

The Intersection of Artificial Intelligence with Pharma and Biochemistry: Implications of CHATGPT in Scientific Research

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Abstract

By means of this document, it was possible to analyze the main characteristics of the volume of scientific production related to the study of the variables Artificial Intelligence and Pharmacy. A bibliometric analysis was proposed to analyze details such as Year of Publication, Country of Origin of the publication, Area of Knowledge in which the published research is carried out and the Type of Publication most frequently used by the authors of each document published in high-impact journals indexed in the Scopus database during the period between 2017 and 2022. Among the main findings, it was possible to determine that, for the execution of the different research methodologies, the report of 202 scientific documents related to the study of the use of AI in the area of Pharmacy and Biochemistry was achieved. The maximum number of publications made in a year was 56 papers submitted in 2022. The country of origin of the institutions that reported the highest number of records in Scopus was the United States, with 44 documents. The area of knowledge with the greatest influence at the time of executing the research projects that resulted in scientific publications was Medicine, which contributed great theoretical material in a total of 93 publications. Finally, the type of publication most frequently used to publicize findings from the analysis of the aforementioned variables was the Journal Article, which represented 39% of the total scientific production.

Keywords: Artificial Intelligence, Pharmacy, Biochemistry, ChatGPT.

1. Introduction

The rapid advancement of artificial intelligence has unleashed a transformative wave in various industries, and the fields of pharmacy and biochemistry are no exception. AI technologies have begun to revolutionize the way pharmaceutical research and biochemical studies are conducted, offering unprecedented opportunities for innovation, efficiency, and discovery. At the forefront of this intersection is ChatGPT, an AI model developed by OpenAI. The integration of ChatGPT into scientific research brings with it a multitude of implications that promise to accelerate progress in pharmacy and biochemistry.

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Pharmacy and biochemistry are linked disciplines that play critical roles in the development of new drugs, the understanding of biological processes, and the advancement of medical science. Traditionally, these fields have relied heavily on expensive, time-consuming, and labor-intensive experimental methods. However, AI has emerged as a revolutionary element, capable of augmenting and even surpassing human capabilities in various aspects of research and analysis.

One of the most notable applications of AI in pharmacy and biochemistry is the prediction of molecular structures and properties. ChatGPT, with its natural language processing capabilities, can interact with researchers to generate hypotheses, design experiments, and offer insights into complex molecular structures. His in-depth knowledge of chemical concepts allows him to assist scientists in drug discovery by suggesting potential chemical compounds that exhibit specific properties or interact with target molecules. Not only does this speed up the drug development process, but it also allows researchers to explore novel avenues that may have gone unnoticed with traditional methods.

Another critical facet of AI's impact in these fields is data analytics. Pharmacy and biochemistry generate vast amounts of data from experiments, clinical trials, and genetic studies. ChatGPT's ability to analyze and interpret this data quickly and accurately is invaluable. It can help researchers identify patterns, correlations, and trends within these datasets, helping to uncover critical insights into disease mechanisms, drug interactions, and patient outcomes. In addition, the AI model can help automate routine data processing tasks, freeing up scientists to focus on more creative and intellectually demanding aspects of their work.

The potential of AI-powered virtual labs is yet another frontier at the confluence of AI, pharma, and biochemistry. ChatGPT can simulate *in silico* experiments, providing a safe and cost-effective environment for testing hypotheses and refining research protocols. Not only does this reduce the need for physical experimentation, but it also minimizes the risks associated with working with hazardous substances, thus improving safety in research laboratories. In addition, ChatGPT plays a vital role in spreading knowledge and collaboration within the scientific community. It can help researchers access up-to-date information from a wide range of scientific literature, facilitating literature reviews, citation recommendations, and summaries of research findings. Its language translation capabilities also bridge language barriers, enabling collaboration between scientists around the world and ultimately accelerating the pace of scientific discovery. For this reason, this article seeks to describe the main characteristics of the compendium of publications indexed in the Scopus database related to the variables Artificial Intelligence and Pharmacy, as well. Such as the description of the position of certain authors affiliated with institutions, during the period between 2017 and 2022.

