

# Attitudes towards using smart devices and medical applications among pharmacy students, preceptors and faculty members in Jordan

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## Abstract

**Objective:** To determine the utilisation, purposes, barriers and attitudes towards the use of smart devices and medical applications among pharmacy students, preceptors, and faculty members at Jordan University of Science and Technology.

**Methods:** A cross-sectional online survey was conducted at Jordan University of Science and Technology using a 28-item questionnaire.

**Results:** A total of 618 students (25%), 24 preceptors (100%), and 28 faculty members (50%) completed the survey. The vast majority of the respondents (98%) were using smart devices, however, only 69% were medical applications users. Using medical applications for academic purposes was more significant among students ( $p=0.013$ ), while the usage in direct patient care was more significant among preceptors ( $p<0.001$ ). The respondents generally indicated positive attitudes towards the use of medical applications, despite some barriers reported.

**Conclusion:** Pharmacy students, preceptors, and faculty members generally recognise the value of medical applications in pharmacy education and practice. Educational and healthcare institutions should facilitate the use of these tools, which can promote evidence-based practice.

**Keywords:** Medical Applications, Pharmacy Education, Pharmacy Practice, Smart Device

## Introduction

The use of smart devices (*e.g.* smart phones, tablets and portable media player) in recent times has dramatically increased (Boulos *et al.*, 2011). The availability of these portable devices with computer-like features has opened the door for new approaches to communication, networking, data sharing, and accessing information. The different types of smart devices have been incorporated with certain software programmes, called applications (apps) (Nason *et al.*, 2015), which are designed to achieve different purposes (Wallace *et al.*, 2012). In healthcare practice and education, a wide range of medical apps are currently available on smart devices, and are responsible, in part, for the high utilisation of these devices among healthcare professionals (HCPs) from various disciplines, including pharmacy (Mosa *et al.*, 2012; Ventola, 2014).

Smart devices and medical apps provide a unique opportunity to change the traditional method of education, and scientific literature searching in healthcare professional education (Mi *et al.*, 2016). Pharmacy students, educators, and practitioners alike could particularly benefit from the utilisation of medical apps

in pharmacy education and practice. In Northeastern University, United States of America (USA), pharmacy faculty members reacted positively toward the use of tablet technology in pharmacy education. It allowed them to apply new learning strategies as well as enhance productivity (DiVall & Zgarrick, 2014). Furthermore, incorporation of i-Pad<sup>®</sup> technology in problem-based learning (PBL) was reported to improve pharmacy students' performance and encouraged them to be active learners (McFalls, 2013). These smart technologies offer rapid access to information resources such as drug information references, clinical calculators, laboratory references, clinical treatment guidelines, point-of-care information, biomedical journals articles, and news (Aungst, 2013; Ventola, 2014). However, the process of finding and selecting the most appropriate medical apps at different apps stores is challenging (Aungst, 2013), particularly with the number of medical apps increasing with time. Moreover, the need for subscription, account creation, user registration, and the need for internet access are among the most commonly encountered problems of using medical apps (Aungst, 2013).

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With the expanding role and distribution of medical apps in clinical practice settings, and their usage for a variety of purposes among both patients, and healthcare professionals, it becomes necessary to incorporate topics on appropriate use and to encourage the utilisation of mobile technologies, and medical apps within pharmacy education programmes. Pharmacy students should become familiar with the most beneficial medical apps in pharmacy practice (e.g. Micromedex<sup>®</sup>, Lexicomp<sup>®</sup>, Epocrates<sup>®</sup>, and Dynamed<sup>®</sup>), learn how to appropriately select and use these apps, and know how to critically evaluate the information obtained from different medical apps (Aungst, 2014). In addition, students should be able to take the advantages of these new technologies for delivering optimal pharmaceutical care (Marken, 2011). Although Khan and Hadi had investigated the use of smart devices and medical apps among pharmacy preceptors in Saudi Arabia (Khan & Hadi, 2014), to our knowledge, there was no study in the Middle East region that concurrently determined the adoption rate and attitudes toward the use of smart devices and medical apps among pharmacy students, faculty, and preceptors. The Faculty of Pharmacy at Jordan University of Science and Technology (JUST), which was established in 1979, is the leading pharmacy school in Jordan with the highest student cohort of 450 enrolled annually. The present study aimed to evaluate the general use of smart devices and medical apps among pharmacy students, preceptors, and faculty members in the Faculty of Pharmacy at JUST. The study also aimed to identify the main purposes of using medical apps, the major barriers, and the challenges encountered when using medical apps, and to evaluate the general attitude toward the role of smart devices and medical apps in pharmacy education and practice.

