

Survey of Knowledge of Pharmacy Students and Pharmacists Regarding Artificial Intelligence in Lattakia

Alaa Deeb, Ayat Abbood



Abstract: Artificial Intelligence is crucial in various sectors, including pharmacy. A survey was conducted to assess the level of knowledge about artificial intelligence (AI) among pharmacy students and pharmacists in Lattakia. A total of 117 participants took part in the survey, with most participants aged between 18 and 25 years (88.9%). This finding underscores the importance of the younger generation understanding AI, considering its role as a key advancement in future industries. Of the participants, 79.5% were female, and 71.8% were students at a pharmacy college. Notably, 80% of users actively engage with platforms such as Facebook, YouTube, WhatsApp, Instagram, Telegram, and Google. Surprisingly, 88% reported a lack of familiarity with AI. Survey responses highlighted the perceived benefits of AI, with 63% citing profit enhancement, 70% pointing to the availability of drug-related data and side effects, and 88% emphasising the reduction of prescription errors. Conversely, 82% acknowledged a primary drawback of AI as the potential decrease in job opportunities. 70% believe that a smart pharmacy would monitor medication expiration dates, remove expired drugs, and automate ordering from suppliers based on needs. Furthermore, approximately two-thirds envisioned an innovative laboratory capable of calibrating tools, documenting test outcomes, analyzing data, and automatically receiving, labeling, and storing samples. 63% acknowledged the need for more education on AI, while 53% recognized the importance of integrating AI into the pharmacy curriculum. The findings revealed that pharmacy students and pharmacists possess limited awareness regarding AI in general and its specific applications in pharmacy.

Keywords: Pharmacy, Artificial Intelligence, Knowledge, Survey.

Abbreviations: AI: Artificial Intelligence WHO: World Health Organization

I. INTRODUCTION

Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the 21st century [1], revolutionizing industries [2], enhancing productivity [3], and changing the way people connect with machines [4]. It empowers machines with elements of human intelligence [5],

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enabling them to perform tasks such as learning [6], reasoning, problem-solving [7], and decision-making [8]. AI is increasingly embedded in our daily lives [9] and extends its uses into numerous fields [10], including finance [11], education [12], manufacturing [13], and, most notably, healthcare [14] and pharmaceuticals [15], where it has the potential to save lives [16] and accelerate medical breakthroughs [17].

In the medical field [18], AI has remarkably advanced diagnostic and therapeutic processes [19]. According to the World Health Organization (WHO) [20], AI-based systems can analyze medical images such as X-rays [21] and MRIs [22], achieving accuracy levels of 97% in certain applications, compared to 85% for traditional human analysis [23]. Among the most notable practical models is Google's "DeepMind" system [24], which can predict acute kidney failure 48 hours before symptoms appear with 93% accuracy. 6% accuracy [25]. Additionally, AI-powered imaging tools can detect diseases like cancer [26]. In the pharmaceutical industry [27], AI plays a key role in accelerating drug discovery processes that previously took up to 12 years [28]. In 2021, AI contributed to identifying six promising drug compounds for COVID-19 treatment in less than six months [29]. Data shows that AI reduces prescription errors by 30% [30]. This information indicates that AI is not merely a hopeful innovation but has evolved into a significant force transforming the realms of medicine and pharmacy [31]. AI is expected to save 400 400,000 patients annually in Europe alone by 2030 [32]. Consequently, investing in this technology has become crucial for nations seeking to enhance their healthcare systems [33]. Therefore, evaluating how well healthcare professionals grasp AI is vital [34]. A 2023 study conducted by the American Pharmacists Association found that while 68% of pharmacists are familiar with AI concepts [35], only 35% comprehend its practical applications [36]. The effect of artificial intelligence on education is apparent [37]. AI will influence higher education in various aspects, primarily focusing on two key areas: student enrollment and course content [38]. A questionnaire was conducted to evaluate the knowledge of pharmacy students and pharmacists regarding artificial intelligence (AI) in Lattakia.

П. METHODS

The study was conducted between December 2024 and March 2025 using an online survey in Google Forms. Participants were pharmacy students or pharmacists in Lattakia. The online questionnaire

was distributed through social networks (Facebook and WhatsApp). The questions included participants' demographic data,

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AI-related practices and hobbies, and knowledge about artificial intelligence.

III. RESULTS

A. Demographic Data of Participants

One hundred seventeen responses were collected in this research. Table 1 shows the demographic characteristics of the participants.

