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Artificial intelligence in pharmacy practice: Attitude and willingness of the community pharmacists and the barriers for its implementation

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Original article

Artificial intelligence in pharmacy practice: Attitude and willingness of the community pharmacists and the barriers for its implementation

Anan S. Jarab [a,b], Walid Al-Qerem [c], Karem H Alzoubi [d,e], Haneen Obeidat [a], Shrouq Abu Heshmeh [a], Tareq L. Mukattash [a], Yara A. Naser [f], Ahmad Al-Azayzih [a,*]

[a] Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology. P.O. Box 3030. Irbid 22110, Jordan
[b] College of Pharmacy, AL Ain University, Abu Dhabi, United Arab Emirates
[c] Department of Pharmacy, Faculty of Pharmacy, Al-Zaytoonah University of Jordan. P.O. Box 130, Amman 11733, Jordan
[d] Department of Pharmacy Practice and Pharmacotherapeutics, College of Pharmacy, University of Sharjah, Sharjah, UAE
[e] Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan
[f] School of Pharmacy, Queen's University Belfast, Medical Biology Centre, 97 Lisburn Road, Belfast BT9 7BL, Northern Ireland, UK

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ABSTRACT

Background: Artificial intelligence (AI) is the capacity of machines to perform tasks that ordinarily require human intelligence. AI can be utilized in various pharmaceutical applications with less time and cost.
Objectives: To evaluate community pharmacists' willingness and attitudes towards the adoption of AI technology at pharmacy settings, and the barriers that hinder AI implementation.
Methods: This cross-sectional study was conducted among community pharmacists in Jordan using an online-based questionnaire. In addition to socio-demographics, the survey assessed pharmacists' willingness, attitudes, and barriers to AI adoption in pharmacy. Binary logistic regression was conducted to find the variables that are independently associated with willingness and attitude towards AI implementation.
Results: The present study enrolled 401 pharmacist participants. The median age was 30 (29–33) years. Most of the pharmacists were females (66.6%), had bachelor's degree of pharmacy (56.1%), had low-income (54.6%), and had one to five years of experience (35.9%). The pharmacists showed good willingness and attitude towards AI implementation at pharmacy (n = 401). The most common barriers to AI were lack of AI-related software and hardware (79.2%), the need for human supervision (76.4%), and the high running cost of AI (74.6%). Longer weekly working hours (attitude: OR = 1.072, 95% C.I (1.040–1.104), P < 0.001, willingness: OR = 1.069, 95% Cl. 1.039–1.009, P-value = 0.011), and higher knowledge of AI applications (attitude: OR = 1.697, 95%Cl (1.327–2.170), willingness: OR = 1.790, 95% Cl. (1.396–2.297), P-value < 0.001 for both) were significantly associated with better willingness and attitude towards AI, whereas greater years of experience (OR = 20.859, 95% Cl (5.241–83.017), P-value < 0.001) were associated with higher willingness. In contrast, pharmacists with high income (OR = 0.382, 95% Cl. (0.183–0.795), P-value = 0.010), and those with<10 visitors (OR = 0.172, 95% Cl. (0.035–0.838), P-value = 0.029) or 31–50 visitors daily (OR = 0.392, 95% Cl. (0.162–0.944), P-value = 0.037) had less willingness to adopt AI.
Conclusions: Despite the pharmacists' positive willingness and attitudes toward AI, several barriers were identified, highlighting the importance of providing educational and training programs to improve pharmacists' knowledge of AI, as well as ensuring adequate funding support to overcome the issue of AI high operating costs.
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* Corresponding author at: Clinical Pharmacy Department, Faculty of Pharmacy-Jordan University of Science and Technology, Irbid 22110, Jordan.
E-mail addresses: anan.jarab@aau.ac.ae (A.S. Jarab), waleed.qirim@zuj.edu.jo (W. Al-Qerem), khalzoubi@just.edu.jo (K.H Alzoubi), hanin.ahmad@gmail.com (H. Obeidat), srabuheshmeh19@ph.just.edu.jo (S. Abu Heshmeh), tlmukattash@just.edu.jo (T.L. Mukattash), yara.naser@qub.ac.uk (Y.A. Naser), aaazayzih@just.edu.jo (A. Al-Azayzih).
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1. Introduction