## Methods

This study was a descriptive cross-sectional survey using a 28-item questionnaire. The questionnaire was developed based on the objectives of the study and through review of the literature (Franko & Tirrell, 2012; Mosa *et al.*, 2012; Aungst, 2013; Boruff & Storie, 2014; Rodis *et al.*, 2016). The initially developed questionnaire underwent content validity by pharmacy faculty members with expertise in pharmacy practice research and questionnaire development. Several modifications were made to the first draft of the questionnaire through an iterative process. The pre-final version of the questionnaire was uploaded and designed on Survey Planet<sup>®</sup>, which is a professional tool for developing online surveys (Survey Planet, LLC, Los Angeles, CA). Finally, the questionnaire was administered to a sample of six pharmacy students, two preceptors, and two faculty members to test the clarity, readability, and comprehension of its items. Minor modifications were applied and the final version of the questionnaire was produced. The language of the questionnaire was English, as it is the official language of study at JUST. A copy of the final questionnaire can be obtained through the corresponding author.

The final online version of the questionnaire consisted of five sections: (1) socio-demographic and professional characteristics (eight items); (2) usage of smart devices (four items); (3) usage and usefulness of medical applications (seven items); (4) perceived barriers towards the use of medical applications (three items); and (5) attitudes towards the use of medical apps in pharmacy education (six items). All questions were closed. Each participant was allowed by Survey Planet<sup>®</sup> to provide his/her responses for sections that were relevant to him/her. For example, those who indicated not having smart devices, were only allowed to provide responses to the questions in the first section of the online survey, while those who did not use medical apps could only provide responses for questions in the first, second, and fifth sections. The study was approved by Institutional Review Board at JUST.

All pharmacy students, preceptors, and faculty members in the College of Pharmacy at JUST were invited to participate in the study via email with an online link to the questionnaire through the Survey Planet<sup>®</sup>. Furthermore, an announcement along with the questionnaire's URL link was posted on targeted Facebook groups and websites that belong to pharmacy students at JUST. The survey was open from August to September 2016. In order to increase the response rate, a reminder e-mail was sent to the target population every two weeks over the period of two months. The questionnaire was anonymous, therefore identifying the participants or their responses was not possible. At the end, all individual responses were reviewed and those provided by ineligible respondents (e.g. non-pharmacy students) were excluded from data analysis. Ineligible respondents were identified by asking the respondent at the beginning of the survey if he/she is a pharmacy student at JUST, and those who answered "No" were not allowed to complete the survey. Further, "Other" was the last option in the question asking about student academic year, and those who choose it were excluded from the analysis.

Statistical analyses of the collected data were performed using Statistical Package for Social Sciences, version 22 (IBM SPSS<sup>®</sup> Statistics for Windows; IBM Corp, Armonk, New York, USA). Descriptive and inferential statistics were used for the data analyses. Frequencies and percentages were used to summarise the responses generated. *Chi-square* test was utilised to determine any significant differences among the study groups. Group comparisons between students, preceptors, and faculty members were presented in tables. A *p*-value of less than 0.05 indicates statistical significance.

## Results

Of the 2500 pharmacy students, 24 preceptors, and 56 faculty members at the JUST Faculty of Pharmacy who were sent the online link of the survey, a total of 618 students, 24 preceptors, and 28 faculty members with corresponding response rates of 25%, 100%, and 50%,

respectively, fully completed the questionnaire and were included in the analyses. Of the 618 students who responded to the survey, 360 (58.3%) were Pharm.D students, while 258 (41.7%) were BSc. Pharmacy students. Table I shows the various demographic characteristics of the student, preceptor, and faculty respondents, while Table II displays the distribution of student respondents according to their major and academic year. The number of Pharm.D students who responded was significantly higher than that of BSc students. However, no significant differences were observed between the responses provided by the Pharm.D students and those provided by the BSc students. The majority of the respondents were within the age range of 18-24 years (90.6%), female (84.2%), native speakers of Arabic (98.5%), and of Jordanian nationality (84.5%). Most faculty members were either MSc. or Ph.D degree holders, while the highest qualification among preceptors was predominantly Pharm.D degree.

**Table I: Demographic characteristics of students, preceptors, and faculty members participating in a study of using smart devices and medical applications in pharmacy education**

