Artificial Intelligence in Pharmacy Practice

Ms. Ankita S. Thube[1], Ms. Pratiksha D. Thube[1], Ms. Mayuri J. Deore[2]
SSJP Shri Sai College of Pharmacy ,Khandala,[1]
SSJP Shri Sai College of Pharmacy khandala, (Dept: pharmaceutical chemistry),[2] Tal. Vaijapur, Dist. Chh. Sambhajinagar -423 701 Maharashtra, India

ABSTRACT

Artificial intelligence (AI) is transforming pharmacy practice by increasing efficiency, accuracy, and personalization of care.AI applications in pharmacy help to optimize operation by automating prescription verification, predicting medication adherence, reducing dispensing error, and enabling real-time inventory control.Artificial Intelligence The main goal of AI is to create intelligence, which aids in decision-making and the visualization of knowledge—cracking issues. AI is crucial to many pharmacy domains, including formulation development, drug delivery, and discovery. Artificial intelligence, hospital pharmacy accidents, and polypharmacology all hinder research and development by speeding up the process, cutting costs, and raising success rates.

Keyword: Artificial intelligence, Drug discovery, Pharmacy practice, Safety, medication management, Ethical issues.

INTRODUCTION

Artificial intelligence By improving medication management, optimizing workflows, and enhancing patient safety and outcomes, artificial intelligence is rapidly changing pharmacy practices. To ensure data-driven therapy this season, optimize therapy, and reduce medication, a believing pharmacist is integrating AI technology, such as machine learning and natural language processing, into various aspects of pharmacy practices. (1) Artificial Intelligence (AI) is the ability of machines to perform tasks like sensing, thinking, learning, and decision-making that typically require human intelligence. (2)

The use of AI technology in pharmacy practice, a crucial component of the health care system, can be very advantageous. Medication management, patient counselling, and medication safety are all aspects of healthcare that pharmacy practice contributes to. Medication errors, drug interactions, and suboptimal medication are just a few of the amusing issues that the traditional pharmacy practice faces. These issues can have serious health consequences for patients, and technology is a promising solution to these problems and pharmacy practice. (3)Artificial intelligence (AI) is technology that is revolutionizing. a number of industries, including health care. AI has the potential to significantly improve medication management and special care in pharmacy practice.(4)

There is no more crucial industry when it comes to saving lives than the pharmaceutical industry, which uses clinical trial data analysis techniques to increase their success in meeting client requests and expectations. Medical emergencies such as the current pandemic and other global health care issues necessitate ongoing innovation and the application of new technologies. (5)The field of artificial intelligence (AI) is concerned with the development and use of algorithms for information analysis and interpretation. It is the use of advanced computer algorithms to perform tasks like humans, such as making observations and interpretations. It is based on an understanding of intelligent behavior and the creation of algorithms that exhibit such behavior. What AI does is to identify potential problems and provide various options to solve them. (6) AI systems can help organize dosage forms, routes of administration, or treatment plans in a better way and provide guidance to physicians. Algorithms could be used to standardize prescriptions by checking their appropriateness with the latest guidelines by updating the operating system from time to time. Machines with AI incorporated can also be applied for predicting and analyzing the outcomes of the treatment plan for various diseases and disorders. (7)

