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ORIGINAL STUDY

Assessing Pharmacists' Knowledge of Drugs' Dialyzability in Four Health Institutions in Al-Najaf, Iraq

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Abstract

Background: Drugs' dialyzability is the degree to which a drug is filtered out of the blood stream during dialysis. This process is influenced by various factors, including properties of the drug and dialysis procedure. As drug experts, pharmacists must pay close attention to drugs' dialyzability when counseling patients on medications to ensure that therapeutic drug concentrations are maintained in the patient's body.

Aim: This study aimed to assess the knowledge of pharmacists working in dialysis centers or hospitals with dialysis wards regarding drugs' dialyzability.

Methodology: A descriptive cross-sectional study was conducted in November 2022. A three-section questionnaire was developed and distributed to 160 pharmacists. Its first section gathered six demographic questions about the participants. The second included 12 questions related to dialysis and drugs' dialyzability, while the third section contained 13 questions about the dialyzability of the most commonly used drugs in dialysis wards.

Result: A total of 141 pharmacists were enrolled, resulting in a response rate of 88.12%. Most of the participants (83.7%) were female, with a mean age of 27.82 ± 4.18 years. About one-third of participants worked in dialysis wards. Surprisingly, only 27% of the pharmacists had fair to good knowledge regarding drugs' dialyzability. There was no significant difference in the knowledge of pharmacists with different age groups, genders, degrees, institutions and years of experience, except for those who had worked in dialysis wards when compared with those who never worked there before.

Conclusion: The analysis of the data indicates the need to improve pharmacists' knowledge, especially for those working or about to work in dialysis wards. Continuous educational programs and workshops can help maintain and enhance knowledge after graduation.

Keywords: Drug, Dialyzability, Pharmacists, Knowledge

Dialysis is a procedure that simulates the function of kidney through removing waste products and excessive fluids out of the blood. It's used for patient's whom their kidneys failed to do their normal job. For example, those with end stage renal disease (ESRD) or acute kidney injury (AKI). According to the case, dialysis will be performed temporally or permanently. The two main modalities

of dialysis are hemodialysis and peritoneal dialysis [1]. Globally, hemodialysis is the commonest one, where 89% of patients receiving dialysis are on hemodialysis [1–3].

Both modalities are depending on simple diffusion for removing waste products and uremic toxins from the blood to another fluid called the dialysate (dialysis fluid) [1]. By the same technique (simple diffusion), some drugs also can be removed from the blood. The extent to which that happens is known as drugs'

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dialyzability. Indeed, depending on some physico-chemical properties of the drug itself and of dialysis technical aspects, drugs are classified into two classes, dialyzable and non-dialyzable. Drug properties that affect its dialyzability include its molecular weight (size), protein binding and volume of distribution; where, drugs with low molecular weight (less than 500 Da), low binding to plasma protein (especially albumin) and small distribution volume are more affected by dialysis (i.e., more dialyzable). On the other hand, properties of dialysis procedure that affected drug dialyzability include membrane (filter) characteristics, blood and dialysate flow rates inside the filter and the duration of dialysis procedure [1,4,5].

In order to avoid drugs' dialyzability, dialyzable drugs should be administered after completing dialysis session, otherwise a supportive dose of the parent drug should be administered after completing dialysis session to replace what was removed during dialysis [4–6]. Another study revealed that under dose due to dialysis clearance can be overcome through increasing the administered dose of the dialyzable drug to ensure adequate therapeutic efficacy after dialysis [7].

As a drug expert, the hospital pharmacist is the one whom responsible for delivering the right drug to the right patient in the right dose and time. He works side by side with other medical team members to ensure patient's safety [8,9]. At dialysis wards, clinical pharmacists have a dual responsibility. They undertake the responsibility of counseling medications with key information (i.e. dose, timing, side effects and contraindications) to reach the maximum benefit [10,11] and decrease drug related problems [12]. On the other hand, in a communal capacity, they play a key role in raising the awareness of dialysis patients through encouraging them to adhere to their medications -including dialysis session itself- and to ask about the right manner and time to take these medications [13]. indeed, it has been estimated that the adherence to the medications is significantly correlated to the knowledge [14].

For dialysis patient, pharmacist must put in consideration two important aspects: the first is that kidneys are no longer functional. Consequently, doses should be carefully calculated according to patient's glomerular filtration rate (GFR). The second is the clearance of the drug through dialysis procedure, which leads to decrease the therapeutic efficacy of the drug [15]. Antibiotics resistance [16], loss of chemotherapies efficiency [15] and inability to control blood pressure [17,18] are the results of administering dialyzable antibiotics, chemotherapies and anti-hypertensives at the wrong time.

