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Evaluating the Benefits of Using Mobile Application (diarrhea management step by step) in the Management of Diarrhea by Community Pharmacists

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Abstract

Diarrhea is a common problem that leads patients to seek a pharmacist's advice. It is associated with significant morbidity and mortality. The majority of pharmacists in Iraq did not manage diarrheal cases properly. Therefore, the current study aimed to evaluate the benefit of a new mobile application (diarrhea management step by step) to improve the pharmacist's role in managing diarrhea. The study was conducted from 21st September to 21st October 2021 using a pre-post design via a simulated patient (SP) technique. A validated diarrhea scenario was presented to each pharmacist by the SP twice, the first time before and the other after giving the mobile application to the pharmacist. Furthermore, pharmacists were asked to rate the application regarding its ease of use, reducing the time needed for managing diarrhea cases, reducing diagnostic errors, reducing medication errors, and applicability in daily clinical practice. The study sample involved 50 community pharmacists; only 47 completed the study. After using the application, all questions necessary to assess diarrhea were significantly improved. Moreover, the average number of questions asked to the SP was significantly increased. On the other hand, providing the SP with an appropriate non-pharmacological and pharmacological treatment was also significantly improved. Additionally, counseling the SP about the dispensed medication was also improved. Most participating pharmacists agreed with the application's ease of use, ability to reduce diagnosis and medication errors, and applicability in clinical practice. In conclusion, the tested application effectively improves the pharmacist's role in the assessment and management of diarrhea.

Keywords: Mobile application, Diarrhea, Pharmacist's role, Iraq

تقييم فوائد استعمال تطبيق الهاتف النقال (علاج الاسهال خطوة بخطوة) في علاج الاسهال بواسطة صيادلة المجتمع

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الخلاصة

الاسهال هو من اكثر الأسباب التي تجعل المريض يقوم باستشارة الصيدلي. يرتبط الاسهال بزيادة حدوث المراضة والوفيات. ومع ذلك ، فإن غالبية الصيادلة في العراق لم يعالجوا حالات الإسهال بشكل سليم. لذلك ، فإن الدراسة الحالية تهدف إلى تقييم فائدة تطبيق الهاتف المحمول الجديد (إدارة الإسهال خطوة بخطوة) في تحسين دور الصيدلي في علاج حالات الإسهال. أجريت الدراسة في الفترة من ٢١ سبتمبر إلى ٢١ أكتوبر ٢٠٢١ باستخدام تصميم (قبل-بعد) عبر تقنية المريض الوهمي. تم عرض سيناريو للإسهال (تم التحقق من صحته) لكل صيدلي من قبل المريض الوهمي مرتين، المرة الاولى قبل والثانية بعد إعطاء تطبيق الهاتف المحمول للصيدلي. علاوة على ذلك، طُلب من الصيادلة تقييم التطبيق من حيث سهولة استخدامه، وتقليل الوقت اللازم لعلاج حالات الإسهال، وتقليل الأخطاء التشخيصية، وتقليل أخطاء الأدوية، وإمكانية إستخدام التطبيق في الصيدلية أثناء العمل اليومي. تضمنت عينة الدراسة ٥٠ صيدلي. ومع ذلك، أكمل الدراسة ٤٧ صيدلانيا فقط. بعد استخدام التطبيق، تحسنت جميع الأسئلة اللازمة لتقييم الإسهال بشكل ملحوظ. علاوة على ذلك ، تم زيادة متوسط عدد الأسئلة التي تم طرحها على المريض الوهمي بشكل كبير. من ناحية أخرى، تزويد المريض الوهمي بالعلاج غير الدوائي والدوائي المناسب تحسن بشكل كبير. بالإضافة إلى ذلك، زادت المعلومات التي تم اعطائها للمريض الوهمي عن الأدوية التي تم صرفها. معظم الصيادلة المشاركين وافقوا وبشدة على سهولة استخدام التطبيق ، وقدرته على تحسين التشخيص وتقليل الأخطاء الدوائية، وإمكانية تطبيقه للاستخدام في الممارسة السريرية اليومية. نستنتج من ذلك، إن التطبيق الذي تم اختباره فعال لتحسين دور الصيدلي في تقييم وعلاج الإسهال.

الكلمات المفتاحية : تطبيق للهاتف النقال . الاسهال. دور الصيدلي. العراق.

Introduction

A community pharmacist is an expert who dispenses medications, counsels patients, and manages their care plan [(1)]. Common reasons for contacting a pharmacist by Iraqi patients include purchasing a medication and/or seeking medical advice about a medication or a minor ailment [(2,3)], which can be defined as "common but self-limiting or uncomplicated conditions which can be diagnosed and managed with over-the-counter medications and without complicated medical interventions" [(4)].