2. General Objective

To analyze, from a bibliometric approach, the characteristics in the volume of scientific production related to Artificial Intelligence and Pharmacy, registered in Scopus during the period 2017-2022.

3. Methodology

This article is carried out through a research with a mixed orientation that combines the quantitative and qualitative method.

On the one hand, a quantitative analysis of the information selected in Scopus is carried out under a bibliometric approach of the scientific production corresponding to the study of Artificial Intelligence and Pharmacy.

On the other hand, examples of some research works published in the area of study mentioned above are analyzed from a qualitative perspective, based on a bibliographic approach that allows describing the position of different authors on the proposed topic.

It is important to note that the entire search was carried out through Scopus, managing to establish the parameters referenced in Figure 1.

3.1 Methodological design



Figure 1. Methodological design

Source: Authors' own creation

3.1.1 Phase 1: Data collection

Data collection was carried out from the Search tool on the Scopus website, where 202 publications were obtained from the following filters:

TITLE-ABS-KEY (artificial AND intelligence, AND pharmacy) AND PUBYEAR > 2016 AND PUBYEAR < 2023

- Published documents whose study variables are related to the study of Artificial Intelligence and Pharmacy
- Works published in journals indexed in Scopus during the period 2017-2022.
- Without distinction by country of origin
- No distinction in areas of knowledge.
- No distinction of type of publication.

3.1.2 Phase 2: Construction of analytical material

The information collected in Scopus during the previous phase is organized and then classified by graphs, figures and tables as follows:

- Co-occurrence of Words.
- Year of publication.
- Country of origin of the publication.
- Area of knowledge.
- Type of Publication.

3.1.3 Phase 3: Drafting of conclusions and outcome document

In this phase, the results of the previous results are analysed, resulting in the determination of conclusions and, consequently, the obtaining of the final document.

4. Results

4.1 Co-occurrence of words

Figure 2 shows the co-occurrence of keywords found in the publications identified in the Scopus database.

