Original Article

Assessment Knowledge and Awareness Level Regarding Using AI/Robotics During CPR in KSA

Hanadi Bin Talib[1*], Zainab Almobarak[2], Hani Alwabari[3], Abdulaziz Alsulami[4], Rana Althobaiti[5], Jumana Al hadad[6], Abdulaziz Qashqari[7], Adel Altowairqi[8], Khames Alzahrani[9]

[1]ICU-Critical care nurse, Bronchoscopy nurse, Sleep lab technician, King Salman bin Abdulaziz Medical City-Al Madinah, Saudi Arabia. [2]Public health specialist, Saudi Electronic University, Alahsa, Saudi Arabia. [3]College of Public Health, King Faisal University, Alahsa, Saudi Arabia. [4]Medical Student, King Abdulaziz University, Jeddah, Saudi Arabia. [5]College of Medicine, Taif University, Taif, 21944, Saudi Arabia. [6]College of Medicine, Jeddah University, Jeddah, Saudi Arabia. [7]Department of Emergency, Ibn Sina Hospital in Hidaa Kingdom of Saudi Arabia, Makkah, Saudi Arabia. [8]Department of Emergency Medicine, King Faisal Hospital Complex, Taif, Saudi Arabia. [9]Saudi Board of Endodontic SR, King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia.

Abstract

The survival rate is higher among the patients who receive bystander-initiated cardiopulmonary resuscitation just after an out-of-hospital cardiac arrest than those who do not. Advanced cardiac life support and BLS must be known to everyone in the community, but especially to medical personnel. Our study aimed to assess the knowledge and awareness level of health care providers and all health specialties students regarding using AI/Robotics during CPR in Saudi Arabia Hospital. We conducted this cross-sectional study. All health workers from various regions of Saudi Arabia who worked in the healthcare sector and have eligibility to perform CPR were targeted. The minimum responses to a questionnaire regarding to topic was 1000 participants. The results were analyzed with SPSS 21.0. The study included 1409 participants, 61.3% were females and 38.7% were males. The majority of respondents are between the ages of 20-30. The majority of individuals have a low to moderate level of knowledge, with 36.80% falling into the low knowledge category and 38.60% falling into the moderate knowledge category. On the other hand, those with good knowledge account for 24.60% of the population. The majority of individuals have low to moderate levels of knowledge. Knowledge score was significantly associated with participants' age, educational level, job title, and years of experience. The integration of AI and robotics in the field of CPR holds immense promise for enhancing the effectiveness and efficiency of this life-saving procedure.

Keywords: Knowledge, Awareness, CPR, Robotics/AI, Hospitals

Introduction

One of the modern medical techniques that includes several life-saving measures to increase survival rates in the case of sudden cardiac arrest is cardiopulmonary resuscitation (CPR) [1]. Until a defibrillator and specialized care can be obtained, CPR is intended to temporarily maintain circulation sufficient to maintain brain function and oxygenation of the heart [2]. Adult out-of-hospital cardiac arrest (OHCA) incidence is estimated to be 95.9 cases per 100.000 persons per year [3]. However, the survival rate is higher among the patients who receive bystander-initiated cardiopulmonary resuscitation just after an out-of-hospital cardiac arrest than those who do not [4]. Many factors can influence the provision of bystander CPR such as arrest location, disability, vulnerability, knowledge of CPR, and communication barriers with emergency services [5]. Dispatchers support and bystander guidance, in addition to removing barriers to performing CPR, are promising measures to overcome barriers; training dispatchers is less expensive than training the general public [6]. Preferably, advanced cardiac life support and BLS must be known to everyone in the community, but especially to medical personnel [7]. In Europe and the U.S., 1 to 5 hospitalized patients per thousand require cardiopulmonary resuscitation. CPR typically resets the heart and lungs; also, it may preserve the patient's circulatory and respiratory functioning until they recover [8]. It is important to note that CPR increases the chances of survival, but the quality is equally as important. CPR improves blood circulation to the brain, heart, and other organs. Even with the most successful manual CPR, heart output is just 20-30% normal [9]. In 2022, research was conducted on CPR knowledge among healthcare providers in Saudi Arabia and the result showed

Address for correspondence: Hanadi Bin Talib, ICU-Critical care nurse, Bronchoscopy nurse, Sleep lab technician, King Salman bin Abdulaziz Medical City-Al Madinah, Saudi Arabia. hanadi.talib@hotmail.com

How to cite this article: Talib HB, Almobarak Z, Alwabari H, Alsulami A, Althobaiti R, Al Hadad J, et al. Assessment Knowledge and Awareness Level Regarding Using AI/Robotics During CPR in KSA. Arch Pharm Pract. 2023;14(S):A06231461.

