

Pharmacist's Knowledge of Forensic Pharmacy Services

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ABSTRACT

Goal: The knowledge of forensic pharmacy is a grave issue in practice. For example, forensic pharmacy services are obligatory for crime and drug-related death investigations. The current study purposes to affirm Pharmacist knowledge of forensic pharmacy in the Kingdom of Saudi Arabia. **Methods:** It was a qualitative examination with a cross-section design. An electronic validated and reliability survey was dispersed to all pharmacists and pharmacy interns. All students were omitted from the study. The questionnaire checked demographic data about the responders and pharmacist's basic and advanced knowledge of forensic pharmacy and resources of forensic pharmacy. Statistical Package of Social Science (SPSS), Microsoft Excel, and survey monkey did all analysis. **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 pharmacists' knowledge of forensic pharmacy services were (2.0) with high scores element was the valuation of basic knowledge of the forensic pharmacy was the medications induced addiction (2.74). In contrast, the lowest scores were the job description of forensic pharmacist (1.5). The average score advances knowledge of forensic pharmacy (1.92). The highest score knowledge was the cardiovascular medications (3.00), while the lowest score knowledge of advanced knowledge of forensic pharmacy was the resources of forensic pharmacy (1.37). The most resources applied for Forensic pharmacy services were internet 224 (56.71%) and healthcare practitioners 222 (56.20%). **Conclusion:** The pharmacists' knowledge of forensic pharmacy services was insufficient. Therefore, the preventing of crimes problems and drug-related death are obligatory to improve patient outcomes. The undergraduate and postgraduate education and training of forensic pharmacy services in highly recommended in Saudi Arabia.

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

INTRODUCTION

Pharmaceutical care services are increasing over the past years in Saudi Arabia or the rest of the world.^[1-5] The pharmacist shift directing from medication caring to patients cares.^[6,7] That has imitated in patient's clinical outcomes and improve the economy of the healthcare system.^[8-12] The pharmacy plays an active role model in Saudi Arabia in numerous pharmacy services. It encompassed total parenteral nutrition, anticoagulation services, drug information services, and pharmacy critical care services.^[8-12] However, some medical fields want the pharmacist to share more with treating or management teams counting nuclear medicine, forensic medicine, and other subspecialties of paediatrics. Forensic medicine is well recognised in Saudi Arabia, and there is a job by the name of the forensic pharmacist. However, most active jobs in this field are working at poisoning centres. Recently, the healthcare ministry composed all forensic medications active under one department and called forensic medicine services. It has entailed of forensic medicine, poisoning center, forensic laboratories, and related issues. As a result, the pharmacist will play an active role in the new administration. Various

studies discovered the job descriptions of forensic pharmacists and forensic clinical pharmacists.^[13,14] Besides, the jobs of the forensic pharmacy technicians. They applied various activities but not limited to drug information resources of any toxic material or drug poisoning, the analysis inside of forensic material, investigation of drug-related morbidity and mortality.^[15-17] Forensic pharmacists necessity the knowledge to perform their jobs to take care of new jobs of forensic pharmacy. Various publications discussed forensic pharmacy and the role of pharmacists. However, the author is not conversant with any studies about pharmacist's knowledge of forensic pharmacy in Saudi Arabia or Arabic countries, or the rest of the world. The objective of the current examination is to affirm the pharmacist's knowledge of forensic pharmacy in Saudi Arabia.

METHODS

It scrutinises a cross-sectional survey that conversed pharmacist's knowledge of forensic pharmacy in Saudi Arabia. It self-reported an electronic survey of the pharmacist, counting pharmacists from internship to consultant,