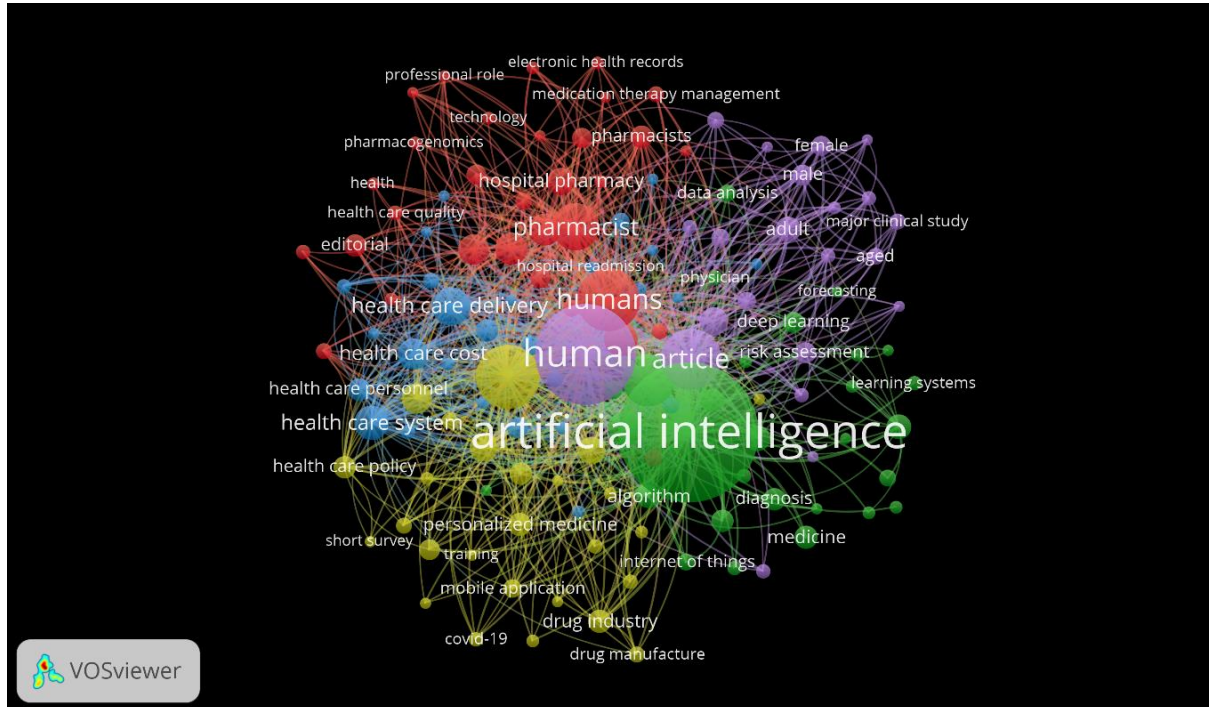


Figure 2. Co-occurrence of words

Source: Authors' own elaboration (2023); based on data exported from Scopus.

Artificial Intelligence was the most frequently used keyword within the studies identified through the execution of Phase 1 of the Methodological Design proposed for the development of this article. Pharmacy is among the most frequently used variables, associated with variables such as Personalized Medicine, Diagnosis, Biochemistry, Data Analysis, Risk Assessment, ChatGPT. From the above, he argues, the intersection of artificial intelligence, pharmacy and biochemistry represents a profound shift in the way research and innovation occur in these fields. ChatGPT, as a cutting-edge AI model, offers a powerful tool that enables scientists to tackle complex challenges, optimize processes, and explore new frontiers in understanding and treating disease. ChatGPT's implications for scientific research go far beyond mere automation; They encompass the potential to unlock previously inaccessible knowledge, drive innovation, and improve the quality of life for millions of people through the development of new pharmaceuticals and advances in biochemistry. As we delve deeper into the implications of this transformative technology, it becomes clear that the synergy between AI and these disciplines is the key to a brighter future in healthcare and scientific exploration.

4.2 Distribution of scientific production by year of publication

Figure 3 shows how scientific production is distributed according to the year of publication.

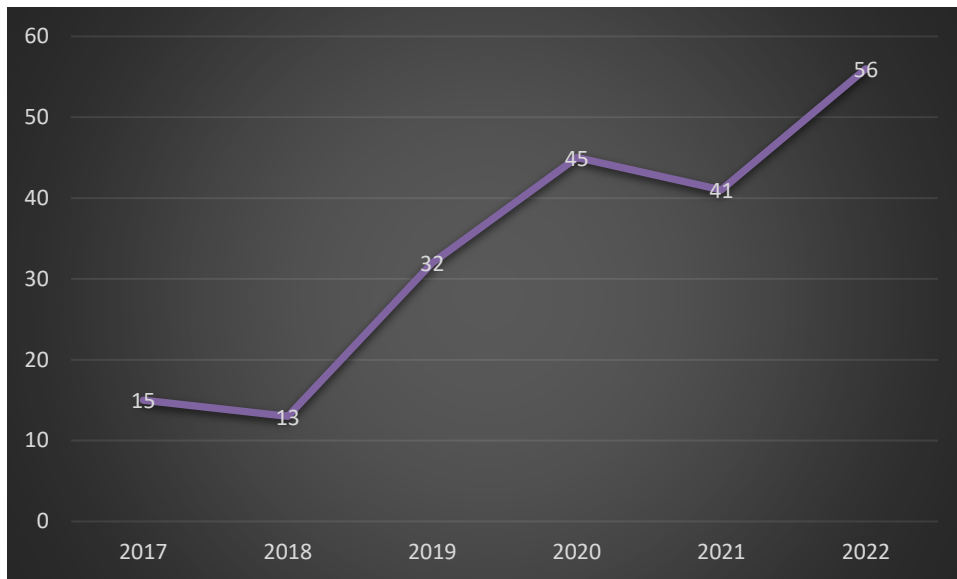


Figure 3. Distribution of scientific production by year of publication.

