

Are Our Healthcare Workers Well Protected during COVID-19? Learning from Current Experiences and Challenges

Siti Munira Yasin, Kamarulzaman Muzaini, Ely Zarina Samsudin, Mohamad Ikhsan Selamat, Zaliha Ismail

Department Of Public Health Medicine, Faculty of Medicine, Universiti Teknologi MARA (UiTM), Selangor, Malaysia

Received

24th April 2020

Received in revised form

10th June 2020

Accepted

12th June 2020

Corresponding author:

Ely Zarina Samsudin,

Department of Public Health Medicine,
Faculty of Medicine,
Universiti Teknologi MARA (UiTM),
47000 Sungai Buloh, Selangor,
Malaysia.

Email: elyzarina07@yahoo.com

Tel: +603-61267180

Fax: +603-61267550

ABSTRACT

The outbreak of novel coronavirus disease 2019 (COVID-19) has been declared a Public Health Emergency of International Concern by the World Health Organization. The incidence of this pandemic continues to rise, with 40,665,438 confirmed cases and 1,121,843 deaths worldwide by 21 October 2020. During this public health crisis, healthcare workers are at the frontline of the COVID-19 outbreak response, and as such are at risk of being infected and developing job burnout while in the line of duty. This study reviews the history of COVID-19 outbreak, infection control measures in hospitals during COVID-19 outbreak, healthcare workers' risk of infection and other health effects from battling COVID-19, and challenges and recommendations for protecting healthcare workers during this pandemic. At present, healthcare workers are every country's most valuable resources, and their safety must thus be ensured. Strong medical leadership, clear pandemic planning, policies and protocols, continuous educational training, adequate provision of personal protective equipment, psychological support, and the provision of food, rest, and family support for healthcare workers would augment a climate of safety in the workplace, ensure their wellbeing, and improve their capacity to battle this ongoing pandemic.

KEYWORDS: COVID-19, pandemic, healthcare workers, health personnel, occupational safety and health, worker protection, outbreak response measures, safety climate, review

INTRODUCTION

The outbreak of novel coronavirus disease 2019 (COVID-19) has been declared a Public Health Emergency of International Concern by the World Health Organization (WHO) [1]. The incidence of this pandemic continues to rise, with 40,665,438 confirmed cases and 1,121,843 deaths worldwide by 21 October 2020 [1]. During this public health crisis, healthcare workers (HCW) are at the front line of the COVID-19 outbreak response, and as such are at risk of being infected while in the line of duty. Indeed, figures from China's National Health Commission indicate that as of early March, more than 3,300 HCW have been infected, and by the end of February, at least 22 had died [2, 3]. Moreover, HCW are at risk of developing burnout due to working long hours with significant pressure and often times inadequate resources [4, 5].

Here, we describe the history of COVID-19 outbreak, infection control measures in hospital during COVID-19 outbreak, HCW' risk of infection and other health effects from battling COVID-19, and challenges and recommendations in protecting HCW during this pandemic.

History of COVID-19 Outbreak

Coronaviruses are a group of positive-stranded RNA zoonotic pathogens that belongs to the family *Coronaviridae*. The novel coronavirus (2019-nCoV) was first identified in the province of Wuhan, Hubei, China in 19 December 2019, starting off as a mystery cluster of pneumonia of unknown aetiology [6, 8]. They found that most of the infected patients were epidemiologically linked to Wuhan's Huanan seafood wholesale market, as they worked at or lived around the



market in which wild animals were traded. The disease was first identified on 7 January 2020 by the Chinese Center for Disease Control and Prevention (China CDC) from the throat swab sample of a patient [9, 10]. On 11th January, the Wuhan Municipal Health Commission announces the first death caused by coronavirus. Subsequently on 21st January, the Chinese authorities confirmed human to human transmission of this virus, and the first reported case in USA followed by secondary transmission of the virus reported in Germany, Vietnam and Japan. By 20th February, Brazil confirms its first coronavirus infection in Latin America, which means that cases had been identified in all continents except Antarctica [11]. In Malaysia, the first case was detected in January 2020 as an imported case from China traveller, before spreading and becoming localised cases in March 2020. Up to the end of April, after almost five months of its emergence, the number of confirmed cases has exceeded 6,000 total cases with 102 deaths [12]. Due to the widespread nature of this virus across various continents, WHO declared it as a pandemic on the 11 March 2020 [13]. As of 21 October 2020, the pandemic had affected 235 countries [1].

