Special Article

Artificial Intelligence beyond Chess: Opportunities for Medicine, Public Health and Social Medicine

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Abstract :
History was created in 1997 when Deep Blue, an Artificial Intelligence (AI) enabled chess engine, beat the world chess champion. Since then AI and machine learning are being increasingly used in other fields including health care to perform complex tasks. The present commentary compares chess and medicine and how lessons learnt from the application of AI in chess leading to "advanced chess" can be used to develop AI enabled "advanced medicine." It supports the proposition that while at present it may appear that advances in medical technology are putting a strain on the doctor-patient relationship, in the long run AI and machine learning have the potential to enrich medical care by giving the gift of time to doctors to facilitate better communication with patients and win their trust. Impact of AI and machine learning on Public Health and their role in reviving of Social Medicine has also been discussed.
Key words: AI; machine learning; healing; social medicine; public health

Chess as crucible of Artificial Intelligence: from game to game changers in health care.

Chess has served as a crucible of artificial intelligence (AI) and machine learning. Alan Turing and Claude Shannon developed algorithm for chess on paper way back in 1948.[1] Since then with more advanced computing power chess engines have become more popular. It was predicted that if machines could play chess they would replace humans in many tasks requiring intelligence. Calculations by computers beyond the capacity of human matches outcomes by human intelligence, intuition and experience. What humans lack in way of limited calculations they compensate with intuition backed up with experience and study. Earlier versions of computer chess engines played by brute calculations with access to huge data bases of opening moves. Around a decade ago, there was an even balance – the best computers playing at about the same level as the best chess players. [2] Over the years AI and machine learning have become game changers in many fields including health care.

Similarities between chess and medicine: concept of "advanced chess" and "advanced medicine" to cope with the present crises in medicine.

History was created in 1997, when IBM computer Deep Blue beat world chess champion Garry Kasparov. However, the methods used by the human and the machine differed. The world champion played with human creativity and intuition. The machine played by evaluating systematically almost 200 million likely moves on the chess board per second and winning with brute number crunching force. [3] The brute computing strength of the machine was matched by the world champion's mastery in pattern recognition and spatial visualization, properties which later generations of machines have since acquired in addition to self learning properties. According to the former world champion, Kasparov, if you cannot beat them, join them. This led to "advanced chess" where each player uses machine as an aid during the tournament. [2] This compliments the computing strength of the machine with the intuition, creativity, and experience of the human player. In the same manner one can think of using AI and machine learning as an aid to doctors rather than an adversary.

Chess and medicine have many similarities. It is debated whether chess is an art or science. [2] The French artist Marcel Duchamp had a lifelong passion for chess. He stated, "I am still

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a victim of chess. It has all the beauty of art – and much more. It cannot be commercialized. Chess is much purer than art in its social position." [4] Similar debate surrounds medicine. It may be one of the oldest arts but the youngest science, softer than the hard sciences, rich in possibility and promise. [5, 6] Regrettably it is becoming increasingly commercialized.

AI is poised to impact the field of health care at a time when medicine is passing through crises. Medical technology is negatively affecting the doctor-patient relationship and raising the cost of health care. We may know the genome of our patients but fail to build up the rapport required to earn their trust. We may diagnose the cause of vomiting in a patient once we get the expensive CAT scan report revealing to us that an obstructed inguinal hernia was the reason for an elderly patient's vomiting which should have been obvious on a thorough history and clinical examination.[7]

AI and machine learning have much potential to make medicine more precise. Harnessing of big data will contribute to better prediction in diagnosis and prognosis. However it has to be tempered with human intuition and judgment, to prevent it degenerating into assembly line medical care. This will involve wisdom on part of doctors.[8] Combining computing strength of chess engines with human creativity and intuition resulted in "advanced chess." Similarly, big data processing should be combined with creativity and intuition of experienced doctors to ensure "advanced medicine."

Machines unlike human physicians do not get tired, bored or biased, reasons for most medical errors. A review revealed more than 12 million medical errors in US yearly among outpatients.[9]

Over the past decades health care has become the biggest business, largest employer and very expensive – paradoxically time spent between-doctor and patients have reduced with these trends. Events have overtaken doctors who in an earlier era were busy with patient care in their private clinics where they enjoyed complete autonomy. Today most doctors in private sector have to work in large corporate hospitals due to unaffordability and unsustainability of small clinics as a result of rising cost of medical technology. In this corporate culture doctors have lost their autonomy at the altar of profit making by owners of large hospitals. Increasingly there are fault lines in the doctor patient relationships.

