Knowledge of Pharmacists about Cardiopulmonary Resuscitation Medications in Saudi Arabia

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ABSTRACT

Objectives: To illustrate the knowledge of pharmacists about CPR medications services in Saudi Arabia. **Materials and Methods:** The study analyzed a cross-sectional survey that discussed pharmacist's knowledge of Cardiopulmonary Resuscitation (CPR) medications in Saudi Arabia. The survey consisted of respondents' demographic information about pharmacists and Cardiopulmonary Resuscitation (CPR) drugs, assessment of primary and advanced knowledge, and the resources used for Cardiopulmonary Resuscitation (CPR) medications. The 5-point Likert response scale system was used with closed-ended questions. The survey was validated through the revision of expert reviewers and pilot testing. Besides, various tests of the reliability of McDonald's ω, Cronbach alpha, Gutmann's λ2, and Gutmann's λ6 were carried out with the study. The data analysis of the Pharmacist practice of Cardiopulmonary Resuscitation (CPR) medications is done through the survey monkey system. Besides, the statistical package of social sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16 were implemented. **Results:** A total number of 439 pharmacists responded to the questionnaire. Of them, more than one-third responded from the Central region (122 (31.69%)), one Quarter responded from the Eastern region (91 (23.64%)), and one-fifth responded from the southern part (79 (20.52%)). Males responded more than females (203 (53.14%)) versus 179 (46.86%)), with statistically non-significant differences between all levels (p=0.219). Most of the responders were in the age group of 36-45 years (152 (39.48%)) and 46-55 years (134 (34.81%)), with statistically significant differences between all age groups (p=0.000). The majority of pharmacists had training courses in Basic Life Support (BLS) (293 ((77.11%)), Advance Cardiac Life Support (ACLS) (289 ((76.05%)), Pediatric Cardiac Life Support (PCLS) (287((75.53%)), and Neonatal Cardiac Life Support (NCLS) (203 ((53.42%)), with statistically significant differences between all levels (p=0.000). The average score of basic knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications was (1.67). The element "know how to prepare and dispense ACLS medications list" obtained the highest score (2.04). The aspect "there is an official standardized NCLS medications list" (1.94), and The element "there is an official standardized PCLS medications list" (1.93). The average score of advanced knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications was (1.86). The element "know the compatibility of ACLS medications" obtained the highest score (2.31). The aspect "know the drug - interactions with NCLS medications" (2.27), and The element "know the drug - interactions with PCLS medications" (2.17). The resources used most about the CPR medications were Medical association literature/guidelines/recommendations 307 (76.56%), Peer discussions 298 (74.31%), and Scientific literature 293 (73.07%). **Conclusion:** The pharmacists' knowledge of CPR medication was inappropriate. Therefore, undergraduate education and training of CPR medication is high recommended. Besides, involvement training for postgraduate studies is required to improve pharmacy staff knowledge of CPR services and patient outcomes in Saudi Arabia.

Keywords: Knowledge, Pharmacists, Cardiopulmonary Resuscitation, Medications.

INTRODUCTION

Over the past years, clinical pharmacy services expanded at hospital pharmacies locally.[1-6] That includes various programs, such as drug information services, pain management, total parental nutrition, anticoagulants services, antimicrobial stewardship program, and critical care services.[7-12] All previous services required specialized clinical pharmacists or trained pharmacists. One service can be provided by either clinical or staff pharmacy called pharmacy Cardiovascular, pulmonary resuscitation services.[13] The pharmacist can participate in the CPR code, prepare and dispense the medication, dosing calculation, and drug information related to the emergency code.[13-15] Basic life support is required for a Saudi license by Saudi Healthcare Specialists and the Saudi center of accreditation of healthcare institutions and international quality management standards.[16-18] Participation in the CPR code involves knowledge and skills. The competency of the CPR code is required for most hospitals internationally, and the pharmacist's role during CPR is well-known and standardized.[13-15] Few studies evaluate the CPR knowledge or competency of pharmacists.[5,14,15,19-21] Most of the previous focused on pharmacists participating in the CPR code services.[5,14,15,20,21] At the same

time, one study only discussed pharmacist knowledge of CPR and focused on CPR technique, not discussed medications.[19] The authors were unaware of any investigation into pharmacist knowledge of the CPR medications locally or in the gulf and Arabic countries. The objective of the current cross-sectional study is to assess the pharmacist knowledge of the CPR code medications in Saudi Arabia.

