

Pharmacist Practice of Forensic Pharmacy Services

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ABSTRACT

Goal: The current study expected to demonstrate the forensic pharmacy practice in the Kingdom of Saudi Arabia. **Methods:** It is an analysis of a cross-sectional study. An electronic survey was dispersed to all pharmacists and pharmacy interns. All students were omitted from the existing study. The survey consisted of demographic data about responders and practice aspects and implementations of forensic pharmacy. All analysis was completed using Microsoft Excel and Statistical Package of Social Science (SPSS), and Survey monkey. **Results:** The total number of responding pharmacists was 402. Of those, 198 (49.75%) were male, while 200 (50.25%) were female, with statistical significance between them ($p < 0.001$). Almost three-quarters of the pharmacists had bachelor's degrees 303 (75.56%), with statistically significant among all pharmaceutical degrees ($p < 0.001$). The total average scores of pharmacist feature elements of forensic pharmacy services were 2.5. The high scores element was forensic pharmacy and potential drug-drug interactions (1.42). On the contrary, the lowest score aspect of nuclear pharmacy was forensic pharmacy, education and training program (1.26). The average score of forensic pharmacy practice implementation was 3.15. With high scores was the pharmacist always parts in crimes medicine committee (3.74), while the lowest forensic pharmacy practice implementation scores were attendance several courses or workshops about forensic pharmacy (2.41). **Conclusion:** The pharmacist part elements or the practice applications of forensic pharmacy were insufficient. The pharmacist plays an active role in the forensic pharmacy practice. Recognized forensic pharmacy with a clear job description of pharmacy staff with the relationship with forensic medicine and forensic strategic planning is mandatory to improve forensic pharmacy services in Saudi Arabia.

Key words: Practice, Pharmacist, Forensic, Pharmacy, Saudi Arabia

INTRODUCTION

Forensic medicine is well recognised in the Kingdom of Saudi Arabia.^[1,2] Forensic medicine was started in the 1960s at the Ministry of Health in Saudi Arabia.^[2] Each region had one forensic medicine associated with higher administration. Each forensic medicine section had physicians dedicated in forensic medicine, nurses, related employment. There were annual reports about forensic medicine published through MOH statistical books published annually.^[3,4] They had a job description for each staff and policy and procedures of the department. They were an active member of the criminal and death committee. The education of forensic medicine is delivered through 60% of the college of medical universities.^[1,5] Currently, Saudi health of specialties had four years of forensic medicine board.^[6] Forensic medicine is delivered through numerous countries, counting Egypt and Kuwait.^[1] Moreover, It includes well-developed, standardized, highly educated forensic medicine in the United Kingdom and the United States of America.^[1,7-9] However, a discretion survey about forensic medicine services was not printed in Saudi Arabia or Arabia countries. The practice training of forensic medicine is not typical during

undergraduate studies.^[5] Forensic science takes care of all criminal or unexplained death of any adults or pediatrics.^[2] In comparison, the forensic pharmacy debated intentional medications related to morbidity and mortality counting the intentional poisoning and toxic material analysis in the forensic laboratories. The pharmacist offers many activities to forensic medicine practice.^[10-13] Various literature conversed the pharmacist and clinical pharmacist activities in the forensic services. Besides, a forensic pharmacy technician had been designated. Many basic activities should be employed during forensic pharmacy practice. That includes but is not limited to the vision and mission of forensic pharmacy, values, objectives, annual plan of forensic pharmacy. Besides, also entails policy and procedures of forensic pharmacy. For any forensic medicine, demand for forensic pharmacy services is to be applied. The forensic pharmacy activities implemented were not known in Saudi Arabia or Gulf countries, or the rest of the world. The current investigation deliberated the forensic pharmacy activities implementation in Saudi Arabia.