Neither doctors nor patients are happy, resulting in poor job satisfaction and burnout in doctors,[10] and litigation and violence on part of the patient.[11] All because the "care" is missing from "healthcare." [12]

What hope is there of the situation improving? With increasing use of AI and machine learning in health care there is hope. The greatest opportunity offered by machine learning in health care is P4 (personalized, predictive, precise and participatory) medicine. [13] Two of the Ps, personalized and participatory offer hope for revival of social medicine.

Exhaustive phenotyping from prewomb to tomb (lust to dust),[12] pattern recognition and machine learning eliminating human monitoring will spare time for deep empathy and connection between doctors and patients. With machine as partners performing mundane tasks rather than adversaries, doctors will have more time to communicate with their patients. This has potential to revive the doctor patient relationship.

Machine pattern recognition will help in fields like radiology, pathology and dermatology – disciplines with patterns and also other specialities without patterns such as medicine, surgery and psychiatry, to some extent compensating for limited number of health professionals. [12] AI as partners in health care has the potential to achieve equitable distribution in remote and resource poor settings.[14]

Impact of AI and machine learning on Public Health

Besides, augmenting individual medicine, AI and machine learning tools using big data have great potential to promote public health. Being more complex than chess, because of multitudes of determinants of health acting in combination to form different public health patterns unique to each community, application of AI can identify patterns in complexity. Continuously monitoring big data can predict trends and serve as early warning system for outbreaks. Google maps can identify traffic situation in real time. Similarly footfalls in hospitals and health centres, movement of populations, animals, birds, meteorological conditions, vector density and so on can be monitored by AI and machine learning. These can be vital inputs to predict outbreaks in real time.

Data mining enhanced by AI is the future in public health. [15] Besides useful for predicting and controlling communicable diseases it has potential for important role in mapping and controlling non communicable diseases (NCDs). NCDs have complex aetiologies both at individual and environmental level. Epidemiology and informatics on NCDs can be linked up by data mining across environmental, individual, economic and biologic data sources. [16] These will play an important role of surveillance and monitoring as well as health technology assessment to put public health on a firmer footing.

AI may bring back empathy in clinical medicine and promote the art of healing.

At the level of individual patients, technology and machines while facilitating advances in diagnosis and treatment also brought about fissures in the doctor patient relationship. The most disruptive worldwide are the Electronic Health Records (EHRs). EHRs preclude eye contact between doctor and patient adversely affecting rapport. Doctors are reduced to data entry clerks. Burnout among them has been attributed to EHRs,[12] which in turn increases risk of medical errors jeopardizing patient wellbeing.[17]

Perhaps these disruptions are teething troubles of evolving technology. Medical technology, AI and machine learning

seem to make health care depersonalized in the short run. However they also have the potential to make health care human again.[12] Once achieved, doctors would regain their role as healers. Healing, beyond mere curing, should be the ideal of health care. The future may bring back the past. In the pre-antibiotic era the doctor's personality, empathy and reassurance promoted healing. This was because doctors compensated for the lack of remedies by developing the healing art. They also had the time to do so. Increased specialization, corporate health care, and time constraints have rusted the healing touch of doctors. [18] There is focus on the illness rather than the patient, the cure, and the fascination of saving a life.

How will AI and machine learning bring back healing to health care? It will do so by the gift of time doctors will have to interact with the patients. It is estimated that once the full impact of AI is realized time made available for patient interaction will increase by 25%.[19] AI enabled voice and image recording would make EHRs extinct. Doctors will be able to communicate better with their patients. They can pay more attention to social history which besides cementing the doctor-patient relationship can give important insights into social etiology, social pathology and social therapy in health and disease. Present day medical graduates do not see the relevance of social medicine beyond passing the Preventive and Social Medicine examination. AI and machine learning may outperform the doctor in mundane medical tasks but will face a dead end when faced with social and cultural aspects of health and disease. In these domains doctors will have an edge over machines. Patients always prefer to listen to a doctor whom they can trust rather than a machine. [20] AI and machine learning when fully evolved thus have the potential to revive the forgotten discipline of Social Medicine.[21]

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