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The Role of AI in Revolutionizing Healthcare Practices: Conceptual Approach

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ABSTRACT

Artificial intelligence is transforming and enhancing modern healthcare by enabling technologies that predict, understand, learn, and act. Whether used to uncover new genetic code linkages or manage surgery-assisting robots, AI combines the terms "artificial" and "intelligence." Intelligence encompasses reasoning, generating novel ideas, understanding information, and acquiring knowledge. In contrast, "artificial" refers to something not genuine or naturally occurring.

In healthcare, traditional machine learning, a form of AI, is commonly used for precision medicine. This approach aims to determine the most effective treatment procedures for a patient based on their specific qualities and therapy context. Supervised learning, a prerequisite for most machine learning and precision medicine applications, requires a training dataset with a known outcome variable, such as disease onset.

This paper explores key applications of AI in healthcare and the ethical principles guiding its application.

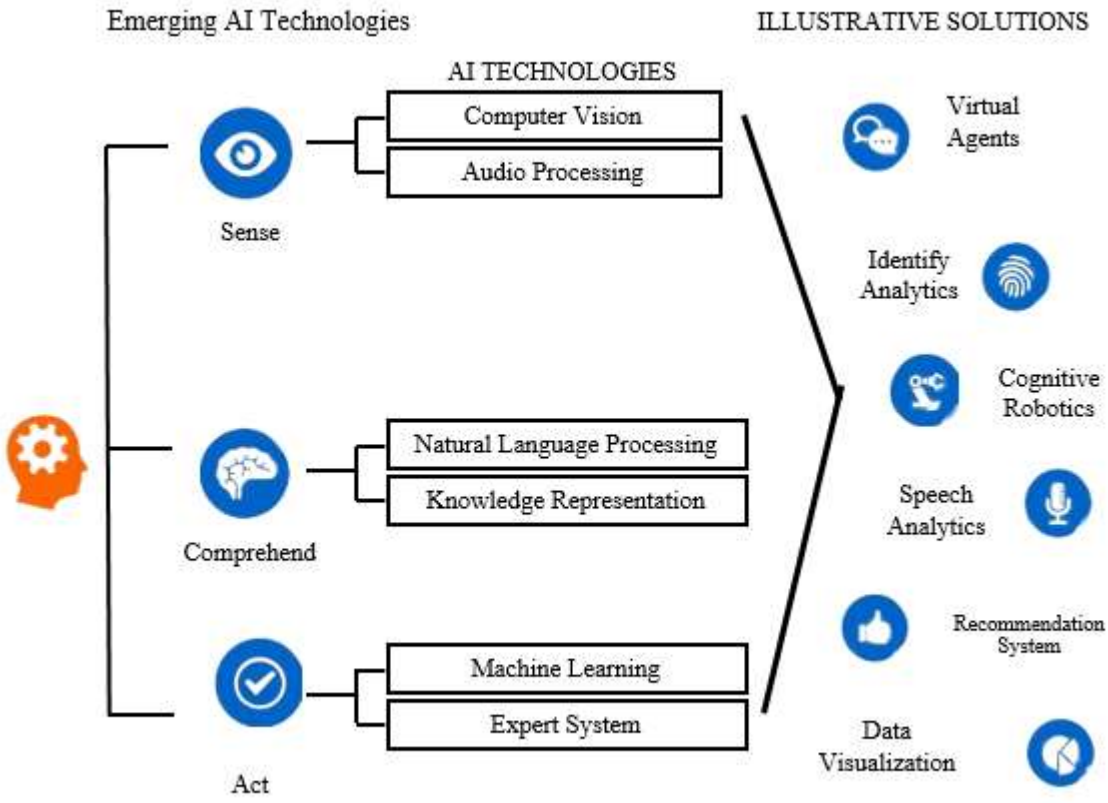
Key words: Artificial Intelligence, Health care, Machine and Deep Learning. ,

Introduction

The term "artificial intelligence" combines "artificial," meaning not real or natural, with "intelligence," defined as the capacity to reason, generate new ideas, perceive, and learn. In the field of computer science, artificial intelligence aims to create intelligent machines that behave and react similarly to humans. This encompasses tasks such as developing AI systems that can recognize speech, learn, plan, and solve problems (Verma, 2018).

The primary goals of artificial intelligence are to understand human intelligence and create intelligent systems capable of performing tasks that typically require human intellect. However, every significant technological advancement brings both opportunities and challenges. While AI is expected to significantly enhance economic growth, there are concerns that automation may lead to job losses. Therefore, there is a pressing need to establish the necessary infrastructure and policies to address these potential impacts (Srivatsava, 2018).

