The Practice of Pharmacy Infection Control by Pharmacists in Saudi Arabia

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Received: 01-02-2021;
Accepted: 17-05-2021;

Access this article online
www.ijpcs.net
DOI: 10.5530/ijpcs.2021.10.20

ABSTRACT

Objectives: In this study, we aimed to illustrate the practice of pharmacy infection control by pharmacists in the Kingdom of Saudi Arabia. **Methods:** In this cross-sectional study, we aimed to assess the practice of pharmacy infection control by pharmacists in Saudi Arabia. We used a self-reported electronic survey questionnaire and distributed it to pharmacists from interns to consultants and specialists in Saudi Arabia. The survey collected demographic information of the pharmacists and about the implemented pharmacy infection control practices. The practice of pharmacy infection control and pharmacy infection control responsibilities among the types of healthcare professionals. We used 5-point Likert response scale system with close-ended questions to obtain responses. The data were collected through the Survey Monkey system and analyzed with Statistical Package of Social Sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel (version 16) software. **Results:** A total of 435 pharmacists responded to the questionnaire. Of them, one-quarter belonged to the central region (97 (22.35%)), followed by the northern region (92 (21.2%)), and there were no statistically significant differences between the provinces (p=0.637). Most of the responders were from a community pharmacy (81 (18.62%)), Ministry of Health (MOH) hospital (69 (15.86%)), and military hospitals (49 (11.26%)), with statistically significant differences between working sites (p=0.000). Moreover, 212 (48.96%) were female, while 221 (51.04%) were male, with non-statistically significant among the areas (p=0.665). Most of the responders were in the age group of 24–30 years (151 (34.87%)) and 36–40 years (101 (23.33%)) with statistically significant differences between all age groups (p=0.000). The average score of the elements related to the implementation of pharmacy infection control practices was 3.07, with high scores obtained for the aspect "the vision of pharmacy infection control" (3.79) and "mission of pharmacy infection control" (3.55). In contrast, the lowest score was obtained for the element "competition in infection control pharmacy" (2.51) and infection control pharmacy and quality management (2.65). The average score for the element implementation of pharmacy infection control practice was 3.47, with high scores obtained for the element "the pharmacist share in infection control committee" (4.37) and "the pharmacist was always a staff member of infection control or pharmacy departments" 3.84. In contrast, the lowest score was obtained for the element attending several courses or workshops about pharmacy infection control (3.17). The scores for the single-test reliability analysis of McDonald's ω was 922, Cronbach's α was0.919, Gutmann's λ2 was 0.930, Gutmann's λ6 was 0.973, and Greater Lower Bound was 0.990. **Conclusion:** In this study, pharmacists' practice of pharmacy infection control was found to be inadequate in Saudi Arabia. Therefore, implementing infection control in pharmacy practice is required to prevent drug-related infection control problems. In addition, we recommend improving the infection control practice in pharmacy services in Saudi Arabia.
Key words: Practice, Pharmacy, Infection, Control, Saudi Arabia.

INTRODUCTION

Infection control is an essential concept for healthcare professionals, including pharmacists.[1-6] The pharmacist needs to prevent the infection before or during dispensing of medications. The pharmacist needs to follow hand hygiene regularly to avoid any transmission of infection.[7] Moreover, infection control needs to be periodically practiced at different pharmacy services, including inpatient pharmacy, outpatient pharmacy, and clinical pharmacy services.[1-6] It is required for the pharmacy environment, workplaces, equipment, and pharmacy staff. Pharmacists distribute and dispense hand sanitizer and disinfectant solutions to various healthcare sections in their organization. There are different standards of infection control for medical and nursing care.[1-6] However, only a few studies have talked about complete pharmacy infection control programs or guidelines, and some have focused their research on one type of pharmacy service during the mass gathering.[8-13] Various practices of pharmacy infection control should be addressed such as vision, mission, strategic plan, and policies and procedures in addition to the competency of pharmacy infection control, surveillance-monitoring, immunization for pharmacy staff and trainees, and medications storage.[1-6] However, to the best of our knowledge, there are no studies, especially

on pharmacy practice of pharmacy infection control.[14-16] Therefore, in this study, we aimed to assess the practice of pharmacy infection control in the Kingdom of Saudi Arabia.

