Review Article

Current status and applications of Artificial Intelligence (AI) in medical field: An overview

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ABSTRACT

Background/objectives: In the current scenario, artificial intelligence (AI) is going to change almost all the areas of the medical field. The need is to study the research carried out in this technology and identify its different applications in the medical field.
Methods: Studies and research articles on "artificial intelligence" and "artificial intelligence in the medical field" have identified significant applications of AI. This article explores and shows how AI helps to solve challenging problems in the medical field through extensive research and development.
Results: The study identified five significant technologies as being used in AI in the medical field and the process of implementing AI. Finally, this article identifies ten primary applications of AI in the medical field, along with a brief description. AI provides a productive clinical decision to improve patient outcomes.
Conclusions: Different technologies are adopted and experimented with increasing automation in the medical field. Nowadays, AI is being introduced in the medical field to keep a medical record in digital format and conduct patient checkup using smart technologies. It provides solutions, especially in targeted treatments, uniquely composed drugs and personalised therapies. AI is an innovative technology that helps to guide the surgeon during medication, treatment and operation. The main application of this technology is for better decision-making for complicated cases. It can also help to track, detect, investigate and control the infection in the hospital. This technology develops and optimises online patient appointment platforms. In future, it will be helpful in all medical areas to serve humanity.

1. Introduction

The concept of artificial intelligence (AI) arrived in 1956, but significant development took place during the last twelve years. It is helpful to review thousands of the medical record to provide faster treatments with superior outcomes. AI simulates the features of the human being intelligence and processes using machine-like computer systems. This technology can quickly learn, predict, analyse, reach conclusions and even self-correct themselves. It is developed to solve different medical problems, planning, imaging, speech recognition and learning a specific trait. AI systems provide training on a given set of data to predict better results and help to solve complex problems with high accuracy.[1–3]

AI helps healthcare teams to reduce documentation time by storing patient's data digitally and forming a digital database, which can further be used for diagnosis, treatment and regular medicare. Based on the final requirements, medical specialists in consultation with software and hardware professionals can develop a platform for data collection and routine tasks. Generic software programmes are being customised for specific applications. Accordingly, diagnosis, treatment and posttreatment care modules specific to patient's requirements are to be developed. However, the analysis of the collected data is vital to the performance of the AI system.

AI increases the creativity of doctors and surgeons. These intelligent machines behave as human beings that quickly

understand the language capturing of medical data, text, images, bioinformatics and financial transaction. These machines can understand human language to make an errorless decision.[4,5] It enables a precise surgery of the patient by providing appropriate information. This technology can be used to identify and collect enough quality and quantity of patient data, which can further be used to predict, reduce risk during joint replacement and stay of admission in the hospital and improve recovery chances.[6,7]

In the current scenario, AI seems to be the best technology that can be used for providing higher life expectancy. It provides AI-assisted robotic surgery for a complicated case. This technology creates information through different virtual support and regularly communicates with the patient. In rural areas, there is a shortage of healthcare providers, and this technology can be increasingly used to fulfil this shortage. It improves the quality of medical students to fulfil any urgent demand for rural areas.[8,9] This technology not only improves the efficiency of health professionals but also improves the quality of healthcare service at a lesser cost. It provides advice to doctors towards accurate diagnosis.[10,11]

AI plays a significant role in scanning technologies such as X-rays, computed tomography, magnetic resonance imaging, and three-dimensional scanners. These are helpful to make a better decision regarding the patient. AI suggests proper diet and eating habits for better health. It efficiently manages patient booking and reminds about doctor's appointment.[12—14] This technology is also helpful in virtual interaction with doctors, and with its deployment, the medical field becomes efficient to solve various challenges. This article addresses the following research questions:

RQ1: to study different advantages of AI in the medical field;

RQ2: to identify different technologies used by AI in the medical field;

RQ3: to identify the process of AI implementations in the medical field;

RQ4: to identify significant applications of AI in the medical field.

