BJGH Brazilian Journal of Global Health
Revista Brasileira de Saúde Global

Perspectives and expectations of the use of artificial intelligence as a work tool for pharmaceutical residents in clinical pharmacy: cross-sectional study

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ABSTRACT

OBJECTIVE

To analyze the perspectives and expectations of pharmacy residents regarding the use of artificial intelligence (AI) as a work tool, identifying factors influencing their acceptance and willingness to adopt this technology in professional practice.

METHOD

This descriptive cross-sectional study included 39 pharmacy residents enrolled in multiprofessional programs in Brazil in 2024. Online questionnaires assessed their knowledge, experiences, expectations, ethical challenges, and barriers to AI implementation. Responses were analyzed for relative frequency.

RESULTS

Among the participants, 74.4% were women, reflecting the feminization trend in healthcare, and 71.8% had never used AI in practice. Regarding knowledge, 51.3% reported a medium level, while 46.2% indicated limited knowledge. Most participants expressed positive expectations, highlighting AI's potential to optimize workflows and enhance data analysis. However, significant barriers included high costs (56.4%) and resistance to change (51.3%).

CONCLUSION

AI has significant potential to transform pharmaceutical practice, improving safety and quality of care. However, its implementation requires continuous professional training, overcoming cultural and institutional barriers, and fostering an organizational culture that values both technology and the critical judgment of professionals.

KEYWORDS

Artificial intelligence; Clinical pharmacy; Pharmaceutical technology.

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INTRODUCTION

Artificial intelligence (AI) is defined as the theory and development of computer systems capable of performing tasks that normally require human intelligence. Such tasks may include speech recognition, learning; visual perception; mathematical computation; reasoning, problem-solving, decision-making, and language translation.[1] In the current context of contemporary industrial advances, the widespread use of advanced digital technologies and devices to foster innovation and generate value across multiple sectors is evident.[2] The healthcare domain is no exception to this trend. Globally, hospitals and healthcare providers are investing heavily in digital technologies such as artificial intelligence (AI), machine learning, sensors, and intelligent robots. Also notable is the use of big data analytics and the Internet of Things (IoT), applied to improve the quality of care and optimize operational efficiency.[3]

However, it is crucial to initially analyze the role that the tool can play in order to explore the opportunities and challenges associated with its applications in the healthcare sector. It is clear from the many concrete examples of AI applications that it has vast and far-reaching potential, from streamlining innovation in operational processes to the most complex patient care in emergency situations.[3]

The field of pharmacy has been adept at leveraging technological automation to improve workflow efficiency and reduce operational costs, while promoting safety, accuracy, and efficiency in a variety of pharmacy settings. Implementing automated dispensing gives pharmacists more time to interact with a greater volume of patients, while improving health outcomes.[4] The introduction of computers into the pharmacy can be traced back to the 1980s, and since then, computers have been employed in a variety of roles, including data collection, pharmacy retail management, clinical research, medication storage, pharmacy education, clinical pharmacy, among others. With the advent of AI, the long-term potential for the evolution of the pharmaceutical sector is still unknown.[4]

Focusing on Clinical Pharmacy (CP), the term emerged around 1960 in the United States and currently defines the area of pharmacy focused on optimizing drug treatments and reducing the possible risks caused by drugs. CP brings together knowledge and skills for specialized pharmaceutical practice, with the responsibility of ensuring the use of drugs appropriately in relation to patient care. It is the area focused on patient care that aims to promote, protect and restore health and prevent its complications due to the inappropriate medication use.[5]

The clinical pharmacist is a professional specialized in the rational use of drugs, which constitutes one of their areas of activity in which they contribute to patient care by reviewing and making recommendations, rationalizing drug therapy with the aim of maximizing the safety and results of pharmacotherapy, thus minimizing errors related to the use of drugs. Although prescription review represents a regulated barrier to care safety in Brazil, CP services face challenges in their implementation in a consolidated and consistent manner.[7] In this context, several tools have emerged, with AI standing out, which supports decision-making related to clinical risks, based on information contained in the electronic medical record. AI also contributes to the prioritization of patients with a greater potential for adverse events. The algorithm used classifies atypical prescriptions according to database patterns, enabling optimization and agility in the pharmacotherapy review process performed by clinical pharmacists.[8]

Therefore, the objective of this study was to analyze the perspectives and expectations of pharmacy residents regarding the use of AI as a work tool, identifying factors that influence their acceptance and willingness to adopt this technology in their professional practice.