MATERIALS AND METHODS

The study analyzed a cross-sectional survey that discussed Pharmacist knowledge about Cardiopulmonary Resuscitation (CPR) medications in Saudi Arabia. It self-reported an electronic survey of the pharmacist, including pharmacists from internship to consultant, pharmacist specialties, and Saudi Arabia. All non-pharmacist or students, non-completed, non-qualified surveys will be excluded from the study. The survey consisted of respondents' demographic information about pharmacists and Cardiopulmonary Resuscitation (CPR) medications, assessment of primary and advanced knowledge, and the resources used about the Cardiopulmonary Resuscitation (CPR) medications.[14,15,19-25] The 5-point Likert response scale system was used with closed-ended questions. According to the previous litterateur with an unlimited population size, the sample was calculated as a cross-sectional study, with a confidence level of 95% with a z score of 1.96 and a margin of error of 5%, a population percentage of 50%, and drop-out rate 10%. As a result, the sample size will equal 380-420 with a power of study of 80%.[26-28] The response rate required for the calculated sample size is at least 60-70 % and above.[28,29] The survey was distributed through social media such as whatsapp and Telegram groups of pharmacists. The reminder message had been sent every 1-2 weeks. The survey was validated through the revision of expert reviewers and pilot testing. Besides, Various tests of the reliability of McDonald's ω, Cronbach alpha, Gutmann's λ2, and Gutmann's λ6 were carried out with the study. The data analysis of the pharmacist's knowledge of Cardiopulmonary Resuscitation (CPR) medications is done through the survey monkey system. Besides, the statistical package of social sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel sheet version 16. It included a description and frequency analysis, good of fitness analysis, and correlation analysis. Furthermore, inferential analysis of factors affecting pharmacist's basic and advanced knowledge of Cardiopulmonary Resuscitation (CPR) medications with linear regression. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) guided the reporting of the current study.[30,31]

RESULTS

A total number of 439 pharmacists responded to the questionnaire. Of them, more than one-third responded from the Central region (122 (31.69%)) one Quarter responded from the Eastern region (91 (23.64%)), and one-fifth responded from the southern region (79 (20.52%)), with statistically significant differences between the provinces (p=0.000). Most of the responders were from University hospitals (91 (20.92%)), National Guard Hospitals (80 (18.39%)), and Private ambulatory care clinics (68 (15.63%)), with a statistically significant difference between working sites (p=0.000). Males responded more than females (203 (53.14%)) versus 179 (46.86%)), with statistically non-significant differences between all levels (p=0.219). Most of the responders were in the age group of 36-45 years (152 (39.48%)) and 46-55 years (134 (34.81%)), with statistically significant differences between all age groups (p=0.000). Most of the responders held Doctor of Philosophy (130 (34.21%)), Pharm D (89 (23.42%)), Bachelor Pharmacy (73 (19.21%)), Postgraduate year three PGY-3 (66 (17.37%)), and Doctor of Philosophy in Pharmacy (65 (14.01%)). Most pharmacists had a work experience of 1-3 years (82 (21.41%)), 4-6 years (80 (20.89%)), and less than one year (74 (19.32%%)), with a statistically non-significant difference between years of experience (p=0.364). Most of pharmacists works at outpatient pharmacy (248 ((65.26%)), Inpatient Pharmacy (237 ((62.37%)), Satellite Pharmacy (224 ((58.95%)), and Narcotics and Controlled (204 ((53.68%)). The majority of pharmacists had training courses in Basic Life Support (BLS) (293 ((77.11%)), Advance Cardiac Life Support (ACLS) (289 ((76.05%)), Pediatric Cardiac Life Support (PCLS) (287 ((75.53%)), and Neonatal Cardiac Life Support (NCLS) (203 ((53.42%)), with statistically significant differences between all levels (p=0.000). There was a medium positive correlation between age (years) and academic qualifications based on Kendall's tau_b (0.426) and Spearman's rho (0.511) correlation coefficients, with a statistically significant difference between the two factors (p<0.000). There was a medium positive correlation between site of work and academic qualifications based on Kendall's tau_b (0.524) and Spearman's rho (0.553), with a statistically significant difference between the two factors (p<0.000) (Tables 1 and 2).

The average score of basic knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications was (1.67). The element "know how to prepare and dispense ACLS medications list" obtained the highest score (2.04). The aspect "there is an official standardized NCLS medications list" was (1.94), and The element "there is an official standardized PCLS medications list" (1.93). In contrast, the lowest score was obtained for the component "know the doses of NCLS medications" (1.29). The score for the element "know how to administer NCLS medications to the patients" was (1.30), and for the aspect "know the doses of PCLS medications," it was (1.35), with a statistically significant difference between the responses (p<0.000). (Table 3). The average score of advanced knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications was (1.86). The element "know the compatibility of ACLS medications" obtained the highest score (2.31). The aspect "know the drug - interactions with NCLS medications" was (2.27), and The element "know the drug - interactions with PCLS medications" (2.17). In contrast, the lowest score was obtained for "know the prices or cost of NCLS medications" (1.57). The score for the element "know the adverse drug reactions of ACLS medications list" was (1.62), and for the component "know the doses of PCLS medications," it was (1.35), with a statistically significant difference between the responses (p<0.000). (Table 4). The resources used most about the CPR medications were Medical association literature/guidelines/recommendations 307 (76.56%), Peer discussions 298 (74.31%), and Scientific literature 293 (73.07%) Table 5). The score for single-test reliability analysis of McDonald's ω was 0.972, Cronbach's α was 0.970, Gutmann's was λ2, 0.975, Gutmann's λ6 was 0.999, and Greater Lower Bound was 0.999 with statistically significant (p<0.05).

