

Artificial Intelligence in Medical Science: The New Age of Healthcare

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Received 20 December 2023; Revised 2 January 2024; Accepted 12 January 2024

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ABSTRACT- AI showcases an ocean of opportunities to health care, enhancing a variety of common medical practices—from identifying the best treatment plans for patients suffering with critical illnesses to diagnosing ailments. Artificial Intelligence can help foretell health trajectories, self-operate administrative tasks and entrust the treatments. This research article will discuss emerging and current AI tools present for accelerating patient care and their possible benefits, challenges associated with the use of these tools and policy options to address challenges or improve benefits of the use of these tools. Recent breakthroughs in the application of Artificial Intelligence in healthcare has been outlined. The probable direction of AI augmented healthcare system in future has also been discussed.

KEYWORDS- Artificial Intelligence, Diagnosis, HealthCare, Medical, Technology, WHO.

I. INTRODUCTION

Artificial Intelligence (AI) intends to use machine processes and computers to simulate human intelligence and execute difficult automated tasks. Although they aim to reflect the capabilities of the human mind, AI-enabled machines are also capable of surpassing it in a number of ways, particularly by sifting through huge amount of big data efficiently in order to identify patterns, trends and anomalies. In fact the most impactful way AI is transforming our world is within the area of health care, where it is being used to create personalized treatment plans, diagnose, drug research and even predict patient survival rates. Even after more than a decade of significant focus, the adoption of AI in clinical practice still remains limited, as many AI products for healthcare are at the design and develop stage. The strength of AI is in its ability to learn and identify patterns and relationships from huge multidimensional and multimodal datasets. Dr Tedros Adhanom, WHO Director-General stated that “Like all new technology, artificial intelligence holds enormous potential for improving the health of millions of people around the world, but like all technology it can also be misused and cause harm”. AI majorly aims to support healthcare individuals with a variety of tasks from clinical documentation to administrative workflow and patient outreach as well as support at special sector such as in

medical device automation, image analysis and patient monitoring.

Some major forms [1] of Artificial Intelligence used in health care are as listed below:

A. Machine learning (ML)

This training algorithm uses data sets, such as health records, to create models that are capable of performing tasks like information categorizing or predicting the outcomes.

B. Deep learning (DL)

Although a subset of machine learning, this involves greater volume of data, training times, and many layers of machine learning algorithms that produces neural networks which are capable of rather more complex tasks.

C. Neural language processing (NLP)

It is specifically the use of machine learning to understand verbal or written human language. In health care, NLP interprets documentation, reports, notes and published research.

D. Robotic process automation (RPA)

It is the use of Artificial Intelligence in computer programs to automate clinical and administrative workflows. RPA is used by few health care organizations for the betterment of patient experience and their daily function facilities.

II. APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

As artificial intelligence has been majorly adopted now, so has the number of ways increased in which this technology is being used across the healthcare sector. Researchers have not yet expected AI to replace health care professionals, instead, they see it as a support and a boon in improving the work-life of health professionals in the coming future. AI is also of much benefit to the patients who are in its interaction every day. While lower operational costs can be expected by health care professionals due to better decision-making and more efficient automated services, providers can also influence the technology to design customized treatment plans and accurately diagnose conditions. Patients can also hope for potentially improved health outcomes and

minimized costs resulting from more reliable health services.

Here are some of the most common applications of AI in the health sector today:

A. Health care analytics

Machine Learning algorithms are trained using past data to produce insights, optimize health outcomes and improve decision-making.

B. Precision medicine

Artificial Intelligence is used to generate personalized treatment plans for patients that take into account such factors as their medical history, lifestyles, environmental factors and genetic makeup.

C. Predict diseases and illness

Using predictive models, health care providers can effectively determine the likelihood that someone might develop a particular condition or contract a similar disease.

D. Interpret tests and diagnose diseases

Machine Learning models can be trained using common medical scans, like X-rays or MRIs, to diagnose and interpret such conditions as tumors.

There are many different opinions on the most beneficial applications of AI for healthcare. Forbes in 2018, stated that the most impactful area will be administrative workflows, robotic surgery, image analysis, virtual assistants and clinical decision support. An Accenture report in 2018 briefs the similar area and also includes connected machines, cyber security and dosage error reduction. In 2019 McKinsey reported that important areas could be connected and cognitive devices, robotics-assisted surgery, targeted and personalized medicine and electroceuticals.