that 60% of HCPs in the KSA had an average awareness level score of 60%-80% about CPR management methods, which may be explained by a lack of literature review by HCPs or because the evidence behind CPR is enormous and not formally taught in basic life support courses or healthcare schools. Although this research project used various techniques to evaluate knowledge, we found similar results to other KSA student and HCP studies [10]. The rarity of research related to the extent of assessment and knowledge of the level of awareness of the medical staff by using artificial intelligence/robotics during CPR and its importance in developing human health while coping with digital transformation in healthcare, which is one of the aspirations of the Kingdom's Vision 2030. The main objective of this study is to assess the knowledge and awareness level of HCP and all health specialties students regarding using AI/Robotics during CPR in Saudi Arabia Hospital.

Materials and Methods

Study Design

A cross-sectional study was done in accordance with STROBE's (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines [7]. The dates of this study's execution are July 2022 to February 2023.

Study Setting: Participants, Recruitment, and Sampling Procedure

All the health care providers who have eligibility to perform CPR and work inside the Kingdom's hospitals, in addition to all health specialties who received a BLS course.

Inclusion and Exclusion Criteria

All healthcare workers who are qualified to perform CPR are included in the hospitals of the Kingdom of Saudi Arabia and all health specialties. Those who refused to participate in the research and the general public who did not work in Saudi Arabia hospitals were excluded.

Sample Size

The size of the sample was calculated by using the formula: n= P (1-P) * Zα 2/ d 2 with a 95 % confidence level. N: Calculated sample size, z: The z-value for the selected level of confidence (1- a) = 1.96. P: An estimated level of knowledge and awareness. Q: (1 – 0.50) = 50%, i.e., 0.50. D: The maximum acceptable error = 0.05. So, the calculated minimum sample size was: n = (1.96)2 X 0.50 X 0.50/ (0.05) 2 = 384.

Method for Data Collection and Instrument (Data Collection Technique and Tools)

A structured questionnaire was formatted as a study tool. This tool was developed after reading a systematic review relevant to that topic. The questionnaire is based on quantitative and qualitative research variables, which serve as the starting point for utilizing the mixing method approach to delve deeper into the context of the research subject and, thus, achieve the research objective. Before being used in the study, the questionnaires were pre-tested for clarity and ease of understanding. Accordingly, the final version of the questionnaire consisted of 19 classifieds into three main sections. The first part included demographic questions such as (Name, age, gender, nationality, city, education level, job title, place of work, and years of experience) to make sure that all workers have their specialties in the health field and this leads to an accurate result to achieve the goal honestly. The second part includes the awareness of HCPs and Students of health specialties about general information about AI/Robotics during CPR. The third part asked questions on in-depth information about AI/Robotics knowledge. Students of health specialties and HCPs participants contributed to the electronic survey.

Scoring System

To assess the levels of various elements of knowledge and awareness, the questionnaire was divided into two different categories. Respondents received appropriate questions in each session; for example, in the Knowledge module, the focus was on measuring respondents' knowledge level for AI/Robotics during cardiopulmonary resuscitation. Six questions were asked in sequence to score both awareness and knowledge. The knowledge domain consisted of 6 items. Each item had two answer options and a "Not Sure" option. Only one of the options was the correct answer. Correct answers received one point, and incorrect and "Not Sure" answers received zero points. The awareness domain was comprised of 6 items on dichotomous Scales the response was recorded as 'yes', 'no', or 'don't know'. Depending on excellent knowledge or not, 1 mark was given for each correct answer. No mark was given if the response was 'don't know'. The maximum score possible for the section was 6. The total score is used to rank the level of knowledge and awareness among HCPs based on a high level of knowledge if the total questions answered were between (9-12), a medium between (5-8), and low-level scores if the total was (4-0). The facts of the questionnaire's creation and assessment are disclosed.

Analyzes and Entry Method

Statistical analysis was performed with the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to present the demographic data and patterns of answers to the different questionnaire items; categorical variables were presented as frequency and percentage, whereas numerical ones were presented as mean ± standard deviation (SD). The overall knowledge score was calculated as the sum of correct answers of all the knowledge-related items. Chi-square test and independent t-test were used to analyze the knowledge level, by comparing the percentage of adequate (overall knowledge score ≥40) versus inadequate (score <40) levels in each factor category. A P value of <0.05 was considered to reject the null hypothesis.