2. Benefits of AI in the medical field

AI can solve different medical challenges, such as sorting out a different level of difficulties while performing complex surgery with better quality and outcome. Now the patient can enjoy with the timely and accurate decision.[15—17] The different benefits of AI in the medical field areas are as follows:

- To check anomalies and suggest medical intervention
- To predict upcoming diseases
- Accurate and efficient diagnosis
- Helpful for complex and new treatment
- Balance blood/glucose levels of the patient
- Proper monitoring of patient
- Provide comfort to doctors and patients
- Proper training for medical students
- Improve safety in hospitals
- Collect data during surgery which help to improve the future procedure
- Positive patient outcomes
- Improve doctor/surgeon experience
- Improve medical outcomes
- Enhanced pathological result
- Reduced diagnostic cost
- Maintain clinical record
- Provide excellent service to the patient.

AI is helpful to perform a variety of tasks in the medical field, such as automated measurement tasks such as carina angle measurement, aortic valve analysis, and pulmonary artery diameter. Presently, it is used to detect the level of fracture and trauma of the orthopaedics patient.[18,19]

3. Different types of AI technologies in the medical field

AI has a significant impact on the medical field, with the help of different innovative technologies. It helps nurses, doctors, and surgeons to make their work easy. These technologies support to form individualised treatment plans for patients. It is applicable in the medical diagnostic support system for the diagnosis of congenital heart diseases.[20,21] It plays a significant role in storing health records electronically. It can increase accuracy, speed, and consistency in diagnosis. These technologies accurately predict the patient outcomes and are helpful in capturing additional information as missed by the doctors. In large-scale medical organisation, these are used in the proper management of the health system by monitoring cost recovery, health expenditure, and responses of treatment. Table 1 depicts the different types of AI technologies used in the medical field.

These technologies are applied for all kinds of health-related aspects and used in different fields such as orthopaedics, neurology, cardiology and oncology. It provides a more impactful and accurate service to the patient. Doctors can now reduce their manual work and improve their planning, clinical decision-making and treatment techniques.[47,48] Patient history of the disease now can be quickly identified, and a notification sent to the patient family. With the help of backend processing and data storage, AI can easily handle the routine request. When it is overdue in the laboratory test, it will send a notification to the concerned patient.[49,50]

4. Advancement of AI

AI provides disruptive innovation in the medical field. It efficiently analyses information, medical record and systems and enhances digital automation to provide faster and consistent results. This technology is useful for digital consultation and proper medication management for the patient.[1,6,8] It helps doctors for better achievement, which are discussed in the following sections:

4.1. Medicine

AI provides advancement in diagnosis, treatment personalisation and drug development. It accurately undertakes the time-consuming process of medicine. This technology is useful for clinical trials and helpful for effective monitoring to achieve an accurate result. It has the ability for proper monitoring of the patient and proper communication of information.

4.2. Surgery

Doctors and surgeons are efficiently integrating AI in surgery by capturing data of all phases. AI has a promising future to provide the highest quality for patient care. It generates an evidence-based clinical decision to improve patient care and surgeon workflow. It appropriately provides efficient results of complex surgery.

4.3. Radiology

AI-assisted surgery improves consistency and accuracy, and they also learn in real-time working conditions. They could help the surgeon to obtain better surgical and treatment results. All the variations and development help the patient towards an active recovery and better chances of procedures. This technology can also

Table 1
Different types of artificial intelligence technologies in the medical field.

S. no	Technologies	Description	References
1	Machine learning (ML)	• Machine learning systems are programs which are self-improving and learning with no experience or being trained over some time • They can evaluate the medical results automatically and present them with a probabilistic degree of accuracy • ML algorithms can make decisions with the following algorithms and methods such as supervised learning, unsupervised learning, semisupervised learning and reinforced learning • In the medical field, this technology is used to identify the probability of disease • ML is helpful to save the record of the patient for better treatment	22–27
2	Artificial neural network (ANN)	• Artificial neural network works and is inspired by the neural structure of the human brain, working on the concept of backpropagation and layers (input layers, hidden layer, output layers) • ANN functions similar to neurons as each neuron is connected similarly to each ANN neuron has weight and are connected • Through the training of ANN with large sets of data, the best weight equivalent to bond strength in human brain neurons makes sure that the best path is procured through ANN • Helpful in forecasting the incidence of disease and in decision-making	28–33
3	Natural language processing (NLP)	• NLP refers to the speech recognition and evaluation of languages with different techniques • There are many independent NLP algorithms such as parsing, POS, tagging using Hidden Markov model (HMM) • In the medical field, this technology is useful for clinical decision trials and supports and analyses the unstructured dataf • It is also used for automated coding and maintains clinical documentation of the patient	34–37
4	Support vector machine (SVM)	• A support vector machine determines the class groups of data for the given input data • It solves the problem of data classification in the primary basis • They are used in e-mail spam filters when an SVM classifier is trained; it can be used to see new and unseen data points for future correlations • Used for collection and processing of medical data • Appropriately manage patient and are helpful in making an evidence-based decision	38–42
5	Heuristics analysis (HA)	• This technique uses a trial and error method for detection and discovery to solve a problem • The basic algorithm on which heuristic analysis works is by using such a practical solution which may not yield the optimal goal but works sufficiently to fulfil that goal • Heuristic analysis is best to approach for patient safety and efficiently identify different problems	43–46