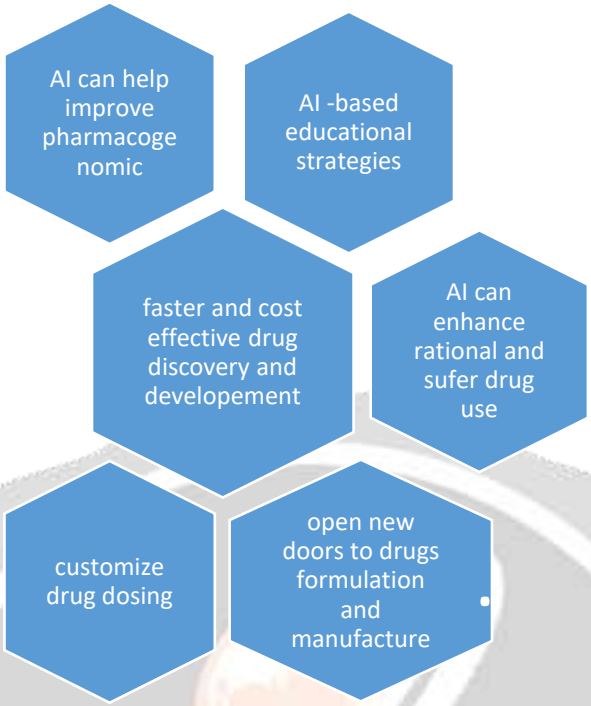

Fig. 1. Drug discovery and devalopment

Treatment is quickly shifting from the traditional patient-centered approach. These can be further successful by the integration of technologies such as AI to suit the needs of personalized medicine, from progressing through medical examination, preventive monitoring, drug dosage adjustment, and customized treatment plans for the patient. [8]

METHODOLOGY

shows the methodical approach used to find, select, and extract the most current and pertinent research on AI applications in pharmacy practices. This procedure guarantees a thorough and current analysis of the field's developments, difficulties, and new trends.[9]

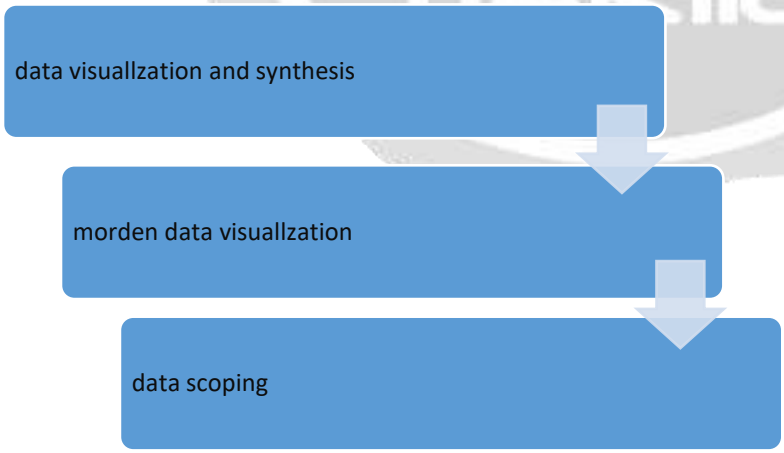

Fig.2. Methodology stageses

Using cutting-edge internet and AI-powered search tools, we carried out an extensive literature review to investigate the most recent developments, difficulties, and uses of AI in pharmacy and drug discovery.[10] These resources included

repositories like arXiv and ResearchGate, specialized AI-driven literature platforms like PubMed, Scopus, Web of Science, and Semantic Scholar, and contemporary search engines.The most pertinent, current research published in peer-reviewed journals and preprint archives was retrieved thanks to the use of AI search algorithms. [11]By gathering data from multidisciplinary databases, including those in the computer science, pharmaceutical, and medical fields, we methodically scoped the data. Diverse viewpoints on AI applications in pharmacy were covered thanks to this step.[12] AI in drug discovery, "machine learning in pharmacy," "challenges in AI for pharmaceuticals," and "modern AI applications" were among the keywords and Boolean operators used in the search. Important details about applications, techniques, and difficulties are extracted using a methodical approach. [13]

MACHINE LEARNING

One modern use of AI is machine learning, which advances the possibility of providing machines with data so they can learn things on their own and make human labor easier. One of the main characteristics of artificial intelligence is learning. It is the machines' capacity to use feedback and real-time data to gradually improve performance. [14]

One kind of artificial intelligence is machine learning, which can learn from data and produce quality results. When ideas like big data, data science, and analysis come to mind, the terms artificial intelligence and machine learning are frequently used together. [15] In multinational industries, machine learning is a very effective way to manage such large amounts of data. In fact, they function similarly to a super computer.These devices, commonly referred to as "Humanoids," are extremely skilled at what they do. These machines/robots are capable of speaking, responding to complicated queries, and performing several tasks simultaneously.

