INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

**Review Paper**

# A Review on Artificial Intelligence in Pharmacy

**Awari Nilam*, Vaidya Sayali, Gunjal Rutuja, Sonali Gavale, Pallavi Phalke**

*Matoshri Radha College Of Pharmacy Virgoan, Akole ,Ahilyanagar, India.*

ARTICLE INFO

Published: 21 May 2026
Keywords:
Impurity profiling, ICH guidelines, hyphenated techniques, impurity isolation, pharmaceutical analysis
DOI:
10.5281/zenodo.20325588

## ABSTRACT

Artificial Intelligence (AI) is rapidly transforming the field of pharmacy and the pharmaceutical industry by improving efficiency, accuracy, and patient care. Clinical pharmacy focuses on optimizing drug therapy and enhancing patient outcomes through services like medication review and reconciliation. The integration of AI into this field has introduced advanced tools for data analysis, decision-making, and personalized treatment approaches. AI plays a significant role in drug discovery and development by reducing time, cost, and complexity, while improving success rates. It also supports pharmaceutical manufacturing, marketing, and pharmacovigilance by ensuring better quality control, safety monitoring, and predictive analysis.In addition, AI enables personalized medicine by analyzing patient-specific data such as genetic, clinical, and lifestyle information, leading to more targeted therapies. It enhances diagnostic accuracy through analysis of medical images and large datasets, and improves patient counselling through virtual tools and automated systems. Technologies like robotic pharmacies and AI-based platforms such as IBM Watson further demonstrate its practical applications in healthcare. Overall, AI is revolutionizing pharmacy practice and the pharmaceutical industry by enabling faster innovation, improving patient safety, and supporting data-driven healthcare decisions. Despite its advantages, continuous research and development are required to overcome challenges and fully utilize its potential in future healthcare systems.

## INTRODUCTION

Hospital or community pharmacists provide patient care in clinical pharmacy, a branch of health science, to maximize pharmaceutical therapy and advance wellness, illness prevention, and health[4]. Clinical pharmacy services include medication order review (i.e., evaluating the appropriateness of current medications based on health conditions, indications, and therapeutic goals of each medication) and medication reconciliation (i.e., comparing the patient's medication orders with all the medications the

***Corresponding Author:** Awari Nilam
**Address:** *Matoshri Radha College Of Pharmacy Virgoan, Akole ,Ahilyanagar, India.*
**Email** ✉: nilamawari103@gmail.com

**Relevant conflicts of interest/financial disclosures**: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

patient has taken in order to detect medication discrepancies and then communicate the newly reconciled list to the patient and the clinical care providers). Clinical pharmacy services have been shown in numerous trials to actively support patient safety by enhancing medication adherence, reducing adverse drug events, minimizing hospital stays, and increasing drug therapy outcomes.[5,6]
The field of computer science known as artificial intelligence (AI) focuses on using symbolic programming to solve problems. It has significantly developed into a problem-solving science with enormous applications in engineering, business, and healthcare. The creation of expert systems is one of the most important uses of AI. It has been actively engaged in the science of issue solutions by applying pharmaceutical engineering and occupational health care. The outcomes of artificial intelligence are comparable to those of human attentional processes. Typically, this approach entails creating effective systems that exhibit explicit or approximate fusion, self-correction/adaptation, and the application of acquired data or training data.The primary goal of artificial intelligence in pharmacy is to evaluate efficient data processing challenges and provide abstract solutions. This type of calculation is referred to as a technique and is equivalent to a mathematical theorem. Machine learning that replicates specific cognitive activities is analyzed by artificial intelligence.[7,8]

**Importance of Al in pharmacy**

A survey conducted by U.S. News found that pharmacists rank as the 13th highest-paid professionals among 150 surveyed. On average, pharmacists earn $120,950 annually, the unemployment rate in this field is low at 1.6%. [1] Traditionally, pharmacists ensured prescriptions were accurately filled and checked for any harmful interactions between medications. However, in the last five years, big data and AI have changed the landscape. Now, robots are gaining trust among doctors, and many institutions use them alongside humans to perform tasks once done solely by people.[1]
Pharmaceutical companies have many potential compounds to fight diseases, but no efficient tools to identify them. Developing drugs is tough and expensive, costing up to $2.6 billion and taking 12–14 years. This is where AI helps. It speeds up drug development, cutting costs, improving returns, and possibly lowering prices for consumers. AI is especially better than humans in this task.[2]