MATERIALS AND METHODS

Study design

This is a descriptive, exploratory, cross-sectional study using a questionnaire that analyzed perspectives and expectations regarding the use of AI as a work tool in clinical pharmacy.

Data collection procedure

Data were collected through online questionnaires (via Google Forms), made available to participants. This is a convenience sample, using the snowball technique, with the survey tool sent to pharmacy residents and a request/invitation for them to share it among their peers.

As an eligibility criterion, this sample included residents (1st-year residents - R1 and 2nd-year residents - R2) regularly enrolled in the year 2024; including R1s and R2s exclusively from the pharmacy area, and excluded questionnaires that were not completed in full.

This questionnaire was constructed by the researcher and we carried out a pre-test with professionals from different and similar areas to identify and correct possible typing and comprehension errors. The pilot participants provided feedback on their experiences in order to make the questionnaire clearer.[9]

It consisted of two parts: Part A – Characterization of the participants, with identification of gender and age, and Part B – Perceptions and expectations of the use of AI, with questions that verify the understanding and experience with AI, expectations of future development, impact on routine, essential skills, perception of acceptance, challenges in adaptation, concerns about the safety of recommendations and the vision of the evolution of the professional's role with advances in health.

Data analysis

The response data were entered into an Excel spreadsheet for analysis. Relative frequency measures were calculated for each of the questionnaire questions. These measures helped to summarize and describe the participants' responses, allowing a more detailed analysis of the use of AI as a work tool for pharmacy residents in clinical practice.

Ethical aspects

Since this is a study involving human beings, it was forwarded to the Research Ethics Committee (REC) for review and approved with CAAE 80563224.1.0000.0081 and opinion number: 6.895.620. All participants who agreed to participate in the study signed the Free and Informed Consent Form, being aware that their data will be preserved and anonymized and that they could withdraw from participation at any time without any cost. In addition, all researchers involved in the study signed the Commitment and Confidentiality Form, reinforcing, in accordance with Resolution 466/2012, the responsibility for confidentiality and preservation of those involved.

RESULTS

The final sample consisted of 39 pharmaceutical residents, first-year and second-year residents of the Multiprofessional Residency Program, with characterization of the participants, such as gender identification and age. The distribution by gender showed a female predominance, with 74.4%, in terms of age group, the majority of residents were concentrated between 26 and 30 years old (43.6%) and between 21 and 25 years old (38.5%), indicating a significant presence of young professionals (Table 1).

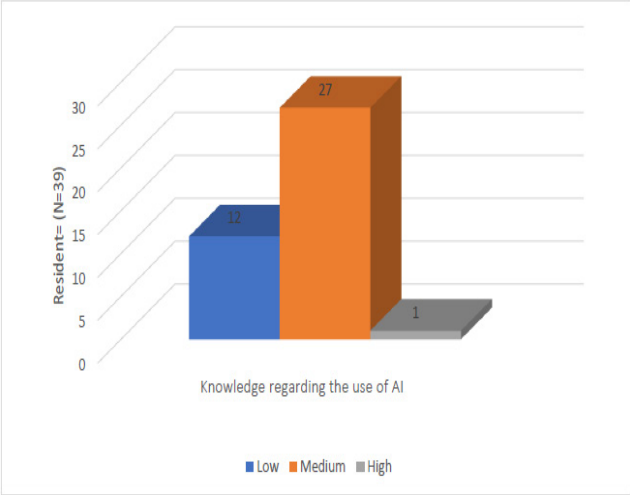
Table 1 - Results of searches conducted based on the descriptors