METHODS

It analyses a cross-sectional survey that deliberated pharmacist's practice of forensic pharmacy in Saudi Arabia. It self-reported an electronic survey of dentists, counting pharmacists from internship to consultant, pharmacist specialties, and Saudi Arabia. All non-pharmacist or students and non-completed surveys will be accepted from the study. The survey comprised of respondents' demographic information about pharmacists and practice knowledge of selected aspects for forensic pharmacy practice and implementation. The 5-point Likert response scale system was applied with closed-ended questions. According to the previous literature with unlimited population size, the sample was planned as a cross-sectional study, the confidence level 95% with z score of 1.96 and margin of error 5-6.5%, population percentage 50%, and drop-out rate 10%. As a result, the sample size will equal 480 to 420 with a power of study of 80%.^[14-16] The response rate compulsory calculated sample size to be measured at least 60-70 % and above.^[16,17]

The survey was dispersed through social media of what's applications and telegram groups of pharmacists. The prompt message had been sent every 1-2 weeks. The survey was authenticated through the revision of expert reviewers and pilot testing. Besides, numerous tests of reliability McDonald's ω , Cronbach alpha, Guttman's λ_2 , and Guttman's λ_6 had been done with the study. The data analysis of the pharmacist's practice of nuclear pharmacy is finished through the survey monkey system. Besides, the statistical package of social sciences (SPSS) and Jeffery's Amazing Statistics Program (JASP), Microsoft excel sheet version 16 with description and frequency analysis, good of fitness analysis, correlation analysis, and inferential analysis of factors marks pharmacist's practice of nuclear pharmacy. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) showed the reporting of the current study.^[18,19]

RESULTS

The total number of responding pharmacists was 402, with most of them coming from the south area 252 (62.69%) with statistically momentous among the regions ($p < 0.001$). Of those, 198 (49.75%) were male, while 200 (50.25%) were female, with statistical significance between them ($p < 0.001$). Most of the responders were in age (24-30) years 269 (67.08%) with statistically important between all ages level ($p < 0.001$). Almost three-quarters

of the pharmacists had bachelor's degrees 303 (75.56%), with statistically significant among all pharmaceutical degrees ($p < 0.001$). The majority of responders worked at community pharmacy 124 (30.85%), MOH hospitals 107 (26.62%), and military hospitals 76 (18.91%). Most pharmacists were staff pharmacists 284 (70.65%), and half of the responders had practised three years and less 213 (53.25%) with the majority of their practice at the community pharmacy 115 (31.86%) and outpatient pharmacy 88 (24.38%) with statistically significant between them ($p < 0.001$). There is a strong positive association between Age (years) and Years of experience at pharmacy career Kendall's tau_b (0.699) or Spearman's rho (0.747) with statistically significant difference ($p < 0.001$). On the other hand, there is a negative medium correlation between position and age or Years of experience at pharmacy career with Kendall's tau_b (-0.447) or Spearman's rho (-0.488) or Kendall's tau_b (-0.460) or Spearman's rho (-0.511) respectively with statistically significant difference ($p > 0.05$) as reconnoitred in Table 1 and 2.

The total average scores of pharmacist aspect elements of forensic pharmacy services were 2.5. The high scores element was forensic pharmacy and potential drug-drug interactions (1.42), forensic pharmacy and medications

errors system (1.39), and forensic pharmacy and drug quality reporting system (1.39). On the contrary, the lowest score facet of nuclear pharmacy was forensic pharmacy and education and training program (1.26), the vision of forensic pharmacy (1.29), and the strategic plan of forensic pharmacy (1.29) with statistically significant between answers ($p < 0.001$) as explored in Table 3. The average score of forensic pharmacy practice implementation was 3.15. With high scores was the pharmacist always shares in crimes medicine committee (3.74), the clinical pharmacist had an active role in forensic medicine departments (3.55), and the pharmacist share in forensic medicine committee (3.53). In contrast, the lowest forensic pharmacy practice implementation scores were attend several courses or workshops about forensic pharmacy (2.41), and there is electronic forensic pharmacy (2.74). Besides, there are numerous forensic pharmacy resources in practice (2.80) with statistically significant differences between answers ($p < 0.001$) as explored in Table 4. The highest score Forensic pharmacy (to authorities) currently is the responsibility was a forensic pharmacist (4.43) and forensic medicine doctors (3.62). In contrast, the lowest score was forensic nurses (2.98), with a statistically noteworthy difference between them ($p < 0.001$)

Table 1: Demographic information.

Nationality	Response Count	Response Percent	p-value (X2)
Central area	72	17.91%	< 0.001
North area	24	5.97%	
South area	252	62.69%	
East area	11	2.74%	
West area	43	10.70%	
Answered question	402		
Skipped question	0		
Gender	Response Count	Response Percent	
Male	198	49.75%	< 0.001
Female	200	50.25%	
Answered question	398		
Skipped question	4		
Age	Response Count	Response Percent	
24-30	269	67.08%	< 0.001
31-35	73	18.20%	
36-40	28	6.98%	
41-45	9	2.24%	
46-50	8	2.00%	
> 50	14	3.49%	
Answered question	401		
Skipped question	1		

Table 2: Demographic, social information.