Infection Control Measures in Hospitals during COVID-19 Outbreak

In an era of emerging and re-emerging communicable disease health threats, the significance of infection prevention and control measures in healthcare settings should not be underestimated. Thus, as recommended by WHO, infection prevention and control should be an ongoing hospital activity taken by all hospital staff and units during COVID-19. The objectives of this exercise include reducing the transmission of healthcare-associated infections, enhancing the safety of all who are present in the hospital, augmenting the ability of the hospital to respond to epidemics, and reducing or eliminating the risk of the hospital itself from amplifying the epidemic [14]. Holistically, there are two aspects of infection prevention and control for the containment and mitigation of pathogens that may constitute a major public health threat. The pharmacological aspect of infection prevention and control comprise vaccines and antivirals, whereas the non-pharmacological aspect involve early detection,

isolation, reporting, application of routine infection control precautions for all patients, and the establishment of infection control infrastructure to support infection control activities [15].

Based on the WHO interim guidelines [15], key strategies to reduce the risk of pathogen exposure and transmission associated with healthcare include elimination or reduction, engineering and environmental controls, administrative controls, and the use of personal protective equipment (PPE). These strategies are described in more detail under the following subheadings:

a) Elimination or reduction

According to WHO, early detection and source control is the most critical measure for the prevention of spread of acute respiratory disease (ARD) of potential concern in the healthcare setting [15]. The Zhejiang University School of Medicine, early pioneers of COVID-19 management and prevention, recommends establishing a fever clinic for this purpose [16]. A pre-examination and triage area to perform preliminary screening of patients should be set up using the predetermined screening criteria (Table 1). In this regard, all confirmed cases, all probable cases, and suspected cases who are clinically ill or have uncontrolled medical conditions, immunocompromised status, are pregnant, or at extremes of age should be admitted [17]. Suspected cases who do not require admission should be put under Home Surveillance Order for 14 days and provided with a Home Assessment Tool [17]. Similarly, it is equally important to exclude HCW who are at risk of contracting the ARD of potential concern from the hospital. These HCW include those with relevant international travel history or household contact who are being investigated as suspected case for COVID-19. HCW who intend to travel internationally or have returned from overseas should declare to respective Head of Department promptly [17]. Meanwhile, HCW with household contact who are being investigated as suspected case for COVID-19 should be excluded from work until the first RT-PCR result of the suspected case is available, and may return to work if the RT-PCR result is negative [17]. On the other hand, HCW who are exposed to patients with confirmed COVID-19 in the line of duty require an exposure risk assessment and

Table 1 Case definition of COVID-19 (Guidelines COVID-19 Management In Malaysia No. 5/2020, Annex 1, last update 5 October 2020)

Suspected Case of COVID-19	Probable Case of COVID-19	Confirmed Case of COVID-19	Person Under Surveillance (PUS)
<p><i>Clinical history</i></p> <p>At least two of the following symptoms: fever, chills, rigors, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, acute onset nasal congestion or running nose</p> <p>OR</p> <p>Any one of the following symptoms: cough, shortness of breath, difficulty in breathing, sudden new onset of anosmia, sudden new onset of ageusia</p> <p>OR</p> <p>Severe respiratory illness with at least one of the following: clinical evidence of pneumonia, acute respiratory distress syndrome</p> <p><i>Epidemiological history</i></p> <p>Attended an event OR areas associated with known COVID-19 cluster OR red zones</p> <p>OR</p> <p>Travelled to/resided in a foreign country within 14 days before the onset of illness</p> <p>OR</p> <p>Close contact to a confirmed case of COVID-19, within 14 days before onset of illness.</p>	<p><i>Laboratory investigation</i></p> <p>A person with RTK Ag positive awaiting for RT-PCR confirmation</p> <p>OR</p> <p>A suspect case with chest imaging showing findings suggestive of COVID-19 disease</p>	<p><i>Laboratory investigation</i></p> <p>Laboratory confirmation of infection with the COVID-19, irrespective of clinical signs or symptoms</p>	<p>Asymptomatic individual subjected to Home Surveillance Order</p>

