

Artificial Intelligence in Health Care: A New Era for Indian Medical Practice

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ABSTRACT

Introduction: What is Artificial Intelligence (AI)?

Computer machines are programmed to learn, think and make decisions like humans. Machine learning, deep learning methods, are integral part of the Artificial intelligence.

Basics of Data Science and Machine Learning: The data go through several steps like cleaning, feature extraction, feature scaling using various machine learning algorithms. The multipurpose large language AI models and domain specific models are available.

Why AI Matters in Indian Healthcare

India Faces a Dual Challenge: High patient load and limited health infrastructure. AI offers scalable, cost-effective tools to assist overburdened healthcare providers.

Key Applications of AI in Healthcare: The key applications of AI include diagnosis and screening, treatment planning, decision support Systems (DSS), workflow optimization, Precision and personalized care.

Indian Context: Opportunities and Challenges

High mobile penetration enables AI-based telemedicine in rural areas. Also remote patient monitoring, and offering specialist care for rural people are possible with this technology. There also challenges like data Privacy, bias, standardization, trust of clinicians and patients and organizations like CDSCO and ICMR are addressing this.

Augmented Intelligence: Building AI models taking the help of domain experts- Doctors or paramedics and incorporating it in the clinical environment with the Physician in the loop of health care.

Future Prospects: The upcoming Explainable AI (XAI) models, Retrieval Augmented Generation systems, Model Context Protocol, Federated Learning will improve the quality and performance of the AI systems.

Conclusion: AI is not a threat to doctors—it is a powerful tool that augments human intelligence and capable of revolutionizing Indian healthcare system.

INTRODUCTION

What is Artificial Intelligence (AI)?

Artificial Intelligence (AI) refers to the simulation of human intelligence in computer machines. These machines are programmed to learn, think and make decisions using data science methods.

At its core, AI consists of:

- **Machine Learning (ML):** Algorithms that allow computers to learn patterns from data and improve over time without being explicitly programmed. This is done by various algorithms based on statistical mathematics.
- **Deep Learning (DL):** A subset of ML using artificial neural networks, mimicking the way humans learn from experience. It learns on its own without human assistance.
- **Natural Language Processing (NLP):** Enables machines to understand and respond to human language.
- **Computer Vision:** The ability of machines to interpret and analyze visual data, such as X-rays MRIs, and clinical photos.

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All these put together called as Artificial intelligence systems or AI models which can be interacted using our natural language either written or as speech prompts. The AI systems have the capabilities to understand any language containing your pertinent queries and provide the precise information and knowledge learnt (Figure 1). The multimodal AI can process all inputs namely image, text, audio and video and generate similar outputs.

BASICS OF DATA SCIENCE AND MACHINE LEARNING

Data + Data = Information. For example fasting state + blood sugar value 125 = Diabetes that means two data can provide an information when combined. Suppose if the patient has Diabetes + hypertension = high risk for CVD. Here two information forms knowledge about disease process. Traditionally old computers process input data into information and display. The data are stored in database. But modern day computers can process information and store them as Vector base or knowledge base. The data science provides tools for building data driven AI systems for our use [1]. Basically the data is cleaned; features extracted; trained into model and undergoes evaluation. Then it is deployed as applications for the clinical user (Figure 2).

They are aimed to provide solutions for prediction, classification or Clustering problems. As health care providers, we have predictive questions like at what age someone may develop myocardial infarction? (Precise singular answer) or what complications he will develop? (more than one answer – classification). But in the research setting if you want to know the relationship of multiple interrelated risk factors (many but interrelated with ranking) is called clustering (Figure 3). Generative AI generates supportive information or knowledge. There are many such multipurpose AI applications called as Foundation models: Chat GPT- microsoft, Claude Ai, Gemini- Google,

