Artificial Intelligence: Present status and future prospectives in health care domain

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ABSTRACT

Artificial intelligence technologies are growing rapidly and opening the vista of opportunities in the medical field. AI evolving the way of practice in the medical field and showing promising outcomes. Application of AIs are still in a developing state and still need acceptance from medical professionals as they are not prepared and trained for such advanced technologies. But better care for patients, medical professionals has to be acclimatised with these advanced AI technologies.
These advanced AI technologies still need validation for reliability, safety, precision and soundness which are underway.
The purpose of this paper discuss an overview of AI in the Medical field, related risk & ethical issues and futuristic opportunities in the Medical field.

Key Words: Artificial Intelligence, ANN, CNN, Machine learning, Medical sciences, Dental Sciences
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INTRODUCTION

AI is a new branch of applied sciences that endows machines with the ability to mimic intelligent human behavior[1]. Artificial intelligence (AI) can be described as imitation of action, thoughts, behavior of intricate and complex human mind by an innovative technology and to further replicate them in attaining useful tasks like finding solutions, locating objects taking decisions and performing tasks[2]. We can witness usefulness of AI in our day to day activities like searching our solutions on various search engines and use of robotic devices in cleaning

of floors[3]. AI has now becoming an essential part of health care systems at higher centers. Clinical medicine has come up with a large number of AIprototypesfor automatic predictionof disease risk, detection of abnormalities/pathologies,diagnosis of disease, and evaluation of prognosis[4]–[6]. AI has an ample applicability in radiology, research laboratories, dentistry and robotic surgeries[4]. Various types of robots are already part of our everyday life, they support production in industrial applications, and aid in maintenance like they cut our grass and clean our floors[7]. The robotic applications have huge impact on life style as these innovations are time and man power saving and proving economically relevant[7]. AI holds a promising future not only in industrial sector but in domain of research and health care in terms of providing better patient care with utmost precision[8].The purpose of this review is to summarize the applications of AI in the field of medicine.

HISTORY

The term "artificial intelligence" (AI) was coined in the 1950s and *connotes*to the idea of assembling tools that are competentof performing work that are normally performed by humans[9]. The credit of this innovation which is now recognized as AI was pioneered by Walter pits in the year of 1943[9]. They proposed a model of artificial neurons[9]. The word "Artificial intelligence" first adopted by American Computer scientist John McCarthy at the Darmouth Conference in 1956[9]. In 1959, the first computer assisted trainable neural networks were invented.

Image processing–It is a statistical process that enhances an image with an objective to achieve enhanced clarity, retrieval of specific information, or pattern measurements. Basically the input is an image which is processed to create an output which in turn is a better defined picture for a certain applied purpose[10]

Computer vision –It can be described as processing of a picture to enable identification of the image input and to convert this into an appropriate meaningful output resulting in its interpretation[10].

Artificial neural network (ANN) - This modality connotes to a prototype based on mathematical equation on nonlinear statistical data modelling tools where complex relationships occur between inputs and the output. This process imitates the human brain in processing several types of details and creating patterns for use in a decision making process through neural networks. Basically in ANN the input is entered into a set of algorithms and their output is re-entered to a different set of algorithmto generate the final output[11].

Machine learning - This is the ability of a computer to learn from memory or experience, i.e. to modify its processing based upon newly acquired information. This process using the fundamentals of deep learning mimics the memory of human brain to generate meaningful conclusions and thus helps in decision making[12]. The deeplearning is a process in which an algorithm receives data as excel, images or radiographs and does an analysis based on artificial neuronal network mimicking human brain and helps in interpretation of the data (i.e. excel charts, images etc.) to draw conclusions which help in diagnosis and treatment planning of the patient[10].

Convolutional neural network (CNN)–It is a specific type of ANN, typically based on deep learning algorithms with several hidden layers to analyze data. The association between layers are complex and multiple hidden layers exist in each CNN[10].