1. Materials and methods

1.1. Study design

A descriptive cross-sectional study was conducted in November 2022 to evaluate pharmacists' knowledge regarding drugs' dialyzability in Al-Najaf city, Iraq. The study was conducted in four health institutions, namely Al-Hakeem General Hospital, Al-Sader Medical City, Al-Najaf Educational Hospital, and Blood Diseases and Dialysis Center. These institutions were selected due to containing the main dialysis wards in the city.

The study used a newly-made questionnaire that had been tested for validity by four academic experienced specialists, including a clinical pharmacy specialist, two pharmacology specialists, and a biostatistics specialist. The revised questionnaire was sent to 10 pharmacists to perform a pilot study, and the Cronbach alpha value was 0.81.

1.2. Survey design

The questionnaire consisted of three sections. The first section asked about pharmacist's demographic data, including age, gender, degree, institution, years of experience, and whether the pharmacist had worked at a dialysis ward or not. The second section included one open-ended question about the meaning of the term “drugs' dialyzability” and 11 multiple-choice questions asking general information about dialysis and drugs' dialyzability. The last section asked about the dialyzability of 13 of the most commonly used drugs. Each correct answer gave one point, while incorrect or “not sure” answers gave 0 points. The full score for the questionnaire was 25 points, and the resulting total scores ranged from 0 to 25. A score of >17 indicated good knowledge, 13–17 indicated fair knowledge, while a score <13 indicated inadequate knowledge.

1.3. Participants

According to the pharmacy departments, the total number of pharmacists working at the clinical wards of the four institutions was 205. The Raosoft online calculator was used to calculate the required sample size. assuming a confidence interval (CI) of 95%, margin of error of 5%, the minimum effective sample size was 135 [19].

The questionnaire was delivered by hand to 160 pharmacists, which were informed that participation was voluntary, confidentiality would be kept, and the questionnaire would take a maximum of 10 min to be completed. They were also instructed

Table 1. Demographic data of the participant pharmacists.

Variables		No.	%
Age	≤30 years	125	88.7
	31–40 years	14	9.9
	>40 years	2	1.4
Gender	Male	23	16.3
	Female	118	83.7
Highest educational level attained	Bachelors	135	95.7
	Higher diploma	1	0.7
	Master's degree	5	3.5
Working place	Al-Hakeem	33	23.4
	General Hospital		
	Al-Najaf	43	30.5
	Educational Hospital		
	Al-Sader Medical City	49	34.8
Years of work experience (in hospital pharmacy)	Blood Diseases and Dialysis Center	16	11.3
	<1 year	73	51.8
	1–3 years	21	14.9
	4–7 years	38	27.0
	8–10 years	4	2.8
Have you ever worked on dialysis center	>10 years	5	3.5
	Yes	54	38.3
	No	87	61.7

to choose “not sure” whenever they had no idea about the right answer.

1.4. Inclusion and exclusion criteria

All pharmacists working in the clinical wards of the four mentioned health institutions were included in the study. On the other hand, exclusion criteria include pharmacists who were working in the mentioned institutions but not in the clinical wards, as well as, pharmacists working in other health institutions.

1.5. Data analysis

The data were analyzed using version 24 of the SPSS program. Categorical data were expressed as frequencies and percentages. According to Kolmogorov–Smirnov test for, the data were not normally distributed, hence, non-parametric tests (Man-Whitney and Kruskal–Wallis test) were used to compare the difference between means. As well as, Chi-square test for association was performed. The P-value was considered significant when the result was <0.05.

2. Results

From 160 pharmacists had received the questionnaire, 141 accepted to answer it, resulting in a response rate of 88.12%. The majority of respondents were female, comprising (83%) of the sample. The

mean age of participants was 27.82 ± 4.18 years, with the majority being below 30 years old. On average, participants had 2.5 years of experience at hospital pharmacy, and almost all (95%) were holding bachelor's degree in pharmaceutical science. The sample was drawn from four health institutions, with approximately one third of respondents (38%) having worked in dialysis wards. Additional demographic data are presented in [Table 1](#).

Of the participants, only 15% correctly defined the term drugs' dialyzability in the open-ended question. About 62% of the participants knew that the dialyzable drug is the drug that can be removed by dialysis procedure. Roughly half were aware that drugs with low molecular weight and low protein binding are more dialyzable, while those with high volume of distribution are less dialyzable. However, only 26% knew that technical aspects of the dialysis procedure can impact drugs' dialyzability. And approximately 65% of the participants were aware that dialysis procedure can be used for removing toxins from the blood in case of acute toxicity.

