of eye protection is to wear the same eye protection without changing between patient encounters for repeated close contact encounters with several different patients. Long-term eye protection can be applied to disposable and reusable devices (12).

Risks that may occur in long-term use

- Using the glasses for a long time may increase the discomfort and fatigue of healthcare professionals.
- With prolonged use of glasses, skin tissue damage may occur on the face.

Glasses replacement criteria and precautions

- If the glasses are contaminated with a chemical splash, infectious substance, or bodily fluids,
- If the glasses hinder the safety of healthcare workers or the visibility of the healthcare environment, or if they are loose,
- The use of the same glasses between a patient with COVID-19 and a non-COVID-19 patient by a healthcare professional is not recommended due to the risk of contamination with another patient who is sensitive to COVID-19 (13).

Reuse

- Clean the glasses with soap / detergent and water, then disinfect using 0.1% sodium hypochlorite (then rinse with clean water) or clean with 70% alcohol wipes.
- The glasses can be cleaned immediately after removal and hand hygiene is performed. It is then placed in a closed container designated for cleaning and disinfection.
- Make sure the surfaces are clean by disinfecting the surface before cleaning the glasses.
- The appropriate contact time with the disinfectant (eg 10 minutes when using 0.1% sodium hypochlorite) must be observed before the glasses are reused. After cleaning and disinfection, it should be stored in a clean area to prevent re-contamination (13).

b) Medical Masks

According to the definition of Centers for Disease Control and Prevention (CDC), long-term use of face masks means continuing to work with the same mask without changing the face mask between new patient contacts for repeated close contact encounters with several different patients. Healthcare professionals should be careful not to touch face masks. If the person touches or adjusts the face masks, they should immediately provide hand hygiene (14).

According to the World Health Organization (WHO), long-term use of medical masks is defined as use without removing up to 6 hours when looking at cases diagnosed with COVID-19.

Risks that may occur in long-term use

- Prolonged use of the medical mask may increase the risk of contamination with the COVID-19 virus and other pathogens.
- Wearing the mask for a long time may increase the risk of the healthcare professional touching the mask; If the mask is touched / adjusted, hand hygiene should be performed immediately.
- With prolonged use of medical masks, damage or reactions to facial skin tissue may occur.
- The medical mask's filtration task may be reduced, thereby increasing the risk of breathing resistance and breathing unfiltered ambient air from the sides of the medical mask (13).

Medical mask replacement criteria and precautions

- If the mask gets wet, dirty or damaged, or breathing becomes difficult,
- If the mask is exposed to chemicals, infectious substances, or human body secretions,
- If the mask is removed from the face for any reason,
- If the front is touched to adjust the mask,
- Follow the safe procedure to remove the mask and do not touch the front of the mask,

Reuse

To date, no evidence of medical mask reuse is available and is not recommended.

Alternative products in the absence of a medical mask

- FFP1 filter face mask
 - Face shield with suitable design to cover the sides of the face and under the chin,
- These alternatives should only be used in critical emergencies of medical mask deficiency (13).

c) Filtered Face Masks (FFP2, FFP3 or N95)

Long-term use refers to the practice of wearing the same N95 mask without removing the mask between patient encounters for repetitive close contact encounters with several different patients. Long-term use is suitable for situations where multiple patients with the same infectious disease are diagnosed (for example, patients treated in the same hospital unit). When long term use of N95 filter mask is applied, the maximum recommended long term use is 8-12 hours. Filtered face masks should not be worn for multiple work shifts and should not be reused after prolonged use. N95 masks should be removed before activities such as food and toilet breaks (15).

Risks that may occur in long-term use

- Prolonged use of filter masks may increase the risk of contamination with the COVID-19 virus and other pathogens. If the filter masks are touched / adjusted, hand hygiene should be performed immediately.
- Facial dermatitis, respirator-induced acne, respiratory fatigue, impaired working capacity, increased oxygen demand, premature exhaustion at lighter workloads, high CO₂ levels, increased nasal resistance and filter mask adjustments, mask or face touches, under-mask touches and eye touches has been reported after prolonged use of the filter mask.
- Prolonged use can clog the filtration media, which can lead to increased respiratory resistance.

Filtered mask replacement criteria and precautions

- If it gets wet, dirty, damaged, or difficult to breathe,
- If it is exposed to chemical splashes, infectious substances or human body fluids,
- If it is removed from the face for any reason,
- If the front of the mask is touched,
- Follow the safe procedure to remove it and the front of the filter mask should not be touched (13).