METHODS

It was a cross-sectional study that explored the practice of pharmacy infection control during pharmaceutical care in Saudi Arabia. We used an electronic and self-reported survey questionnaire and distributed it to pharmacists from interns to consultants and all pharmacy specialties in Saudi Arabia. All non-pharmacists, students, and incomplete surveys were excluded from the study. The survey collected demographic information of the pharmacists and data regarding the practice and implementation of pharmacy infection control and pharmacy infection control (to authorities) responsibility of types of healthcare professionals. We used a 5-point Likert response scale system with close-ended questions to obtain responses. Based on the previous literature with unlimited population size, the sample was calculated for this cross-sectional study with a population percentage of 50%, the confidence level of 95%, a *z* score of 1.96, and a margin of error of 5–6.5%, and drop-out rate of 10%. Thus, the calculated sample size was around 251–432 with a power of study of 80%.[17-19] The response rate required for the calculated sample size was at least 60–70%.[19,20] The survey was distributed through social media such as WhatsApp and Telegram apps. In addition, a reminder message was sent once every 2-3 weeks. The expert reviewers and pilot testing validated the survey data. Moreover, the test of reliability Gutmann's λ6, Gutmann's λ2, McDonald's ω, and Cronbach's α were calculated. The data were analyzed through the Survey Monkey system, and we used Statistical Package of Social Sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel (version 16) software for data analysis. We performed descriptive and frequency analysis, the goodness of fit analysis, correlation analysis, and inferential analysis of factors affecting medication safety practice. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) guided the reporting of the results of this study.[21-23]

RESULTS

A total of 435 pharmacists responded to the survey. Of them, one-quarter were from the central region (97 (22.35%)) and northern area (92 (21.2%)), and there were no statistically significant differences between the provinces (p=0.637). Of those, most of the responders were from a community pharmacy (81 (18.62%)), Ministry of Health (MOH) hospitals (69 (15.86%)), and military hospitals (49 (11.26%)), with statistically significant differences between worksites (p=0.000). Of the total responders, 212 (48.96%) were female, and 221 (51.04%) were male, and there was no statistically significant difference between them (p=0.665). Most of the responders were in the age group of 24–30 years (151 (34.87%)) followed by 36–40 years (101 (23.33%)), with statistically significant differences between all age groups (p=0.000). Most of the pharmacists were pharmacy staff (192 (44.55%)) and pharmacy supervisors (104 (24.13%)), with statistically significant differences between all levels of qualifications (p=0.000). The majority of the responders held Bachelor in Pharmacy degree (281 (64.75%)), Master in Pharmacy degree (94 (21.66%)), and Diploma in Pharmacy (90 (20.74%)). Most pharmacists have work experience of 7–9 years (117 (27.08%)) and 4–6 years (116 (26.85%)), with statistically significant differences between all levels of experience (p=0.000). Almost one-fifth of the pharmacists practiced at the clinical pharmacy (62 (18.08%)), outpatient pharmacy (61 (17.78%)), and inpatient pharmacy (555 (16.03%)), with statistically significant differences between all sites of pharmacy practice (p=0.000). There is a strong positive correlation between age (years) and years of experience in pharmacy career based on Kendall's tau_b (0.576) and Spearman's rho (0.701), with statistically significant differences between them (p<0.001) (Tables 1 and 2). The average score for the implemented items for pharmacy infection control practice was 3.07, with high scores obtained for the elements "the vision of pharmacy infection control" (3.79), "mission of pharmacy infection control" (3.55), "infection control pharmacy and drug quality reporting systems" (3.37), and "the strategic plan of pharmacy infection control" (3.35). In contrast, low scores were obtained for the elements "infection control pharmacy competency" (2.51), "Infection control pharmacy and quality management" (2.65), and "policies and procedure of pharmacy infection control" (2.77), with significant statistical differences between all responses (p=0.000) (Table 3). The average score for the elements of pharmacy infection control practice implementation was 3.47, with high scores obtained for the elements "the pharmacist share in infection control committee" (4.37) and "the pharmacist was always a staff member of infection control or pharmacy departments" (3.84). In contrast, the lowest score was obtained for the element "the attendance of several courses or workshops about pharmacy infection control" (3.17) and "there are electronic pharmacy infection control performances" (3.34), with a statistically significant difference between all the answers in all aspects in pharmacy practice (p=0.000) (Table 4). The highest scores of pharmacy infection control (to authorities) were obtained for the element "the responsibility of types of healthcare professionals was an infection control pharmacist" (3.95) and "infection control doctors" (3.94). In contrast, the lowest score was obtained for the element "infectious diseases doctors" (3.29) and "infection control nurses" (3.37), with statistically significant differences between the responses (p=0.000) (Table 5). The score for the single-test reliability analysis of McDonald's ω was 922, Cronbach's αwas 0.919, Gutmann's λ2 was 0.930, Gutmann's λ6 was 0.973, and Greater Lower Bound was 0.990.