**AI and its benefits in patient-centric pharma strategy**

Several pharma companies and healthcare providers understand the importance of collecting patient-specific data gathered either from patients directly or through data stored in the hospital directories. The data can be even collected during the clinical trial process. [1] For healthcare professionals, data collected through the patient pool enables them to understand various challenges they have to deal with. Whereas data gathered via touch points by the pharma companies indicates the stage of engagement. As for payers in the pharma industry, a good knowledge of market access, benefits of clinical trials and formulae lists play a crucial role.[1] [2] AI and ML technology help in bringing all these together with the right brand performance measurement and customized fit-for-purpose methods that help the companies to have a competitive edge in the market. AI technology can also be essentially used for understanding patient behaviour in the use of medicines or drugs prescribed under standard care. This allows increased care for number of patients who can receive the potential therapy. This further impacts the overall progress of the disease condition. Pharma companies are collecting multiple data

points like a patient's genes, patient's characters or phenotypic, molecular and other clinical data [2]

**AI in drug discovery**

Klopman created a new computer program to study the relationship between the structure of organic molecules and their activity. This program automatically identifies molecule structures using a specific code and then analyses substructures responsible for biological activity. It was used to study the cancer-causing potential of certain chemicals and the activity of pesticides called ketoxime carbamates.[3] Aliped and colleagues developed a new method using deep neural networks (DNNs) to predict the effects of various drugs. They trained these networks using gene expression data from experiments on human cell lines. The study included 678 drug samples tested on cell lines called A549, PC-3, and MCF-7. The DNNs accurately categorized drugs into different therapeutic groups. This study demonstrated for the first time that DNNs can recognize the pharmacological properties of multiple drugs.[3]

**Benefits of using AI in drug development:**

**Drug designing**

AI technology helps in optimizing the process of drug designing by improving the R&D process by identifying new molecules, discoveries and target-based drug validation resulting in significant cost-savings, better treatment options and affordable therapies.

**Drug manufacturing**

AI can help in improving the drug manufacturing process that involves quality control, reduced design time, reduced waste, predictive maintenance and better production reuse making the manufacturing process faster and accurate reducing human intervention and eliminating any errors.

**Drug marketing**

AI can help in defining the customer journey allowing the companies to use strategies and marketing techniques that would help them to persuade the customer to make the purchase. AI will also allow companies to analyse past campaigns and design new marketing campaigns based on the historical data and through predictive analysis.

**Treatment for Rare Diseases**

According to a study by Global Genes, 95% of rare diseases do not have single FDA approved treatment, which means AI can be used in pharmacology to find new treatments for rare diseases like Parkinson's and Alzheimer's. [9]

**Ai in pharmaceutical industry**

Artificial Intelligence (AI) has changed the entire business operations in the Pharma and Healthcare industry. It is estimated that the pharmaceutical industry is worth $450 billion globally, and it takes around $2.6 billion for a drug to get officially authorized and bring into the market for public consumption. Today, pharma companies are investing in tech companies and bringing in AI-based applications for better drug development. Initially, AI in pharmaceutical industry was applied in the areas of drug discovery for predicting molecule-target bonding, to identify biomarkers, to discover new drug indications, clinical trials and to improve manufacturing efficiencies.

Today we can see the use of AI technology in almost every stage of the pharma industry, majorly being data analysing and processing. Adopting the AI and Machine Learning (ML) technology will allow businesses to reveal the astounding potential available in the pharma sector, with higher success rates especially in the research and development areas that play a crucial role in the manufacturing of life-changing drugs.AI works as a self-learning

system that continuously responds and analyses data allowing researchers to collect effective information regularly. Moreover, the more data AI analyses and responds too, the smarter it becomes, thus, continuously making advancements in the pharmaceutical industry. The patient-centric approach means businesses need to have a multi-faceted approach. Being patient-centric means offering personalized drugs and treatments specific to people, adjusted as per genetic make-up, type of disease, their lifestyle and medical history. It deals with a faster and more accurate diagnosis, allowing more tailored responses. Thus, AI, combined with patient-centric approaches, will help provide more personalized and remote care, along with diseases prevention through tailored health and lifestyle support.

