

CHALLENGES AND SOLUTIONS TO SHORTAGE OF PERSONAL PROTECTIVE EQUIPMENT DURING COVID-19 PANDEMIC: A CASE STUDY ON CORPORATE AND COMMUNITY RESPONSE

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Abstract: The COVID-19 pandemic has resulted in declining global economy in many sectors, including the manufacturing of personal protective equipment (PPE), as a result of factory lockdowns, restriction of movement and social distancing. At the peak of infection, the demand of PPE superseded the supply causing an alarming crisis capacity. Contingency plans to ensure continuous PPE availability at hospitals or clinical centres were critical to safeguard health care workers and the front-line personnel. Best practice guidelines from the Ministry of Health were followed and adjusted to local setting to optimise the use of PPE. Many contributions were made by the citizens to overcome this pandemic, and this section discusses the responses from other organizations and communities. Reach-out programmes to the community, corporate and non-governmental organisations were part of the strategy to overcome the critical PPE supply. Promotional flyers to attract donation, resources and man power for “do-it-yourself” PPE projects were some of the initiatives taken at our institute. This article highlights the challenges and solutions to PPE shortages, including corporate and community’s rapid and enormous response at the age of COVID-19 pandemic experienced at the Advanced Medical and Dental Institute, Universiti Sains Malaysia.

Keywords: COVID-19, personal protective equipment, corporate and community response.

Introduction

The world is still facing unprecedented challenge with communities and economies everywhere affected by the growing COVID-19 pandemic. WHO declared it as a public health emergency of international concern or “pandemic” as human-to-human transmission escalated at a worrying trend (World Health Organization, 2020). The Malaysian government and the Ministry of Health (MoH), as the key players, together with other relevant agencies, non-governmental organizations (NGOs), as well as its citizens have made tremendous efforts to handle the pandemic throughout these trying times. One of the challenges faced by Malaysia was the shortage of personal protective equipment (PPE). Many contributions were made by the citizens to overcome this pandemic (Shah *et al.*, 2020). A clinical centre such as Advanced Medical and Dental Institute, was affected as the end user of PPE and other related items. The

challenges and solutions to PPE shortage that we experienced are discussed here, highlighting a quick response by the staff, local community, non-governmental (NGO) and corporate organisations to mitigate further threats of the infection.

Handling COVID-19 in Malaysia

The government began to take early and strict prevention measures to protect the health of Malaysians (Majid, 2020). Among the efforts to prevent disease transmission was enforcement of health screening at all points of entry and to an increase in the number of hospitals that could treat COVID-19 cases. Public and private hospitals worked closely together to accommodate the growing number of cases (The Edge Markets, 2020). Another measure taken by the government to cushion the impact of COVID-19 was setting up a special fund known as the COVID-19 Fund, to raise money

to be channelled to patients, particularly those affected financially, due to the quarantine procedure (BERNAMA, 2020).

Movement Control Order (MCO) was implemented on March 18, 2020 pursuant to the Prevention and Control of Infectious Diseases Act 1988 and the Police Act 1987 (ZICO Law, 2020). The country was put under a partial lockdown through MCO whereby non-essential businesses, universities and schools were closed. On 4th May 2020, some economic sectors were allowed to resume operations under a Conditional MCO (CMCO). New rules and standard operating procedures (SOPs) were introduced on physical distancing, checking in either manually or using “My Sejahtera” application (to facilitate contact tracing), hand sanitisation and a mandate on facemask. On 10th June, the Malaysia Prime Minister announced the Recovery Movement Control Order (RMCO) with more relaxation of the MCO restrictions to be in force until 31st December 2020. COVID-19 outbreak in Malaysia is still on alert with high numbers of cases reported each day. As of 28 October 2020, a total of 28,640 confirmed cases had been reported out of 31 million population (Figure 1) with 18, 499 (65%) recovered cases and 238 death cases (0.83%) (Ministry of Health Malaysia, 2020a).

Literature Review

Personal Protective Equipment (PPE) is protective against infected patients, infective materials, toxic agents and other dangerous substances (Hick *et al.*, 2003). The Occupational Safety and Health Administration provides guidelines on identifying risk, appropriate use of PPE, training, maintenance and periodic review on the effectiveness of the current PPE program (Roux & Dramowski, 2020). The use of PPE depends on a dynamic re-evaluation process according to conventional usage, contingency or a crisis capacity. The latter would further necessitate us to adopt strategies which might not follow standards but have to be considered during PPE shortages (Centers for Disease Control and Prevention, 2020).