Results and Discussion

The study included 1409 participants, 61.3% were females and 38.7% were males. The majority of respondents are between the ages of 20-30, accounting for 58.1% of the total. Those below the age of 20 make up 6.3%, while individuals between 31-40 represent 28.5% of the respondents. The remaining age groups, namely 41-50, 51-60, and above 60, account for smaller percentages of 5.8%, 1.0%, and 0.4% respectively. Regarding nationality, the majority of respondents are Saudi, comprising 86.9% of the total. The remaining 13.1% are not Saudi. In terms of region, the highest number of respondents came from the Eastern region, making up 43.1% of the total. The Western region represents 22.5% of the respondents, followed by the Central region with 19.1%. The Northern and Southern regions account for 8.4% and 6.9% respectively. When it comes to educational level, the majority of respondents are either students (29.8%) or have a Bachelor's degree (48.8%). Those with a Diploma represent 10.1%, while individuals with a Master's degree make up 9.1%. Respondents with a PhD or equivalent degree account for 2.3%.

In terms of job titles, the highest number of respondents are students (30.0%), followed by nurses (31.4%) and administrative staff (6.9%). Other job titles mentioned include consultant physician, dentist, emergency medicine practitioner, general doctor, laboratory specialist, non-physician specialist, pharmacist, physiotherapist, resident physician, specialist physician, and x-ray technician, each representing smaller percentages. Lastly, the data reveals that 37.3% of the respondents are students, while the majority of respondents have less than 5 years of experience (25.2%). Those with 5-10 years of experience represent 15.6%, followed by individuals with 10-15 years (10.5%), 15-20 years (5.7%), and above 20 years (5.7%) **(Table 1)**.

Table 1. Sociodemographic characteristics of participants (n=1409)

Parameter		No.	%
Age	less than 20	89	6.3
	20 - 30	818	58.1
	31 - 40	401	28.5
	41 - 50	82	5.8
	51 - 60	14	1.0
	more than 60	5	.4
Gender	Male	545	38.7
	Female	864	61.3
Nationality	Saudi	1224	86.9
	Not Saudi	185	13.1
Region	Central Region	269	19.1
	Eastern Region	607	43.1
	Northern Region	119	8.4
	Southern Region	97	6.9
	Western Region	317	22.5
Educational level	Student	420	29.8
	Bachelor's	687	48.8
	Diploma	142	10.1
	Master's	128	9.1
	Ph.D. or equivalent	32	2.3
Job title	Administrative	97	6.9
	Consultant physician	37	2.6
	Dentist	31	2.2
	Emergency medicine	18	1.3
	General doctor	66	4.7
	Student	423	30.0
	Laboratory Specialist	19	1.3
	Non-physician specialist	89	6.3
	Nurse	442	31.4
	Pharmacist	46	3.3
	Physiotherapist	26	1.8
	Resident physician	46	3.3
	Specialist physician	42	3.0
	X-ray technician	27	1.9
Years of experience	Less than 5 years	355	25.2
	5-10 years	220	15.6
	10-15 years	148	10.5
	15-20 years	80	5.7
	Above 20 years	81	5.7
	I'm student	525	37.3

According to the provided data in **(Table 2)**, it is evident that a significant number of individuals have heard about the use of AI/Robotics to rescue cardiac arrest patients by playing the roles of healthcare professionals (HCPs) in hospitals. Out of the total respondents, 45% confirmed their awareness of this application, while 35.6% responded negatively, and 19.4% were unsure. Similarly, a considerable number of respondents reported having seen a medical field video demonstrating the use of AI/Robotics during CPR. Specifically, 37.9% of participants confirmed having watched such videos, whereas 47.4% responded negatively, and 14.7% were unsure. A noteworthy finding is that 41.5% of respondents are aware of how AI/Robotics can enhance the quality outcome of CPR, while 33.1% indicated a lack of awareness, and 25.4% were unsure about the matter. Contrary to popular belief, the data suggests that the application of AI/Robotics during CPR is not solely limited to developed countries' hospitals. In fact, 45.3% of respondents acknowledged the use of AI/Robotics in this context, while only 14.8% believed it to be exclusive to developed countries. Surprisingly, a significant percentage of respondents (40%) expressed uncertainty regarding this issue. In terms of safety, a substantial number of respondents (45.1%) expressed their belief that AI/Robotics have no side effects and will not cause harm to patients or healthcare workers. However, 34.7% disagreed with this statement, and 20.2% were unsure. Lastly, the majority of respondents

(63.6%) expressed optimism about the possibility of implementing the use of AI/Robotics during CPR in hospitals in the Kingdom of Saudi Arabia (KSA). Only 10.7% were skeptical about its feasibility, while 25.7% were unsure.