Factors affecting the basic knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications

Factors affecting *basic knowledge* were analyzed. We adjusted the significant values using the independent samples Kruskal–Wallis test and the Bonferroni correction for multiple tests. Basic understanding of pharmacists about the Cardiopulmonary Resuscitation (CPR) *medications* includes location, worksite, age, gender, Academic qualifications, years of experience, present of adults, pediatrics, and neonate CPR teams at an institution. The north region showed the lowest scores (1.0865), with statistically significant differences between regions (p=0.000). Twelve worksites affected the ***basic*** knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications. The lowest scores (1.3385) and (1.4065) were obtained from MOH hospitals

Table 1: Demographic, social information.

Nationality	Response Count	Response Percent	*p*-value (X2)
Central area	122	31.69%	0.000
North area	64	16.62%	
South area	79	20.52%	
East area	91	23.64%	
West area	29	7.53%	
Answered question	**385**		
Skipped question	**54**		
Site of work	**Response Count**	**Response Percent**	***p*-value (X2)**
MOH Hospitals	44	10.11%	0.000
Military hospitals	13	2.99%	
National Guard Hospital	80	18.39%	
Security forces hospitals	19	4.37%	
University Hospital	91	20.92%	
MOH primary care centers	65	14.94%	
Private hospitals	25	5.75%	
Private ambulatory care clinics	68	15.63%	
Private primary healthcare center	3	0.69%	
Community pharmacy	19	4.37%	
Pharmaceutical company	6	1.38%	
University	2	0.46%	
Answered question	**435**		
Skipped question	**4**		
Gender	**Response Count**	**Response Percent**	
Male	203	53.14%	0.219
Female	179	46.86%	
Answered question	**382**		
Skipped question	**57**		
Age	**Response Count**	**Response Percent**	
24–35	94	24.42%	0.000
36–45	152	39.48%	
46–55	134	34.81%	
> 55	5	1.30%	
Answered question	**385**		
Skipped question	**54**		

Table 2: Demographic, social information.

The last academic qualifications	Response Count	Response Percent	*p*-value (X2)
Bachelor Pharm	73	19.21%	0.000
Pharm D	89	23.42%	
Master	18	4.74%	
Ph D	130	34.21%	
Residency R1	2	0.53%	
Residency R2	2	0.53%	
Residency R3	66	17.37%	
Fellowship	0	0.00%	
Answered question	**380**		
Skipped question	**59**		
Years of experience in a pharmacy career	**Response Count**	**Response Percent**	
< 1	74	19.32%	0.364
1 – 3	82	21.41%	
4 – 6	80	20.89%	
7 - 9	62	16.19%	
> 9	85	22.19%	
Answered question	**383**		
Skipped question	**56**		
The practice area	**Response Count**	**Response Percent**	
Inpatient Pharmacy	237	62.37%	
Outpatient Pharmacy	248	65.26%	
Satellite Pharmacy	224	58.95%	
Narcotics	204	53.68%	
IV admixture	137	36.05%	
Extemporaneous Preparation	72	18.95%	
Clinical Pharmacy	90	23.68%	
Inventory Control	75	19.74%	
Drug Information	13	3.42%	
Emergency pharmacy	5	1.32%	
Medication safety	5	1.32%	
Repacking	4	1.05%	
Pharmacy Education and Training	134	35.26%	
Pharmacy Research	121	31.84%	
Primary care pharmacy	56	14.74%	
Community pharmacy	64	16.84%	
Answered question	**380**		
Skipped question	**59**		
Did you take any of the following training courses	**Response Count**	**Response Percent**	
Basic Life Support (BLS)	293	77.11%	0.000
Advance Cardiac Life Support (ACLS)	289	76.05%	
Pediatric Cardiac Life Support (PCLS)	287	75.53%	
Neonatal Cardiac Life Support (NCLS)	203	53.42%	
Nothing	6	1.58%	
Answered question	**380**		
Skipped question	**59**		

Table 3: Cardiopulmonary Resuscitation (CPR) medications assessment of basic knowledge.

