

AI in Health Care

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The beginnings

Nearly 200 years ago, there was a science-led turbulence in the world; it was the discovery of electricity. Now we are standing at a similar technological crossroads. It is not just a question of inventing something new. The invention of Artificial Intelligence (AI) has put a question mark on the superiority of human intelligence. One thing that should be kept in mind is that civilization has never won a debate against technology. Science and technology—be it fire or electricity or computer—have always found their place in civilization.

Our age on the planet Earth is nearly one lakh and a half year, but human civilization is just around 10,000 years old. We do not have any record, not even any idea as to what we had done before the beginning of civilization.

Gradually we learnt science and mathematics; we thought of developing some structure or formula to make our calculations easier. The era of fifth century B.C. is very important for Indian civilization because that was the time of Gautama Buddha and the ancient physicians, Charaka and Sushruta. In the West, it was the time of Hippocrates. During that period, many Indians also began to think about mechanical and automated basis of calculation. One of them was Āryabhatta. From his writings, it was evident that it was the beginning of algebraic thoughts. With these thoughts and

ideas, we had to wait for many years. The 9th and the 10th century A.D. witnessed remarkable achievements of Islamic Science. We cannot come to the Western civilization without considering the contribution to human civilization from Damascus, from Baghdad, the cradle of Islamic civilization. One such contributor was Al-Khwarizmi who invented Algebra. The word Algorithm which we shall here mention repeatedly was originally formed out of mispronunciation of his name.

Thereafter, we saw some supremely gifted people who could be regarded as the first human computers. They were polymaths working in political establishments, government offices, and war offices of different countries and many of them were women. One human computer in India was Shakuntala Devi who could calculate orally the square root of an eight-digit number.

However, we could not afford to be dependent solely on those few personalities. We had to find out such a method which could be used even by common people to solve complicated mathematics. Many people were engaged in this venture and one of the first persons in early 19th century was an English man, Charles Babbage, who invented a machine using different moving parts like gear, pulleys, etc., and the machine was given the name 'Difference Computer'. In those days, there used to be lots of trading through ships and there were huge financial transactions involving complicated

calculations. Charles Babbage insisted on using his machine instead of performing the boring and tedious calculations. This was in 1820 when Babbage first showed the mechanized calculations. But at that time people did not accept it as they thought it had no future. Even the scientific community did not give much importance to Babbage.

‘Enigma’ is a recent movie based on the life of Alan Turing who was one of the most gifted human beings in the last 100 years. He was a mathematics teacher in a university and possessed an extremely sharp brain. Most of the time, he used to sit in front of the machine to attempt code-breaking. In London, there is a small village called Bletchley where few people go. At that time, in the 1940s, during World War II, Hitler was planning to attack London.

There were telegraph machines which could receive codes but code-breaking was not possible. Alan Turing, while sitting in the park, invented a machine and named it the Enigma machine. Till the end of the World War II, Germany was not aware of this machine. While Germany was under the impression that they were sending secret codes, Turing was busy decoding them using his Enigma machine. So, the first successful application of computing in our life was done in 1940s.

England could survive World War II because of two technologies. One was decoding by Alan Turing and another was the application of Radar for the first time in the world. We realized the power of mechanical computing after 1940s and in course of time several computers were built.

Then came the idea of real-time communication of work so that one could share his/her work with others. Science slows down if we are to carry our books, files, etc., from one place to another.

Science has to be accurate and communicative. The work along these lines started worldwide and, probably, in 1981, scientists of the Stanford University were successful in sending a message from one room to an adjacent one within the university. There was no telephone call, no one had to leave his or her chair. But in no time, they exchanged data. That was the big breakthrough of technology. The first of January, 1983, is considered to be the birthday of Internet. The creators of Internet Organization www (World Wide Web) are Vinton Cerf and Bob Kahn. The present form of Internet was provided by Berners-Lee.

In 1956, John McCarthy, following the path of Alan Turing, came up with the idea of making an Enigma-type machine that could train machines to think and produce the results of their thinking. So, much before the Internet came into existence, the thought of Artificial Intelligence (AI) had begun to take shape and some work on it started. Finally, Nobel Prize was awarded to Hopfield and Hinton for their contribution towards AI. It was through them only that the world first recognized the existence of AI as a valid kind of information technology. Since there was no Nobel Prize for AI, they were given the Nobel Prize in Physics. Naturally, the physicists were not happy about it as they did not consider information technology as a part of Physics. They appealed to the Nobel Committee not to consider in future those who were working on information technology as physicists. However, these two Nobel Prize winners showed us that even the machines can do intelligent thinking.