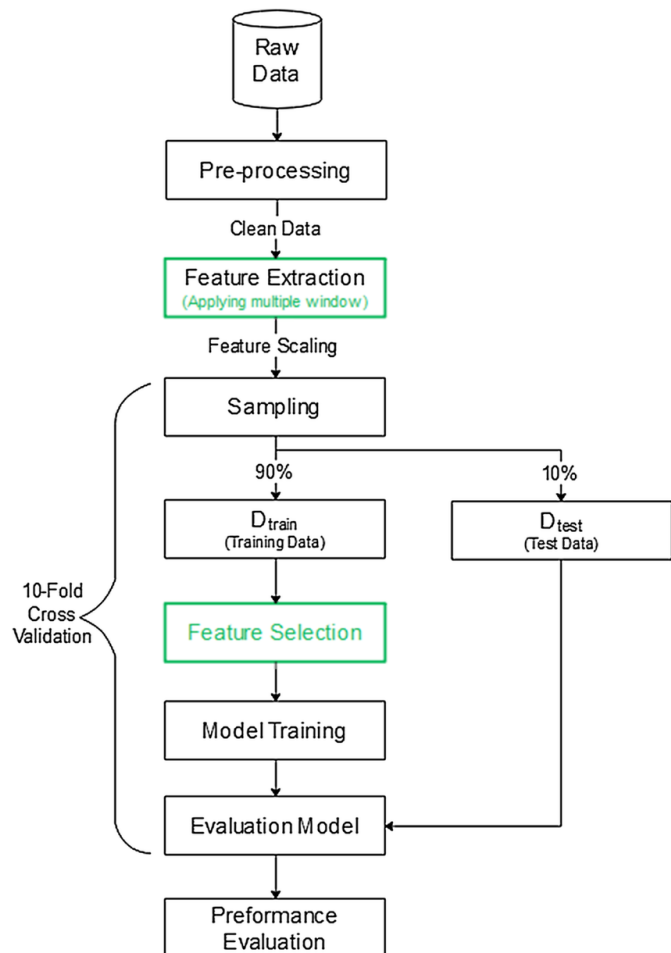


Figure 2. Data science process.

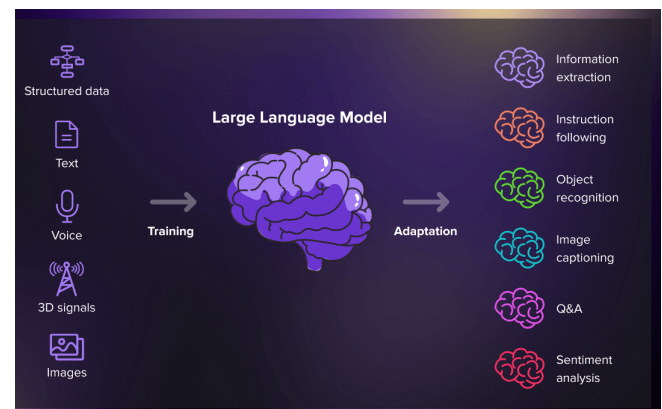


Figure 3. Large language model application.

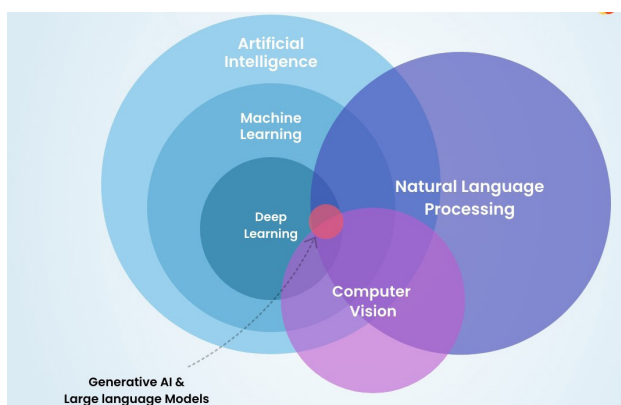


Figure 1. Graphical representation of artificial intelligence.

Perplexity, Deep seek- Chinese. These multipurpose models are broadly trained for wide range of use to all professionals (Figure 3). But there are also domain specific models available for medical practitioners like Physicians, Radiologists, Oncologists, Dermatologists etc. FDA has approved few AI systems like IDX- DR for diabetic retinopathy screening, Minimed 780 G for closed loop insulin pump, and few oncology and Radiology AI models after validation.