No	Items	No knowledge		1-25% knowledge		26-50% knowledge		51-75% knowledge		76-100% knowledge		Total	Weighted Average	*p*-value (X2)
1	Have you ever heard about the concept of Cardiopulmonary Resuscitation (CPR) Or Advance Cardiac Life Support (ACLS) medications?	66.06%	288	10.32%	45	8.72%	38	9.86%	43	5.05%	22	436	1.78	0.000
2	Have you ever heard about the concept of Pediatric Cardiac Life Support (PCLS) medications?	70.74%	307	8.99%	39	11.52%	50	6.22%	27	2.53%	11	434	1.61	0.000
3	Have you ever heard about the concept of Neonatal Cardiac Life Support (NCLS) medications?	60.42%	261	21.53%	93	5.56%	24	9.95%	43	2.55%	11	432	1.73	0.000
4	At your institutions, is there an official standardized ACLS medications list?	60.98%	261	7.48%	32	21.96%	94	5.14%	22	4.44%	19	428	1.85	0.000
5	At your institutions, is there an officially standardized PCLS medications list?	62.38%	262	10.00%	42	5.00%	21	17.38%	73	5.24%	22	420	1.93	0.000
6	At your institutions, is there an official standardized NCLS medications list	65.54%	272	11.33%	47	2.89%	12	3.61%	15	16.63%	69	415	1.94	0.000
7	Do you know how to prepare and dispense the ACLS medications list?	64.20%	260	6.17%	25	6.91%	28	6.42%	26	16.30%	66	405	2.04	0.000
8	Do you know how to prepare and dispense the PCLS medications list?	66.75%	269	6.45%	26	3.97%	16	20.35%	82	2.48%	10	403	1.85	0.000
9	Do you know how to prepare and dispense the NCLS medications list?	67.77%	265	4.35%	17	7.16%	28	18.67%	73	2.05%	8	391	1.83	0.000
10	Do you know how to administer ACLS medications to patients?	67.44%	261	5.17%	20	16.54%	64	7.75%	30	3.10%	12	387	1.74	0.000
11	Do you know how to administer PCLS medications to patients?	69.11%	264	19.11%	73	6.28%	24	3.14%	12	2.36%	9	382	1.51	0.000
12	Do you know how to administer NCLS medications to patients?	84.82%	324	8.12%	31	1.83%	7	2.62%	10	2.62%	10	382	1.30	0.000
13	Do you know the doses of ACLS medications?	83.85%	322	4.95%	19	3.13%	12	5.21%	20	2.86%	11	384	1.38	0.000
14	Do you know the doses of PCLS medications?	82.81%	318	7.03%	27	5.47%	21	2.08%	8	2.60%	10	384	1.35	0.000
15	Do you know the doses of NCLS medications?	85.04%	324	7.09%	27	3.41%	13	2.62%	10	1.84%	7	381	1.29	0.000
	Answered											**439**		
	Skipped											**0**		

and National Guard Hospitals, respectively, with statically significant differences among all sites (*p*=0.0.00). The male (1.7641) affected the basic knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications more than the female (1.4277), with a statistically significant difference (*p*=0.000). The responders' age affected pharmacists' basic knowledge about Cardiopulmonary Resuscitation (CPR) *medications*. Pharmacists aged 36-45 showed the lowest score (1.3343), with a statistically significant difference between all age groups (*p*=0.000). Eight levels of the last academic qualifications affected the basic knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications, with the lowest score (1.0677) obtained for the third year of pharmacy residency R3 in pharmacy with a statistically significant difference between all levels (*p*=0.000). Five levels of work experience did not affect the basic knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications, with non-statically significant differences among all levels (*p*=425). The pharmacist does not know about the presence of Adults CPR team at the institution (2.3929) affected the basic knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (*p*=0.000). The pharmacist does not know about the presence of a pediatrics CPR team at the institution (2.1861) affected the basic knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (*p*=0.000). The pharmacist does not know about the presence of the neonatal CPR team at the institution (2.3384) affected the basic knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (*p*=0.000).

The relationship between the basic knowledge of the Cardiopulmonary Resuscitation (CPR) medications and factors such as location, worksite, age (years), gender, academic qualifications, years of experience in a pharmacy career, Present of Adults CPR team at the institution. Present of pediatrics CPR team at the institution and neonates CPR team at the institution. The multiple regression analysis considered perception as the dependent variable and factors affecting it as an expletory variable. There was a medium relationship (R=0.581 with *p*=0.000) between the basic knowledge of the Cardiopulmonary Resuscitation (CPR) medications and its factors. Four out of nine (location, gender, experiences, and Present of the Pediatrics CPR team at the

Table 4: Cardiopulmonary Resuscitation (CPR) medications assessment of advanced knowledge.