Factors influencing the pharmacist's practice of pharmacy infection control

In this study, we performed independent samples Kruskal–Wallis test and the Bonferroni correction for multiple tests to obtain adjusted significant values, which are as follows. The factors that might affect pharmacists' practice of pharmacy infection control include location, worksite, gender, age, practice area, current position held, and years of experience. Gender alone did not affect the knowledge of storage, with a non-statistically significant difference between males and females (p>0.05). Five locations affected the practice of pharmacy infection control by pharmacists. The western region showed the lowest scores (2.8144), with a statistically significant difference between all regions (p=0.000). Fourteen levels of the working site showed low scores, in which case private hospitals obtained the lowest score (2.4963), with a statistically significant difference between them (p=0.000). Six different age groups affected the practice of pharmacy infection control. The lowest score (2.7477) was obtained for the age group of 24–30 years, with a statistically significant difference between all age groups (p=0.000). Twelve practice areas showed a low score (2.4762), and the area of pharmaceutical companies showed a statistically significant difference (p=0.000). Five career positions affected the practice of pharmacy infection control, with the lowest score (2.7767) obtained for the intern position, which was statistically significant (p=0.013). Six levels of years of experience affected the practice of pharmacy infection control. The lowest score (2.7478) was obtained for <1 year of experience, followed by 1–3 years of experience (2.7578) and >12 years of experience (2.7474), and the differences were statistically

Table 1: Demographic, social information.

Locations	Response Count	Response Percent	*p*-value (X2)
Central area	97	22.35%	0.637
North area	92	21.20%	
South area	83	19.12%	
East area	79	18.20%	
West area	83	19.12%	
Answered question	**434**		
Skipped question	**1**		
Site of work	**Response Count**	**Response Percent**	***p*-value (X2)**
MOH Hospitals	69	15.86%	0.000
Military hospitals	49	11.26%	
National Guard Hospital	25	5.75%	
Security forces hospitals	41	9.43%	
KFSH&RC	2	0.46%	
University hospital	24	5.52%	
MOH primary care centers	23	5.29%	
Private hospitals	25	5.75%	
Private ambulatory care clinics	26	5.98%	
Private primary healthcare center	26	5.98%	
Community pharmacy	81	18.62%	
Pharmaceutical companies	38	8.74%	
Non-employment	3	0.69%	
Intern	3	0.69%	
Answered question	**435**		
Skipped question	**0**		
Gender	**Response Count**	**Response Percent**	
Male	221	51.04%	0.665
Female	212	48.96%	
Answered question	**433**		
Skipped question	**2**		
Age	**Response Count**	**Response Percent**	
24-30	151	34.87%	0.000
31-35	89	20.55%	
36-40	101	23.33%	
41-45	60	13.86%	
46-50	30	6.93%	
> 50	2	0.46%	
Answered question	**433**		
Skipped question	**2**		

Table 2: Demographic, social information.