Deep learning -Deep learning is a subset of machine learning which is structured similar to human brain processing, wherein the data is analyzed multiple times through a set of algorithms and finally an output or results are generated. Every evaluation is carried out in a different layer, meaning that it is based on the output of the previous layer. These layers of computation are called hidden layers because their inputs are analysed multiple times via

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deep learning by various layers and each layer creates an output score which is the input score of the next layer until a final result is achieved[9].

APPLICABILITY OF ARTIFICIAL INTELLIGENCE IN HEALTH SCIENCES

Inclusion of AI in the form of robotics and expert computed systems has a tremendous influence on industrial, infotainment, commercial and medical field[13]. In medical systems it has diverse applications in diagnosis, analysis of electronic medical records especially in radiographic image interpretations and therapeutic. It helps in determining the prognosis along with diagnosis of various clinical conditions[14]. With paucity of trained medical professionals especially physicians and radiologists and advancements in field of science the incorporation of AI is need of the hour[15]. AI applications in health industry has a marked cost benefit ratio which favours its implementation in various fields[13].

AI IN THE MEDICAL FIELD

Experience and knowledge are two requisites for a successful patient care. Thus incorporation of these two parameters are mandatory in understanding artificial intelligence and its implications in medicine[10]. The more experience and data (analysis of information) we have, the more we are enabled for taking superior and knowledge-based decisions[10]. AI is gaining acceptance in the medicine and surgical field, but in radiology widest applications are in use. This can be attributed to tremendous advancements in image-recognition skills with the help of ANN, CNN, machine learning and deep learning which helps in interpretation of radiographic image[2].

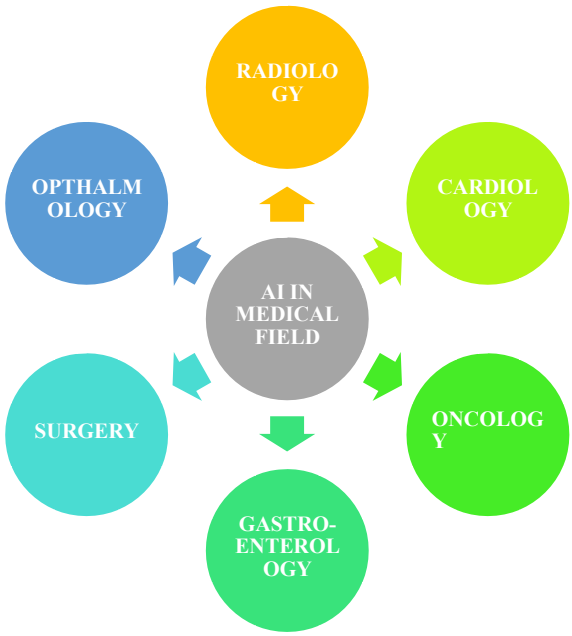

Figure 1 – Application of AI in various medical field

A platform that highlights intracranial bleeding for radiologists is already CE approved and was designed by MaxQ-AI Ltd. (Tel Aviv, Israel)[10]. This project from Israel focused on decision support tools to improvise clinical outcomes in acute medical

emergency scenarios in real-time. They process three-dimensional CT data, detect intracranial bleeding and locates the bleeding area[10]. Taking this concept one step further, investigators developed a platform to detect large vessel occlusion (LVO) in the brain causing strokes[16]. The systemanalyses the images and when it detects LVO, a signal is generated which immediately sent a text message alert to the radiologist and neurologist[16].The amalgamation of AI into EMR has been foundto be effective in the reduction of mortality via early detection of heart failure. This is attributed to the ability of AI to achieve a longitudinal evaluation of patient statisticsand vitals to find patterns and thereby determine predictors for heart failure[17]. AI found to be helpful in the detection of cardiac arrhythmias and even can identify hyperkalemia from electrocardiography. The CADe system (computer aided diagnosis system) alerts the endoscopist to abnormal findings on the monitor by highlighting the area of abnormality. After targeting the abnormality and switching to NBI (narrow band imaging) view, the CADx system can define the endoscopic images further to a real-time suggested diagnosis[18]. The AI application and deep learning for the detection of diabetic retinopathy have been proven to be successful for early diagnosis[19]. Somashekhar et al. demonstrated that machine learning is reliable for the diagnosis of cancer[20].

