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.

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A cross-sectional study of assessing knowledge, attitude, and practice of COVID-19 resuscitation among health care workers in a hybrid hospital for COVID-19 in Malaysia

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ABSTRACT

Background: The COVID-19 pandemic is an international public health emergency. As hospitals receive more severe forms of COVID-19 that necessitate resuscitation, emergency health care workers (HCW) must follow interim COVID-19 resuscitation guidelines.
Objective: The aim is to evaluate the levels of knowledge, attitude, and practice among emergency HCW of the COVID-19 resuscitation protocol by the European Resuscitation Council (ERC).
Methods: A cross-sectional study using a validated questionnaire was conducted among HCW in the emergency department of University of Malaya Medical Centre (UMMC), Malaysia from April to June 2021.
Results: A total of 159 respondents were included in the analysis (89% response rate). Sixty-eight percent of respondents had adequate knowledge regarding COVID-19 resuscitation. Majority of the respondents had knowledge on airborne-precaution personal protective equipment (PPE) (99%) and infection control measures (98%). Nearly 73% were pessimistic about the COVID-19 prognosis. Seventy-three percent of respondents thought an arrested COVID-19 patient may benefit from cardiopulmonary resuscitation (CPR) and 94% were willing to administer CPR provided airborne-precaution PPE was available. Ninety percent of respondents reported adherence to resuscitation guidelines. There were significant differences in the mean knowledge scores between designation, education levels, and COVID-19 training. Overall, the respondents' level of practice was insufficient (27%), with a mean score of 53.7% (SD = 14.7). There was a lack of practice in the resuscitation of the intubated and patients who were being prone. There was insufficient practice about ventilation technique, use of supraglottic devices, and intubation barriers. There was a positive correlation between adequate knowledge and good practice.
Conclusion: Emergency HCW have adequate knowledge, but poor compliance to the ERC COVID-19 guidelines. Emergency HCW were willing and confident to resuscitate COVID-19 patients, despite fears of nosocomial infection and expectation of poor patients' prognosis. Ongoing education and training programs are recommended to improve their knowledge, cultivate a positive attitude, and achieve good compliance with COVID-19 resuscitation guidelines.

1. Introduction

The COVID-19 pandemic is a global threat and an international public health emergency. As of October 30, 2021, more than 2.4 millions Malaysians were infected with COVID-19, with 28,832 deaths recorded [1]. According to the statistics, 66% of those who died were unvaccinated, 22.4% were partially vaccinated, and 11.6% were completely vaccinated [1]. Patients with older age (≥51 years), underlying comorbidities such as chronic kidney disease and chronic pulmonary disease, and unvaccinated were more likely to be severely affected by COVID-19 [2]. Currently, unvaccinated individuals account for nearly 95% of COVID-19-infected critically ill patients [3]. The

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utilization rate of intensive care unit (ICU) beds across the country had reached 80%, and hospitals are accepting more patients with moderate to severe COVID-19 complications who require resuscitation [4].

COVID-19 is transmitted directly through respiratory droplets or indirectly through contact with contaminated surfaces [5,6]. Airborne transmission may occur in medical institutions during aerosol-generating procedures (AGP) [7–9]. COVID-19 can be spread by particles suspended in the air and may be inhaled by health care workers (HCW) within the vicinity [6]. For a variety of reasons, resuscitation poses significant risks to emergency HCW. Firstly, cardiopulmonary resuscitation (CPR) entails numerous AGP such as chest compressions, assisted ventilation, and tracheal intubation [7–9]. Secondly, resuscitation creates a stressful atmosphere that may contribute to the breaching of infection control measures such as improper donning or doffing of personal protective equipment (PPE) [7]. Thirdly, resuscitation procedures necessitate emergency HCW working in close proximity to one another and patients [7]. Poor adherence to infection control measures may negatively impact the workforce dynamics due to the need for exposed HCW to be quarantined, further reducing an already depleted workforce [7]. As of August 17, 2021, a total of 7,599 (3.05%) of HCW were infected with COVID-19, in which 5,135 (67.6%), had completed their vaccination. About 2,446 (32.2%) were asymptomatic, 10 had moderate illness, 4 had severe illness, and only 3 were severely ill [10]. The main source of infection among HCW was from nosocomial acquisition, further emphasizing the need to implement COVID-19 resuscitation guidelines [11].