Pharmacist Qualifications	Response Count	Response Percent	p-value (X2)
MOH Hospitals	107	26.62%	
Military hospitals	76	18.91%	
National Gaurd Hospital	11	2.74%	
Security forces hospitals	4	1.00%	
University hospital	12	2.99%	
MOH primary care centers	15	3.73%	
Private hospitals	12	2.99%	
Private ambulatory care clinics	1	0.25%	
Private primary healthcare center	6	1.49%	
Community pharmacy	124	30.85%	
Pharmaceutical company	15	3.73%	
University (Academia)	9	2.24%	
Retried	2	0.50%	
Un-employment	8	1.99%	
Answered question	402		
Skipped question	0		
Academic Qualifications	Response Count	Response Percent	
Diploma in Pharmacy	29	7.23%	
Bachelor's in pharmacy	303	75.56%	
Master	47	11.72%	
Pharm D	73	18.20%	
Ph. D	9	2.24%	
PGY 1	6	1.50%	
PGY 2	8	2.00%	
PGY 3	4	1.00%	
Fellowship	1	0.25%	
Other (please specify)	0	0.00%	
Answered question	401		
Skipped question	1		
Position Held	Response Count	Response Percent	
Director of Pharmacy	18	4.48%	<0.001
Assistant Director of Pharmacy	18	4.48%	
Supervisor	32	7.96%	
Pharmacy staff	284	70.65%	
Pharmacy Intern	50	12.44%	
Answered question	402		
Skipped question	0		

continued...

Years of experience at Physician career	Response Count	Response Percent	
Less than one year	213	53.25%	< 001
1-3	87	21.75%	
4-6	41	10.25%	
7-9	15	3.75%	
10-12	12	3.00%	
>12	32	8.00%	
Answered question	400		
Skipped question	2		
The practice area	Response Count	Response Percent	
Inpatient Pharmacy	46	12.74%	< 001
Outpatient Pharmacy	88	24.38%	
Satellite Pharmacy	3	0.83%	
Narcotics and Controlled	4	1.11%	
Extemporaneous Preparation	1	0.28%	
Clinical Pharmacy	46	12.74%	
Inventory Control	8	2.22%	
Drug Information	5	1.39%	
IV admixture	11	3.05%	
Pharmacy informatics	1	0.28%	
Hospital Pharmacy administration	4	1.11%	
Forensic medicine	1	0.28%	
Community pharmacy	115	31.86%	
Lecturer (Academia)	2	0.55%	
Pharmaceutical company	14	3.88%	
Non-specific	12	3.32%	
Answered question	361		
Skipped question	41		

as explored in Table 5. The majority of responders did not work in forensic pharmacy 369 (92.02%), there is no statically significant differences between all practice or did not practice forensic pharmacy or answered by they do not distinguish and all aspect of forensic pharmacy or implantation ($p>0.05$). The reliability test of McDonald's ω , 0.892, Cronbach alpha 0.894, Guttman's λ_2 , 0.911, and Guttman's λ_6 , 0.966.

Factors manipulating the items forensic pharmacy practice (average scores). The various factor might impact the forensic pharmacy practice. Using

independent samples Kruskal-Wallis test and the Bonferroni correction for multiple tests have adjusted significant values, the results showed as follows. The various factor might impact the forensic pharmacy practice. Five locations exaggerated the forensic pharmacy practice, with south the lowest average score (1.1714) with statically significant differences ($p=0.000$), while it is not statically momentous with forensic pharmacy practice implementation ($p=0.544$). Thirteen levels of work pretentious the aspects of forensic pharmacy practice with

Table 3: The aspects for Forensic pharmacy practice.