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Diarrhea is one of the most commonly encountered minor ailments in the community pharmacies of the developed and developing countries [5-7]. Although most cases of diarrhea are self-limited [8], it can be associated with significant morbidity and mortality in all age ranges, especially for children <5 years of age [9]. According to the WHO report, diarrhea is one of the top 10 causes of death globally with more than 1.3 million deaths in 2015 [10]. However, the mortality rate of diarrhea was greater in developing countries like Iraq as compared to developed countries [5]. The main reason for diarrhea associated mortality was related to its risk in causing dehydration and electrolyte imbalance, which if left without treatment can progress to acidosis and circulatory collapse that associated with impaired perfusion of vital organs, leading to renal damage and eventually death [11]. Unfortunately, many studies that were conducted in Iraq found that the majority of pharmacists did not manage (assess and/or treat) diarrheal cases in a proper way. The main reason for such problem was the lack of sufficient knowledge in management of diarrhea and other minor ailments [12, 13]. Some studies found that the use of new technologies such as computers [14] and smart mobiles [15] can assist pharmacists and improve their work efficiency and productivity [16]. Therefore, the current study aimed to evaluate the benefit of newly developed mobile application to improve pharmacist's role in the management of diarrhea in a community pharmacy setting.

Methods

Study design

A pre-post experimental study design was used to assess the benefits of using a mobile application (diarrhea management step by step- freely available on Google play store) [17] to improve the community pharmacist's role in diagnosis and treatment of diarrhea cases. This assessment was performed through a simulated patient (SP) approach [18]. A well-developed and validated scenario about diarrhea for an elderly patient with hypertension and prostatic hyperplasia was presented to each pharmacist by the simulated patient (SP) twice, the first time before giving the mobile application to the pharmacist and the second time after providing pharmacists with the application and training them on it. In other words, the first assessment visit was used to assess the pharmacist's role in the management of diarrhea, while the second assessment visit was used to evaluate the benefit of using the application on the pharmacist's ability to manage diarrhea. Each pharmacist was trained by the researcher about the use of the application and its features.

In the first assessment visit, the SP did not enter the pharmacy until it is free from customers to minimize the possibility of incomplete assessment of the patient case by the busy pharmacist. Thereafter, the SP presented his case (scenario) to the pharmacist and responded to any queries raised by the pharmacist. To ensure concealment of the assessment process, the SP bought all dispensed medications, without regard to their suitability to manage the case. After the end of the 1st assessment visit by 1-3 days, the application and a brief demonstrating video were shared with the pharmacist using Bluetooth technology. After providing the pharmacist with the application and training on it using different diarrhea cases, an assessment of the pharmacist's role in diagnosis and management of diarrhea was performed by presenting a scenario similar to that in the first visit to the pharmacist. In the second assessment visit some measures were followed to maximize concealment of the assessment process and ensure dealing of the pharmacist with the case in a realistic way. The first measure was presenting the scenario by a new SP that did not enter the pharmacy in the first visit. The second measure was scheduling the second visit within 7-10 days after the first visit to ascertain that the pharmacist forgets the details of the case, and thus reducing the chance of bias in using the application through guessing the case and the SP by the pharmacist. At the end of the second assessment visit, each pharmacist was thanked for participation in the study. Additionally, some information was obtained from the participating pharmacist including age, gender, years of experience, academic degree, college that he/she graduated from. Furthermore, the pharmacist was asked to rate the application in regard to 5 different points (ease of use, reducing the time needed for management of diarrhea cases, reducing diagnostic errors, reducing medication errors, applicability in daily clinical practice) using numerical scale from 0 to 10.

In both assessment visits, the interview with the pharmacist was recorded by the SP mobile phone to facilitate documentation of all details. All records were analyzed by the main researcher to assess and document the role of the pharmacist in diagnosis and management of diarrhea in both visits using specially designed checklists. The study was ethically approved by the ethical committee at College of Pharmacy /University of Baghdad.

The simulated patients

Students from the College of Pharmacy – University of Baghdad worked as the SP after being trained about the diarrhea scenario by the main researcher. Despite the fact that two SPs were sufficient for conducting the present study, three students were enrolled as SP in this study. The third student intended for emergency cases in which one of the SPs was known or detected by the pharmacist. To ensure maximum concealment of the emergency SP, the student was trained to ask the pharmacist about a suitable treatment for his acne, and then present the diarrhea scenario.

