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Information technology in pharmacy practice: Barriers and utilization

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ABSTRACT

A web-based cross-sectional study was conducted to evaluate pharmacists' perception of information technology (IT) utilization and to explore the barriers for its implementation in hospital and community pharmacies. Three scores were calculated including tasks, frequency of use, and capability scores. The majority of the participants (n = 784) were community pharmacists (88.8%) and had less than 10 years of work experience (94.8%). Google was the most frequently used source for information (72.4%). No vision or strategic plan for IT was the most common barrier for IT utilization (41.5%). Pharmacists who had a Doctor of Pharmacy (Pharm. D) degree had a significantly higher mean in the three calculated scores, and females had a significantly higher tasks score mean. Quantile regression results showed that Pharm. D holders had significantly higher task scores (Coefficient = 1.09, p-value < 0.01) than those with Bachelor of Pharmacy (BPharm) degree, who had significantly lower frequency and capability scores (Coefficient = −6.68 and −1.80, p = 0.02 and <0.01, respectively). Efforts should be made by the different healthcare authorities to overcome the identified bariers and to improve pharmacists' utilization of IT in order to improve patient care and health outcomes.

INTRODUCTION

Since the mid-1990s, information technologies (ITs) have played a significant role in academia and economic growth worldwide (Badescu and Garcés-Ayerbe, 2009). The importance of ITs has been realized in a variety of business industries and health professionals fields, including pharmacy (Chonsilapawit and Rungpragayphan, 2016). In the past century, the introduction of technology and the Internet into pharmacy practice has been considered the most important change in the field (Kumar, 2015). Additionally, technology and automation had an established role in supporting business processes in the history of the pharmacy field (Fox *et al*., 2011). Besides their role in business, ITs have been incorporated into several pharmacy aspects, including oncology (Yap *et al*., 2009), antimicrobial stewardship programs (Pestotnik, 2005), and pharmacokinetics (Leader *et al*., 1996). The use of IT in pharmaceutical practices is becoming more common due to the wide Internet coverage and the extensively used healthcare-dedicated smartphones application (Al Bawab *et al*., 2018).

Globally, there is an accelerating rate of challenges and demands to improve the health services provided for the patients and to enhance health outcomes (Bhuvan *et al*., 2020). The provision of ITs in the pharmacy setting in order to improve health outcomes and to match patients' expectations is expected to increase significantly over the upcoming years because of the transformation of the healthcare system (Valdiserri *et al*., 2013).

In Jordan, there is an increased need to utilize IT in the community pharmacy in order to maximize the productivity, to enhance the access to essential information resources efficiently (Holler, 2013), to ensure proper healthcare for all patients, to facilitate the professional communication process (using medical records and accurate medication profiles), to report adverse drug reactions, and to ease pharmacotherapeutic follow-up (Néri *et al*., 2017). Moreover, health IT can reduce

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medication errors and improve system reliability, which can be achieved by using electronic medication reconciliation systems (Agrawal and Wu, 2009). Furthermore, the use of IT apps in the laboratory systems, in logistic drug supply, and as a source of drug information has been deemed necessary in the community pharmacy setting (Leung *et al*., 2016). To effectively apply ITs in pharmacy practice, pharmacists must have a variety of skills (Alwani and Soomro, 2010). Such skills can be obtained by implementing a dedicated training program to fill any IT gaps needed by pharmacists in clinical practice (Néri *et al*., 2017).

Pharmacy informatics could be described as a research area that investigates the medications-specific data such as collection, analysis, storage, usage, and distribution for the implementation of improved medication therapy management, which enhances improved clinical outcomes (Néri *et al*., 2017). The present study aim was to investigate pharmacists' utilization of IT and the capability and frequency of using different Internet resources and to investigate the barriers for IT implementation. Findings should be useful in identifying the target where efforts need to be focused to improve pharmacists' utilization of ITs in pharmacy practice in Jordan.

METHODS

Study design and subjects

A web-based design questionnaire was used in this cross-sectional study. The questionnaire was distributed online and filled out by pharmacists working in community and hospital settings across Jordan. The study participants were pharmacists who graduated from one of the Jordanian universities or any other university accredited by the Ministry of Higher Education who are licensed for pharmacy practice in Jordan. The study objectives and the right of not to participate in the study were reported on the first page of the survey. Pharmacists who agreed to participate were asked to click agree before starting the survey questions. The study received ethical approval (Reference No. 12/133/2020) from the Ethical Committee at King Abdullah University Hospital and was approved by the Deanship of Research at Jordan University of Science and Technology.