The percentage of pharmacists who correctly identified meropenem, gentamicin, lisinopril, methotrexate, aspirin, and folic acid as dialyzable drugs were 33%. While, only 27% were correctly identified digoxin, carvedilol, eprirx, amlodipine, insulin, and heparin as non-dialyzable drugs. Other question and percentages of correct responses are summarized in [Table 2](#).

Data analysis revealed that the mean knowledge score for participating pharmacists was 39.7%, with 10% only demonstrating good knowledge, while the percentages of those with fair to inadequate knowledge level were 17% and 73% respectively. There was no significant difference in knowledge between pharmacists with various age groups, genders, degrees, institutions or years of work experience. The only significant difference was found between those who had worked in dialysis wards and who never worked there before, where the pharmacists who had worked at dialysis wards had slightly higher knowledge regarding the subject. On the other hand an association was found between knowledge and pharmacist degree ([Table 3](#)).

3. Discussion

Several studies have highlighted the risk of medication-related problems (MRPs) in hemodialysis patients, including the issue of sub-therapeutic dosing, defined as administering a dose below the required level [20,21]. Dialyzable drugs given before a dialysis session can contribute to this problem by affecting drug dialyzability [22].

Table 2. Numbers and percentages of correct answers of the participant pharmacists for the whole questionnaire.

N	Item	Correct response			
		no.	%	Mean score	SD
1	Drug dialyzability is the extent to which a drug is removed from the blood through dialysis procedure.	21	14.9	0.15	0.36
2	End stage renal disease (ESRD) is a condition where GFR is less than 15 ml/min/1.73m ² .	93	66.0	0.66	0.48
3	Before dispensing medications for chronic dialysis-dependent patients, the pharmacist should check the level of creatinine clearance.	119	84.4	0.84	0.36
4	Any type of KRT (hemodialysis, peritoneal dialysis or kidney transplantation can be used to treat patient with ESRD.	53	37.6	0.38	0.49
5	Dialyzable drug is the drug that can be removed through dialysis.	88	62.4	0.62	0.49
6	Drug is more able to be dialyzed if it has low molecular weight.	71	50.4	0.5	0.50
7	A drug with high volume of distribution (Vd) needs long time to be dialyzed.	71	50.4	0.5	0.50
8	A drug with low protein binding is the more dialyzable drug.	68	48.2	0.48	0.50
9	Dialysis properties like membrane material, blood and dialysate flow rates and duration of dialysis can affect drug dialyzability.	37	26.2	0.26	0.44
10	If a patient is on dialysis, it's important to check drug dose, timing and drug–drug interaction.	55	39.0	0.39	0.49
11	To avoid drug's dialyzability, the pharmacist should administer the drug after dialysis session or before dialysis with a supportive dose after dialysis session.	49	34.8	0.35	0.48
12	In addition to standard use, dialysis can also be used for acute poisoning.	92	65.2	0.65	0.48
13	carvedilol is a non-dialyzable drug.	52	36.9	0.37	0.48
14	Heparin is a non-dialyzable drug.	34	24.1	0.24	0.43
15	Insulin is a non-dialyzable drug.	51	36.2	0.36	0.48
16	Gentamicin is a dialyzable drug.	51	36.2	0.36	0.48
17	Metformin is a dialyzable drug.	47	33.3	0.33	0.47
18	Lisinopril is a dialyzable drug.	40	28.4	0.28	0.45
19	Digoxin is a non-dialyzable drug.	48	34.0	0.34	0.48
20	Methotrexate is a dialyzable drug.	28	19.9	0.2	0.40
21	Amlodipine is a non-dialyzable drug.	38	27.0	0.27	0.45
22	Aspirin is a dialyzable drug.	50	35.3	0.35	0.48
23	Meropenem is a dialyzable drug.	56	39.7	0.4	0.49
24	Eprex is a non-dialyzable drug.	30	21.3	0.21	0.41
25	Folic Acid is a dialyzable drug.	56	39.7	0.4	0.49

To ensure a diverse sample, pharmacists from both dialysis and non-dialysis clinical wards were included in this study, and a good response rate of 88% was achieved due to high participant interest. All of the pharmacists in this study were working in hospitals containing dialysis unit, having various years of experience. The dominant were females, with a male to female ratio of 1:5.13. This is not surprising, since most of the workers in hospitals clinical wards are females, while males tend to occupy managerial positions, working in the dispensary or taking night shifts.