Table-1: Demographic Characteristics of Participant	Table-I:	Demographic	Characteristics	of Participants
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Demographic data					
Characteristics	Percentages %				
Gender					
Female	79.50%				
Male	20.50%				
Marital s	tatus				
Single	95.70%				
Married	4.30%				
Divorced	0%				
Age (ye	ars)				
25-18	88.90%				
35-26	9.40%				
45-36	0.90%				
60-46	0.90%				
others	0%				
Employmen	nt status				
Community pharmacist	28.20%				
Hospital pharmacist	0%				
Medical representative	5.10%				
Unemployed	64.10%				
Others	8.90%				
Experie	nce				
5>	93.20%				
Oct-06	5.70%				
Nov-20	1.10%				
20<	0%				
Study	y				
College student	71.80%				
Graduate	23.90%				
Master	2.60%				
PhD	1.70%				
Academic	e year				
First	1.20%				
Second	17.60%				
Third	17.60%				
Fourth	27.10%				
Fifth	36.50%				
Langua	ges				
English	90.60%				
German	17.10%				
Frensh	20.50%				
Arabic	82.10%				
Russian	2.60%				
Korean	0.90%				
Turkish	0.90%				

Most participants were females (79.5%), single (95.7%), and between 20 and 25 years old (88.9%). 64% of participants are unemployed, and 28% work in community pharmacies. Most of the survey participants are fluent in English (%90), besides their mother language, Arabic. 71.8% of surveyed participants were pharmacy students. This group is interested in evaluating awareness and knowledge about artificial intelligence in the medical field and pharmacy.

B. Participant Knowledge About AI

Firstly, the participants' comprehension regarding AI was evaluated (Table 2). Due to the rise in the popularity of social

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media platforms [39], participants were asked about their usage of such platforms [40]. As anticipated, over 80% reported using Facebook, YouTube, WhatsApp, Instagram, Telegram, and Google. Nearly 20% indicated that they utilise ChatGPT.

	Options	Percentages %
	Facebook	95.70%
	WhatsApp	92.30%
	YouTube	87.20%
	Instagram	85.50%
Applications	Telegram	96.60%
	Reddit	1.70%
	Google	79.50%
	Chat GPT	29.90%
	Nerd AI	1.70%
	Photoshop	45.10%
	Video editing	43.10%
II-bbi	Graphic design	41.20%
Hobbles	Programming	13.70%
	Data analysis	11.80%
	Technical analysis	5.90%
	Yes	0.90%
Do you know Al	No	88%
sufficiently?	Maybe	11.10%
	Yes	9.40%
Do you know the types of	No	31.60%
AI?	Maybe	59%
	Genie	6.90%
	Nerd AI	3.40%
	Chaton AI	3.40%
11	ChatBot	67.20%
nave you previously	Claude.AI	6.90%
used any of these tools?	Deepchem	1.70%
	RDkit	5.20%
	Schcödinger suite	3.40%
	Others	11.90%
Can AI be trusted to	Yes	76.90%
make crucial decisions?	No	23.10%
Do you think electronic	Yes	28.20%
tools/machines are	No	39.30%
capable of self-learning and self-improvement?	Maybe	32.50%

88% indicated that they do not feel adequately knowledgeable about artificial intelligence. Nearly 60% of those surveyed reported a lack of understanding concerning various AI types. Approximately 30% believed that technologies or machines can learn autonomously and improve themselves. AI encompasses crucial information that helps individuals develop expertise in specific digital hobbies, such as graphic design and photography. Half of those surveyed are familiar with using photo-related applications, including video editing, Photoshop, and graphic design software.

Examples of AI tools include Genie, NERD AI, CHATON AI, Chatbot, Claude AI, DeepChem, RDKit, and Schrödinger Suite [41]. Approximately 50% have used Chatbot, while only a few participants have experience with the other tools.

The second part of this section focused on the impact of artificial intelligence in the pharmacy field (Tables 3 and 4). 84.6% and 70% of respondents

recognized the implementation of AI within The healthcare sector and pharmacy.

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Table-III: Data of Concepts of Participants about AI and Pharmacy

Options	Percentages %			
Have you previously heard that AI is being integrated into				
healthcare?				
Yes	84.60%			
No	7.70%			
Maybe	7.70%			
Do you believe that is used in pharm	nacies?			
Yes	70.10%			
No	12%			
Maybe	17.90%			
In your opinion, what are the AI adva	antages?			
Making complex choices	16.20%			
Enhancing profit margins	62.40%			
Tracking patient histories remotely	70.10%			
Minimizing prescription mistakes	77.89%			
Patient examination and diagnosis	15.40%			
In your opinion, what are the AI disady	vantages?			
Reduction in job opportunities	82.10%			
Making difficult decisions without any	48 70%			
emotional input	10.7070			
High costs associated with AI tools	63.20%			
Reduced profitability	40.20%			
Which of these aspects resonates with your ethic	ical apprehensions			
regarding AI?	1			
Absence of emotions on the machine when	63.20%			
providing medicines				
Inadequate protection of personal data	55.60%			
Potential for data manipulation	59%			
An incomplete database	41.90%			
What is your imagination of 'smart ph	armacy"?			
A pharmacy that dispenses medications without	41%			
human involvement				
A pharmacy that issues prescriptions according	46.2007			
to medical directives without a pharmacist's	46.20%			
supervision				
A pharmacy that listens to patient symptoms,	26 500/			
assesses conditions, and suggests appropriate	20.30%			
A pharmacy that monitors medication				
expiration dates, removes expired drugs, and				
automates ordering from suppliers based on	70.90%			
needs				
What is your imagination of a smar	rt lab?			
A laboratory that autor amously calls -t-				
medical apparentus	16.20%			
A laboratory that automatically receives, labels,	43.60%			
and stores samples				
A laboratory that calibrates instruments, writes	59%			
test results, and analyzes data				
A laboratory that automatically receives, labels,	59.80%			
and stores samples				