Study instruments

The study questionnaire was designed after an extensive review of relevant studies in the literature. The sociodemographic part included age, gender, educational level, working area, and years of experience. The second part was adapted from Néri *et al*. (2017) to assess the utilization of IT in practice, while the barriers domain was adapted from Al-Alwani and Soomro (2010). The survey was reviewed by two professors in pharmacy practice and two experts in information technology for face and content validity. The survey was piloted on 15 pharmacists, and changes were implemented to enhance the clarity of the questionnaire items. The pilot data was not included in the final analysis.

Sample size calculation

A convenient sampling technique was applied; based on the Kish formula (Kish, 1965), the minimum required sample with a confidence interval level of 95% and a 5% margin for error was 385 pharmacists.

Statistical analysis

Data were analyzed using SPSS Software Version 25 (IBM SPSS, Armonk, NY). The Kolmogorov–Smirnov normality test showed not normally distributed data. Continuous variables were presented as medians and median absolute deviation, while categorical variables were presented as frequencies and percentages. The 11-item Internet use task score was calculated according to the number of "Yes" answers. The second score was the capability score which was calculated based on the nine-item questionnaire presented in Table 3. The score for each item ranged from 0 for "Incapable" to 3 for "Very capable," with a maximum score of 27. The third score was the frequency score which evaluated the participants' usage frequency of the different Internet software in clinical practice. The score was calculated based on the answers to the nine-item questionnaire presented in Table 4. The score for each item ranged from "Daily" = 5 points to "Never used" =0, with a maximum score of 45. Pearson's correlation test was used to find the correlations between the three computed scores. Quartile regression models were applied to find the predictors of frequency, capability, and task scores. Age, sex, working field, years of experience, and educational level represented the independent variables, and educational level was presented as a dummy variable.

RESULTS

A total of 784 pharmacists completed the study questionnaire. The median age was 24 years (MAD = 1). As shown in Table 1, most of the pharmacists were females (82.9%), worked in community pharmacies (88.8%), had less than 10 years of experience (94.8%), and were bachelor's pharmacy degree holders (61.9%). The participants had at least one out of four electronic devices for personal use: these were laptops (81.6%; n = 640), smartphones (97.8%; n = 767), desktop computers (41.7%; n = 327), and tablets (36%; n = 282). To access the Internet, Google Chrome was the most used web browser (92.5%).

Most of the participants (31.3%) spent more than 15 hours per week using Internet devices. The participants reported that they connect to the Internet mostly for searching about drug-drug interactions (91.1%), medications' mechanism of action (86.7%), adverse drug reactions (85.6%), and disease pathology information (86.5%). More than half of the participants (52.9%) used the paper form instead of software for documentation purposes. The median for the task score was 9 (MAD= 2). Information on IT utilization is presented in Table 2.

The majority of the participants (80.6%) indicated that they were able to use Google, whereas only 11% were able to use MD Consult, Micromedex, and Scopus. Google and Medscape were the most frequently used resources to search for clinical information. Medians for the frequency score and capability score were 21 (MAD = 9) and 14 (MAD = 4), respectively. Tables 3 and 4 present the capability and frequency of using Internet resources by the study pharmacists, respectively.

As shown in Table 5, the most recognized barriers for IT implementation were lack of time in school for IT-related

Table 1. Demographic characteristics of the participating pharmacists (n = 784).

Variable		Frequency (percent)	Median (MAD)
Gender	Female	650 (82.9%)	
	Male	134 (17.1%)	
Working field	Community pharmacy	696 (88.8%)	
	Hospital pharmacy	88 (11.2%)	
Experience (years)	<10	743 (94.8%)	
	≥10	41 (5.2%)	
Field of study	BSc Pharmacy	485 (61.9%)	
	Pharm. D	123 (15.7%)	
	Diploma	128 (16.3%)	
	Postgraduate (MS/Ph.D.)	48 (6.1%)	
Age			24(1)
Device for personal use	Desktop computer	327 (41.7%)	
	Laptop	640 (81.6%)	
	Tablet	282 (36%)	
	Smartphone	767 (97.8%)	
Web browser	Google Chrome	725 (92.5%)	
	Internet Explorer	23 (2.9%)	
	Mozilla Firefox	14 (1.8%)	
	Other	22 (2.8%)	

Table 2. IT utilization by the participating pharmacists (n = 784).