Figure – 1: Schematic Representation of Artificial Intelligence



Source: NITI Aayog National Strategy For AI 2018 P.13

Types of Artificial Intelligence

It entails a variety of responsibilities, including developing artificial intelligence for computers that can recognize speech, learn, plan, and solve issues.

(Bajpai & Wadhwa, 2018)

Table 1: Types of Artificial Intelligence

1	Artificial Narrow intelligence (ANI)	Non-sentient machine intelligence, typically focused on a narrow ask (narrow AI).
2	Artificial General intelligence (AGI)	(Hypothetical) machine with the ability to apply intelligence to any problem, rather than just one specific problem, typically meaning "at least as smart as a typical human
3	Artificial Super intelligence (ASI)	(Hypothetical) artificial intelligence far surpassing that of the brightest and most gifted human minds. The idea that computers can surpass human intelligence, social skills and scientific knowledge across domains.

Source: Yang & etal. November, 2021

It depicts the general framework of artificial intelligence. Perceptual, cognitive, and decision-making intelligence are all involved in the evolution of artificial intelligence. When a machine possesses perceptual intelligence, it indicates that it has the same basic senses as people, such as vision, hearing, touch, etc. A higher level of induction, reasoning, and knowledge acquisition is known as cognitive intelligence. It is motivated by brain-like intelligence, cognitive science, and brain science to give machines human-like reasoning and cognitive capacities. When a machine possesses sensory and cognitive abilities, it is frequently expected to make the best decisions, much like humans, to enhance industrial manufacturing, people's lives, etc. To make the best decisions possible, decision intelligence has to broaden data science through the utilization of applied data science, social science, decision theory, and managerial science. The infrastructural layer of artificial intelligence, supported by data, storage and processing capacity, machine learning algorithms, and AI frameworks, is essential for achieving the objectives of perceptual intelligence, cognitive intelligence, and decision-making intelligence. Subsequently, it may analyze the inherent principles governing data in order to facilitate and achieve the implementation of AI applications through the process of training models. Artificial Intelligence (AI) is finding a wider and deeper application in the fields of fundamental sciences, industrial

manufacturing, human life, social governance, and cyberspace. This development has a significant influence on our work and way of life (Yang & etal, 2021)

Key Features of Artificial Intelligence

AI can be distinguished from other emerging technologies by its essential properties.

Intentionality - AI algorithms utilize real-time data acquired from sensors, cameras, or remote inputs to aid in decision-making.

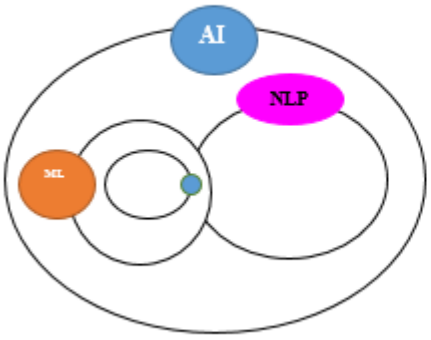
Intelligence The integration of machine learning and data analytics is crucial for the development of artificial intelligence. Machine learning involves the identification of underlying trends and patterns in datasets, such as digital information, satellite imagery, visual data, or text. These patterns are then saved for future use. (BMU).

Table 2: Snapshot of Artificial Intelligence

Global Race of Artificial Intelligence	
1.	70% of firms in India have AI projects p and running
2.	57% companies in Singapore have such projects
3.	53% US Companies have AI projects well underway
4.	19% of companies in Japan have running AI Projects
Data for Use	
1.	91% of Indian companies plan using their data to train AI models
2.	62% of companies globally will do so for AI
3.	28% of Japanese companies will opt for AI
Industries Leading AI Adoption	
1.	70% of technology firms are piloting AI projects
2.	55% of banking and finance companies have such projects (AI)
3.	50% of manufacturing firms are committed to AI
4.	38% of healthcare firms are using AI in their work
5.	25% of media, entertainment have taken up AI
Intelligence Challenges	
1.	40% of large firms say AI projects have increased IT Costs
2.	53% of Indian firms likely to trim IT ops to help AI Projects
3.	56% of Singapore companies are likely to do so.