Source: Authors' own elaboration (2023); based on data exported from Scopus

Among the main characteristics evidenced through the distribution of scientific production by year of publication, the number of publications registered in Scopus was in 2022, reaching a total of 56 documents published in journals indexed on this platform. The above can be explained thanks to articles such as the one titled "ChatGPT Performance in Pharmacist Licensing Examination in Taiwan", this article aims to examine the accuracy of ChatGPT in the Taiwan pharmacist licensing exam and investigated its potential role in pharmacy education. Methods: ChatGPT was used in Taiwan's first pharmacist licensing exam in 2023 in Mandarin and English. The questions were manually entered one by one. Graphical questions, chemical formulas and tables were excluded. Textual questions were scored according to the number of correct answers. Graph question scores were determined by multiplying the number and correct rate of text questions. This study was conducted from March 5 to March 10, 2023, using ChatGPT 3.5. Results: ChatGPT's success rate on the Chinese and English questions was 54.4% and 56.9% in the first stage, and 53.8% and 67.6% in the second stage. In the Chinese language exam, only the pharmacology and pharmacochimistry sections obtained passing scores. English test scores were higher than Chinese tests in all subjects and were significantly higher in dispensing pharmacy and clinical pharmacy, as well as therapeutics. Conclusion: ChatGPT 3.5 failed Taiwan's pharmacist licensing exam. Although you can't pass the exam, you can improve quickly using deep learning. It reminds us not only to use multiple-choice questions to assess a pharmacist's ability, but also to use a wider variety of assessments in the future. Pharmacy education should be modified according to exams, and students should be able to use AI technology for self-study. (Wang, 2023)

4.3 Distribution of scientific production by country of origin.

Figure 4 shows how the scientific production is distributed according to the nationality of the authors.

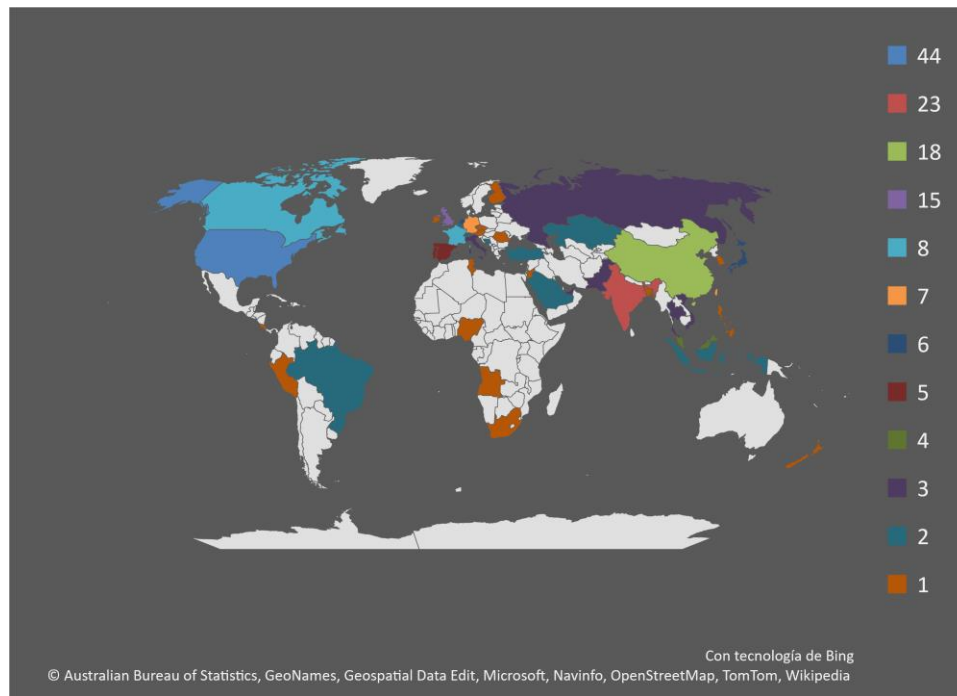


Figure 4. Distribution of scientific production by country of origin.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