Variables	N°	%
Pharmaceutical Residents	39	100
Gender		
Female	29	74,4
Male	10	25,6
Age		
21-25	15	38,5
26-30	17	43,6
31-35	4	10,3
over 40 years old	2	5,1

Source: Own audit

Regarding knowledge about AI (graph 1), 20 residents (51.3%) considered their level of knowledge to be average, while 18 (46.2%) reported low knowledge. Only 1 (2.6%) stated that they had advanced knowledge of the technology.

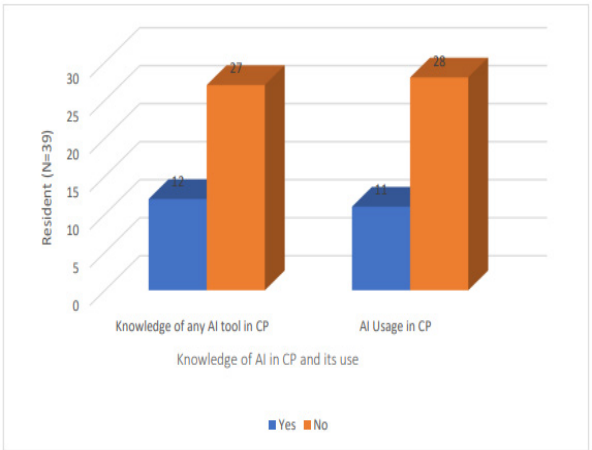
Graph 1 - Knowledge regarding the use of AI



Source: own audit

Most of the interviewees, 27 residents (69.2%), were ot aware of specific AI tools applied to clinical pharmacy (graph 2), and 28 (71.8%) had never used these technologies in their professional practice.

Graph 2 - Knowledge of AI in CP and its use



Source: own audit

Graph 3 shows the residents' perceptions about aspects related to the implementation of AI in clinical pharmacy. It was observed that most respondents (27 residents) consider AI to be faster than humans for certain tasks, while 10 stated that they were unsure about this advantage and only 2 disagreed with this premise.

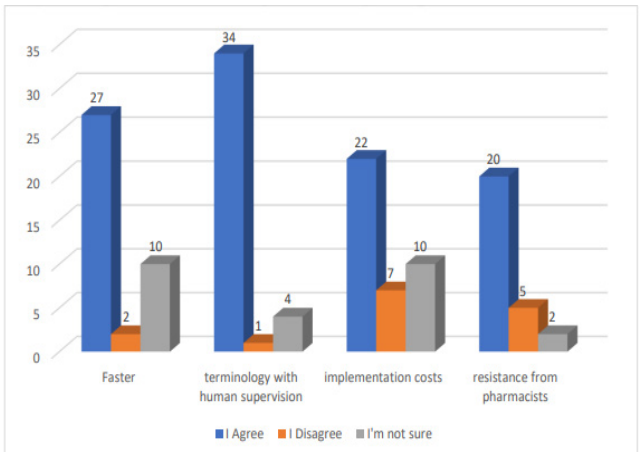
When addressing the need for human supervision over the pharmaceutical terminology used by AI, most participants (34, corresponding to 87.2%) agree that human intervention is essential to ensure accuracy and safety. On the other hand, 1 resident (2.6%) disagrees and 4 (10.3%) show uncertainty.

Regarding high costs as a barrier to the adoption of AI in clinical pharmacy, 22 (56.4%) identified this factor as significant, while 7 (17.9%) do not consider costs a limitation, and 10 (25.6%) indicated doubt about the influence of costs.

Regarding pharmacists' resistance to technological changes, 20 participants (51.3%) recognized this resistance as a relevant obstacle, while 14 (35.9%) demonstrated uncertainty and 5 (12.8%) disagreed.