Artificial intelligence (AI) is the capacity of machines to carry out tasks that ordinarily require human intelligence, including sensing, thinking, learning, and decision-making. (SAS Insights, 2023) Take, for instance, ChatGPT, an innovative tool empowered by AI. It employs language models to engage in open discussions with individuals, effortlessly addressing queries, delivering information, and generating insightful responses. (What is ChatGPT? Unlock new ways of language learning, 2023) AI has extensive applications in a variety of areas, including healthcare, finance, transportation, and manufacturing. In healthcare, AI can be utilized for medical imaging analysis, tailored treatment, and a variety of other applications. (Bhattamisra et al., 2023; Hajjo et al., 2022).

The pharmaceutical sector has seen a significant surge in data digitization in recent years. Yet, the issue of gathering, evaluating, and applying such knowledge to solve complicated clinical problems prompts the adoption of AI due to its ability to manage massive volumes of data with greater automation. (Khan, 2023; Miles and Walker, 2006; Ramesh et al., 2004) AI has the potential to transform many aspects of pharmacy practice, including drug discovery, drug safety monitoring, medication management, and patient care in a shorter period of time and less effort. (Paul et al., 2021) In addition, AI can have a significant impact on pharmacists' work and drive them to become more patient-focused rather than only concerned with dispensing prescriptions, as well as help them ensure that patients receive the most benefit from their medications and maintain their health. (Raza et al., 2022).

Despite these advantages of AI, pharmacists' willingness and attitude towards AI implementation in pharmacy can vary based on their individual experiences and perspectives. Some pharmacists may be receptive to AI and view it as a valuable tool to enhance patient care and optimize pharmacy operations. Others may be more skeptical and concerned about the potential impact of AI on their profession and job security.

A complex interaction of elements is anticipated to influence pharmacists' willingness and attitude toward AI. As AI continues to advance and proliferate in the healthcare sector, it will be crucial to address these elements, give pharmacists the resources and support they need to successfully integrate AI into their practices, and pinpoint the obstacles that stand in the way of the adoption of such a technology in pharmacy settings.

To the best of our knowledge, the current study is the first one to assess pharmacists' willingness and attitudes towards the adoption of this technology at pharmacy, and the barriers that hinder them from doing that. In addition to the paucity of research in this subject, findings of the present study should provide baseline data on pharmacists' willingness and perception towards AI use and its associated factors, in addition to the hurdles that prevent the adoption of AI technology in pharmacy.

2. Methods

2.1. Study design and subjects

In the current cross-sectional study, an online, self-completed survey was randomly distributed in English using Google forms on pharmacists across Jordan in the period from August 2022 through January 2023. Pharmacists were included in the study if they graduated from universities recognized by the Ministry of Higher Education and received authorization to work as pharmacists by the Ministry of Health and the Jordanian Pharmaceutical Association. The researcher emphasized that participation is voluntary and the data will be kept confidential and to be only used for research purposes. Pharmacists who agreed to participate were asked to sign a consent. The study received ethical approval from the Institutional Review Board and the Deanship of Research at Jordan University of Science and Technology.

2.2. Study instrument

The study survey was developed after retrieving the literature related to AI implementation in pharmacy practice. (Kiran et al., 2021; Raza et al., 2022; Sangave and Cheung, 2022) In addition to socio-demographics and work-related questions, the survey also included three additional parts to assess pharmacists' willingness, attitudes, and barriers to AI implementation in pharmacy settings. The willingness part consisted of 16 items, the attitude part of 15 items, and the barriers part of 13 items. The scoring of the willingness and attitude domains was performed on a 5-point Likert scale ranging from strongly disagree (1 point) to strongly agree (5 points), with a maximum possible score of 80 for willingness, and 75 for attitudes. The internal consistency of the willingness, attitudes, and barriers towards implementing AI were assessed by computing Cronbach's alpha and the results indicated excellent internal consistency (Cronbach's alpha willingness = 0.969, Cronbach's alpha attitude = 0.955, Cronbach's alpha barriers = 0.902). The medians for willingness an attitude scales were computed and participants who scored above the median were included in the high score group while those who scored below the median were included in the low score group for each scale. An expert panel of different background, that is, an AI researcher, epidemiologist and pharmacist examined the questionnaire for face and content validity. The survey was also piloted on ten pharmacists for clarity of questions, relevance of items, and time for completion. Data obtained from the pilot test was not included in the final data analysis. A custom-designed questionnaire was used to collect socio-demographic characteristics including age, sex, marital status, educational level, and other practice related variables.