	We do not have any it		< 25 % implemented		25-50 % implemented		51-75 % implemented		76-100 % implemented		Total	Weighted Average	p-value
The vision of forensic pharmacy	83.08%	334	9.20%	37	4.48%	18	2.49%	10	0.75%	3	402	1.29	<0.001
Mission of Forensic pharmacy	83.08%	334	8.21%	33	4.48%	18	3.73%	15	0.50%	2	402	1.30	<0.001
The strategic plan of forensic pharmacy	84.33%	339	7.71%	31	3.73%	15	2.99%	12	1.24%	5	402	1.29	<0.001
The annual plan of forensic pharmacy	84.58%	340	6.47%	26	3.98%	16	3.48%	14	1.49%	6	402	1.31	<0.001
Policy and procedure of forensic pharmacy	84.79%	340	6.48%	26	4.49%	18	2.49%	10	1.75%	7	401	1.30	<0.001
Forensic pharmacy competency	82.59%	332	7.96%	32	3.98%	16	2.74%	11	2.74%	11	402	1.35	<0.001
Forensic pharmacy and quality management	82.96%	331	6.77%	27	4.26%	17	4.76%	19	1.25%	5	399	1.35	<0.001
Forensic pharmacy and education and training program	85.29%	342	6.73%	27	4.99%	20	2.49%	10	0.50%	2	401	1.26	<0.001
Forensic pharmacy and medications errors system	79.55%	319	8.98%	36	5.99%	24	3.74%	15	1.75%	7	401	1.39	<0.001
Forensic pharmacy and adverse drug reactions	81.09%	326	8.21%	33	6.47%	26	3.48%	14	0.75%	3	402	1.35	<0.001
Forensic pharmacy and drug quality reporting system	80.10%	322	8.46%	34	5.72%	23	3.73%	15	1.99%	8	402	1.39	<0.001
Forensic pharmacy and potential drug-drug interactions	79.05%	317	7.98%	32	6.73%	27	4.74%	19	1.50%	6	401	1.42	<0.001
Forensic pharmacy and intentional poisoning	81.84%	329	8.71%	35	5.22%	21	3.23%	13	1.00%	4	402	1.33	<0.001
Forensic pharmacy and chemical weapon	81.59%	328	9.20%	37	4.48%	18	3.98%	16	0.75%	3	402	1.33	<0.001
Forensic pharmacy and research	82.84%	333	7.21%	29	4.48%	18	4.23%	17	1.24%	5	402	1.34	<0.001
Answered												402	
Skipped												0	

statically significant differences ($p=0.000$). In comparison, there is not statically significant with forensic pharmacy practice implementation ($p=0.060$). Six levels of age affected forensic pharmacy practice and forensic pharmacy practice implementation with statically significant differences ($p=0.027$) and ($p=0.013$) respectively as generally, there is not any precise age for significant differences. There are not statically significant differences in the persuading the Forensic pharmacy basic knowledge in gender ($p=0.000$). There are no statically significant differences in controlling the Forensic pharmacy practice and Forensic pharmacy practice implementation in gender ($p=0.282$). Five levels of a position affected forensic pharmacy practice and implementation with statically significant differences ($p=0.000$) and ($p=0.003$), respectively. There is no exact

position that had significant differences. Finally, six levels of experience affected the Forensic pharmacy practice and forensic pharmacy practice implementation with non-statically significant differences ($p=0.182$) and ($p=0.176$), respectively, as explored in Table 6. The relationship between the practice aspect of forensic pharmacy and factors location, site of work, age (years), pharmacist gender, years of experiences at pharmacy career and position Held, established through a multiple regression model and measured the practice facet of Forensic pharmacy dependent variable and factors were observed as an expletory variable. A weak relationship was $R(0.182)$ with ($p=0.041$) between forensic pharmacy practice and factors. All factors were non-significant differences ($p>0.05$). However, there was one factor only; the position held elucidated

13.4 % ($p=0.018$) of a negative connection and variation in the preparation of nuclear pharmacy implementation with a statistically significant ($p<0.05$) through multiple regression model and established by Bootstrap model. The relationship among practice aspect of Forensic pharmacy and one factor verified by the non-existence of multicollinearity with the position held factor ($VIF=3.212$) almost nearest three or less than ten^[20,21,22] as explored in Table 7.

The relationship between advanced forensic pharmacy practice implementation and factors location, site of work, age (years), pharmacist gender, Years of experience in pharmacy career, and Position Held. It was verified through a multiple regression model and measured the forensic pharmacy practice implementation-dependent factors were regarded as the

Table 4: Forensic pharmacy practice implementation.