Variable	Total N=670 n (%)	Students N=618 n (%)	Preceptors N=24 n (%)	Faculty Members N=28 n (%)	<i>p</i> - value*
Age in years					
18-24	607 (90.6)	603 (97.6)	2 (8.3)	2 (7.1)	<0.001
25-29	35 (5.2)	14 (2.3)	20 (83.3)	1 (3.6)	
30-34	18 (2.7)	1 (0.2)	1 (4.2)	16 (57.1)	
35-39	5 (0.7)	0 (0.0)	0 (0.0)	5 (17.9)	
40 or more	5 (0.7)	0 (0.0)	1 (4.2)	4 (14.3)	
Gender					
Male	106 (15.8)	96 (15.5)	1 (4.2)	9 (32.1)	0.018
Female	564 (84.2)	522 (84.5)	23 (95.8)	19 (67.9)	
Marital status					
Single	618 (92.2)	599 (96.9)	10 (41.7)	9 (32.1)	<0.001
Married	51 (7.6)	19 (3.1)	13 (54.2)	19 (67.9)	
Divorced	1 (0.1)	0 (0.0)	1 (4.2)	0 (0.0)	
Widowed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Native language					
Arabic	660 (98.5)	608 (98.4)	24 (100.0)	28 (100.0)	0.931
English	9 (1.3)	9 (1.5)	0 (0.0)	0 (0.0)	
Other	1 (0.1)	1 (0.2)	0 (0.0)	0 (0.0)	
Nationality					
Jordanian	591 (84.9)	539 (87.2)	24 (100.0)	28 (100.0)	0.023
Palestinian	39 (5.6)	39 (6.3)	0 (0.0)	0 (0.0)	0.175
Syrian	39 (5.6)	39 (6.3)	0 (0.0)	0 (0.0)	0.175
Other	27 (3.9)	26 (4.2)	0 (0.0)	1 (3.6)	0.585
Current major (student) and highest academic qualification (other)					
BSc. in Pharmacy	258 (38.5)	258 (41.7)	0 (0.0)	0 (0.0)	<0.001
Pharm.D	379 (56.6)	360 (58.3)	18 (75.0)	1 (3.6)	
MSc.	14 (2.1)	0 (0.0)	6 (25.0)	8 (28.6)	
Ph.D	19 (2.8)	0 (0.0)	0 (0.0)	19(67.9)	

\* A *p*-value of less than 0.05 indicates statistical significance

**Table II: The distribution of pharmacy students according to major and academic year**

Variable	Total N=618 n (%)	BSc. in Pharmacy N=258 n (%)	Pharm.D N=360 n (%)	<i>p</i> - value*
Study level				
First year student	29 (4.7)	15 (5.8)	14 (3.9)	<0.001
Second year student	99 (16.0)	34 (13.2)	65 (18.1)	
Third year student	112 (18.1)	55 (21.3)	57 (15.8)	
Fourth year student	137 (22.2)	62 (24.0)	75 (20.8)	
Fifth year student	169 (27.3)	92 (35.7)	77 (21.4)	
Sixth year Pharm.D student	72 (11.7)	0 (0.0)	72 (20.0)	

\* A *p*-value of less than 0.05 indicates statistical significance

As shown in Table III, 97.8% of the respondents had reported possession of at least one type of a smart device. There were no statistically significant differences among the three groups in terms of smart device ownership ( $p=0.677$ ). Of those who indicated ownership of smart devices, smartphone was used by 91.6% of the students, and 100% of both preceptors and faculty members. Other types of smart devices, such as i-Pad<sup>®</sup>, i-Pod<sup>®</sup>, tablet, and others had been listed by the respondents in varying proportions. Samsung<sup>®</sup> and Apple<sup>®</sup> were the most commonly used brands of smart devices. Larger percentages of preceptors and faculty members as compared to students owned smart devices for a period longer than three years ( $p=0.019$ ).

Overall, only 454 (69.3%) of all the smart devices owners participating in this study used medical apps (Table IV). Preceptors showed a significantly higher utilisation of medical apps (100%) when compared to students (68.2%) and faculty members (66.7%) ( $p=0.004$ ). The majority of medical apps users (93.8%) had one to five medical apps on their smart devices and there was no significant difference among the three groups. In addition, Drug.com<sup>®</sup>, Lexicomp<sup>®</sup>, Medscape<sup>®</sup>, and UpToDate<sup>®</sup> were the most commonly reported types of medical apps used by the respondents (Table IV). Moreover, the usage of both Lexicomp<sup>®</sup> and Medscape<sup>®</sup> was significantly higher among preceptors when compared with students and faculty members ( $p<0.001$ ). On the other hand, students reported significantly greater usage of Drug.com than faculty members and preceptors (55.6% vs. 38.9% vs. 29.2%;  $p=0.019$ ). More than 40 medical apps, other than those listed in the survey, were reported by 104 participants, and with JoDrugs<sup>®</sup> app listed by 56.7% of them.