2.3. Sampling technique and sample size calculation

We used convenience-sampling technique, which involves selecting participants based on their accessibility and availability to the researcher. The Krejcie and Morgan formula (Krejcie and Morgan, 1970) was used to compute the minimum required sample size. The formula is:

$$S = X^2NP(1 - P) + a^2(N - 1) + X^2P(1- P);$$

where S = required sample size, X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841), N = the population size, P = the population proportion (assumed to be 50 since this would provide the maximum sample size) and d = the degree of accuracy expressed as a proportion (0.5). Krejcie and Morgan composed sample size tables based on the above formula for different population sizes, confidence levels and margin of errors. The population size was assumed to be above 1,000,000 (indefinite) and the computed minimum sample size required was 384 for 95% Cl and 5% margin of error.

2.4. Statistical analysis

Statistical analysis was conducted using SPSS version 28. (Karamurugan and Govindarajan, 2023) The normality for the continuous variables was assessed by examining Q-Q plots and by running Kolmogorov Smirnov test, and results showed that the data was not normally distributed. Categorical variables were presented as frequencies and percentages and continues variables as median

Table 1
Sociodemographic characteristics of the enrolled pharmacists (n = 401).

		Median (95% Cl.) or N (%)
Age		30 (29–33)
Sex	Male	134 (33.4%)
	Female	267 (66.6%)
Marital Status	Married	205(51.1%)
	Others	196 (48.9%)
Educational level	Diploma	132 (32.9%)
	Bachelor's	225 (56.1%)
	Master/PhD	44 (10.9%)
Year of experience	<1	79 (19.7%)
	1–5	144 (35.9%)
	6–10	99 (24.7%)
	11–15	38 (9.5%)
	>15	41 (10.2%)
Income level	Low	219 (54.6%)
	High	182 (45.4%)
Type of pharmacy	Governmental pharmacy (healthcare centers)	60 (15%)
	Hospital pharmacy	51 (12.7%)
	Chain pharmacy	58 (14.5%)
	Independent pharmacy	232 (57.9%)
Area of Residency	North	154 (38.4%)
	Middle	154 (38.4%)
	South	93 (23.2%)
Number of daily pharmacy visitors	<10	16 (4%)
	11–30	128(31.9%)
	31–50	108 (26.9)
	>50	149 (37.2%)
Number of working pharmacists		2 (2–3)
Number of daily prescriptions		30 (25–40)
Average time spent with the patient (min)		5 (5–7)
Weekly working hours		48 (48–54)
Internet access	No	80 (20.9%)
	Yes	303 (79.1%)
Drug information source	Nonscientific	217 (56.1%)
	Scientific	170 (43.9%)
Have you heard the term AI before this survey? “	No	89 (22.2%)
	Yes	312 (77.8%)
How do you rate your knowledge about AI application/machine learning?		3 (3–4)

AI: Artificial intelligence.

and 95% Cl. Willingness and attitude scores were categorized into two groups based on the median, individuals with scores less than or equal to the median were classified as “low”, whereas the rest were assigned to the “high” group. (Farrington and Loeber, 2000) Two binary regression models were used to evaluate variable associated with the willingness' and attitude' scores. Significance was determined at P-value < 0.05.