preset and postset the data variable related to the procedure so as to predefine notions. AI has recently made substantial strides in perception (the interpretation of sensory information) which allows for better representation and interpretation of complex data.

4.4. Hospital administration and medical records

In the healthcare industry, this technology keeps the record in digital form to improve efficiency and accuracy. AI in hospital management systems leads to various improved and synchronised factors and data in contrast to the improved medical records, automation of customer and patient data storage, collection and results. This technology helps track the vital statistics of the patients and provides real-time information to the doctor and to the family of the patients. Thus, it is helpful for the proper verification of patient health systems, which effectively leads the hospital. It accurately predicts the cause of the disease of a person. AI provides digital control of the hospital administration to increase the efficiency of doctors, surgeons and hospital staff.

4.5. Cardiology

AI is also used in cardiology to reduce the risk of sudden cardiac death. It integrates evidence-based data regarding cardiac diseases. This technology makes aware of the blockage in the heart valve to avoid the chances of a heart attack. Moreover, it provides proper information on the flow of blood. The implementation of AI helps in every aspect of a patient entering a hospital to getting treatment until being healthy again.

5. Process chart of AI in the medical field

AI provides accurate and rapid communication for complicated surgery. During the busy schedule of doctors, it automatically schedules, checks and develops follow-up processes. It improves the efficiency of treatment with minimum risk of diagnosis. Doctors, scientists and researchers used this technology to facilitate humanity.[51,52] AI technology can scan a patient's laboratory result and update/remind the patient at a proper time. The successful application areas include automatic electrocardiogram, cardiac monitoring, clinical laboratory analysis, medical imaging, electroencephalography, respiratory monitoring and anaesthesia. This emerging technology can quickly analyse the blood test, sugar level evaluation, medical imaging and different other tasks.[53,54] When patient data are embedded into algorithms, AI can extract the required information to solve the given medical problem. Fig. 1 shows the process chart of AI in the medical field.

By using AI, the computer can understand human speech and writing to manage and evaluate the patient using different technologies. It guides doctors, surgeons and physicians in how to improve outcomes and learn the skill in real time. AI guides the surgeon step-by-step and further analyses to make improvement and achieve superior outcomes.[55,56] It also suggests what types of innovation can be created in the medical field. It measures doctors' adherence and helps to treat a number of new problems. In dailylife medical applications, AI can improve efficiency with minimum risk. It has a great ability to acquire information using neural networking, advanced imaging and natural language processing.[57,58]