Diagram illustrating the mechanism of machine learning The diagram illustrates how machine learning depends not only on the knowledgeable engineer's performance on training bases but also on how he conducts new experiments. [16] One of the most significant technical approaches to AI is machine learning, which serves as the foundation for numerous recent developments and business uses of AI. The statistical method of modern machine learning aids in defining the output and potential applications of data. [17]

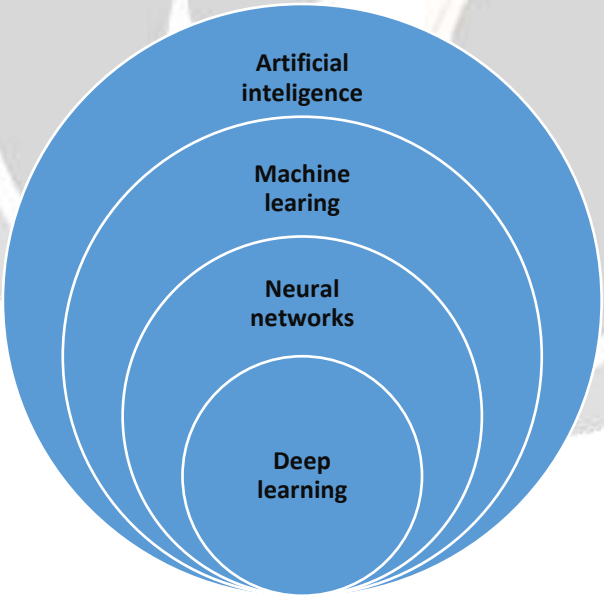

Fig.3. Machine learning

- **Artificial intelligence:** allows a system to automatically learn and improve from experience.
- **Machine Learning:** allows a system to automatically learn and improve from experience.

- **Neural Networks:** Allows programs to recognize patterns and solve common problems AI, ML and DL.
- **Deep learning:** allow to complex algorithms and deep neutral nets to train a model. [18]

AI FUNCTION

For the purposes of this systematic literature review, we concentrate on the functions of AI as described by Dejoux and Leon (2018), despite the fact that it is currently difficult to agree upon a definition of AI. Table 1. below illustrates the wide range of functions. [19]

Title	Description	Example
Robotics	Focused on creating computer controlled movements of tangible objects in a range of environments.	Robotic services
Experts system (ES)	Designed to stimulate the problem solving behavior of a human.	DENDRAL: An expert system for molecular prediction in chemical analysis.
Machine learning	Automatically improve its techniques and outcome asit gathers more information.	Many of the more sophisticated recommendation system, like You Tube and Google.
Natural Language Processing (NLP)Designed to understand and	Designed to understand analyse language as used by humans. The foundation of AI-powered speech recognition is NLP.	Intelligent agents, such as Apple's siri and amazon alexa.
Machine vision	The application of algorithmic inspection to image analysis.	The autonomous vehicle computer vision system.
Speech recognition	Can be interpreted as a method that addresses the conversion of spoken words into written language.	Google dictate translate spoken words into text using speech recognition.

Table 1. AI functions.

SUMMARY AND CONCLUSION

From a theoretical idea, artificial intelligence has quickly developed into a powerful force that influences almost every facet of contemporary life. Its capacity to evaluate information, automate difficult jobs, and support human judgment keeps opening up new possibilities in industry, education, healthcare, and science. However, as AI becomes more powerful, it also brings up significant issues regarding privacy, justice, ethics, and the nature of work in the future. In addition to innovation, responsible development and careful governance are also necessary for the future. The impact of AI will ultimately depend on how intelligently society decides to incorporate it, maximizing its potential for advancement while making sure it stays in line with human values.

REFERENCE

1. Schöning V, Khurana A, Karolak A. Editorial: Spotlight on artificial intelligence in experimental pharmacology and drug discovery. Frontiers in Pharmacology. 2023 Aug 28;14.

2. S, Bahadduri P, Fretland J, Lu C. 2020 FDA Drug-Drug Interaction Guidance -Comparison Analysis and Action Plan by Pharmaceutical Industrial Scientists. Current Drug Metabolism. 2020 Jun 20;21.

3. Sudsakorn S, Bahadduri P, Fretland J, Lu C. 2020 FDA Drug-Drug Interaction Guidance -Comparison Analysis and Action Plan by Pharmaceutical Industrial Scientists. Current Drug Metabolism. 2020 Jun 20;21.

4. Brock T, Boone J, Anderson C. Health Care Education Must Be More of a Team Sport. American Journal of Pharmaceutical Education. 2016 Feb;80(1):1.

5. Recent Advances in Artificial Intelligence Applications in Pharmacy Practice. Asian Journal of Pharmaceutics. 2024 Sep 1;18(03).