3. Results

The present study enrolled 401 pharmacist participants. The median age was 30 (29–33) years. The majority of the participants were females (66.6%) and more than half of them were non-married (51.1%). Most of the pharmacists had bachelor's degree of pharmacy (56.1%), and low-income (54.6%). The highest percentage of the participants had one to five years of experience (35.9%), while only (10.2%) had more than 15 years. The most frequently reported number of pharmacy visitors was more than 50 daily (37.2%) and the median for the daily average prescriptions was 30 (25–40). More than half of the participants were using at least one of the nonscientific sources to obtain drugs information (56.1%). The majority of the enrolled pharmacists had internet connection (79.1%) and were aware of the AI term (77.8%) Sociodemographic characteristics of the study participants are described in Table 1.

Pharmacists' willingness to implement AI technology was high, with a median score of 72 (71–74) out of maximum possible score of 80. The participants were most willing to utilize the AI technology in obtaining primary care and communicating with care providers from home (82.3%), and identifying drug-related problems (80.5%), while the least willingness was for using AI to improve patients' adherence (72.5%). Participants' responses to the willingness to implement AI technology for several tasks at workplace are presented in Table 2.

As shown in Table 3, the pharmacists generally showed a positive attitude towards AI technology implementation in the pharmacy setting, with a median attitude score of 63 (62–65) out of

Table 2
Willingness of the pharmacists to apply AI technology (n = 401).

Item	Frequency (%) or Median (95% Cl)				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Medical data collection	233 (58.1)	80 (20)	53 (13.2)	18 (4.5)	17 (4.2)
Social data collection	190 (47.4)	110 (27.4)	58 (14.5)	30 (7.5)	13 (3.2)
Data claim (Insurance)	208 (51.9)	107 (26.7)	48 (12)	24 (6)	14 (3.5)
Detecting hidden and undiagnosed diseases	226 (56.4)	84 (20.9)	45 (11.2)	24 (6)	22 (5.5)
Identifying drug-related problem	227 (56.6)	96 (23.9)	42 (10.5)	22 (5.5)	14 (3.5)
Specifying treatment outcome	212 (52.9)	104 (25.9)	39 (9.7)	24 (6)	22 (5.5)
Evaluating different treatment options	195 (48.6)	112 (27.9)	52 (13)	26 (6.5)	16 (4)
Designing care plan	201 (50.1)	100 (24.9)	56 (14)	28 (7)	16 (4)
Resolved drug-related problem	219 (54.6)	77 (19.2)	59 (14.7)	27 (6.7)	19 (4.7)
Implementing care plan	203 (50.6)	91 (22.7)	57 (14.2)	33 (8.2)	17 (4.2)
Follow up and monitoring patients	211 (52.6)	82 (20.4)	62 (15.5)	31 (7.7)	15 (3.7)
Connecting healthcare provider systems together	220 (54.9)	86 (21.4)	60 (15)	24 (6)	11 (2.7)
Obtain primary care and communicate with care providers from home	232 (57.9)	98 (24.4)	32 (8)	27 (6.7)	12 (3)
Improving patient adherence	203 (50.6)	88 (21.9)	42 (10.5)	25 (6.2)	43 (10.7)
Medication dispensing	214 (53.4)	98 (24.4)	38 (9.5)	27 (6.7)	24 (6)
Patient counseling	205 (51.1)	100 (24.9)	49 (12.2)	24 (6)	23 (5.7)
Willingness to employ AI technology score	72 (71–74)				
Willingness level Low	197 (49.1)				
High	204 (50.9)				

AI: Artificial intelligence.

Table 3
Attitude toward AI technology implementation in the community pharmacy (n = 401).