Previous resuscitation guidelines did not emphasize the provision of care in biohazard scenarios such as COVID-19. To rectify this, the European Resuscitation Council (ERC) has published COVID-19 resuscitation guidelines highlighting infection control measures [8]. Emergency HCW are the first point of contact with COVID-19 patients and are at the highest risk of occupational exposure due to AGP during resuscitation [9,12]. Previous studies have evaluated HCW knowledge on COVID-19 infection control [13–16]. Bhagavathula et al. found a disparity of knowledge and attitude between doctors and allied heatlh personnel on COVID-19 transmission and disease prevention [13]. Hossain et al. demonstrated that despite 99% of HCW had adequate knowledge on PPE, they had poor practice in correct usage of PPE [14]. Abd Samat et al. had reported 68.9% of emergency HCW had good knowledge, but poor confidence regarding intubation strategies in COVID-19 patients and the risk of viral exposure [15]. However, these studies were focused on infection control measures [13,14,16] or airway management [15] and COVID-19 resuscitation was not explicitly explored.

Given the COVID-19 nosocomial exposure among emergency HCW, assessing their readiness to comply with the ERC guidelines is crucial to prevent viral transmission. The purpose of this study is to address the gap in the levels of knowledge, attitude, and practice (KAP) towards the ERC COVID-19 resuscitation guidelines among emergency HCW.

2. Methods

This study is a prospective cross-sectional research, using a newly developed and validated questionnaire to evaluate the KAP of COVID-19 resuscitation among HCW in the emergency department (ED) of University of Malaya Medical Centre (UMMC), Malaysia. UMMC is a hybrid-COVID-19 tertiary hospital that receives both COVID-19 and non-COVID-19 patients. UMMC has a total of 1,600 beds and 22 ICU beds. More than 150 beds were designated for COVID-19 patients [17]. This study was conducted over a period of two months (April to June 2021). This study was approved by the Medical Research Ethics Committee of UMMC.

The inclusion criteria were emergency HCW involved in resuscitation of COVID-19 patients. This includes specialists in emergency medicine (emergency physician, EP), emergency medicine doctors (medical officer, MO), nurses, and allied health personnel who assist medical doctors during resuscitation (assistant medical officer, AMO) (n = 260). Incomplete questionnaire forms were exlcuded. The sample size was estimated using Krejcie and Morgan (1970) method [18]. With a population size of 260, 50% response rate, 95% confidence interval, Z of 1.96, and 5% margin of error, the calculated sample size was 155. A total of 170 samples was required after adjustment of the 10% dropout rate.

Convenience sampling was used to recruit on-duty emergency HCW. Written consent was obtained from all respondents. The confidentiality of all respondents was ensured and the questionnaire forms were only accessible to the primary investigator.

A KAP questionnaire was developed based on the ERC COVID-19 resuscitation guidelines. The content validity indexes rated by six experts for each KAP domains were 0.95, 0.96, and 1.00, respectively. The internal consistency was calculated using the Cronbach's alpha (α) coefficient, which were 0.74, 0.76, and 0.79 for each KAP domain, respectively. The Cronbach's α coefficient for the entire questionnaire was 0.76. The test and re-test reliability was analysed by the intraclass correlation coefficient of 0.74. The finalised KAP questionnaire was divided into four parts. Part one consisted of the respondents' socio-demographic factors. Part two included 14 knowledge items pertaining resuscitation of COVID-19 patients (K1 – K14). The third section of the questionnaire consisted of 10 items to gauge respondents' attitude towards COVID-19 resuscitation (A15 – A24). The fourth part consisted of 12 items determining level of practice among HCW on COVID-19 resuscitation (P25 – P36) [Supplementary figure S1].

