Antibiotic Prescribing Pattern: Pharmacy Staff Knowledge about Antibiotics at Primary Health Care Centers in Riyadh City, Saudi Arabia

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ABSTRACT

Objectives: To declare pharmacy staff knowledge of the rational use of antibiotics at primary health care centers in Riyadh City, Saudi Arabia. **Methods:** Self-administered Questionnaires were distributed to fifty-six pharmacy staff (pharmacists and pharmacy technicians) from randomly selected twenty-five primary health care centers in Riyadh City, Saudi Arabia. The questionnaire included demographic information and 14 closed-ended questions about the rational usage of antibiotics. **Results:** All the fifty-six pharmacy staff responded to the survey with a response rate of 100%. The responders consisted of having a Diploma in pharmacy (28 (50%)), a Bachelor's in pharmacy (27 (48.2%)), and one (1.8%) post-graduated pharmacist. Most pharmacy technicians were female, 18 (32.1%) vs. 10 (17.9%) male, with non-statistically significant differences between them (*p*=0.131), while the pharmacists were female 22 (39.3%) vs. male 5 (8.9%) with statistically significant differences between them (*p*=0.001). There is insufficient knowledge of the rational use of antibiotics among pharmacy technicians and pharmacists respondents. All pharmacy technicians and pharmacists in the study knew that antibiotics are mainly used for bacterial infections. However, many pharmacy technician and pharmacist participants did not know that antibiotics are ineffective for viral and fungal infections (25% and 14.3% for pharmacy technicians, respectively) vs. (16.1, and 17.9% for pharmacists, respectively). There was no difference in the mean knowledge of antibiotic prescription among respondents, pharmacy technicians, and pharmacists. Furthermore, the respondents had no statistically different knowledge regarding age, gender, and working experience (*p*>0.05). However, the age factor might play a significant role in antibiotics knowledge for pharmacy technicians only. Conclusion: The primary health care centers Pharmacy staff (pharmacy technicians and pharmacists)' knowledge of antibiotics rational usages was insufficient. Targeting training and educating about antibiotics generally emphasize antimicrobial resistance risks are highly recommended.

Keywords: Pharmacy, Knowledge, Antibiotics, Primary healthcare center, Riyadh, Saudi Arabia.

INTRODUCTION

Antibiotic resistance threat has become a worldwide public health attention, with the clinical and economic burden.[1] The World Health Organization (WHO) stated that antibiotic resistance leads to an increase in mortality of 25,000 people yearly in European hospitals, costing about 1.5 billion euros.[1] Although many countries have successfully decreased the prescription of antibiotics, primary healthcare centers are still responsible for the frequent and inappropriate use of antibiotics.[2,3]

The pharmacist is doing a critical role in providing care to various patients. Pharmaceutical care delivers to various diseases that are mainly suffering from illness. Those patients had Cardiovascular problems, neurological disorders, gastrointestinal problems, infections diagnosed, and other health illnesses. Those diseases required specific knowledge and experience. One of the serious diseases was infectious diseases and related antibiotics. The antibiotics usage had critical issues locally. Therefore, an antibiotics stewardship program was established early.[4] The antibiotics stewardship program must cover all hospitals and primary healthcare facilities. The first clinic's primary healthcare centers meet the patients and deliver general and specific treatment for all patients and infectious diseases and antibiotics treatment. Many of the antibiotics used are in the treatment of suspected respiratory infections.[5]

The pharmacist needs knowledge and training for the antibiotics stewardship program while implementing the program items. The pharmacist has a prominent role in counseling patients about the appropriate use of medications, drug program implementations,[6] education on the correct use and prescription of antibiotics to the general population and healthcare professionals,[7] and decreasing the antimicrobial resistance threat as stewardship program outcome.[8] Therefore, the initial evaluation of current antibiotics and rational usage knowledge is demanding. Various studies have been conducted on the rational usage knowledge of pharmacists at hospitals and primary healthcare facilities.[9-11] However, evaluating pharmacist and pharmacy technician knowledge background of rational usages of antibiotics is rarely found locally.[12-17] The authors were unfamiliar with previous research on the current topics published earlier. The current research aims to determine the knowledge of the rational usage of antibiotics by pharmacy staff at primary healthcare centers in Saudi Arabia.