specific management depending on the level of risk assigned (Table 2). This is adapted from guidelines of confirmed COVID-19 cases from the United States of America Centers for Disease Control and Prevention and Public Health England that is regularly updated when new evidence arises [18, 19]. The recommendation states that healthcare workers having prolonged close contact (i.e. exposures of 15 minutes or longer) with COVID-19 patients, although adhering to recommended PPE, are still considered as those with identifiable risk [20]. Besides, it is difficult to exclude any inconsistencies in the use of PPE as recommendations vary from one healthcare facility to another, depending on the present supply of PPE [21].

In addition to the above, as infected patients represent the main source of pathogens in healthcare settings, promoting respiratory hygiene and cough etiquette would eliminate or reduce the dissemination of infectious agent from the source. This could be achieved via visual alerts (e.g. posters, banners) that are placed at strategic locations such as entrances to outpatient facilities and that instructs patients and their accompanying persons on how to practice respiratory hygiene and cough etiquette. Other elimination and reduction strategy to prevent nosocomial transmission include health declaration and temperature and symptom screening at hospital entry points.

b) Environmental and engineering control

An important strategy for environmental and engineering control is isolation. This includes physical barriers or partitions to guide patients through triage areas, curtains separating patients in shared rooms, and isolation rooms [22]. Isolation wards with adequate ventilation controls and controlled laminar flow of air should be available whenever possible in healthcare facilities, and spatial separation (>1 meter) between patients should be enforced [15, 16]. In addition, methods to reduce the concentration of infectious respiratory aerosols in the air and to reduce the presence of contaminated surfaces and items should be applied. This includes adequate ventilation (e.g. natural ventilation and ventilation system) and cleaning and disinfecting contaminated surfaces and items.

c) Administrative control

The establishment of sustainable infection control infrastructures and activities, clear policies on early recognition, reporting and surveillance of ARD of potential concern, implementation of appropriate infection control measures, adequate and regular supplies of PPE, organization of services, and staff planning and training should be put in place.

Administrative controls also involve Standard Precautions that should be applied routinely in all healthcare settings when providing care for all patients, which includes hand hygiene, use of PPE, respiratory hygiene, cleaning and disinfection of the environment and equipment, waste management, packing and transporting patient-care equipment, linen, laundry and waste from isolation areas, and prevention of needle-stick or sharps injuries [15, 17]. In addition to Standard Precautions, additional protective measures should be implemented. This includes droplet, airborne, and contact precautions when providing care for patients infected by an infectious respiratory disease caused by a novel pathogen with epidemic or pandemic potential with unknown route of transmission [15], such in the case of COVID-19. For this purpose, the administration of hospitals should provide education and training for HCW on how to follow infection control precautions with all patients with acute febrile respiratory illness, and ensure that infection control supplies (soap, clean running water, alcohol-based hand rub, PPE, cleaning and disinfection materials) are adequate at all times. Besides that, cross-infection measures such as guiding the public to get access to non-emergency services such as chronic disease treatment in non-COVID hospitals should also be taken to minimize the risk of cross infection [16].

d) PPE

PPE should be used together with the above strategies to further reduce healthcare workers' possibility of exposure to biological hazards. The use of PPE serves as a method to avoid direct contact with patient's blood, body fluids, secretions and non-intact skin.

Table 2 Exposure risk assessment and management of healthcare workers exposed to patient with confirmed COVID-19 (Guidelines COVID-19 Management in Malaysia No. 5/2020, Annex 21, last update 14 August 2020)