	Strongly disagree		Disagree		Uncertain		Agree		Strongly agree		Total	Weighted Average	
The pharmacist always active member in the mortality committee at healthcare institutions	5.74%	23	4.49%	18	41.15%	165	28.93%	116	19.70%	79	401	3.52	<0.001
The pharmacist share in forensic medicine committee	4.99%	20	4.99%	20	41.65%	167	28.68%	115	19.70%	79	401	3.53	<0.001
The pharmacist always a staff member of forensic medicine departments	8.71%	35	12.94%	52	43.03%	173	22.39%	90	12.94%	52	402	3.18	<0.001
The pharmacist always shares in crimes medicine committee	4.73%	19	2.74%	11	31.34%	126	36.57%	147	24.63%	99	402	3.74	<0.001
The pharmacist had clear job descriptions in forensic medicine departments	14.21%	57	8.73%	35	43.64%	175	19.70%	79	13.72%	55	401	3.10	<0.001
The clinical pharmacist had active role in forensic medicine departments	5.99%	24	4.49%	18	40.15%	161	27.68%	111	21.70%	87	401	3.55	<0.001
There is documentation of potential impact and outcomes with forensic medicine	14.79%	59	12.78%	51	47.87%	191	15.04%	60	9.52%	38	399	2.92	<0.001
I attended several courses or workshops about Forensic pharmacy	30.40%	121	17.59%	70	37.44%	149	10.05%	40	4.52%	18	398	2.41	<0.001
There is electronic forensic pharmacy	18.70%	75	10.47%	42	55.11%	221	9.98%	40	5.74%	23	401	2.74	<0.001
There are various of forensic pharmacy resources in the practice	11.94%	48	15.42%	62	58.21%	234	9.70%	39	4.73%	19	402	2.80	<0.001
Answered												402	
Skipped												0	

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

	Strongly disagree		Disagree		Uncertain		Agree		Strongly agree		Total	Weighted Average	
Forensic medicine Doctors	11.47%	46	8.23%	33	19.45%	78	28.43%	114	32.42%	130	401	3.62	<0.001
Forensic Pharmacist	3.48%	14	2.49%	10	6.72%	27	22.64%	91	64.68%	260	402	4.43	<0.001
Pharmacy technicians	11.22%	45	10.97%	44	40.65%	163	24.19%	97	12.97%	52	401	3.17	<0.001
Forensic Nurses	13.50%	54	13.75%	55	44.25%	177	18.50%	74	10.00%	40	400	2.98	<0.001
Toxicology laboratories	15.21%	61	10.47%	42	21.20%	85	26.43%	106	26.68%	107	401	3.39	<0.001
Answered												402	
Skipped												0	

expletory variable. There was a weak relationship $R(0.372)$ with ($p=0.000$) between forensic pharmacy practice implementation and factors with non-statistically significant difference ($p>0.05$). Besides, the relationship established by through Standardized Coefficients Beta through multiple regression model and long-established by Bootstrap model as explored in Table 8.

DISCUSSION

The description of forensic pharmacy is an essential step to create it.^[10,12] The practice contained of aspects of forensic pharmacy and some fundamental elements of implementation and responsibility of the forensic pharmacy services and relationships with forensic medicine. The existing examination will discover the forensic pharmacy practice with tolerable convenience sample size, good validation by the expert reviewer, and a high-reliability test. Most of the responders from

the South region is the place most authors had lived. The majority of responders were from a community pharmacy or hospital pharmacist with an almost equal gender to imitate those practices. Most of the responders were young pharmacists with a bachelor's degree and less than three years of experience expected to reproduce the actual current of a forensic pharmacy career. The young pharmacist is getting experiences. However, the young pharmacist is getting higher

Table 6: Factors (average scores) influencing the aspects for forensic pharmacy practice and forensic pharmacy practice implementation.