With advancements in technology, patients have become more alert and knowledgeable as they have better access to information. These day patients interact with their peer groups and other patients through various mediums and exchange experiences, thereby, contributing to real-time data generation. As the patients have become empowered, it has improved their presence in the market, with an expectation to be heard during drug manufacturing and development process.[9]


**Fig:Ai in pharmaceutical industry** [10]

**Role of AI in pharmacy careers**

AI has already started to play a significant role in various aspects of pharmacy careers and its influence is likely to continue growing.

**1.Drug Discovery and Development:**

As the hunt for new medicinal compounds becomes more difficult and time-consuming due to the growth of chemical space, the gap between medication discovery and development is growing daily. Recently, there has been a lot of interest in medicinal chemistry's use of artificial intelligence (AI) as a means of revolutionizing the pharmaceutical sector. Finding and developing new medications, or medication discovery, is a challenging and time-consuming process that has traditionally depended on time-consuming techniques like trial-and-error research and high-throughput screening. However, artificial intelligence (AI) techniques like machine learning (ML) and natural language processing provide the potential to speed up and enhance this process by enabling more precise and efficient analysis of vast amounts of data. Consequently, tactics that

expand upon the principles of methods that are based on artificial intelligence are particularly useful in many phases of drug development, including finding and confirming drug targets, modeling medications, and improving their druggable properties. Establishing patient-centered clinical trials is also essential since it enhances the decision-making process.[10,11]

**2. Personalized medicine:**

Artificial intelligence (AI) integration is driving the revolution in personalized medicine, which is transforming the healthcare sector. Our capacity to evaluate enormous volumes of intricate data has greatly improved thanks to AI technologies, which have also enhanced diagnosis and treatment results. This article will examine how AI is transforming customized medicine, how it affects disease diagnosis and detection, and how it will affect healthcare in the future.

Personalized Medicine's Development: From Conventional Methods to AI Integration

Traditional medical practices sometimes assumed that there was a one-size-fits-all approach to therapy. But it's becoming more and more obvious that a person's response to treatment is greatly influenced by their unique genetic, lifestyle, and environmental characteristics. This insight led to the development of customized medicine, a strategy that adjusts medical treatments to each patient's particular needs. By acknowledging the significance of individual variability in treatment outcomes, personalized medicine has completely transformed the healthcare sector. Healthcare providers can now create more effective tailored interventions by taking into account a patient's genetic composition, lifestyle decisions, and environmental factors. Patient outcomes have improved as a result of healthcare's shift to individualized medicine.[12]

**3.Diagnosis process:**

Medical diagnostics involves evaluating medical conditions or diseases by assessing symptoms, medical history, and test results. Its primary aim is to identify the root cause of a health issue and provide an accurate diagnosis for effective treatment. This process often includes diagnostic tests like imaging (e.g., X-rays, MRI, CT scans), blood tests, and biopsies. The outcomes of these tests assist healthcare providers in selecting the most appropriate treatment. Beyond diagnosis, medical diagnostics is used to track disease progression, evaluate treatment effectiveness, and identify potential health issues before they worsen. The recent advancements in AI have the potential to transform medical diagnostics by enhancing prediction accuracy, speed, and efficiency. AI can analyze medical images (such as X-rays, MRIs, ultrasounds, CT scans, and DXAs) to help healthcare providers diagnose diseases more accurately and rapidly. Furthermore, AI can process extensive patient data, including 2D/3D imaging, bio-signals (e.g., ECG, EEG, EMG, and EHR), vital signs (e.g., body temperature, pulse rate, respiration rate, and blood pressure), demographic details, medical history, and lab results, supporting decision-making and offering precise predictions. This can assist healthcare professionals in making more informed decisions about patient care. Using multimodal data—comprising various forms of information like images, signals, and text—offers an ideal solution for improved diagnostic decisions. By integrating diverse data sources, healthcare providers gain a more comprehensive understanding of a patient's health, leading to more accurate diagnoses and reducing the risk of misdiagnosis. Multimodal data aids in monitoring disease progression, improving the management of chronic conditions. Additionally, employing multimodal data and Explainable AI (XAI) techniques can help healthcare providers detect potential health issues

earlier, preventing them from becoming serious or life-threatening.[13]