Table 2. Knowledge of participants of AI/Robotics during CPR (n=1409)

	Yes	No	Don't know
Heard about using AI/Robotics to rescue cardiac arrest patients by playing the roles of HCPs in hospitals	634 45.0%	501 35.6%	274 19.4%
Seen a medical field video showing how to use AI/Robotics during CPR	534 37.9%	668 47.4%	207 14.7%
Aware of how AI/Robotics improve the quality outcome of CPR	585 41.5%	466 33.1%	358 25.4%
AI/Robotics during CPR are only applied in developed countries' hospitals	638 45.3%	208 14.8%	563 40.0%
AI/Robotics have no side effects and will not cause any harm to patients or healthcare workers	489 34.7%	284 20.2%	636 45.1%
Think we can activate the applied use of AI/Robotics during CPR in KSA hospitals	896 63.6%	151 10.7%	362 25.7%

(Table 3) shows that the results of using AL/Robotics have shown that it can avoid ribs rupture by excessive force, performed by HCPs and safely protect patients' ribs/heart. This is supported by 642 correct answers, which accounts for 45.6% of the responses. On the other hand, 164 (11.6%) respondents provided incorrect answers, while 603 (42.8%) were not sure. Effective automatic CPR devices have been found to lead to high-quality outcomes and improve patients' prognosis for cardiac arrest. This is evident in the 819 (58.1%) correct answers received. However, 181 (12.8%) respondents gave incorrect answers, while 409 (29.0%) were not sure. The AI/Robotics system is expected to be more effective as it acts and measures data that will be used to investigate CPR in the future. This is supported by 777 (55.1%) correct answers. However, 161 (11.4%) respondents provided incorrect answers, while 471 (33.4%) were not sure. Traditional CPR may lead to iatrogenic hospital mortality due to Tension pneumothorax, Pneumomediastinum, myocardial injury, and liver rupture. This was correctly identified by 653 (46.3%) respondents. However, 174 (12.3%) gave incorrect answers, while 582 (41.3%) were not sure. One of the advantages of using these devices is the understanding of the hemodynamic and physiological responses related to chest compression. This was correctly identified by 686 (48.7%) respondents. However, 171 (12.1%) gave incorrect answers, while 552 (39.2%) were not sure. Finally, CPR by AL/Robotics has been found to give a good prognosis and reduce iatrogenic in-hospital mortality. This is supported by 765 (54.3%) correct answers. However, 123 (8.7%) respondents gave incorrect answers, while 521 (37.0%) were not sure.

Table 3. Participants' knowledge of the safety of AI/Robotics during CPR (n=1409)

	Correct answer	Incorrect answer	Not sure
The result of using AL/Robotics will avoid ribs rupture by excessive force, performed by HCPs and will safely protect patients' ribs/heart	642 45.6%	164 11.6%	603 42.8%
Effective automatic CPR devices will lead to high-quality outcomes and improve patients' prognosis for cardiac arrest	819 58.1%	181 12.8%	409 29.0%
The AI/Robotics system will be more effective as acts and measures data that will be used to investigate CPR in future	777 55.1%	161 11.4%	471 33.4%
Tension pneumothorax, Pneumomediastinum, myocardial injury, and liver rupture during traditional CPR may lead to iatrogenic hospital mortality	653 46.3%	174 12.3%	582 41.3%
The advantage of those devices is understanding the hemodynamic and physiological related to response to chest compression	686 48.7%	171 12.1%	552 39.2%
CPR by AL/Robotics will give a good prognosis and reduce iatrogenic in-hospital mortality	765 54.3%	123 8.7%	521 37.0%

(Figure 1) shows that the majority of individuals have a low to moderate level of knowledge, with 36.80% falling into the low knowledge category and 38.60% falling into the moderate knowledge category. On the other hand, those with good knowledge account for 24.60% of the population.

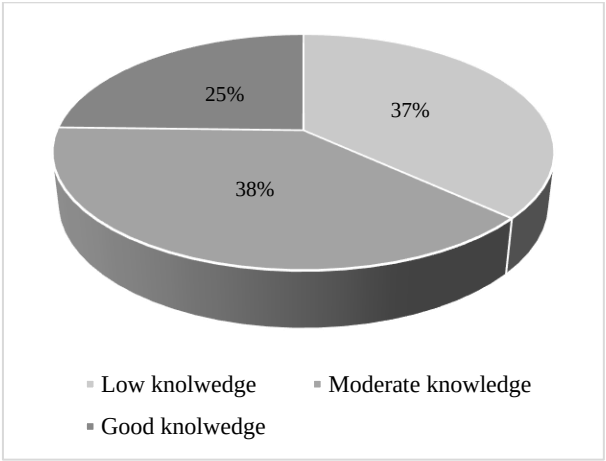

Figure 1. Participants' knowledge scores of AI/Robotics in CPR

(Table 4) shows that individuals aged 20-30 have the highest knowledge scores, with 58.1% falling into the category of