It is important to highlight that these perceptions reflect personal opinions and not necessarily practical experience with specific AI tools in FC, considering that not all participating residents have direct contact with technologies of this nature. Therefore, the results should be interpreted as indicators of perceptions and expectations, and not as a technical evaluation based on the actual use of these tools.

Graph 3 - Agreement and disagreement regarding AI in CP



Source: own audit

Regarding Table 2, the description of the results followed the order of the questions:

In question 1: "In your opinion, how else can AI help in CP?", the participants presented evenly distributed answers. Fifteen (38.5%) pointed out the usefulness of AI in the collection of reports, while 12 (30.8%) highlighted the improvement of pharmacotherapeutic monitoring. Another 12 (30.8%)

mentioned prioritization to filter prescriptions as a relevant application.

In question 2: "How do you believe AI will be able to impact the routine and responsibilities of the clinical pharmacist in the future?", time optimization was the most cited answer, with 27 (69.2%) of the participants recognizing this benefit. On the other hand, 3 (7.7%) expressed concern about excessive dependence on technology. In addition, 9 (23.1%) believe that AI will be able to expand the scope of the clinical pharmacist's work.

In question 3: "Expectations of the application of AI in CP", 26 (66.7%) of the participants highlighted the impact of AI on greater pharmaceutical intervention. Next, 9 (23.1%) mentioned the reduction of prescription errors, while 4 (10.3%) considered greater effectiveness in monitoring as the main benefit.

In question 4: "Concerns generated by the use of AI", 26 (66.7%) reported the loss of clinical reasoning ability and use of evidence as the main concern. Another 6 (15.4%) pointed out the lack of transparency in algorithms, while 7 (17.9%) highlighted the risk of security threats.

In question 5: "Factors that influence the implementation of AI", complexity in regulation was the most cited factor, with 20 (51.3%). Integration between systems was mentioned by 11 (28.2%), while lack of evidence and concerns about privacy and data security were indicated by 4 (10.3%) each.

Table 2 – Perceptions and expectations of pharmaceutical residents regarding the use of AI in CP.

Question	Response	N (%)
1. In your opinion, how else can AI help in CF?	In improving pharmacotherapeutic monitoring In collecting reports In prioritizing and filtering prescriptions	12 (30,8) 15 (38,5) 12 (30,8)
2. How do you believe AI will impact the routine and responsibilities of clinical pharmacists in the future?	In optimizing time In excessive dependence on technology Expanding the scope of action	27 (69,2) 3 (7,7) 9 (23,1)
3. Expectations of AI application in CP	Reduction in prescription errors Greater number of interventions Greater effectiveness in monitoring	9 (23,1) 26 (66,7) 4 (10,3)
4. Concerns generated	Loss of clinical reasoning skills and use of evidence Lack of transparency in algorithms Possible threat	26 (66,7) 6 (15,4) 7 (17,9)
5. Factors that influence the implementation of AI	Integration between systems Complexity in regulation Lack of evidence Data privacy/security	11 (28,2) 20 (51,3) 4 (10,3) 4 (10,3)

Source: own audit

DISCUSSION

The discussion of this study highlights that, even with limited familiarity with AI, pharmacy residents support its transformative potential in clinical pharmacy. They pointed out relevant contributions, especially in the management of pharmacotherapeutic monitoring, in line with global trends in technological innovation in health.

Although the practical application of AI in CP is still in its early stages, the results observed in other areas of health reinforce its predictions and positive impact. In studies conducted with radiologists, for example, AI has demonstrated effectiveness in the analysis of diagnostic images, simplifying diagnostic time and increasing accuracy in 85% of cases.[10] In nursing, AI technologies have been used to monitor restricted signals in real time, allowing immediate interventions and minimizing adverse events in intensive care units.[11]

These advances suggest that, despite the initial lack of knowledge of some participants, the development of AI may be a promising tool in CF. Its implementation depends on continuous processes of familiarization, training and integration with the already conditioning practices, allowing a gradual and effective adoption that maximizes the expected benefits.[11] Overcoming these difficulties, together with professional training, is essential to ensure that AI effectively complements pharmacy practice, promoting safer and more efficient care.