**4.Patient Counselling and Education:**

Artificial intelligence (AI) provides innovative solutions through personalized educational content, virtual consultations, and language translation tools. Virtual reality simulations help alleviate patient anxiety by familiarizing them with medical procedures, while automated reminders and follow-ups help reinforce important information. AI ensures uniformity in the information provided across various practices, which improves patient understanding and enhances their overall experience. These AI-driven tools enable dental professionals to improve communication, education, and patient satisfaction when explaining treatments. AI encompasses a range of technologies that allow machines to mimic human intelligence and perform tasks such as learning, problem-solving, and decision-making. In dentistry, AI has become a transformative tool with wide-ranging applications in areas like diagnosis, treatment planning, and patient management. Notable uses of AI in dentistry include image analysis for interpreting radiographs, predictive modeling for assessing risks, and virtual simulations for planning treatments.[14]

**5.pharmacovigilance:**

Pharmacovigilance (PV) was primarily designed to ensure patient safety, particularly for those who have limited exposure to treatment drugs during clinical trials and research. It allows for the observation of drug profiles over an extended period, providing valuable insights into long-term use. PV also focuses on specific populations, such as the elderly, racial groups, pediatric patients, and pregnant women, for whom data from long-term drug exposure is often incomplete, making PV studies essential. The approval of life-saving drugs, such as anticancer, antitubercular, and antiretroviral medications, often follows a fast-track system to ensure timely availability for patients, with PV assessing and communicating the risks and effectiveness of these drugs. In developing countries, PV remains a relatively new concept with limited adoption. However, globally, there is growing recognition of the need for systems to monitor the safety of drugs after they are marketed.[15],[16].

**Tools of AI**

**IBM Watson for oncology**

Watson for oncology is a software that helps doctors make better decisions when treating cancer. It does this by looking at a lot of medical information about a patient and then suggesting treatment options based on that information. It can understand both the meaning and context of the information, even if it's not organized in a clear way. Watson can gather important details about the patient and explain them in simple language, which is really helpful for creating the right treatment plan. It uses a mix of patient information and research to figure out the best treatment options. Watson has access to a ton of information from medical literature and research, which helps it make smart recommendations.[17]

**Robot pharmacy**

A robot at UCSF is really good at making sure patients get the right medications. It can make pills and injections, including chemotherapy drugs, which are really strong medicines. This lets pharmacists and nurses focus more on taking care of patients. Here's how it works: Doctors and pharmacists send medicine orders to the robot. Then, the robot picks out the right pills and puts them into packages. These packages have barcodes and hold all the medicine a patient needs for 12 hours. The robot can also make sterile medicines for chemotherapy and fill syringes with

the right doses. The integration of robotic technology at UCSF Medical Centre for pharmaceutical manufacturing and monitoring indeed underscores a significant advancement in patient safety. With its ability to accurately prepare hundreds of thousands of doses and handle hazardous medications, the system not only enhances precision but also frees up pharmacists and nurses to concentrate more on direct patient care and collaboration with doctors, maximizing their expertise for improved healthcare outcomes.[17]

The automated pharmacy system at UCSF operates seamlessly, receiving electronic medication orders from physicians and pharmacists. Robotics then pick, package, and dispense individual doses of pills, which are assembled onto a bar-coded plastic ring by machines. This innovative approach ensures efficient organization and dispensing of medications, simplifying patient adherence by consolidating doses onto a single, convenient platform for a 12-hour period. The inclusion of an inventory management system within the automated facility at UCSF is pivotal for meticulous tracking of every product. With a refrigerated and two non-refrigerated pharmacy warehouses, the system ensures efficient storage and withdrawal of supplies and medications. These fully automated facilities not only streamline operations but also maintain optimal conditions for storage, enhancing overall efficiency and quality assurance in pharmaceutical management.[17]