AI IN DENTAL FIELD

Various technologies of AI have an array of applications in different branches of dentistry. Applicability ranges from diagnosis of diseases, categorisation of patients , treatment planning to the asisgnment of prognosis.Radiographic interpreation with the help of computed alogirithm is useful for diagnois of carious lesions, pathological conditions of jaws and TMJ diseases, alveoloar bone assessment for diagnosing periodontal conditions and treatment lanning for implants Machined learning has a usbility in smile designing and planning for orthodontic cases.. AI has helped in better designing of dental chair with voice command operational features.

TABLE 1 : AI USED IN DIFFERENT FIRLDS IN DENTISTRY[21]

YEAR	STUDY	AI USED	DETAILS	SPECIALITY
2018	Lee et al[22]	Deep learning network	Diagnosis of caries	Radiology
2016	Jung and Kim[23]	Artificial neural network	Need for orthodontic extraction	orthodontics
2018	Thanathornwong[24]	Bayesian network	Clinical decision support	Orthodontics
2018	Patcas et al[25]	Convolutional neural network	Treatment outcome analysis	Orthodontics
2014	Papantonopoulos et al.[21]	MLP neural network	Clinical and immunologic data Sets	Periodontics
2015	Ozden et al[21]	Support vector machine	Risk factors, clinical periodontal Parameters	Periodontics
2018	Lee et al[26]	Convolutional neural network	Diagnosis and prediction of periodontally compromised teeth	Periodontics
2018	Feres et al[27]	Support vector machine	Aggressive and chronic	Periodontics

			periodontitis	
1995	Speigh et al[28]	Artificial neural network	Risk assessment of oral cancer	Oral medicine
2018	Kim et al[29]	Artificial neural network, support vector machine, logistic regression	Prediction of medication related osteonecrosis of jaw	Oral medicine

ETHICAL CONSIDERATIONS IN ARTIFICIAL INTELLIGENCE

There are certain facets which raise ehical concerns on applicability of AI in health care systems.We as health care providers are dealing with lives of individuals so relying on mere hardware and computed algorithims for taking crucial life saving decisions in diagnosis and treatment of patients raises concerns[30].Thus valdification of AI in medical systems and to work in sync with numerous clinical situations which have their unique histories and clinical presentations requires thourogh training of medical practioners and long term studies to implement them with evidence based research in long run.

AI systems are complex but can be used to generate a new insight and support as an adjunctive aid in taking decisions.

CHALLENGES AND DRAWBACKS

It is crucial to improve data quantity, quality, and readability by standardizing methodology in data curation and reporting[9]. Establishing an open-access standard data set, which contains comprehensive demographic, clinical, experimental, and treatment data, would be a critical task in the further stages of AI development to facilitate the evaluation and comparison of different algorithms[31]. Data-driven AI calculates output in a purely computational manner; however, it fails to illustrate the decision-making in required medical format. The lack of interpretability and transparency reflects the black-box nature of many Machine Learning modalities which are not conducive to verification[31]. Rigorous scientific inquiry and humanistic treatment models that respond to patient and practitioner narrative exchanges are imperative for the understanding of the clinical phenotypes of AI and its relationship to personalized care[32]. Constant up-gradation of processing power is required for the application of AI, for that the extraction of information needed from a continuous updated medical and dental database. Because the computational power of classical computers has been largely saturated, the insufficient computational resources in data processing are one of the obstacles that constrain the efficiency of AI[33], [34].