Variable		Frequency (percentage)
Estimated Internet hours per week:	< 1 hour	32 (4.1%)
	1–5 hours	181 (23.1%)
	6–10 hours	212 (27%)
	11–15 hours	114 (14.5%)
	>15 hours	245 (31.3%)
In clinical practice, you use Internet to	Mechanism of action of medicines	680 (86.7)
(Frequency of "Yes")	Drug doses	676 (86.2)
	Drug–drug interactions	714 (91.1)
	Drug–food interactions	594 (75.8)
	Adverse drug reactions	671 (85.6)
	Dosage forms	579 (73.9)
	Learn about clinical pharmacy methods	562 (71.7)
	How to document clinical pharmacy activities	496 (63.3)
	Information about disease pathology	678 (86.5)
	Drug incompatibility	584 (74.5)
	Commercial name into generic and vice versa	631 (80.5)
Software name	I don't use software. I register in paper form	415 (52.9%)
for documenting clinical practice	Record my clinical practice in a word file	191 (24.4%)
	Record my practice on a spreadsheet in Excel	84 (10.7%)
	Register my practice on a worksheet in Access	28 (3.6%)
	Other	66 (8.4%)

Table 3. Internet resources used by the study participants.

Rate your ability to use	Very capable	Capable	Somewhat incapable	Incapable	Median (MAD)
Google	632 (80.6%)	123 (15.7%)	23 (2.9%)	6 (0.8%)	3 (0)
Bireme	66 (8.4%)	179 (22.8%)	261 (33.3%)	278 (35.5%)	1 (1)
Google Scholar	246 (31.4%)	270 (34.4%)	149 (19%)	119 (15.2%)	2 (1)
PubMed	224 (28.6%)	277 (35.3%)	155 (19.8%)	128 (16.3%)	2 (1)
Scopus	87 (11.1%)	186 (23.7%)	254 (32.4%)	257 (32.8%)	1 (1)
UpToDate	170 (21.7%)	211 (26.9%)	217 (27.7%)	186 (23.7%)	1 (1)
MD Consult	87 (11.1%)	201 (25.6%)	254 (32.4%)	242 (30.9%)	1 (1)
Medscape	333 (42.5%)	234 (29.8%)	128 (16.3%)	89 (11.4%)	2 (1)
Micromedex	91 (11.6%)	180 (23%)	262 (33.4%)	251 (32%)	1 (1)

Table 4. Frequency of use of different Internet resources by the study participants (n = 784).

How frequently do you search for information in clinical practice?	Daily	Weekly	2 to 3 times a month	Once a month	Rarely (<once a month)	Never used	Median (MAD)
Google	568 (72.4%)	143 (18.2%)	49 (6.3%)	11 (1.4%)	9 (1.1%)	4 (0.5%)	5 (0)
Google Scholar	95 (12.1%)	139 (17.7%)	184 (23.5%)	127 (16.2%)	77 (9.8%)	162 (20.7%)	3 (1)
Bireme	34 (4.3%)	54 (6.9%)	171 (21.8%)	125 (15.9%)	34 (4.3%)	366 (46.7%)	1 (1)
PubMed	82 (10.5%)	165 (21%)	211 (26.9%)	105 (13.4%)	89 (11.4%)	132 (16.8%)	3 (1)
Scopus	43 (5.5%)	57 (7.3%)	173 (22.1%)	120 (15.3%)	54 (6.9%)	337 (43%)	2 (1)
UpToDate	89 (11.4%)	113 (14.4%)	186 (23.7%)	101 (12.9%)	55 (7.0%)	240 (30.6%)	2 (2)
MD Consult	47 (6.0%)	59 (7.5%)	196 (25%)	112 (14.3%)	49 (6.3%)	321 (40.9%)	2 (1)
Medscape	178 (22.7%)	208 (26.5%)	176 (22.4%)	74 (9.4%)	54 (6.9%)	94 (12%)	3 (1)
Micromedex	50 (6.4%)	64 (8.2%)	176 (22.4%)	123 (15.7%)	41 (5.2%)	330 (42.1%)	2 (1)

Table 5. Barriers to IT implementation (n = 784).