	The aspects for Forensic pharmacy practice								Forensic pharmacy practice implementation						
	Factors	N	Average scores	Std. D	Median	Lower Bound	Upper Bound	P-value	N	Average scores	Std. D	Median	Lower Bound	Upper Bound	P-value
Region	Central	72	1.5241	.77982	1.0667	1.3408	1.7073	0.000	72	3.1696	.88891	3.2500	2.9607	3.3785	0.544
	North	23	1.9797	1.04706	1.5333	1.5269	2.4325		23	2.9884	1.07362	3.3000	2.5241	3.4527	
	South	247	1.1714*	.58248	1.0000	1.0984	1.2444		247	3.1508	.60186	3.0000	3.0754	3.2262	
	East	10	1.6067	.81009	1.3000	1.0272	2.1862		10	3.1144	.73459	2.8500	2.5890	3.6399	
	West	43	1.4874	.82754	1.1333	1.2327	1.7421		43	3.2589	.83012	3.1000	3.0034	3.5144	
	Total	395							395						
Site of works	MOH Hospitals	107	1.3328	.76216	1.0000	1.1868	1.4789	0.000	107	3.0663	.88029	3.1000	2.8975	3.2350	0.060
	Military hospitals	76	1.1868	.55426	1.0000	1.0602	1.3135		76	3.1039	.64445	3.0500	2.9567	3.2512	
	National Guard Hospital	11	1.5636	.84188	1.0000	.9981	2.1292		11	2.9000	.50794	3.0000	2.5588	3.2412	
	Security forces hospitals	4	2.1000	1.29900	1.9333	.0330	4.1670		4	2.7250	.35000	2.7500	2.1681	3.2819	
	University hospital	12	2.0278*	.94643	1.8667	1.4264	2.6291		12	3.1370	.89708	3.0000	2.5671	3.7070	
	MOH primary care centers	15	1.2578	.69322	1.0000	.8739	1.6417		15	3.0800	.63942	3.2000	2.7259	3.4341	
	Private hospitals	12	1.5278	.91650	1.0333	.9455	2.1101		12	3.4120	.45229	3.4000	3.1247	3.6994	
	Private primary healthcare center	6	1.4373	.81133	1.1000	.5859	2.2887		6	3.7667	.74476	3.8000	2.9851	4.5482	
	Community pharmacy	124	1.2157	.59391	1.0000	1.1101	1.3212		124	3.1959	.61333	3.0000	3.0869	3.3049	
	Pharmaceutical company	15	1.5244	.68678	1.2667	1.1441	1.9048		15	3.4133	.79809	3.8000	2.9714	3.8553	
	University (Academia)	9	1.6667	.87050	1.0667	.9975	2.3358		9	3.5333	.62650	3.5000	3.0518	4.0149	
	Retried	2	1.5667	.80139	1.5667	-5.6335-	8.7668		2	3.2500	.49497	3.2500	-1.1972-	7.6972	
	Un-employment	8	1.6250	1.35456	1.0000	.4926	2.7574		8	2.7375	1.02670	2.8000	1.8792	3.5958	
	Total	401							401						
Age	24-30	267	1.2890	.69148	1.0000	1.2057	1.3723	0.027	267	3.2080	.67284	3.1000	3.1269	3.2891	0.013
	31-35	72	1.3055	.65896	1.0000	1.1506	1.4603		72	3.0577	.74906	3.0500	2.8817	3.2337	
	36-40	26	1.5128	.88519	1.0000	1.1553	1.8704		26	3.0132	.83097	3.0000	2.6776	3.3489	
	41-45	9	1.5630	1.02962	1.0000	.7715	2.3544		9	2.4815	.91274	2.7000	1.7799	3.1831	
	46-50	7	1.8762	1.28491	1.1333	.6878	3.0645		7	2.9143	1.25357	2.6000	1.7549	4.0736	
	> 50	14	1.4238	.67005	1.0667	1.0369	1.8107		14	3.4786	.55356	3.5500	3.1590	3.7982	
	Total	395							395						
Gender	Male	196	1.3555	.76672	1.0000	1.2475	1.4635	0.282	196	3.1056	.76986	3.0000	2.9972	3.2141	0.282
	Female	199	1.3013	.67781	1.0000	1.2065	1.3960		199	3.2049	.67030	3.1000	3.1112	3.2986	
	Total	395							395						
Employment	Director of Pharmacy	18	1.3479	.63257	1.0333	1.0333	1.6624	0.000	2.6630	1.01980	2.8000	2.1558	3.1701	2.6630	0.003
	Assistant director of Pharmacy	17	1.8235	1.03761	1.1333	1.2900	2.3570		3.2922	.81022	3.3000	2.8756	3.7087	3.2922	
	Supervisor	29	1.6092	.91595	1.0667	1.2608	1.9576		2.9467	.77516	3.0000	2.6519	3.2416	2.9467	
	Pharmacy Staff	282	1.3060*	.71011	1.0000	1.2228	1.3893		3.2188	.71904	3.1000	3.1345	3.3031	3.2188	
	Pharmacy intern	49	1.1102*	.40151	1.0000	.9949	1.2255		3.0490	.39745	3.0000	2.9348	3.1631	3.0490	
	Total	395							395						
Experiences	<1	211	1.2915	.70585	1.0000	1.1957	1.3873	0.182	211	3.1925	.66444	3.1000	3.1024	3.2827	0.176
	1-3	87	1.3126	.70556	1.0000	1.1623	1.4630		87	3.1946	.71896	3.1000	3.0414	3.3479	
	4-6	39	1.3949	.73276	1.0000	1.1573	1.6324		39	2.9162	.84597	3.0000	2.6420	3.1905	
	7-9	14	1.5139	.84138	1.0000	1.0281	1.9997		14	2.9286	.95549	2.8500	2.3769	3.4803	
	10-12	12	1.4167	.82001	1.0000	.8957	1.9377		12	3.0944	.46294	3.0500	2.8003	3.3886	
	>12	32	1.4167	.80607	1.0000	1.1260	1.7073		32	3.2201	.86820	3.3500	2.9071	3.5332	
	Total	395							395						