Category of risk exposure	Circumstances	Management
High-risk	<p>Unprotected exposure where HCW's nose and mouth were exposed and close contact* occurred with a COVID-19 patient during the infectious period with no source control (the patient was NOT on a 3-ply surgical mask)</p> <p>OR</p> <p>Unprotected exposure while present in the room when AGP was performed on a COVID-19 patient during the infectious period</p>	<p><i>Symptomatic</i></p> <ul style="list-style-type: none"> Exclude from work for at least 14 days with home surveillance order and home assessment tool. Combined NP and OP swab for RT-PCR to be collected immediately A repeat test after 48 hours must be carried out if the first test is negative If both initial tests are negative, a repeat NP and OP swab for RT-PCR test shall be performed at day 13 from symptom onset <p><i>Asymptomatic</i></p> <ul style="list-style-type: none"> Exclude from work for at least 14 days with home surveillance order and home assessment tool. Combined NP and OP swab for RT PCR to be collected 72 hours after the potential exposure A repeat test after 48 hours must be carried out if the first test is negative If both initial tests are negative, a repeat NP and OP swab for RT-PCR test shall be performed at day 13 from date of exposure
Medium-risk	<p>Unprotected exposure where HCW's nose and mouth were exposed and close contact occurred with a COVID-19 patient during the infectious period with good source control (the patient was NOT on a 3-ply surgical mask)</p>	<p><i>Symptomatic</i></p> <ul style="list-style-type: none"> Exclude from work for at least 14 days with home surveillance order and home assessment tool. Combined NP and OP swab for RT-PCR to be collected immediately A repeat test after 48 hours must be carried out if the first test is negative If both initial tests are negative, a repeat NP and OP swab for RT-PCR test shall be performed at day 13 from symptom onset <p><i>Asymptomatic</i></p> <ul style="list-style-type: none"> Exclude from work for at least 14 days with home surveillance order and home assessment tool. Combined NP and OP swab for RT PCR to be collected 72 hours after the potential exposure A repeat test after 48 hours must be carried out if the first test is negative <p>If both initial tests are negative, a repeat NP and OP swab for RT-PCR test shall be performed at day 13 from date of exposure on serial interval of the disease it is recommended to start the swab from day 3 after exposure.</p>

Low-risk	<p>Brief interactions (< 15 minutes, more than 1-meter distance) with a COVID-19 patient during the infectious period</p> <p>Protected exposure while in close contact with a COVID-19 patient during the infectious period with good source control (the patient was wearing a 3-ply surgical mask)</p> <p>The use of eye protection in addition to a 3-ply surgical mask or respirator would further lower the risk of exposure</p>	Symptomatic No testing or work restriction required
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Note: HCW = healthcare workers; AGP = aerosol generating procedure; NP = nasopharyngeal; OP = oropharyngeal; RT-PCR = real-time polymerase chain reaction

* Close contact defined as

- i. HCW (excluding laboratory workers) who exposed to positive patient:
 - Have any unprotected exposure of their eyes or mouth or mucus membranes, to the bodily fluids (mainly respiratory secretions e.g. coughing, but also includes blood, stools, vomit, and urine) of the case, OR
 - Have a cumulative unprotected exposure during one work shift (i.e. any breach PPE other than) for more than 15 minutes face-to-face (< 1-meter distance) to a case OR
 - Have any unprotected exposure (i.e. any breach in the appropriate PPE) while present in the same room when an AGP is undertaken on the case
- ii. Laboratory HCW who have not fully adhered to good laboratory practice for cumulative more than 15 minutes in one work shift, while testing samples positive patient

For this purpose, its use is guided by risk assessment concerning anticipated contact with blood, body fluids, secretions and non-intact skin for routine patient care (Table 3). HCW must undergo strict training and examinations to ensure that they know how to put on and remove personal protective equipment [16]. In the case where powered air-purifying respirator (PAPR) is not available, the N95 mask plus face shield are still adequate to offer a good protection to the HCW [23, 24].

To achieve adequate infection prevention and control, engagement and active participation from all stakeholders, i.e. hospital administrators, HCW, support staff, and patients, is essential. In this regard, the promotion of a safety climate and leadership is key to promote compliance with infection control recommendations [15]. For this purpose, an infection control committee and infection control programs with trained personnel should be established to keep infection control policies current and to monitor

compliance with them. In addition, clear policies and protocols, adequate training in infection control procedures, promotion of a culture of adherence to infection control practices, and administrative support would improve individual and institutional attitudes in complying with their role in controlling epidemics in the healthcare settings [15].