6. Leung R. Increasing the Impact of JMIR Journals in the Attention Economy. Journal of Medical Internet Research. 2019 Oct 31;21(10):e16172.

7. Rieke N, Hancox J, Li W, Milletarì F, Roth HR, Albarqouni S, et al. The future of digital health with federated learning. npj Digital Medicine [Internet]. 2020 Sep 14 [cited 2020 Nov 2];3(1):1–7. Available from: https://www.nature.com/articles/s41746-020-00323-1

8. Majewski KB, Van Der Volgen J. The National Library of Medicine (NLM) Learning Resources Database. Medical Reference Services Quarterly. 2024 Oct;43(4):326–34.

9. Khan IY. The Ecological and Ethical Cost of Scaling AI. AI Policy Exchange Forum. 2025 Aug;Abdullah AA, Hassan MM, Mustafa YT. A Review on Bayesian Deep Learning in Healthcare: Applications and Challenges. IEEE Access. 2022;10:36538–62.

10. Thaler RH. From Homo Economicus to Homo Sapiens. Journal of Economic Perspectives [Internet]. 2000 Feb;14(1):133–41. Available from: https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.14.1.133

11. Cozmuta R, Merkel PA, Wahl E, Fraenkel L. Variability of the impact of adverse events on physicians' decision making. BMC Medical Informatics and Decision Making. 2014 Sep 25;14(1).

12. Zawacki-Richter O, Marín VI, Bond M, Gouverneur F. Systematic review of research on artificial intelligence applications in higher education – where are the educators? International Journal of Educational Technology in

Higher Education [Internet]. 2019 Oct 28;16(1):1–27. Available from: https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-019-0171-0

13. R. Recent Trends of AI in Pharmaceutical Industries: A Review. Open Access Journal of Data Science and Artificial Intelligence. 2024;2(1).

14. Stone JL, Norris AH. Activities and Attitudes of Participants in the Baltimore Longitudinal Study. Journal of Gerontology. 1966 Oct 1;21(4):575–80.

15. Berger R. Critical Review of "Ethics & Governance of Artificial Intelligence for Health" by the World Health Organization (WHO). Journal of science, humanities and arts. 2024 Jan 1;11(1).

16. Epanechnikov VA. Non-Parametric Estimation of a Multivariate Probability Density. Theory of Probability & Its Applications. 1969 Jan;14(1):153–8.

17. Berger R. Critical Review of "Ethics & Governance of Artificial Intelligence for Health" by the World Health Organization (WHO). Journal of science, humanities and arts. 2024 Jan 1;11(1).

18. Du J, Luo S, Shi P. AI-Driven Multimodal Brain-State Decoding for Personalized Closed-Loop TENS: A Comprehensive Review. Brain Sciences. 2025 Aug 23;15(9):903.

19. Spedding S. Open Access Publishing of Health Research: Does Open Access Publishing Facilitate the Translation of Research into Health Policy and Practice? Publications. 2016 Jan 21;4(1):2.

20. Ma HL, Pan L, Lin AQ, Yang L, Ai MG. Current evidence on auriculotherapy for cancer-related fatigue: A systematic review and meta-analysis of randomized controlled trials. Complementary Therapies in Clinical Practice. 2025 Nov;61:102025.

21. Wan Y, Nakayama M, Aldana CF, Jarvis FA. Persona-driven generative AI in pharmaceuticals. Drug Discovery Today. 2025 Nov;104520.

22. Nassif AB, Shahin I, Attili I, Azzeh M, Shaalan K. Speech Recognition Using Deep Neural Networks: A Systematic Review. IEEE Access. 2019 Feb 1;7:19143–65.

23. Artificial intelligence in information systems research: A systematic literature review and research agenda,International Journal of Information Management,Volume 60,2021, 102383,ISSN 0268-4012,https://doi.org/10.1016/j.ijinfomgt.2021.102383.

24. Collins C, Dennehy D, Conboy K, Mikalef P. Artificial Intelligence in Information Systems research: a Systematic Literature Review and Research Agenda. International Journal of Information Management [Internet].2021;60(102383).

25. Christopher Collins, Denis Dennehy, Kieran Conboy, Patrick Mikalef,Artificial intelligence in information systems research: A systematic literature review and research agenda,International Journal of Information Management,Volume 60,2021,102383,ISSN 0268-4012.