WHY AI MATTERS IN INDIAN HEALTHCARE

India faces a dual challenge: high patient load and limited health infrastructure. India is heterogeneous with unequal geography, socio-economics, and health care systems with rural urban divide. AI offers scalable, cost-effective tools to assist overburdened healthcare providers by enhancing speed, accuracy, and efficiency. Remote patient care is possible with available communication technologies when added with AI can overcome the barriers in health care delivery.

KEY APPLICATIONS OF AI IN HEALTHCARE

1. Diagnosis and Screening

AI algorithms can analyze ECG, radiological images, pathology slides, and retinal scans to detect diseases at an early stage.

- Radiology: AI tools detect lung nodules, fractures, or stroke signs in CT/MRI scans.
- Ophthalmology: AI like Google's DeepMind detects diabetic retinopathy in retinal images.
- Oncology: Histopathological image analysis for cancer detection with high accuracy.

2. Treatment Planning

AI assists in creating personalized treatment protocols based on patient history, genomic data, and clinical guidelines.

- Oncology: IBM Watson for Oncology recommends evidence-based cancer therapies.
- Cardiology: AI analyzes ECGs, helps predict cardiac events, and aids in risk stratification.

3. Decision Support Systems (DSS)

Clinical Decision Support Systems use AI to assist doctors in diagnosis, drug prescriptions, alerts, and treatment pathways.

- CDSS tools are embedded in EMRs to support physicians during consultations.
- Example: Drug allergies prompt during prescription, drug interaction alert, various calculators – eGFR, Cardiac risk, ICU prognosis and Sepsis prediction alerts in ICUs reduce mortality by early intervention.

4. Workflow Optimization in Hospitals

AI can streamline hospital operations:

- Automated triaging in OPD/ER
- Scheduling optimization for surgeries/tests
- Predictive maintenance for equipment
- Chatbots for patient communication, therapy compliance and reminders

5. Precision and Personalized Medicine

- The multifaceted power of AI provides high degree of accuracy in prediction which human lack.
- Precision medicine in both clinical care and prevention is possible with the help of AI.
- Personalized medicine can be practiced when clinical findings are aligned with genetic data.

INDIAN CONTEXT: OPPORTUNITIES AND CHALLENGES

Opportunities

- High mobile penetration enables AI-based telemedicine in rural areas.
- Remote patient monitoring, Rural out reach of specialist care.
- Startups like Qure.ai, Niramai, and Predible Health are making global impact.
- Government initiatives like Ayushman Bharat Digital Mission (ABDM) support AI adoption.

Challenges

- Data privacy and standardization issues [2].
- Black Box effect in deep learning which may introduce errors.
- Need for skilled workforce to manage AI tools.
- Trust and acceptance by clinicians and Patients.

Ethical and Regulatory Considerations

- Data Privacy concerns [3].
- Accountability: Clear responsibility in adverse events involving AI [4].

- Bias and Transparency: AI tools must be trained on Indian patient data [5].
- Regulation: CDSCO and ICMR are developing AI-specific guidelines [6].

Augmented Intelligence

Building AI models taking the help of domain experts—Doctors or paramedics and incorporating it in the clinical environment with the Physician in the loop of health care. It brings the human intelligence and AI together in the work place for better patient care.

India AI is an ambitious project of Government of India which is getting momentum towards this direction [7].

Future Prospects

The upcoming Explainable AI (XAI) models, Retrieval Augmented Generation systems, Model Context Protocol, Federated Learning will try to address the ethical and regulatory issues [8].

CONCLUSION

AI is not a threat to doctors—it is a powerful tool that augments human intelligence. When combined with the clinician's judgment and empathy, AI can revolutionize Indian healthcare delivery. Early adoption, responsible use, and clinician involvement are the key to success. We should propagate digital and AI literacy among our

clinicians and medical students to cope up with the New AI era of medical practice. We should integrate the digital and AI ecosystem in our clinics and hospitals and involve our patients into that for data sharing and remote monitoring.

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