METHODS

The study was a cross-sectional of pharmacists' knowledge of the rational use of antibiotics in primary health care centers in Riyadh city. Riyadh City is served by almost 120 Primary Healthcare Centers (PHC) distributed across five health sectors. The study sample consisted of randomly selected (25 PHCs) among total primary healthcare centers across the city, offering services to a large population relatively representative of Riyadh City. The scope of primary health care services is explained in a previous study.[18] It was a self-administrated questionnaire by fifty-six pharmacy staff working at PHC to measure pharmacist and pharmacy technician knowledge about antibiotics. The questionnaire included information about age, marital status, nationality, level of education, and experience years. The questionnaire contained 14 closed-ended questions, which three choices can answer: Yes or No, and I am not sure. Also, the questionnaire contained three open-ended questions: (a) if antibiotic prescriptions were registered at the pharmacy, (b) if there is any plan to improve antibiotic prescribing in the annual pharmacy work plan, (c) if there are any steps taken to improve the antibiotic prescription in the pharmacy. Data were analyzed using a questionnaire that was tested for validation. Permission to conduct the research was obtained from the general administration for analyses and studies at the Ministry of Health (1440-1033702). A letter of approval was sent to the health sectors. The pharmacy staff's sociodemographic characteristics and knowledge scores were analyzed by Descriptive statistics (frequencies and percentages), and Chi-Square was used to compare non-numerical variables. A *p*-value of 0.005 was set as statistical significance at a 95% confidence interval. Various tests of reliability McDonald's ω, Cronbach alpha, Gutmann's λ2, and Gutmann's λ6 been done with the study The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) guided the reporting of the current study.[19,20]

RESULTS

The total responders were 56 pharmacy staff, with a response rate of 100%. The responders consisted of having a Diploma in pharmacy (28 (50%)), a Bachelor's in pharmacy (27 (48.2%)), and one (1.8%) post-graduated pharmacist. Most pharmacy technicians were female, 18 (32.1%) vs. male 10 (17.9%), with non-statistically significant differences between them (p=0.131), while the pharmacists were female 22 (39.3%) vs. male 5 (8.9%) with statistically significant differences between them (p=0.001). The age distribution of most pharmacy technicians was in range (36-45 years) 15 (26.6%) with statistically significant differences among all levels (p=0.02). In contrast, most pharmacists were in the range (36-45 years) 15 (26.6%) with non-statistically significant differences among all levels (p=0.06). Most pharmacy technicians had a work experience of 6-10 years (12 ((21, 4%) with a non-statistically significant difference between years level of experience (p=0.368). In comparison, most pharmacists had 11 years and above (17 (30.4%)), with a statistically significant difference between years level of experience (p=0.000). There are non-statistically significant differences in gender and age distribution between pharmacy technicians and pharmacists (p=0.294) and (p=0.532), respectively. In contrast, the pharmacists had more working experience years than pharmacy technicians, with statistically significant differences between them (p=0.000) as explored in Table 1. There are non-statistically significant correlations between all demographic variables (age, gender, educational levels, and working experiences) (p>0.05). However, there were positive correlations between age and working experiences with pharmacy technicians; Kendall's tau_b value was (0.567), and Spearman's rho (0.603) was statistically significant (p<0.01). Furthermore, there were positive correlations between age and working experiences with pharmacists. Kendall's tau_b value was (0.676), and Spearman's rho (0.741) was statistically significant (p<0.01). There is insufficient corrected knowledge of the rational use of antibiotics among pharmacy technicians (51.13%) and pharmacists (58.87%) respondents with non-statistically different (p>0.05). All pharmacy technicians and pharmacists in the study period knew that antibiotics are mainly used for bacterial infections. However, many pharmacy technician and pharmacist participants did not know that antibiotics are ineffective for viral and fungal infections (25% and 14.3% for pharmacy technicians, respectively) vs. (16.1, and 17.9% for pharmacists, respectively). The percentage indicated that common cold and flu should be treated with antibiotics was 10.7% for pharmacy technicians and pharmacists, with the same percentage; those who suggested that antibiotics can treat pain and inflammation were 12.5% and 16.1% for pharmacy technicians and pharmacists, respectively. The facts indicating that overexposure to antibiotics and their misuse are contributing factors for developing antibiotic resistance were identified by over two-thirds of all the participants (pharmacy technicians, pharmacists). Inducing secondary infection by antibiotics due to killing normal was thought by 23.2% by pharmacy technicians and pharmacists with the same percentage. Discontinuing antibiotic therapy before finalizing the standard course in case the patient is recovering was identified by 25% of pharmacy technicians and pharmacists in 19.6% of the participants. Almost one-fourth of pharmacy technicians and pharmacists only know that narrow-spectrum antibiotics are preferred over a broad spectrum. Whereas pharmacy technicians 30.4% and pharmacists 23.2% agreed that bacteriostatic is preferred over bactericidal. Antibiotics can cause allergic reactions, and efficacy is better if antibiotics are new and the price is high, identified by pharmacy technicians at 16.1% and 14.3% with both items, respectively. In contrast, the pharmacists agreed with 21.4% and 10.7%, respectively. Only 10.7% of pharmacy technicians and 19.6% of pharmacists agreed that the risk of antibiotic resistance is decreased with fewer antibiotic prescriptions. All previous elements were non-statically significant between pharmacy technician, pharmacist, and post-graduated pharmacist in answering the questions (p>0.05) Table 2. The score for single-test reliability analysis of McDonald's ω was (0.669), Cronbach's α was (0.646), Gutmann's was λ2, (0.689), Gutmann's λ6 was (0.735), and Greater Lower Bound was (0.884).