Table 7: Multiple regression of Factors with the aspects for Forensic pharmacy practice.

	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)	.182 ^b	.033	2.212	.041 ^b	1.798	.261		6.883	.000	1.284	2.311		
	Location					-.040-	.034	-.061-	-1.189-	.235	-.106-	.026	.949	1.054
	Site of work					.008	.009	.047	.912	.363	-.009-	.025	.931	1.074
	Age (years)					.075	.052	.123	1.421	.156	-.029-	.178	.332	3.014
	Pharmacist gender					-.005-	.075	-.004-	-.068-	.946	-.153-	.143	.915	1.093
	Years of experience at pharmacy career					-.043-	.042	-.092-	-1.027-	.305	-.126-	.040	.311	3.212
	Position Held					-.111-	.047	-.134-	-2.368-	.018	-.204-	-.019-	.782	1.279

a. Dependent Variable: Nuclear pharmacy basic knowledge, Predictors: (Constant), Location, Age (years), Pharmacist gender, Position Held, and Years of experiences at pharmacy career.

Bootstrap for Coefficients

	Model	B	Bootstrap ^a				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	1.798	.006	.304	.001	1.216	2.414
	Location	-.040-	.000	.041	.323	-.119-	.042
	Site of work	.008	.000	.009	.397	-.010-	.025
	Age (years)	.075	.000	.064	.252	-.053-	.194
	Pharmacist gender	-.005-	-.001-	.080	.953	-.155-	.148
	Years of experiences at pharmacy career	-.043-	-.001-	.048	.360	-.135-	.055
	Position Held	-.111-	-.001-	.056	.054	-.227-	-.003-

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

position employment due to their availability and desirable than pharmacy technician. The current search showed that the average scores of aspect forensic pharmacy were not satisfactory. The most practical elements of forensic pharmacy were drug-drug interaction, medications error system, and drug quality reporting system.^[23,24] All those aspects were mandatory for the Saudi Center of healthcare accreditation in Saudi Arabia.^[25]

In comparison, the rare practice of forensic pharmacy was education and training of forensic pharmacy, vision, and strategic plan. That is, no complete program of forensic pharmacy was implemented. The study results showed that the average score of forensic pharmacy practice implementation was neutral. The most practical activities implemented were the pharmacist participated in the crimes and forensic medicine committees, and the pharmacist had a role in the forensic medicine department. That might be implemented at some hospitals or some forensic medical

sections. However, it was not expected at all healthcare institutions.

On the contrary, the rare activities executed attended lectures or workshops about forensic pharmacy resembling earlier forensic medicine studies.^[26] Besides, electronic forensic pharmacy systems at their institutions and the availability of forensic pharmacy resources in the institution's library. The forensic pharmacy system desires more focus to review it and update it thoroughly. All responders are highly suggested that pharmacists should be responsible for forensic pharmacy, not physicians or nurses that is expected for responder pharmacists and more opinions from physicians and nurses in future studies. Most responders were not committed at forensic pharmacies, resemble previous forensic medicine studies.^[5] However, the biostatistics analysis displayed no statistically significant difference between had practice experiences or not in answering all elements of forensic pharmacy practice aspects. It is mainly

the vision of forensic pharmacy was not clear, or the program was not started in practice.

