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Artificial intelligence in healthcare: Should it be included in the medical curriculum? A students' perspective

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ABSTRACT

The application of artificial intelligence (AI) in healthcare has increased due to rapid digitization and integration of computer science in all fields. However, the outcome in relation to patient treatment and healthcare delivery is not that visible. The reasons could be non-availability of data, lack of computerization and financial constraints. Besides this, the lack of appropriate teaching at undergraduate level about AI and its medical applications could be an obstacle. Including AI in medical school curriculum and collaboration with faculties of computer science can augment the knowledge of medical students about AI at the graduate level for better application in the real world. This will help the medical profession to prepare their younger fraternity for the future in AI.

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INTRODUCTION

Among the many characteristics that distinguish humans from other species is our ability to understand and learn from our past life experiences and simultaneously living in the future.[1] This is the basis of artificial intelligence (AI), which in healthcare is the use of complex algorithms and software to emulate human cognition in the analysis of complicated medical data.[2] Now 65 years old, AI is still struggling for existence in academics, research and its implementation in medicine. Although there are numerous publications in the field, AI is still in its infancy. Since its inception in 1956 by John McCarthy at Dartmouth,[3] formal training of AI in medical colleges is not a routine due to which algorithms of AI can become difficult to apply in the real world. As AI has regained momentum and attention in the past two decades, it is imperative to teach medical students how to obtain desired benefits.

Scenario of undergraduate admissions in India

In India, a student at high school must choose medical stream subjects to get admission in medical school; mathematics and computer science are usually not chosen by these students.

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The study of AI involves a knowledge of mathematics and computer science, comprising algorithms and probabilities. In medical school, students can find it difficult to understand the logics and deductions applied in AI due to incomplete knowledge about computer languages.[4] It is widely agreed that students who opt for engineering as a graduate degree are more suitable for courses related to AI as they have knowledge of mathematics and computer science. However, these students may fail to apply AI appropriately when it comes to healthcare services. This scenario is the same in Asian countries as there is no bridge course available for medical students who wish to pursue AI at the graduate or master's level.[5]

Learning in AI

AI is a branch of computer technology that deals with the design and development of intelligent machines to mimic the cognitive function of humans.[6] There are two subtypes of AI, namely machine learning (ML) and deep learning (DL).[7] ML, as the name suggests, is the learning aspect of AI. It deals with developing computer algorithms so that they can learn how to make decisions. DL is the next stage in the evolution of ML. Its algorithms are inspired by the information processing patterns found in the human brain, just as we identify and classify different patterns of information in our brain.

The basic learning in AI requires to learn entirely simple and user-friendly computer programming languages such as Python, which was created by Van Rossum in 1991.[8] Python can be used directly by the developer to run a program. The language can be interpreted by an emulator or a virtual machine along with native machine language which the hardware understands easily. Python is also a general-purpose programming language which can be used across many domains and technologies. Some of the Python libraries used in AI are NumPy, Pandas, Scikit learn and TensorFlow.[9]

Applications of AI in healthcare

During our bedside clinical posting of general surgery in the 3rd year of MBBS, our group of 10 students were asked to examine a 45-year-old woman who presented with a 3-month history of a lump in the right breast. We were asked to make a differential diagnosis based on history only. With our limited knowledge, we could think of a lump that can be benign or malignant. Next, we were given films of mammography with the report from a remote clinic stating that there was a lump in the upper outer quadrant of the right breast with no microcalcifications, suggestive of BI-RADS (breast imaging reporting and data system) grade III.[10] Our professor of general surgery asked us: 'What next?' All of us were clueless. It was then our professor introduced the term 'AI'. He told us that AI can help in

improving accuracy to categorize a breast lump into benign or malignant and obviate the need of unnecessary invasive investigations.[11]

The primary aim of health-related AI applications is to analyse relationships between diagnosis of disease, its treatment and patient outcomes.[12] It can also be helpful in developing treatment protocols, research in drug formulation, personalized medicine, development of medical devices and monitoring patients.[13] All these require active participation of a trained clinician or a biomedical scientist along with an AI expert to analyse the outcome in relation to patient care.