Participants were asked to choose one or more of five pre-specified primary uses of medical apps. A large proportion (59.6%) of the three study groups were using medical apps for educational and learning purposes, and the proportion was significantly higher among students

**Table III: The general trend of using smart devices among study participants**

Variable	Total N=670 n (%)	Students N=618 n (%)	Preceptors N=24 n (%)	Faculty Members N=28 n (%)	p-value**
Use of smart devices					
Yes	655 (97.8)	604 (97.7)	24 (100.0)	27 (96.4)	0.677
No	15 (2.2)	14 (2.3)	0 (0.0)	1 (3.6)	
Duration of use					
Less than 2 yrs	97 (14.8)	94 (15.6)	2 (8.3)	1 (3.7)	<b>0.019</b>
2-3 yrs	134 (20.5)	130 (21.5)	1 (4.2)	3 (11.1)	
More than 3 yrs	424 (64.7)	380 (62.9)	21 (87.5)	23 (85.2)	
Types of smart devices*					
Smartphone	604 (66.1)	553 (91.6)	24 (100.0)	27 (100.0)	0.097
i-Pod	20 (2.2)	17 (2.8)	0 (0.0)	3 (11.1)	<b>0.033</b>
i-Pad	121 (13.2)	109 (18.0)	3 (12.5)	9 (33.3)	0.100
Tablet	109 (11.9)	103 (17.1)	3 (12.5)	3 (11.1)	0.617
Other smart device	60 (6.6)	60 (9.9)	0(0.0)	0 (0.0)	0.062
Brands of reported smart devices*					
Apple/iPhone	242 (28.2)	218 (36.1)	8 (33.3)	16 (59.3)	<b>0.048</b>
Samsung	319 (37.2)	293 (48.5)	14 (58.3)	12 (44.4)	0.578
Blackberry	8 (0.9)	8 (1.3)	0 (0.0)	0 (0.0)	0.710
Sony	59 (6.9)	57 (9.7)	2 (8.3)	0 (0.0)	0.244
HTC	54 (6.3)	51 (8.4)	3 (12.5)	0 (0.0)	0.220
Huawei	60 (7.0)	59 (9.8)	1 (4.2)	0 (0.0)	0.156
Nokia	17 (2.0)	17 (2.8)	0 (0.0)	0 (0.0)	0.479
LG	33 (3.8)	31 (5.1)	1 (4.2)	1 (3.7)	0.928
Lenovo	31 (3.6)	31 (5.1)	0 (0.0)	0 (0.0)	0.253
Xiaomi	5 (0.6)	5 (0.8)	0 (0.0)	0 (0.0)	0.808
Motorola	6 (0.7)	5 (0.8)	0 (0.0)	1 (3.7)	0.275
Other Brands	24 (2.8)	23 (3.8)	0 (0.0)	1 (3.7)	0.622

\*This question allows for multiple responses

\*\* A p-value of less than 0.05 indicates statistical significance

when compared to the other groups ( $p=0.013$ ). On the other hand, the usage of medical apps in clinical practice in a ward environment was more significant among preceptors ( $p<0.001$ ). Other specific purposes for using medical apps are presented in Table IV. In general, preceptors had reported significant searching for clinical pharmacy practice-related information or resources via medical apps, including treatment guidelines, patient counselling information, drug-drug interaction, drug pregnancy category, clinical calculations, lab test interpretation, and searching for medical news or journal articles. Furthermore, preceptors showed more frequent use of medical apps when compared to students and faculty members ( $p=0.001$ ). When medical apps users were asked to evaluate the level of usefulness of using medical apps, the majority of students (53.6%) and faculty members (50%) said that they “usually” found medical apps to be useful, while the majority of preceptors (58.3%) found medical apps to be “always”