**MEDi robot**

MEDi stands for Medicine and Engineering Designing Intelligence. It's a robot designed to help kids manage pain during medical procedures.[17] The idea came from Tanya Beran, a professor in Alberta, who noticed how scared kids were in hospitals. The robot starts by talking to the kids and explaining what will happen during the procedure. Then, during the procedure, it helps them stay calm, breathe correctly, and cope with any pain. Even though the robot can't think or plan on its own, it can be programmed to act like it has artificial intelligence (AI).[18]

MEDi sounds like a promising initiative aimed at improving the healthcare experience for children undergoing medical procedures. It's impressive how technology, even without the ability to think or reason, can be programmed to provide comfort and guidance in such situations. It's fascinating how MEDi, the pain management robot, was conceived to address the distress children often experience during medical procedures. Tanya Beran's leadership in this project highlights the intersection of medicine and engineering in improving healthcare experiences. The approach of establishing a connection with children and guiding them through procedures is both innovative and compassionate.[19]

**Berg**

Berg is a biotech company based in Boston that uses AI in its work. They have a platform that uses AI to help discover new drugs. This platform has a big database of patient information, which helps them find and confirm the causes of diseases. Then, they use this data to decide on the best treatments. The company's goal is to make drug discovery faster and cheaper by using AI.[20] AI helps remove the guesswork involved in drug development. Berg's process involves getting data from human tissue samples, studying things like metabolites and proteins, and using AI algorithms to figure out what's causing the disease. Berg's integration of AI into its drug discovery platform, alongside its extensive patient database, signifies a cutting-edge approach to biomedical research. By leveraging AI algorithms to identify and validate disease biomarkers, Berg can potentially revolutionize treatment selection, offering more

targeted and effective therapies for various conditions. [20] This approach holds promise for advancing precision medicine and improving patient outcomes. Berg's motto aligns with the essence of AI-driven drug discovery, aiming to accelerate the process while reducing costs by eliminating guesswork. Their method, involving the procurement and analysis of sequencing data from human tissue samples, alongside metabolite and protein information, exemplifies a comprehensive approach. By leveraging AI algorithms to interpret this data, Berg can accurately pinpoint the underlying causes of diseases, potentially leading to more effective treatments in a shorter timeframe.[20]

**AI in medical speciality**

•**Cardiology:** It's fascinating how AI is revolutionizing cardiology with image analysis techniques. Its applications span from diagnosing various heart conditions to evaluating different types of scans like echocardiography and cardiac MRI. This advancement holds great promise for more accurate diagnoses and better patient outcomes[21].

•**Ophthalmologyhogy**: Artificial intelligence has made considerable progress in ophthalmology, particularly in analyzing medical images and data. AI algorithms are capable of detecting eye conditions such as diabetic retinopathy and macular degeneration from retinal images, predicting disease risk and progression, and offering treatment recommendations to assist doctors. Although AI holds great potential in enhancing diagnosis and expanding access to eye care, challenges such as data biases and issues with generalization need to be addressed through careful development and validation of these technologies.[22]

•**Oncology:** AI's role in oncology spans prognosis determination based on histological and genetic data, aiding in treatment planning, and predicting outcomes such as post-surgery complications and radiation therapy success. The vast data generated by cancer genomics, facilitated by next-generation sequencing, offers a rich landscape for AI to identify genetic aberrations and enhance personalized treatment approaches. This convergence of technology and data holds great promise for improving cancer care and patient outcomes.[23]

•**Neurology:** Furthermore, ongoing research explores additional AI platforms utilizing CT and MRI for early stroke diagnosis, treatment, and prognosis, showcasing the potential of AI in enhancing neurologic care. The term artificial intelligence (AI) describes the emulation of human intelligence in computers that have been designed to think and learn similarly to humans. AI is being used in neurology to analyze enormous volumes of complicated data, such as genetic data, clinical records, and brain imaging images. This capacity makes it possible to diagnose neurological disorders more quickly and accurately, which improves patient outcomes.[24]