Many recognized institutions such as the Mayo Clinic, National Health Service and Memorial Sloan Kettering Hospital have incorporated AI algorithms in their daily practice.[14] Seeing its wider implications, the All India Institute of Medical Sciences, the premier institute of India, is also doing clinical projects related to AI in the field of oncology, medicine, ophthalmology, cardiology and diagnostic radiology.

OBSTACLES TO INCORPORATE AI IN MEDICAL CURRICULUM

Although advantages of AI are known to all, inclusion in the undergraduate medical curriculum is going to be neither swift nor easy. One of the major hurdles is limited digitization in medical colleges, which is mainly due to financial constraints.[15] At present, many hospitals and institutions do not have computers for day-to-day clinical work, as a result data acquisition, which forms the basis of AI, is not done. Moreover, development of an effective AI system requires a multidisciplinary team of educational experts, data scientists for analysing big data and physicians for ensuring clinical relevance and accuracy of the AI system.[16] Most medical schools in India lack this infrastructure and expertise.

RECOMMENDATIONS TO INCLUDE AI IN MEDICAL CURRICULUM

Incorporating AI in the medical curriculum is not challenging once the authorities are convinced about it. The medical curriculum must be changed from one of the traditional memorization models to a logical and analytical one.[17] Based on the literature search, we suggest a framework to implement AI in undergraduate medical curriculum in a step-wise manner as follows:

1. At the MBBS entrance level, this is the earliest point to embed the knowledge of AI into medicine. Along with physics, chemistry and biology, the entrance examination can also test mathematical concepts such as linear algebra and calculus as these are important for the elementary understanding of AI. In this way, the foundation of AI will be set for the rest of the medical curriculum.

2. In the core phase of MBBS, the 1st and 2nd year curriculum should incorporate knowledge about computer languages, fundamentals of AI and robotic technologies. The 3rd year is the ideal time to familiarize students with the clinical application of AI as during this time, the clinical postings start and students are in the process of history taking, pattern recognition and decision-making.[18] Initially, such an arrangement can be once a week. In the final year, group-wise tutorial-based and interactive sessions can be conducted to solve one or more problems which are based on applying concepts from data sciences and AI technology to clinical

practice. Access to computer-assisted learning can orient the students to critically appraise research and learn evidence-based medicine. Furthermore, didactic revision of fundamentals and advanced topics related to AI should be reinforced during the final year. An optional examination at the end of MBBS can help the students analyse the subject more seriously.

3. Some recognized universities are offering good-quality courses on EdTech platforms (Coursera, Edx, Udemy) on data sciences, computer languages and ML for students who want to gain more knowledge and pursue a career in the field of AI. These courses can be done alongside the medical course.

4. Medical schools can collaborate with faculties of engineering and computer science to understand the semantics behind real-world AI applications.[19] For example, basics of software development and futuristic prospects related to AI can be valuable for students.

5. Research projects related to AI can be given to interested students as part of undergraduate teaching or postgraduate thesis so that they are more competent to apply the knowledge of AI in healthcare.[20] Many national and international conferences related to AI are being organized where students may present their research output and stay up-to-date with the latest developments in AI.

6. For students who want to pursue AI for their masters, they should be offered a bridge certificate course wherein despite holding a medical degree, they may be allowed to get admission for masters in India as well as abroad.

CONCLUSIONS

It is beyond debate that AI has the potential to change healthcare outcomes by making faster and accurate diagnosis and screening, reducing human errors, decreasing medical costs and labour, faster processing of medical data and analysing medical information for research purposes.[21] However, to make this happen, machines and clinicians must work synergistically in the field of AI. Thus, present-day clinicians and budding doctors need to be trained in AI technologies. Since our existing medical curriculum does not focus on this issue, it should be reformed to integrate AI strategically across different stages of MBBS training. This will also result in the participation of clinicians in the development of AI tools.

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