Item	Frequency (%) or median (95%Cl.)				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I like to be up-to-date in AI application in pharmacy setting	260 (64.8)	69 (17.2)	37 (9.2)	24 (6)	11 (2.7)
I like to receive training on AI because it's important to improve my career as a community pharmacist	203 (50.6)	116 (28.9)	37 (9.2)	33 (8.2)	12 (3)
I believe that AI will improve the services provided in the community pharmacy	226 (56.4)	83 (20.7)	49 (12.2)	34 (8.5)	9 (2.2)
I feel that AI will improve the community pharmacy customer satisfaction	198 (49.4)	94 (23.4)	74 (18.5)	26 (6.5)	9 (2.2)
I fear that AI could replace my job as pharmacist [a]	53 (13.2)	67 (16.7)	100 (24.9)	118 (29.4)	63 (15.7)
I believe that AI applications will be widely used in pharmacy practice	183 (45.6)	102 (25.4)	65 (16.2)	34 (8.5)	17 (4.2)
I believe that AI can help reduce medication errors	187 (46.6)	106 (26.4)	67 (16.7)	28 (7)	13 (3.2)
I feel that AI will enhance tailored pharmaceutical care plan	186 (46.4)	104 (25.9)	73 (18.2)	28 (7)	10 (2.5)
I feel that AI will assist in performing clinical investigation tasks more efficiently than humans	162 (40.4)	95 (23.7)	70 (17.5)	41 (10.2)	33 (8.2)
I feel that AI can enhance pharmacist's role in patient follow-up and monitoring	168 (41.9)	128 (31.9)	65 (16.2)	23 (5.7)	17 (4.2)
I believe that AI is very useful for organizing our daily work	179 (44.6)	113 (28.2)	72 (18)	24 (6)	13 (3.2)
I believe that AI always makes the best choice since it never gets tired (mentally or physically)	163 (40.6)	96 (23.9)	80 (20)	33 (8.2)	29 (7.2)
I believe that AI can multitask more effectively than humans and analyze data more quickly	176 (43.9)	111 (27.7)	67 (16.7)	34 (8.5)	13 (3.2)
I feel that AI can improve patient outcomes	162 (40.4)	110 (27.4)	78 (19.5)	34 (8.5)	17 (4.2)
I feel that AI can reduce the cost of care	165 (41.1)	109 (27.2)	60 (15)	29 (7.2)	38 (9.5)
Attitude score	63 (62–65)				
Attitude level Low	198 (49.4)				
High	203 (50.6)				

[a] Negative sentence, AI: Artificial intelligence.

maximum possible score of 75. The highest agreed/strongly agreed statements were reported in items "I like to be up-to-date in AI application in pharmacy setting" and "I like to receive training on AI because it's important to improve my career as a pharmacist." (82% and 79.5% respectively), while the least agreement was with the statement "I feel that AI will assist in performing clinical investigation tasks more efficiently than humans" (64.1%).

As shown in Table 4, the most commonly recognized barriers to implement AI in the pharmacy sector were lack of AI-related software and hardware (79.2%), the need of AI for human supervision (76.4%), and the high running cost of AI (74.6%).

As shown in Table 5, pharmacists who worked more had higher odds of having positive attitude when compared to those who had less working hours (OR = 1.072, 95% C.I:1.040–1.104, P < 0.001). Pharmacists who had higher knowledge about AI applications had significantly higher odds of having positive attitude than those with lower knowledge (OR = 1.697, 95%Cl: 1.327–2.170, P < 0.001). As shown in Table 6, increased working hours (OR = 1.069, 95% Cl: 1.039–1.009, P < 0.01) and improved knowledge (OR = 1.790, 95% Cl: 1.396–2.297, P-value < 0.001) were associated with increased willingness to utilize AI at the community pharmacy setting. Pharmacists with six to ten years of experience were also more willing to implement AI at their workplace than those with less than one year of practice (OR = 20.859, 95% Cl: 5.241–83.017, P < 0.001). In contrast, pharmacists with high income (OR = 0.382, 95% Cl: 0.183–0.795, P < 0.05) and those who had less than ten visitors (OR = 0.172, 95% Cl: 0.035–0.838, P < 0.05) or 31–50 visitors daily (OR = 0.392, 95% Cl.:0.162–0.944, P < 0.05) showed less willingness to adopt AI when compared with those who had greater than 50 visitors daily.

4. Discussion

The revolution of AI technology use in pharmacy has blossomed over years to decades, which had the advantage of saving time and money, and simplifying many pharmaceutical tasks. (Kiran et al., 2021) However, no studies have evaluated pharmacists' willingness and attitude towards the implementation of AI technology in the community pharmacy setting, as well as the barriers that

Table 4
Barriers to implement AI technology in the community pharmacy (n = 401).