**Table IV: The utilisation of medical applications and their primary uses among study participants**

Variable	Total N=655 n (%)	Students N=604 n (%)	Preceptors N=24 n (%)	Faculty Members N=27 n (%)	p-value**
Use of medical apps					
Yes	454 (69.3)	412 (68.2)	24 (100.0)	18 (66.7)	<b>0.004</b>
No	201 (30.7)	192 (31.8)	0 (0.0)	9 (33.3)	
Number of Medical apps					
1-5	426 (93.8)	387 (93.9)	23 (95.8)	16 (88.9)	0.790
6-10	24 (5.3)	21 (5.1)	1 (4.2)	2 (11.1)	
More than 10	4 (0.9)	4 (1.0)	0 (0.0)	0 (0.0)	
Commonly used medical Apps*					
UpToDate	118 (9.8)	105 (25.5)	9 (37.5)	4 (22.2)	0.398
Micromedex	17 (1.4)	12 (2.9)	2 (8.3)	3 (16.7)	<b>0.005</b>
Lexicomp	221 (18.4)	188 (45.6)	23 (95.8)	10 (55.6)	<b>&lt;0.001</b>
Epocrates	11 (0.9)	9 (2.2)	1 (4.2)	1 (5.6)	0.561
DynaMed	20 (1.7)	19 (4.6)	1 (4.2)	0 (0.0)	0.646
Skyscape	19 (1.6)	18 (4.4)	1 (4.2)	0 (0.0)	0.663
Medscape	177 (14.7)	150 (36.4)	20 (83.3)	7 (38.9)	<b>&lt;0.001</b>
MedPage Today	10 (0.8)	10 (2.4)	0 (0.0)	0 (0.0)	0.594
Pubmed	74 (6.2)	64 (15.5)	5 (20.8)	5 (27.8)	0.320
Drug.com	243 (20.2)	229 (55.6)	7 (29.2)	7 (38.9)	<b>0.019</b>
Webmed	86 (7.2)	82 (19.9)	3 (12.5)	1 (5.6)	0.223
Pocket Lab Values	10 (0.8)	10 (2.4)	0 (0.0)	0 (0.0)	0.594
Lab Pro Values	11 (0.9)	10 (2.4)	1 (4.2)	0 (0.0)	0.685
MedCalc	17 (1.4)	13 (3.2)	3 (12.5)	1 (5.6)	0.059
Calculate	51 (4.2)	47 (11.4)	3 (12.5)	1 (5.6)	0.729
QxMD	12 (1.0)	11 (2.7)	1 (4.2)	0 (0.0)	0.702
Other	104 (8.7)	98 (23.8)	3 (12.5)	3 (16.7)	0.359
Primary uses of medical apps*					
Education - teaching and/or learning	405 (59.6)	373 (90.5)	19 (79.2)	13 (72.2)	<b>0.013</b>
Clinical practice - ward environment	129 (19.0)	105 (25.5)	17 (70.8)	7 (38.9)	<b>&lt;0.001</b>
Clinical practice - ambulatory clinic	45 (6.6)	40 (9.7)	5 (20.8)	0 (0.0)	0.074
Research	88 (13.0)	77 (18.7)	4 (16.7)	7 (38.9)	0.099
Other	12 (1.8)	10 (2.4)	0 (0.0)	2 (11.1)	0.057
Purposes of using medical apps*					
Searching for drug information	411 (20.5)	370 (89.8)	24 (100.0)	17 (94.4)	0.214
Searching for clinical treatment guidelines	280 (14.0)	248 (60.2)	22 (91.7)	10 (55.6)	<b>0.007</b>
Reading point-of-care information from sources such as DynaMed or UpToDate	124 (6.2)	112 (27.2)	6 (25.0)	6 (33.3)	0.820
Finding patient counselling information	218 (10.9)	189 (45.9)	21 (87.5)	8 (44.4)	<b>&lt;0.001</b>
Checking for drug-drug or drug-herb interaction	268 (13.4)	238 (57.8)	21 (87.5)	9 (50.0)	<b>0.012</b>

Variable	Total	Students	Preceptors	Faculty Members	p-value**
	N=655	N=604	N=24	N=27	
	n (%)	n (%)	n (%)	n (%)	
Clinical calculations (e.g. renal function, BMI, IBW)	139 (6.9)	118 (28.6)	16 (66.7)	5 (27.8)	<0.001
Laboratory test interpretation	106 (5.3)	90 (21.8)	14 (58.3)	2 (11.1)	<0.001
Searching for medical news	113 (5.6)	95 (23.1)	12 (50.0)	6 (33.3)	0.009
Searching or reading for journal articles	83 (4.1)	69 (16.7)	8 (33.3)	6 (33.3)	0.030
None of these	16 (0.8)	16 (3.9)	0 (0.0)	0 (0.0)	0.429
Other	8 (1.5)	6 (1.0)	0 (0.0)	2 (11.1)	0.008
Use frequency					
Several times a day	117 (25.8)	98 (23.8)	15 (62.5)	4 (22.2)	0.001
Once or twice a day	91 (20.0)	82 (19.9)	7 (29.2)	2 (11.1)	
2-3 times a week	118 (26.0)	113 (27.4)	2 (8.3)	3 (16.7)	
Once a week	59 (13.0)	55 (13.3)	0 (0.0)	4 (22.2)	
Rarely used	65 (14.3)	60 (14.6)	0 (0.0)	5 (27.8)	
Never used	4 (0.9)	4 (1.0)	0 (0.0)	0 (0.0)	
How often have you found medical apps to be useful?					
Always	183 (40.3)	164 (39.8)	14 (58.3)	5 (27.8)	0.069
Usually	240 (52.9)	221 (53.6)	10 (41.7)	9 (50.0)	
Rarely	30 (6.6)	26 (6.3)	0 (0.0)	4 (22.2)	
Never	1 (0.2)	1 (0.2)	0 (0.0)	0 (0.0)	
The estimated time per session of using medical apps in clinical practice and educational activities					
None	16 (3.5)	14 (3.4)	0 (0.0)	2 (11.1)	0.059
1-10 min	173 (38.1)	147 (35.7)	16 (66.7)	10 (55.6)	
11-20 min	121 (26.7)	111 (26.9)	5 (20.8)	5 (27.8)	
21-30 min	57 (12.6)	57 (13.8)	0 (0.0)	0 (0.0)	
31-40 min	44 (9.7)	41 (10.0)	2 (8.3)	1 (5.6)	
41-50 min	6 (1.3)	5 (1.2)	1 (4.2)	0 (0.0)	
51-60 min	18 (4.0)	18 (4.4)	0 (0.0)	0 (0.0)	
More than 60min	19 (4.2)	19 (4.6)	0 (0.0)	0 (0.0)	

\* This question allows for multiple responses  
 \*\* A p-value of less than 0.05 indicates statistical significance

useful. Furthermore, 38% of medical apps users had reported an average use of one to ten minutes per session.