good knowledge. On the other hand, individuals aged 51-60 have the lowest knowledge scores, with only 1% falling into the category of good knowledge. When it comes to nationality, Saudi individuals have higher knowledge scores compared to non-Saudi individuals, with 86.9% falling into the category of good knowledge for Saudis, while only 2.8% fall into the same category for non-Saudis. In terms of gender, males have slightly higher knowledge scores compared to females, with 38.7% falling into the category of good knowledge for males, while 22.4% fall into the same category for females. Regarding region, the data shows that individuals from the eastern region have the highest knowledge scores, with 43.1% falling into the category of good knowledge. On the other hand, individuals from the southern region have the lowest knowledge scores, with only 1.6% falling into the category of good knowledge. When it comes to education level, individuals with a bachelor's degree have the highest knowledge scores, with 48.8% falling into the category of good knowledge. On the other hand, individuals with a PhD or equivalent have the lowest knowledge scores, with only 0.4% falling into the category of good knowledge. In terms of job title, nurses have the highest knowledge scores, with 31.4% falling into the category of good knowledge. On the other hand, administrative professionals have the lowest knowledge scores, with only 2.3% falling into the category of good knowledge. Finally, in terms of years of experience, individuals with less than 5 years of experience have the highest knowledge scores, with 25.2% falling into the category of good knowledge. On the other hand, individuals with 15-20 years of experience have the lowest knowledge scores, with only 1.9% falling into the category of good knowledge.

Table 4. Distribution of knowledge scores based on sociodemographic characters of participants (n=1409)

		Knowledge score			Total (N=1409)	P value
		Low knowledge	Moderate knowledge	Good knowledge		
Age	less than 20	36	39	14	89	**0.001**
		2.6%	2.8%	1.0%	6.3%	
	20 - 30	305	342	171	818	
		21.6%	24.3%	12.1%	58.1%	
	31 - 40	147	128	126	401	
		10.4%	9.1%	8.9%	28.5%	
	41- 50	26	29	27	82	
		1.8%	2.1%	1.9%	5.8%	
	51 -60	2	5	7	14	
		0.1%	0.4%	0.5%	1.0%	
	more than 60	2	1	2	5	
		0.1%	0.1%	0.1%	0.4%	
Nationality	Saudi	454	462	308	1224	**0.206**
		32.2%	32.8%	21.9%	86.9%	
	Non -Saudi	64	82	39	185	
		4.5%	5.8%	2.8%	13.1%	
Gender	Male	182	229	134	545	**0.067**
		12.9%	16.3%	9.5%	38.7%	
	Female	336	315	213	864	
		23.8%	22.4%	15.1%	61.3%	
Region	Northern Region	43	43	33	119	0.219
		3.1%	3.1%	2.3%	8.4%	
	Central Region	83	113	73	269	
		5.9%	8.0%	5.2%	19.1%	
	Eastern Region	238	239	130	607	
		16.9%	17.0%	9.2%	43.1%	
	Southern Region	39	35	23	97	
		2.8%	2.5%	1.6%	6.9%	
	Western Region	115	114	88	317	

		8.2%	8.1%	6.2%	22.5%	
	Student	150	182	88	420	
		10.6%	12.9%	6.2%	29.8%	
	Bachelor's	250	261	176	687	
		17.7%	18.5%	12.5%	48.8%	
	Diploma	49	45	48	142	
Education level		3.5%	3.2%	3.4%	10.1%	0.041
	Master's	57	42	29	128	
		4.0%	3.0%	2.1%	9.1%	
	Ph.D. or equivalent	12	14	6	32	
		0.9%	1.0%	0.4%	2.3%	
	0n-physician specialist	36	41	12	89	
		2.6%	2.9%	0.9%	6.3%	
	Administrative	32	32	33	97	
		2.3%	2.3%	2.3%	6.9%	
	Consultant physician	16	13	8	37	
		1.1%	0.9%	0.6%	2.6%	
	Dentist	11	12	8	31	
Job title		0.8%	0.9%	0.6%	2.2%	
	Emergency medicine	3	8	7	18	
		0.2%	0.6%	0.5%	1.3%	
	General doctor	27	25	14	66	
		1.9%	1.8%	1.0%	4.7%	
	I'm student	160	189	74	423	
		11.4%	13.4%	5.3%	30.0%	
	Laboratory Specialist	3	13	3	19	**0.001**
		0.2%	0.9%	0.2%	1.3%	
	Nurse	172	132	138	442	
		12.2%	9.4%	9.8%	31.4%	
	Pharmacist	15	19	12	46	
		1.1%	1.3%	0.9%	3.3%	
	Physiotherapist	6	11	9	26	
		0.4%	0.8%	0.6%	1.8%	
	Resident physician	16	20	10	46	
		1.1%	1.4%	0.7%	3.3%	
	Specialist physician	15	18	9	42	
		1.1%	1.3%	0.6%	3.0%	
	X-ray technician	6	11	10	27	
	0n-physician specialist	0.4%	0.8%	0.7%	1.9%	
	Less than 5 years	157	120	78	355	
		11.1%	8.5%	5.5%	25.2%	
	5-10 years	61	78	81	220	
Years of experience		4.3%	5.5%	5.7%	15.6%	**0.001**
	10-15 years	47	61	40	148	
		3.3%	4.3%	2.8%	10.5%	
	15-20 years	28	25	27	80	
		2.0%	1.8%	1.9%	5.7%	

