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Strategy of using personal protective equipment during aerosol generating medical procedures with COVID-19



The primary route for transmission of COVID-19 is via aerosolized droplets. Aerosol generating medical procedures (AGMPs) mainly include nebulizer treatment, bronchoscopy, non-invasive ventilation, tracheal intubation, and tracheostomy [1]. Standard eye protection, gown, and gloves are straightforward. Against respiratory transmission, recommendations for personal protective equipment (PPE) for health care workers (HCWs) are controversial. As such, the strategy of using PPE During AGMPs for COVID-19 Patients was discussed in this letter. (Table 1).

Between N95 respirators and surgical masks in protection against laboratory-confirmed respiratory infection and influenza-like illness, there was insufficient evidence to determine a clinically significant difference showed by meta-analysis [3]. The N95 respirator is certified by National Institute for Occupational Safety and Health (NIOSH) to block at least 95% of 300-nm particles. Particles of 30 to 100 nm readily penetrate N95, while surgical masks admit 300-nm particles and do not provide substantial protection from aerosols of 500 nm [2]. Under laboratory condition, N95 respirators exhibit less filter penetration, less face-seal leakage, and less total inward leakage in comparison to surgical masks [3]. The spread of acute respiratory infections is a complicated process. Considering the low nosocomial infection rate of common influenza, larger and longer clinical trials are required to determine the clinical difference. For a sudden and severe pandemic like SARS or COVID-19, it is necessary to take into consideration all the existing clinical/non-clinical evidence, as the safety of HCWs is a critical factor in combatting an epidemic. Therefore, surgical masks for routine care, and N95 respirator for AGMPs maybe a cost-effective and appropriate choice.

Re-use of N95 respirators has been heatedly discussed. Hot air, boiling water, or steam sterilizations are proposed to provide satisfactory disinfection and preserved filtration performance, but better studies are needed to prove the safety and effectiveness. Physically, wearing a one-time-use surgical mask outside the N95 respirator, as a

liquid barrier from the contamination of large droplets, may help keep the respirator relatively clean for reuse.

Reusable facial protective equipment, such as elastomer half-face respirators (EHFRs) and powered air-purifying respirators (PAPRs), is another desirable choice. EHFRs and PAPRs are not as satisfactory as N95 respirators in comfort and ease of verbal communication. EHFRs are not routinely used in hospitals, but they have the same assigned protection factor (APF) as N95 respirators and they are suitable replacements when N95 respirators are in short supply. In addition to a higher level of APF, PAPR provides a full coverage protection of the head and neck. For medical staff familiar with the use of PAPR during SARS, it was proved that PAPRs are more protective than N95 respirators and are recommended for high-risk AGMPs [4].

Covers for patients as the spreaders also help improve the protection efficiency. It is suggested patients wear surgical masks when being transferred or preparing for procedures. Furthermore, barrier enclosures with/without negative pressure were designed for patients undergoing AGMPs. The negative pressure isolation hood covers the patient's head and neck. There are two closed ports for the arms of HCWs to provide care. Laboratory simulations indicate effective confinement of aerosols to the hood. Such temporary barrier enclosures are relatively simple to set up and can add an additional line of defense, especially when PPEs for HCWs are simplified [5].

In conclusion, personnel education and experience play important roles in efficacy of PPEs. Equipment and protocols will surely evolve briskly in the current crisis.

Declaration of competing interest

To the best of our knowledge, the named authors have no conflict of interest, financial or otherwise.

Table 1

Health care workers and patients should be protected by PPE during AGMPs. N95, EHFR and PAPR could be reused after disinfection.

	Routine Care	Low Risk AGMPs [1]	High Risk AGMPs [1]	
		<ul style="list-style-type: none"> • Endotracheal aspiration, • Suction of body fluids, • Bronchoscopy, • Nebulizer treatment, • Manipulation of O2 mask or BiPAP mask, • CPR, • Insertion of nasogastric tube, • Collection of sputum 	<ul style="list-style-type: none"> • Non-invasive ventilation, • Tracheotomy, • Manual ventilation before intubation, • Especially tracheal intubation 	
HCWs	Mask [3]	N95 [3] EHFR [4] (APF ≈ N95) (When N95 respirator is in shortage)	N95 [3] EHFR [4] (APF ≈ N95) (When N95 respirator is in shortage) PAPR [4] (APF > N95) (More protective)	<div style="border: 1px solid black; padding: 5px; text-align: center;">Reusability</div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; padding: 5px; text-align: center;">✓</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">✓</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">✓</div> </div>
	Plus standard eye protection, gown and gloves			
Patients	Mask	Mask	Barrier Enclosures [5]	

PPE: personal protective equipment; HCW: health care worker; AGSP: aerosol-generating medical procedure; N95: N95 respirator; EHFR: elastomer half-face respirator; PAPR: powered air-purifying respirator; APF: assigned protection factor.

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