pharmacist specialties, and Saudi Arabia. All non-pharmacist or students and non-completed surveys will be omitted from the study. The survey consisted of respondents' demographic information about pharmacists and basic and advanced knowledge of selected forensic pharmacy elements, and the resources of knowledge of forensic pharmacy elements in pharmaceutical care. 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 calculated as a cross-sectional study, the confidence level 95% with z score of 1.96 and margin of error 5%, population percentage 50%, and drop-out rate 10%. As a result, the sample size will equal 380-420 with a power of study of 80%.^[18-20] The response rate obligatory of calculated sample size at least 60-70% and above.^[20,21] The survey was dispersed through social media of what's applications and telegram groups of pharmacists. The reminder 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 pharmacists knowledge of forensic pharmacy is completed through the survey monkey system. Besides, the statistical package of social sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft excel sheet version 16. It encompassed a description and frequency analysis, good of fitness analysis, correlation analysis. Beside, inferential analysis of factors touching pharmacists knowledge of nuclear pharmacy and radiopharmaceutical products and linear regression. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) steered the reporting of the existing study.^[22,23]

RESULTS

The total number of responding pharmacists was 402, with most of them coming from the south area 252 (62.69%) with statistically noteworthy 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 momentous between all ages level ($p < 0.001$). Almost three-quarters of the pharmacists had bachelor's degrees 303 (75.56%), with statistically important 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 experienced 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 substantial 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 relationship 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 important difference ($p > 0.05$) as explored in Table 1 and 2.

The total average scores of pharmacists' knowledge of forensic pharmacy services were 2.0 with high scores element was the valuation of basic knowledge of the forensic pharmacy was the medications induced addiction (2.74), the narcotics and controlled medications law (2.67), and Medication Errors or medication safety or patient safety center (2.42). In contrast, the lowest scores were the job description of forensic pharmacist (1.5), and the forensic

pharmacist gets more salary than regular pharmacist (1.5) with statistically substantial between answers ($p < 0.001$) as discovered in Table 3. The average score advances knowledge of forensic pharmacy (1.92). In contrast, the highest score knowledge was the cardiovascular medications (3.00), the medication causes malformation of foetus abortion (2.78), the medications cause permanent disability (2.60), and know the anaesthetic medications (2.48). On the contrary, the lowest score knowledge of advanced knowledge of forensic pharmacy was the resources of forensic pharmacy (1.37), the clinical forensic pharmacist (1.38), and the international guidelines of forensic pharmacy (1.40), with the statistically noteworthy difference among the answers ($p < 0.001$) as explored in Table 4. The most resources used for forensic pharmacy services were internet 224 (56.71%), Healthcare practitioners 222 (56.20%), Drug information resources 190 (48.10%), and SFDA website 189 (47.85%), as explored in Table 5. The reliability test of McDonald's ω , 0.978, Cronbach alpha 0.977, Guttman's λ_2 , 0.978, and Guttman's λ_6 0.987. Factors persuading the forensic pharmacy basic knowledge and forensic pharmacy assessment of advance knowledge.

The numerous factors might impact the forensic pharmacy's basic knowledge. Using

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	p-value (X2)
Male	198	49.75%	< 0.001
Female	200	50.25%	
Answered question	398		
Skipped question	4		
Age	Response Count	Response Percent	p-value (X2)
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%	< 001	
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		

independent samples Kruskal-Wallis test and the Bonferroni correction for multiple tests have adjusted significant values, the results showed as follows. Five locations exaggerated the knowledge, with south the lowest average score (1.5671) with statically significant differences ($p=0.000$). Thirteen levels of the work site pretentious the knowledge that community pharmacy had the lowest average score (1.6749) with statistically significant differences ($p=0.000$). Six groups of age affected the knowledge with age (24-30 years) lowest average score (1.8038) with statically noteworthy differences ($p=0.000$). There are statically significant differences in the inducing the forensic pharmacy basic knowledge in gender ($p=0.000$), stressing male more basic knowledge than the female of the average score (2.1536). Five levels of a position affected the knowledge with pharmacy intern's lowest average score (1.2701) with statically weighty differences ($p=0.000$). Finally, six groups of experiences convoluted the knowledge with less than one year of background with the lowest average score (1.7106) with statistically important differences ($p=0.000$).

Table 3: Forensic pharmacy assessment of basic knowledge.

