

# Examining Nurses' Theoretical Knowledge, Attitude, and Practice of Cardio-pulmonary Resuscitation in Hospitals and Primary Health Care Settings in South Sharqiyah, Sultanate of Oman

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**Abstract Objectives:** This study attempts to identify the level of knowledge, attitude and practice of CPR among nurses in South Sharqiyah governorate, Oman. Moreover, it evaluates the association between the knowledge score and the selected variables. This will help to review the effectiveness of current CPR training, thus set up recommendations for better CPR programs. **Method:** This descriptive cross-sectional study was conducted between April and July 2019 in governmental hospitals and Primary Health care (PHC) institutions in Southern Sharqiyah Oman. A questionnaire-based survey was used to collect data from 282 registered staff nurses, including the Cardiopulmonary resuscitation (CPR) knowledge in both Basic Life support (BLS) and Advanced Cardiac Life support (ACLS), and nurses' attitude and practice towards CPR. **Results:** An excellent response rate of a total of 267 nurses (94.6%) took part in the study. Overall, nurses demonstrated inadequate level of knowledge in BLS their mean±SD of the total knowledge scores was 9.05±3.228. Like BLS knowledge, the participants demonstrated inadequate level of knowledge in ACLS as the total mean ±SD was 3.47±1.784. The study noted a significant association between the total scores of BLS knowledge and nationality (p=0.028). **Conclusions:** The result of this study has confirmed that knowledge of the nurses in BLS and ACLS was found to be low. The study revealed high numbers of staff nurses need to renew BLS and ACLS certificates. Thus, there is a crucial need for innovative educational interventions related to CPR. There is also a need to evaluate the knowledge and performance of CPR in clinical area such as mock drill.

**Keywords:** knowledge, attitude, cardiopulmonary resuscitation, nursing, basic life support, advanced life support, Oman

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## 1. Introduction

Cardiac arrest (CA) is a most dramatic medical emergency that may occur any time, inside or outside the hospital settings. Cardiac arrest is defined as the cessation of the pumping function of the heart, which is confirmed by lack of response and absence of carotid pulse and normal breathing. [1] Globally, the incidence of Sudden cardiac arrest range between 20-140 per 100,000 people and around 2-11% among them survive. [2] Moreover, it is estimated that around 17.8million people died from cardiopulmonary dieses each year, and is expected to rise up to 23 million by 2030. [3] In Oman, it is challenging to understand the epidemiology of sudden cardiac arrest due to absence of nationwide standards for surveillance to

examine the actual numbers and outcomes of cardiac arrest. However, on the annual report released by Ministry of Health (2016) indicates that around 25 % of hospital death was caused by heart disease and circulatory problems. [4]

Cardiopulmonary resuscitation CPR is initiated for cardiac arrest patients to circulate the blood artificially to the main organs by giving chest compression to the ventricles [1], minimizing tissues' damage and helping breathing through oxygenation. [2] Health care professionals are required to be competent in responding quickly and effectively to CA by receiving continuous training. Cardiopulmonary resuscitation (CPR) decreases in-hospital cardiac arrests and associated deaths, when patients receive CPR promptly from a well prepared and trained healthcare professionals. [5] Thus, American Heart Association (AHA) initiated guidelines of various level of

CPR include Basic life support BLS, which is opening the airway, oxygenation and maintaining blood circulation at the primary level. [6] Followed by advanced resuscitation interventions advanced life support (ACLS), to maintain circulation, oxygenation and stabilization of the patients. [7] American Heart Association recommends CPR training for the health care practitioners each 2 years, which is revised periodically, and the last version was made in the year 2016. In Oman, CPR training courses are mandatory for healthcare Professionals, and are based on AHA guidelines.

Survival rate and better quality of care for Cardiac arrest patients varies between 2% to 49 % depending on the earlier and immediate recognition of the event, and the effective resuscitative measures taken by the resuscitative team. [8] Evidences form literatures had identified some important factors to increases the successful of in-hospital CPR and effect in the quality of patient lives. Such as, the availability of basic and advanced life support system, the immediate attempt of defibrillation and effectiveness of CPR interventions. [1,2,8] It is suggested that high quality CPR increases the survival chance following CA, as long as the practitioners maintain crucial components of CPR which are minimizing the interruption of chest compression, perform adequate frequency and depth of chest compression, allow for chest expansion, and avoid access ventilation. [2] Similarly, one study had confirmed that early detection of CA, initiation of CPR and prompt management of competent and knowledgeable team are important factors to increases the survival rate. [10] Another study reports that the survival rate can double or triple when CPR is properly performed. [11]

A study undertaken in Turkey found that victims who were resuscitated in-hospital settings within the first four minutes of cardiac arrest had higher survival rates than who did not receive same care. [3] The noticeable improvement in survival rate in United States of America (USA) and United Kingdom (UK) is explained of as a result of increased numbers of training programs for health care professionals and specifically nurses, and the availability of equipment needed during CPR such as defibrillators and drugs. [2,8] Contemporary, health care team include nurses in the position to deliver effective CPR by having enough knowledge and competence of CPR guidelines and the use of defibrillators and other equipment need during CPR. The importance of having CPR knowledge has been proven in many to improve survival of in-hospital CA by 7-24 % of reported cases. [2]

