

“AI-Eyes Healthcare” – A glimpse into the role of artificial intelligence in healthcare and the possible implications in Indian Scenario

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"I don't see that human intelligence is something that humans can never understand."

~ John McCarthy, March 1989

Introduction

Artificial Intelligence (AI) can be described in simplistic terms as “Thinking Machines, a term first coined by one of the founding Fathers of Artificial Intelligence, Prof John McCarthy, nearly 63 years ago [1]. AI is defined as, the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages [2]. Recent technological breakthroughs have undeniably renewed interest in the field of AI, especially following the developmental leap achieved by the likes of IBM Watson and Deep Mind by Google in various fields including Healthcare, Defense, Space research, designing and manufacturing, automated vehicles, natural language processing, games, simulation technology, etc [3].

AI has been applied in medicine as early as 1950s, but notable interest and advances were seen only by 1976 by Gunn [1-2]. With advancement of computers and computer languages, large scale use of Fuzzy systems began in 1989. Till now over 30,000 papers have been written on AI. India stands at seventh position in AI articles and is increasing faster

than ever due to easy access to computing and inherent crave for AI. Best example being the World renowned Mathematical Genius-Srinivas Ramanujan with over 3900 theorems to his credit which were termed as a fraud in the beginning by some of his ardent critics but now with advances in computing and AI, they have been able to understand it's true value and they have used many of them in Space Research by ISRO, NASA and various other space agencies and many Medical applications as well. And this only marks the beginning of understanding of fraction of his entire Theorems Database that he gave almost a Century ago.

Presence of AI in Healthcare:

In the Healthcare domain, AI has been used in fields like *complex decision support systems, diagnostic pathology, diagnostic imaging (X-Ray, Ultrasound Imaging, ECHO, CT, MRI, PET), anatomical 3D modeling for pre-surgical evaluation, healthcare data management (advanced EMR solutions), medical device designing and prototyping, clinical outcome prediction and patient monitoring, autonomous robotic surgery, simulation training, etc.*

Right questions about “AI in Healthcare” and it’s Future:

The idea behind the need for exhaustive inclusion of AI can be determined in these basic questions.

- *What is AI in Healthcare and what are it’s types ?*
- *Is there a need for AI in Healthcare ?;*
- *Which datasets and how many are necessary for designing an acceptable AI solution?;*
- *Why AI supersedes conventional methodologies in Healthcare for diagnosis in long run?;*
- *How to rely on these results ?;*
- *And how to standardize these solutions in future ?;*
- *How to determine the limit of dependency to these solutions ?.*

Probably we are ill-equipped to answer the last two questions with comprehensiveness at this moment, but they are definitely the ones which will be asked in near future, whether we are prepared for it or not and whether we keep neglecting or denying AI’s existence or not.

The inevitability of AI’s extensive presence in Healthcare in the near future, was particularly earmarked at the “*World Conglomeration of AI Experts in 2018*” [4] where in the leading Healthcare and Technology experts in AI reflected the “*present need, pace and inclination towards Healthcare IT development by all Global Tech Giants along with the noticeable up-springing of Start-ups in Healthcare*”. Furthermore they declared that the present “*4th Industrial Revolution (4th IR)* will be led by *Technologies which shape AI in Healthcare* and the following “*5th Industrial Revolution (5th IR)* as being spearheaded by the *Technologies which enable Meaningful Interactions between AI and Humans* [4].

This revolution has potentially helped create a novel category of the “Internet of Medical Things (IoMT). And the need, acceptance, and hence the business in this sector is expected to show a meteoric rise by almost five folds with the estimated valuation being predicted to grow from USD 11 billion to USD 51 billion between 2017 to 2022, especially in the Asia Pacific region [5-6]. One Expert went on further to say that non-

participation in such opportunities must be avoided, as it may later lead them to settle with lower pays or possible joblessness, as in Future the higher pay-scale jobs may be restricted to those who have themselves designed or helped them design or have some association with AI based Solution Makers (to understand and help enhance it’s capabilities by an instant/fast feedback loop) apart from their Clinic hours.

This probably gives us a slight clarity into and potentially *mandates our intervention at it’s conception stage itself*, only to ensure that our involvement must not be deemed too late to change our Pastor undo any future mishappenings.