Study sample

Pharmacists who work in community pharmacies in Baghdad and having android phone were eligible for participation in the current study.
To ensure recruiting a large sample, pharmacists were informed about the developed application and its unique features, besides the study purpose and procedure through an advertisement in two facebook pages (Al-Multaqa Alsaidalani and Multaqa Al-Shaheed Muhand Kamil for pharmacists) with the largest number of pharmacist members. In the advertisement, pharmacists who were interested in the idea of the application and accepted to participate in the study (informed consent) were requested to fill in a Google form. The google form was opened for 1 week from 8th September to 15th September 2021. 314 responses were obtained in that period. All responses were analyzed by the main researcher to check eligibility of pharmacist for the current study; meanwhile only 30 pharmacists were eligible (Figure 1). To increase the sample, an additional convenient sample of 30 pharmacists were contacted in their pharmacies (in Al-Karkh discrete region, Baghdad) and informed about the study. Only 20 pharmacists provided their informed consent to participate. Thus, the total sample of the current study was 50 pharmacists.

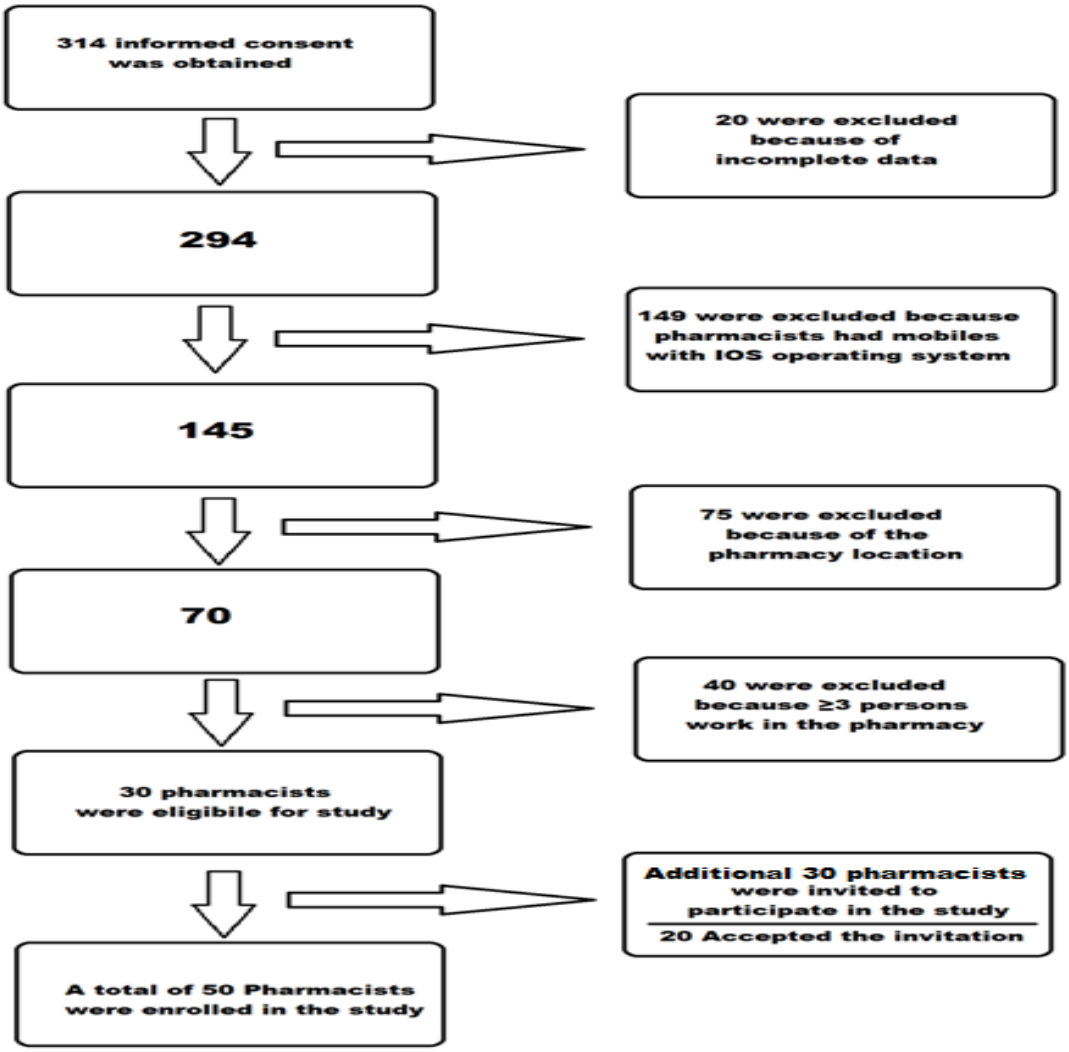

Figure 1. The study sample

Statistical analysis

Data input and analysis was done using statistical package for the Social Sciences (SPSS) version 17. Categorical variables were presented as number and frequencies while continuous variables were presented as mean ± standard deviation. Chi square test was used to test the significance in the difference among non-paired categorical variables. McNemar test was used to test the significance in the difference among paired categorical variables. Shapiro wilk test was used to test the normality of continuous variables. Within each group paired T test was used to the difference in mean for normally distributed continuous variables, while Wilcoxon Sign test was used for abnormally distributed data. Between groups, independent T test was used to the measure difference in mean for normally distributed

continuous variables, while Mann Whitney U test was used for abnormally distributed data. Pearson correlation test was used to measure the correlation between normally distributed continuous data. On the other hand, Spearman rho correlation test was used to measure the correlation between abnormally distributed continuous data. P values less than 0.05 was considered significant.

Results

Demographic data of the participated pharmacists