Within the distribution of scientific production by country of origin, the registrations from institutions were taken into account, establishing the United States as the country of this community, with the highest number of publications indexed in Scopus during the period 2017-2022, with a total of 44 publications in total. In second place, India with 23 scientific papers, and China in third place presenting to the scientific community, with a total of 18 papers among which is the article titled "ChatGPT applications in medical, dental, pharmaceutical and public health education: a descriptive study highlighting the advantages and limitations" The aim of this descriptive study was to investigate the pros and cons of using ChatGPT in medical education, dental, pharmaceutical and public health. Based on an expert panel's discussion and review of existing literature, specific and concise ChatGPT prompts were constructed and responses were generated on February 25, 2023. Our data suggested that in medical education, the benefits of ChatGPT included the possibility of improving personalized learning, clinical reasoning, and understanding of complex medical concepts. Benefits listed in the context of dental education included improved skills through step-by-step instructions and interactive content, with instant feedback on students' techniques. In pharmacy education, advantages included possible explanations of complex topics and the deployment of interactive tools that help develop skills for patient counseling. In public health education, the benefits listed included providing case explanations and scenarios, as well as improving skills in data analysis and literature review. The limitations listed based on ChatGPT-generated content were common across all healthcare disciplines investigated and included data privacy issues, risk of generating biased and inaccurate content, and the risk of impairment of critical thinking and communication skills among healthcare students. The expert panel found ChatGPT-generated content partially useful in the context of health education. However, the content generated by ChatGPT overlooked several important points related to the pros and cons of using ChatGPT in medical, dental, pharmaceutical, and public health education, including: the risk of plagiarism, copyright issues, the risk of academic dishonesty, and the lack of personal and emotional interactions necessary to develop proper communication skills in healthcare education(Sallam, 2023)

4.4 Distribution of scientific production by area of knowledge

Figure 5 shows the distribution of the elaboration of scientific publications based on the area of knowledge through which the different research methodologies are implemented.

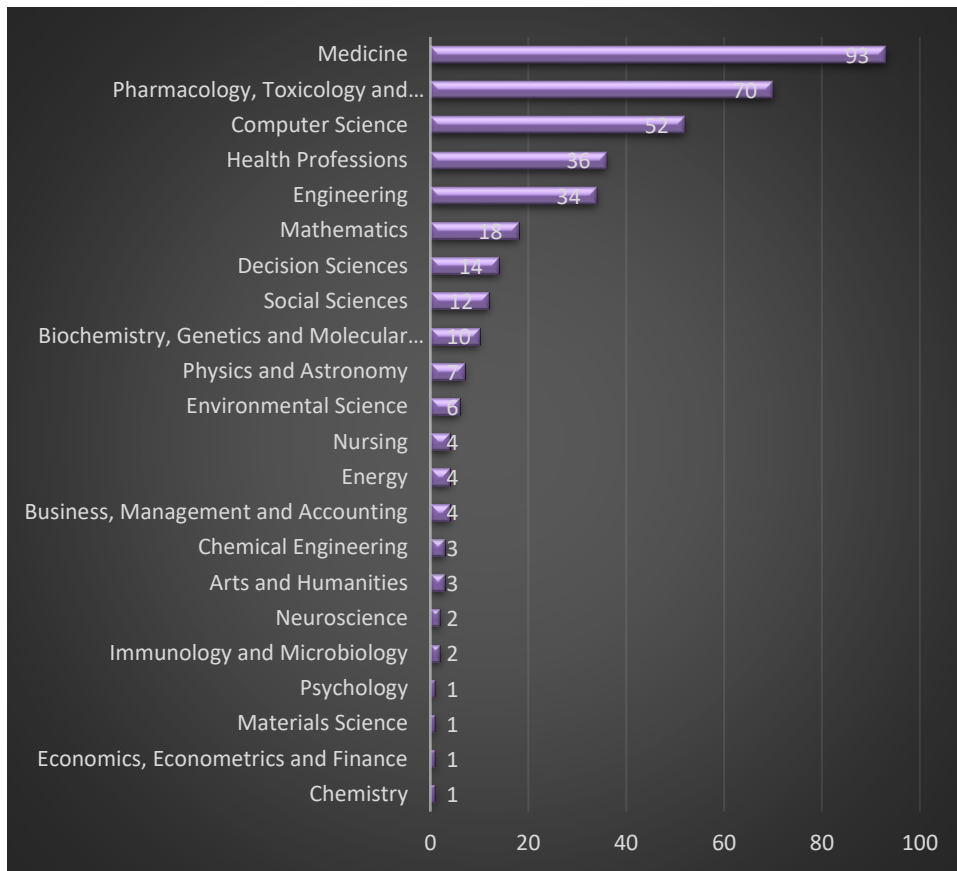


Figure 5. Distribution of scientific production by area of knowledge.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

