

COVID - 19 Challenges

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COVID-19: Masks in Intensive Care Units

With the number of COVID-19 cases increasing in the intensive care units, there is a high risk of infection for healthcare professionals. What kind of masks can be used and what are the most effective strategies to protect against airborne particles?

Currently, there is an increasing number of patients in the intensive care units (ICUs) due to COVID-19 all over the world (some more than others). Since there is a high risk of infection for healthcare professionals (HCP), it is necessary to pay attention to their protection, starting with masks. N95 filtering face piece respirators and surgical masks are commonly used to protect the human respiratory system against fine airborne particles (WHO 1999).

What is the Evidence Behind Masks?

Viral particles are one of the smallest known bioaerosol agents, with a diameter of 20 to 300nm, that can easily penetrate through the human respiratory system (Reponen et al. 2001). Small particles of < 5 µm and < 10 µm diameter readily penetrate until the alveolar space and below the glottis, respectively (Tellier 2019). Previous studies (Oberg et al. 2008; Lee et al. 2008) showed that particles of up to 3,1µm in diameter are not adequately filtered by surgical masks, what may include SARS-CoV-2, assuming that its size is similar to SARS-CoV

[0,08-0,14µm] (Ksiazek et al. 2003).

Surgical masks started to be used to prevent wound infection in the surgery room from staff-generated respiratory bacteria since the early 1900s (Lipp and

■ surgical masks as respiratory protection devices are not National Institute for Occupational Safety and Health certified ■

Edwards 2002; Belkin 1996). Its application has evolved into the prevention of employee exposures, including respiratory viral transmissions (Johnson et al. 2009). Nevertheless, there is an ongoing debate about the use of surgical masks as respiratory protection devices. They are not National Institute for Occupational Safety and Health (NIOSH) certified (Balazi et al. 2006), and it remains uncertain whether they can prevent the transmission of SARS-CoV-2 (Feng 2020; Oberg and Brosseau 2008).

On the other hand, the NIOSH lists nine categories of respirators (N95, N99, N100, P95, P99, P100, R95, R99, and R100). Among these, N95 respirators, with a filtration efficiency of at least 95% a particle size of 0.3 µm (NIOSH 1996), have been recommended by the Centers for Disease Control and Prevention (CDC) for HCP to protect them from infectious diseases potentially spread through the air.

In the ICU setting, we found only one study about COVID-19 related to masks, published the 16th of March: a case report of 41 health workers in contact with the same COVID-19 patient during at least 10 minutes, closer than 2 metres, performing an aerosol-generating procedure (AGP) (endotracheal intubation, extubation, noninvasive ventilation, and open circuit exposure) that used either a surgical mask or an N95 mask (respirator). After two weeks of isolation, they presented neither symptoms nor positive swabs (Ng et al. 2020).

Indeed, the panel of the Surviving Sepsis Campaign for COVID-19 (Alhazzani et al. 2020) makes recommendations and suggestions of whether to use surgical masks or respirators for AGP, non-AGP and for usual care for non-ventilated

COVID-19 patients, purely based on evidence extrapolated from other viruses to SARS-CoV-2. Besides, if we search for studies after the time point when the virus appeared (December 2019) we find not more than two studies, and unrelated to COVID-19 (Radonovich et al. 2019; Long et al. 2020).

Regarding cardiopulmonary resuscitation, as an AGP, all staff should wear airborne personal protective equipment (PPE) including an N95 mask or similar (according to local indications) before commencing chest compressions, and if available, an automated compressor device should be used to minimise required staff and exposure (Alhazzani et al. 2020; Edelson 2020).

What are Public Health Institutions' Position?

WHO (WHO 2020) states that HCP should:

- Wear a medical mask when entering a suspected or confirmed COVID-19 patient's room.
- Use a particulate respirator at least as protective as a US NIOSH N95, EU standard FFP2, or equivalent in settings where AGPs are performed.

CDC (Center for Diseases Control and Prevention 2020) states that HCP should:

- Wear a facemask at all times while they are in the healthcare facility.
- Put on an N95 respirator (or higher-level respirator) or facemask (if a respirator is not available) before entry into the patient room or care area.