Data from patients are requisite for the initial training of AI algorithms, also for validation, undergoing training, and improvement. Furthermore, the development of AI will give rise to data sharing among different institutions and sometimes, beyond the national boundaries. To integrate AI into healthcare, systems must be complied with to protect patient privacy and confidentiality. So personal data have to be anonymized before considering further distribution. Even after taking all these precautions, there is still skepticism in the health care system about secured data sharing.

Safety and security issues are also the concern of AI systems. Mechanisms must be created to control the quality of the algorithms used in AI. To rectify this issue, the US FDA has created a new drug category, “Software as Medical Device,” through which it regulates safe innovation and patient safety.[35]

Another concern of AI systems is accountability in the situations wherein adverse or undesirable outcome takes place. So in such situation legal concerns will arise as who will be held responsible for that event as in this scenario heath care professional is working with an AI device which is again formulated by another expert of technical field who is also liable for that particular incident.These issues will continue to represent a considerable challenge to our legal system and need to be addressed[30].

FUTURE ASPECTS OF AI

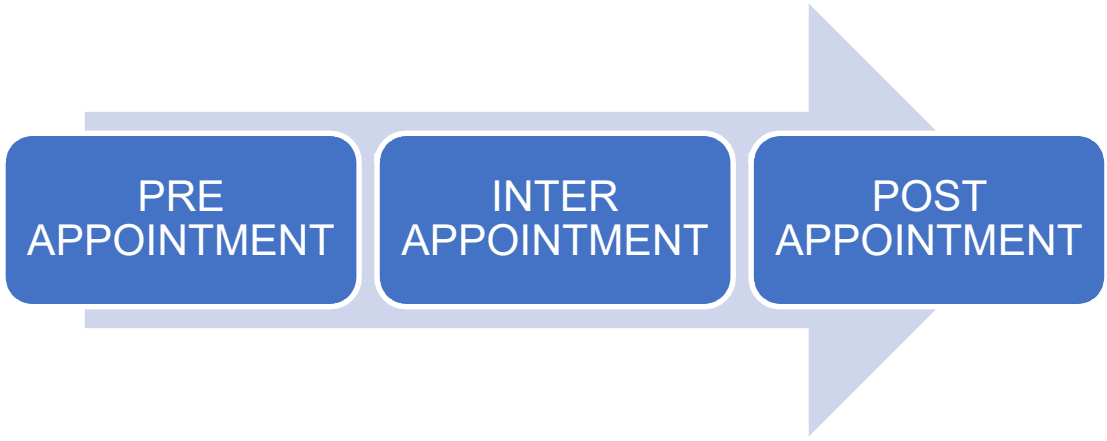

Figure 2 – Application of AI in comprehensive care system[21]

Advancements in AI are focused in two aspects in near future. First, is the uses of both visual and textual data will be analyzed simultaneously to give an output after processing through an array of algorithms. Researchers have reported that recent AI prototypes are so advanced that they can clear a medical licensing exam proving its analytical ability at par with human brain[36]. Second, significant advances are expected in the sector of embodied AI. This genre of AI will incorporate perception and reasoning with an ability to interact with environment. Embodied AI will have functioning very similar to human brain and work on a principal of artificial neuronal networking with deep thinking[36].

CONCLUSION

The inclusion of AI is promising for growth and development in the medical sciences for betterment of human race. AI is a technology that is rapidly being adopted in many domains of medicine to improve performance, precision, time efficiency and to reduce the cost with minimization of man power. In medical sphere, this technology paves way for improved patient care through earlier detection and diagnosis, improved workflow, thus lowering medical errors, lessening medical costs, along with decreasing morbidity and mortality. The road to the successful incorporation of AI into the medical sector will require training in continuing medical education, is a challenging situation as most institutions are currently not prepared for it. Various AI systems for diverse medical and surgical disciplines are formulated and preliminary results are promising. AI systems show promising and encouraging future and may prove a great aid to medical health professionals in coming years.

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