	There is no Knowledge		1-25% Knowledge		26-50 % Knowledge		51-75 % Knowledge		76-100 Knowledge		Total	Weighted Average	p-value (X2)
Have you ever heard about the concept of forensic pharmacy?	65.17%	262	16.92%	68	7.96%	32	7.46%	30	2.49%	10	402	1.65	< 001
Have you ever heard about the concept of a forensic pharmacist job?	66.17%	266	16.92%	68	8.21%	33	5.72%	23	2.99%	12	402	1.62	< 001
In Saudi Arabia, are there legal provisions in the medicines act that provide for Medication Errors (MEs) activities?	33.58%	135	30.85%	124	14.18%	57	12.69%	51	8.71%	35	402	2.32	< 001
In Saudi Arabia, is there a Medication Errors or medication safety or patient safety center?	28.93%	116	28.18%	113	24.44%	98	8.48%	34	9.98%	40	401	2.42	< 001
In Saudi Arabia, is there an official crime or problem?	48.13%	193	20.45%	82	11.47%	46	6.98%	28	12.97%	52	401	2.16	< 001
Do you know the severity classification for Medication Errors (MEs)?	52.24%	210	16.92%	68	10.95%	44	8.46%	34	11.44%	46	402	2.1	< 001
Do you know the system of medications errors sentinel events?	70.00%	280	9.75%	39	10.00%	40	5.00%	20	5.25%	21	400	1.66	< 001
Do you know the narcotics and controlled medications law?	18.66%	75	39.05%	157	15.42%	62	10.20%	41	16.67%	67	402	2.67	< 001
Do you know the ethics used in forensic pharmacy?	66.75%	267	10.50%	42	9.25%	37	4.50%	18	9.00%	36	400	1.79	< 001
Do you know the medications induced addiction?	16.71%	67	39.15%	157	15.21%	61	10.97%	44	17.96%	72	401	2.74	< 001
Do you know the job description of a forensic pharmacist?	75.12%	302	9.45%	38	7.71%	31	5.22%	21	2.49%	10	402	1.5	< 001
Do you know the medical discrimination system?	56.97%	229	17.41%	70	11.69%	47	7.96%	32	5.97%	24	402	1.89	< 001
In Saudi Arabia, the forensic pharmacist get more salary than regular pharmacist	74.81%	300	12.22%	49	4.74%	19	4.49%	18	3.74%	15	401	1.5	< 001
Answered												402	
Skipped												0	

The numerous factor might influence the forensic pharmacy valuation of advanced knowledge. Five locations exaggerated the knowledge, with south the lowest average score (1.5669) with statically significant differences ($p=0.000$). Thirteen levels of the work site affected the knowledge that community pharmacy had the lowest average score (1.6923) with statistically important differences ($p=0.000$). Six groups of age exaggerated the knowledge with age (24-30 years) lowest average score (1.7875) with statically significant differences ($p=0.000$). Regarding gender, the

male has more knowledge than the female of the average score (2.0449) with statically significant differences in the manipulating the Forensic pharmacy advance knowledge ($p=0.007$). Five levels of a position affected the knowledge with pharmacy intern's lowest average score (1.3431) with statically significant differences ($p=0.000$). Finally, six groups of the level of experiences affected the knowledge with less than one year experiences had a lowest average score (1.7198) with statically significant differences ($p=0.000$) as explored in Table 6.

The relationship between forensic pharmacy basic knowledge and factors location, site of work, age (years), pharmacist gender, years of experience in pharmacy career, and position Held. It was revealed through a multiple regression model and measured the Forensic pharmacy basic knowledge dependent variable, and factors were measured an expletory variable. There was a medium relationship R (0.451) with ($p=0.000$) between Forensic pharmacy basic knowledge and factors. All factors were non-significant differences ($p>0.05$). However, there are only

Table 4: Forensic pharmacy assessment of advanced knowledge.