No	Items	No knowledge		1-25% knowledge		26-50% knowledge		51-75% knowledge		76-100% knowledge		Total	Weighted Average	*p*-value (X2)
1	Do you know the adverse drug reactions of the ACLS medications list?	72.07%	307	8.45%	36	8.45%	36	7.28%	31	3.76%	16	426	1.62	0.000
2	Do you know the adverse drug reactions PCLS medications list?	58.14%	250	25.12%	108	9.30%	40	5.81%	25	1.63%	7	430	1.68	0.000
3	Do you know the adverse drug reactions of NCLS medications?	58.97%	253	26.81%	115	6.76%	29	4.90%	21	2.56%	11	429	1.65	0.000
4	Do you know the contraindications of ACLS medications?	59.39%	253	23.47%	100	5.40%	23	9.15%	39	2.58%	11	426	1.72	0.000
5	Do you know the contraindications of PCLS medications?	61.78%	257	22.60%	94	5.77%	24	5.05%	21	4.81%	20	416	1.69	0.000
6	Do you know the contraindications of NCLS medications?	51.11%	207	18.52%	75	20.25%	82	7.65%	31	2.47%	10	405	1.92	0.000
7	Do you know the drug - interactions with ACLS medications?	51.15%	201	4.33%	17	36.39%	143	5.85%	23	2.29%	9	393	2.04	0.000
8	Do you know the drug - interactions with PCLS medications?	50.92%	193	5.28%	20	23.22%	88	17.15%	65	3.43%	13	379	2.17	0.000
9	Do you know the drug - interactions with NCLS medications?	52.36%	200	6.02%	23	20.94%	80	3.14%	12	17.54%	67	382	2.27	0.000
10	Do you know the compatibility of ACLS medications?	50.92%	194	6.30%	24	6.56%	25	33.60%	128	2.62%	10	381	2.31	0.000
11	Do you know the compatibility of PCLS medications?	51.30%	197	5.47%	21	22.14%	85	19.27%	74	1.82%	7	384	2.15	0.000
12	Do you know the compatibility of NCLS medications?	52.34%	201	21.61%	83	4.69%	18	2.86%	11	18.49%	71	384	2.14	0.000
13	Do you know how to monitor the clinical or laboratory of ACLS medications after they are given to the patients?	65.45%	252	7.79%	30	5.97%	23	18.70%	72	2.08%	8	385	1.84	0.000
14	Do you know how to monitor clinical or laboratory PCLS medications after they are given to the patients?	51.84%	197	19.21%	73	23.68%	90	3.42%	13	1.84%	7	380	1.84	0.000
15	Do you know how to monitor the clinical or laboratory of NCLS medications after they are given to the patients?	53.16%	202	36.05%	137	5.00%	19	3.68%	14	2.11%	8	380	1.66	0.000
16	Do you know the prices or cost of ACLS medications?	55.15%	209	35.62%	135	2.90%	11	2.90%	11	3.43%	13	379	1.64	0.000
17	Do you know the prices or cost of PCLS medications?	56.84%	216	34.47%	131	3.42%	13	4.21%	16	1.05%	4	380	1.58	0.000
18	Do you know the prices or cost of NCLS medications?	55.15%	209	36.41%	138	5.54%	21	2.11%	8	0.79%	3	379	1.57	0.000
	Answered											**439**		
	Skipped											**0**		

Table 5: The Resources used for the CPR medications.

NO		Responses	
1.	Scientific literature	293	73.07%
2.	Peer discussions	298	74.31%
3.	Medical association literature/guidelines/recommendations	307	76.56%
4.	Internet (e.g., Google searches, WebMD, etc.)	42	10.47%
5.	Drug labeling	22	5.49%
6.	CPR education courses	162	40.40%
7.	SFDA website	149	37.16%
8.	Drug information resources (Lexi comp-drug information, Micromedex, Epocrates ..etc.)	173	43.14%
9.	None of the above have consulted any source	3	0.75%
	Answered	**401**	
	Skipped	**38**	

Table 6: Multiple regression of Factors with the basic knowledge of the Cardiopulmonary Resuscitation (CPR) medications.

Model		R	R Square	F	Sig.	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
						B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.581 [b]	.337	20.468	.000[b]	2.060	.246		8.376	.000	1.576	2.543		
	Location					-.039	.036	-.059	-1.088	.277	-.110	.032	.618	1.617
	Site of work					.135	.018	.393	7.413	.000	.099	.171	.651	1.536
	Age (years)					.297	.066	.260	4.488	.000	.167	.428	.546	1.832
	Pharmacist gender					-.030	.091	-.017	-.333	.740	-.209	.149	.701	1.427
	Academic qualifications					-.238	.029	-.538	-8.140	.000	-.295	-.180	.419	2.387
	Years of experience in a pharmacy career					-.007	.027	-.011	-.247	.805	-.060	.047	.955	1.047
	The presence of Adults CPR team at the institution					-.962	.115	-.603	-8.357	.000	-1.189	-.736	.352	2.843
	The presence of the Pediatrics CPR team at the institution					.003	.161	.002	.021	.984	-.313	.320	.157	6.356
	The presence of the Neonates CPR team at the institution					.364	.133	.254	2.737	.007	.103	.626	.212	4.720

a. Dependent Variable: basic knowledge of the Cardiopulmonary Resuscitation (CPR) medications, Predictors: (Constant), Location, Age (years), Pharmacist gender, Position Held, and Years of experience in a pharmacy career, Presence of Adults CPR team at the institution, presence of pediatrics CPR team at the institution, and presence of neonatal CPR team at the institution.

Bootstrap for Coefficients							
Model		B	Bias	Bootstrap[a]			
				Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	2.060	-2.994E-05	.288	.001	1.541	2.697
	Location	-.039	-.001	.060	.513	-.160	.077
	Site of work	.135	.002	.029	.001	.083	.195
	Age (years)	.297	.007	.109	.012	.096	.516
	Pharmacist gender	-.030	.004	.114	.789	-.242	.209
	Academic qualifications	-.238	-.004	.055	.001	-.355	-.140
	Years of experience in a pharmacy career	-.007	.001	.027	.794	-.058	.048
	The presence of Adults CPR team at the institution	-.962	-.018	.203	.001	-1.413	-.600
	The presence of the Pediatrics CPR team at the institution	.003	.028	.268	.994	-.441	.594
	The presence of the Neonates CPR team at the institution	.364	-.026	.184	.038	-.082	.649