However, it is suggested that high number of practitioners is not prepared to provide CPR, despite the training programs in effective CPR techniques. [10] Knowledge deficit in CPR affects the performance of the staff during CPR, therefore leads to poor quality of CPR, as poor-quality CPR has been revealed to have similar outcomes to victims receiving no CPR. [8,9,11,12] This is similar of the result found in a cross-sectional study that CPR knowledge significantly impacted some aspects of performance such as rate of chest compression and the hand placement. [12]

The nature role of nurses allows them to spend more time with the patients since nurses provide care to patients 24 hours a day [13], and they are frontline who detect

collapsed patient in inpatient units, start immediate CPR and calling resuscitative team. [5] In addition, most of the time doctors may not be present near to the patient in case of emergency. [12] Given this fact, nurses need to be alert, with quick clinical reasoning, technical skills and emotional control to act in face of an emergency. [8,9,13] Therefore, nurses should be knowledgeable and skillful in providing effective and safe techniques of resuscitation. Lack of knowledge and skills have been found as contributing factors to patient survival and poor outcomes in post cardiac arrest. [1,2,9] The knowledge of guidelines significantly impacts some aspects of performance during cardiac arrest management. [11] Despite the crucial roles of nurses as a part of resuscitative team, however, studies found that nurses have poor knowledge in cardiopulmonary resuscitation in light of international guidelines. [5,12,15,16] Specifically, a cross sectional study assessed theoretical knowledge of CPR among 100 nurses, revealed that 46% of them had inadequate knowledge and 54% had moderate knowledge. [12] In addition, this study found a statistically significant association between the area of work and level of knowledge. In relation to the content of knowledge deficit, one study identified that nurses were not able to answer questions that related to patient survival and CPR outcomes and they lack motivation in updating their knowledge in cardiopulmonary resuscitation. [16] The knowledge gaps among nurses in CPR guidelines differ all over the studies. However, detection of Cardiac arrest, the rate, depth and location of chest compression and the drugs are used in CPR were most common knowledge deficit found in the studies. [5]

The knowledge of cardiopulmonary resuscitation is affected by some factors. For instance, one study revealed that resuscitation training courses had a positive effect on the theoretical knowledge for nurses and doctors, as participants who attended BLS courses scored higher than who did not attend the same courses. [17] The same study reported that nurses who worked in clinical areas with more chance of getting cardiac arrest such as Intensive Care Unit (ICU) and Cardiac Care Unit (CCU), had more knowledge than nurses worked in low risk areas. These findings are similar to another study found that nurses who work in high risk areas are more motivated to learn about CPR than other nurses in low risk areas. [12]

Anecdotal reports indicate that most nurses working in clinical settings have inadequate knowledge. No such study has been conducted in Sultanate of Oman. Some health institutions also do not have enough physicians specially that are located in remote areas, so nurses manage patients autonomously. For this, nurses must be competent and ready in managing cardiac arrest patients as well as other life-threatening conditions anytime and anywhere. Globally, very few studies examined nurses' attitude and practice from this perspective. This study may give a baseline data about cardiac arrest practice, thus can help in planning for proper training or improve BLS and ACLS programs in national level. It will also develop alternative strategies in CPR training programs that might be more effective, less expensive and more accessible than available existing programs.

The main aim of the study was to assess the theoretical knowledge, attitude, and practice of cardiopulmonary

resuscitation. This study also identified the association between the level of CPR knowledge with selected background variables and clinical variables.

## 2. Methodology

### 2.1. Study Design

This Multi centers, descriptive, cross sectional study was conducted between April to July 2019. A random sample of registered nurses who work in hospitals and primary health care settings in South Sharqyah governorate, Sultanate of Oman were chosen as study population. All registered full-time nurses with two or more years' experience, working in clinical areas were included in the study. However, nurses with less than 2 years of experience, working in private health institutions, working in administration and having any type of leave during the data collection were excluded. The nurses were recruited from primary health care and all hospital units, including medical/surgical units, pediatric/maternity units, critical care units, and outpatient departments. The samples were calculated by using population proportion formula, Confidence interval (CI) -95%, proportion (P) -50%, marginal of error (d) -5 and 10% non-response rate. According to this calculation, the required sample size was 282 participants.

### 2.2. Measurement

KAP questionnaires, A self-administered questionnaires contains of knowledge, attitude and practice (KAP) was used (open and close ended questions). The first part (PART 1) Includes demographic and social details such as: age, gender, marital status, level of education, professional category, working area, health institution category: hospital, primary health care, years of experience number of training courses related to CPR, date of last course taken in BLS and ALS and other clinical variables questions.

The second part (PART 2) , assessed the level of nurses' knowledge in BLS and ACLS and has 25 -typed multiple choice. The questions were derived from a standard reference namely American Heart Association guideline for CPR, which is used to train BLS and ACLS in Oman (updated version 2016). The knowledge questions were based on the courses content of the AHA and were validated by experienced AHA, BLS and ACLS instructors. The correct answer will be given score (1) and the wrong answer will be given (0). A minimum score of 84% defined adequate knowledge (as outlined in the AHA, BLS and ACLS courses).

For BLS knowledge, all nurses who participated in the study will fill the knowledge questionnaires, whereas nurses who work in pediatric and SCBU will be excluded from ALS questions as they have other course called Pediatric advanced life support (PALS).