III. METHODOLOGY

There are many different ways to build Artificial Intelligence system for healthcare. Often we find healthcare problems to apply AI solutions to, without considering local context such as user needs, clinical workflows, safety, trust and ethical implications. In Fig 1, a human-centered and problem-driven approach has been described, adapted from frameworks by Wiens et al, Care and Sendak for building an effective and reliable AI-augmented healthcare systems. [2]

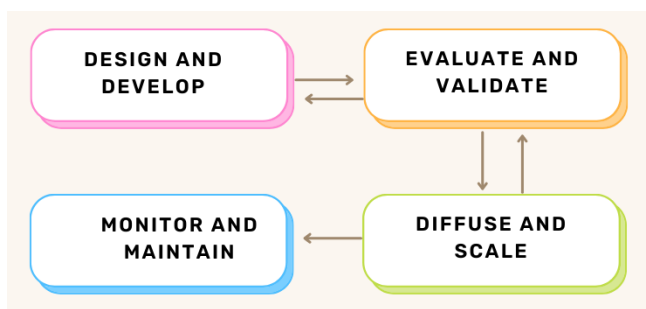


Figure 1: Multi-step, iterative approach to build reliable and effective AI-augmented systems in healthcare.

- **Design and develop**

The primary stage is to design and develop AI solutions

for appropriate problems by using experimentation approach and a human-centered Artificial Intelligence inculcated with engagement of appropriate stakeholders, especially the healthcare personals themselves.

Experimentation: The prime focus should be on piloting of new stepwise experiments to make AI tools, using strong feedback loops from stakeholders to promote rapid experiential learning and incremental alterations. The experiments should allow the testing out of new ideas concurrently, experimenting to see which one works, finding out what works and what doesn't, and why.

Human-centered AI: A human-centered AI approach unites an ethnographic understanding of health system with AI. User-designed research lets us first understand the key problems including the constraints, needs and workflows in healthcare organizations and the promoters and barriers to the incorporation of AI within the clinical context. The next step after defining key problems, is to identify the problems that are suitable for AI to solve, if there is presence of applicable datasets to produce and later evaluate AI. By contextualizing algorithms in an already present workflow, AI systems shall operate within present norms and practices to make sure to provide appropriate solutions to existing problems for the end user.

Stakeholder: Co-creation and Engagement build a multidisciplinary team including social scientists and computers, research leadership and operational, and clinical stakeholders like caregivers, physician and patients and subject experts e.g. for biomedical scientists that would include authorizers, financiers, motivators, connectors, conveners, implementers and champions. A multi-stakeholder team brings the strategic, technical, operational expertise to outline problems, success metrics, goals and intermediate milestones.

- **Evaluate and validate**

Secondly, we must repeatedly evaluate and validate the forecasts made by the AI tool to understand how well it is performing. Since this is critical, the evaluation must be based on three dimensions: clinical utility, statistical validity and economic utility. [3]

Clinical utility: To determine clinical utility, one must evaluate the algorithm in a real-time environment on a temporal validation set (e.g. external geographic and longitudinal datasets) and a hold-out to demonstrate clinical effectiveness and generalizability.

Statistical validity: It is the understanding of the performance of AI on metrics of accuracy, robustness, reliability, stability and calibration.

Economic utility: It quantifies the net advantage relative to the cost from the investment in the AI system.

- **Scale and diffuse**

Most of the Artificial Intelligence systems are primarily designed to solve a problem at one particular healthcare system based on the population of patient specific to that location and context. Scaling up of AI systems needs specific attention for the deployment modalities, the regulatory system, model updates, variation between reimbursement environment and systems.

• **Monitor and maintain**

Since an AI system has been deployed clinically, it must be regularly monitored and maintained to check for risks and adverse events using appropriate post-market surveillance. Healthcare organizations, AI developers and regulatory bodies must cooperate to compile and analyze the relevant datasets for clinical performance, safety-related risks and adverse events.

IV. RESEARCH FINDINGS OF ROLE OF AI IN HEALTHCARE

Some of the major research findings [4] are listed below:

Researchers at Stanford have developed an AI algorithm which can diagnose up to 14 types of medical conditions concurrently from medical images. [5]

Neuroradiologists at Mayo Clinic have been using AI to find out molecular biomarkers within magnetic resonance imaging scans rather than testing collected samples during surgery[6].

- Memorial Sloan Kettering Cancer Center researchers have developed a deep learning model that uses only the reported diagnoses as labels for training on whole-slide images, thus it avoids manual annotation of big data sets that other deep learning models would need.[7]
- Massachusetts Institute of Technology (MIT) has recently introduced a new deep learning-based AI prediction model which will predict the occurrence of breast cancer up to 5 years in advance. [8]
- Many hospitals in Canada are now using AI to predict the patient numbers to the emergency department 2 or 3 days earlier, making the hospital capable to take any proactive action in resource allocation or staffing. [9] [10]
- Satya Nadella, chief executive officer of Microsoft said that ‘AI is perhaps the most transformational technology of our time, and healthcare is perhaps AI’s most pressing application.’
- Tim Cook, chief executive officer of Apple says that ‘[Healthcare] is a business opportunity ... if you look at it, medical health activity is the largest or second-largest component of the economy.’
- Google Health quoted that ‘We think that AI is poised to transform medicine, delivering new, assistive technologies that will empower doctors to better serve their patients. Machine learning has dozens of possible application areas, but healthcare stands out as a remarkable opportunity to benefit people.’