Fifty pharmacists were included in this study; however, two participants were withdrawn from the study and the application was not working on the smartphone of one participant. Therefore, the sample size of the study was 47. However, only 27 pharmacists were found to use the application, and 20 did not use the application during the 2nd assessment visit. Most participants graduated from Iraqi public universities in the last 5 years & hold BSc. degree in pharmaceutical sciences. Study participants' average working experience in community pharmacies was 7.14 years (Table 1).

Table 1. Characteristics of the participated pharmacists

Parameter		Participants who used the application (n=27)	Participants who did not use the application (n=20)	P value	All participants (n=47)
Gender	Male	15 (55.56%)	10 (50%)	0.706*	25 (53.19%)
	Female	12 (44.44%)	10 (50%)		22 (46.81%)
Graduation college	Public Iraqi University	18 (66.67%)	12 (60%)	0.699*	30 (63.83%)
	Private Iraqi University	3 (11.11%)	4 (20%)		7 (14.89%)
	International Universities	6 (22.22%)	4 (20%)		10 (21.28%)
Graduation year	1980-2000	1 (3.7%)	2 (10%)	0.391*	3 (6.38%)
	2001-2010	7 (25.93%)	5 (25%)		12 (25.53%)
	2011-2015	3 (11.11%)	0 (0%)		3 (6.38%)
	2016-2021	16 (59.26%)	13 (65%)		29 (61.70%)
Years of experience	Mean±SD	6.47±5.80	8.11±9.76	0.948^	7.14±7.70
	>10 years	5 (18.52%)	7 (35%)	0.082*	12 (25.53%)
	5-10 years	8 (29.63%)	1 (5%)		8 (17.02%)
	<5 years	14 (51.85%)	12 (60%)		27 (57.45%)
Academic degree	BSC	22 (81.48%)	18 (90%)	0.300*	40 (85.11%)
	MSC	2 (7.41%)	2 (10%)		4 (8.51%)
	PhD	3 (11.11%)	0 (0%)		3 (6.38%)

*Statistical analysis by chi square test; ^ Statistical analysis by Mann Whitney U test.

Assessment of the pharmacist's role in the diagnosis of diarrhea

At the 1st assessment visit (Before using the developed application), the most commonly asked questions by pharmacists were: "Who is the patient?" and "What are the disease symptoms?". Meanwhile, questions about the action taken and the recent travel history were not asked by any pharmacist. Additionally, the average number of questions asked to the SP was about 1.5 questions. Furthermore, 19% of the pharmacists supplied the SP with the medication without asking him any questions. Additionally, a non-significant difference was detected in all of the above questioning skills between the group of pharmacists who used the application and those who did not use it (Table 2).

At the second assessment visit, all questions necessary to assess diarrhea were significantly improved only among pharmacists who used the application. Moreover, the average number of questions asked to the SP was significantly increased to about 5 times among the group of the application users, while it was decreased non-significantly among the non-users of the application. Consequently, the optimum assessment of the diarrhea case (by asking all necessary questions) was significantly improved by participants who actively used the application. All of the aforementioned positive changes were also significant in the whole study sample. Further details are given in Table 2.