	There is no Knowledge		1-25% Knowledge		26-50 % Knowledge		51-75 % Knowledge		76-100 Knowledge		Total	Weighted Average	p-value (X2)
Do you know the analysis of forensic medications ions?	72.32%	290	11.47%	46	6.98%	28	5.99%	24	3.24%	13	401	1.56	< 001
Do you know medications induced death	19.40%	78	42.79%	172	17.91%	72	12.44%	50	7.46%	30	402	2.46	< 001
Do you know the medications cause permanent disability?	8.25%	33	50.25%	201	22.00%	88	12.25%	49	7.25%	29	400	2.60	< 001
Do you know the Medication causes malformation of fetus abortion?	9.98%	40	41.40%	166	22.94%	92	12.47%	50	13.22%	53	401	2.78	< 001
Do you know the narcotics or controlled medications during a medical examination for a new job?	46.77%	188	22.64%	91	10.45%	42	8.71%	35	11.44%	46	402	2.15	< 001
Do you know about toxic-kinetics used in forensic pharmacy?	69.58%	279	10.22%	41	8.98%	36	6.48%	26	4.74%	19	401	1.67	< 001
Do you know the cosmetics used in forensic pharmacy?	78.11%	314	8.96%	36	7.46%	30	2.74%	11	2.74%	11	402	1.43	< 001
Do you know the international guidelines of forensic pharmacy?	80.35%	323	7.71%	31	6.47%	26	2.99%	12	2.49%	10	402	1.40	< 001
Do you know the clinical forensic pharmacist?	80.80%	324	8.48%	34	4.74%	19	4.24%	17	1.75%	7	401	1.38	< 001
Do you know the off-labeled or non-approved medications?	62.44%	251	10.20%	41	9.45%	38	7.96%	32	9.95%	40	402	1.93	< 001
Do you know the anesthetic medications?	26.62%	107	34.08%	137	16.42%	66	10.95%	44	11.94%	48	402	2.48	< 001
Do you know the cardiovascular medications?	6.97%	28	39.55%	159	18.66%	75	15.92%	64	18.91%	76	402	3.00	< 001
Do you know the factors affecting hiding results during drug analysis?	75.87%	305	11.19%	45	5.97%	24	3.23%	13	3.73%	15	402	1.48	< 001
Do you now herbal contributed permanent disabilities or death	67.58%	271	16.71%	67	7.48%	30	2.24%	9	5.99%	24	401	1.62	< 001
Do you know forensic toxicology	79.95%	319	7.27%	29	5.01%	20	5.26%	21	2.51%	10	399	1.43	< 001
Do you know the resources of forensic pharmacy	79.30%	318	9.73%	39	7.23%	29	1.75%	7	2.00%	8	401	1.37	< 001
Answered												402	
Skipped												0	

Table 5: The most resources used for nuclear pharmacy information.

Answer Choices	Responses	
Healthcare practitioners	222	56.20%
Scientific literature	144	36.46%
Peer discussions	36	9.11%
Medical association literature/guidelines/recommendations	38	9.62%
Drug information resources (Lexicomp-drug information, Micromedex, Epocrates ..etc	190	48.10%
SFDA website	189	47.85%
Drug Bulletin	46	11.65%
Relatives and friends	119	30.13%
Nuclear pharmacy education courses	97	24.56%
Internet	224	56.71%
The drug information center at the hospital	143	36.20%
Awareness lectures in a hospital	20	5.06%
Awareness lectures primary healthcare center	14	3.54%
Healthcare care awareness events at the market	12	3.04%
Answered	395	
Skipped	7	

Table 6: Factors (average scores) influencing the Forensic pharmacy basic knowledge and Forensic pharmacy assessment of advance knowledge.