Factor associated with rational usage of antibiotics knowledge of both pharmacy technician and pharmacists

No factors were associated with differences in the mean rational usage of antibiotics knowledge among respondents, pharmacy technicians, and pharmacists. All respondents had non-statistically different knowledge regarding age, gender, level of education, and working experience (p>0.05). There was a weak relationship (R=0.276 with p=0.433) between the pharmacy technician and the pharmacist's knowledge about the rational usage of antibiotics and their factors. The final multiple linear regression model has shown participants' rational usage of antibiotics knowledge with factors. Age, gender, level of education, and working experience were unrelated to the study participants' knowledge of antibiotic rational usage. The bootstrap model was also confirmed (Table 3).

Factor associated with rational usage of antibiotics knowledge of pharmacy technicians only

No factors were associated with differences in the mean rational usage of antibiotics knowledge among respondents, pharmacy technicians only. All respondents had non-statistically different knowledge regarding age, gender, and working experience (p>0.05). There was a weak relationship (R=0.276 with p=0.584) between the pharmacy technician's knowledge about the rational usage of antibiotics and their factors. The final model of the multiple linear regression has shown that age, gender, and working experience were unrelated to the study participants' knowledge of antibiotic rational usage. The bootstrap model was also confirmed (Table 4).

The logistic regression model analysis declared that all odds ratio of factors the gender and working experiences of rational usage of antibiotics elements knowledge among the pharmacy technicians non-statistically significant ($p>0.05$). However, the odd ratio of age levels (20-35) and (36-45) years factors associated with rational usage of Antibiotics tremendously statistically significantly increased ($p=0.000$) with answers (Yes) to Antibiotics usage for viruses and the risk of antibiotic resistance is decreased with fewer antibiotic prescriptions which both of them were wrong answers. In contrast, The odd ratio of age levels (20-35) and (36-45) years factors associated with rational usage of Antibiotics tremendously statistically significant increased ($p=0.000$) with answers (Not sure) to Antibiotics misuse decrease sensitivity, Antibiotics can cause secondary infections, if a patient takes antibiotics the patient can be discontinued before the complete course, and the risk of antibiotic resistance is decreased with fewer antibiotic prescriptions. The odd ratio statistically significantly increased ($p=0.000$) with the answer (No) with Antibiotics can cause allergic reactions with age (20-35). The odd ratio was statistically significantly decreased ($p=0.000$) with the answer (Not sure) that Antibiotics can cause allergic reactions with age (20-35), as explored in Table 5.

Factor associated with rational usage of antibiotics knowledge of pharmacists only

No factors were associated with differences in the mean rational usage of antibiotics knowledge among respondents with pharmacist education. All respondents had non-statistically different knowledge regarding age, gender, and working experience ($p>0.05$). There was a weak relationship ($R=0.340$ with $p=0.567$) between the pharmacist's knowledge about the rational usage of antibiotics and their factors. The final model of the multiple linear regression has shown that age, gender, and working experience were unrelated to the study participants'

Table 1: Demographic, social information.