Table 2. Assessment of the pharmacist's role in the diagnosis of diarrhea

Diagnostic questions		Application users (n=27)			Application non-users			Difference at end of the study#	All participants (n=47)		
		Baseline N (%)	End of the study N(%)	P value	Baseline N (%)	End of the study N(%)	P value	P value	Baseline N (%)	End of the study N(%)	P value
Who is the patient?		21 (77.78)	27 (100)	0.041	16 (80)	12	0.344	<0.0001	37(78.72)	39 (82.98)	0.804
What are the disease symptoms?		8 (29.63)	26 (96.30)	<0.0001	7 (35)	3 (15)	0.219	<0.0001	15 (31.91)	29 (61.7)	0.007
How long is the duration of diarrhea?		5 (18.52)	26 (96.30)	<0.0001	1 (5)	0 (0)	1.00	<0.0001	6 (12.77)	26 (55.32)	<0.0001
What is the action taken by the patient?		0 (0)	24 (88.89)	<0.0001	0 (0)	0 (0)	1.00	<0.0001	0 (0)	24 (51.06)	<0.0001
Questioning about medical history of the patient		6 (22.22)	27 (100)	<0.0001	2 (10)	3 (15)	1.00	<0.0001	8 (17.02)	30 (63.83)	<0.0001
Questioning about medication history of the patient		2 (7.41)	26 (96.30)	<0.0001	0 (0)	2 (10)	0.500	<0.0001	2 (4.26)	28 (59.57)	<0.0001
Additional conditions that necessitate referral	Recent history of antibiotic usage	1 (3.7)	25 (92.59)	<0.0001	0 (0)	0 (0)	1.00	<0.0001	1 (2.13)	25 (53.19)	<0.0001
	Recent history of travel abroad	0 (0)	26 (96.30)	<0.0001	0 (0)	0 (0)	1.00	<0.0001	0 (0)	26 (55.32)	<0.0001
No any question was asked		5 (18.52)	0 (0)	0.063	4 (20)	8 (40)	0.344	<0.0001	9 (19.15)	8 (17.02)	1.00
Diagnosis of the case	Number of questions asked by the pharmacist*	1.59±1.45	7.67±1.11	<0.0001	1.3±0.92	1±1.03	0.230	<0.0001	1.47±1.25	4.83±3.50	0.0001
	Optimum assessment of the case	0 (0)	24 (88.89)	<0.0001	0 (0)	0 (0)	1.00	<0.0001	0 (0)	24 (51.06)	<0.0001

* Maximum number of questions is 8 questions.

Difference at the end of study values between application users and non-users.

Assessment of the pharmacist's role in diarrhea treatment

At the 1st assessment visit (Before using the developed application), the non-pharmacological advice was mentioned appropriately to the SP by less than 5% of the participated pharmacists. Antimotility agents were dispensed by most (~ 90%) of the participated pharmacists. However, the choice of antimotility agent was appropriate (not contraindicated) by less than half of the participated pharmacists. Besides that, 1/5 of the participated pharmacists dispensed an antibiotic to the SP. Meanwhile, an optimum management for the SP case was detected by about 1/3 of the participated pharmacists. Treatment of diarrhea case was not significantly different at baseline level between the group of application users and non-users. At the second assessment visit, providing the SP with an appropriate non-pharmacological and pharmacological treatment was significantly improved only in the group of pharmacists who actively used the application at the time of the interview with the SP. All the above improvements were detected also in the whole study sample. Further details are shown in table 3.

Assessment of the participant's role in patient's counseling and education about the prescribed antimotility medication

At the 1st assessment visit (Before using the developed application), about 1/3 of the pharmacists dispensed a medication without providing the SP with any educational information about it. Pharmacists provided the SP with an average of one educational point, in which the dose (33%) and dosing regimen (26%) of the dispensed antimotility agent were the most frequently, mentioned information. On the other hand, no any participant mentioned the treatment time scale and the possible side effects of the dispensed product. All participated pharmacists failed to provide the SP with appropriate counseling and education.

At the second assessment visit, counseling the SP with the necessary information about dispensed medication was improved only by the group of pharmacists who actively used the application; however, significant improvement was detected only in regard to information about the drug dose and dosing frequency. Additionally, the average educational points mentioned to the SP was increased significantly by pharmacists who used the application (from 1.11 to 2.15), while it was decreased by application non-users (1 to 0.7). Furthermore, the number of pharmacists who dispensed a medication without providing the SP with any educational information about it was decreased significantly by the group of application users. All of the aforementioned positive changes were also significant in the whole study sample. All details are given in Table 4.

Participants' opinions about the developed application

About two-thirds of the participated pharmacists strongly agreed with the ease of application use and its ability to reduce diagnosis and medication errors. On the other hand, about 3/4 of pharmacists showed an agreement about the application's ability to reduce the time needed to deal with diarrhea cases and its applicability for use in daily clinical practice (Table 5). Furthermore, there was a non-significant difference between the users and non-users of the application in regard to their rating of the developed application (Table 6).