The third section (PART3), assessed the attitude of nurses in CPR using LIKERT scale. The questions used 5 grading (strongly agree, agree, neutral, strongly disagree and disagree)

The last part (PART 4) is the practice questions used 5 scale or grading, and asked the participants the level of confident in CPR practice.

### 2.3. Data Collection

Validity of the questionnaire tool was tested by pilot study and the staff nurses who participated were excluded from the main study.

In the main study, each health institution was asked for a permission to conduct the study. The researcher personally went to collect data of the study and got the questionnaires filled by the nurses. Initially, the study purpose was explained to the head of the nursing in the health institution and received permission. Then, explanation for the nurses who were selected randomly was done by the researchers. The data was collected in spot and it was not allowed for the participants to take out and return the questionnaire as it contains knowledge questions. There was comprehensive training for data collectors who were selected to assist in data collection.

### 2.4. Data Analysis

Descriptive statistics, using Statistical Package for the Social Science (SPSS) version 25.0. The general characteristics of the subjects were analyzed with real number and percentage. The knowledge level of BLS and ALS of nurses was done with mean and standard deviation (SD). The chi-square was used to find out the association between the level of knowledge and the variables. The probability value of (P) less than 0.05 was considered as statistically significant. Spearman was used to find out the correlation between the practice and the selected variables.

### 2.5. Ethical Consideration

The study was approved by the regional committee and from the Institutional Review Board of the Ministry of Health, Sultanate of Oman. All participant information was confidential, and they were given consent paper to sign prior entering the study.

The participants were provided information about the aims and procedures of the study, the estimated time to complete the questionnaire and their right to withdraw anytime from the study.

## 3. Results

During the period from April 2019 to July 2019, among the total 282 nurses, 267 of them filled the questionnaire (response rate of 94.6%) and most of them were females (89.9%;n=240). More than half of the participants (58.3%;n=148) were belonged to the age group of 31-40 years. A high percentage (70%; n=187) of percentage were Omani nurses, in compare to non-Omani (n=80, 30%). The majority of the participants have diploma certificates (78.4%; n=208), whereas out of 267 participants only 22 got specialization. The majority of the participants have BLS certificate (94%), however, almost the half of them their certificates wer not valid (expired,

more than 2 years) at the time of data collection (48.2%; 119). In contrast, excluding Special care baby unit (SCBU) and pediatric nurses (n=30, 11.2%) from the main sample (only 40.0% did ALS course, and out of them a high percentage (n=85,86.7%) their certificates are not valid (not active). In regard to clinical variables, high percentage of

nurses did not get CPR refreshment programs or activities (n=128; 48.1%). Although (n=243, 91%) of nurses are willing to attend upcoming CPR courses, 47.6% of nurses answered that they are not willing to pay for CPR courses. Further details regarding the demography of the participants are mentioned in [Table 1](#).

**Table 1. General distribution of demographic variables/clinical variables and their frequency percentage**

Variables	Category	Frequency(n)	Percent (%)
<b>Gender</b>	Male	27	10.1%
	female	240	89.9%
	<b>Sub Total</b>	267	100%
<b>Age Group</b>	Age20-30	81	31.9%
	Age 31-40	148	58.3%
	Age 41-50	25	9.8%
	<b>Sub Total</b>	254	100.0%
<b>Nationality</b>	Omani	187	70.0%
	Non- Omani	80	30.0%
	<b>Sub Total</b>	267	100.0%
<b>Level of education</b>	Diploma	209	78.4%
	Bachelor	52	20.0%
	Master	4	15.1%
	<b>Total</b>	265	100.0%
<b>Specialty certificates</b>	Midwifery	8	36.4%
	Administration	1	4.5%
	Critical care	5	27.3%
	Nephrology	3	13.6%
	Mental health	1	4.5%
	Diabetic	1	4.5%
	Neonatal	3	9.1%
	<b>Specializations</b>	22 out of 267	100.0%
<b>Position title</b>	Supervisor	2	0.7%
	In-charge	18	6.7%
	Sr nurse	103	38.6%
	Staff nurse	144	53.9%
	<b>Total</b>	267	100.0%
<b>Working Institution</b>	Health center	57	21.3%
	School Health	11	4.1%
	EHC	30	11.2%
	Hospital	169	63.3%
	<b>Total</b>	267	100.0%
<b>Year of experiences</b>	Two to five	43	16.1%
	Six to ten	90	33.7%
	Eleven to fifteen	74	27.7%
	Sixteen or more	60	22.5%
<b>BLS certificates</b>	Yes	251	94.0%
	No	16	6.0%
<b>BLS valid certificate (active 2 years)</b>	Valid	128	51.8%
	Not valid	119	48.2%
<b>ACLS certificate (excluding 30 nurses SCBU &amp; Pediatric)</b>	Yes	95	40.0%
	No	140	59.5%
<b>ACLS valid certificate (active 2 years)</b>	Valid	13	13.3%
	Not valid	85	86.7%
<b>Clinical variables: Nurses attended CPR refreshment activities/programs</b>	Yes<6 months ago	34	12.8%
	Yes<1 year ago	40	15.0%
	Yes>1 year ago	64	24.1%
	No	128	48.1%
<b>Nurses willingness to attend upcoming CPR course</b>	Yes	243	91%
	No	24	9.0%
<b>Nurses willingness to pay for upcoming AHA courses</b>	Yes	140	52.4%
	No	127	47.6%

