

## Proposal for an Operator's Protection Devices in SARS-COV-2 Unconventional Settings

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### ABSTRACT

During epidemics, health services must respond quickly to a massive patient admission. Protection of health workers becomes a priority to ensure the adequate level of care but recent outbreaks of SARS-CoV-2 showed a worldwide difficult to manage this emergency based on supply of personal protective devices and equipment. A simple-to-assemble device consisting of a face mask and a breathing filter system is effective in preventing risk of biological contamination by healthcare workers. We are against its routine use in normal condition, but we suggest that this device can be used in limited-resource settings or even in the case of acute shortage of personal protective devices and equipment.

**Keywords:** Protective devices; Equipment; Pandemics; Breathing filter system

### DESCRIPTION

The recent outbreak of epidemic Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has been challenging for health care systems around the world [1]. The existing high risk of contagion among healthcare workers has prompted the World Health Organization to recommend using "A particulate respirator at least as protective as a US National Institute for Occupational Safety and Health (NIOSH)-certified N95, European Union (EU) standard FFP2, or equivalent, when performing aerosol generating procedures such as tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, and bronchoscopy" [2].

During this emergency, hospitals on the frontline have been faced with the rapid depletion of personal protective devices and equipment (PPE) and with an unacceptably high risk of infection among healthcare workers. In order to cope with an acute shortage of PPE, we propose the use of a simple and effective device which protects the operator from droplet and air contamination when performing high risk maneuvers on a patient's airway.

The device consists of a face mask equipped with a Breathing Filter System (BFS), assembled using common equipment we

routinely use in the operating theatre, intensive care unit or emergency department (Figure 1).



**Figure 1:** Example of proposed device consisting of a common face mask used in emergency departments and OR with a breathing filter system applied for mechanical ventilation.

BFS were introduced to prevent infections in intubated patients during mechanical ventilation [3] and they can be divided into two main categories: mechanical and electrostatic. Mechanical filters (e.g. HEPA, high efficiency particulate air filters) are made

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up of a hydrophobic membrane consisting of packed glass fibers which form a large pleated surface with small pores. Electrostatic filters consist of a flat membrane with large pores involving low-density electret fibers which exert a permanent electrostatic repulsion force. Both devices can also contain a filter joined by a Heat and Moisture Exchanger (HME) to retain a portion of the patient's exhaled heat and moisture in order to warm and humidify inspired gas [4].

Several scientific studies have shown mechanical filters to be more effective than electrostatic ones in preventing transmission of infectious diseases, especially those with a viral etiology [5-7] with Bacterial (BFE) and Viral Filtration Efficiency (VFE) >99.99% approximately [8] and at an average price of around £ 2 each [9].

The average duration of efficient filtration is around 24 hours, depending on manufacturing recommendations, but some evidence emphasizes their use for up to 72 hours [10]. It is advisable to test the tightness of the appropriate size mask on the operator's face before use, and then apply the filter at the air inlet. We proposed using mechanical or HEPA filters rather than electrostatic ones for the greater protection the former offer against viruses.

Then, elastic bands or strips could be used to keep the mask tight on the operator's face and ensure optimal adherence, thus avoiding air leaks. Limitations are related to the size and weight of this self-built device, with a significant risk of improper positioning and contamination, and impeding ability to get close to the patient's head during intubating maneuvers. In addition, healthcare workers could become fatigued with prolonged use due to the resistance to air flow. On the other hand, the filter does not hamper the line of vision and does not obstruct the view during endotracheal intubation or similar maneuvers.

Health worker's safety must always be guaranteed even in the event of an epidemic or catastrophe. In 2009, H1N1 influenza a pandemic led to a lack of supply of protective devices, masks and respirators in the U.S especially in the emergency setting [11]. Recently, SARS-COV-2 outbreaks proved that the national health services are unable to guarantee protective equipment to health personnel at a sustainable rate to deal with the emergency [12].

## CONCLUSION

The proposed device can ensure employee safety by means of equipment already available in the hospital setting with the additional advantage of a relatively low cost. We do not recommend their routine use because the traditional well-established and recommended PPE devices undoubtedly provide a greater level of safety and comfort which no device can replace.

Nevertheless we believe this unconventional filtering mask could be a resource of some value in specific and selected cases such as emergency airway maneuvers in limited-resource settings or even in the case of acute shortage of PPE.

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