Table 3. Assessment of the pharmacist's role in treatment of diarrhea

	Application users (n=27)			Application non-users (n=20)			Difference at end of the study#	All study participants (n=47)		
	Baseline	End of the study	P value	Baseline	End of the study	P value		Baseline	End of the study	P value
Advising the patient about the non-pharmacological measures										
Mentioned appropriately	1 (3.70)	20 (81.42%)	<0.0001	1 (5%)	1 (5%)	1.00	<0.0001	2 (4.26%)	21 (44.68%)	<0.0001
Not mentioned	26 (96.30%)	7 (18.52%)		19 (95%)	19 (95%)			45 (95.76%)	26 (55.32%)	
The dispensed product to treat diarrhea										
Anti-motility agent	23 (85.19%)	27 (100%)	0.125	19 (95%)	20(100%)	1.00	1.00	42 (89.36)	47 (100%)	0.063
Products other than anti-motility agents	4 (14.81%)	0 (0%)		1 (5%)	0 (0%)			5 (10.64%)	0 (0%)	
Dispensing an additional product (e.g., ORS, antibiotics) with the antimotility agent	4 (14.81%)	1 (3.7%)	0.375	6 (30%)	1 (5%)	0.063	0.828	10 (21.28%)	2 (4.26%)	0.021
Antibiotics dispensed^	5 (18.52%)	0 (0%)	0.063	7 (35%)	1 (5%)	0.031	0.240	12 (25.53%)	1 (2.13%)	0.001
Treatment of the case										
Number of medications dispensed	1.15±0.36	1.04±0.19	0.180	1.30±0.47	1.10±0.31	0.102	0.510	1.21±0.41	1.06±0.25	0.011
Appropriateness of the dispensed medication(s) $	11 (40.74%)	26 (96.30%)	<0.0001	4 (20%)	8 (40%)	0.289	<0.0001	15 (31.91%)	34 (72.34%)	<0.0001

ORS= oral rehydration solution. $Appropriate treatment of the case through recommending a suitable antimotility agent (not contraindicated and not interacted with the patient's medications) without antibiotic therapy. ^ Some antibiotics were dispensed with antimotility agents while others dispensed alone. # Difference at the end of study values between application users and non-users.

Table 4. Assessment of the pharmacist's role in patient's counseling and education about the prescribed antimotility medication.

	Application users (n=27)			Application non-users (n=20)			Difference at end of the study#	All study participants (n=47)		
	Baseline	End of the study	P value	Baseline	End of the study	P value		Baseline	End of the study	P value
Education about the Initial drug dose										
Appropriate	9 (33.33%)	22 (81.48%)	0.002	7 (35%)	5 (25%)	0.727	<0.0001	16 (34.04%)	27 (57.45%)	0.043
Inappropriate	18 (66.67%)	5 (18.52%)		13 (65%)	15 (75%)			31 (65.96%)	20 (42.55%)	
Education about the drug Dosing frequency										
Appropriate	9 (33.33%)	20 (74.07%)	0.007	5 (25%)	4 (20%)	1.00	<0.0001	14 (29.79%)	24 (51.06%)	0.041
Inappropriate	18 (66.67%)	7 (25.93%)		15 (75%)	16 (80%)			33 (70.21%)	23 (48.94%)	
Education on the duration of taking the medication (Treatment time scale)										
Appropriate	0 (0%)	2 (7.41%)	0.500	0 (0%)	0 (0%)	1.00	0.214	0 (0%)	2 (4.26%)	0.500
Inappropriate	27 (100%)	25 (92.59%)		20 (100%)	20(100%)			47 (100%)	45 (95.74%)	
Education about the possible medication side effects										
Appropriate	0 (0%)	3 (11.11%)	0.250	0 (0%)	0 (0%)	1.00	0.123	0 (0%)	3 (6.38%)	0.250
Inappropriate (not mentioned)	27 (100%)	24 (88.89%)		20 (100%)	20 (100%)			47 (100%)	43 (93.62%)	
Patient education & counseling $										
No any advice was given to the SP	10 (37.04%)	1 (3.70%)	0.012	6 (30%)	13 (65%)	0.023	<0.0001	16 (34.04%)	14 (29.79%)	0.832
Points of information that was given to the patient (Max = 4 points)	1.11±1.05	2.15±0.86	0.001	1.1±0.91	0.7±0.98	0.210	<0.0001	1.11±0.98	1.53±1.16	0.070
Points of information that is given to the patient in a correct way (Max = 4 points)	0.89±0.85	1.78±0.93	0.003	1.0±0.79	0.45±0.83	0.078	<0.0001	0.94±0.82	1.21±1.10	0.206
Appropriate patient education and counseling (all 4 points)	0 (0%)	1 (3.70%)	1.00	0 (0%)	0 (0%)	1.00	0.384	0 (0%)	1 (2.13%)	1.00

$Patient education must include information about drug dose, drug dosing regimen, drug side effect, and treatment time scale.