If AI in Healthcare needs to entrust True accountability in Future then we have this rare opportunity Today to practically design it from scratch to understand it’s problems and limitations and try to solve them before they become ubiquitous and a potential catastrophic outcome due to weak foundation becomes a probabilistic reality due to it’s universal presence.

Without a doubt, the debates between Good and Bad outcomes with AI can take a Lifetime. But here the onus is upon us as Healthcare service providers. *When the question is about Healthcare, the decisions to change or alter the systems affecting Healthcare need to be borne out of our own interventions and struggles.*

The call for “*Digitization of Healthcare in India*” at the “*World Health Assembly*” is a formal “*Cabinet-approved proposal by Health Ministry and hence necessitates our deeper roles as the providers of Truthful Information / Clinical Assistance for such initiatives from the stages of Conception through Implementation and Field-Trials phase. Indian government’s recent introduction of the World Health Assembly resolution on digital health as a starting point towards the creation of health data as a global public good* [7].

And hence we need to keep aside our plausible deniability and understand the

context by analyzing the answers to the first 4 questions posed above with the necessary comprehensiveness that they deserve. A Clinician's productive involvement in this forms the much needed "*Human-AI Link. For example, Clinicians who help to develop these solutions when they are created by participating in approving their usage in Human trials or those who may use it as "End-users" with no feedbacks.*

This necessary demand, as is unfilled today, leaves a visible grey area in majority of Healthcare Tech companies, which essentially requires to be filled by temporary but dedicated involvement of the Best Clinicians by maybe providing few minutes of time now than facing the unknown consequences when AI becomes mandatory for improving the overall output of Healthcare service providers.

What is the concept of AI in Healthcare and its types ?:

Artificial Intelligence (AI) in Healthcare, is defined as "the utilization of complex algorithms and software to estimate human cognition in the analysis of complicated medical data."

AI's ability to acquire information, recognize complex human behavioral patterns with novel logic creation and provide meaningful, actionable output to the Healthcare provider (*Concept of Machine Learning*) differentiates it from traditional tech solutions in Healthcare. Also, few other characteristics of the simple AI algorithms take tasks literally, with no reaction if sudden change of scenario ensues. And most simple algorithms are considered black boxes, that is their incapability to understand the *causality (Why?)* of the very scenario that it has been trained for. Continued repetition of tests on these derived algorithms from large-scale datasets is the Key to create a meaningful AI solutions.

What are the types of AI and relevant used cases in Health domain?:

AI basically has two broad divisions namely Machine Learning (ML) and Natural Language Processing (NLP). Under these two basic things there are several subheadings Robotic, Artificial Neural Network (ANN), Deep Learning (DL), Fuzzy Expert Systems, Clinical Application,

Treatment, Prediction, Diagnosis, Evolutionary computation etc and many more yet to come. Initial AI usage can be seen in fuzzy systems which reacts to Human like corrections in response eg: Alarm in digital watch, Freezer, camera face (Image) recognition, warning in Pulse Oximeters, smoke alarm etc.

Is there a need for AI in Heath-care ?:

The final Goal of any AI solution is to *understand, achieve and surpass the best of the abilities of Human intelligence in that particular field.* It is any Clinician's dream to have a software (or AI solution) which can make sense out of real-time parameters recorded in an ICU setup for any age groups and provide them with Truthful or Meaningful" alarms/notifications and provide concurrent Actionable Data for the same based on the expected protocols and scenarios.

And the greatest strength of AI based solutions is that it's structure is designed to think like a Human mind (Like any other AI based solutions in other domains), understand the variations and intricacies of our interpretations and finally learn to interpret with better accuracy, which increases each and every time this cycle is repeated. This is done for an AI model by Training them with specific heterogenous Datasets from real patients (known as Training datasets Open-source/ freely available on Internet or). And hence, the fact that it can potentially be programmed to do the same meticulous analysis simultaneously in any number of datasets (from OPD, in-patients, ICU, population, etc) in a negligible timeframe with an unmatched persistence by tireless work for hours, days or weeks and keep learning the Human behaviorism in Medical Decision Making simultaneously essentially promising the best outcome every single time.