Healthcare workers' risk of infection and other health effects from battling COVID-19

While millions of people worldwide confine themselves at home to minimize the transmission of SARS-CoV-2, the opposite is true for HCW. HCW are crucial frontliners in treating and managing infected patients, and as such, they are at high risk of inadvertent exposure to SARS-CoV-2. In addition to exposure from droplets and direct contact with infected patients, HCW are in danger of contracting COVID-19 from fomites.

Table 3 Recommended personal protective equipment to be used by healthcare workers when managing suspected or confirmed COVID-19 cases (Ministry of Health Malaysia Annex 8, last update 5 August 2020)

Setting	Activity	Type of PPE
Any areas in healthcare facility	Direct contact with any patient	<ul style="list-style-type: none"> • Surgical mask • Frequent hand hygiene
<i>Emergency Department</i>		
Primary triage	Involved in triaging patients Maintain more than 1 meter spatial distance at all times	<ul style="list-style-type: none"> • Surgical mask • Frequent hand hygiene
Secondary triage	History taking and physical examination	<ul style="list-style-type: none"> • Surgical mask • Isolation gown • Gloves • Face shield/goggles • Boot cover/shoe cover (when anticipating spillage and vomiting)
Examination room/consultation room	History taking and physical examination	<ul style="list-style-type: none"> • Surgical mask • Isolation gown • Gloves • Face shield/goggles • Boot cover/shoe cover (when anticipating spillage and vomiting)
Ambulance transfer vehicle	Involved in driving the patient with suspected/confirmed COVID-19 BUT NO direct contact with patient.	<ul style="list-style-type: none"> • Surgical mask • Frequent hand hygiene
	Involved in driving the patient with suspected/confirmed COVID-19 and involved in loading and unloading of patients Always maintain at foot end of stretcher	<ul style="list-style-type: none"> • Surgical mask • Isolation gown • Gloves • Face shield/goggles
	Transporting suspected/confirmed COVID-19 patient to the referral health care facility	<ul style="list-style-type: none"> • N95 mask • Isolation gown • Gloves • Face shield/goggles • Head cover
Ambulance transport vehicle	Decontamination of ambulance that transported suspected/confirmed COVID-19 patient	<ul style="list-style-type: none"> • Surgical mask • Long-sleeved plastic apron • Gloves • Face shield/goggles • Boots or closed shoes

Patient cubicle/resuscitation zone	Performing AGP on suspected/confirmed COVID-19 patients <ul style="list-style-type: none"> • Intubation, extubation and related procedures/CPR • Tracheotomy/tracheostomy procedures • Manual ventilation • Suctioning • Bronchoscopy • Nebulization 	Minimum recommendation: <ul style="list-style-type: none"> • N95 mask • Isolation gown • Gloves • Face shield/goggles • Head cover • Boot cover/shoe cover
Specimen collection area	Performing oropharyngeal or nasopharyngeal swab	<ul style="list-style-type: none"> • N95 mask • Isolation gown • Long-sleeved plastic apron • Gloves • Face shield/goggles • Head cover • Boot cover/shoe cover (when anticipating spillage or vomiting)

Inpatient Facilities

Patient room	Providing care suspected/confirmed COVID-19 patients who are not intubated and able to wear surgical mask	<ul style="list-style-type: none"> • Surgical mask • Isolation gown • Gloves • Face shield/goggles • Boot cover/shoe cover (when anticipating spillage or vomiting)
	Providing care to suspected/confirmed COVID-19 patients who are not intubated but NOT able to wear surgical mask	<ul style="list-style-type: none"> • N95 mask • Isolation gown • Gloves • Face shield/goggles • Head cover • Boot cover/shoe cover (when anticipating spillage or vomiting)
	Performing oropharyngeal or nasopharyngeal swab to suspected/confirmed COVID-19 patients	<ul style="list-style-type: none"> • N95 mask • Isolation gown • Gloves • Face shield/goggles • Head cover • Boot cover/shoe cover (when anticipating spillage or vomiting)
	Providing care to suspected/confirmed COVID-19 patients who are ventilated in a closed circuit	<ul style="list-style-type: none"> • N95 mask • Isolation gown • Gloves • Face shield/goggles • Head cover • Boot cover/shoe cover (when anticipating spillage or vomiting)
	Performing AGP on suspected/confirmed COVID-19 patients <ul style="list-style-type: none"> ○ Intubation, extubation and related procedures ○ Tracheotomy/tracheostomy procedures ○ Manual ventilation ○ Suctioning ○ Bronchoscopy ○ Nebulization ○ Non-invasive ventilation ○ Surgery and post-mortem procedures in which high speed devices are used 	Option 1 (Preferred): <ul style="list-style-type: none"> • PAPR • Isolation gown with plastic apron/coverall suit • Gloves • Face shield/goggles • Boot cover/shoe cover