Table 5. Pharmacists' opinions about the developed application (all participants)

Parameter	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	P value*
Ease of use	31 (65.96%)	12 (25.53%)	1 (2.13%)	2 (4.26%)	1 (2.13%)	<0.0001
Reduce time	10 (21.28%)	24 (51.06%)	9 (19.15%)	1 (2.13%)	3 (6.38%)	<0.0001
Reduce diagnosis errors	32 (68.09)	10 (21.28%)	2 (4.26%)	1(2.13%)	2 (4.26%)	<0.0001
Reduce medication errors	30 (63.83%)	13 (27.66%)	1 (2.13%)	2 (4.26%)	1 (2.13%)	<0.0001
Applicability in daily clinical practice	20 (42.55%)	15 (31.91%)	9 (19.15%)	1 (2.13%)	2 (4.26%)	<0.0001

Strongly agree score= 10 and 9; agree score = 7 and 8; Neutral score = 5 and 6; disagree score = 3 and 4; strongly disagree score = 1 and 2. *Statistical analysis by chi square test.

Table 6. Rating of the application: A comparison between application users and non-users.

Parameter	Study Group	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	P value
Ease of use	Application users	17 (63%)	9 (33.33%)	0 (0%)	1 (3.70%)	0 (0%)	0.361
	Application non-users	14 (70%)	3 (15%)	1 (5%)	1 (5%)	1 (5%)	
Reduce time	Application users	6 (22.22%)	15 (55.56%)	4 (14.81%)	1 (3.70%)	1(3.70%)	0.671
	Application non-users	4 (20%)	9 (45%)	5 (25%)	0(0%)	2 (10%)	
Reduce diagnosis errors	Application users	19 (70.37%)	7 (25.93%)	1 (3.70%)	0 (0%)	0 (0%)	0.310
	Application non-users	13 (65%)	3 (15%)	1 (5%)	1 (5%)	2 (10%)	
Reduce medication errors	Application users	21 (77.78%)	5 (18.52%)	1 (3.70%)	0 (0%)	0 (0%)	0.070
	Application non-users	9 (45%)	8 (40%)	0 (0%)	2 (10%)	1 (5%)	
Applicability in daily clinical practice	Application users	16 (59.26%)	6 (22.22%)	4 (14.81%)	0 (0%)	1 (3.70%)	0.090
	Application non-users	4 (20%)	9 (45%)	5 (25%)	1 (5%)	1 (5%)	

Strongly agree score= 10 and 9; agree score = 7 and 8; Neutral score = 5 and 6; disagree score = 3 and 4 strongly disagree score = 1 and 2.

Discussion

The results of the current study showed that only 57.4% of participated were found to use the application during the visit of the SP in their pharmacies. This finding may indicate that the usage of the application is either not easy or not beneficial for the pharmacist. However, this explanation is rejected because the agreement about the application's benefits and its ease of use was not significantly different between pharmacists who used the application and those who did not use it. Instead, the shyness of some pharmacists to use a mobile device during the patient interview may be the main reason for the non-usage of the application [(19)].

Regarding the assessment of diarrhea, the current study showed that the most commonly asked questions to the SP were related to the patient age and diarrhea associated symptoms. On the other hand, questioning about action taken and the history of recent travel were not asked by any pharmacist. This finding was similar to the behavior of Sudanese community pharmacists when they deal with diarrhea cases [(20)]. Additionally, the poor questioning skills of the participated pharmacists in the current study were also found in a pilot study that assessed the role of the community pharmacists in the management of the common cold in Baghdad, Iraq [(21)].

Furthermore, the current study showed that about one fifth of the pharmacists supplied the SP with a medication without asking him any question. This problematic finding was also obtained in other studies conducted in Vietnam [22,23] and in Belgium [24]. The main reason for such finding was the lack of financial incentives for the pharmacist who performs this service (assessment of the patient case) as compared to those who just dispense the medication without any assessment of the case [25].