Table V summarises the main sources of information about medical apps, the major barriers encountered when using or intending to use those apps, and the main support required to enhance the effective use of the apps. The greatest percentage of students and preceptors believed that medical apps were part of their education in pharmacy school (50 – 54.4%), and were mentioned by teachers in classroom (53.9 – 58.3%), or by friends or classmates in pharmacy school (55.6 – 62.5%). In contrast, social media was the main source of knowledge about medical apps among faculty members (50%) (Table V). Problems such as limited wireless internet

**Table V: The major sources of knowledge, barriers, and required supports for using medical applications**

Variable	Total	Students	Preceptors	Faculty Members	p-value**
	N=454	N=412	N=24	N=18	
	n (%)	n (%)	n (%)	n (%)	
From where did you learn about medical Apps*					
It was part of the education in pharmacy school	242 (20.3)	224 (54.4)	12 (50.0)	6 (33.3)	0.204
It was mentioned by teachers in classroom	239 (20.0)	222 (53.9)	14 (58.3)	3 (16.7)	0.007
Friends or classmates in pharmacy school	247 (20.7)	229 (55.6)	15 (62.5)	3 (16.7)	0.004
Friends or classmates from other health professions schools	71 (5.9)	65 (15.8)	6 (25.0)	0 (0.0)	0.085
Medical or pharmacy staff from where you work	53 (4.4)	42 (10.2)	6 (25.0)	5 (27.8)	0.008
Medical or pharmacy staff at training sites	91 (7.6)	79 (19.2)	9 (37.5)	3 (16.7)	0.087
Social media (e.g. Facebook, Twitter, LinkedIn, ResearchGate...etc.)	161 (13.5)	147 (35.7)	5 (20.8)	9 (50.0)	0.141
News on radio or television	18 (1.5)	18 (4.4)	0 (0.0)	0 (0.0)	0.385
Professional organisation	21 (1.8)	18 (4.4)	1 (4.2)	2 (11.1)	0.409
Family	32 (2.7)	32 (7.8)	0 (0.0)	0 (0.0)	0.173
Other	19 (1.6)	14 (3.4)	2 (8.3)	3 (16.7)	0.013
Barriers for using medical apps*					
Lack of or limited wireless access in school or workplace	206 (21.5)	182 (44.2)	17 (70.8)	7 (38.9)	0.033
Knowing which medical apps are available	157 (16.4)	145 (35.2)	8 (33.3)	4 (22.2)	0.522
Understanding how to use the medical apps	108 (11.3)	107 (26.0)	1 (4.2)	0 (0.0)	0.003
The need for subscription of the apps	156 (16.3)	135 (32.8)	14 (58.3)	7 (38.9)	0.034
Recognising when it is appropriate to use one	54 (5.6)	51 (12.4)	3 (12.5)	0 (0.0)	0.282
Technical difficulties	53 (5.5)	46 (11.2)	5 (20.8)	2 (11.1)	0.357
Complicated installation or downloading process	65 (6.8)	52 (12.6)	10 (41.7)	3 (16.7)	<0.001
Lack of permission to install software (e.g., corporate Blackberry)	49 (5.1)	41 (10.0)	5 (20.8)	3 (16.7)	0.177
Lack of time	59 (6.1)	56 (13.6)	2 (8.3)	1 (5.6)	0.479
None	40 (4.2)	37 (9.0)	0 (0.0)	3 (16.7)	0.156
Other barriers	13 (1.4)	11 (2.7)	0 (0.0)	2 (11.1)	0.076
Required Support for medical Apps*					
No support is required	66 (7.3)	65 (15.8)	0 (0.0)	1 (5.6)	0.056
Hands-on workshops on how to use medical apps on smart devices	119 (13.2)	110 (26.7)	6 (25.0)	3 (16.7)	0.632



Variable	Total	Students	Preceptors	Faculty Members	p value**
	N=454	N=412	N=24	N=18	
	n (%)	n (%)	n (%)	n (%)	
Drop-in troubleshooting assistance	45 (5.0)	43 (10.4)	1 (4.2)	1 (5.6)	0.497
Online guide to the use of available apps	172 (19.0)	158 (38.3)	10 (41.7)	4 (22.2)	0.357
More resources	141 (15.6)	127 (30.8)	5 (20.8)	9 (50.0)	0.123
Other support	8 (0.9)	8 (1.9)	0 (0.0)	0 (0.0)	0.660

\* This question allows for multiple responses

\*\* A p-value of less than 0.05 indicates statistical significance

access in school or workplace, lack of knowledge of which medical apps are available, lack of understanding of how to use medical apps, and the need for subscription were the most frequently cited barriers by medical apps users. Providing access to medical apps, online guides to the use of available apps, and the need for more resources were repeatedly listed by medical apps users when asked about the support they may require.