Almost all of us are familiar with typing in word file. Suppose you have written 100 essays on cow on your word document. If you now go back to word file again and

command it to write an essay on cow, it cannot. This is because it has not learnt to think; it has not been taught the required technology. It is to be taught the principle of child learning.

Hopfield and Hinton had worked for years to analyse scientifically how a child learnt, how the brain developed; how the information lay stored and how this information, if required, was utilized while talking. This entire process of a child's learning has been replicated in AI. Hopfield and Hinton created the entire network based on human neuronal pathways. Machine learning needs the software to learn from data that we feed and to acquire the power of analysing.

What is AI all about? How does it differ from the previous computer programmes? AI not only stores data but can also analyse the data. When we give command, AI possesses the power to answer according to the command.

In AI, we come across terms like model, algorithm, etc. Model is the programme that uses the data we feed and algorithm is the instruction given to the data set so that these data can be analysed properly. Based on this algorithm, it can interpret X-rays, can draw pictures, can write a text for us and can do many more. Ever since applied artificial intelligence entered India, various activities have been going on for the last 4-5 years. Right now, in the entire world, India occupies the third position in terms of AI activity after U.S.A. and China.

In health care

AI can be applied in various fields. It finds maximum application in the financial sector followed by energy resource. AI also has its application in health care which is the topic of today's discussion.

Any new technology passes through many phases. In the first stage, there is a feeling of freshness—this is known as innovative trigger. Next, when people realize that it is truly very exciting, it passes through a peak known as the peak of inflated expectation. At present, we are in the peak of expectation with AI. In fact, we now want AI to do everything for us. In near future, as people start criticizing some of its limitations, there will be a downward phase. This is called the trough of disillusionment. Finally comes the plateau of productivity when the benefits and limitations are well understood.

At present, we are yet to reach the plateau of productivity. People of any age group are now excited about AI in the same way as a child is excited with a new toy. Right now, various talks are going on about AI and these are mostly bipolar. This is known as Utopia vs Dystopia. Many of us are using AI unknowingly; air travel through Digi Yatra, for example, is an application of AI. We have learnt to identify individuals correctly by analysing the photograph. AI divides your face into nearly twenty co-ordination points and measures the distances between these points. The machine reduces you to a formula which is linked to the Aadhar card number. Thus with the help of AI, a person can be identified correctly using facial photograph and we had to wait for more than 150 years to achieve it.

This tremendous computational capability is applied in various sectors of health care. Using this capability, medical records are maintained in hospitals. We, the doctors, use it for diagnosis, for creating database. It is also being used to sort out insurance. Any ordinary individual can track his or her treatment plan, and with a smartwatch on the wrist, it is possible to get the health directive for the entire month. Maybe in near

future, you will start receiving ‘prompt’ on personalized medicine.

I’ll now give some idea on how things are shaping in health care. One example is fully automatic e-prescription. Here you phone someone and see the photograph of a doctor while no doctor is actually there, you are speaking to an AI. The moment you start speaking, you are given a QR code and a bar code and a prescription is generated. If you want, you may download the prescription and proceed with the treatment.

Next is the use of the computational capability of AI. If someone comes to our hospital and asks for a piece of paper to note down something, we cannot provide it. This is because everything is in the computer and there is no paperwork. Jokingly, we say COWS to refer to computers on wheels. Starting from the diet plan of a patient, everything like the operation note, admission of the patient, all that were told in OPD, the X-ray report, etc.—everything is captured by the machine. Now, people are taking these computers from one place to another. But I’m quite sure that within next two years, every hospital in India will have 100-200 robots to do the work of moving the computers.

There is great excitement regarding the application of AI in medicine. Users of AI tools like ChatGPT, Gemini, etc., know quite well that these are like oceans, oceans of knowledge. Finding the answer to any query quickly is not possible in this ocean. To make the use of AI simpler and easier, AI agents or Chatbots are developed.

One very common example is the booking of train ticket through the website of Indian Railways. As you open the site, you find one Chatbot already present there. It will orally ask you various questions like where and when to go, etc. The entire process is voice-activated. The Chatbot

works so precisely because it is linked to a huge database. These are called ‘agents’ in this huge ocean of activity.

Same is the case with the booking of movie tickets. The ‘agent’ will enquire about the particulars like the location of the hall, show time, preferred ticket price, etc. Finally, you get the ticket once the payment is made.