6. AI applications in the medical field

In our daily life, there are requirements for new innovative technologies which positively affect human lives. In the medical field, AI provides various positive points to create innovation. A doctor with the help of this technology can check patients without visiting any clinics/hospital. Thus, this technology is now available for providing online service to the patient. Any query of the patient
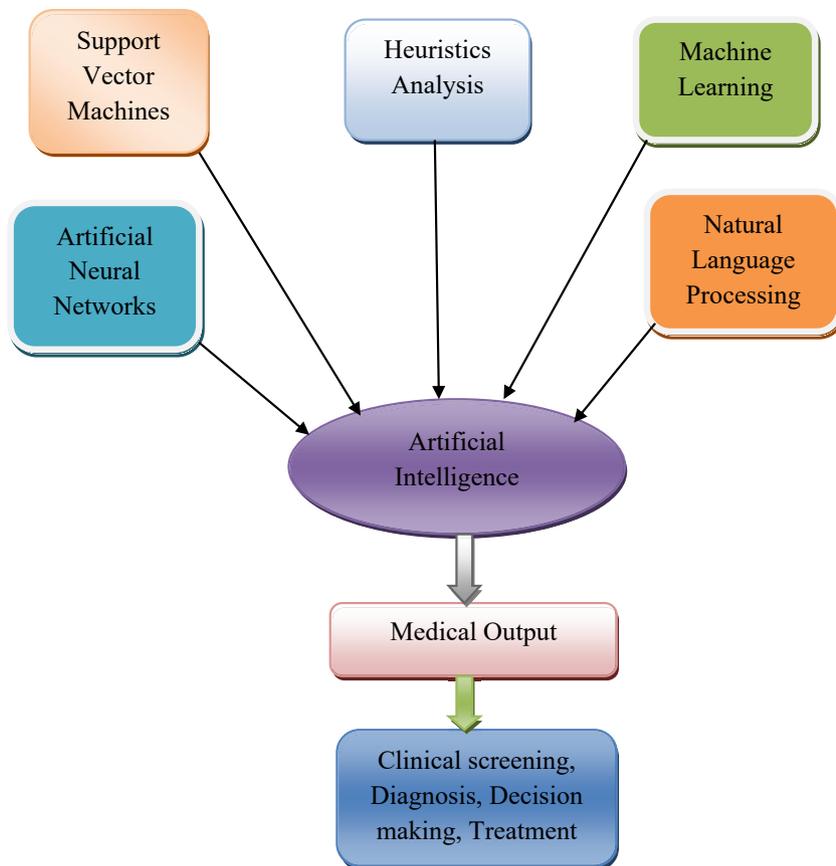
Fig. 1. Process chart of artificial intelligence in the medical field.

for a variety of health issues can quickly be taken up.[59,60] It has different applications for planning the treatment to achieve a better result. Table 2 discusses different applications of AI in the medical field.

AI provides an excellent capability to perform the required task in the medical field with lesser involvement of human beings. AI seems to be the best tool for clinical judgement, analysis and training purpose. It is proved that there is accurate and fast diagnosis by proper implementation of this technology. For proper safety of the patient, which is the main requirement of the patient, AI can reduce human errors while performing treatment and surgery.[88,89] The medical team can investigate the complicated medical test, and data can be generated. It is used to analyse the genetic profile of an individual patient. This technology captures data regarding patient histories, case studies and health conditions.[90–92] It can adequately alert the patient for proper medication, diet and exercise for better health.

7. Discussion

AI uses complex algorithms and dedicated software for the analysis of complex and substantial medical data. It provides correct and feasible results without the direct input of human beings. This technology can interpret and advance with the information through smart machines. The main aim of AI is to analyse the relationship between treatment/prevention techniques and patient outcomes. AI solutions support the hospital to improve patient satisfaction, reduce cost and fulfil the staff and workforce requirements. By using this technology, there is an improvement in computing power and faster collection of data. Robot-assisted

surgery can be enhanced by using this electronic health record system. This technology evaluates the outcome of surgery/therapy to produce a better result. It can communicate information about the possible disease to occur. AI can notice/record changes during the proper monitoring of the patient. In the medical field, all patient data are different; this technology can easily collect and store data digitally, which can be helpful in diagnosis and treatment. It checks for the improvement by analysing the different laboratory test and their primary cause of the disease. This information can be helpful for the patient during emergency cases. AI trained new doctors and medical students for knowledge and better performing of surgery. With the help of available patient/medical data, AI can easily decide to improve patient outcomes.

8. Future direction

In the upcoming years, AI assists doctors and physicians to make better clinical decisions in all medical areas. This technology can provide up-to-date information and knowledge for the proper care of the patient. The future of health care will become better by proper implementation of AI. It focuses on converting unstructured text to the machine language and then records data electronically. AI will be used for financial management and innovation. It can capably perform a required medical task in lesser time and cost. This technology can digitally collect, store and categorise the data for better health conditions. AI can answer different queries of the patient without the presence of doctors. It can collect all unstructured data and visual images than a human being. It will bring new possibilities in education, training, research and development. With the help of proper treatment, it reduces the mortality rate. It

Table 2
Artificial intelligence applications in the medical field.