Pharmacist's Qualifications	Response Count	Response Percent	*p*-value (X2)
Diploma in Pharmacy	1	0.23%	
Bachelor in pharmacy	281	64.75%	
Master	94	21.66%	
Pharm D	90	20.74%	
Ph. D	12	2.76%	
PGY 1	9	2.07%	
PGY 2	15	3.46%	
PGY 3	7	1.61%	
Fellowship	4	0.92%	
Other (please specify)	2	0.46%	
Answered question	**434**		
Skipped question	**1**		
Position Held	**Response Count**	**Response Percent**	
Director of Pharmacy	46	10.67%	0.000
Assistant Director of Pharmacy	51	11.83%	
Supervisor	104	24.13%	
Pharmacy staff	192	44.55%	
Intern	38	8.82%	
Answered question	**431**		
Skipped question	**4**		
Years of experience at Dentists career	**Response Count**	**Response Percent**	
Less than one year	69	15.97%	0.000
1-3	83	19.21%	
4-6	116	26.85%	
7-9	117	27.08%	
10-12	25	5.79%	
>12	22	5.09%	
Answered question	**432**		
Skipped question	**3**		
Pharmacy practice	**Response Count**	**Response Percent**	
Pharmacy adminstration	1	0.29%	0.000
Inpatient Pharmacy	55	16.03%	
Outpatient Pharmacy	61	17.78%	
Satellite Pharmacy	17	4.96%	
Narcotics and Controlled	22	6.41%	
Extemporaneous Preparation	8	2.33%	
Clinical Pharmacy	62	18.08%	
Inventory Control	26	7.58%	
Drug Information	17	4.96%	
IV admixture	19	5.54%	
Community pharmacy	33	9.62%	
Pharmaceutical companies	22	6.41%	
Answered question	343		
Skipped question	92		

Table 3: Pharmacy infection control practice.

	No activity had been implemented		It was formally discussed and considered, but it was not implemented		It is partially implemented in hospitals for some or all areas, patients, drugs, staff		It is fully implemented in the hospital for some areas, patients, drugs, and staff		It is fully implemented throughout the hospital for all patients, drugs, and staff		Total	Weighted Average	*P*-value
The vision of pharmacy infection control	17.93%	78	8.97%	39	7.59%	33	7.59%	33	57.93%	252	435	3.79	0.000
Mission of pharmacy infection control	17.97%	78	7.37%	32	6.45%	28	37.79%	164	30.41%	132	434	3.55	0.000
The strategic plan of pharmacy infection control	14.32%	62	6.00%	26	24.48%	106	40.42%	175	14.78%	64	433	3.35	0.000
The annual plan of pharmacy infection control	15.70%	68	14.55%	63	22.63%	98	34.18%	148	12.93%	56	433	3.14	0.000
Policy and procedure of pharmacy infection control	24.48%	106	24.48%	106	19.17%	83	13.39%	58	18.48%	80	433	2.77	0.001
Infection control pharmacy competency	28.87%	125	24.25%	105	22.63%	98	15.24%	66	9.01%	39	433	2.51	0.000
Infection control pharmacy and quality management	22.30%	97	27.82%	121	20.69%	90	20.69%	90	8.51%	37	435	2.65	0.000
Infection control pharmacy and education and training program	17.28%	75	21.66%	94	26.27%	114	23.27%	101	11.52%	50	434	2.90	0.000
Infection control pharmacy and medications errors system	22.86%	99	14.55%	63	18.71%	81	30.48%	132	13.39%	58	433	2.97	0.000
Infection control pharmacy and adverse drug reactions	24.88%	108	7.83%	34	14.52%	63	35.71%	155	17.05%	74	434	3.12	0.000
Infection control pharmacy and drug quality reporting systems	17.36%	75	11.57%	50	14.58%	63	29.86%	129	26.62%	115	432	3.37	0.000
Infection control pharmacy and chemical weapon	16.40%	71	13.39%	58	16.17%	70	30.25%	131	23.79%	103	433	3.32	0.000
Infection control pharmacy and research	17.55%	76	13.63%	59	23.09%	100	34.41%	149	11.32%	49	433	3.08	0.000
Infection control pharmacy and surveillance monitoring system	17.09%	74	17.55%	76	23.79%	103	31.41%	136	10.16%	44	433	3.00	0.000
Infection control pharmacy and unit dose system	22.81%	99	16.13%	70	25.58%	111	23.96%	104	11.52%	50	434	2.85	0.000
Infection control pharmacy and inpatient pharmacy	15.01%	65	31.87%	138	21.02%	91	16.86%	73	15.24%	66	433	2.85	0.000
Infection control pharmacy and outpatient pharmacy	18.20%	79	24.65%	107	17.97%	78	25.58%	111	13.59%	59	434	2.92	0.000
Infection control pharmacy and medications storage	19.59%	85	15.90%	69	17.05%	74	24.42%	106	23.04%	100	434	3.15	0.019
Infection control pharmacy and extemporaneous preparation	22.45%	97	12.50%	54	17.82%	77	32.87%	142	14.35%	62	432	3.04	0.000
An effective immunization programs for staff and patients	21.43%	93	9.91%	43	24.65%	107	27.19%	118	16.82%	73	434	3.08	0.000
The outbreak detection and management	17.51%	76	16.82%	73	11.75%	51	26.96%	117	26.96%	117	434	3.29	0.000
The immunization system for new pharmacy staff or pharmacy trainees	17.88%	76	20.94%	89	15.29%	65	24.00%	102	21.88%	93	425	3.11	0.040
The accidental sharp devices immunization system	28.41%	123	15.01%	65	10.39%	45	31.41%	136	14.78%	64	433	2.89	0.000
Answered												**435**	
Skipped												**0**	