	Factors	Forensic pharmacy assessment of basic knowledge							Forensic pharmacy assessment of advanced knowledge						
		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	2.8165	.97160	2.7596	2.5882	3.0448	0.000	72	2.6675	1.00349	2.4063	2.4317	2.9033	0.000
	North	23	2.5518	.92907	2.6154	2.1501	2.9536		23	2.5772	.86495	2.5000	2.2031	2.9512	
	South	247	1.5671*	.67464	1.3077	1.4826	1.6517		247	1.5669*	.63059	1.3125	1.4878	1.6459	
	East	10	3.1462	.82805	3.0769	2.5538	3.7385		10	2.6688	.79825	2.7500	2.0977	3.2398	
	West	43	2.6133	1.09804	2.3846	2.2754	2.9512		43	2.2295	.97487	1.8750	1.9294	2.5295	
	Total	395							395						
Site of works	MOH Hospitals	106	2.2092	1.02754	2.0385	2.0113	2.4071	0.000	106	2.0302	.97580	1.6458	1.8423	2.2181	0.000
	Military hospitals	74	1.6939	.75354	1.3077	1.5193	1.8684		74	1.7226	.68951	1.3750	1.5628	1.8823	
	National Guard Hospital	10	2.7231	1.01352	2.5000	1.9980	3.4481		10	2.3063	.43844	2.2500	1.9926	2.6199	
	Security forces hospitals	4	3.0962	.60691	3.0000	2.1304	4.0619		4	3.0406	.63273	3.1563	2.0338	4.0474	
	University hospital	12	2.9808	.91554	2.8846	2.3991	3.5625		12	2.7111	.78662	3.0625	2.2113	3.2109	
	MOH primary care centers	15	1.7846	.73965	1.5385	1.3750	2.1942		15	1.8056	.76192	1.4375	1.3836	2.2275	
	Private hospitals	11	2.0629	.80591	1.6923	1.5215	2.6044		11	1.8977	.44483	1.7500	1.5989	2.1966	
	Private primary healthcare center	6	1.9359	.49713	1.9231	1.4142	2.4576		6	1.8854	.43376	1.9688	1.4302	2.3406	
	Community pharmacy	122	1.6749*	.95257	1.3077	1.5042	1.8457		122	1.6923*	.91622	1.3125	1.5281	1.8565	
	Pharmaceutical company	15	2.5231	1.00892	2.2308	1.9644	3.0818		15	2.2369*	.99151	1.8125	1.6879	2.7860	
	University (Academia)	9	2.4188	.69243	2.2308	1.8866	2.9510		9	2.2639	1.01251	1.8750	1.4856	3.0422	
	Retried	2	2.6154	.43514	2.6154	-1.2942-	6.5250		2	2.9063	.92808	2.9063	-5.4322-	11.2447	
Un-employment	8	2.9231	.96865	3.0000	2.1133	3.7329	8	2.7500	.95080	2.7813	1.9551	3.5449			
Total	395						395								
Age	24-30	267	1.8038*	.97315	1.3077	1.6866	1.9211	0.000	267	1.7875*	.92476	1.3750	1.6761	1.8990	0.000
	31-35	72	2.1074	.75829	1.8462	1.9292	2.2856		72	1.9571	.64300	1.7500	1.8060	2.1082	
	36-40	26	2.7189	.84320	2.6538	2.3784	3.0595		26	2.5455	.73804	2.3563	2.2474	2.8436	
	41-45	9	2.4615	1.01687	2.1538	1.6799	3.2432		9	2.3958	.93070	2.1875	1.6804	3.1112	
	46-50	7	3.1648	1.00632	2.9231	2.2341	4.0955		7	2.8125	1.24896	2.7500	1.6574	3.9676	
	> 50	14	3.1461	.68960	2.8846	2.7479	3.5442		14	2.5208	.77254	2.2813	2.0748	2.9669	
	Total	395							395						
Gender	Male	196	2.1536*	.97880	1.9231	2.0157	2.2915	0.000	196	2.0449*	.93254	1.6771	1.9136	2.1763	0.007
	Female	199	1.8608	.97981	1.3846	1.7238	1.9977		199	1.8095	.86180	1.3750	1.6891	1.9300	
	Total	395							395						
Employment	Director of Pharmacy	18	2.4263	.99534	2.6154	1.9313	2.9213	0.000	18	2.0903	.76313	2.0625	1.7108	2.4698	0.000
	Assistant director of Pharmacy	17	2.6900	.62736	2.8462	2.3675	3.0126		17	2.4853	.70832	2.3125	2.1211	2.8495	
	Supervisor	29	2.8240	.84320	2.6154	2.5033	3.1448		29	2.5507	.82377	2.5000	2.2374	2.8641	
	Pharmacy Staff	282	1.9818	.98804	1.5385	1.8660	2.0976		282	1.9193	.92285	1.5000	1.8111	2.0275	
	Pharmacy intern	49	1.2701*	.47364	1.1538	1.1341	1.4062		49	1.3431*	.50164	1.2500	1.1990	1.4872	
	Total	395							395						
Experiences	<1	211	1.7106*	.94230	1.3077	1.5827	1.8384	0.000	211	1.7198*	.91961	1.3125	1.5950	1.8446	0.000
	1-3	87	1.9446	.87202	1.6154	1.7587	2.1304		87	1.9108	.82059	1.6250	1.7359	2.0857	
	4-6	39	2.4448	.74176	2.3846	2.2043	2.6852		39	2.2506	.66328	2.0625	2.0356	2.4657	
	7-9	14	2.8077	.77145	2.6538	2.3623	3.2531		14	2.3438	.80329	2.1563	1.8799	2.8076	
	10-12	12	2.7735	.80847	2.6923	2.2598	3.2872		12	2.4924	.65119	2.6417	2.0786	2.9061	
	>12	32	2.9485	.93202	2.8397	2.6125	3.2845		32	2.5404	.90449	2.3438	2.2143	2.8665	
	Total	395							395						