	<ul style="list-style-type: none"> ○ High-frequency oscillating ventilation ○ High-flow Nasal Oxygen ○ Induction of sputum ○ Dental procedures 	<p>Option 2</p> <ul style="list-style-type: none"> ● N95 mask ● Coverall suit ● Gloves ● Face shield/goggles ● Boot cover/shoe cover <p>Option 3 (if Option 1 & 2 not available)</p> <ul style="list-style-type: none"> ● N95 mask ● Isolation gown ● Gloves ● Face shield/goggles ● Head cover ● Boot cover/shoe cover
	Transporting specimen to lab	<ul style="list-style-type: none"> ● Surgical mask ● Gloves ● Plastic apron (optional)
Laboratory	<p>Manipulation of respiratory specimens which include oropharyngeal swabs, nasopharyngeal swabs, sputum, tracheal aspirate, BAL must be accorded high risk</p> <p>Specimen handling for RT-PCR or antigen testing prior to viral inactivation step, must be carried out in BSL-2 or equivalent facilities</p>	<ul style="list-style-type: none"> ● N95 mask ● Isolation gown ● Gloves ● Face shield/goggles ● Head cover ● Boots or closed shoes
	<p>Handling and processing of specimens from suspected/confirmed COVID-19 intended for additional laboratory tests, such as haematology, microbiology, biochemistry, cytology or histopathological processing should apply standard precautions to provide a barrier between the specimen and personnel</p>	<ul style="list-style-type: none"> ● Surgical mask ● Isolation gown ● Gloves ● Face shield/goggles ● Boots or closed shoes
Outside patient room (more than 1-2 m away)	Any activity that does not lead to contact with suspected/confirmed COVID-19	<ul style="list-style-type: none"> ● Surgical mask ● Frequent hand hygiene
Administrative Areas/Public Areas	Security officers in healthcare facilities	<ul style="list-style-type: none"> ● Surgical mask ● Maintain spatial distance of more than 1 meter ● Frequent hand hygiene

Note: AGP = aerosol generating procedure; PAPR = powered air-purifying respirator; BAL = bronchoalveolar lavage; RT-PCT = real time polymerase chain reaction

As shown previously, in Taiwan, it was found that transmission via fomites had contributed to the SARS and MERS Middle East respiratory syndrome outbreak [25]. During the SARS outbreak, 17 HCW from Taipei Heping Hospital had contracted the virus without direct contact with index case, and post outbreak, it was found that there were SARS-CoV RNA nucleic acids on the water fountains in the triage and also the observation units, which were supposed to be 'clean area' [26]. In the case of SARS-CoV-2, though no firm evidence was found with regards to airborne transmission, evidence show that SARS-CoV-2 to be viable in the fomite form of up to three days in the environment. Recently, the issue of asymptomatic transmission of SARS-CoV-2 is of growing concern [27].

One of the most common problem highlighted during the COVID-19 pandemic is personal protection of HCW. Although it is worth mentioning that the percentage of HCW infected with COVID-19 was only 2.7% as compared to SARS (21.1%), it is important to understand the causes in order to implement strategies to reduce such occurrence. The instances in which HCW were infected previously were during the use of aerosol generating procedures, such as endotracheal suction and intubation, nebulisers, cardiopulmonary resuscitation, high flow oxygen and nasogastric feeding [28, 29]. In these instances, one of the cause was due to inadequate personal protection being supplied to these HCW, as at the time the pathogens were not understood well and awareness was rather poor. Hence, the frontliners consisting of 60% of nurses did not implement adequate PPE before commencing treatment. The second cause is related to the increase in duration of exposure of HCW to infected patients in large numbers, which directly increases the risk of getting infected. This is further enhanced by impaired immunity as a result of elevated stress levels from increased work intensity, work pressure, and lack of rest time. The third reason is due to the shortage of PPE. As the pandemic accelerates, access to PPE for HCW becomes a main concern. PPE scarcity have been experienced in the most affected healthcare facilities and healthcare workers are witnessing it [30]. Finally, the fourth reason may be due to HCW having inadequate training for infection prevention control, as there may not be enough time for systematic training