To evaluate respondents' knowledge on COVID-19 resuscitation, the questionnaire included items on transmission modes (K1, K2), AGP (K3, K4), infection control measures (K5 – K8), complications (K9, K10, K14), and predictors of severity (K11 – K13). Respondents' options were "yes", "no", or "I don't know". A correct response was assigned 1 mark, while incorrect or I don't know were assigned 0. To measure attitude, the questionnaire included items on prognosis (A15, A24), willingness to perform CPR (A16, A17, A19, A20), adherence to resuscitation guidelines (A18, A22, A23), and perceptions towards adequacy of resuscitation training (A21). Response options were 5-point Likert Scale (strongly agree, agree, not sure, disagree, strongly disagree). To assess practice levels, questionnaire included items on practice of COVID-19 resuscitation protocol (A25), assessment of cardiac arrest (A26), types of PPE used (A27 – A29), advanced airway management (A30, A32), ventilation technique (A31), and CPR (A33 – A36). Response options were "yes", "no", or "not sure". A score of 1 was given for correct practice and 0 for incorrect or bad practice [Supplementary figure S1].

The results were analysed using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp, Armonk, NY). Descriptive statistics were tabulated as frequency (n), percentage (%), mean, and standard deviation (SD). Levels of knowledge and practice scores were categorised into adequate (>60%) and inadequate (<59.9%). The attitude domain was categorized into positive, not sure, and negative attitudes. The relationships between socio-demographic factors and mean scores for each KAP domains were analysed using independent *t*-test or one-way analysis of variance (ANOVA). Correlation between each KAP domains was analysed using Pearson's rank correlation.

3. Results

Out of the 260 emergency HCW, a total of 179 completed the surveys (89% response rate), and 159 were included in the analysis after excluding 20 incomplete forms. Of these, 62.3% (n = 99) of the respondents were female. The mean age of the respondents was 31.6 (SD = 5.4). This study comprised of 73 (45.9%) nurses, 54 (34%) MO, 23 (14.5%) AMO, and 9 (5.7%) EP. Of these, 39 (24.5%) had working experience between 1 and 4 years, 73 (45.9%) had 5–9 years, and 47 (29.6%) had 10 years or more. Seventy respondents (44%) had a diploma in Nursing, 54 (34%) had a bachelor's degree in Medicine, and 21 (13.2%) had a diploma in Medical Assistant. Most of the respondents had attended Basic Life Support (BLS) 99.4% (n = 158), Advanced Cardiac Life Support (ACLS) 64.8% (n = 103), and COVID-19 training

89.3% (n = 142) [Table 1].

About 95% (n = 151) of the respondents were aware that COVID-19 is transmittted through respiratory droplets and airborne. Eighty-five percent (n = 136) answered chest compression produce aerosol, whereas 66% (n = 106) recognised defibrillation is a non-AGP. Majority of the respondents had knowledge on airborne-precaution PPE (99%, n = 158) and infection control measures (98%, n = 156). Overall, 68% (n = 108) of emergency HCW had adequate knowledge (score >60%), with a mean score of 64.7%. Emergency physicians were the most knowledgeable in COVID-19 resuscitation (69%, SD = 10.1), followed by MO (67.4%, SD = 12.1), AMO (63.9%, SD = 7.9), and nurses (62.4%, SD = 9.1) with $p = 0.027$. Respondents with higher levels of education were more likely to answer correctly regarding COVID-19 resuscitation, whereby bachelor's and master's degree holders' scores were 67.1% (SD = 12.2) and 68.7% (SD = 8.6), respectively. Respondents who participated in COVID-19 training scored higher 65.3% (SD = 10.4) versus 60.0% (SD = 9.1) [Table 2].