Moreover, other institutions and organ-

isations recommend the respirators over surgical masks for protection, together with the rest of the PPE [cloth masks are not PPE (Center for Diseases Control and Prevention 2020)] and precaution in the performance of procedures to guarantee the staff safety (Matos et al. 2020; Nicola et al. 2020; Abi Saleh et al. 2020).

What About the Resources?

Low-middle income countries are also dealing with the pandemic, and there is a high concern in their ICUs about the staff protection and the limited resources they might face in this situation.

Supported by the Oxford University Press for the Infectious Diseases Society of America (IDSA), Bahl et al. write: "the ability of countries to respond effectively depends on the safety and confidence of the health workforce, especially in low-income countries with low ratios of HCWs [Health Care Workers] per head of population, and protective measures are crucial to ensure a functional health workforce" (Bahl et al. 2020).

This reasoning led to proposals of alternatives to overcome the scarcity of PPEs (Table 1) (Bong 2020).

Hitherto, the CDC states that standard respirators and facemasks should be removed and discarded after using them, and reusable respirators must be cleaned and disinfected according to manufacturer's reprocessing instructions prior to re-use. Meanwhile, other institutions are testing other decontamination procedures to allow the reuse of respirators (FDA 2020).

In brief, it is inevitable to pay attention to our world as a whole helping the less privileged to have fatal outcomes, and indeed prevention and protection might be the answer (Bong 2020).

Do we Need RCTs to Prove the use of Masks?

There is only a randomised controlled trial registered in ClinicalTrial.gov

Minimise contamination during AGP	Use transparent plastic drapes or clear box for bag and mask, intubation and extubation.
Use face-shields to prevent contamination of masks	Face-shields can be easily made from common inexpensive materials, including plastic bottles.
Creative solutions to make PPEs using everyday materials:	
• Masks	-In the absence of N95 masks, consider DIY options -Standard anaesthesia facemask or scuba diving masks with viral/bacterial filter
• Eye protection	- Any waterproof material that protects the front and side of the eyes will be adequate -Consider safety goggles obtained from hardware stores, swimming or diving goggles
• Protective gowns	-Any splash-proof or water-proof material will do -Consider plastic aprons, plastic bags, garbage bags, raincoats, ponchos.

Table 1. Alternatives to PPEs

(NCT04296643) in which nurses will be randomised to use either medical masks or N95 respirators when providing care to patients with COVID-19. This Canadian multi-centre randomised controlled trial will assess whether medical masks are non-inferior to N95 respirators when nurses provide care involving non-aerosol generating procedures.

Since this an important issue for health-care workers and patients, it is crucial to clearly understand the role of masks in the ICU. ■

Key Points

- It is necessary to pay attention to protection of health-care workers, including use of appropriate masks.
- N95 filtering face piece respirators and surgical masks are commonly used to protect the human respiratory system against fine airborne particles.
- Viral particles are one of the smallest known bio-aerosol agents, with a diameter of 20 to 300nm, that can easily penetrate through the human respiratory system.
- Particles of up to 3,1µm in diameter are not adequately filtered by surgical masks, what may include SARS-CoV-2, assuming that its size is similar to SARS-CoV.
- The WHO recommends medical masks when entering a COVID-19 patient's room and a particulate respirator when performing aerosol generating procedures.
- The CDC recommends wearing a facemask at all times while in a healthcare facility and an N95 respirator or higher before entry into a patient room or care area.

Abbreviations

AGP: Aerosol-generating procedure
 CDC: Centers for Disease Control and Prevention
 DIY: Do it Yourself
 EU: European Union
 FDA: Food and Drug Administration
 HCP: Healthcare professionals
 HCWs: Healthcare workers
 ICU: Intensive Care Unit
 IDSA: Infectious Diseases Society of America
 NIOSH: National Institute of Occupational Safety and Health
 PPE: Personal protective equipment
 RCT: Randomised Controlled Trial
 WHO: World Health Organization

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