Select all the applicable barriers	Does not limit	Slightly limit	Somewhat limit	Greatly limit
No Budget	250 (31.9%)	262 (33.4%)	195 (24.9%)	77 (9.8%)
Lack of finding for hardware	191 (24.4%)	305 (38.9%)	224 (28.6%)	64 (8.2%)
No electronic, science text books	220 (28.1%)	289 (36.9%)	204 (26%)	71 (9.1%)
Lack of English training needed for IT	229 (29.2%)	272 (34.7%)	202 (25.8%)	81 (10.3%)
Not enough time in school for IT-related activities	202 (25.8%)	274 (34.9%)	212 (27%)	96 (12.2%)
No instructional support for incorporating IT into teaching	180 (23%)	288 (36.7%)	226 (28.8%)	90 (11.5%)
Lack of vision or strategic plan	185 (23.6%)	273 (34.8%)	230 (29.3%)	96 (12.2%)
Science curriculum not compatible with IT	174 (22.2%)	321 (40.9%)	207 (26.4%)	82 (10.5)
No access to Internet during school	235 (30%)	264 (33.7%)	189 (24.1%)	96 (12.2%)
Classroom architecture not suitable for IT	212 (27%)	280 (35.7%)	203 (25.9%)	89 (11.4%)

activities, lack of instructional support for incorporating IT into teaching, and lack of vision or strategic plan for IT. On the other hand, the lack of a specific budget for IT was the lowest barrier identified by the study pharmacists.

The internal consistencies of the three calculated scores were confirmed by Cronbach's alpha values, which were task score = 0.76, capability score = 0.88, and frequency score = 0.90. Pearson's correlation test showed a positive but weak correlation between task score and frequency score (r = 0.179, p-value < 0.0001) as well as task score and capability score (r = 0.219, p-value < 0.0001). However, a significant, strong, and positive correlation was found between capability score and frequency score (r = 0.537, p-value < 0.0001).

As indicated by the quantile regression results, the only variable that was significantly associated with the three scores was educational degree. Diploma holders had significantly higher frequency scores when compared to B-pharm graduates (coefficient = 6.68, p-value < 0.01). Similarly, Pharm. D graduates had significantly higher scores than B-pharm graduates (coefficient = 3.54, p-value = 0.04). The capability scores of using Internet software in clinical practice were also significantly different between different degree groups. Pharm. D and diploma holders had significantly higher scores (coefficient = 1.7, p < 0.05) when compared to B-pharm graduates (coefficient = 1.8, p < 0.05). Pharm. D graduates also had significantly higher task score when compared with B-pharm graduates (coefficient=1.1, p < 0.01).

DISCUSSION

Pharmacists have always been at the forefront of integrating new technologies into the healthcare system (White and Hohmeier, 2015). ITs can provide pharmacists with easy access to the large volume of available health-related data, which may help them optimizng patient care in clinical practice.

Similar to the finding from a Brazilian study conducted on hospital pharmacists (Néri *et al*., 2017), participants had at least one electronic device for personal use, mainly smartphones (97.8%) and laptop computers (81.6%) in this study. Google was the most frequently used resource for clinical practice in the current study and in several other studies conducted in Brazil (Néri *et al*., 2017), Greece (Kostagiolas *et al*., 2011), Malaysia (Bhuvan *et al*., 2020), Canada (Chonsilapawit and Rungpragayphan, 2016), and the United Arab Emirates (Abu-Gharbieh *et al*., 2015). Although search engines such as Google and Yahoo could be helpful in obtaining medical information, the use of multiple search engines could be necessary to gather more relevant and comprehensive information (Wang *et al*., 2012). In order to enhance the pharmacists' capabilities to use such engines, training sessions should be provided to pharmacy students and pharmacists. The importance of these training sessions is also emphasized by the participants' assessment of their capabilities to use different search engines as the majority of them felt competent using Google but not using evidence-based engines, which also affects the frequency of the use of these engines.

In the current study, only 14.5% of the pharmacists spent more than eleven hours per week using Internet-connected devices. An earlier Brazilian study reported that more than half of the pharmacists were connected for more than 11 hours per week (Néri *et al*., 2017).