Table 7: Multiple regression of Factors with the Forensic pharmacy assessment of basic knowledge.

	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)	.451 ^b	.204	16.530	.000 ^b	2.365	.324		7.293	.000	1.727	3.003		
	Location					-.058-	.042	-.064-	-1.386-	.166	-.140-	.024	.949	1.054
	Site of work					.012	.011	.052	1.104	.270	-.009-	.033	.931	1.074
	Age (years)					.027	.065	.033	.422	.674	-.101-	.156	.332	3.014
	Pharmacist gender					-.052-	.094	-.026-	-.558-	.577	-.236-	.132	.915	1.093
	Years of experience at pharmacy career					.206	.052	.319	3.932	.000	.103	.309	.311	3.212
	Position Held					-.170-	.058	-.149-	-2.915-	.004	-.285-	-.055-	.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)	2.365	.041	.370	.001	1.721	3.166
	Location	-.058-	-.001-	.054	.286	-.167-	.043
	Site of work	.012	.000	.011	.294	-.010-	.034
	Age (years)	.027	-.003-	.072	.695	-.113-	.167
	Pharmacist gender	-.052-	-.003-	.099	.621	-.245-	.145
	Years of experiences at pharmacy career	.206	-.001-	.062	.003	.086	.328
	Position Held	-.170-	-.008-	.060	.007	-.302-	-.063-

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

two factors (Years of experiences) explained 31.9 % positive relationship ($p=0.000$), and pharmacist's position explained 14.9 % negative relationship ($p=0.004$) the variation in the Forensic pharmacy basic knowledge through multiple regression model and confirmed by Bootstrap model. The relationship verified by the non-existence of multi-collinearity with the years of experiences factor Variance Inflation Factor ($VIF=3.212$) and pharmacist's position ($VIF=1.279$) almost nearest three or less than five^[24-26] as explored in Table 7. There was a weak relationship R (0.372) with ($p=0.000$) between forensic pharmacy advanced knowledge and factors. All factors were non-significant differences ($p>0.05$). However, there are only three factors locations, explained 16.3% negative relationship, (Years of experiences) explained 21.6 % positive relationship ($p=0.011$), and pharmacist's position explained 11.3 % negative relationship ($p=0.035$) the variation in the forensic pharmacy advanced knowledge through multiple regression model and confirmed by Bootstrap model.

The relationship verified by the non-existence of multi-collinearity with, locations factor Variance Inflation Factor ($VIF=1.054$), the years of experiences ($VIF=3.212$) and pharmacist's position ($VIF=1.279$) almost nearest three or less than five^[24-26] as explored in Table 8.