Seventy-three percent (n = 117) of the respondents perceived the prognosis of COVID-19 cardiac arrest is poor. Approximately 80% (n = 128) deemed that Do Not Attempt CPR (DNACPR) should be established early in COVID-19 cardiac arrest. Majority of the respondents were willing (94%, n = 150) and confident (72%, n = 114) to perform CPR if airborne-precaution PPE was used. Nearly 80% (n = 127) of the respondents believed CPR on COVID-19 patients should be performed even if no ICU beds were available. The majority of respondents felt that it was critical to assess the risk of viral exposure before performing resuscitation (97%, n = 154) and to adhere to the resuscitation protocol (90%, n = 143). In order to minimize viral exposure, respondents believed the presence of family members during resuscitation should be discouraged (86.8%, n = 138). Seventy-nine percent (n = 126) of the respondents perceived that the hospital provided adequate training for COVID-19 resuscitation [Table 3].

To secure the airway in COVID-19 cardiac arrest, 41% (n = 65) preferred insertion of laryngeal mask airway (LMA) over endotracheal intubation as they believed LMA is more effective. Sixty-seven percent (n = 107) practiced disconnecting the ventilator during resuscitation of COVID-19 cardiac arrest patient. Only 32.7% (n = 52) of the respondents recognised the importance of the two-hand bag-valve-mask (BVM) ventilation technique. Nearly 70% (n = 111) of respondents were unaware that chest compression can be done in prone position. Overall, only 27% (n = 43) correctly practice COVID-19 resuscitation based on the ERC guidelines (score >60%), with a mean score of 53.7% (SD = 14.7).

Emergency physicians and MO adhered better to ERC guidelines compared to other designations with 66.6% (SD = 10.2) and 62.5% (SD = 14.8), respectively. Respondents who had more than 5 years of working experience scored better in practice domain compared to those less experienced (55.7%, SD = 13.8 versus 47.0%, SD = 15.6). The mean practice score among respondents who attained bachelor's (60.5%, SD = 15.8) and master's degree (66.1%, SD = 10.3) were higher than those of lower qualifications. Respondents with ACLS and COVID-19 training conferred higher mean scores of 58.1 (SD = 14.9) and 54.8 (SD = 15.0), respectively [Table 2].

Table 1
Descriptive statistics of the respondents' socio-demographic factors.

Socio-demographic factors	Results	
Gender	n	Percentage (%)
Male	60	37.7
Female	99	62.3
Age	n	Percentage (%)
21 – 30	70	44.0
31 – 40	83	52.2
41 – 50	4	2.5
≥ 51	2	1.3
	Mean (+/- SD): 31.6 (+/-5.4)	
Years of working experience	n	Percentage (%)
1-4	39	24.5
5-9	73	45.9
≥ 10	47	29.6
Occupation	n	Percentage (%)
Emergency physician	9	5.7
Medical officer	54	34.0
Nurse	73	45.9
Assistant medical officer	23	14.5
Educational level	n	Percentage (%)
Diploma	91	57.2
Diploma in Nursing	70	44.0
Diploma in Medical Assistant	21	13.2
Bachelor's degree	58	36.4
Bachelor's degree in Nursing	3	1.9
Bachelor's degree in Medical Assistant	1	0.6
Bachelor's degree in Medicine	54	34.0
Master's degree	10	6.3
Master's degree in Medical Assistant	1	0.6
Master's degree in Emergency Medicine	9	5.6
Attended BLS course	n	Percentage (%)
Yes	158	99.4
No	1	0.6
Attended ACLS course	n	Percentage (%)
Yes	103	64.8
No	56	35.2
Attended COVID-19 training	n	Percentage (%)
Yes	142	89.3
No	17	10.7

Abbreviations: ACLS, Advanced Cardiac Life Support; BLS, Basic Life Support; SD, Standard deviation.