Artificial intelligence (AI) has several advantages in the pharmaceutical field [42]. The participant's understanding of the benefits of AI in pharmacy was assessed. The advantages include making important decisions and examining and diagnosing patients. Regarding the drawbacks of AI in pharmacy, concerns involved the reduction in job opportunities and the high cost of AI tools [42]. The feedback concentrated on enhancing profitability (63%), providing drug-related information and side effects (70%), and minimizing prescription errors (88%). Regarding the disadvantages of AI, 82% of participants identified the main disadvantage as a decrease in job opportunities.

Table-IV: Survey Data on Participants' Thoughts about **AI in Pharmacy**

Ontions	Doroontago %			
When the physical import factory is montioned, the compare	ref centage 70			
when the phrase smart factory is mentioned, the concepts that tend to arise				
A factory/lab that years AI to determine the munity and				
concentration of active ingredients	50.40%			
A lab/factory that uses AI to formulate drug				
compounds based on their intended target (local or				
systemic) and the administration method (oral or	60.70%			
injectable)				
A facility designated for pharmaceutical packaging	47.000/			
and the automatic generation of labels	47.90%			
An AI-enhanced manufacturing establishment that				
streamlines the movement of finished	34.20%			
pharmaceuticals to distribution centres				
The subsequent actions incorporate AI within AI in the	drug discovery and			
development.				
Purification and extraction of active pharmaceutical	45 30%			
ingredients (APIs) during the preclinical stage	45.5070			
In silico analysis of drug pharmacodynamics	62.40%			
Evaluating side effects and interactions digitally 56 40%				
throughout the clinical stage	50.1070			
If smart pharmacies, smart factories, and innovative lab	os were operational,			
would you feel confident collaborating with them a	s a pharmacist?			
Yes	21.40%			
No	31.60%			
Maybe	47%			
Upon finishing this questionnaire, do you need additional education on AI?				
Yes	63.20%			
No	5.10%			
Maybe	27.40%			
I do not know	4.30%			
Do you think it is essential to include AI in pharmacy school programs?				
Yes	52.10%			
No	20.50%			
Maybe	26.50%			
I do not know	0.90%			

A smart pharmacy [43], an innovative laboratory [44], and a smart factory [45] are concepts related to AI [46].

The concept of a smart pharmacy differed widely among the participants. 70% felt that a smart pharmacy would monitor medication expiration dates, remove expired drugs, and automate restocking from suppliers based on needs. Approximately two-thirds of the respondents envisioned a smart lab capable of calibrating devices, generating test results, analyzing data, and automatically receiving, tagging, and storing samples. Regarding the smart factory, two-thirds believed that AI contributes to designing drug compounds based on target specifications and delivery methods.

Nearly two-thirds of participants believed that analysing drug pharmacodynamics and assessing side effects and interactions through digital means during the clinical phase are the next steps in integrating AI into drug discovery and development. Half of the participants expressed uncertainty about their comfort level with smart pharmacies, factories, and labs. 63% recognized the necessity for further education on AI. 53% deem it critical to incorporate AI into the pharmacy education curriculum.

IV. DISCUSSION

AI is a transformative force changing the future of education and industries

worldwide Various [47]. types of AI are employed to tackle challenges [48] and

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facilitate decision-making [49]. AI can enhance medication management [50], improve patient care quality [51], and increase efficiency in pharmacy operations [52]. Additionally, AI can strengthen interactions between patients [53] and their healthcare providers [54]. Students also benefit from AI in their studies, such as learning languages [55], editing academic research [56], gathering references [57], engaging in interactive problem-solving [58], and organizing their studies. This survey aimed to assess the knowledge of pharmacists and pharmacy students regarding artificial intelligence (AI). Most respondents were only familiar with basic tools for their daily tasks or academic inquiries. Nevertheless, only a few participants were knowledgeable about or had utilized more advanced AI applications in the pharmacy field. In our country, due to the limited use of AI in laboratories, pharmacies, and clinical settings, most participants were unaware of smart pharmacies that utilise AI for drug delivery or labs that employ AI in drug discovery. Regarding the drawbacks of AI, most participants agreed that it reduces job opportunities. However, from a personal perspective, AI may create more job opportunities by introducing new roles due to the rapid advancements in the field. As for the benefits, a vast majority agreed that AI would reduce prescription errors. However, this is not entirely accurate, as some patients require personalised monitoring and thus an application of personalised medicine.

V. CONCLUSION

The results showed that pharmacy students and pharmacists have limited knowledge about AI specialised in pharmacy, particularly in tools contributing to the discovery and development of drugs. Therefore, universities should incorporate AI as a subject in their curriculum, a recommendation supported by a significant proportion of the survey participants.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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