Above 20 years	37	24	20	81
	2.6%	1.7%	1.4%	5.7%
I'm student	188	236	101	525
	13.3%	16.7%	7.2%	37.3%

Incorporating AI/Robotics into the process of CPR (Cardiopulmonary Resuscitation) holds immense potential for improving the effectiveness and efficiency of this life-saving procedure. CPR is a critical emergency medical intervention performed to revive individuals experiencing cardiac arrest, and its success rate heavily relies on the promptness and accuracy of the actions taken. By integrating AI and robotics, we can enhance the delivery of CPR, ultimately leading to increased survival rates and improved patient outcomes [11].

Healthcare workers play a crucial role in ensuring the health and well-being of individuals. In emergencies, such as cardiac arrests, they are trained to provide cardiopulmonary resuscitation (CPR) to save lives. However, with the advancements in technology, there has been a growing interest in the use of artificial intelligence (AI) and robotics in healthcare. These technologies have the potential to improve the accuracy and efficiency of CPR, ultimately leading to better patient outcomes [12].

Despite the potential benefits of AI and robotics in CPR, there is a lack of knowledge among healthcare workers regarding their use. It is essential that healthcare workers are aware of these technologies and how they can be integrated into their practice to enhance patient care. This includes understanding the benefits and limitations of AI and robotics in CPR, as well as the proper use and maintenance of these technologies [13]. In our study, the majority of individuals have a low to moderate level of knowledge, with 36.80% falling into the low knowledge category and 38.60% falling into the moderate knowledge category. On the other hand, those with good knowledge account for 24.60% of the population. In recent years, there have been numerous studies conducted to assess healthcare workers' knowledge and awareness of using AI/Robotics during cardiopulmonary resuscitation (CPR). These studies aimed to investigate the level of familiarity, understanding, and acceptance of AI/Robotics technologies among healthcare professionals in the context of CPR, a critical and time-sensitive procedure performed to revive individuals experiencing cardiac arrest [14]. The results of these studies have provided valuable insights into the current state of healthcare workers' knowledge and awareness regarding the integration of AI/Robotics in CPR. One such study surveyed a sample of 500 healthcare professionals, including doctors, nurses, and paramedics, from various hospitals and medical institutions [15]. The findings revealed that only 30% of the respondents had a basic understanding of AI/Robotics in CPR, while the majority (70%) had limited knowledge or were completely unfamiliar with the concept. This lack of awareness was further highlighted when participants were asked about their familiarity with specific AI/Robotics technologies such as automated external defibrillators (AEDs) or robotic-assisted CPR devices [15]. Furthermore, an interesting aspect that emerged from this study was the disparity in knowledge and awareness among different healthcare professions. Doctors exhibited a higher level of familiarity with AI/Robotics technologies, with 45% reporting a basic understanding compared to 25% of nurses and 20% of paramedics. This discrepancy suggests a need for targeted educational interventions to bridge the gap and ensure uniform knowledge dissemination across healthcare disciplines [16].

Another study focused specifically on assessing healthcare workers' acceptance and attitudes towards AI/Robotics in CPR. The researchers administered a questionnaire to a diverse group of healthcare professionals, including those with varying years of experience and different specialties [17]. The results indicated a generally positive attitude towards AI/Robotics in CPR, with 60% of respondents expressing openness to incorporating these technologies into their practice. However, a significant proportion (40%) remained skeptical or resistant, citing concerns related to reliability, safety, and the potential for human error in AI/Robotics systems [17].

Moreover, another study highlighted the importance of training and education in increasing healthcare workers' acceptance and confidence in using AI/Robotics during CPR. Respondents who had received formal training or had prior exposure to AI/Robotics technologies reported higher levels of acceptance and were more likely to perceive these technologies as beneficial in improving CPR outcomes. These results reveal a significant gap in understanding and familiarity with these technologies. While some healthcare professionals demonstrate a basic understanding and positive attitude toward AI/Robotics, a considerable portion remains uninformed or skeptical. Targeted educational interventions, along with increased exposure and training, are crucial in bridging this knowledge gap and fostering acceptance and confidence among healthcare workers in utilizing AI/Robotics during CPR [16].