Item	Frequency (%)		
	Agree	**Not sure**	**Disagree**
Lack of AI Information	180 (46.1)	124 (31.8)	86 (22.1)
Lack of AI flexibility	159 (40.7)	110 (28.2)	121 (31.1)
The low ability to sympathize and consider the emotional well-being of the patient	215 (55.6)	69 (17.8)	103 (26.6)
Difficulty to apply AI	165 (42.4)	119 (30.6)	105 (27)
Lack of training	235 (60.6)	90 (23.2)	63 (16.2)
High running cost of AI	288 (74.6)	60 (15.5)	38 (9.8)
Fear of litigation	266 (69.1)	74 (19.2)	45 (11.7)
Lack of time	228 (58.8)	93 (24)	67 (17.3)
Translating medical terminology into machine language involves collaboration between healthcare practitioners and artificial intelligence	271 (70)	78 (20.2)	38 (9.8)
AI requires human supervision	298 (76.4)	66 (16.9)	26 (6.7)
If a vital decision (such as end-of-life care) must be taken, the AI cannot make the decision and will generate an unreliable report	279 (72.1)	69 (17.8)	39 (10.1)
Regulatory and social constraints may limit AI's potential to help medical practitioners	286 (74.1)	67 (17.4)	33 (8.5)
Lack of AI-related software and hardware	305 (79.2)	52 (13.5)	28 (7.3)

AI: Artificial intelligence.

hinder them from doing so, which was the main objective of this study.

The current study showed high willingness and attitude towards AI technology implementation in pharmacy setting, with several identified barriers. Number of weekly working hours and participants' knowledge of AI technology were significantly associated with both willingness and attitude towards AI, while years of work experience, income, and number of pharmacy visitors per day were significantly associated with willingness to implement AI technology in pharmacy.

The current study participants demonstrated strong interest in using AI in the pharmacy sector. A study conducted in Saudi Arabia reported that 87% of the pharmacists showed high willingness towards the use of telepharmacy technology. (Alanazi et al., 2021) In comparison, high willingness to adopt AI it the field of medicine was also expressed by physicians and medical students in a previous studies conducted in China, (Chen et al., 2022) and Pakistan. (Ahmed et al., 2022) Another survey conducted among doctors in India found that 62% of the participants were willing to learn AI-related tools. (Samyuktha et al., 2020) With regard to dentistry, a previous study indicated a substantial level of excitement for integrating AI technology into dental practice. (Hamd et al., 2023) According to another study, a significant majority of nurses in the field expressed agreement that AI holds potential for numerous nursing applications and practices. (Abuzaid et al., 2022) The current study participants indicated the highest willingness in using AI to obtain primary care and communicate with healthcare professionals from home (82.3%). This makes sense because one of AI's most advantageous applications is guiding users toward the most affordable healthcare options and facilitating communication with healthcare providers. (Raza et al., 2022).

Table 5
Factors associated with pharmacists' attitude towards implementing AI technology.