Table 4: Pharmacy infection control practice with implementation.

	Strongly disagree		Disagree		Uncertain		Agree		Strongly agree		Total	Weighted Average	*p*-value
The pharmacist share in infection control committee	3.22%	14	3.22%	14	5.06%	22	30.11%	131	58.39%	254	435	4.37	0.000
The pharmacist always a staff member of infection control or pharmacy departments	3.93%	17	8.31%	36	10.16%	44	55.43%	240	22.17%	96	433	3.84	0.000
The pharmacist had clear job descriptions in infection control departments or pharmacy department†	4.38%	19	15.21%	66	31.34%	136	27.65%	120	21.43%	93	434	3.47	0.000
The clinical pharmacist had an active role in infection control performances	7.59%	33	21.38%	93	18.62%	81	28.28%	123	24.14%	105	435	3.40	0.000
There is documentation of potential impact and outcomes with infection control	12.41%	54	8.51%	37	19.54%	85	32.18%	140	27.36%	119	435	3.54	0.000
I attended several courses or workshops about pharmacy infection control	14.12%	61	18.29%	79	22.22%	96	27.31%	118	18.06%	78	432	3.17	0.000
There is electronic pharmacy infection control performances	8.47%	36	18.59%	79	21.18%	90	33.88%	144	17.88%	76	425	3.34	0.000
There are various of pharmacy infection control resources in the practice	5.53%	24	20.51%	89	23.27%	101	28.57%	124	22.12%	96	434	3.41	0.000
The pharmacy infection control are responsible any medication or medications devices related infection control	7.83%	34	14.75%	64	16.36%	71	37.56%	163	23.50%	102	434	3.54	0.000
The pharmacy infection control should be covered by health insurance	8.10%	35	8.56%	37	21.53%	93	40.28%	174	21.53%	93	432	3.59	0.000
Answered											**435**		
Skipped											**0**		

significant (p=0.000). The relationship between the practice of pharmacy infection control and factors including location, worksite, age (years), gender, practice area, years of experience, and current position held. Multiple regression analysis revealed a weak relationship (R=0.234 with p=0.001) between pharmacy infection control practice and its factors. All factors showed non-significant differences (p>0.05). However, a single factor (i.e., age) explained a 20.1% positive relationship to the pharmacy infection control knowledge variation, with a statistically significant difference (p=0.014), which the Bootstrap model confirmed. The non-existence of multi-collinearity verified the relationship with the years of experiences factor with variance inflation factor (VIF) of 2.340 less than three or five[24-26] (Table 6).