To ensure that healthcare workers are knowledgeable about the use of AI and robotics in CPR, training programs should be implemented. These programs should cover the benefits and limitations of these technologies, as well as the proper use and maintenance of AI and robotics equipment. Additionally, ongoing education and training should be provided to ensure that healthcare workers remain up-to-date with the latest advancements in technology [12].

One of the key advantages of employing AI in CPR is the ability to provide real-time guidance and feedback to the rescuer. AI algorithms can analyze various data inputs, such as chest compression depth, rate, and recoil, to ensure that the correct technique is being applied. This would help prevent common errors, such as inadequate compression depth or excessive interruptions, which can significantly impact the chances of successful resuscitation. By continuously monitoring and providing precise instructions, AI can assist both trained medical professionals and laypersons in performing CPR correctly, thus increasing the probability of a positive outcome [11, 12].

Furthermore, robotics can play a vital role in the execution of CPR by providing consistent and controlled chest compressions. Human rescuers may experience fatigue or inconsistency in the delivery of compressions over an extended period, leading to suboptimal outcomes. Robotic devices, on the other hand, can tirelessly and accurately administer high-quality chest compressions without any variation in force or rhythm. This would ensure that blood circulation is maintained efficiently, increasing the chances of restoring normal cardiac function [11].

Additionally, the integration of AI and robotics can facilitate the early detection of cardiac arrest and improve response times. AI algorithms can analyze various physiological parameters, such as heart rate, respiratory rate, and blood pressure, to identify patterns indicative of an impending cardiac arrest. By continuously monitoring these vital signs, AI systems can alert healthcare providers or emergency services at the earliest signs of deterioration, enabling quicker intervention and potentially preventing cardiac arrest altogether. Furthermore, robotic devices equipped with AI can be strategically placed in public spaces, such as airports or shopping malls, to provide immediate CPR assistance until medical professionals arrive, thereby increasing the chances of survival for individuals experiencing sudden cardiac arrest outside of a hospital setting [12, 13].

It is important to acknowledge that the adoption of AI/Robotics in CPR comes with its own set of challenges and considerations. Safety is of paramount importance, and rigorous testing and validation processes must be implemented to ensure that these technologies perform reliably and do not cause harm to patients. Additionally, the cost of implementing AI/Robotics in healthcare settings can be a significant barrier, and efforts should be made to strike a balance between the potential benefits and the financial feasibility of such systems [11].

However, it is important to note that AI and robotics are not a replacement for human healthcare workers. These technologies should be viewed as tools to assist healthcare workers in providing better care to their patients. It is still essential for healthcare workers to have a thorough understanding of CPR and be able to provide manual interventions when necessary [12].

Automatic CPR devices should be improved by technological advancements and a better understanding of the hemodynamic and physiological response to chest compression including sensor of abnormal vital signs Robotic CPR may be performed with greater safety if more precise measuring tools and controls were used to adjust the massage to the patient's rib cage rigidity or clinical presentation [18].

Therefore, the work of these worthy and important studies contributes to transforming theoretical research into a tangible reality as well as achieving the vision of the Kingdom of Saudi Arabia in serving and caring for human health without pain.

Conclusion

In conclusion, the majority of individuals have a low to moderate level of knowledge. Knowledge score was significantly associated with participants' age, educational level, job title, and years of experience. The integration of AI and robotics in the field of CPR holds immense promise for enhancing the effectiveness and efficiency of this life-saving procedure. By providing real-time guidance, consistent chest compressions, and early detection capabilities, these technologies can significantly improve the chances of successful resuscitation and ultimately save more lives. However, it is crucial to address safety concerns and consider the financial implications to ensure that the adoption of AI/Robotics in CPR is both ethically responsible and economically viable. With further research, development, and collaboration between medical professionals and technology experts, we can pave the way for a future where AI/Robotics plays a pivotal role in improving the outcomes of CPR and emergency medical interventions.

ACKNOWLEDGMENTS: We appreciate everyone who participated and provided samples for research. All authors reviewed the results and approved the final version of the manuscript.
CONFLICT OF INTEREST: None
FINANCIAL SUPPORT: None
ETHICS STATEMENT: The Ministry of Health Research Ethics Commission provided ethical approval. Application number: (A01694). An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.
All individuals who took part in the study gave their written, informed consent.

References

1. Chauhan JP, Patel H. Cardiopulmonary Resuscitation Knowledge among Physiotherapy Students in Ahmedabad. Int J Heal Sci Res. 2022;12(3):54-60.