	Pharmacy Technicians			Pharmacist			Postgraduate Rph.			Total	Pharmacy Tech Vs. Pharmacists
Gender	**Response Count**	**Response Percent**	**p-value (X2)**	**Response Count**	**Response Percent**	**p-value (X2)**	**Response Count**	**Response Percent**	**p-value (X2)**	**Response Count**	
Male	10	17.9	0.131	5	8.9	0.001	0	0		15 (26.78%)	0.294
Female	18	32.1		22	39.3		1	1.8		41 (73.21%)	
Answered question	28	50		27	48.2		1	1.8		56 (100%)	
Skipped question	0										
Age	**Response Count**	**Response Percent**		**Response Count**	**Response Percent**						
20-35	10	17.9	0.020	7	12.5	0.060	1	1.8		18 (32.1%)	0.532
36-45	15	26.6		15	26.6		0	0		30 (53.6%)	
46 and above	3	5.4		5	8.9		0	0		8 (14.3%)	
Answered question	28	50		27	48.2		1	1.8		56 (100%)	
Skipped question	0										
Pharmacist Qualifications	**Response Count**	**Response Percent**		**Response Count**	**Response Percent**		**Response Count**	**Response Percent**			
Diploma	28	50		0	0		0	0		28 (50%)	0.000 (compared with postgraduate)
Bachelor's degree	0	0		27	48.2		0	0		27 (48.2%)	
Postgraduate	0	0		0	0		1	1.8		1(1.8%)	
Answered question	28	50		27	48.2		1	1.8		56 (100%)	
Skipped question	0										
Years of experience in a pharmacy career	**Response Count**	**Response Percent**		**Response Count**	**Response Percent**		**Response Count**	**Response Percent**			
Pharmacy intern	0	0	0.368	0	0	0.000	0	0		0 (0%)	0.000
Less than one year	0	0		0	0		1	1.8		1 (1.8%)	
1- 5 years	6	10.7		3	5.4		0	0		9 (16.1)	
6 – 10 years	12	21.4		7	12.5		0	0		19 (33.9%)	
11years and more	10	17.9		17	30.4		0	0		27 (48.2%)	
Answered question	28	50		27	48.2		1	1.8		56 (100%)	
Skipped question	**0**										

Table 2: Level of knowledge toward the rational use of antibiotics among pharmacy staff respondents.