One application that has become quite popular nowadays is the chest X-ray analysis using health Chatbot. Once the Chatbot receives the X-ray image, it will be ready with the diagnosis. A few months back, I had been to U.S.A. and there I had the opportunity to witness one trial run in the Massachusetts General Hospital. Most confusing and complicated medical cases of last 100 years, which had already been diagnosed, were retrieved to challenge Chatbot. Ten such cases were challenged in our presence and 9 out of 10 were correct diagnoses.

The question of accuracy

With so many applications of AI, the first question that comes to mind is regarding its accuracy. At this moment, most of the AI activities are matched with human activity. In fact, human activities are not totally flawless. In a complicated clinical challenge, human failure rate was 47% whereas the failure rate of AI was around 52%. So AI is matching human behaviour.

AI is like a tool; so one must know the purpose of using it. A round screw cannot be opened using a flat screwdriver. In the same way, ChatGPT is a good option if you need text-based knowledge that involves large number of questions and answers. Gemini is useful for questions related to reasoning or logic. Similarly, there is separate AI for generating images.

I'll now try to explain how AI is helping the doctors in surgery. In case of heart operation, doctors wait for the artery, which is like a tube, to narrow down and finally to stop in order to find the problem of the patient. But AI is able to analyse the tissues around the arteries even when the arteries are normal. AI can inform doctors about any inflammation or irritation in these tissues which started nearly a year before a patient is diagnosed with coronary disease. We do not have this kind of analysis in our hand, but AI can warn people in advance with early prediction.

Dermatology and eye are the two areas where accuracy of AI is extremely high. Skin disease is one of the most popular areas—99% of the dermatologists diagnose by seeing. AI does the same thing with the help of computers.

Eye is completely mathematical—both the anterior and the posterior chambers are analysed by AI. Eye is now said to be the gateway to the human body. Just looking at someone's eye, AI can predict if the person is having atherosclerosis; it can also tell about the chance of cerebral stroke in the next two years. By seeing the eye, AI can tell whether hypertension control and diabetic control are adequate. So, ophthalmology is taking a different turn today.

The biggest challenge at present is diagnostics. Doctors now see the images of the CT scan and the X-ray. I am sure that in the coming two or three years, a regulation will come out prohibiting seeing anyone's CT scan or X-ray images. This is because a computer eye is nearly 500 times more powerful than a human eye in X-ray diagnostics. So, AI can cover the entire area of radio diagnostics. First of all, a machine observes it, then one algorithm diagnoses it before it comes to the doctors.

It took many years for us to learn to study ECG image. We use this knowledge to see whether the blood supply to the heart is normal and the heart rate is regular or not. Now, with the help of AI, a person can know about the pumping of the heart from the ECG image in a way no standard cardiologist can. AI can understand patterns that we cannot. AI has nearly 50000 databases from which it can identify the required pattern. We, the doctors, advise patients to go for echocardiogram in order to know the pumping rate of the heart, but AI does not require an echocardiogram for this purpose.

Even more interesting is the difference between the biological and the chronological age. Use of AI is changing the age assessment. A person may be 45 years old but due to various illness, he or she may look older by 10-15 years. With some people it is the other way round. Because of good body structure, a 70-year-old may look like a 50-year-old. Prediction of biological age from ECG by AI plays an important role in insurance policy. Birth certificate age will now be superseded by biological age.

'Leonardo AI robotic arm' is the latest development which competes with the surgeons in OT. Its efficiency lies in its movement. Our hand is capable of two-plane movements, one is up-down and another sideways. It can have circular movement also. So, at best we can have four movements using our wrist. In contrast, a robotic arm is capable of making twelve-plane movements and that too in a limited space. The robot is so named because Leonardo da Vinci gave the concept in his notepad. While painting, he regretted that the movement of human fingers was limited. He said that a day would come when man would create a machine having joints capable of any type of movement. This is exactly what the robot is doing now.

Robotic surgery

In case of robotic surgery, the surgeon is not in the close vicinity of the patient but controls the robotic arm movement from a distance. It is even possible now to operate the robotic arm from one country when the robotic surgery is being carried out in another, once the robot is docked into position. We witnessed one such operation in a workshop involving an arterial harvesting in the heart. The operation was carried out by a surgeon in Chicago on a patient in Belgium.

In case the fees of your anesthetist are too high, you can opt for a robotic anesthesia machine. The robot can give you intravenous injection after checking your heart rate and pulse rate. It can anesthetize after checking consciousness, heart rate and pulse rate. At the end of the procedure, it reverses the process. The robot informs the doctor once the patient is awake. All this is possible today.