On the contrary, the factors were affecting the pharmacy infection control implementation. We adjusted the significant values using independent samples Kruskal–Wallis test and the Bonferroni correction for multiple tests. Various factors influenced the implementation of pharmacy infection control, including location, worksite, gender, age, practice area, current position held, and years of experience. Two factors (gender and practice area) did not affect the knowledge of storage with a non-statistically significant difference (p>0.05). Five locations affected the implementation of pharmacy infection control practice. The southern region showed the lowest scores (3.3759), with a statistically significant difference between the regions (p=0.003). Fourteen groups of the worksite affected the implementation of pharmacy infection control, with the highest scores obtained for the university hospital (3.9708) and military

hospital (3.8653), and the differences were statistically significant (p=0.000). Six different age groups affected the practice of infection control implementation, and the lowest score (3.3547) was obtained for the age group of 31–35 years, with a statistically significant difference (p=0.001). Five different current positions held affected the practice of infection control implementation, and the highest score (3.7485) was obtained for pharmacy staff, and the differences were statistically significant (p=0.000). Six groups of work experiences affected the practice of infection control implementation, and the lowest score (3.3481) was obtained for 1–3 years of experience, with statistically significant differences between all age groups (p=0.000). The relationship between pharmacy infection control implementation

Table 5: The pharmacy infection control (to authorities) currently is the responsibility of the following.

	Strongly disagree		Disagree		Uncertain		Agree		Strongly agree		Total	Weighted Average	*p*-value
Infection control Doctors	9.45%	41	10.60%	46	8.99%	39	18.20%	79	52.76%	229	434	3.94	0.000
Infection control Pharmacist	6.45%	28	4.84%	21	7.14%	31	50.46%	219	31.11%	135	434	3.95	0.000
Infection control Pharmacy technician	9.88%	41	7.95%	33	27.95%	116	35.90%	149	18.31%	76	415	3.45	0.000
Infection control Nurses	5.75%	25	16.32%	71	24.14%	105	42.76%	186	11.03%	48	435	3.37	0.000
Infectious diseases doctors	5.07%	22	23.04%	100	25.12%	109	31.11%	135	15.67%	68	434	3.29	0.000
Infectious diseases clinical pharmacist	8.76%	38	12.90%	56	20.74%	90	23.73%	103	33.87%	147	434	3.61	0.000
Answered											**435**		
Skipped											**0**		

Table 6: Multiple regression of Factors with the Pharmacy infection control practice.[a]

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)	.234 [b]	.055	2.746	.009[b]	2.327	0.385		6.047	0.000	1.570	3.085		
	Location					−0.027	0.035	−0.041	−0.754	0.451	−0.096	0.043	0.954	1.048
	Site of work					0.001	0.016	0.004	0.068	0.946	−0.030	0.033	0.745	1.342
	Age (years)					0.145	0.059	0.201	2.469	0.014	0.030	0.261	0.427	2.340
	Pharmacist gender					0.200	0.108	0.105	1.860	0.064	−0.012	0.412	0.893	1.120
	Practice area					0.031	0.017	0.106	1.788	0.075	−0.003	0.064	0.807	1.239
	Current Position					−0.008	0.053	−0.009	−0.143	0.886	−0.112	0.097	0.709	1.410
	Years of experiences					0.003	0.054	0.005	0.060	0.952	−0.104	0.110	0.461	2.170

a. Dependent Variable: Pharmacy infection control practice, Predictors b: (Constant), Location, Site of work, Age (years), Pharmacist gender, Practice area, years of experience, and current Position.