No	Items	Education levels	Yes		No		Not sure		Total		
1	Antibiotics are helpful for bacterial infection.	Diploma	50%	28	0%	0	0%	0	28	50%	0.000
		Bachelor Degree	48.2%	27	0%	0	0%	0	27	48.2%	
		Postulated	1.8%	1	0%	0	0%	0	1	1.8%	
2	Antibiotics are helpful for viral infections.	Diploma	25%	14	25%	14	0%	0	28	50%	0.331
		Bachelor Degree	16.1%	9	32.1%	18	0%	0	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
3	Antibiotics are helpful for Fungi.	Diploma	14.3%	8	33.9%	19	1.8%	1	28	50%	
		Bachelor Degree	17.9%	10	28.6%	16	1.8%	1	27	48.2%	0.735
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
4	Colds and coughs must always be treated with antibiotics, as patients will recover more quickly.	Diploma	10.7%	6	35.7%	20	3.60%	2	28	50%	0.771
		Bachelor Degree	10.7%	6	37.5%	21	0%	0	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
5	Antibiotics are indicated to reduce any type of pain and inflammation.	Diploma	12.5%	7	31.1%	18	5.4%	3	28	50%	0.855
		Bachelor Degree	16.1%	9	26.8%	15	5.4%	3	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
6	Antibiotic exposure appears to be the principal risk factor for developing antibiotic resistance.	Diploma	30.4%	17	17.9%	10	1.8%	1	28	50%	0.316
		Bachelor Degree	39.3%	22	7.1%	4	1.8%	1	27	48.2%	
		Postulated	1.8%	1	0%	0	0%	0	1	1.8%	
7	Misuse of antibiotics might lead to a loss of sensitivity to specific pathogens and may make antibiotics less likely to work in the future.	Diploma	32.1%	18	12.5%	7	5.4%	3	28	50%	0.401
		Bachelor Degree	37.5%	21	8.9%	5	1.8%	1	27	48.2%	
		Postulated	1.8%	1	0%	0	0%	0	1	1.8%	
8	Antibiotics might cause secondary infections after killing the human body's normal flora.	Diploma	23.2%	13	16.1%	9	10.7%	6	28	50%	0.478
		Bachelor Degree	23.2%	13	21.4%	12	3.6%	2	27	48.2%	
		Postulated	1.8%	1	0%	0	0%	0	1	1.8%	
9	If a patient takes antibiotics and he/she has recovered before completing the standard antibiotic course, the patient can be recommended to discontinue antibiotic therapy to avoid antibiotic overuse.	Diploma	25.0%	14	17.9%	10	7.1%	4	28	50%	0.857
		Bachelor Degree	19.6%	11	26.8%	15	1.8%	1	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
10	Prescribing broad-spectrum antibiotics is preferred over prescribing narrow-spectrum antibiotics.	Diploma	26.8%	15	21.4%	12	1.8%	1	28	50%	0.725
		Bachelor Degree	26.8%	15	17.9%	10	3.6%	2	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
11	Prescribing bacteriostatic antibiotics is preferred over prescribing bactericidal antibiotics.	Diploma	30.4%	17	14.3%	8	5.4%	3	28	50%	0.648
		Bachelor Degree	23.2%	13	19.6%	11	5.4%	3	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
12	Antibiotics can cause allergic reactions	Diploma	16.1%	9	25%	14	8.9%	5	28	50%	0.335
		Bachelor Degree	21.4%	12	21.4%	12	5.4%	3	27	48.2%	
		Postulated	1.8	1	0%	0	0%	0	1	1.8%	
13	The efficacy is better if antibiotics are newer and with high prices or expensive.	Diploma	14.3%	8	16.1%	9	19.6%	11	28	50%	0.970
		Bachelor Degree	10.7%	6	19.6%	11	17.9%	10	27	48.2%	
		Postulated	0%	0	1.8%	1	0%	0	1	1.8%	
14	The risk of antibiotic resistance is decreased with fewer antibiotic prescriptions.	Diploma	10.7%	6	16.1%	9	23.2%	13	28	50%	0.207
		Bachelor Degree	19.6%	11	10.7%	6	17.9%	10	27	48.2%	
		Postulated	1.8%	1	0%	0	0%	0	1	1.8%	
	Answered question								56		
	Skipped question								0		

Table 3: Multiple regression of Factors with the boh pharmacists and pharmacy technician's knowledge of antibiotic rational usage.

Model						Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		R	R Square	F	Sig.	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.266[b]	.071	0.969	.433[b]	1.966	.249		7.908	.000			1.467	2.465
	Gender					-.122	.081	-.207	-1.497	.141	-.285	.041	.950	1.052
	Age					.069	.070	.174	.980	.332	-.072	.209	.580	1.724
	Level of education					-.039	.060	-.090	-.654	.516	-.160	.081	.957	1.045
	Working experiences					-.042	.058	-.128	-.722	.474	-.158	.074	.583	1.714

a. Dependent Variable: **pharmacists and pharmacy technicians' of antibiotic rational usage**, Predictors: (Constant), Gender, age, level of education, and working experiences.

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	1.966	.025	.248	.001	1.533	2.491
	Gender	-.122	-.004	.083	.147	-.292	.046
	Age	.069	.004	.056	.219	-.031	.185
	Level of education	-.039	-.006	.058	.480	-.173	.061
	Working experiences	-.042	-.004	.051	.398	-.146	.048

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

Table 4: Multiple regression of Factors with the pharmacy technician's knowledge of antibiotic rational usage.

Model						Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		R	R Square	F	Sig.	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.276[b]	.076	0.661	.584[b]	1.664	.386		4.314	.000	.868	2.459		
	Gender					-.091	.113	-.160	-.807	.428	-.324	.142	.973	1.028
	Age					.040	.106	.094	.378	.709	-.179	.259	.630	1.588
	Working experiences					.049	.092	.134	.537	.596	-.140	.238	.616	1.623

a. Dependent Variable: **pharmacy technicians' of antibiotic rational usage**, Predictors: (Constant), Gender, age, and working experiences.