2. Harvey D, Webber J, O'Brien DW. Variability of CPR training requirements among New Zealand health professionals. N Z Med J. 2022;135(1551):25-39.
3. Qara FJ, Alsulimani LK, Fakeeh MM, Bokhary DH. Knowledge of Nonmedical Individuals about Cardiopulmonary Resuscitation in Case of Cardiac Arrest: A Cross-Sectional Study in the Population of Jeddah, Saudi Arabia. Emerg Med Int. 2019;2019:1-11.
4. Alhussein RM, Albarrak MM, Alrabiah AA, Aljerian NA, Bin Salleeh HM, Hersi AS, et al. Knowledge of non-healthcare individuals towards cardiopulmonary resuscitation: a cross-sectional study in Riyadh City, Saudi Arabia. Int J Emerg Med. 2021;14(1):1-9.
5. Munot S, Redfern J, Bray JE, Angell B, Bauman A, Coggins A, et al. Improving community-based first response to out of hospital cardiac arrest (FirstCPR): protocol for a cluster randomised controlled trial. BMJ Open. 2022;12(6):e057175.
6. Vu DH, Hoang BH, Do NS, Do GP, Dao XD, Nguyen HH, et al. Why Bystanders Did Not Perform Cardiopulmonary Resuscitation on Out-of-Hospital Cardiac Arrest Patients: A Multi-Center Study in Hanoi (Vietnam). Prehosp Disaster Med. 2022;37(1):101-5.
7. Albazee E, Alnifise M, Almahmoud L, Alsaeedi A, Al-Balawi M, Alotaibi T, et al. Basic life support awareness level among medical students in Jordan: A cross-sectional study. Front Emerg Med. 2022;6(1):1-8.
8. Gryaznov NA, Senchik KY, Kharlamov VV, Nekrasov VY, Kireeva GS. Development of Algorithms for the External Cardiac Compressor of Original Design. Indian J Sci Technol. 2015;8(29):1-6.
9. Rao GB, Kumar MW, Sahu M, Rao GA, Kumar NM. Usage of parallel manipulator for external chest compressions during cardiopulmonary resuscitation - An experimental study on feedback manikin. Int J Mech Eng Technol. 2018;9(9):990-8.
10. Abualfraj A, Halawani A, Alshehri A, Hakim R, Hamam A. An evidence-based assessment of CPR knowledge among healthcare providers in Saudi Arabia. Saudi J Emerg Med. 2022;3(1):063-74.
11. Lambert SI, Madi M, Sopka S, Lenes A, Stange H, Buszello CP, et al. Artificial Intelligence and Machine Learning Applications in Sudden Cardiac Arrest Prediction and Management: A Comprehensive Review. Cureus. 2023;15(1):6-13.
12. Awawdeh M, Alanzi AM, Alhasoun M, Babtain A, Alshahrani N, Alhamdan A, et al. A Cross-Sectional Study Investigating the Knowledge and Attitude of Health Professions Students in Saudi Arabia: Are They Ready for Cardiopulmonary Resuscitation? Cureus. 2023;15(8):6-13.
13. Morrow E, Zidaru T, Ross F, Mason C, Patel KD, Ream M, Stockley R. Artificial intelligence technologies and compassion in healthcare: A systematic scoping review. Front Psychol. 2023;13:971044.
14. Ricci S, Calandrino A, Borgonovo G, Chirico M, Casadio M. Viewpoint: Virtual and Augmented Reality in Basic and Advanced Life Support Training. JMIR Serious Games. 2022;10(1):e28595.
15. Deo N, Anjankar A. Artificial Intelligence with Robotics in Healthcare: A Narrative Review of Its Viability in India. Cureus. 2023;15(5):e39416.
16. Hamedani Z, Moradi M, Kalroozi F, Manafi Anari A, Jalalifar E, Ansari A, et al. Evaluation of acceptance, attitude, and knowledge towards artificial intelligence and its application from the point of view of physicians and nurses: A provincial survey study in Iran: A cross-sectional descriptive-analytical study. Heal Sci Reports. 2023;6(9):1-10.
17. Lambert SI, Madi M, Sopka S, Lenes A, Stange H, Buszello CP, et al. An integrative review on the acceptance of artificial intelligence among healthcare professionals in hospitals. NPJ Digit Med. 2023;6(1):1-14.
18. Talib HS, Almurashi AA, Alzahrani KT. Cardiopulmonary Resuscitation CPR Quality Outcome of Patients with Cardiac Arrest by Using Robotics/Artificial Intelligence in Hospitals. Int J Innov Res Med Sci. 2022;7(09).