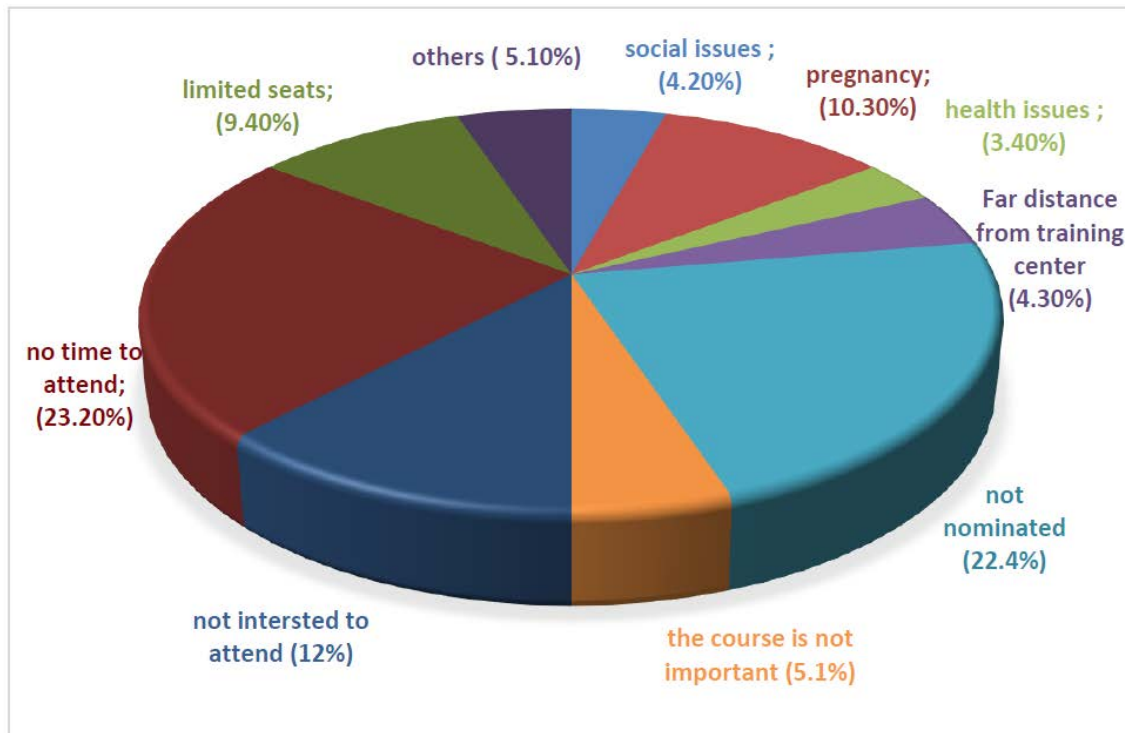


Figure 1. Reasons for not validating BLS certificate within 2 years, (n=116)

Nurses who did not have valid BLS certificate (n=119, 48.2%) were asked to specify the reasons for un valid BLS certificate within 2 years, n=116 of them responded. The two main reasons where; no time to attend (23.2%) and not nominated (22.4%). Further details are shown in Figure 1.

The knowledge level of nurses in BLS and ACLS is presented in detail in Table 2. Using the minimum score of 84%, it was disappointing to note that overall participants (267) demonstrated inadequate knowledge in Basic life support and their mean±SD of the total knowledge scores was 9.05±3.228. Similar findings were shown in the level of ALS knowledge (after excluding 30 SCBU and pediatric nurses n=237), nurses demonstrated inadequate level of knowledge in ACLS as the total mean ±SD was 3.47±.1.784.

Table 2. Overall scores of BLS and ACLS knowledge

	BLS knowledge	ACLS knowledge
Mean	9.04	3.47
Standard Deviation SD	3.228	1.784
Minimum	2	0
Maximum	16	8
Total	267	237
Missing	0	0 (excluding 30 nurses from SCBU and pediatric nurse)
Inadequate knowledge participants score less than 84% frequency (%)	255(95.5%)	224(83.9%)
Adequate knowledge Participants score of each 84% and more Frequency (%)	12(4.5%)	13(4.9%)

SD, Standard deviation; BLS, Basic Life support; ACLS, Advanced life support; SCBU, Special care baby unit.

The study noted a significant association between the level of BLS knowledge and nationality (p=0.028) (Table 3). Non-Omani nurses also have higher percentage of adequate knowledge (8.8%) than Omani nurses (2.7%) However, there was no association between the total scores and the validation of BLS certificate (p=0.09). Surprisingly, there was no significant association between the working institution (p=0.80), level of education (0.28) and total scores of knowledge (p=0.24), despite that nurses with Bachler level and above have slightly higher adequate knowledge in compare to diploma (7.1%, 3.8% respectively).

Whereas, no significant association between the level of ACLS knowledge and the selected variables as shown in Table 4. However, higher percentage of adequate knowledge is shown slightly more in non-Omani (8.3%) in compare to Omanis (4.2%), in Bachler and above (7.8%) with Diploma (4.9%) and in ACLS valid certificate (15.4%) with not valid ACLS certificate (6.0%).