Why AI supersedes conventional methodologies in Healthcare for diagnosis in long run?:

A basic "Decision tree" methodology helps us in achieving only 2% accuracy in diagnosis, Random diagnosis" provides 1% accuracy, Differential Diagnoses 3% accuracy, Random

forecast which is commonly used as intuition in day-to-day practice has only 1% accuracy and the Linear regression exclusion has 3% accuracy. And by the time we reach linear progression accuracy by chance, we would have lost lot of money and precious time. And hence the cost-benefit ratio is multifold. These inaccuracies can be tackled and by using AI in the form of Support machine vectors which has the highest accuracy of 42% (As of today), Neural Network Analysis - 31% accuracy (Which is increasing every day and is likely to overtake all the same), Discriminant analysis 8% accuracy, Logistic regression 3% accuracy and many more supportive analysis algorithms with scoring systems which leads to near diagnosis faster and economical or in a reasonably acceptable way. [1-2].

Which datasets and how many are necessary for designing an acceptable AI solution?:

The datasets required are the documented parameters derived from the Patient's Case File. The solutions in any domain of AI have better success rates when they are fed with high-quality data from right sources. These datasets need to be entered meticulously to train these AI models with Specified Rule Systems. These are then trained with Outcome-based Classifications.

There is a considerable gap in *understanding the gravity of this step* in AI solution's success across the World. And this in itself is a major hindrance with factors such as incompleteness, insufficiency, ill-defined parameters" in the Patient's file (Maintained as hard copies), Insurance claim forms with summaries (Interim or Final), EMHR (Electronic Medical Health Records) records, which are critically important for forming this model. This consequently hampers effectiveness and accuracy.

And hence, emphasis on appropriateness, adequacy and right methodology of Data Collection from the sources is critical. To improve meticulousness, recording only the right values from the connected monitor along with a seamless interconnectivity with other devices and an access to previous health records with possibility of automated correlation generating algorithms can be the solution for the same.

Evidence for AI Standards:

Medical devices and Drugs used in Medical practice are required to undergo extensive standardized evaluation, usually done by randomized clinical trials (RCTs) with effectively carried outpost-marketing surveillance [8-9]. Similarly for validating clinical effectiveness for AI based Healthcare solutions, it is necessary to formulate globally acceptable standards by forming a Panel comprising of Clinicians from major Countries like US, UK, Japan, India, Russia, China, Brazil, etc with an open invitation for remaining countries to participate or object freely under the neutral ambit structure like United Nations. With many Software Engineers contributing to Healthcare Tech companies being Indians, it is a uniquely powerful opportunity for India to initiate these discussions and take a giant lead in supporting the Technology that will revolutionize the Future of Healthcare. The formation of global standards for AI solutions in Healthcare will form the strong basis for introducing the more advanced AI solutions in the future.

In the future, the advanced AI solutions with meticulous hardware integration are expected to extend their roles in actual Procedure or Surgery in Humans. And hence the global rules formulated for basic acceptance in Healthcare in general will form a strong basis for the same. For example, the US-FDA (Food and Drug Administration) has allowed only one pathological solution in the World with a permission to market it [8-9]. The solution is known as PIPS (Philips Intelli Site Pathology Solution-PIPS, Philips Medical Systems Nederland B.V.) and can be used to assist pathologists by enabling them to review the interpretation of the digital images of the surgical pathology slides prepared from FFPE (Formalin Fixed Paraffin Embedded) tissues [8-9]

Conclusion

'AI in Healthcare necessitates a "Balancing Act between Medical and Technical Communities" that needs our thoughtful indulgence in order to procreate an AI which embodies these simplistic ideas of being logical yet sensible, profoundly accurate but

with a Human touch to last generations ahead with the right training to accept every new challenge in Healthcare and excel in the same too.

To ensure the sobriety in this Technological boom on AI, there is an urgent need for undivided attention from us as "Clinicians and Healthcare providers". We must understand that there is no serious learning curve in our technological up-gradation or depth of understanding while doing so. But for a careful and thoughtful contribution

to guarantee a "Well structured AI in Healthcare", Healthcare providers need to provide the right information with right rules and regulations to prevent any future harm from it's usage or any legal hassles for acceptance.

This is just the beginning of the "AI-Saga in Healthcare" and many more strides are yet to be taken and hence this "Saga" continues with our pursuit to contribute more in future too.

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