Bootstrap for Coefficients							
			Bootstrap[a]				
						95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	2.327	−0.006	0.434	0.001	1.479	3.179
	Location	−0.027	−0.001	0.040	0.502	−0.110	0.050
	Site of work	0.001	0.000	0.019	0.946	−0.036	0.036
	Age (years)	0.145	−0.002	0.056	0.015	0.031	0.250
	Pharmacist gender	0.200	−0.005	0.110	0.069	−0.021	0.405
	Practice area	0.031	0.000	0.020	0.135	−0.009	0.070
	Current Position	−0.008	0.001	0.053	0.876	−0.106	0.099
	Years of experiences	0.003	0.005	0.057	0.954	−0.107	0.119

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

Table 7: Multiple regression of Factors with the Pharmacy infection control implementation.[a]

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)	.292 [b]	.085	4.424	.000[b]	3.263	0.230		14.183	0.000	2.810	3.716		
	Location					−0.032	0.021	−0.082	−1.531	0.127	−0.074	0.009	0.954	1.048
	Site of work					−0.011	0.010	−0.071	−1.169	0.243	−0.030	0.008	0.745	1.342
	Age (years)					0.063	0.035	0.143	1.781	0.076	−0.007	0.132	0.427	2.340
	Pharmacist gender					−0.060	0.064	−0.052	−0.937	0.349	−0.187	0.066	0.893	1.120
	Practice area					0.002	0.010	0.014	0.242	0.809	−0.018	0.023	0.807	1.239
	Current Position					0.133	0.032	0.260	4.179	0.000	0.070	0.195	0.709	1.410
	Years of experiences					0.000	0.033	−0.001	−0.014	0.989	−0.064	0.063	0.461	2.170

a. Dependent Variable: Pharmacy infection control implementation, Predictors [b]: (Constant), Location, Site of work, Age (years), Pharmacist gender, Practice area, years of experience, and current Position

Bootstrap for Coefficients

Model		B	Bootstrap[a]				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	3.263	0.011	0.221	0.001	2.844	3.692
	Location	−0.032	−0.001	0.021	0.119	−0.074	0.008
	Site of work	−0.011	0.000	0.010	0.256	−0.029	0.008
	Age (years)	0.063	0.001	0.036	0.085	−0.007	0.133
	Pharmacist gender	−0.060	−0.002	0.063	0.336	−0.182	0.064
	Practice area	0.002	0.000	0.010	0.815	−0.018	0.023
	Current Position	0.133	−0.001	0.027	0.001	0.080	0.184
	Years of experiences	0.000	−0.002	0.036	0.994	−0.072	0.066

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

and factors affecting it, including location, worksite, age (years), gender, practice area, years of experience, and current position held, was analyzed through a multiple regression model. According to the results, there was a weak relationship (R=0.292 with p=0.000) between pharmacy infection control practice and factors affecting it. All factors did not show significant differences (p>0.05). However, a single factor (i.e., current position) explained 26% of the positive relationship in variation to the implementation of pharmacy infection control, with a statistically significant difference between them (p=0.014). The non-existence of multi-collinearity verified the relationship with the years of experiences factor with variance inflation factor (VIF=1.410) less than three or five[24-26] (Table 7).