Table 5, shows the frequency of correct answers in BLS and ACLS knowledge questions. A higher percentage of nurses (87%,n= 231) of the nurses knew the indication to start cycles of chest compressions and breathing for an unconscious victim. However, only (39%, n=105) knew how to give rescue breathing for infants. Similarly, only 44% of the nurses answered correctly in compression-ventilation ratio for rescuer child CPR. In regards to ACLS knowledge, it is evident that participants showed inadequate knowledge in emergency medications as only 34% of the participants were able to identify the second choice of drug should be given for pulseless Ventricular Tachycardia /Ventricular Fibrillation following injection Epinephrine. Similarly, only 52% answered correctly about the proper dosing of epinephrine for VF/ pulseless VT. The highest answers among all questions was in question related the indication of oropharyngeal airway (63%).

Table 3. Association of selected background variables with level of BLS Knowledge on cardio-pulmonary among nurses (N=267)

Variables	Category	BLS – knowledge n(%)		Total n(%)	Chi-Square & p- value*
		In-adequate	Adequate		
Age by group	Specification of variables				
	Age20-30	80	1	81	
		98.8%	1.2%	100.0%	
	Age 31-40	141	7	148	9.253
		95.3%	4.7%	100.0%	0.009
	Age 41-50	21	4	25	
Nationality		84.0%	16.0%	100.0%	
	Omani	182	5	187	
		97.3%	2.7%	100.0%	4.819
	Non- Omani	73	7	80	0.028
Level of education		91.3%	8.8%	100.0%	
	Diploma	201	8	209	
		96.2%	3.8%	100.0%	1.123
	Bachler and Above	52	4	56	0.289
Working institutions		92.9%	7.1%	100.0%	
	PHC institutions	94	4	98	
		95.9%	4.1%	100.0%	0.061
	Hospitals	161	8	169	0.804
Do you have BLS certificate?		95.3%	4.7%	100.0%	
	Yes	240	11	251	
		95.6%	4.4%	100.0%	0.122
	No	15	1	16	0.726
Validation of BLS certificate		93.8%	6.3%	100.0%	
	Not Valid	116	3	119	
		97.5%	2.5%	100.0%	2.714
	valid	119	9	128	0.099
	93.0%	7.0%	100.0%		

\*significant at p-value <0.05.

Table 4. Association of selected background variables with level of ACLS Knowledge among nurses (n=237)

Variables	Category	ACLS – knowledge n(%)		Total n(%)	Chi-Square & p- value*
		In-adequate	Adequate		
Age by group	Specifications of variables				
	Age20-30	65	4	69	
		94.2%	5.8%	100.0%	
	Age 31-40	125	6	131	0.529
		95.4%	4.6%	100.0%	0.768
	Age 40-50	23	2	25	
Nationality		92.0%	8.0%	100.0%	
	Omani	158	7	165	
		95.8%	4.2%	100.0%	1.618
	Non-Omani	66	6	72	0.203
Level of education		91.7%	8.3%	100.0%	
	Diploma	175	9	184	
		95.1%	4.9%	100.0%	1.084
	Bachler and above	47	4	51	0.582
Working institutions		92.2%	7.8%	100.0%	
	PHC institutions	94	4	98	
		95.9%	4.1%	100.0%	0.635
	Hospitals	130	9	139	0.426
Do You have ACLS certificates?		93.5%	6.5%	100.0%	
	Yes	89	6	95	
		93.7%	6.3%	100.0%	0.481
	No	134	6	140	0.487
Validation of ACLS certificate		95.7%	4.3%	100.0%	
	Not valid	80	5	85	
		94%	6%	100.0%	1.226
	valid	11	2	13	0.268
	84.6%	15.4%	100.0%		

Significant at p-value <0.05

(n=237) as 30 nurses and from pediatric wards and SCBU were excluded from the total participants

**Table 5. Frequency of correct responses in theoretical knowledge section for BLS and ACLS questions**

Questions on CPR		Correct answers	
Q#	Questions of BLS	Frequency(n)	Percentage (%)
21	What is the most likely cause of cardiac arrest following a myocardial infarction?	177	66%
22	How long can the brain survive without Oxygen before the cell death occurs?	148	56%
23	What is the indication to start cycles of chest compressions and breathing for an unconscious victim?	231	87%
24	A 65 years old male patient is found un conscious, what should be done next after checking scene safety:	141	53%
25	What is the definitive treatment to get a normal heart rhythm for a client who is having ventricular fibrillation is?	148	55%
26	What is the compression/ ventilation ratio for an adult victim?	205	77%
27	What is the correct rate of compressions in a minute?	123	46%
28	Depth of compression in adults during CPR:	171	64%
29	21-year-old intoxicated college student turns blue and collapses while eating a hot dog at a restaurant. You are concerned that this student may have choked. What is the best method to clear an obstruction from the airway?	196	73%
30	What mistake is most likely to cause gastric inflation during use of a bag-mask ventilation?	156	58%
31	How long should a pulse check last?	109	41%
32	Where you should check a pulse in an infant?	145	54%
33	The correct compression-ventilation ratio for 1-rescuer child CPR is ____ compressions and ____ breaths.	118	44%
34	What is the location for chest compression?	218	82%
35	How do you give rescue breathing for an infant?	105	39%
36	How often should rescuers switch roles when performing two-rescuer CPR?	125	47%
37	What is the correct sequence of the BLS steps, according to the 2016 AHA guidelines?	128	48%
Q#	Questions of ACLS knowledge		
38	The rhythm shown down (strip) is most likely:	100	%42
39	The proper dosing of epinephrine for VF/ pulse less VT is	122	52%
40	The second choice of drug should be given for pulse less VT/VF following injection Epinephrine is:	82	34%
41	A systole is a common rhythm and should be treated with the following EXCEPT	97	40%
42	In an adult with an advanced airway in place during two-rescuer CPR, how often should the breaths be administered?	89	37%
43	An or pharyngeal airway is indicated for which of the following patients?	150	%63
44	79-year-old individual is in Supra Ventricular Tachycardia. BP is 80/50, and he is complaining of chest discomfort and feels like passing out. What is the next appropriate step?	77	32%
45	What is the energy recommendation for synchronized cardio version for un stable AF in adult based, on AHA 2016 guideline?	124	53%