The vast majority of the study participants showed a generally positive attitude towards the role of smart devices and medical apps in pharmacy education and practice (Table VI). No significant differences were observed among the study groups in terms of their attitude towards smart devices and medical apps. Most of them (93.9%) "strongly agreed" or "agreed" that the university or hospital should support the use of medical apps in educational and practice settings. The majority (88%) believed that this would be useful for achieving learning outcomes of pharmacy programmes, contribute in providing optimal pharmaceutical care and improving patients' health outcomes. They also indicated that medical apps would be used more often in the future. In addition, the greatest proportion of the surveyed respondents thought that the information obtained through medical apps is accurate and trustworthy. However, nearly one-third (208 respondents) showed a neutral stand toward this statement. Finally, the majority (77.4%) believed that most pharmacy students, preceptors, and faculty members need training programs or workshops about how to optimally use medical apps.

## Discussion

This study concurrently investigated the utilisation of smart devices and medical apps among pharmacy students, preceptors, and educators. The demographic characteristics of the respondents were similar to those of the general population in Jordan, as the majority of them were native Arabic speakers and having Jordanian nationality (World Population Review, 2017). However, 85% of the respondents were female which reflects the dominance of female pharmacy students at JUST (around 75%). As expected, the possession of smart devices was highly prevalent among the studied cohorts. This finding

**Table VI: The general attitudes of study participants toward the use of smart devices and medical applications in pharmacy education and practice**

Attitudinal statement	1	2	3	4	5
	N (%)	N (%)	N (%)	N (%)	N (%)
The university/faculty or hospital should support the use of medical apps in educational and practice settings	423 (64.6)	192 (29.3)	33 (5.0)	5 (0.8)	2 (0.3)
It would be useful for achieving program learning outcomes, if the pharmacy school/faculty incorporates the use of medical apps into the curriculum	275 (42.0)	303 (46.3)	65 (9.9)	11 (1.7)	1 (0.2)
Most pharmacy students, preceptors, and faculty members need a training programme or workshop about how to optimally use medical apps	236 (36.0)	271 (41.4)	127 (19.4)	19 (2.9)	2 (0.3)
Medical apps are expected to be used more often in the future	337 (51.5)	275 (42.0)	37 (5.6)	6 (0.9)	0 (0.0)
In pharmacy practice, the usage of medical apps would contribute in providing optimal pharmaceutical care and improving patients health outcomes	296 (45.2)	281 (42.9)	67 (10.2)	11 (1.7)	0 (0.0)
In general, most medical apps provide accurate and trusted health-related information	103 (15.7)	296 (45.2)	208 (31.8)	46 (7.0)	2 (0.3)

1=Strongly Agree; 2=Agree; 3=Neutral; 4=Disagree; 5=Strongly Disagree.

is in alignment with the general trend anecdotally observed in Jordan and other countries in the region, where the popularity and availability of smart devices, particularly smartphones, has increased in recent years. The prevalence of smart devices observed in the present study is higher than that reported among pharmacy students in a Malaysian pharmacy school (64.1%) and among pharmacy preceptors in Saudi Arabia (88.9%) (Khan & Hadi, 2014; Elsayed *et al.*, 2015).

Despite the popularity of smart devices among the studied groups, the utilisation of medical apps was relatively low among both pharmacy students and faculty members (66.7%-68.2%). Similar use patterns of medical apps was found among pharmacy students in Malaysia (61.5%) (Elsayed *et al.*, 2015). Although free access to medical apps was not provided at any hospitals at Jordan, all preceptors reported the use of medical apps on their smart devices, which reflected their job responsibilities as clinical pharmacists in different patient care environments. In these settings, smart devices and medical apps provide rapid and easy access to clinically related information (Richardson & Burdette, 2003; Hardyman *et al.*, 2013). In fact, such applications are indispensable point-of-care tools and sources of evidence-based practice for most clinicians including clinical pharmacists (Ventola, 2014). Medical apps that are considered as good sources of drug and clinical