However, as observed in this research, the adoption of AI faces significant challenges that go beyond the local context, reflecting global concerns. Most residents mentioned difficulties related to high costs and cultural resistance, which is in line with international studies. In fact, Chen and Loh (2020)[11] observed that more than 60% of health professionals reported resistance to AI due to ethical concerns and fear of professional replacement. In addition, studies highlight that the lack of specific software and hardware and the high operational cost of AI, as pointed out by Alsobhi *et al*. (2022)[12], are critical barriers. These challenges include not only equipment expenses, but also costs related to software development and technical training, which limit adoption.[12]

These factors reinforce that, despite the transformative potential of AI, its successful implementation requires strategies that overcome financial and cultural barriers. Robust financial support, careful integration into professional practice, and ongoing training efforts are needed for AI to complement and enrich the work of clinical pharmacists, promoting safer and more efficient patient-centered care.[12]

Pharmacists limited familiarity with AI is another crucial factor, as insufficient training limits their ability to integrate the technology with confidence and safety into clinical practice. Resolution No. 10/24 of the Federal Council of Pharmacy (FCP) encourages ongoing training in emerging technologies, such as AI, emphasizing that these skills are essential for professional development and to ensure that AI complements, rather than replaces, pharmacists' clinical judgment.[13] The importance of ongoing training is corroborated by studies with nurses and physicians who use AI in diagnostics and clinical decision support, where the lack of training and complete understanding of the technology resulted in additional challenges and inadequate use of available systems.[14]

Another important point of the research was the concern about over-reliance on AI, which can compromise professional autonomy and evidence-based practice. A study conducted with healthcare professionals in Germany highlighted that, although AI optimizes decision-making processes, its implementation requires caution so as not to compromise professionals' critical thinking skills, a vital aspect in making informed and humanized decisions. This same study established that AI should serve as a support tool, with active involvement and supervision of healthcare professionals, en-

suring that the use of technology is a complement to clinical judgment, not a substitute.[15]

CONCLUSION

The study demonstrated that, although pharmacy residents have little knowledge about AI and its use in CP, their perspectives are positive regarding the impact of this technology on clinical practice. AI is perceived as a promising tool to improve safety, efficiency and quality in pharmacotherapy monitoring, contributing to the reduction of prescribing errors and optimization of pharmaceutical interventions. However, significant barriers, such as high implementation costs and resistance to technological change, were highlighted as challenges.

In addition, the scarcity of studies in the scientific literature on the use of AI in CP makes it difficult to objectively assess its effectiveness and limits the basis for its implementation in practice. This absence reinforces the need for more robust and evidence-based research to explore the potential of AI in this field, since the conclusions of this study are predominantly based on the perceptions and expectations of residents, and not on technical analyses of the performance of these tools.

In this context, Resolution No. 10/24 of the Federal Pharmacy Council (FPC) plays a fundamental role in encouraging continued training in emerging technologies, such as AI, and in reinforcing the importance of pharmacists' clinical judgment in the use of these tools. This initiative is crucial to overcome limitations related to technical training and to ensure that AI is effectively and ethically integrated into professional practice.Only then will it be possible to unlock the full transformative potential of AI, ensuring that it functions as a support for CP, without compromising the autonomy and clinical reasoning of pharmaceutical professionals.

ACKNOWLEDGEMENTS

First, I would like to thank God, who gave me the health, strength and wisdom to complete this work.

I am immensely grateful to my advisor, Dr. Paula Yuri Sugishita Kanikadan, for her dedicated guidance, patience and valuable contributions that were essential to the development of this study. Her trust and support were fundamental to the success of this project.

I would also like to thank my co-advisor, Dr. Débora Driemeyer Wilbert, for her essential contribution, support and enriching guidance, which were crucial to the construction of this work, both of which were fundamental to my academic and professional growth.

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