4. Discussions

This study evaluated respondents' KAP towards the COVID-19 resuscitation protocol by the ERC. Sixty-eight percent (n = 108) respondents had adequate knowledge on COVID-19 resuscitation, similar to previous studies [13,15]. Majority of the respondents had adequate knowledge on COVID-19 mode of transmission, AGP, and proper PPE usage. However, this did not translate into good practice as shown by the low correlation coefficient (r-value) of 0.214, p = 0.007 [Table 4]. It is worth noting that this study was conducted during the rapid surge of COVID-19 cases in Malaysia [1]. Afulani et al. found that during massive COVID-19 outbreak, suboptimal pandemic preparedness, stigma of infection, and fear of poor patient outcomes negatively impact patient care [19]. Burnout and fatigue during patient influx were also found to cause feelings of cynicism, pessimism, and negativism inadvertently leading to suboptimal patient care [20].

Nosocomial acquisition of COVID-19 is the main source of infection among HCW [10]. Lack of practice on COVID-19 resuscitation can be deleterious as CPR may generate aerosol, increasing the risk of nosocomial transmission [7,8,9,21]. Proper usage of PPE can reduce the transmission risk during performing AGP [7,8,9,14,15]. In line with this study, Hossain et al. also observed that emergency HCW had good knowledge of distinguishing droplet-precaution PPE from airborne-precaution PPE [14]. Even though airborne-precaution PPE limits the HCW's field of vision, impairs manual dexterity, and interrupts team communication during resuscitation, adherence to PPE standards is critical to avoid nosocomial transmission [9].

This study revealed a knowledge gap between medical doctor and other allied HCW, consistent with previous studies [13,15,16]. However, further analysis to identify independent predictors for knowledge

Table 2
Mean knowledge and practice scores with their confidence levels for socio-demographic factors.

Socio-demographic factors		Knowledge		Practice	
		Mean score (SD)	*p*-value	Mean score (SD)	*p*-value
Gender*	Male	65.7 (11.7)	0.351	55.9 (14. 7)	0.126
	Female	64.1 (9.5)		52.3 (14.6)	
Age**	21–30	63.7 (9.9)	0.707	48.1 (13.5)	0.000
	31–40	65.3 (11.0)		58.3 (14.4)	
	41–50	67.8 (4.1)		52.1 (14.2)	
	≥ 51	67.8 (5.0)		58.3 (0.00)	
Occupation**	EP	69.0 (10.1)	0.027	66.6 (10.2)	0.000
	MO	67.4 (12.1)		62.5 (14.8)	
	Nurse	62.4 (9.1)		47.5 (11.1)	
	AMO	63.9 (7.9)		47.5 (12.9)	
Years of working experience**	1–4	65.5 (10.7)	0.849	47.0 (15.6)	0.004
	5–9	64.4 (11.4)		56.3 (14.1)	
	≥ 10	64.4 (8.1)		55.1 (13.6)	
Educational level**	Diploma	62.6 (8.9)	0.010	47.5 (11.3)	0.000
	Diploma in Nursing	62.4 (9.3)		47.6 (11.1)	
	Diploma in Medical Assistant	63.2 (7.9)		47.2 (12.4)	
	Bachelor's degree	67.1 (12.2)		60.5 (15.8)	
	Bachelor's degree in Nursing	61.9 (4.1)		44.4 (12.7)	
	Bachelor's degree in Medical Assistant	71.4 (0.0)		33.3 (0.0)	
	Bachelor's degree in Medicine	67.4 (12.1)		62.5 (14.8)	
	Master's degree	68.7 (8.6)		66.1 (10.3)	
	Master's degree in Medical Assistant	71.4 (0.0)		66.7 (0.0)	
	Master's degree in Emergency Medicine	69.0 (10.1)		66.7 (10.2)	
Attended BLS*	Yes	64.6 (10.3)	0.182	53.7 (14.8)	0.804
	No	78.5 (0.0)		50.0 (0.0)	
Attended ACLS*	Yes	65.3 (10.6)	0.330	58.1 (14.9)	0.000
	No	63.6 (9.9)		45.4 (10.3)	
Attended COVID-19 training*	Yes	65.3 (10.4)	0.050	54.8 (15.0)	0.004
	No	60.0 (9.1)		44.1 (7.6)	

Abbreviations: ACLS, Advanced Cardiac Life Support; AMO, Assistant medical officer; BLS, Basic Life Support; EP, Emergency physician; MO, Medical officer; SD, Standard deviation.
p-value ≤ 0.05 is considered as a significant.
* Independent *t*-test.
** One-way ANOVA.

score using multinominal regression analysis found no statistical significance for designation, education level, and COVID-19 training. Similarly, Hossain et al. found no disparities in knowledge of COVID-19 infection control measures between medical doctors and other allied HCW [14].