DISCUSSION

There are numerous jobs for pharmacists. The pharmacist can work in the hospital pharmacy, community pharmacy, pharmaceutical companies, toxicology and forensic chemistry laboratories, and academic pharmacy, counting Universities and training centers.^[13,27] Over the past years, there were shortage of workforce in the pharmacy field.^[28,29] The ministry of education prolonged the number of colleges of pharmacies in the past years. As a result, the number of graduate pharmacists increases, and they need job vacancies.^[30] Recently, the Ministry of Human Resources lengthened the pharmacist jobs in the pharmaceutical companies and community pharmacies. In the

past years, the pharmacist delivers excellent patients care services, counting clinical pharmacy specialty or medication distribution services, and is expanding by the time.^[2,3] The impact of pharmacists in drug therapy is well recognized in Saudi Arabia in several fields of pharmacy.^[10,31-33] However, the area of forensic medicine was absent the pharmacist locally or internationally. Despite, there was nominated jobs by the ministry of Human Resources. Through recent variations in the curriculum of the college of pharmacy, the pharmacist had many knowledge and practice experiences. In forensic medicine, the pharmacist can examine the toxic or intention poisoning material, Monitor and prevent the medication errors and drug-related problems that lead to intentional death, assessment any dangerous drug interaction or drug-food interaction. Besides, provide and lead the poisoning management related issues, drug or substance addiction. As a result, the pharmacist desires knowledge for forensic medicine and work in the forensic pharmacy field.^[28,29] Based on the authors' best knowledge,

Table 8: Multiple regression of Factors with the Forensic pharmacy assessment of advanced knowledge.

	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)	.372 ^b	.138	10.361	.000 ^b	2.478	.308		8.034	.000	1.871	3.084		
	Location					-.134-	.040	-.163-	-3.378-	.001	-.212-	-.056-	.949	1.054
	Site of work					.013	.010	.061	1.247	.213	-.007-	.033	.931	1.074
	Age (years)					.016	.062	.021	.251	.802	-.106-	.137	.332	3.014
	Pharmacist gender					-.054-	.089	-.030-	-.610-	.542	-.229-	.121	.915	1.093
	Years of experience at pharmacy career					.127	.050	.216	2.554	.011	.029	.225	.311	3.212
	Position Held					-.118-	.056	-.113-	-2.120-	.035	-.227-	-.009-	.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	Bias	Std. Error	Sig. (2-tailed)	Bootstrap ^a		
					95% Confidence Interval		
					Lower	Upper	
1	(Constant)	2.478	.030	.383	.001	1.799	3.322
	Location	-.134-	-.002-	.054	.016	-.244-	-.033-
	Site of work	.013	.000	.011	.256	-.009-	.034
	Age (years)	.016	-.001-	.068	.810	-.123-	.143
	Pharmacist gender	-.054-	-.003-	.089	.548	-.232-	.112
	Years of experiences at pharmacy career	.127	.001	.055	.018	.027	.240
	Position Held	-.118-	-.005-	.057	.036	-.238-	-.018-

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

there was little or nil investigation about pharmacist's knowledge of forensic pharmacy locally or Gulf and Middle East countries. The current study goals to declare the pharmacist knowledge of forensic pharmacy in Saudi Arabia. Based on the responder's results with suitable sample and satisfactory calculated sample size and power of eighty. Besides, it includes good validation and a high-reliability score of the various test. The majority of responders from the southern region were predictable because most of the authors were situated in the south area of Saudi Arabia and dispersed the electronic survey at their location. The gender distribution is almost the sample and resembles the Saudi population. The majority of responders were young age; which is probable because more willing to partake in the research than other groups of age. Most of the responders had a bachelor's degree, which was expected because most pharmacy colleges graduated at this level. Most of them worked at a community pharmacy, which might non-Saudi responders graduated from outside

Saudi Arabia. Those young pharmacists had low working experiences and working as community pharmacists or at the outpatient pharmacy. There is a strong positive association between age and the number of years of experience anticipated (Higher age and higher experiences). It also includes negative medium correlation employment and age that's young age with higher positions. It might be linked to younger pharmacists available for higher work in the pharmacy practice.