An unprecedented crisis such as the COVID-19 pandemic presented challenging issues in PPE supply in many countries, and Malaysia was not spared. Increasing demand of PPE was monumental when there was disruption in supply. In a country that largely depends on import of PPE and medical supplies such as Malaysia, this had a negative impact on the healthcare system and safety of the people. At the early stage of the pandemic, the Economic Action Council meeting held on 23 March 2020 agreed to allocate RM 600 million to battle COVID-19 and RM500 million was utilized to buy ventilators and personal protective

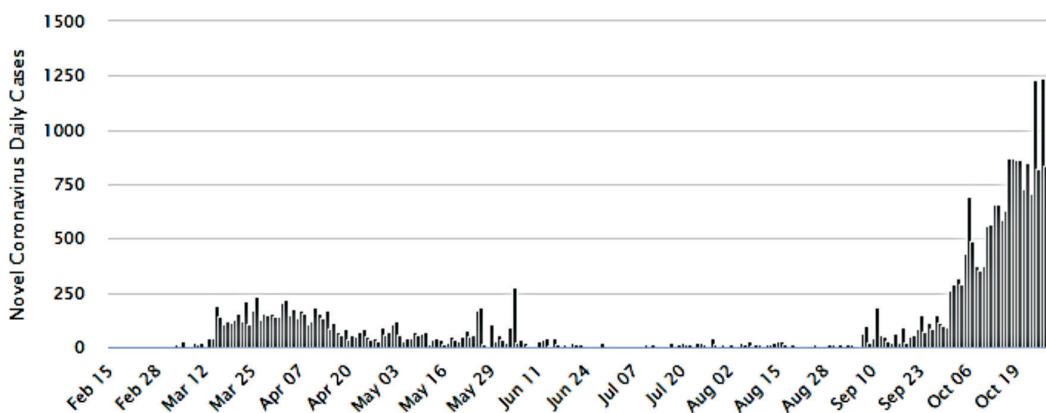


Figure 1: Daily confirmed COVID-19 cases in Malaysia; Data updated until 28th October 2020

Source: (Worldometer, 2020)

equipment (PPE) mainly for the use of frontliners (Yusof, 2020).

There are several identified causes of PPE shortage: Supply chain disruption, panic buying and stockpiling, single use PPE and depletion of hand sanitizer. At the peak of COVID-19 pandemic in Malaysia, PPE shortages were primarily due to the increased surge of PPE use with a reduction in supply. The epicentre of COVID-19 out of China saw closure of PPE manufacturing factories, which had disrupted the supply chain significantly.

The disruption of supply chain was made worse by public misinformation, panic buying and stockpiling, particularly for three-ply masks. The price of PPE increased three to four folds, thus inflated the expenditure of managing the outbreak. MCO implementation marked the highest threat of COVID-19 infection in Malaysia during which the capacity surge of PPE especially for masks, gowns, face shields and goggles had culminated to a critical level and the efforts to replenish PPE escalated tremendously.

Another challenge in PPE shortage is was due to the recommended single use of most PPEs after a session of clinical activity and not exceeding the limit in the manufacturer's instructions. The issue of re-processing certain PPEs such as disposable fluid repellent coveralls or disposable fluid-repellent-long sleeved isolation gowns and eye protective equipment remain a big dilemma to solve PPE shortage in many countries (Rowan & Laffey, 2020) which is of great global public health concern. Currently, there is no effective vaccine for tackling this COVID-19 pandemic where disease countermeasures rely upon preventing or slowing person-to-person transmission. Specifically, there is increasing efforts to prevent or reduce transmission to front-line healthcare workers (HCW). Currently, there is still limited information on the PPE materials which would allow more than a single use or re-processing/recycling of PPE. Innovative re-processing ideas like using vaporized hydrogen peroxide for microbial inactivation on medical devices to extend PPE utilisation and ensure

its sustainability (McEvoy & Rowan, 2019) ethylene oxide remains the predominant nonthermal gaseous option, sterilizing c. 50% of all manufactured devices. Vaporized hydrogen peroxide (abbreviated VH₂O₂ by the International Organization for Standardization.

Countries around the world put up their own strategies in combating COVID-19 and to address the PPE issues. Malaysia advocated a systematic targeted strategy rather than a mass screening approach to battle the infection in the country by active case detection. The screening for COVID-19 among exposed individuals and their contacts was conducted where there was a positive case and a cluster of infection was established in the area (Teoh & Yusof, 2020). This has rationalized the use of PPE and extended the availability of PPE for all healthcare workers (HCW).