• **Radiology:** The dominance of radiology in FDA-approved AI medical devices, accounting for over 70%, underscores the significant integration of AI in this field. Radiology departments have long embraced AI-friendly digital imaging, leveraging systems like picture archiving and communication systems (PACS), widely used across healthcare organizations including VAMCs. While AI extends beyond interpreting black-and-white images, grayscale images commonly used in radiology offer a suitable foundation for AI applications, facilitating enhanced diagnostic capabilities and workflow efficiencies. The standardization of grayscale images in radiology

lends itself well to AI analysis, facilitating improved diagnostic accuracy and workflow efficiency. For instance, the utilization of AI in analysing simple radiographs, such as wrist fractures on X-rays, has shown significant improvement in diagnosis when employed by emergency care professionals. Additionally, AI has enhanced the interpretation of chest X-rays (CXR) for various illnesses including pneumonia, tuberculosis, malignant lung cancer lesions, and COVID-19, showcasing its potential to augment diagnostic capabilities across different medical scenarios.[25]

•**Dermatology**: AI has the potential to increase the effectiveness and precision of conventional diagnostic techniques in dermatology, such as visual inspection, skin biopsy, and histopathologic analysis. This paper gives a brief overview of the technology and emphasizes the recent advancements in dermatology using AI. The way that patient care is provided in the field of dermatology will change as computer technology advances and its role in AI grows. It is challenging to anticipate with precision the scope of AI's effects and when it will eventually become a reality in dermatology because the field is still in its relative clinical infancy. We have examined its possible future consequences under the presumption that AI will evolve because of the factors that affect its impact in dermatology.[26]

•**Mental Health:** The development of AI applications in mental health care has faced challenges due to the interactive nature of the field. However, there's potential for significant progress, particularly through the utilization of Natural Language Processing (NLP). Given the high reliance on textual data such as clinical notes, mood assessment scales, and documentation of interactions, successful AI applications in mental health care are likely to heavily leve rage NLP technologies. These tools can help extract valuable insights from textual data, enabling more efficient and personalized patient care in the mental health domain.[27]

•**General and personalized:** AI's versatility in medicine extends beyond diagnosis and imaging analysis to various critical tasks. For instance, it aids in identifying patients with suspected sepsis, calculating iron levels in the liver, and estimating hospital mortality upon admission. Additionally, AI can guide decisions regarding resuscitation status and the initiation of mechanical breathing at the end of life, contributing to more informed and personalized patient care across different medical AI in medical speciality:[27]

Application of artificial intelligence in the pharmaceutical industries:

1.Research and development.
2. Drug development.
3. Diagnosis.
4. Disease prevention.
5. Epidemic prediction.
6. Remote monitoring.
7. Manufacturing.
8. Marketing.
9. Rare diseases and personalized medicine.
10. Processing biomedical and clinical data.
11. Identifying clinical trial candidates.

**1) R and D:** Pharma companies globally are using advanced machine learning and AI tools to make drug discovery faster and more efficient. These tools help by finding complex patterns in large amounts of data, which can solve problems related to complicated biological systems.[28]

**2)Drug development:** AI has the potential to make research and development (R&D) better. It can help with creating and finding new molecules, as well as testing and discovering new drugs.[29]

**3) Diagnosis:** Doctors can use advanced machine learning systems to gather, process, and analyse large amounts of patient healthcare data. Healthcare providers worldwide use this technology to store sensitive patient information securely in the cloud or a central system, known as electronic medical records (EMRs).[30]

**4) disease prevention:** Pharma companies can use AI to find cures for both common diseases like Alzheimer's and Parkinson's, as well as rare diseases. Typically, these companies avoid developing treatments for rare diseases because the return on investment (ROI) is low compared to the time and money required to create such drugs.[31]

**5) epidemic predictions:** AI and machine learning are now used by many pharmaceutical companies and healthcare providers to track and predict disease outbreaks around the world. These technologies use data from various sources on the internet to analyse how different factors like geography, environment, and biology affect people's health in different places. They also look at past outbreaks to find patterns. This is especially helpful for poorer countries that don't have the medical resources or money to handle outbreaks effectively.