The average score of basic knowledge of forensic pharmacy was lacking; almost 20% only resemble of earlier forensic medicine study.^[34] The highest knowledge was about drug-induced addition, the narcotics law, and the medications error system, which was expected because those elements had been executed in the pharmacy practice with close monitoring by Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI). While the lowest score knowledge was the job of the forensic pharmacist or the higher salary offers to the forensic pharmacist expected

from responders because most of them work at community pharmacies far away from the forensic pharmacy practice. Also, forensic pharmacy is not taught during pharmacy, poor or nil continuous education and forensic pharmacy. The hospital pharmacist did not contain the forensic pharmacy services, did not included as members of the mortality community or criminal committee. The current examination exposed the average scores of advanced knowledge of forensic pharmacy were poor. The highest knowledge was about cardiovascular medications or medications harmful to the foetus or get an abortion, significant adverse events, and anesthesia medications expected because knowledge loads daily practice and is used for forensic pharmacy knowledge.

On the contrary, the lowest advanced knowledge of forensic pharmacy was the resources of forensic pharmacy or clinical pharmacist or pharmacy international guidelines related to poor education during college of pharmacy and the bulk of responders not working in

forensic laboratories or forensic pharmacy field. Due to poor forensic pharmacy knowledge, most responders applied healthcare practitioners or the internet, and seldom-used drug information resources look like preceding forensic medicine studies.^[35] The various current factors might be the results of essential knowledge and advanced knowledge of forensic pharmacy. It includes location, site of work, age, gender, employment, number of years of experiences with a statistically significant difference. The south region had a lower score of basic and advanced knowledge of forensic pharmacy. The reason is unclear and might be that a pharmacist does not distinguish the forensic medicine services, or the responders are not trained at forensic pharmacy services. The community pharmacist had a lower score of knowledge because it is not their practice field or not educated about forensic pharmacy. The lower age had lower basic and advanced knowledge of forensic pharmacy because they newly graduated with enough education from the college of pharmacy. The female responders had lower knowledge than females that might relate to their practice or trained at forensic pharmacy services because females are fairer than males in this field and can admit the criminal cases. The pharmacy intern had lower knowledge of forensic pharmacy, and this is normal because they still have not fully finished their forensic pharmacy knowledge and need more education and training in and more practice with future manner. The lower years of experience had lower basic and advanced knowledge of forensic pharmacy as expected. The responders are still young and need more time for practice and additional training with short courses or long training in residency programs. The study presented multiple regression analysis, and there was an association between factors and basic and advanced knowledge of forensic pharmacy. The only two positive depending factors number of years experiences and negative dependence factors positions. In the basic knowledge forensic pharmacy, each unit of increase of years involvements the basic knowledge increase with 31%, while each unit of positions increases the knowledge decrease by 15%. In the advanced knowledge of forensic pharmacy, each unit of year's experiences increase the advanced knowledge increase by 21%, while each unit of position the advanced knowledge reductions by 11%.

Moreover, with each one-unit increase of location, the advanced knowledge reduced by 16%. The location might clarify the areas of forensic pharmacy services provided to the population. Forensic pharmacy desires more education and training in the college of

pharmacy, emphasizing forensic pharmacy residency program.

Limitations

Various limitations were created in the study includes the unequal distribution of responders among locations, site of work, age, position hold, and several years' experience. In addition, the majority of responders were young age with few years of experience with lower positions. It is representative of their insufficient knowledge about forensic pharmacy and related issues. As a result, it isn't easy to compare the study results with the earlier examination that did not exist.

CONCLUSION

The current electronic survey with the convenient method and tolerable sample size discussed the pharmacist's knowledge of forensic pharmacy services that was poor. Pharmacists know medication-induced addition or narcotics law, while forensic pharmacist job description with unsatisfactory knowledge. The primary and advanced forensic pharmacy knowledge is exaggerated by the number of year's experiences and career positions. The implementation of education and training of forensic pharmacy is mandatory to improve new services 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

KSA: Kingdom of Saudi Arabia; **SPSS:** Statistical Package of Social Sciences; **JASP:** Jeffery's Amazing Statistics Program; **Stroke:** 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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