Medicine was the area of knowledge with the highest number of publications registered in Scopus, with a total of 93 documents that have been based on its variable methodologies: Artificial Intelligence and Pharmacy. In second place, Pharmacology, Toxicology and Pharmacy with 70 articles and Computer Science in third place with 52. The above can be explained thanks to the contribution and study of different branches, the article with the greatest impact was registered by the area of Medicine entitled "Evaluation of the perceptions and willingness of community pharmacists to integrate ChatGPT into their pharmaceutical practice: a study of Jordan" This study aimed to examine the degree of knowledge of community pharmacists about the generative pre-training transformer of chat (ChatGPT), their willingness to embark on this new development of artificial intelligence (AI) and the barriers they face in incorporating this unconventional source of information into pharmaceutical practice. Methods: A cross-sectional study was conducted among community pharmacists in Jordanian cities between April 26, 2023 and May 10, 2023. Convenience and snowball sampling techniques were used to select study participants due to time and resource constraints. The questionnaire was distributed by research assistants through popular social media platforms. A logistic regression analysis was used to assess predictors affecting their willingness to use this service in the future. Results: A total of 221 community pharmacists participated in the current study (response rate was not calculated because voluntary recruitment strategies were used). Surprisingly, nearly half of pharmacists ($n = 107$, 48.4%) indicated a willingness to incorporate ChatGPT into their pharmacy practice. Nearly half of pharmacists ($n = 105$, 47.5%) demonstrated a high perceived benefit score for ChatGPT, while approximately 37% of pharmacists ($n = 81$) expressed a high concern score for

ChatGPT. More than 70% of pharmacists believed that ChatGPT lacked the ability to use human judgment and make complicated ethical judgments in its responses (n = 168). Finally, logistic regression analysis showed that pharmacists who had prior experience using ChatGPT were more willing to integrate ChatGPT into their pharmacy practice than those with no prior experience using ChatGPT (odds ratio 2.312, P = 0.035). (Abu-Farha, 2023)

4.5 Type of publication

In the following graph, you will see the distribution of the bibliographic finding according to the type of publication made by each of the authors found in Scopus.

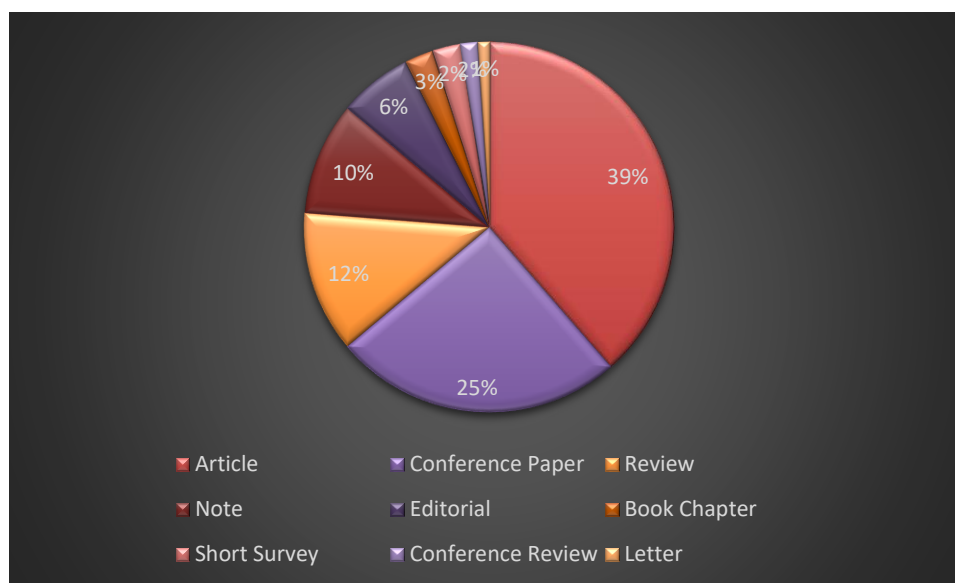


Figure 6. Type of publication.