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	1.664	-.024	.376	.001	.918	2.338
	Gender	-.091	.005	.113	.404	-.305	.138
	Age	.040	.003	.097	.646	-.142	.246
	Working experiences	.049	.003	.079	.506	-.095	.232

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

Table 5: Logistic regression analysis of factors associated with pharmacy technicians with rational usage of Antibiotics.

		Characteristics		Odd ratio (OR)	CI 95%		*p* value
1	Antibiotics usage for virus	Age (Yes answer)	20-35	1039791648.290	130905201.502	8259157462.428	**0.000**
			36-45	799765544.359	799765544.359	799765544.359	**0.000**
			46 and above				
		Gender	Male	0.329	0.048	2.252	0.257
			Female				
		Working experiences	1-5	0.113	0.006	2.247	0.153
			6-10	0.348	0.035	3.425	0.365
2	Antibiotic misuse decreases sensitivity	Age (Not sure answer)	20-35	18424721.091	307645.428	1103446746.902	**0.000**
			36-45	30192047.618	30192047.618	30192047.618	**0.000**
			46 and above				
		Gender	Male	2.754	.143	53.077	0.502
			Female				
		Working experience	1-5	2.195	.016	297.306	0.754
			6-10	.850	.028	26.100	0.926
			46 and above				
3	Antibiotics can cause secondary infections	Age (Not sure answer)	20-35	3531677.024	209167.024	59630539.905	**0.000**
			36-45	12848898.195	12848898.195	12848898.195	**0.000**
			46 and above				
		Gender	Male	4.529	.454	45.221	0.198
			Female				
		Working experiences	1-5	12.476	.239	650.227	0.211
			6-10	2.800	.141	55.604	0.500
4	If a patient takes antibiotics, the patient can be discontinued before completing the course	Age (Not sure answer)	20-35	62001768.217	2813528.924	1366333656.545	**0.000**
			36-45	127319598.476	127319598.476	127319598.476	**0.000**
			46 and above				
		Gender	Male	3.354	.269	41.838	0.347
			Female				
		Working experiences	1-5	1.239	0.022	69.463	0.917
			6-10	0.168	0.005	6.152	0.332
			46 and above				
5	Antibiotics can cause allergic reactions	Age (No answer)	20-35	1419584100.201	38635485.600	52159795230.500	**0.000**
			36-45	1.915	.062	59.163	0.710
			46 and above				
		Gender	Male	0.518	.061	4.415	.547
			Female				
		Working experiences	1-5	2.429E-10	2.429E-10	2.429E-10	
			6-10	0.673	0.053	8.478	0.760
		Age (Not Sure answer)	20-35	4.610E-10	1.278E-11	1.663E-08	**0.000**
			36-45	0.464	0.011	20.490	0.691
			46 and above				
		Gender	Male	1.225	.097	15.408	0.875
			Female				
		Working experiences	1-5	714515511.120	714515511.120	714515511.120	
			6-10	0.727	0.023	23.364	0.857
			46 and above				

continued...

Table 5: Cont'd.

6	The risk of antibiotic resistance is decreased with fewer antibiotic prescriptions	Age (Yes answer)	20-35	243637460.977	15446684.618	3842844847.166	**0.000**
			36-45	93128732.417	93128732.417	93128732.417	**0.000**
			46 and above				
		Gender	Male	5.217	0.394	69.114	0.210
			Female				
		Working experiences	1-5	2.743	0.052	143.413	0.617
			6-10	1.846	0.088	38.825	0.693
			46 and above				

Table 6: Multiple regression of Factors with the pharmacist's knowledge of antibiotic rational usage.

Model						Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		R	R Square	F	Sig.	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.340 [b]	.116	0.752	.567[b]	2.070	.493		4.195	.000	1.049	3.091		
	Gender					-.142	.107	-.271	-1.332	.196	-.362	.078	.929	1.076
	Age					.094	.081	.317	1.172	.253	-.072	.261	.527	1.898
	Level of education					-.044	.134	-.082	-.332	.743	-.321	.232	.628	1.591
	Working experiences					-.066	.077	-.269	-.848	.405	-.226	.095	.383	2.609

a. Dependent Variable: **pharmacists' knowledge of antibiotic rational usage**, Predictors: (Constant), Gender, age, level of education, and working experiences.