Various factors exaggerated the aspects of the practice of forensic pharmacy or the implementation of forensic pharmacy. The location might move the aspect practice of forensic pharmacy with prominence on the south region having the lowest score related to most of the aspects not found in their area. In contrast, the location did not affect the implementation of forensic pharmacy. The work site was another factor that had almost high scores at university hospitals linked to the might aspect of forensic pharmacy found there and its need for teaching medical or pharmacy students. On the contrary, the site of work did not affect forensic pharmacy employment. The age was another one that affected both forensic pharmacy and implementation aspects without clear which age of group might affect them related to sample size by comparing the average score of all ages among both facets of forensic pharmacy and implementation. The elements score lower than the implementation

Table 8: Multiple regression of Factors with the Forensic pharmacy practice implementation.

	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)	.139 ^b	.019	1.270	.270 ^b	2.625	.263		9.988	.000	2.108	3.141		
	Location					.006	.034	.009	.180	.857	-.060-	.072	.949	1.054
	Site of work					.015	.009	.087	1.667	.096	-.003-	.032	.931	1.074
	Age (years)					-.021-	.053	-.035-	-.405-	.686	-.125-	.082	.332	3.014
	Pharmacist gender					.097	.076	.067	1.280	.201	-.052-	.246	.915	1.093
	Years of experience at pharmacy career					.030	.042	.063	.704	.482	-.054-	.113	.311	3.212
	Position Held					.068	.047	.081	1.429	.154	-.025-	.161	.782	1.279

a. Dependent Variable: Nuclear pharmacy basic knowledge, Predictors: (Constant), Location, Age (years), Pharmacist gender, Position Held, and Years of experiences at pharmacy career.

Bootstrap for Coefficients

	Model	B	Bootstrap ^a				
			Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
						Lower	Upper
1	(Constant)	2.625	.032	.378	.001	1.950	3.458
	Location	.006	-.001-	.040	.875	-.079-	.084
	Site of work	.015	.000	.009	.111	-.004-	.032
	Age (years)	-.021-	.000	.064	.743	-.148-	.102
	Pharmacist gender	.097	-.005-	.080	.233	-.066-	.253
	Years of experiences at pharmacy career	.030	-.004-	.053	.549	-.074-	.128
	Position Held	.068	-.003-	.058	.245	-.056-	.177

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

of forensic pharmacy related to diverse opinions, or the survey was not very clear for them. Gender does not affect the aspect and performance of forensic pharmacy. The position factors can affect parts of forensic pharmacy with the lowest score of pharmacy intern and pharmacy staff, which is expected because they were newly graduated and need more time to gain more practice knowledge at the forensic pharmacy. The position might affect forensic pharmacy implementation with clears, which position in pharmacy career can mark more due to sampling size. Besides, the job was affected negatively by 13.4%, with each one surge of work. Higher position cause lower aspect of forensic pharmacy. The number of years of experience does not affect the element of forensic pharmacy or implementation. There was not any connection between all factors and forensic pharmacy implementation scores.

Limitations

Although the existing survey stated critical information in forensic pharmacy and

implementation, there were numerous limitations including the sampling method. It was the convenient sample. The sample checked unequal distribution of responders per geographic location, unequal age distribution, and most demographic information with statistically significant differences. Most responders were young, recently graduated, and worked in community pharmacy. As a result, the study results have not imitated all types of the hospital or forensic pharmacists or age level or experiences. Further studies mandatory comparable demographic data in highly acclaimed. The research about forensic pharmacy practice is rare or non-existent, and it was difficult to compare the study results with previous studies.

CONCLUSION

The practice of forensic pharmacy was inadequate. The majority of pharmacists work in forensic pharmacy through potential drug-drug interactions in forensic sciences, forensic pharmacy, medications errors systems, and

drug quality reporting systems. No numerous factors predisposed the forensic pharmacy practice except position career number only. The number of forensic pharmacy staff should be augmented and involved in forensic medicine. Further study of forensic medicine and pharmacy services in-depth detail was necessitated to setup up a strategic plan and improve forensic pharmacy practice in Saudi Arabia.

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CONFLICT OF INTEREST

The authors declare that there is 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

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 statement: guidelines for reporting observational studies; **SFDA:** Saudi Food and Drug Authority; **CBAHI:** Saudi Central Board for Accreditation of Healthcare Institutions.

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