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

institution) were non-significant differences (p>0.05). However, multiple regression analysis confirmed that two factors (i.e., academic qualifications and presence of the Adult CPR team at the institution) explained 53.8 % and 60.3%, respectively, of the negative relationship to the variation in perception, with a statistically significant difference (p=0.000), and (p=0.000). The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with the current position factor with a variance inflation factor (VIF) of 2.387 and 2.843, respectively less than three or five as a sufficient number of VIF(32)(33)(34). Besides, three factors (i.e., work site, age, and Present of Neonates CPR team at the institution) explained 39.3%, 26.0%, and 25.4%, respectively, of the positive relationship to the variation in knowledge, with a statistically significant difference (p=0.000), (p=0.000), and (p=0.007). The bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a variance inflation factor (VIF) of 1.536 and 1.832, respectively less than three or five as a good number of VIF. Except for the presence of the Neonates CPR team at the institution, had an existence of multicollinearity with a variance inflation factor (VIF) of 4.720 (Table 6).[32-34]

Factors affecting the advanced knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications

Factors affecting the perception were analyzed. We adjusted the significant values using the independent samples Kruskal–Wallis test and the Bonferroni correction for multiple tests. *Advanced* knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) *medications* includes location, worksite, age, gender, Academic qualifications, years of experience, Present of Adults CPR team at the institution, Present of Pediatrics CPR team at the institution, Present of Neonate CPR team at institution. The north region showed the lowest scores (1.0911), with statistically significant differences between regions (p=0.000). Twelve worksites affected the *advanced* knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) *medications*. The working site affected the factors of ***advance***d knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) *medicines*. The lowest scores (1.3385) and (1.4065) were obtained from MOH hospitals and National Guard Hospitals, respectively, with statically significant differences among all sites (p=0.0.00). The gender was non-statistically significant and affected the *advanced* knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) *medications* (p=0.248). The age of the responders affected the *advanced* expertise of pharmacists in Cardiopulmonary Resuscitation (CPR) *drugs*. Pharmacists aged 24-35 was the lowest score (1.7341), with a statistically significant difference between all age groups (p=0.000). Eight levels of the last academic qualifications affected the advanced knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications, with the lowest score (1.2765) obtained for Pharm D with a statistically significant difference between all levels (p=0.000). Five levels of work experience did not affect the advanced knowledge of pharmacists about Cardiopulmonary Resuscitation (CPR) medications, with non-statically significant differences among all levels (p=856).

The pharmacist does not know about the presence Adults CPR team at the institution (2.4485) or the presence of Adults CPR team at the institution (2.2305) affected advanced knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (p=0.000). In addition, the pharmacist does not know about the existence of a pediatrics CPR team at the institution (2.0507) or the presence of a pediatrics CPR team at the institution (2.2007) affected advanced knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (p=0.000). In addition, the pharmacist does not know about the presence of Present of neonatal CPR team at the institution (2.1364) or the presence of the neonatal CPR team at the institution (2.1931) affected advanced knowledge of pharmacists about the Cardiopulmonary Resuscitation (CPR) medications with a statistically significant difference between all answers (p=0.000).

The relationship between the advanced knowledge of the Cardiopulmonary Resuscitation (CPR) medications and factors such as location, worksite, age (years), gender, academic qualifications, years of experience in a pharmacy career, Present of Adults CPR team at the institution. Present of pediatrics CPR team at the institution and Present of neonate's CPR team at the institution The multiple regression analysis considered perception as the dependent variable and factors affecting it as an expletory variable. There was a medium relationship (R=0.652 with p=0.000) between the basic knowledge of the Cardiopulmonary Resuscitation (CPR) medications and its factors. Seven out of nine were non-significant differences (p>0.05). However, multiple regression analysis confirmed that one factor (i.e., the presence of Adults CPR team at the institution) explained 52.1 % of the negative relationship to the variation in perception, with a statistically significant difference (p=0.000). Therefore, the bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a variance inflation factor (VIF) of 2.843, respectively less than three or five as a sufficient number of VIF. [32-34] Besides, one factor (i.e., work site) explained 33.6% of the positive relationship to the variation in knowledge, with a statistically significant difference (p=0.000). Therefore, the bootstrap model was also confirmed. Furthermore, the relationship was verified by the non-existence of multicollinearity with a variance inflation factor (VIF) of 1.536 less than three or five as a sufficient number of VIF (Table 7).[32-34]