The success factors depend largely on the satisfaction of the end users and the results that the AI-based systems produce(see the below figure 2).

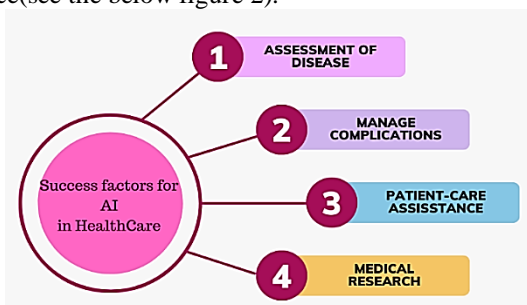


Figure 2: Some common factors that determine success of AI in Health care industry

Some of the major workforce challenges [11] [12] are as listed below:

- WHO has issued first global report on Artificial Intelligence (AI) in health and the report emphasizes that systems trained primarily on data collected from individuals in high-income countries may not perform well for individuals in low- and middle-income states.
- Lack of understanding about what a definite type of AI technology can or cannot do.
- Not having clear strategies for compiling different AI technologies into the existing care systems, so that it can effectively solve the most pressing problems in health organizations.
- A shortage of a well-guided workforce for AI’s implementation.
- The incompatibility with legacy infrastructure of AI technologies
- Lack of access to diverse and good medical data for training Machine Learning (ML) algorithms.
- Bias and Limitations in data used to build AI tools can minimize their safety and effectiveness for different groups of patients, which may lead to treatment disparities.
- It is challenging for AI tools to integrate and scale up into new settings due to differences among patient populations and institutions.
- Sometimes lack of transparency can be found in part due to the inherent difficulty of deciding how some of them work, and also because of some controllable factors, such as the shortage of evaluations in clinical settings.
- Since more AI systems are introduced, large quantities of data will now be in the hands of more organizations and people, adding to privacy concerns.
- The multiplicity of involved parties in deploying, developing and using AI tools is one of many factors that has rendered liability associated with the use of AI tools to be uncertain. This would slow down the adoption and impede innovation.

V. FUTURE SCOPE

AI is set to change the health care landscape in coming years. Apart from improving health facility operations, treatment plan development, patient diagnoses and overall health outcomes, Artificial Intelligence is also expected to help with the discovery of new medical cures.

- A significant growth is expected in the use of artificial intelligence in health care in the coming decade. According to Grand View Research, AI in health care has been forecasted to be valued at \$208.2 billion in 2030, which is much higher than its 2022 market size value of \$15.4 billion.
- Some researches indicate that AI would lead to significant job cuts as this technology will automates tasks like interpreting radiologic images while other believe that this is unlikely to be the case. A 2019 research paper proclaims that actual job loss is estimated to be just five percent or less over the next ten to twenty years, which indicates that most job seekers will have little to worry about for the destined future.
- The future capacity of AI might involve the use of video and audio capturing tools with tonal or facial

interpretation for detection of stress in the home or office, or the incorporation of skin lesion detection apps into real-time video for the visits of dermatologists.

VI. CONCLUSION

AI augments and amplifies, in spite of replacing human intelligence. Therefore when we build AI systems in healthcare, it is important to not replace the compulsory elements of the human interaction in medicine rather focus on it, and improve the effectiveness of that interaction. WHO's latest report cautions against overestimating the benefits of AI in healthcare industry, especially when it is occurring at the cost of core investments and strategies that are required to attain universal health coverage[13].

The implementation and development of AI in healthcare is costly and complex, so health organizations must take smart decisions and introduce strategic plans that enable their organizations to bring real value to them. Some considerations for the successful development, deployment, and integration of AI in healthcare is as followed:

- Both short-term and long-term goals of your organization should be considered.
- Establishing the leadership, culture, team and collaboration.
- Selecting appropriate AI tools, platform and approaches for implementing the AI strategy.
- Designing efficient data strategy to understand patient insights. [14]
- Context and protocols for safely using AI technology should be determined.
- Performance standards should be established to measure AI success.
- Nationwide AI-powered digital healthcare ecosystems must be developed.

CONFLICTS OF INTEREST

The authors declared that they have no conflicts of interest.

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