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

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Research Article

Artificial Intelligence in Healthcare

Rahul*, Sujeet Pratap Singh, Pramod Mishra, Dr. Tarkeshwar Prashad Shukla

SCPM college of pharmacy.

ARTICLE INFO

Published: 23 Nov 2026
Keywords:
Artificial Intelligence in Healthcare
DOI:
10.5281/zenodo.24459373

ABSTRACT

Artificial intelligence (AI) is becoming an important part of modern healthcare. It refers tocomputer-based methods that perform tasks commonly associated with human intelligence, such asrecognising patterns, interpreting information, making predictions a supporting decisions. Inhealthcare, AI can help analyse medical images, identify patients who may be at risk, support clinicaldocumentation, monitor health information and assis research. This project explains the meaning of AIin healthcare, its main objectives, practical applications, common methods and likely futuredevelopments. It also considers limitations such as biased data, privacy risks, errors, unequal accessand the need for clinical oversight. AI should be understood as a support for healthcare professionalsrathe than an automatic replacement for their judgement. Safe use depends on reliable evidenc careful evaluation, transparency, data protection and clear responsibility. The project is based on areview of guidance and literature from international health organisations and scientific publications.

INTRODUCTION

Healthcare produces large amounts of information, including medical images, laboratory results,prescriptions, doctors' notes, wearable-device readings and electronic health records. Finding usefulpatterns in these records can be difficult and time-consuming. AI offers tools that can process largedatasets and identify relationships that may be hard for people to notice quickly. For example, animage- analysis system may highlight an area that deserves a radiologist's attention, while a predictionmodel may estimate which patients are more likely to experience a complication.

AI in healthcare includes several approaches. Machine learning systems learn patterns from examples;deep learning uses multi-layer neural networks to analyse complex data; natural language processingworks with written or spoken language; and computer vision interprets images and video. Generative AIcan produce text or other content, but its outputs may contain mistakes and must be checked. Thesemethods are being explored in clinical care, hospital operations, public health, medical education andbiomedical research.

***Corresponding Author:** Rahul
Address: SCPM college of pharmacy
Email ✉: rahultiwari868788@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.

The value of an AI system is not established simply because it performs well in a laboratory test. It must be assessed in the setting where it will be used, with attention to patient outcomes, workflow, fairness, safety and cost. The World Health Organization has emphasised that ethics and human rights should guide the design and use of AI for health. Therefore, responsible implementation is as important as

technicalperformance.

Objective

- To explainthe meaning and basic concepts of artificial intelligence inhealthcare.
- To describe important clinical, administrative, researchand public-healthapplications.
- To outline common AI methods and the stages involved in developing and evaluating a healthcare AI system.
- To identifythe benefits as well as the technical, ethical, legal and practical challenges.
- To discuss future possibilities and the importance of humansupervisionand responsible governance.

Application

1. Medical imaging and diagnosis support

AI models can examine X-rays, CT scans, MRI scans, ultrasound images and retinal photographs. They may flag suspicious regions, measure structures or help prioritise studies for review. The clinician remains responsible forinterpreting findings inthe context of the patient's historyand othertests.

2. Early warning and risk prediction

Models can combine observations such as vital signs, laboratory values and clinical history to estimate the risk of deterioration, readmission or certain complications. Such predictions are useful only when they are sufficiently accurate for the local patient population and are connected to a clear clinical response.

3. Personalised treatment support

AI may help compare patient characteristics with research evidence to support treatment planning. In cancer care, for example, computational tools can assist with analysing tumour features and organising complex information. These tools support discussion; they do not independently decide what treatment a personshould receive.

4. Remote monitoring and wearable devices

Smart watches, home monitoring devices and connected sensors can collect information such as heart rate, activity or glucose readings. AI can help identify unusual patterns and summarise trends for patients and care teams. Device accuracy, alert fatigue and access to follow-up care must be considered.

5. Drug discovery and medical research

AI can help researchers screen candidate molecules, predict molecular properties, analyse biological data and identify possible links in large datasets. These methods may make parts of research more efficient, but laboratorytesting and clinical trials remainessential.