DISCUSSION

The pharmacist provides pharmaceutical care to all types of patients. Ambulatory care and inpatient services. All inpatient services included an acute and critical care facilities. All sections of healthcare organizations should organize a cardiopulmonary resuscitation team as required by the Saudi Center Board for Healthcare Accreditation (CBAHI) and international standards.[16,17] All healthcare organizations should follow the guidelines of the Saudi Heart Association. It is also essential that all pharmacy staff acquire Basic Life Support and optional Advanced Life Cardiac Support for adults, pediatrics, and neonates.[16,17] All CPR teams were required to have the equipment and CPR medications for adults, pediatrics, and neonates.[16,17] Each list of drugs should be kept in nursing units and an additional CPR box at the pharmacy department. For the calling code of CPR, all the team members should attend the calling unit to save the patient life by making CPR. The CPR medication at the nursing and CPR box should be inspected monthly to ensure all medications supply available with appropriate expiration dates.[5,16,17] The participants of the CPR code currently are optional according to pharmacy services. However, the pharmacist should certify with BLS and ACLS before participating in the code.[16,17] Before sharing the code, the pharmacist should know CPR medications well. The current cross-sectional approach is distributed through a survey of pharmacists with different locations, working sites, ages, experience, and positions. The wide variety reflected the pharmacy society demographic information similar to previous studies.[14,15,19-21] Besides, it had reliability results better than the previous study,[19] appropriately calculated sample size better than previous

Table 7: Multiple regression of Factors with the advanced knowledge of the Cardiopulmonary Resuscitation (CPR) medications.

Model		R	R Square	F	Sig.	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
						B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1.	(Constant)	.652 [b]	.425	29.743	.000[b]	1.793	.220		8.139	.000	1.360	2.226		
	Location					.050	.032	.078	1.547	.123	-.014	.113	.618	1.617
	Site of work					.111	.016	.336	6.795	.000	.079	.143	.651	1.536
	Age (years)					-.032	.059	-.029	-.539	.590	-.149	.085	.546	1.832
	Pharmacist gender					.099	.081	.058	1.216	.225	-.061	.259	.701	1.427
	Academic qualifications					.039	.026	.092	1.493	.136	-.012	.091	.419	2.387
	Years of experience in a pharmacy career					.011	.024	.018	.434	.665	-.037	.059	.955	1.047
	The presence of Adults CPR team at the institution					-.800	.103	-.521	-7.755	.000	-1.003	-.597	.352	2.843
	The presence of the Pediatrics CPR team at the institution					-.076	.144	-.053	-.528	.598	-.360	.207	.157	6.356
	The presence of the Neonates CPR team at the institution					.222	.119	.161	1.857	.064	-.013	.456	.212	4.720

a. Dependent Variable: advanced knowledge of the Cardiopulmonary Resuscitation (CPR) medications, Predictors: (Constant), Location, Age (years), Pharmacist gender, Position Held, and Years of experience in a pharmacy career, Presence of Adults CPR team at the institution, presence of pediatrics CPR team at the institution, and presence of neonatal CPR team at the institution

Bootstrap for Coefficients							
Model		B	Bias	Bootstrap[a]			
				Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1.	(Constant)	1.793	-.005	.256	.001	1.325	2.351
	Location	.050	-.004	.055	.374	-.061	.157
	Site of work	.111	.002	.027	.001	.061	.170
	Age (years)	-.032	-.004	.090	.714	-.216	.145
	Pharmacist gender	.099	.001	.101	.329	-.111	.292
	Academic qualifications	.039	.001	.047	.403	-.060	.128
	Years of experience in a pharmacy career	.011	.000	.024	.666	-.033	.058
	The presence of Adults CPR team at the institution	-.800	-.019	.204	.003	-1.240	-.448
	The presence of the Pediatrics CPR team at the institution	-.076	.033	.258	.783	-.495	.526
	The presence of the Neonates CPR team at the institution	.222	-.012	.180	.169	-.224	.508

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

studies,[14,19,20,21] and lower than one published report.[15]

The average score of basic knowledge of CPR medicine was inadequate. The highest knowledge was preparing and dispensing ACLS medicine and NCLS medication list. That's expected because the pharmacist's main job during the CPR code is to provide medication, as discussed previously in pharmacist practice in CPR.[5,14,19-21] In contrast, the lowest knowledge was about the doses and method of administration for NCLS, as discussed previously of pharmacist practice in all patient's types of CPR.[5,14,19-21] That's due to only one-half of responders being certified by the NCLS. Moreover, most responders had poor knowledge of the standardized medication list, the doses, and the administration method of medicine for ACLS, PCLS, and NCLS. That's related to the lack of discussion during pharmacy school education and the absence of training during pharmacy practice. Besides, the role of the pharmacist is not clarified in healthcare organizations. Thus, there is no previous investigation to compare with the current findings.

Various demographic factors might affect the pharmacist's knowledge of CPR medication. The locations might affect the understanding. The lowest score was in the northern region. That's the corresponding shortage number of pharmacists and clinical pharmacists. The working site might act as pharmacist knowledge explored with MOH and security forces hospitals. The majority of pharmacists working on both sites properly not shared with CPR code. They regularly monitor the CPR stock. The male had more knowledge than the female, which might make the gender participate in the CPR code more than females. Another factor might affect the pharmacist's ability, especially with age 36-45, due to other position responsibilities. The lowest knowledge of CPR code medication was third year of residency. That's a related busy schedule of residency, and they did not train in this topic or the specialty is different. Moreover, it was not required commonly from the residency program as reported previously.[21] The number of years of experience did not affect the pharmacist's knowledge of CPR medications, as reported in the previous study.[15] That's related to the factor of practice in the CPR code; it will increase pharmacist knowledge. The pharmacist might have a good understanding of general medications but not focuses on CPR Medications.

