Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Personal ventilation hood for protecting healthcare workers from aerosol-transmissible diseases

Introduction

The surge in numbers of critically ill patients with COVID-19 can occur rapidly and challenge the finite burden of healthcare systems, especially the capacity of intensive care unit (ICU). Airborne infection isolation rooms with negative pressure are not universally available, particularly in resource-constraint countries. Moreover, the safety of the ICU practitioners’ is compromised due to the shortage of personal protective equipment (PPE) and extensive environmental contamination. Although the current evidence points towards droplet precaution [1] rather than the airborne transmission of COVID-19, concerns of nosocomial transmission in shared rooms remain, mainly when aerosol-generating procedures are performed [2], such as intubation. Moreover, transferring patients out of the ICU for investigations poses a considerable risk in contaminating the patient and the physicians and hospital healthcare workers.

We examined the personal ventilation hood designed by Kai-Chen Tseng, places in a hospital bed as protective equipment to protect against exposure of aerosol-transmissible diseases. The device consists of a hospital bed ventilation hood and uses a suction pipe to connect the hood and a wall-mounted suction unit, allowing airflow (rate: 1 L/s; pressure: -25inHg) through the HEPA filter (Fig. 1).

We created two scenarios to experiment; an ultrasonic humidifier device was used to simulate droplets sized 2-5 μm exhaled in size 3.8 square metres hospital room. Thirteen environmental surfaces were chosen based on Ong et al. [3], which showed significant environmental contamination by symptomatic SARS-CoV-2 patient. We also included both sides of the bed rails collected three times in a period of 30, 60, and 120 min. Simulations were conducted – one with and another without the hood, and three moist cotton swabs were taken from each

Fig. 1. Personal ventilation hood, suction pipe made assembled from medical equipment.
environmental surface every 30, 60, and 120 min. Cotton swabs were checked for fluorescent markers under Ultraviolet light. The results are illustrated with a cumulation of time (Appendix A) and indicated either the absence “−” or presence “+” or presence with high density “++” of fluorescent markers.

The provisional pilot study shows, the hood offers several potential implications. In terms of healthcare workers’ safety, the hood ensures lower close contact with the patients, primarily perform medical and surgical procedures that can potentially generate aerosolized particles include intubation and bronchoscopy. It has been observed that efficient containment can be achieved using simple construction and essential medical equipment by considering pressure differential and airflow patterns.

This experiment has several limitations. Due to clinical restrictions during an outbreak, the simulations only presumed the patient lying on bed without any movement around the room. Thus, we are unable to control under any human-environment condition, and the air ventilation in the room would have thinned the presence of fluorescent markers on the surfaces. Moreover, the environmental sites sampled represent only a small fraction of the total area. Further studies are required to validate these initial results. The hood protects patients that would be required to undergo several tests differently, radiology, physical therapy, pulmonary, and laboratory. Even in situations where a patient needs to be moved to another facility, the hood could limit the exposure to other patients and hospital personnel. We urged that with the protection provided to both patient and hospital personnel, visitors of the health facility are protected from possible exposure. This result is consistent with other researchers [4,5] that emphasize the need to adapt to the healthcare setting in the wake of the COVID-19 pandemic.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2020.07.036.

References

[1] Clinical Management of COVID-19. Accessed June 8 https://www.who.int/publications-detail-redirect/clinical-management-of-covid-19; 2020.
[2] Brosseau LM. Are powered air purifying respirators a solution for protecting healthcare workers from emerging aerosol-transmissible diseases? Ann Work Exposures Health. 2020;1–3 doi:10.1016/j.aweh.2020.02.001.
[3] Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. JAMA. 2020;323(16):1610–2. https://doi.org/10.1001/jama.2020.3227.
[4] Kampf G, Todt D, Pflaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect. 2020;104(3):246–51. https://doi.org/10.1016/j.jhin.2020.01.022.
[5] Fischer WA, Crozier I, Rausch DG, et al. Shifting the paradigm — applying universal standards of care to Ebola virus disease. New Engl J Med. 2019;380(15):1389–91. https://doi.org/10.1056/NEJMp1817070.

Connie Cai Ru Gan MPH
Centre for Environment and Population Health, Griffith University, Queensland, Australia
Yu-Chi Tseng M.D.
Mackay Memorial Hospital, Hsinchu, Taiwan
Feng-You Lee M.D.
Taichung Tzu Chi Hospital, Taichung, Taiwan
Kuan-I Lee M.D.
Taichung Tzu Chi Hospital, Taichung, Taiwan
Corresponding author at: Emergency Department, Taichung Tzu Chi Hospital, Tzu Chi Medical Foundation, Address: No. 88, Section 1, Feng Xing Road, Tanzi District, Taichung City 427, Taiwan.
E-mail address: leeguanto@gmail.com

14 July 2020