**Table 6. Attitude of nurses towards CPR**

n (%)				
1	Attitude of nurses on CPR	Positive	Neutral	Negative
1.2	I believe that CPR is part of nursing role	176(65.9%)	5(1.8%)	95(35.5%)
1.3	I think that mastering CPR intervention should be made mandatory to all nurses	157(58.8%)	16(5.9%)	94(35.2%)
1.4	I am able to identify the signs and symptoms of cardiac arrest (person in need of Basic life support BLS Immediately)	138(51.65)	42(15.7%)	87(32.5%)
1.5	I do not hesitate to start CPR in a victim	114(42.6%)	52(51.3%)	99(37%)
1.6	I don't feel panic during CPR	105(39.3%)	74(27.7%)	84(31.4%)
1.7	I feel competent to perform CPR during sudden cardiac arrest	129(48.3%)	49(18.3%)	87(32.5%)
1.8	It is important for me to check the crash cart contents periodically as per my health institution policy	156(58.4%)	16(5.9%)	93(34.8%)
1.9	I am able to identify the equipment's and drugs in crash cart	148(55.4%)	27(10.1%)	89(33.3%)
2	Attitudes towards training			
2.1	It is important to me to attend CPR training courses and in-service training	162(60.6%)	11(4.1%)	94(35.2%)
2.3	I feel that my training in CPR based on recent AHA guidelines is adequate to equip me to handle resuscitation confidently	132(49.4%)	52(19.4%)	81(30.3%)
2.4	I think that CPR skills should be rehearsed at least once per year	145(54.3%)	33(12.3%)	88(32.9%)
2.5	I think that current CPR courses, which are conducted in my governorate are useful and effective	147(55%)	30(11.2)	98(36.7%)
2.6	My health institution is providing regular refreshment courses related to resuscitation	111(41.5%)	58(21.7%)	94(35.2%)
2.7	My health institution announces for CPR courses schedule before enough time	128(47.9%)	52(19.4%)	85(31.8%)
2.8	I would like to renew my CPR certificates each 2 years	146(54.6%)	24(8.9%)	95(35.5%)
2.9	After learning CPR, I would like to teach others	141(52.8%)	36(13.4%)	85(31.8%)
3	Attitudes towards CPR guidelines			
3.1	I believe that following CPR guidelines properly in CPR practice, will increase survival rate	160(59.9%)	18(6.7%)	88(32.95)
3.2	My clinical setting has labeled instructions for recognition and management of cardiac arrest.	129(48.3%)	55(20.5%)	83(31%)
3.3	Resuscitation guidelines are available my clinical setting	128(47.9%)	49(8.3%)	86(3.2%)
3.4	It is important for me to read CPR guidelines before entering CPR courses	161(60.2%)	21(7.8%)	84(31.4%)
4	Attitudes towards practice of CPR in the health institution			
4.1	I think the practice of CPR in my department is conducted according to updated AHA guidelines	135(50.6%)	41(5.3%)	121(45.3%)
4.2	I think that all equipment's for cardiac arrest are available in crash cart of my health institution	128(47.9%)	33(12.3%)	105(39.3%)
4.3	It is important to report and document about CPR to improve the quality of care	147(55%)	26(9.7%)	85(31.8%)
4.4	I think all staff nurses in my setting are competent to provide CPR	123(46%)	61(22.8%)	83(31%)
4.5	I think that doctors in my clinical setting manage Cardiac arrest effectively	106(39.7%)	70(26.2%)	91(34%)
4.6	I get adequate team support during CPR	159(59.5%)	64(23.9%)	85(31.8%)

Table 7. Association of selected background variables with level of Attitude on CPR among nurses (N=267)

Variables	Category	Attitude Level n (%)			Total n (%)	Chi-Square & p- value
		Neutral	Disagree	Agree		
Age by group	20-30	6	26	49	81	
		7.4%	32.1%	60.5%	100.0%	
	31-40	11	46	91	148	0.656
		7.4%	31.1%	61.5%	100.0%	0.956
	41 -50	1	7	17	25	
Nationality	Omani	16	45	126	187	
		8.6%	24.1%	67.4%	100.0%	4.923
	Non-Omani	2	44	34	80	0.001
		2.5%	55.0%	42.5%	100.0%	
Level of education	Diploma	16	61	132	209	
		7.7%	29.2%	63.2%	100.0%	8.855
	Bachler and Above	2	28	26	56	0.011
		3.6%	50.0%	46.4%	100.0%	
Working institutions	PHC institutions	6	6	86	98	
		6.1%	6.1%	87.8%	100.0%	4.953
	Hospitals	12	83	74	169	0.002
		7.1%	49.1%	43.8%	100.0%	
Validation of BLS certificate	Not valid	10	52	57	119	
		8.4%	43.7%	47.9%	100.0%	15.864
	Valid	6	29	93	128	0.001
		4.7%	22.7%	72.7%	100.0%	
Validation of ACLS certificate	Not valid	5	26	54	85	
		5.9%	30.6%	63.5%	100.0%	3.132
	valid	0	7	6	13	0.208
		0.0%	53.8%	46.2%	100.0%	