Source: Business Standard 28th April, 2024

Figure 3: Understanding the Relationship between AI, Ml, DL & NLP



- AI is a broad field that includes anything relating making machines smart.
- NLP is the branch of AI focused on teaching machines to understand, interpret, and generation human language
- ML is a subset of AI that involves systems that can learn by themselves
- DL is a subset of ML that uses models built on deep neural networks to detect patterns with minim human involvement

Source: Alawois etal, 2021

Artificial Intelligence in Healthcare

Healthcare professionals engage in a cyclical process of collecting, evaluating, and integrating data from various sources. They use clinical expertise and empirical research to validate these findings and draw practical conclusions (Wubinch et al., 2024). Artificial intelligence (AI) is a cutting-edge technology with significant potential in the healthcare industry. AI has rapidly expanded across numerous disciplines, enhancing the ability of robots to perceive, interpret, learn, and perform clinical and administrative healthcare tasks (Rodriguez et al., 2020).

Integrating individual patient data with information from other parts of the healthcare system enhances AI's predictive capabilities, leading to better decision-making through improved public health surveillance and more efficient research processes. AI is poised to assist healthcare professionals in various ways, including automating patient data documentation, expediting image analysis, and supporting virtual observation, diagnosis, rehabilitation,

mental health support, and patient outreach (Pradhan et al., 2021). In India, the healthcare sector has significantly benefited from AI integration, contributing to improvements in cost, efficiency, quality, and other factors, with stakeholders advocating for AI-driven healthcare projects (Chatterjee, 2021).

Artificial intelligence relies on data from medical tasks such as diagnosis, treatment planning, and screening. Clinical data includes demographics, medical records, digital information from medical equipment, clinical examinations, laboratory tests, and images. AI systems can be categorized into two types: machine learning (ML) algorithms that analyze structured data like genomics and imaging, and natural language processing (NLP) algorithms that extract features from unstructured sources such as clinical notes and medical literature (Rahman & Panday, 2021).

The most common application of classical machine learning in healthcare is precision medicine, which predicts effective treatment protocols for patients based on various characteristics and treatment contexts. Most machine learning and precision medicine applications use supervised learning, where a training dataset with a known outcome variable (e.g., disease onset) is required (Davenpart & Kalakota, 2019).

It illustrates how collaboration between humans and AI can enhance clinical efficacy, safety, and efficiency, as well as improve access and cost-effectiveness of care. It's important to note that collaboration between humans and machines does not imply that machines cannot operate autonomously. AI can be fully automated for tasks where machines excel, such as cancer screening, diabetic retinopathy detection, and certain cardiac conditions, or tasks where errors have minimal consequences, such as identifying vaccine recipient demographics. Maintaining a balanced approach between valued human care and the automation levels provided by AI technologies is crucial in human-machine collaborations.

Key Areas applied Artificial Intelligence in Healthcare

Medical Diagnosis: AI algorithms can analyze vast amounts of medical data, including test results, patient records, and medical imaging, to aid medical professionals in making faster and more accurate disease diagnoses. Artificial intelligence has the potential to assist radiologists in detecting anomalies in X-rays and CT scans, as well as early signs of breast cancer in mammograms.

Personalized Treatment Plans: AI can evaluate a patient's health data, such as personal details, medical history, and lifestyle choices, to develop individualized treatment plans. This approach, known as precision (personalized) medicine, tailors treatment modalities according to each patient's specific characteristics, resulting in more targeted and effective treatments.

Virtual Health Assistants: Virtual health assistants equipped with AI capabilities, often referred to as "chatbots," can schedule appointments, provide real-time health information to patients, and respond to inquiries about medications, symptoms, and lifestyle advice. These virtual assistants reduce the workload for healthcare professionals, increase patient engagement, and improve access to healthcare services.

Predictive Analytics: AI enables healthcare practitioners to generate data-driven forecasts and take preventive actions by analyzing massive datasets to identify patterns and trends. For example, AI can help identify individuals at risk of chronic illnesses such as diabetes or cardiovascular disease, allowing for early interventions to prevent or better manage these conditions.

Drug Discovery and Development: By analyzing large volumes of biomedical data, artificial intelligence (AI) accelerates the discovery and development of new drugs by identifying promising candidates, predicting their toxicity and efficacy, and optimizing their chemical structure. This can significantly reduce the time and cost required to bring new pharmaceuticals to market.

Remote Patient Monitoring: AI enables medical professionals to remotely monitor patients with chronic illnesses, instantly collecting and analyzing patient data including vital signs, activity levels, and medication adherence. This improves patient outcomes by detecting early warning signs and enabling timely interventions.

Healthcare Administration: AI streamlines administrative tasks in the healthcare industry, such as scheduling appointments, processing patient co-payments, and managing admissions. This enhances operational efficiency, reduces the administrative burden on healthcare personnel, and improves overall patient experience (Bozic, 2023).