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	2.070	.062[b]	.458[b]	.002[b]	1.410[b]	3.264[b]
	Gender	-.142	-.009[b]	.120[b]	.234[b]	-.394[b]	.084[b]
	Age	.094	.010[b]	.073[b]	.212[b]	-.030[b]	.255[b]
	Level of education	-.044	-.008[b]	.083[b]	.606[b]	-.257[b]	.087[b]
	Working experiences	-.066	-.011[b]	.084[b]	.394[b]	-.276[b]	.064[b]

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

knowledge of antibiotic rational usage. The bootstrap model was also confirmed (Table 6), and other Logistic regression model analyses declared that all odds ratio of factors (gender, age, and working experiences) not associated with knowledge of antibiotic prescription among the pharmacists were not statistically significant ($p<0.05$).

DISCUSSION

Antibiotic usage is a big concern in the World Health Organization. It releases various statistics about antibiotic resistance periodically to distribute the importance and various of antibiotic resistance.[1] Thus, the WHO recommended the best usage of antibiotics and the implementation of antimicrobial stewardship programs in each country. The antimicrobial stewardship program was established locally several years ago.[4] The program started at hospital facilities, and primary healthcare centers were planned as the next step.[4] Also, the impact of the program needs to be evaluated thoroughly. Thus, Various studies were conducted locally at the hospital in different departments, inpatient, outpatient, emergency, and critical care services to measure antibiotics consumption before the program implementation.[21-23]

Furthermore, the rational usage of antibiotics at the primary care center. The study randomly selected 25 primary Heather centers and 120 centers in Riyadh city and included all pharmacy staff, pharmacy technicians, and pharmacists to assess knowledge of rational usage. It might be the first pilot study done at the Primary Healthcare Center because most previous studies were conducted at hospitals or community pharmacies.[9-17] The reliability test was medium, related to a small sample of participants.

The response was 100%, which improved the cooperation of pharmacy staff with pharmacy research. Almost half of the responders were pharmacy technicians, and another half were pharmacists, which is an excellent point to compare them equally. The gender distribution was almost not significant. However, there was a difference among pharmacists, which females more than make, which was expected because most females mainly worked at primary health care due to stable work and without night shit. The gender distribution resembles some previous studies[9,10,11,17] and differed from another study due to different healthcare facilities settings.[12,24] The age distribution between respondents was not significant, like in the previous study.[10,12,24] However, there are higher ages of pharmacy technicians because there is an old staff of pharmacy technicians due to holding the pharmacy technician studies. Most pharmacy staff had more than six years of experience, like the previous study,[24] and differed from another study.[17] The pharmacist had more statistically significant experience than the pharmacy technician, which differed from the previous study.[12] That is suitable for antibiotics knowledge assessment because the pharmacist is more knowledgeable than pharmacy technicians. There was cheerful coloration among age and experiences with pharmacy technicians and pharmacists. That is expected because the pharmacy staff is getting old and exposed to more work, problems, performances, and additional experiences.

The knowledge level of antibiotic's rational use is almost inadequate for pharmacy technicians and pharmacists. One-half of pharmacy technicians and pharmacists had only had antibiotics rational use knowledge available, which differed from the previous study,[24] which had a large sample size that can provide a clearer picture than our study with a small sample size, and antibiotics policy and procedures available. Regarding the level of pharmacists' knowledge about antibiotics, 100% of the respondents affirmed that antibiotics are helpful for bacteria treatment. That is not surprising since it is well-known that antibiotics can inhibit the synthesis of protein, RNA, and cell walls, leading to bacterial cell death without losing viability.[25]

The results showed inadequate knowledge of responders with various elements such as antibiotics could be viral or fungal infections or usage for common cold or cough and pain and general inflammation that resemble of had been reported in previous studies[24,26] and differed from other.[14,15] The pharmacy staff is expected to be a significant barrier that prevents reaching wrong medical therapy to patients, which requires a certain level of knowledge that enables them to filtrate prescriptions and catch up on any medication error committed by prescribers. However, having pharmacy staff with deficient knowledge in differentiating antivirals and anti-fungals from antibiotics is disappointing since such information is fundamental in medical care. Each pharmacist should know that anti-fungals and antivirals are entirely different from antibiotics. These results strongly suggest that enormous efforts should be spent to enhance pharmacists' knowledge and awareness of antibiotics by implementing educational activities such as seminars, training sessions, and regular newsletters. The antibiotic education session will increase the knowledge of rational antibiotic usage.[11] Such deficient knowledge is an issue locally and in other countries.[11]