Fountain: Authors' own elaboration (2023); based on data provided by Scopus.

The type of publication most frequently used by the researchers referenced in the body of this document was the one entitled Journal Articles with 39% of the total production identified for analysis, followed by Session Paper with 25%. Journals are part of this classification, representing 12% of the research papers published during the period 2017-2022, in journals indexed in Scopus. In this last category, the one entitled "Psychometric properties and assessment of knowledge, attitude, and practice towards ChatGPT in pharmaceutical practice and education: a study protocol" stands out. This protocol aims to describe the development, validation, and use of a tool to assess knowledge, attitude, and practice towards ChatGPT (KAP-C) in pharmacy practice and education. The KAP-C tool development and validation process will include a thorough literature search to identify relevant constructs, content validation by a panel of experts for item relevance using the Content Validity Index (CVI), and facial validation by sample participants for item clarity using the Content Validity Index. Validity Index (FVI), Readability and Difficulty Index using the Flesch-Kincaid Readability Test, Gunning Fog Index or Simple Gobbledygook Measure (SMOG), Reliability Assessment Using Internal Consistency (Cronbach's Alpha), and Exploratory Factor Analysis (EFA) to determine the underlying factor structures (eigenvalues, scree graph analysis, factor loads, and varimax). The second phase will use the validated KAP-C tool to conduct KAP surveys among pharmacists and pharmacy students in selected low- and middle-income countries (LMICs) (Nigeria, Pakistan and Yemen). The final data will be analyzed descriptively using frequencies, percentages, mean (standard deviation) or median (interquartile range) and inferential statistics such as Chi-square or regression analysis using IBM SPSS version 28. (Mohammed, 2023)

5. Conclusions

Through the bibliometric analysis carried out in this research work, it was possible to establish that the United States was the country with the highest number of records published in the Artificial Intelligence and Pharmacy variables. with a total of 44 publications in the Scopus database. In the same way, it was possible to establish that the application of theories framed in the area of Medicine, were used more frequently in how the integration of ChatGPT has transformed the changes of countless industries with emphasis on pharmaceuticals, allowing these large companies to adapt and evolve our pharmacological discoveries more effectively and allowing personalized medicine with greater precision. In the field of pharmaceutical production, the implementation of artificial intelligence such as ChatGPT provides great development to the industry, allowing the safety of essential components for manufacturing in an efficient and effective way and also reducing manufacturing time, over costs associated with traditional manufacturing methods such as trial and error. The infinite number of algorithm interfaces used by artificial intelligence has the quality of being able to analyze large amounts of data immediately, including molecular structures, biological pathways, being able to identify drug targets, efficiency and optimize pharmacology formulations. In biochemistry, this intersection of artificial intelligence can help to understand complex biological processes and thus be able to predict protein structures. Using the information interface provided by ChatGPT, such as machine learning, it can analyze large amounts of data sets and information, identifying what the shortcomings in the research processes may be. This would also make it possible to find new molecular markers that provide knowledge about the mechanisms of different diseases. Artificial language can generate powerful tools for information gathering, data collection, and hypothesis generation in the fields of pharmacology and biochemistry, thus facilitating scientific research. It can assist with literature reviews, help researchers sift through large volumes of scientific literature, and quickly retrieve relevant information. ChatGPT can also generate hypotheses, propose experimental designs, and help interpret research results. However, it's important to understand that AI technology like ChatGPT also has its limitations. They are based on the data they were trained on, and biases or inaccuracies in the training data can affect their results. Therefore, it is very important to validate and critically evaluate the results generated by artificial intelligence models, especially in the context of scientific research.

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