Ethical Principles for AI Technology in Healthcare

All relevant stakeholders must adhere to the same values and ethical principles guiding the development and deployment of AI technology in healthcare. Various datasets and methods, including supervised, semi-supervised, and unsupervised learning, are employed in AI technology. Health professionals and researchers are cautious about these "machine-driven" analytical techniques despite their promising nature due to their complexity. Unlike other AI applications, AI for Health directly impacts human life and may have significant consequences for patients in all respects. illustrates ten ethical principles addressing challenges unique to AI for health. These principles are patient-centered and intended to direct all stakeholders in the responsible and reliable development and implementation of AI for health (ICMR, 2023).

Concerns in Healthcare

Administrative Workflow: Healthcare professionals, including doctors, nurses, and other staff, are burdened with extensive documentation and administrative tasks. This can lead to fatigue and reduced concentration among medical staff attending to patients, potentially resulting in incorrect diagnoses. Therefore, AI should be utilized to automate these repetitive tasks.

Inadequate Staff: There is a shortage of physicians and nurses to care for patients, leading to longer wait times and increased anxiety for patients. This shortage also puts pressure on medical professionals to see more patients within limited time frames.

Surgery: Various types of surgeries, including non-invasive, major, and minor procedures, need to be conducted efficiently. Lengthy procedures can lead to fatigue and decreased concentration among surgeons.

Diagnosis: Physicians and nurses currently rely on symptoms observed in patients and limited sources of information to make diagnoses. There is a need for quicker and more accurate diagnostic options.

Health Monitoring: Patients often need to visit hospitals regularly for routine health monitoring, which can be a time-consuming process. This can lead to patients neglecting their health until their conditions worsen. Therefore, quicker and more accurate AI techniques should be considered to address this issue (Kourou et al., 2021).

Table 2: **WHO's guiding principles for regulating AI in healthcare**

Sl.No.	Guideline
1.	Protecting autonomy
2.	Promoting safety
3.	Ensuring transparency
4.	Fostering responsibility
5.	Ensuring equity
6.	Promoting sustainable AI

Source:

On a global level, the World Health Organization published an update in October 2023 outlining important regulatory factors regarding AI for health (see to Table 2 above). The WHO emphasizes the importance of determining the efficacy and safety of AI systems, providing appropriate systems to individuals in need as soon as possible, and encouraging communication among stakeholders, which include manufacturers, regulators, developers, patients, and healthcare professionals (Bouderhum, 2024).