We, the surgeons, have performed various types of operations. One of the most difficult operations is the prostatectomy. The prostate gland being very small in size and situated at a depth, it is difficult to get a clear view and this causes lot of bleeding during operation. Today, if you look at the robotic prostatectomy, it is like poetry! There is no blood loss at all. The entire screen shows the complete view. So, these operations have really been revolutionized.

Normally, doctors go for one CT scan and one ultrasound scan before proceeding for the operation. In robotic surgery, as soon as the necessary robotic parts are introduced into the patient's body, AI superimposes all the structures on the operative field. In course of operation, if the surgeon shows a tendency to cut a region two inches above the actual point, the machine would not move, preventing the

doctor from taking this erroneous step. The robot will allow you to operate as long as you are operating in the appropriate area. With a bleep, the robot will signal if any step mismatches with the scan. Every moment of the operation is being recorded, the doctors would be audited and criticized for even the minutest deviation from the ideal.

Defects of a vehicle can be detected from the vibrations while it is moving. Similarly, by analysing the vibration of human body, one gets the idea of the different parameters of the body. A sensor mattress is a device that continuously measures eight parameters of the body when a person lies down on it. It is not that only your doctor observes these but anyone concerned about your health may get information from anywhere about all your movements in addition to the health parameters as long as you are lying down on the mattress. This is one of the original Indian-based technologies.

One very important application of AI is the analysis of the 3D structure of protein within a short time. Previously, it used to take more than a year to find the 3-dimensional structure of protein, after analysing the 2-dimensional structure. Now AI is able to do it in a few days. During Covid-19 period, synthesis of Moderna vaccine got stuck after 80% development because the 3-dimensional structure was not known. Moderna structure was defined by AI. No original antibiotic has been synthesized since 1967; the last original antibiotic failed in lab test. The last synthetic antibiotic developed using AI is Halicin.

The biggest problem

OPD in hospitals is one of the main areas where service of AI can be utilized. The biggest problem with AI is the impact it is going to have on manpower. The first impact

will be the reduction of employees in all sectors. ChatGPT can answer many more questions than you can even after achieving sufficient academic qualifications. Hence, in each sector, starting from health care to bank, finance, accountancy, education, etc., there is a big question on skill and employability. Multinational companies have already started retrenching their employees. In India also, workers are going to get the same treatment specially for those jobs which are repetitive, non-analytical and do not call for original contribution from their side.

Does AI commit mistakes? According to the AI scientists, there is nothing called 'error' in AI; they use the euphemism, 'hallucination'. Even though AI has some error rate, it is very reluctant to admit any error.

A person with the ambition to create a history-friendly large-language AI model may develop an algorithm and may write a data with the help of intelligent students. But even if things go smoothly, what would not let you go ahead is the electric bill because data centres consume power like anything. Two nuclear power stations are needed to run ChatGPT. If these were operated from Bangalore, the entire city would dry up, because of the volume of water needed for cooling. So, a tremendous resource management is necessary. India, in spite of several limitations, is still holding no. 3 position in technology build-up. There is no question of India going for any competition with China which has many more AI patents and supercomputers than we have. So we must focus on India so that our technology becomes accessible to our people.

A blessing or a curse

Let us now come back to the question: Is AI a blessing or a curse? Like any other technology, its selective application in the appropriate area, how far common people can access it and whether the cost is affordable—these are the factors that decide the benefits of AI. On the other hand, application of AI just anywhere like a child with attention deficiency disorder will bring harm. Use of error-prone model available at lesser cost may lead to disastrous outcome.

We are now standing at the crossroads. The most important question is responsible application, but it is easier said than done. Geoffrey Hinton, the Nobel Prize winner was asked in an interview if there was any single thought that occupied his mind. In reply he said, 'I'm just wondering how much time AI will take to outsmart us. We have just discovered something that is more intelligent than us.'

Before concluding, I shall mention a hospital situated at a distance of about 10 km from Beijing. Previously there used to be 1500 employees and now hardly 20 people are working there. The whole hospital has been reduced to an AI and robot managed hospital.

According to Swami Vivekananda, science is nothing but the finding of unity. I am not sure how many of us have realized the inner meaning of this statement. We really do not know whether the much-talked-about philosophical, spiritual and civilisational unity has brought us to a point where our own creation is poised to outstrip our intelligence. ■

* Dr Kunal Sarkar, Director, Cardiac Surgery, Manipal Hospitals, delivered this lecture in Bengali at the Institute on 8 August 2025. The lecture, slightly edited, was transcribed and translated into English by Alaka Banerjee.