**6) remote monitoring:** It's a major advancement in the pharmaceutical and healthcare fields. Many pharmaceutical companies have now created tools powered by AI algorithms that can remotely monitor patients with serious illnesses.

**7) manufacturing:** Pharma companies can use AI in their manufacturing to boost productivity, efficiency, and speed up the production of life-saving drugs. AI helps manage and improve every part of the manufacturing process.

**Quality control.**

*Predictive maintenance.
*Waste reduction.
*Design optimization.
*Process automation.

**8)marketing:** Since the pharmaceutical industry focuses on sales, AI can be very useful for marketing. It helps companies create unique marketing strategies that can lead to higher profits and better brand recognition.

## FUTURE SCOPE OF ARTIFICIAL INTELLIGENCE

AI in science and research.
*AI in cyber security.
* AI in data analysis.
* AI in transport.
* AI in home.
* AI in health care etc.

## CONCLUSION

Artificial Intelligence (AI) is transforming the field of pharmacy and the pharmaceutical industry by improving efficiency, accuracy, and patient care. From clinical pharmacy services like medication review and reconciliation to advanced drug discovery and development, AI plays a crucial role in enhancing healthcare outcomes. It helps reduce time and cost in drug development, improves manufacturing processes, and supports better marketing strategies. AI also enables personalized medicine by analyzing patient-specific data, leading to more targeted and effective treatments.

In pharmacy careers, AI is improving areas such as diagnostics, patient counselling, and pharmacovigilance by providing faster and more accurate decision-making tools. Technologies like robotic pharmacies and AI-based systems have increased precision and reduced human errors, allowing healthcare professionals to focus more on patient care. Additionally, AI applications in

various medical specialties have improved diagnosis, disease prediction, and treatment planning. Overall, AI has a vast potential to revolutionize the pharmaceutical and healthcare sectors. Despite some challenges, its continuous development will lead to more innovative solutions, improved patient safety, and better healthcare delivery in the future.

## REFERENCES


1. Breitbart. Your pharmacist will Soon be a robot. Available from http://www.breitbart.com/california/2016/05/02/ pharmacist-will-soon-app-robot/. [Last accessed on2017 Jun 24].
2. ES Global Talent. How Artificial Intelligence is Being used in the Pharmaceutical Industry. Available from https://www.nesglobaltalent.com/media/press-releases/how-artificial-intelligence-being-used-pharmaceutical- industry. [Last accessed on 2017 Jun 24].
3. Klopman A. Artificial intelligence approach to structure-activity studies. Computer automated structure evaluation of biological activity of organic molecules. J Am Chem Soc 1984; 106:7315-21
4. American College of clinical pharmacy. The Definition of Clinical Pharmacy. Pharmacotherapy2008; 28: 816–817.
5. World health organisation. Assuring medication accuracy at transitions in care. Patient Safety Solution 2007;1(6), https://www.who.int/patientsafety/solutions/patientsafety/PSSolution6.pdf.
6. Bond CA, Raehl CL. Clinical pharmacy services, pharmacy staffing, and hospital mortality rates. Pharmacotherapy 2007; 27: 481–493
7. Dasta, J. F. (1992). Application of artificial intelligence to pharmacy and medicine. Hospital pharmacy, 27(4), 312-5
8. . Mak KK, Pichika MR. Artificial intelligence in drug development: Present status and future prospects. Drug Discov Today. 2019;24(3):773-80.
9. https://www.proxzar.ai/blog/ai-in-pharmaceutical-industry/
10. P. Patil, N. Nrip, A. Hajare, et al.Artificial intelligence and tools in pharmaceuticals: an overview16 (2023), pp. 2075-2082, 10.52711/0974-360X.2023.00341
11. N.Fleming AI in drug discovery Nature (March) (2018), pp. 5-7
12. https://www.laboratoriosrubio.com/en/ai-personalized-medicine/
13. Ukwuoma C.C., Qin Z., Heyat M.B.B., Akhtar F., Bamisile O., Muaad A.Y., Addo D., Al-Antari M.A. A hybrid explainable ensemble transformer encoder for pneumonia identification from chest X-ray images. J. Adv. Res. 2022 doi: 10.1016/j.jare.2022.08.021. in press.
14. Patil S, Joda T, Soffe B, Awan KH, Fageeh HN, Tovani-Palone MR, Licari FW. J Am Dent Assoc. 2023;154:795–804. doi: 10.1016/j.adaj.2023.05.010
15. Report of CIOMS Working Group IV. Geneva: CIOMS; 1998. Council for International Organisations of Medical Sciences. Benefitrisk balance for Marketed drugs: evaluating safety signals. No. 762. [Google Scholar]
16. Venulet J, Helling-Borda M. WHO's international drug monitoring – The formative years, 1968-1975: Preparatory, pilot and early operational phases. Drug Saf. 2010;33:e1–23. doi: 10.2165/11532410-000000000-00000
17. Abrar P. IBM's Supercomputer Helps Doctors Fight Cancer. Available from: http://www.thehindu.com/business/.IBM's-Supercomputer-helps-doctors-to-fight-cancer/article14556945.ece. [Last accessed on 2017 Jun 24]