Table 3: Potential long-term economic impacts of AI in healthcare

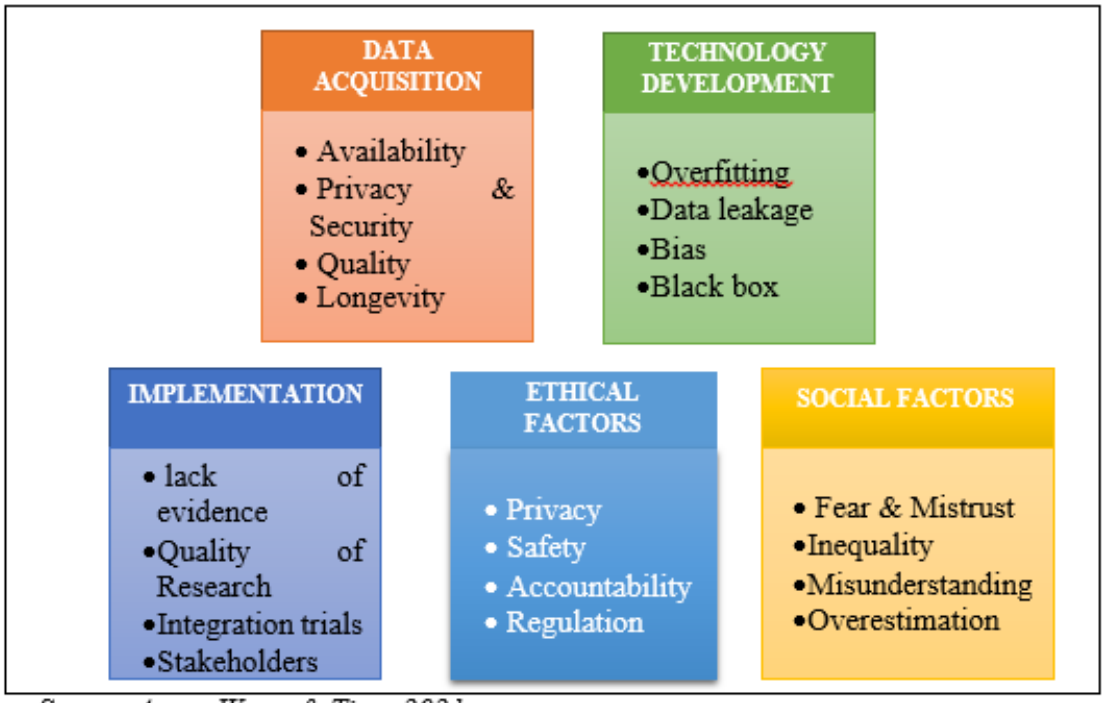
Categories	Sub – Categories	Examples
Cost Saving	**Diagnostic Efficiency**	AI-powered imaging tools that instantly analyse and interpret X-rays, MRIs, or CT scans, reducing the need for multiple radiologists to review images and thus reducing costs. Operational efficiency
	Operational Efficiency	AI-driven appointment scheduling systems that optimize patient flow and reduce waiting times. Such systems can predict no-shows and overbook accordingly, resulting in fewer wasted slots and maximizing revenue for clinics. Treatment efficiency
	Treatment Efficiency	Personalized treatment plans generated by AI, based on a patient's genetics, medical history, and other relevant data. This can lead to more effective treatments that have a higher likelihood of success, reducing the need for prolonged or multiple treatments.
	Preventive Care	Wearable devices integrated with AI algorithms that monitor vital signs and predict potential health issues before they become serious.
Cost Evidence	**Compliance and Litigation**	AI-powered systems that ensure medical practices and procedures strictly adhere to established guidelines, decreasing the chances of non-compliance. This not only avoids financial penalties but also reduces the likelihood of malpractice incidents
	Readmission Penalties	AI-driven clinical pathways, such as Clinical Decision Support Systems (CDSSs), can be implemented to monitor and manage chronic ailments.
	Waste Reduction	. AI systems can be utilized to analyse vast amounts of patient and procedural data to recommend or de-prioritize certain tests and procedures based on their anticipated value for a specific patient.
	Resource optimization	AI can aid in refining resource utilization, ensuring that equipment and human resources are used to their utmost potential and avoiding unnecessary expenditures.
Long – term health outcomes	**Quality of Life**	AI-powered remote monitoring tools allow patients with chronic conditions like diabetes to continuously monitor their glucose levels without frequent hospital visits. productive life for citizens, potentially extending their time in the workforce and their contributions to the economy.
	Population Health Management	A decrease in healthcare expenses due to proactive management, and a reduction in economic downturns which often accompany large-scale disease outbreaks because of decreased productivity and increased healthcare costs.
	Longevity	AI can analyse molecular structures and predict their potential impact on human longevity, leading to the faster discovery of anti-aging compounds. The economic impact of increased longevity means a longer
Innovation and Research	**Technological Breakthroughs**	AI-driven laboratories that can automate and expedite drug discovery processes, leading to faster introduction of new therapeutic agents, which leads to cost savings. Economic
	Spin-off Innovations	AI innovations initially designed for healthcare, such as wearable health monitors, can find applications in other industries, like sports or fitness
	Ripple Effects	The development and commercialization of AI-driven healthcare tools can stimulate local economies by creating jobs in tech, manufacturing, and distribution sectors
Market Competition Dynamics	**Differentiated Services**	Hospitals using AI-driven diagnostic tools can offer more precise treatment plans, differentiating themselves from competitors.
	Enhanced Patient Choice	AI can provide personalized treatment options, giving patients the ability to choose the best fit for their needs.
	Cost-effective Healthcare Models	AI-driven telemedicine platforms can provide expert consultations at a fraction of traditional costs, making healthcare more affordable.

Source: Meslamani, 2023

The Drawbacks of AI

The effective application of any information technology, let alone artificial intelligence, in healthcare faces numerous obstacles. These difficulties arise across the entire AI implementation process, including data collection, technological advancement, clinical application, and moral and societal concerns (Aung & *etlal*, 2021).

Figure 7: A Summary of the Drawbacks of AI in Healthcare from multiple perspectives.



Source:Aung, Wang & Ting, 2021

Conclusion

AI's application in healthcare has the potential to completely transform patient outcomes and care. Clinical laboratory testing and disease detection can be made more accurate, efficient, and economical with the use of AI-driven predictive analytics. AI can also aid in population health management and the development of guidelines by optimizing medication options and providing accurate, real-time data.

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