Overall, most respondents were pessimistic about the prognosis of COVID-19 cardiac arrest patients. The respondents' attitude could be explained by a number of factors. Firstly, the study was conducted during the surge of out-of-hospital cardiac arrests (OHCA) due to COVID-19. As of May 29, 14.5% of Malaysia's total COVID-19 fatalities were attributed to OHCA [22]. A similar trend was also reported around the globe [23,24]. In a study conducted in Lombardy, Italy, OHCA had increased by 58% compared to the same period in 2019, with 77% of the cases were attributed to COVID-19 [23]. In Paris, a study investigating the incidence of OHCA reported two-times increase compared to previous years without pandemic, together with a reduction in survival [24]. Secondly, patients with severe COVID-19 pneumonia who suffered cardiac arrest had a dismal prognosis [25]. According to a study conducted in China, 87.5% of patients admitted with severe COVID-19 pneumonia experienced in-hospital cardiac arrest with poor outcomes [25]. Poor survival rates among COVID-19 cardiac arrest patients may have negatively affected the respondents' perceptions of COVID-19 prognosis.

Nevertheless, many respondents demonstrated high levels of confidence and willingness to perform CPR on suspected COVID-19 patients, especially if airborne-precaution PPE was used. The findings of this study paralleled those of Chong KM et al.'s research [26]. On the other hand, another study in Malaysia observed that only 37% of emergency HCW were comfortable resuscitating COVID-19 patients [15]. However, this study was conducted earlier in the pandemic when COVID-19 resuscitation guidelines were novel.

Eighty-five percent (n = 135) of the respondents will only perform defibrillation with airborne-precaution PPE against the ERC recommendations. This may be because defibrillation is usually performed together with other AGP such as chest compression and assisted ventilation [8]. However, in situations where only defibrillation is required, using airborne-precaution PPE may delay defibrillation, worsen patient's prognosis, and lead to PPE wastage. Moreover, the use of adhesive defibrillator pads futher reduces the risk of aerosol exposure to emergency HCW [8].

This study demonstrated that some respondents had a lack of practice in airway management of COVID-19 patients. Numerous guidelines recommend performing rapid sequence intubation for cardiac arrest COVID-19 patients. The usage of second-generation supraglottic devices is recommended as a rescue if the initial intubation is unsuccessful [9]. Nearly 60% of respondents agreed with the usage of aerosol boxes during intubation. This was due to the protocolised airway management in UMMC that had previously advocated for aerosol boxes. However, the use of aerosol boxes is no longer recommended at this time. A recent simulation study demonstrated the degree of contamination with the use of an aerosol box can be offset with proper donning and doffing technique of PPE [27]. Furthermore, the usage of aerosol box was associated with a lower first pass success rate, longer duration to intubation, limit laryngoscopic view, and therefore expose patients to the risk of hypoxia [9,27,28]. For manual BVM ventilation, 67% (n = 107) preferred the single-hand technique ("C-E grip"), which is linked to poor seal and aerosol dispersion [9]. Instead, the airway operator may ensure a secure BVM seal by using two-hands technique ("V grip") [7,8,9].

Moreover, 58% (n = 92) of respondents disconnected the ventilator when an intubated patient goes into cardiac arrest to commence manual BVM. However, in the event of cardiac arrest in an intubated patient, it was recommended that the ventilator should not be disconnected to

Table 3
Respondents' levels of attitude across items.