The results of the present study showed that the assessment of the diarrhea case using WWHAM questions was improved after providing pharmacists with the developed application and training them on it. The improvement in pharmacists questioning skills was also found in studies that refreshed pharmacists' knowledge through a training meeting with role-play [26]. However, the current improvement could not be attributed to the training of pharmacists, since such improvement was not detected among pharmacists who trained about the application but not used it. Indeed, the improvement by such training meetings was not always optimum or significant [26], due to the fact that knowledge enhancement by educational interventions is transient and may decline with time as a result of forgetfulness [27]. On the other hand, the improvement in questioning skills by the usage of the application is expected to be greater and more persistent than any other educational intervention because the possibility of forgetting scientific information while using the application is very limited. Therefore, the only explanation for the current improvement in pharmacists questioning skills was the usage of the developed application. Similarly, the number of mandatory questions asked by the pharmacist to patients with allergic rhinitis was doubled after using a computerized pharmacy decision support system [28]. This encouraging benefit in pharmacists' questioning skills by the usage of the application was confirmed by the strong agreement of the participated pharmacists on the ability of the application to reduce diagnosing errors.

Regarding the pharmacist's role in the treatment of diarrhea, the results of the present study showed that most pharmacists did not advise the SP about the necessary lifestyle changes during diarrhea management. A similar finding was obtained in studies conducted in Sudan [20] and Vietnam [22]. This limited focus on the non-pharmacological advice could be explained by the fact that all pharmacists focus on dispensing pharmacological agents [12] and thus may forget or neglect the non-pharmacological part of treatment while managing diarrhea and other minor ailments. In the second assessment visit, advising the SP with non-pharmacological measure was significantly improved; this improvement was evident only among pharmacists who used the application and can be attributed to the ability of the application to prevent the unintentional missing of the non-pharmacological advice by reminding pharmacists with the necessary non-pharmacological information. Other mobile applications were also effective to remind users to perform a specific function and thus prevent unintentional missing [29,30].

The present study also showed that the dispensing of antimotility agents was increased, while the dispensing of antibiotics was reduced at the second assessment visit. Such improvement was detected among all participated pharmacists and not limited to those who used the application. This improvement may be linked with the possible improvement in pharmacists' knowledge about the optimum management of diarrhea during the training session about the developed application. Despite this improvement, the selection of an appropriate antimotility agent according to the SP case was not improved among pharmacists who did not use the application. This means that the improvement in the pharmacist's scientific knowledge was not sufficient to improve the selection of an appropriate antimotility agent to the SP, instead proper case assessment [31,32] along with a good scientific knowledge are the key elements to ensure optimum management of the patient case. Meanwhile, the selection of appropriate treatment was significantly improved among the application users, which indicates the benefit of the application in improving the pharmacist's role in management of diarrhea. This benefit was confirmed by the strong agreement on the ability of the application to reduce medication errors by all of the participated pharmacists.

Regarding patient counseling and education, the results of the current study showed that 1/3 of the participated pharmacist did not provide the SP with any educational information; meanwhile, those who educated the SP do so by focusing mainly on the medication dose and dosing frequency while neglecting the treatment time scale and the possible side effects of the dispensed product. This poor counseling skill was detected in many other studies conducted in Iraq [21, 33; 34]. There are many possible reasons behind this poor counseling activity by Iraqi pharmacists. The first reason is the lack of pharmacists' sufficient time in the pharmacy to remember and mention all needed information to the patient [35]. The second reason can be related to the insufficient pharmacist scientific knowledge [35]. This poor scientific pharmacist knowledge can be mainly attributed to the decline in such knowledge with time (forgetfulness) due to the lack of continuous medical education programs for graduated pharmacists [35]. On the other hand, the current study results showed that the average educational points mentioned to the SP was increased significantly and the number of

pharmacists who dispensed a medication without providing the SP with any educational information about it was decreased among pharmacists who used the application. This improvement may be linked with the ability of the application to enhance pharmacists' scientific knowledge and reduce the time needed to remember all the required medical information. Despite all these improvements, mentioning side effects of the dispensed medications was only modestly and non-significantly improved among the application users. This can be explained in that reasons other than lack of pharmacist time and scientific knowledge may be behind the poor patient education and counseling. In this regard, it was found that pharmacists usually provide their patients with more counseling about drugs with prominent side effects [(36)], and since OTC anti-motility drugs are generally safe and well-tolerated drugs [(37)]. Thus, it is expected that pharmacists, even after using the application, may neglect informing the SP about the side effects of the dispensed medication. Therefore, it is not sufficient to provide the pharmacists with the application and train them on its usage unless this is accompanied by reassurance on the role of the pharmacist in warning (informing) the patient about all possible medication side effects (duty to warn) [(38)] without regard to the dispensed medication since this duty enable the patient to detect drug harmful effects at early reversible stage [(39)].

In conclusion the diarrhea management step by step application is an effective method to improve the pharmacist's role in assessment and management of diarrhea.

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