In this study pharmacists' knowledge of drugs' dialyzability was evaluated, the average level of knowledge was determined to be 39.76%. To the

best of our knowledge, there was no similar previous studies to compare our results with. However, in Pakistan, a study was conducted to evaluate pharmacists' knowledge regarding chronic kidney disease using a questionnaire. The percentage of right answers for the only one question asking about the dialyzability was 24.6% [23]. Moreover, we found an association between pharmacists' knowledge and the highest degree attained with a p.value of 0.044, where participants with master's degree were found to be more aware regarding the subject.

Our study found no significant differences in knowledge based on age, gender, institution, degree, or years of experience, except for those who worked in dialysis wards, who showed marginally

Table 3. Participants characteristics and levels of knowledge regarding drugs' dialyzability.

Variables	Total frequency		Pharmacists with good knowledge		Pharmacists with fair knowledge		Pharmacists with inadequate knowledge		p value
	No.	%	No.	%	No.	%	No.	%	
Age									
≤30 years	125	88.7	15	100	20	83.4	90	88.2	0.517 ^a
31–40 years	14	9.9	0	0	4	16.6	10	9.9	0.932 ^b
>40 years	2	1.4	0	0	0	0	2	1.9	
Gender									
Male	23	16.3	2	13.3	6	25	15	14.7	0.395 ^a
Female	118	83.7	13	86.7	18	75	87	85.3	0.647 ^c
Highest educational level attained									
Bachelors	135	95.7	13	86.6	22	91.7	100	98	0.044 ^a
Higher diploma	1	0.7	0	0	1	4.15	0	0	0.271 ^b
Masters	5	3.5	2	13.3	1	4.15	2	2	
Institution									
Al-Hakeem General Hospital	33	23.4	2	13.3	4	16.6	27	26.5	0.475 ^a
Al-Najaf Educational Hospital	43	30.5	6	40	9	37.5	28	27.5	0.129 ^b
Al-Sader Medical City	49	34.8	7	46.6	7	29.3	35	34.3	
Blood Diseases and Dialysis Center	16	11.3	0	0	4	16.6	12	11.7	
Years of work experience									
<1 year	73	51.8	8	53.3	8	33.3	57	55.9	0.592 ^a
1–3 years	21	14.9	2	13.3	6	25	14	13.7	0.487 ^b
4–7 years	38	27	5	33.4	8	33.3	24	23.6	
8–10 years	4	2.8	0	0	1	4.2	3	2.9	
>10 years	5	3.5	0	0	1	4.2	4	3.9	
Have you ever worked on dialysis center									
Yes	54	38.3	5	33.3	14	58.3	35	34.3	0.085 ^a
No	87	61.7	10	66.6	10	41.7	67	65.7	0.041 ^c

^a Chi-square test.^b Kruskal–Wallis test.^c Mann–Whitney test.

better knowledge (p-value of 0.042). In contrast, a study conducted in Saudi Arabia to evaluate pharmacists' knowledge of medications prescribed for dialysis patients found no significant association between knowledge and workplace [24].

Knowledge scoring system used in this study contained three categories: good, fair, and inadequate, based on questionnaire performance. This scoring system is one of numerous scoring systems adopted in many published literatures [25–27]. Good knowledge was defined as answering over 70% of the questionnaire correctly, fair knowledge was 51–70%, and inadequate knowledge was less than 50%. The results showed that only 27% of participants achieved a passing score, highlighting the need for education and training, especially for those working or planning to work in dialysis wards.

This study offers proof that hospital pharmacists need to be educated in order to perform good healthcare services for dialysis populations [25].

One of the limitations of this study is that it was only conducted in a single city (Al-Najaf city), so findings could not be extrapolated to the entire nation.

As a recommendation, we advise that a study of a comparable nature be carried out to cover a larger population in the various governments. Also, we advise planning training sessions and/or seminars in conjunction with the Ministry of Health. As a result, training will increase pharmacists' knowledge and fill any knowledge gaps in areas like dialysis and drugs' dialyzability. Continuous educational programs and workshops can help maintain updated knowledge after graduation [28].

4. Conclusion

The results of this study indicate that the general understanding of drugs' dialyzability was insufficient. Only 27% of the participants demonstrated fair to good knowledge, while the majority reported no prior knowledge on the subject. Indeed, similar level of knowledge was found between participants with different characteristics except for place of working, where pharmacists who had worked in dialysis wards showed better knowledge. As a recommendation, we suggest implementing ongoing educational programs and workshops for pharmacists working in dialysis wards to ensure their knowledge is continuously improving.

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Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with pharmacists' verbal approval after outlining the purpose of the study. The study was approved by the Ethical and Scientific Committee of Researches of Al-Najaf Health Directorate according to the document number 43428 in 27/10/2022.

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