DISCUSSION

The practice of pharmacy infection control is highly essential in the field of pharmacy.[1-6] Various sections of the pharmacy section require infection control tools, which include the IV admixture, compounding sterile and non-sterile medications, and extemporaneous preparation in addition to the preparation and dispensing of medicines at inpatients and outpatient pharmacies.[7,27-29] Therefore, exploring the pharmacy infection practice is highly suggested to resolve any defect. This study, with a validated and highly reliable survey of all types of site pharmacists in different regions with appropriate sample size, was found to be better than that of previous studies.[14-16] It was mainly in terms of community pharmacies, MOH hospitals, and military healthcare organizations. In this study, there were non-significant differences in the number of male and female responders. The responders had obtained a Bachelor's degree in Pharmacy or Diploma in Pharmacy, and most of them practiced in various specialties and outpatient and inpatient pharmacies. Moreover, most respondents who had good work experience also practiced pharmacy infection control. Unfortunately, the pharmacy infection control practice by the respondents was inadequate. Most pharmacists had a vision; the mission of pharmacy infection control was expected, especially from common pharmacy practice. However, some essential practices have not been established, such as competency of the pharmacist, pharmacy infection control, or unclear policies and procedures, which lead to malpractice of pharmacy infection control. Moreover, pharmacists participated in the infection committee in this study and sometimes worked at the infection control department, similar to a previous study.[15] However, education and training programs for pharmacy infection control were seldom practiced or were absent. Moreover, there are no available electronic pharmacy infection control activities. That was expected because it was a new program, and it will take time to become the electronic version. In this study, the pharmacists agreed that pharmacy infection control should be the responsibility of the department of pharmacy, followed by the medical doctors.

In this study, various factors affected the practice of pharmacy infection control, such as the location of the pharmacist. Based on the location, the western region showed the lowest score for the practice of pharmacy infection control, which may be related to an inadequate approach to infection control practice and insufficient education and training provided during undergraduate and postgraduate courses. Other factors that might affect the practice of pharmacy infection control were practice areas. In this case, private hospitals revealed poorly trained pharmacists and inadequate policies and procedures of pharmacy infection control. In contrast, other governmental healthcare organizations showed a high score for infection control practice, such as university hospitals or King Faisal Specialist Hospital and Research Center (KFSHRC). In this study, young age, intern position, and less experience affected the practice of pharmacy infection control. Furthermore, the practice area also influenced the practice of infection control inside the pharmacy. Pharmaceutical companies emphasizing the administration offices might rarely implement or apply the infection control program inside the administration offices. Our results showed that only a single dependent factor (i.e., age) explained 20% of the positive response in the pharmacy infection control practice, which is expected because the pharmacy infection control needs experience in practice

On the contrary, some factors affected the pharmacy infection control implementation, such as location. In this study, we found that the southern region showed the lowest score of performance related to inadequate infection control system inside the pharmacy and insufficient education and training during undergraduate and postgraduate levels. Furthermore, the worksite was another factor that affected the pharmacy infection control implementation. University and military healthcare organizations were the most practiced worksites where there was implementation infection control system. This result was expected because the university provides education and training on pharmacy infection control in a proper setting. Moreover, military hospitals have a very restricted system that prevents the transmission of infection among soldiers. Moreover, both of them should implement pharmacy infection control in practice in a healthcare setting. Age is an additional factor that affected the pharmacy infection control implementation, particularly pharmacists in the age group of 31–35 years with a work experience of 1–3 years because the pharmacy staff was not in positions responsibilities for implementation pharmacy infection control program. In comparison, higher positions had the authority to implement the pharmacy infection control. However, only a single dependent factor positively affected (26%) the implementation of pharmacy infection control, which was expected because the higher position has the authority to implement pharmacy infection control.

Limitations

The results of this study are informative with high-reliability data and acceptable sample size. Moreover, the demographic data of location and gender were equally distributed. However, there were some limitations to this study. For example, there was an unequal distribution of age, worksite, practice area, years of experience, and current position. In addition, there were not many studies to compare with them. Therefore, we recommend further studies with comparable demographic data.

CONCLUSION

The practice of pharmacy infection control by pharmacists in Saudi Arabia was found to be insufficient. Various factors might affect infection control practice, such as young age, low experience, and lower position. In addition, other factors such as geographic location, gender, worksite vary in the practice. Therefore, essential key performance indicators are highly suggested to improve the implementation of pharmacy infection control in Saudi Arabia.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

Funding

None

Consent for Publications

Informed consent was obtained from all the participants

Ethical Approval

This research is 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; **SPSS:** Statistical package of social sciences; **JASP:** Jeffery's Amazing Statistics Program; **STROBE:** Strengthening the reporting of observational studies in epidemiology; **VIF:** Variance Inflation Factor.

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