and hands on practice and appropriate supervision and monitoring mechanisms may be lacking. This situation doubles or triples the risk of new infections and disease transmission among the healthcare workers [31, 32]. As an example, a previous case of one HCW infecting 14 others including a physician whom had died may highlight the problem of insufficient or substandard infection control procedures, which may lead to cross-contamination and eventually disease transmission to the community. This cycle may also contribute to regional epidemic saturation [31].

Indeed, on 1 February 2020, WHO stated that the main driver of transmission is the symptomatic cases, and a HCW was diagnosed in France, the first ever outside China [11, 33]. As of 7th February, WHO warns the world on the possibility of shortages of PPE if cases were to surge. A week later, HCW account had 1,716 confirmed cases of COVID-19. By end of March 2020, in countries with high number of COVID-19 cases such as China and Italy, data showed that 3,300 Chinese HCW and 20% of responding Italian HCW had been infected, with some dying [2]. In Malaysia, on 26 March 2020, the Director General of Health Malaysia declared that 80 Malaysian HCW have been tested positive for COVID-19. Fortunately, none of the Malaysian HCW' source of infection has been linked to the management or treatment of COVID-19 patients in COVID ward, nor linked to attending to patients in non-COVID wards [34, 35].

Furthermore, at this point of time, the worldwide healthcare system is likely operating above the maximum capability and capacity for extended months in order to fight this rampant infection. During this outbreak, HCW have to work long hours with significant pressure and most instances inadequate resources, whilst exposed to dangers inherent due to close interactions with suspected infected patients. Thus, in addition to the risk of COVID-19 infection among HCW, they also at risk of developing physical and mental exhaustion and in some cases burnout [4, 5]. A cross-sectional study done among 1,257 HCW in China found that 7 out of 10 of participants experienced distress symptoms, followed by depression anxiety, and insomnia [5]. This is similar to previous experience of severe acute respiratory syndrome (SARS) and Middle

East respiratory syndrome (MERS), which had resulted in significant mental health issues among HCW [36].

Challenges and Recommendations

HCW' challenge in facing this pandemic include that they need to provide ultimate care for their patients while protecting themselves from contracting the disease and suffering burnout [37, 38]. Despite extensive protective measures that have been outlined and implemented by the governments in order to protect HCW' health and welfare, there are still cases of HCW contracting COVID-19 and succumbing to physical and mental exhaustion. In some ways, the challenges that are faced by HCW in combating the COVID-19 are similar with two previous pandemics, namely SARS-CoV and MERS-CoV [39, 40]. However, the challenges are hugely dependent on the global scale of the infection and the crisis preparedness plan of the country. The larger the extent of the infection throughout the country, the more challenges the HCW would have to contend with. In a nutshell, the challenges stems from three main factors, i.e. individual factor (healthcare workers' knowledge, attitude and risk perception), organisational factors (government and healthcare systems, policies and management expectation), and environmental factors (availability of equipment and supplies). If there is a weakness in these factors, it will negatively impact HCW and healthcare services [41, 42].

In these trying times, the shortage of crucial resources for barrier precautions such as N95 mask, PAPR, face shields, goggles and isolation rooms are one of the main challenges for HCW, especially those who are working at outpatient healthcare facilities and hospital emergency department [43-45]. The barrier protection mechanism is the most crucial first line defence for HCW in order to ensure minimal risk of infection when attending to patients with COVID-19. This limitation in resources leads to inadequate practice of safety precaution by HCW as per recommended in CDC guidelines advances safety. Thus, in order to ensure the adequacy of infection prevention control measures, the government and healthcare facilities need to plan and allocate these resources carefully and appropriately, with priority being given to high-risk healthcare facilities and frontliners who need to manage

a huge number of COVID-19 patients.