Medical information technology is much more than interacting with computing resources (Buckeridge and Goel, 2002). Therefore, pharmacists should know how to appropriately use Internet resources in patient care (Martin *et al*., 1996). This study demonstrated that around 80% of the participants were familiar with the Internet search engines, which were the most common source for seeking clinical information, searching for the mechanisms of action of different medications, drug-drug interactions, drug-food interaction, adverse drug reactions, dosage forms, information about disease pathology, and drug incompatibility. Various studies have recognized the importance of health informatics in promoting health outcomes and minimizing adverse events. Pharmacy informatics must play a significant role in managing and supporting a healthcare system's technology-enabled medication information and knowledge assets; this role would include assisting with authoring, encoding, cataloging, versioning, updating, disseminating, and maintaining an inventory of medication-related information and knowledge (Hawkins, 2016). In the present study, 52.9% of the pharmacists showed that they used the paper form instead of software for documenting clinical practice in this study. Therefore, pharmacists' skills in using different software programs should be improved in order to increase their utilization of these programs and to help enhance clinical practice documentation.

Regarding the use of the Internet during clinical practice, the participants showed moderate basic IT skills and Internet use capability, which varied according to the web browser database, in which most participants showed high capability in using Google and low to moderate ability to use Medscape, Google Scholar, and PubMed. The participants acknowledged that they utilize the Internet for a variety of important uses. This implies that the participants were aware of the information they could obtain from the Internet.

Google and Medscape were the most used resources to search for clinical information in the present study. Google, Google Scholar, and Medscape were also regularly accessed. Pharmacists have rarely used UpToDate, MD Consult, Micromedex, and Bireme to support clinical practice. Similarly, Google was the most frequently used website on a daily basis, and Google Scholar was accessed regularly in a Brazilian study (Néri *et al*., 2017). However, unlike the results found in this study, UpToDate was one of the most frequently accessed resources among pharmacists in the latter study (Néri *et al*., 2017).

Several obstacles to the proper use of IT in clinical practice have been reported in the present study. Lack of time was one of the most common barriers that somewhat or greatly limited the utilization of ITs. This barrier can be overcome by increasing the number of pharmacy staff, which would provide pharmacists with sufficient time to efficiently use ITs. Another important barrier was the lack of instructional support for incorporating ITs into the clinical practice. To surmount this barrier, institutions should provide pharmacists with readily accessible electronic devices and provide access to subscriber-only evidence-based resources.

Furthermore, in comparison with BPharm. graduates, Pharm. D holders had significantly higher task, frequency, and capability scores. This may be attributed to the clinical training and the higher number of evidence-based and literature review courses in the Pharm. D curriculum when compared with the pharmacy curriculum.

Limitations

The self-report method to complete the questionnaire could increase the social desirability bias. Furthermore, the online questionnaire might only allow the participation of community pharmacists who have access to online resources to participate, which might enhance selection bias. However, the online questionnaire enhances a private and relaxed atmosphere to provide more appropriate answers, which minimizes the social desirability bias. Furthermore, the wider use of the Internet in Jordan which reached 67% in all age groups (Kemp, 2020) could increase the representability of the recruited sample to the general population (Eun-Ok and Wonshik, 2004).

CONCLUSION

The current study clearly demonstrates that the majority of the participating pharmacists had high capability in using Google. However, pharmacists showed moderate of low ability in using other Internet resources such as Medscape, Google Scholar, and PubMed. In addition, pharmacists most often accessed Google and Medscape but rarely used UpToDate, MD Consult, Micromedex, and Bireme to support clinical practice. Furthermore, several barriers for IT utilization in pharmacy practice were identified in the present study. Therefore, increasing the number of pharmacy personnel to provide pharmacists with sufficient time to use IT efficiently, along with providing pharmacists with accessible electronic devices and providing access to subscriber-only evidence-based resources, could help overcoming the barriers associated with IT implementation in pharmacy practice.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the international committee of medical journal editors (ICMJE) requirements/guidelines.

ETHICAL APPROVALS

The study received ethical approval (Reference No. 12/133/2020) from the Ethical Committee at King Abdullah University Hospital and was approved by the Deanship of Research at Jordan University of Science and Technology

DATA AVAILABILITY

All data generated and analyzed are included within this research article.

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