practice guidelines information (e.g. Drug.com<sup>®</sup>, Lexicomp<sup>®</sup>, Medscape<sup>®</sup>, and UpToDate<sup>®</sup>) were the most frequently reported to be used by the study respondents (Campbell *et al.*, 2015; Banzi *et al.*, 2016; Chang *et al.*, 2016), and this is compatible with their field of teaching and learning as well as practices. Similar results were reported by Boruff and his colleague who found that medical students, residents, and faculty members at four Canadian universities commonly used their mobile devices for finding drug-related information (73.5%). UpToDate<sup>®</sup> (20.9%), Medscape/eMedicine<sup>®</sup> (12.8%), and Lexicomp<sup>®</sup> (9.8%) were among the most frequently used resources (Boruff & Storie, 2014). We believe that these applications are essential to students' education as we have noticed higher active engagement of those students who are equipped with such applications during our work as preceptors of clinical rotations for the last few years. Although JUST library does not support free access to medical apps that require a subscription, such as Lexicomp<sup>®</sup> and UpToDate<sup>®</sup>, their use among students, preceptors, and pharmacy educators was reported in good proportions. Therefore, there is a real need to support access for these apps taking into consideration the low economic status of most families in Jordan, which have monthly income standing at around US\$637 (Azzeh, 2017). The need for application subscription was also a concern that has previously been reported among health professions students (Mi *et al.*, 2016). Consistent with the most frequently used medical apps, the primary purpose for their usage was for teaching, learning, and searching for drug-related information. As the majority of respondents found medical apps to be "usually" or "always" useful, and spent only one to ten minutes per session, this possibly reflects the efficiency of these tools as important and rapid information resources in pharmacy education and practice.

The collegial circles in pharmacy school and practice settings, including teachers, friends, and colleagues, were the major sources of information about medical apps among students and preceptors, while social media was the main source of information among faculty members. These findings should encourage leaders in pharmacy schools to find effective strategies to enhance teachers' awareness and knowledge about medical apps as faculty members serve as a major source of knowledge for both students and preceptors. Furthermore, conducting workshops and developing online guides to illustrate how to efficiently use smart devices and medical apps are suggested solutions based on our study findings. These supportive measures were also the most frequently reported by medical students, residents, and faculty members (Boruff & Storie, 2014). The limited internet access within the university campus and training sites, lack of knowledge about which medical apps are available and how they should be used, and the need for subscriptions are other issues that should be considered seriously in order to promote the role of medical apps in pharmacy education.

The positive attitude from the respondents towards the role of smart devices and medical apps in pharmacy

education and practice reflect their beliefs in these new technologies as a new approach for delivering pharmacy-related sciences, and should be incorporated in classrooms and experiential training sites. In previous studies, pharmacy faculty members showed a positive stance toward the integration of i-Pad<sup>®</sup> technology into classrooms and various pharmacy education settings (DiVall & Zgarrick, 2014). Furthermore, pharmacy students showed great preference for additional utilisation of new technologies in pharmacy education, and believed that pharmacy schools should support the incorporation of new educational technologies that could enhance the quality of learning and teaching process (Stolte *et al.*, 2011; DiVall *et al.*, 2013).

To our knowledge, this is the first study from the Middle Eastern perspective to investigate and compare the utilisation of and attitudes towards medical apps among pharmacy educators, students, and preceptors. We believe that the study has added value to the existing body of literature related to the use of information technology for teaching and learning in pharmacy. However, this study has some limitations, which are inherent to all questionnaire-based studies. First, the responses related to attitude are subject to social desirability bias. Therefore, such findings should be interpreted with caution. Second, the response rate of 25% for the students' group may appear to be inadequate. Nevertheless, this response rate is not as low as it may appear on the first impression, since the student population at JUST is large and the number of students who responded has exceeded the minimum effective sample size required. Therefore, those who responded were representative of the population from which conclusions and inferences are drawn. Third, the questionnaire was anonymous, so those who responded more than once, if any, could not be identified. Finally, although the study was conducted at the largest pharmacy school in Jordan, the generalisability of findings is limited inside and outside Jordan.

## Conclusion

This study demonstrated that a wide variety of smart devices and medical apps are widely used among pharmacy students, educators, and practitioners in Jordan. However, the utilisation of the medical apps among pharmacy students and educators was relatively low, with limited incorporation in pharmacy curriculum. The findings suggest that the studied cohorts had demonstrated positive attitudes towards, and generally recognise the value of, using these technologies in teaching and learning as well as clinical pharmacy practice. Educational and healthcare institutions should provide support for efficient use of these important tools through training workshops and providing affordable and supported access to the most reliable applications that can promote evidence-based practice and patient care outcomes. Finally, the findings have important implications for pharmacy educators and leaders to

incorporate contents in pharmacy curriculum related to the appropriate identification, evaluation, and application of reliable medical apps in teaching and learning (e.g. challenge-based learning (CBL), problem-based learning (PBL), therapeutics, experiential learning) and clinical practice.

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