Table 8. Correlation between the selected variables and nurses' practice

Variables	Category	level of Confident in CPR practice		Total n (%)	Spearman Correlation & p- value
		Not confident/ or not sur In CPR practice n (%)	Confident: (Very, Moderate Slightly confident) In CPR practice n (%)		
<b>All over nurses (n=267)</b>		80 (30%)	187 (70%)		
Age by group	20-30	24	57	81	
		29.6%	70.4%	100.0%	
	31-40	41	107	148	0.0328
		27.7%	72.3%	100.0%	0.602
	40-50	6	19	25	
Nationality	Omani	40	147	187	
		21.4%	78.6%	100.0%	0.286
	Non-Omani	40	40	80	0.01
		50.0%	50.0%	100.0%	
Level of education	Diploma	57	152	209	
		27.3%	72.7%	100.0%	-0.123
	Bachler and above	23	33	56	0.065
		41.1%	58.9%	100.0%	
Working institution	PHC institutions	14	84	98	
		14.3%	85.7%	100.0%	0.261
	Hospitals	66	103	169	0.01
		39.1%	60.9%	100.0%	
Validation of BLS certificate	Not Valid	45	74	119	
		37.8%	62.2%	100.0%	0.183
	valid	27	101	128	0.004
		21.1%	78.9%	100.0%	
Validation of ACLS certificate	Not valid	22	63	85	
		25.9%	74.1%	100.0%	-0.095
	valid	5	8	13	0.350
		38.5%	61.5%	100.0%	



The attitude of the participants is shown in Table 6. The attitudes of nurses towards CPR in general were positive. More than half of the participants believed that CPR is a part of nursing role (65.9%; n=176). However, only, (39.3%; N=105) do not feel panic during CPR.

Participants reported positive attitude regarding CPR training. More than half of the participants think that CPR skills should be rehearsed at least once per year (54.3%; n=145). In regards CPR guideline, (59.9%; n=160) believed that following CPR guidelines properly in CPR practice, may increases the survival rate of the patient. Almost half of the participants think that practice of CPR in their department is conducted according to updated AHA guidelines (50.6%; n=135). Higher positive attitude was found slightly more among nurses with diploma (63.2%) than Bachelor and above (46.4%); and nurses who work in PHC institutions were found to have more positive attitude (87.8%) than Hospital nurses (43.8%). This study found a significant association between attitude and other variables such as nationality ( $p=0.001$ ), working institution ( $p=0.002$ ), validation of BLS certificate (0.001) as shown in Table 7.

Overall, nurses found themselves confident in CPR practice (70%). Interestingly nurses who revealed as confident in CPR practice were found more among Omani (78.6%) than non-Omani (50.0%), and nurses with Diploma (72.2%) find themselves confident in compare to those who have Bachelor and above(58.9%), and nurses who work in PHC reported more confident level in CPR practice than hospital nurses (85.7%, 60.9% respectively). This study found a significant correlation between practice and other variables nationality ( $p=0.01$ ), working institution ( $p=0.01$ ), validation of BLS certificate (0.004) as shown in Table 8.

## 4. Discussion

Cardio-pulmonary resuscitation has been recognized as crucial factor that is associated to increase the chance of survival rate in cardiac arrest patients. Since nurses consider as the front line personal with the patients, their role in CPR is important. Hence, good theoretical knowledge is prerequisite for nurses to provide effective and high-quality CPR.

To the author's knowledge, this is the first study in Oman to examine nurse's knowledge, attitude, and practice in CPR. The findings of this study add new body of knowledge related to CPR, thus can be used to improve the practice and training activities of CPR. It may also add to the existing knowledge of the literatures globally, especially that there are limited and outdated studies in relation to CPR attitude and practice among nurses.

The present study revealed that surveyed nursing staff had inadequate knowledge in BLS, similar to studies of [15,18,19] In contrast, another study found that nurses demonstrated good level of knowledge [2].

The low level of theoretical knowledge can be partly explained by the fact that although most of the participants had BLS certificate during their nursing profession, however, only half of them have valid (active certificate). In addition, near to half of the participants revealed that they did not attend CPR refreshment activities/programs.

Participation in CPR training programs once every six months improves theoretical knowledge and skills. [20]

A significant association was found between level of BLS knowledge and nationality. The nationality as a variable was not studied in previous studies, so it is difficult to compare and contrast this finding. Surprisingly, the percentage of participants who have adequate knowledge from hospitals was found to have almost the same percentage of people who works in primary health care; health centers, school health and extended health centers. This was not expected as nurses working in hospital are prone to be exposed with cardiac arrest cases more than primary health care nurses. This finding may add new knowledge in the current literatures that studies CPR knowledge among nurses. Similar to study of [19], this study found no significant association between the total score of knowledge and age and years of experience. In contrast to this study, a study among 132 nurses found statistically significant between the level of BLS knowledge and other variables such as age, position, service period, education level and CPR certificate. [1]

In regards to the component of BLS questions, Pediatric and neonatal questions got low scores "CPR ratio". The rate and depth of chest compression, was incorrectly answered by the majority of nurses.