Half of the responders agreed to use broad-spectrum antibiotics, and the patient can stop antibiotics when reliving the symptoms; the percentage of responders similar to one study[13] lower than in a previous study,[17,24] because it might they implemented antibiotics guidelines or more antibiotics uses awareness available. When antibiotic therapy is to be used, it should be targeted to the pathogen as far as possible. Narrow-spectrum antibiotics should be chosen whenever possible.[27] The phenomenon of cross-resistance is one of the principal reasons for recommending narrow-spectrum antibiotics to treat infections whenever possible.[27] If resistance develops, it will usually be to fewer antibiotics than if a broad-spectrum agent had been used.

One-half only knew prescribing bactericidal is better than prescribing bacteriostatic, and knew that narrow spectrum is preferred over broad spectrum. The current evidence differentiating between bacteriostatic and bactericidal drugs suggests that the bactericidal drug has more powerful antibacterial action and can kill bacteria.[11] Bacteriostatic, however, are assumed to require phagocytic cells to clear bacteria and are thought to be less effective without an efficient immune response. Therefore, it is recommended that severely ill and immunosuppressed patients with bacterial infections should be treated with bactericidal.[28,29] Moreover, bactericidal antibiotics are also required in some conditions, such as endocarditis.[30] The cardiac valves are considered focal, immunosuppressed regions to which the accessibility of phagocytic cells is poor. Therefore, bactericidal drugs are generally recommended for phagocyte-independent killing under such circumstances.[31]

Regarding socio-demographical factors and level of knowledge and awareness about antibiotics, the level of education was not significantly associated with higher knowledge. Furthermore, age, gender, and years of experience were not significant factors for the level of knowledge similar to previous studies with gender and differed with experiences.[13] It resembled others with age, gender, and experiences.[17] A different finding reported by a cross-sectional survey evaluated pharmacist knowledge in Sri Lanka, revealing that higher education is related to higher awareness of antibiotic resistance. In contrast, other demographic characteristics, such as gender, geographical area, years of experience, and employment status, were not significantly associated with appropriate antibiotic dispensing.[32] On the other hand, our finding contradicts another study, which found that younger pharmacists and male pharmacists with less experience were likelier to be less aware of antibiotics.[26]

The age factor might have affected the pharmacy technician's responses. The odd ratio of a serif yes with an element that's antibiotic used for viral infection with higher was high that all pharmacy technicians might have misunderstood rational antibiotic in viral infection treatment. In contrast, the pharmacy technician's increased odd ratio with a higher age of few antibiotics might decrease antibiotic resistance. The odd ratio might Most pharmacy technicians antibiotic rational use knowledge element with not sure answered such as antibiotic misuse decrease antibiotic sensitivity, antibiotic-induced secondary infection, and the patient can stop antibiotic any time. All previous examples were essential antibiotic knowledge; with old age, the pharmacy technician decreases the antibiotic knowledge or forgets the basic knowledge. The odd ratio increased for the younger age (20-35) of the pharmacy technicians who answered no for antibiotics-induced allergies, which might reflect the poor knowledge of new graduate pharmacy technicians. There were no published studies about pharmacy technicians to compare results with them.

LIMITATIONS

The study was pilot research with a small sample size and used very few questions about the rational usage of antibiotics. Therefore, the study results cannot be generalized to the entire location. It implies that the extensive samples of pharmacy technicians and pharmacists with broad geographic areas and entire subject locations needed additional questions about antibiotics.

CONCLUSION

A more rigorous approach is needed to enhance the pharmacist's and pharmacy technician's knowledge of antibiotics to prevent the incidence of antimicrobial resistance. Further work in local PHCs, including rural areas, required identifying the awareness about antibiotics among pharmacy staff and exploring the inappropriate prescribing of antibiotics. Furthermore, targeting interventions such as implementing an antimicrobial stewardship program at PHC emphasizes educating and training medical staff, including pharmacy services workforces, about antibiotics and the risk of antimicrobial resistance is highly recommended.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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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

WHO: World Health Organization; **PHCs:** Primary healthcare center; **MOH:** Ministry of Health; **KSA:** Kingdom of Saudi Arabia; **USA:** The United States of America.

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