Optimizing the use of PPE was key to address the issue of PPE shortage. MoH developed a policy which was adapted from WHO (Centers for Disease Control and Prevention, 2020) guidelines to recommend PPE use according to the hazard/risk assessment approach. Infection prevention and control (IPC) measures in managing patient under investigation (PUI) or confirmed corona virus disease in health facilities were put in place (Ministry of Health Malaysia, 2020b). Appropriate training of staff for donning and doffing of the PPE was provided. This will further reduce the risks of transmission of respiratory pathogens to healthcare workers and other people interacting with the patients in the health-care facility. At AMDI, the use of PPE was guided by risk assessment concerning anticipated contact with blood, body fluids, secretions and non-intact skin for routine patient care, and the mode of transmission of the pathogen either from direct contact droplet or aerosol.

The highest risk of exposure where COVID-19 positive cases were being treated were identified, such as COVID-19 diagnostic laboratory and on HCW at the frontlines who were exposed to walk-in patients coming in with influenza-like-illness (ILI) and severe acute respiratory infection (SARI) symptoms.

Full PPEs were recommended which included full face protection with eye goggles, face shield covering up to the neck, three-ply face mask, head cover (hijab style), isolation gown, apron, gloves and foot/boot cover. HCW at clinical areas with lower risks like the specialists' clinics, in-patient, day care, blood bank and waiting areas followed a lesser regulation of PPE with face mask, gloves and apron only.

Many organizations sprang into corporate social responsibility (CSR) actions to assist public response to the pandemic. Some adapted their supply chains to produce personal protective equipment (PPE) and others made contributions of funding or company resources to support first-responders and vulnerable population (Vethirajan *et al.*, 2020); (He & Harris, 2020).

Actions Taken at AMDI Clinical Centre

In the wake of the COVID-19 pandemic and in handling the PPE shortage, AMDI Clinical Centre decided to embrace corporate social responsibility (CSR) initiative and focused on social performance, not profits. This is in line with argument put forth by Ryan and Deci (2000) that motivations of CSR can be divided into intrinsic and extrinsic (Grimstad *et al.*, 2020). The former is understood as an organisation engaging in CSR because it is the right thing to do. While the latter is perceived as the belief that CSR engagement leads to a separable positive outcome for the organization. AMDI, USM took further CSR effort through rapid activated partnership with non-profit organizations, nearby communities and organization in handling the challenges of PPE shortage by strategizing its action in two folds: a) collaboration with communities, organizations and institutions, and b) innovation to address the PPE shortage.

Collaboration with stakeholders

Request for PPE was conveyed to non-governmental organizations (NGO) which worked closely with state government agencies. A "D-I-Y PPE community project" was

launched at the start of MCO after substantial support came from various parties with the aim to produce items that were high in demand but short in supply e.g., isolation gowns, head covers and foot covers. This was possible after a widespread campaign to accumulate resources for the project which employed electronic flyers and banners via emails and social media tools such as WhatsApp, Facebook and Twitter. The PPE project was empowered by AMDI staff, individuals from the community and municipals around the hospital, NGO, and community colleges within the area. The project ran for ten full weeks into early June 2020. An NGO donated the first two rolls of 600 meters of non-woven fluid resistant materials and loan of an industrial sewing machine.

Cloth patterns were designed, paying special attention to ease of sewing with minimal instructions and to be completed in the shortest duration. The latter was a challenging feat due to movement restriction imposed under MCO. Tailors were given sewing instructions either by direct instructions, personal messages or by video tutorials distributed via WhatsApp chat groups. All tailors concluded the sewing at their own homes. Two NGOs, six volunteers involved with industrial cutting and 60 tailors were among the 160 volunteers involved in this project. A total of 1,640 isolation gowns, 565 hijabs, 433 boot covers and 110 surgical caps were produced at the end of the project.

AMDI received generous contribution from corporate, NGO, community, individual and also various groups or associations as listed in Table 1. This included surgical facemask, N95, isolation gowns, Tyvek jumpsuit, boot and head covers. For the PPE project, three NGOs and one community college were directly involved at the pre-production stage, providing materials, sewing kits, tailors or in the distribution of PPE. In addition, there were also donations of hand sanitizers from various sources. The donated items as well as products of the community PPE project were distributed to benefit our front line HCW, clinical staff, patients and their caregivers and also to the non-clinical staff, students and nearby health centres.