Next, overcrowding in healthcare facilities also is one of the biggest challenges faced by HCW [46]. Sudden rise in public panic and anxiety has led them to attend primary healthcare facilities and emergency departments in order to seek medical attention and undergo screening. This is especially intensified when the social media is misused by irresponsible individuals or organizations, as it could lead to the spread of fake news or information that can unnecessarily heighten public anxiety [47]. As a consequence, it may lead to overcrowding at healthcare facilities and overutilization of face mask, tissues, and hand sanitizers and cause subsequent shortages. In addition, this scenario will augment the spread of COVID-19 as overcrowding leads to poor social distancing between individuals who attend the healthcare facilities and HCW [48]. Moreover, the sudden increase in numbers of unnecessary patient visits compels HCW to do extra work, which could lead to burnout. To alleviate this, a measure that could be taken is for the government, stakeholders and media agencies to form a collaboration in order to educate and inculcate knowledge from time to time to the public through social media. Information on current statistics and handling of COVID-19, as well as practices to curb the spread of infection such as hand hygiene practice and surface decontamination would be valuable to promote safety and confidence among the public.

Other than that, limitations exist in relation to the diagnosis of COVID-19 patients. At present, the gold standard confirmatory laboratory testing for COVID-19 is the conventional RT-PCR [49]. Though the whole process can provide results in four to six hours, some public health laboratories might require up to 48 hours to 72 hours to produce results. This delay in reporting could be due to inadequate capacity and capabilities of laboratories in conducting the tests in huge scale [50,51]. Delayed recognition of a patient with COVID-19 is significant and could contribute to negative impact to the effort in breaking the chain of COVID-19 infection [52]. Moreover, contact tracing activity will be delayed. This could increase the risk of HCW' exposure to undiagnosed COVID-19 patients. To account for this, the government initiated plans to increase RT-PCR testing capacity which was made

possible following integrated cooperation of all 61 labs under the Health Ministry, Malaysia Armed Forces, Science, Technology and Innovation Ministry, public and private higher education institutions as well as the private sector [53].

Another challenge relates to personal protection of HCW. Previous studies have shown that HCW sometimes underestimate their personal risk of acquiring an occupational infectious disease [54, 55]. Infected HCW will increase the burden of healthcare services due to shortage of workers [56]. This problem could further affect other HCW' physical and mental health as they need to compensate and work harder to manage enormous numbers of patients [57, 58]. Thus, HCW need to take extra precaution and continuously perform self-monitoring, report signs of illness, and not engage in direct patient care while exhibiting infectious symptoms. To protect them, testing and treatment should be prioritized for symptomatic HCW [57]. To combat burnout, the organisation also need to provide extra support and ensure that HCW get ample rest and are able to attain critical personal needs, such as care of family members [59]. Good leadership and communication skills is crucial in this point of time. Clear, concise and thoughtful communication among HCW can boost their morale and create a sense of control [60]. Transparent policies relating to HCW' safety and health can be developed and communicated to create a safety climate in workplace [61], and management expectations need to be achievable and clarified to HCW. On top of that, organisations need to take initiative in providing continuous educational programs and training for HCW in order to enhance their capacity building. Ultimately, the organisation commitment could improve HCW' performance and boost their capacity in combating this pandemic more efficiently.

CONCLUSION

Ensuring HCW' personal protection is of utmost importance during the COVID-19 pandemic. At present, HCW are every country's most valuable resources, and their safety must be ensured. Strong medical leadership, clear pandemic planning, policies and protocols, continuous educational training,

adequate provision of PPE, psychological support, and the provision of food, rest, and family support for HCW would augment a safety climate in the workplace, ensure their wellbeing and improve their capacity to battle this pandemic.

Conflict of Interest

Authors declare none

Authors Contribution

Author SMY made substantial contribution to the conception and design of the study, acquisition, analysis and interpretation of data, and drafting the article. Author KM made substantial contribution to the acquisition, analysis and interpretation of data, and drafting the article. Author EZS made substantial contribution to the acquisition, analysis and interpretation of data, drafting the article, and revising the article critically for important intellectual content. Author MIS made substantial contribution to the analysis and interpretation of data and revising the article critically for important intellectual content. Author ZI made substantial contribution to the analysis and interpretation of data and revising the article critically for important intellectual content.

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