Attitude		p-value	OR	95% CI. for OR	
				Lower	Upper
Age		0.239	1.038	0.975	1.105
Sex	Female	0.272	1.416	0.761	2.635
	Male (REF)	0	.	.	.
Educational level	Bachelors	0.892	0.955	0.493	1.851
	Master	0.521	0.668	0.195	2.290
	Diploma (REF)	0	.	.	.
Year of experience	1–5	0.274	1.662	0.668	4.136
	6–10	0.274	2.025	0.572	7.170
	11–15	0.744	0.763	0.150	3.880
	>15	0.378	0.453	0.078	2.637
	<1 (REF)	0	.	.	.
Income level	High	0.934	0.972	0.494	1.912
	Low (REF)	0	.	.	.
Type of pharmacies	Hospital pharmacy	0.642	1.494	0.275	8.101
	Chain pharmacy	0.924	1.061	0.313	3.602
	Independent pharmacy	0.166	0.486	0.175	1.351
	Governmental pharmacy (healthcare centers) (REF)	0	.	.	.
Location	Middle	0.504	0.801	0.417	1.538
	South	0.686	1.175	0.538	2.564
	North (REF)	0	.	.	.
Daily visitor	<10	0.379	0.520	0.121	2.232
	11–30	0.377	1.470	0.625	3.455
	31–50	0.150	0.531	0.225	1.257
	>50	0	.	.	.
Pharmacist number		0.079	0.873	0.750	1.016
Daily prescriptions		0.372	1.001	0.999	1.004
Average time spent with the patient		0.869	0.994	0.930	1.063
weekly working hours		**<0.001**	1.072	1.040	1.104
Internet access	Yes	0.433	0.766	0.393	1.492
	No (REF)	0	.	.	.
Drug information source	Scientific	0.122	1.596	0.882	2.885
	Nonscientific (REF)	0	.	.	.
Have you heard the term AI before this survey?	Yes	0.190	0.613	0.295	1.274
	No (REF)	0	.	.	.
How do you rate your knowledge about AI application/machine learning?		**<0.001**	1.697	1.327	2.170

Table 6
Factors associated with pharmacists' willingness to implement AI technology.

		p-value	OR	95% CI for OR	
				Lower	Upper
Age		0.925	0.997	0.938	1.060
Sex	Female	0.418	1.304	0.686	2.476
	Male (REF)	0	.	.	.
Educational level	Bachelors	0.211	1.552	0.780	3.089
	Master/PhD	0.434	0.614	0.181	2.082
	Diploma (REF)	0	.	.	.
Year of experience	1–5	0.058	2.483	0.970	6.352
	6–10	**<0.001**	20.859	5.241	83.017
	11–15	0.113	3.739	0.733	19.066
	>15	0.149	3.705	0.624	21.992
	<1 (REF)	0	.	.	.
Income level	High	**0.010**	0.382	0.183	0.795
	Low (REF)	0	.	.	.
Type of pharmacies	Hospital pharmacy	0.815	0.816	0.149	4.467
	Chain pharmacy	0.409	0.598	0.177	2.025
	Independent pharmacy	0.690	1.237	0.434	3.528
	Governmental pharmacy (healthcare centers) (REF)	0	.	.	.
Location	Middle	0.095	0.575	0.301	1.101
	South	0.304	1.527	0.682	3.421
	North (REF)	0	.	.	.
Daily visitor	<10	**0.029**	0.172	0.035	0.838
	11–30	0.841	0.915	0.385	2.177
	31–50	**0.037**	0.392	0.162	0.944
	>50	0	.	.	.
Pharmacist number		0.177	0.898	0.768	1.050
Daily prescriptions		0.537	1.001	0.998	1.003
Average time spent with the patient		0.409	0.973	0.913	1.038
weekly working hours		**0.011**	1.039	1.009	1.069
Internet access	Yes	0.703	0.870	0.424	1.784
	No (REF)	0	.	.	.
Drug information source	Scientific	0.917	1.033	0.558	1.913
	Nonscientific (REF)	0	.	.	.
Have you heard the term AI before this survey?	Yes	0.409	1.359	0.656	2.815
	No (REF)	0	.	.	.
How do you rate your knowledge about AI application/machine learning?		**<0.001**	1.790	1.396	2.297

Consistent with earlier research findings, (Ahmed et al., 2022; Alanazi et al., 2021; Mugabe, 2021; Swed et al., 2022; Young et al., 2021) the current study participants showed an overall positive attitude towards the use of AI technology. The vast majority of the pharmacists in the current study stated a desire to be updated on AI use in the pharmacy field, which is unquestionably an indication of good attitude. In a study of Canadian vascular surgeons, 84% of the participants were interested or very interested in learning more about AI and machine learning. (Li et al., 2022) These results raise the possibility that learning about AI and being updated with its application may enhance the likelihood to utilize it in the future.