Table 1: List of contributions made by corporate, group, community and individual to AMDI

No.	Name	Category	Particulars
1	Prime Group	Corporate	100 pcs 50's 3-ply face mask 100 pcs face shield 1 pcs intubation box (for anaesthesiology unit)
2	Western Digital Corporation	Corporate	1000 pcs Tyvek jumpsuit 5000 pcs face shields
3	Arcius Ventures	Corporate	60 pcs face shields
4	El Hajj Products	Corporate	120 pcs disposable KN95 mask with breathing valve 131 pcs PPE isolation gown 240 pcs water proof disposable microporous protective boot cover 120 pcs protective medical face shield
5	Alive Farmasi Kota Kemuning,	Corporate	15 boxes (50's) 3-ply face mask tie-on
6	Putra Bertam Community	Community	36 pcs DIY face shields
7	Dharma Association	NGO	40 boxes (50's) face mask
8	Buddist Tzu Chi Butterworth Society	NGO	197 DIY Face shield 20 boxes (50's) face mask tie-on 100 pcs PPE isolation gown 100 pcs PPE boot cover 100 pcs PPE head cover 100
9	Pertubuhan Kebajikan Ikhlas Wilayah Utara Malaysia	NGO	Loan of industrial sewing machine and tailors for PPE project
10	Persatuan Gerakan Amal Bersama (GRAB)	NGO	Non-woven fluid resistant cloth, loan of portable sewing machines, sewing kits, tailors and cutting service for PPE project
11	Pertubuhan IKRAM Malaysia	NGO	Tailors and sewing kits
12	Kepala Batas Industrial Training Institute	Group	100 pcs DIY face shield
13	Kepala Batas Community College	Group	50 pcs DIY face shields Tailors and sewing kits for PPE project

14	MRSM Taiping Alumni Society	Group	106 pcs 55 ml BF1 Anti-Bac Sanitizer Serum 20 pcs 500 ml BF1 Anti-Bac Sanitizer Serum With Pump Head 50 pcs 30 ml Refreshing Essential Oil 4 bottles hand sanitizer 5 L Two boxes N95 mask Two bottles hand sanitizer 1 litre 1 box Sterile gloves
15	Anon A	Individual	10 boxes (50's) 3 ply Face Mask loop
16	Anon B	Individual	4 boxes (50's) 3 ply Face Mask loop
17	Anon C	Individual	1 COVID-19 sampling cubicle

Innovative Solution

An innovative sampling cubicle resembling a biosafety cabinet in the laboratory was donated to us, with built-in arm-length rubber gloves in the front panel to allow ease of sampling. A fully air-conditioned cubicle was relatively easy to disinfect due to its small size. It has a negative air pressure system with high-efficiency particulate air (HEPA) filtration to prevent exposure to virus or other pathogens. In addition, the use of the sampling cubicle reduced face-to-face contact with patients, hence reduced the viral exposure to the front line HCW (The Star, 2020). More importantly, the system also reduced PPE usage, as there would be no need for full donning and doffing of PPE in between patients, resulting in time- and cost-effectiveness. At AMDI we were fortunate to receive one sampling box from an individual contributor.

Conclusion

There were unavoidable challenges to equip HCW and front-line personnel with sufficient protection to battle COVID-19 pandemic. Malaysian NGOs played a key role during the crisis by involving actively in raising funds, production and distribution of PPE to assist HCW involved at the frontlines. Many organisations were slower to initiate corporate

and community activities contributing to the pandemic response due to a few factors such as unprecedented scope and uncertain outlook of the crisis including its global scope, exponential health and catastrophic economic impacts.

We recommend a strong alliance with corporate organisations and community as an inherent strategy adopted by all organisations as one of their core missions. A favourable networking and linkage engagement would ensure a long-term partnership aligned with the commitments of the stakeholders.

In term of global health and safety and COVID-19 challenges in particular, other ways that a CSR can take place is testing, containing spread of infection, providing countermeasures and maintaining the supply chain.

Nevertheless, AMDI, USM handled these challenges well by strategizing internal and external CSR methods for improving employees' and students' well-being and contribution to the society. At the end of this CSR initiative, we managed to overcome the temporary shortage of PPE faced by the neighbouring health care facilities around AMDI USM. Distribution of the PPE donated by the NGOs and from the DIY PPE project have allowed the front liners and health care workers to carry out their job amidst the threat of COVID-19 infection.

Declaration of Competing Interest

None declared

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