6. Hospital administration and clinical documentation

AI-enabled tools can assist with appointment scheduling, coding, summarising records, transcribing consultations and answering routine questions. Human review is important, especially when generated text could affect a diagnosis, prescription, referral ormedical record.

7. Public health

When used with suitable safeguards, AI can help analyse population-level trends, support disease surveillance, forecast service demand and identify gaps in access to care. Data quality and representationare critical because incomplete data canlead to misleading conclusions.

METHODOLOGY

This project uses a descriptive literature-review approach. It brings together concepts and examples

from established health-organisation guidance and peer-reviewed research. It does not report a clinical

experiment or claim to test a new AI model. The following workflow describes how a healthcare AI system maybe developed and assessed:

1. Define the clinical problem

Specify the intended users, patient group, setting and decision the tool is meant to support. A narrowly defined problem is easierto evaluate thana broad claim that a system will improve healthcare.

2. Obtain appropriate data

Collect relevant, representative and lawfully accessible data, such as images or de-identified health

records. Data governance should address consent or other lawful basis, security, access controls and permitted use.

3. Prepare and examine the data

Check data quality, missing values, label consistency and possible imbalances between patient groups orcare settings. Separate training, validationand test data carefullyto reduce data leakage.

4. Train and validate the model

Select a suitable method, train it on development data and tune it using validation data. Measure

performance with metrics appropriate to the task, such as sensitivity, specificity, precision, calibration or area undera curve.

5. Test in realistic conditions

Evaluate the system on data from different sites or time periods where possible. Examine performance across relevant demographic and clinical groups, and assess whetherthe tool fits the real workflow.

6. Conduct clinical and safety review

Clinicians, patients, technical experts and governance teams should review benefits, risks, usability, explainabilityand possible failure modes before deployment.

7. Monitor after deployment

Track errors, changes in data, subgroup performance, user feedback and patient outcomes. Set

procedures for updates, incident reporting, human override and withdrawal if the system becomes unsafe orineffective.

Future Prospects

AI may become more integrated with electronic health records, diagnostic equipment, laboratory

systems and home-monitoring technologies. Better integration could reduce repetitive work and help

clinicians find relevant information at the point of care. However, integration should be designed around clinical needs ratherthanadding technologywithout a clear-benefit.Multimodal systems that combine images, text, laboratory results and sensor data may provide a more complete view of a patient's condition. Generative AI may assist with drafting patient-friendly explanations, summarising records and supporting medical education. These uses require verification because generative systems canproduce plausible but incorrect statements.

Further progress is also expected in privacy-preserving analysis, including approaches that allow

institutions to collaborate without routinely pooling identifiable records. More representative datasets

and evaluation in diverse clinical environments could improve fairness and reliability. In the future,

regulation, standards and independent audits are likely to play a larger role in determining which

systems are suitable forclinical use.

The most important future direction is responsible human-AI collaboration. AI may help professionals

manage information and recognise patterns, while people provide context, communication, empathy

and accountability. The goal should be safer and more accessible care, not automation for its own

sake.

CONCLUSION

Artificial intelligence has the potential to support healthcare in diagnosis, risk prediction, monitoring,

research, administration and public health. It can process complex information quickly and may help

healthcare teams make better-informed decisions. At the same time, AI systems can be inaccurate,

biased, difficult to explain or poorly suited to a new hospital or patient group. They also raise important

questions about privacy, security, consent and accountability. For these reasons, AI should be

introduced only when its purpose is clear, its performance has been independently evaluated and

appropriate human oversight is in place. When developed and governed responsibly, AI can be a

valuable tool that strengthens—not replaces—the human-centred practice of healthcare.

HOW TO CITE: Rahul, Sujeet Pratap Singh, Pramod Mishra, Dr. Tarkeshwar Prashad Shukla, Artificial Intelligence in Healthcare, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 11, 4367-4370. https://doi.org/10.5281/zenodo.24459373

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