The most common barriers to implement AI technology included lack of AI-related software and hardware (79.2%), the need of AI for human supervision (76.4%), and the high running cost of AI (74.6%). In earlier study, the majority of the participants indicated that in addition to the expense of equipment and therapy, there are also implementation costs, such as those associated with software development, as well as providing AI education and training programs, which might all be expensive and limit the adoption of AI. (Alsobhi et al., 2022) Lack of software and high equipment cost were also identified as barriers to AI implementation in the healthcare utility in another study. (Goyal and Khatib, 2022) Such hurdles may necessitate substantial financial support by the healthcare authorities to ensure the availability of AI technology in the community pharmacy setting.

Pharmacists with more years of experience were noticeably more eager to adopt AI in the than their peers in the present study. Prior research produced consistent findings. (Alsobhi et al., 2022; Mugabe, 2021) A possible explanation for this finding would be that as pharmacists gain experience, they become more conscious of the time- and labor-intensive tasks they must perform. As AI makes these tasks simpler, this may improve pharmacists' perception towards AI technology and increase their willingness to adopt it at work place. On the other hand, pharmacists with high income were less willing to implement AI technology in the present study. A study conducted in the United States reported that individuals' intention to use AI-based tools for healthcare purposes was significantly affected by their annual household income level. (Esmaeilzadeh, 2020) The feelings of motivation that low-income people create for employing technology that would reduce their workload in compared to high-income persons who are more satisfied with their jobs may lend credence to this result. In a similar vein, the present study pharmacists who worked for longer hours per week and had more than 50 visitors daily demonstrated significantly higher attitudes and a desire to integrate AI into pharmacy practice than their counterparts, which was most probably due to their awareness of the advantages of AI-associated reduced workload. Medical students surveyed in a Nepalese study thought that AI should be utilized as fast as possible to reduce human errors and workload. (Jha et al., 2022) Moreover, in the current study, improved pharmacists' knowledge of AI technology was associated with greater willingness and attitude to utilize AI in the pharmacy setting. Earlier studies produced comparable findings. (Esmaeilzadeh, 2020; Pinto dos Santos et al., 2019; Al Saad et al., 2022) Earlier research showed that higher educational qualification was associated with improved knowledge about AI. (Alsobhi et al., 2022) This finding sheds the light on incorporating

pharmacists in educational and training programs on AI technology starting from the academic stag in order to improve readiness and enhance willingness to adopt this technology after graduation.

The current study provides valuable insights and recommendations for policymakers, healthcare professionals, researchers, and organizations looking to implement AI technologies in pharmacy settings. Efforts should focus on overcoming the identified barriers to AI implementation, such as the lack of AI-related software and hardware, the need for human supervision, and the high running cost of AI, which may include the provision of accessible and affordable AI solutions. In addition to overcoming these barriers, it is crucial to focus on educational initiatives that enhance pharmacists' understanding of AI. Incorporating AI-related courses into the pharmacy curriculum and offering training programs can equip pharmacists with the knowledge and skills for effectively utilizing AI in pharmacy practice.

4.1. Study limitations

The cross-sectional design used in this study limits the ability to establish a cause-effect relationship. The convenient sampling technique could lead to selection bias. Additionally, the study relied on self-reported data, which may be subject to social desirability bias. Considering the novelty of AI technology and the absence of AI-related courses in Jordanian pharmacy colleges, we presumed that pharmacists' knowledge about MI might be limited and therefore we did not evaluate knowledge comprehensively. Furthermore, conducting a comprehensive evaluation of pharmacists' knowledge in the field of AI would be resource-intensive in terms of time, effort, and cost. Therefore, future research, which evaluates pharmacists' knowledge about AI utilization in pharmacy practice, is deemed necessary.

5. Conclusions

Healthcare providers should adopt future methods that enhance the utilization of AI in pharmacy practice. By conducting educational programs on AI technology, pharmacists can gain the necessary knowledge and skills to understand and effectively utilize AI in their practice. Providing technical support and assistance to pharmacists can help overcome the barrier of lack of AI-related software and hardware. Moreover, offering incentives, such as financial rewards, can incentivize pharmacists to adopt AI technology. Integrating these strategies into practice helps pharmacists adopting AI technology in community pharmacy setting, thereby enhancing patient care and health outcomes.

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Declaration of Competing Interest

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