18. Pantozzi J. This Robot can Help Kids Through Chemo, Vaccinations and other Scary Medical Procedures. Available from: https://www.themarysue.com/medi- robot-for-kids-medical-procedures/. [Last accessed on 2017 Jun 24].
19. trynacit K. MEDi Robot to Comfort Patients in Stollery Children's Hospital. Available from: http://www.cbc. ca/news/canada/edmonton/medi-robot-to-comfort- patients-in-stollery-children-s-hospital-1.3919867. [Last accessed on 2017 Jun 24].
20. Keshavan M. Berg: Using Artificial Intelligence for Drug Discovery. Available from: http://www.medcitynews. com/2015/07/berg-artificial-intelligence/. [Last accessed on 2017 Jun 24].
21. Chen, S. Models of Artificial Intelligence-Assisted Diagnosis of Lung Cancer Pathology Based on Deep Learning Algorithms. J. Healthc. Eng. 2022, 2022, 3972298. [Google Scholar] [CrossRef] [PubMed]
22. https://www.slideshare.net/slideshow/artificial-intelligence-in-ophthalmologypptx/258536610
23. Moore, K.L. Automated radiotherapy treatment planning. In Seminars in Radiation Oncology; WB Saunders: Philadelphia, PA, USA, 2019; Volume 29, pp. 209–218. [Google Scholar]
24. https://txhospitals.in/artificial-intelligence-and-neurology/#:~:text=In%20neurology%2C%20AI%20is%20being,leading%20to%20improved%20patient%20outcomes.
25. Lei, Y.M.; Yin, M.; Yu, M.H.; Yu, J.; Zeng, S.E.; Lv, W.Z.; Li, J.; Ye, H.R.; Cui, X.W.; Dietrich, C.F. Artificial Intelligence in Medical Imaging of the Breast. Front. Oncol. 2021, 11, 2892. [Google Scholar] [CrossRef]
26. https://www.sciencedirect.com/science/article/abs/pii/S0738081X21000572#:~:text=In%20dermatology%2C%20AI%20is%20poised,basic%20overview%20of%20the%20technology.
27. Troulis, M.; Everett, P.; Seldin, E.; Kikinis, R.; Kaban, L. Development of a three-dimensional treatment planning system based on computed tomographic data. Int. J. Oral Maxillofac. Surg. 2002, 31, 349–357. [Google Scholar] [CrossRef] [PubMed]
28. Fazal M I., Patel M E., Tye J., et al., Eur J Radiol,2018,105:246-250.
29. Kamal H., Lopez V., Sheth S A., Front Neurol, 2018.
30. Mateos-Pérez J M., Dadar M., Lacalle-Aurioles M., et al., Neuroimage Clin, 2018, 20:506-522
31. Feng R., Badgeley M., Mocco J.,et al., J Neurointerv Surg,2018,10(4):358-362.

HOW TO CITE: Awari Nilam, Vaidya Sayali, Gunjal Rutuja, Sonali Gavale, Pallavi Phalke, A Review On Artificial Intelligence In Pharmacy, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 5, 5472-5483, https://doi.org/10.5281/zenodo.20325588