Reuse

Reprocessing methods have not been validated by substantial research, and there is currently no standard method or protocol to ensure the effectiveness or integrity of filter masks after reprocessing. However, hydrogen peroxide vapor (16), ethylene oxide (17), UV radiation lamp (17) are some of the methods.

d) Overalls / Aprons

Long-term use of isolation gowns (disposable or fabric) can be expressed as the same healthcare worker to wear when interacting with more than one patient known to be infected with the same infectious disease (18).

Risks that may occur in long-term use

- Prolonged use of aprons can increase the risk of contamination with the COVID-19 virus.
- Prolonged use of aprons can increase the risk of other pathogens being transmitted between patients.

Overalls / apron replacement criteria and precautions

- If the apron gets wet, dirty or damaged,
- If the apron is exposed to splashes of chemicals, infectious substances or human body fluids,
- When performing patient care outside the COVID-19 patient group,
- The safe procedure should be followed to remove the aprons to prevent contamination of the environment.
- The use of the same apron by a healthcare worker between a patient with COVID-19 and a patient who is not COVID-19 is not recommended due to the risk of contamination with another patient who may be sensitive to COVID-19 (13).

Reuse

- Decontamination of a cotton garment is carried out by washing and disinfection methods.
- Cotton aprons should be washed. (Washing in the washing machine (60-90 ° C) and laundry detergent is recommended.)

Alternative products in the absence of overalls / aprons

Disposable lab coats: It should not be used for prolonged contact or when performing aerosol generating procedures and supportive treatments.
 Disposable waterproof plastic aprons: It should not be used during aerosol generating procedures and supportive treatments.
 Reusable (washable) patient gowns, reusable (washable) lab gowns (13).
 On April 13, 2020, last guideline for use of PPE in healthcare settings was published by the Republic of Turkey Ministry of Health (Table 1).

CONCLUSION

There is evidence that PPE use reduces disease transmission rates and protects staff. It is important for staff to understand the purpose of PPE and its role as part of a system to reduce disease transmission from patients to staff and other patients. It is equally important that healthcare providers use it appropriately to maintain limited stocks to ensure adequate supply for the required use throughout the outbreak.

Table 1: Protective Equipment Recommended For Use by Healthcare Staff and Type of Activity (19)

Location	Target Personnel / Patient	Activity	PPE/Process type
Healthcare Settings with inpatient Clinics			
Patient Room	Healthcare personnel	Direct care to the patient	Medical mask Overall/Apron Gloves Goggles/Face shield
		Droplet core: aerosol-generating processes	N95/FFP2 mask Overall/Apron Gloves Goggles/Face shield
	Cleaning staff	When entering the patient room	Medical mask Overall/Apron Gloves Goggles/Face shield (if there is a risk of organic material or chemical splashes)
All other areas with patient passage (clinics, corridors etc.) Triage	All staff, including medical staff	All activities that will not contact the patient	Medical mask
	Healthcare personnel	Preliminary assessment without direct contact with the patient	It should be done in a way to provide at least 1 meter distance. Medical mask Goggles/Face shield
	Patients with / without respiratory symptoms	In every situation	At least 1 meter distance should be provided. Medical mask should be provided if the patient can tolerate.
	Security/secretary/ administrative staff	In every situation	At least 1 meter distance should be provided. Medical mask
Laboratory	Lab technician	While examining respiratory samples	N95 / FFP2 mask Apron Glove Glasses / Face shield
Office	All staff, including medical staff	All administrative tasks that do not require contact with patients	Social distance Medical mask
Healthcare Settings with outpatient Clinics			
Outpatient clinic	Healthcare personnel	During the examination of the patient with respiratory symptoms	Medical mask Apron Glove Glasses / Face shield
	Healthcare personnel	During the examination of patients without respiratory symptoms	Standard measures and medical mask, other PPE according to risk assessment
	Patients with / without respiratory symptoms	In every situation	Medical mask should be provided if the patient can tolerate
	Cleaning staff	Cleaning of rooms where patients with respiratory symptoms are evaluated	Medical mask Apron Work gloves Glasses / Face shield (if there is a risk of organic material or chemical splashes) Boots or work shoes
Waiting area	patients with respiratory symptoms	In every situation	The patient should wear a medical mask. The patient should be taken to the isolation room or a separate area from other people as soon as possible. If this is not possible, it should be kept at least 1 meter distance from other patients.
	patients without respiratory symptoms	In every situation	Medical mask
Administrative Offices	All staff, including medical staff	Administrative duties	Social distance Medical mask
Triage	Healthcare personnel	Preliminary assessment without direct contact with the patient	It should be done in a way to provide at least 1 meter distance. Medical mask Glasses / Face shield
	Patients with / without respiratory symptoms	In every situation	At least 1 meter distance should be provided with the patient. The patient should wear a medical mask.

Conflict of interest

No conflict of interest was declared by the authors.

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