Item	Question	Number of respondents, n (%)		
		Positive	Negative	Not sure
A15	I feel the outcome of sudden cardiac arrest among COVID-19 patient is very poor.	14 (8.8)	117 (73.6)	28 (14.9)
A16	I think it is worth to perform CPR on COVID-19 patient with sudden cardiac arrest in hospital.	117 (73.6)	23 (14.5)	19 (11.9)
A17	I am confident in performing CPR to COVID-19 patient.	115 (72.3)	21 (13.2)	23 (14.5)
A18	Assessing the risk of exposure to COVID-19 virus before performing resuscitation procedures is important.	154 (96.8)	3 (1.9)	2 (1.3)
A19	I am willing to perform CPR on COVID-19 patient with a proper PPE (gloves, long-sleeved gown, N95 mask, full-face shield or PAPR).	150 (94.3)	7 (4.4)	2 (1.3)
A20	I feel that CPR on COVID-19 patient should be performed ONLY if ICU bed is available.	127 (79.9)	22 (13.8)	10 (6.3)
A21	I believe that my hospital provides us an adequate training on COVID-19 resuscitation.	126 (79.2)	10 (6.3)	23 (14.5)
A22	The presence of family members during COVID-19 resuscitation should be encouraged.	138 (86.8)	12 (7.5)	9 (5.7)
A23	Adherence to COVID-19 resuscitation protocol is mandatory.	143 (90)	0	16 (10)
A24	Discuss and document DNACPR if the COVID-19 patient is unlikely to survive after cardiac arrest.	128 (80.5)	10 (6.3)	21 (13.2)

Abbreviations: CPR, Cardiopulmonary resuscitation; DNACPR, Do not attempt cardiopulmonary resuscitation; ICU, Intensive care unit; PAPR, Powered air-purifying respirator; PPE, Personal protective equipment.

Table 4
Correlation coefficicents between mean scores of knowledge, attitude and practice.

Variable	Correlation coefficient (r-value)	*P*- value
Knowledge-Attitude	0.092	0.251
Knowledge-Practice	0.214	0.007*
Attitude-Practice	0.133	0.095

* Correlation significant at 0.01 level (2-tailed).

prevent the dispersion of aerosols [8]. Most respondents had little to no experience with resuscitation of proned patients. This is due to the expedited admission to the ICU after initial resuscitation and proning is not a common practice in ED. Many were not aware that chest compressions can be performed in prone position by compressing between the scapula at the usual depth and rate [7,8]. However, due to recent full occupancy of ICU beds, it is unavoidable for ED to function as an ICU extension in order to manage critically ill COVID-19 patients.

There are several limitations to this study. Firstly, convenience sampling method was used, with emergency HCW being recruited on-duty. Consequently, there is a possibility of selection bias and those on leave were not included in the study. Random sampling should be used in future studies. Secondly, this study is a single-centred study with a relatively small sample size involving emergency HCW. Hence, it may not represent the entire fraternity of HCW performing COVID-19 resuscitation. Larger multi-centred studies across various departments are recommended to identify the common denominators that affect knowledge, attitude, and practice of HCW regarding COVID-19 resuscitation. Thirdly, the items in this questionnaire were only assessing in-hospital components of the ERC COVID-19 guidelines. Further research may assess COVID-19 resuscitation for both pre-hospital and in-hospital settings.

5. Conclusion

Based on this KAP questionnaire, it can be concluded that emergency HCW have adequate knowledge, but had poor compliance to the ERC COVID-19 guidelines. Emergency HCW were willing to resuscitate COVID-19 patients when airborne-precaution PPE is used, despite fears of nosocomial infection. Emergency HCW were confident to perform CPR, regardless of the expectation of poor prognosis in COVID-19 cardiac arrest patients. Therefore, continued educational programs and training are strongly recommended to further enhance their knowledge, cultivate a positive attitude, and establish good compliance with COVID-19 resuscitation guidelines.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary figure S1

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ienj.2022.101214.

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