Nurses who work in pediatrics and SCBU departments were excluded from ACLS questions, to prevent bias in sample as they don't deal with adult patients and they have other AHA courses such as Pediatric life support and neonatal life support. In regard to ACLS knowledge, this study also found inadequate of ACLS knowledge among nurses. This is supported another study revealed that number of nurses who had sufficient knowledge in ACLS was low. [22]

This study found that there was no significant association between ACLS level of knowledge and the selected variables like age, level of education, type of working institution and level of education and validation of ACLS certificate. It was also surprising that the percentage of participants who got adequate ACLS knowledge in Hospital are almost similar to nurses who work in primary health care settings, as hospital nurses are more exposed to cardiac arrest patients than PHC nurses.

Nurses who have valid BLS and ACLS certificates were less. The main reasons identified by the nurses who did not valid BLS certificate and considers as administrative /clinical reasons are no time to attend, not nominated, and limited seats. This can help to identify solution from the stakeholders and reduce the retention rate in attending and renewing BLS course. Participants reported other personal reasons such as pregnancy, don't have interest to attend as the most reasons for not validating BLS certificate. In reality, pregnancy cannot be considered as a logic reason because being a pregnant will be only for 9 months, thus the nurses has time within the 2 years to renew. Another reason found and can be considered as important reason for nurses' reluctance of validating/renewal CPR certificates is that almost more than half of nurses reported that they are not willing to pay for CPR courses. The AHA courses in the governorate started recently and participants should pay for them.

It was also surprising to find nurse who don't do BLS and ACLS during their career. Thus, there

should be appropriate intervention to strengthen the knowledge and skills of nurses in CPR through AHA courses and rehearsal of skills at least once per 6 months. Cardiopulmonary resuscitation courses should be mandatory to all nurses.

Overall, nurses had positive attitude towards Cardiopulmonary resuscitation including attitude of CPR related to nursing role, CPR training, CPR guideline and attitude towards CPR practice. These findings are consistent with those other study. [23] Positive attitude of nurses towards CPR is good foundation to create change and develop new strategies in practice and training of CPR. It is suggested that positive attitude regarding CPR was influenced by some factors. Initially increasing awareness about the importance of CPR in saving the patient's life, as well as increasing the sense of reasonability among nurses towards CPR. The Omani MOH has created multiple centers of training that provide CPR courses in collaboration to American Heart Association AHA. Although nurses have positive attitude towards CPR training, however the number of nurses who have valid certificate in BLS and ACLS consider low. Hence, it is important to identify the factors influence CPR training in details.

This study evaluated the practice of the nurses by asking them their level of confidence that is related to CPR practice. Overall, nurses revealed that they are confident in relation to CPR practice. Specifically, it was surprising to find out that nurses who work in primary health care settings feels more confident in CPR practice than nurses work in hospital settings. This may be due to un proper judgment of PHC nurses due to less exposure to cardiac arrest patients than nurses work in hospitals. There was significant correlation between the practice and some variables such as nationality, work institution and validation of BLS certificates. It is difficult to compare and contrast between this part in study and other studies as less studies examined practice of CPR among nurses and the scale of practice is newly used.

It is recommended that CPR refreshment activities and Drills should be held frequently to assess nurses' readiness of cardiac arrest management. There should be a strategy to motivate the nurses in attending CPR courses and validate their certificate, specially that high percentage of nurses in this study showed they are not willing to pay for the courses. This could be a high constrains may face decision makers in CPR courses. There should be clinical audits to assess nurse's knowledge and performance in CPR in regular base. Further studies are recommended in the future in the same field specially in nurses' performance and skills.

The result of current study should be interpreted in light of its limitations. Although, the instrument has been tested for validity, however, practice part should be tested more as it is adapted by main author and not used before. Finally, since the responses to the questionnaires were based on self-reported data, the data may have been affected by response bias. However, the authors tried to minimize sampling bias by using simple random selection. The data collection was in spot in order to minimize chance of exposure to CPR knowledge.

## 5. Conclusions

The current study conducted in multicenter in Oman among 267 nurses. In general, nurses showed in adequate level of knowledge in both BLS and ACLS. Nurses who have valid BLS are very less. So, it is suggested for the need of regular CPR training including the in-service education and to provide more AHA courses. There should be an audit like drills to assess CPR practice and further studies to examine factors influencing the retention of nurses from BLS and ACLS courses. It is recommended to conduct another study that assess nurse's performance on CPR.

## Statement of Competing Interests

The authors have no competing interests.

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## Advances in Knowledge

-To the best of authors' knowledge, this study is the first to examine the knowledge, attitude and practice of staff nurses in cardiopulmonary resuscitation in Oman.

-The findings indicate inadequate knowledge of nurses in cardiopulmonary resuscitation, thus can help in planning for alternative and innovative CPR training programs training in local and national level.

## Application to Patient Practice

-Improving the knowledge and practice of nurses' in CPR management, ultimately improve the quality of nursing care, improve the patients' outcomes and increase patients' survival rates.

-The availability of these local data from Oman may serve a baseline data about the level of nurses' knowledge in CPR.

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