The presence of the CPR team of pediatrics and neonatal services might affect the knowledge. That's expected because there might be education and training, or the pharmacist might participate in their teams. The most dependable factor affected negatively, with a high percentage, was academic qualifications and the presence of the adult CPR team. That's related to young pharmacists with only Pharm D graduated more sharing in the CPR code, the pharmacist might ignore the education and training if there are official team take of all CPR ceases. In contrast, working side, age, and presence of neonates codes; might be affected positively with variable percentages. If there are good official teams, education, and working site, pharmacist knowledge will increase dramatically. Assume the older and expert pharmacist grows their knowledge of CPR medication. A neonate's CPR code might increase the pharmacist's knowledge related to education and training for all resident physicians for the CPR code and the pharmacist properly sharing the education with physicians. In general, if pharmacists participate in the CPR code, they will gain more knowledge, as reported previously.[15] Thus, there is no previous knowledge investigation to compare with the current findings.

The average score of pharmacist's advanced knowledge of CPR medication was poor. The highest knowledge about ACLS medication compatibility and drug interactions with NCLS medication. That's related to the job of pharmacists to the preparation of medicines. In contrast, the lowest knowledge about NCLS medications' prices, ACLS medicines' ADR, and the PCLS medicines doses. That's expected because it related to the absence of training at healthcare facilities and the lack of pharmacists participating in CPR codes. Moreover, most pharmacists had insufficient knowledge of ADR, contraindications, drug interactions, and the compatibility of ACLS, PCLS, and NCLS medications. Besides, the pharmacist poorly understood medication monitoring and the cost of ACLS, PCLS, and NCLS programs. That's expected because the pharmacist did not participate regularly or pharmacy CPR medication not existed. Thus, there is no previous investigation to compare with the current findings.

Various factors might affect the pharmacist's advanced knowledge of CPR medication. The location and working site might affect the advanced knowledge for the same reason as fundamental knowledge. The working site's lowest knowledge was MOH hospital and national guard hospital. That might not sharing in CPR code, or they provide the medication without interpretation with drug therapy, or the clinical pharmacist did not share with CPR codes. The young pharmacist with a low academic degree had the most insufficient advanced knowledge of CPR medication, which is expected because they are newly graduated and did not teach during pharmacy school. A CPR team for adults, pediatric and neonatal services might affect the pharmacist's knowledge. That's related to present continuous education and training about CPR medication. The most dependable factor affected negatively, with a high percentage, was the presence of an adult CPR team. The pharmacist might rely on the team without updating their knowledge about CPR medication. In contrast, the working site is another dependable factor that positively influences pharmacist knowledge. That's probably because the place had very organized teams and continuous education and training programs about CPR medication. Thus, there is no previous investigation to compare with the current findings.

Most pharmacists used society guidelines and litterateurs as resources for CPR medication. That's anticipated because it was the only resource in the world, and every healthcare professional followed those guidelines. Thus, there is no previous investigation to compare with the current findings.

Limitations

The current cross-sectional analysis demonstrates a comprehensive understanding about knowledge of pharmacists about CPR medication. However, the investigation had various disadvantages, including the methodology of sampling techniques being non-randomized, leading to an unequal number of subjects with different demographic characteristics, in addition to results from the cross-sectional analysis, which might change in the future. Therefore, further periodic studies with randomized sampling tools are highly suggested.

CONCLUSION

The knowledge of the pharmacist about CPR medication was insufficient. Most pharmacists are familiar with preparing and dispensing CPR medications and an official list of medicines in CPR services. Besides, drug comparability and drug interactions of CPR medications. In contrast, most responders were unfamiliar with the doses and method of administration of CPR medications. In addition to inadequate knowledge of adverse drug reactions and the cost of CPR medications. The majority of pharmacists used medical association therapeutics guidelines and peer discussions. Various factors might affect pharmacist knowledge about CPR medication, such as work sites, age, academic qualifications, and the existence of CPR teams at healthcare facilities. Therefore, targeting undergraduate and postgraduate advanced life support

education emphasizes CPR medication is highly recommended in Saudi pharmacy practice.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

Consent for Publications

Informed consent was obtained from all the participants

Ethical Approval

This research was exempted from research and ethical committee or an institutional review board (IRB) approval.

https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html

ABBREVIATIONS

MOH: Ministry of Health; **KSA:** Kingdom of Saudi Arabia; **MOH:** Ministry of Health; **IV:** Intravenous; **ADR:** Adverse Drug Reaction; **CBAHI:** Saudi Central Board for Accreditation of Healthcare Institutions; **BLS:** Basic Life Support; **ACLS:** Advance Cardiac Life Support; **PCLS:** Pediatric Cardiac Life Support; **NCLS:** Neonatal Cardiac Life Support; **CPR:** Cardiopulmonary Resuscitation; **SPSS:** Statistical Package of Social Sciences; **JASP:** Jeffery's Amazing Statistics Program; **STROBE:** Strengthening the reporting of observational studies in epidemiology statement; **VIF:** Variance Inflation Factor.

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