S. no	Technologies	Description	References
1	Recording and storage of medical data	• It collects, stores and analyses the medical data to provide faster access and decision-making • All patient data are electronically stored which facilitates diagnosis and treatment • It provides day-to-day improvement history of the patient • Data stored digitally can help to identify the cause of diseases and help research and development activity • It stores all the medical records of an individual patient and further compares the database of illness	61–65
2	Analyse different test	• Artificial intelligence accurately analyses different tests such as X-ray, ultrasound, MRI and CT scan • It has the capability to check the improvement and significant causes of the disease • It quickly shares patient information in the emergency case which makes the job of doctors and surgeons easy • It efficiently performs, evaluates, validates, predicts and analyses the data using different scanning technologies	66,67
3	Patient monitoring	• It helps to monitor patient condition and follow up all treatments • It provide proper monitoring to obtain more information on exercise, needs and habits of the patient • It helps in monitoring and access information of the patient	68,69
4	Manage all medication system	• AI helps to manage the condition of the patient • This technology facilitates early prediction of vascular diseases • It suggests suitable medication, protein and diet plan to the patient	70–74
5	Proper diagnosis and treatment	• Mainly computer techniques are used in AI for clinical diagnosis and treatment • It can handle a different clinical situation such as diagnosis and complex treatment and predict sufficient results • This technology has the potential to demonstrate several intelligent approaches and applications • In the healthcare industry, all health records and information are stored digitally, thereby helping the treatment process	73,74
6	Medication alert	• It is a personal virtual assistant technology which can alert the patient for proper medication using the app • It provides proper monitoring and education and assists patients with personal clinical needs • AI is an innovative technology to provide better health	75–77
7	A complex and customised treatment	• AI is used to perform complex and customised treatment of the individual patient • This technology can accurately predict the diseases from digitally stored data • It quickly understands the human command to make successful treatment • For the individual patient, it provides proactive alert and customised experience	78–80
8	Patient management and service	• It improves service to the patient in the hospital • It is applicable any time for significant requirements, such as billing, time scheduling and other clinical applications • It quickly analyses medical images such as X-ray, CT and MRI	81,82
9	Training	• Owing to insufficient medical specialists and facilities, the mortality of patient is high for many diseases • Many patients die during practice by new doctors • Owing to these untrained doctors, there is a high risk of diseases and death • AI technology is now available in the medical field to train a new doctor to fulfil different requirements	83,84
10	Decision-making	• AI provides human-like intelligence with the help of computer technology • Health professionals allow this technology for greater data accessibility which helps design/customize a decision support system • It seems to be the best tool to support medical decision-making with the help of available data • It helps create innovation which subsequently increases staff efficiency and patient outcomes	85–87

AI, artificial intelligence; CT, computed tomography; MRI, magnetic resonance imaging.

will recommend an appropriate course of action to prevent diseases with the help of its speech recognition capability. The main limitation of this technology is that it still cannot mimic or show human emotions to an acceptable level, meaning it does not have emotional intelligence.

9. Conclusion

AI can help to monitor and give proper treatment for patients. It makes an assessment using images/results without the requirement of doctors, surgeons and clinicians. AI-based technologies provide decision which can help to predict medical emergencies. It is helpful to provide medical consultation through a digital app. The practical implication of this technology is to increase accuracy in diagnosis and treatment. It can be used in the prevention of disease and reduce medical cost. This technology is used to answer patient questions and reduce unnecessary hospital visits. AI provides an excellent source and identifies problems during the shortage of doctors. This technology first understands the biological origin of a disease for better treatment of the patient. It easily imagines medical images and accurately performs the task. AI helps identify cancer and its treatment with the analysis of patient data. It can be applied for the diagnosis of heart disease. It speeds up the clinical trials to produce a conclusive result. AI constructs analytical algorithms of different features from the patient data, which is helpful to provide information about the patient, survival times and disease levels. In the upcoming years, its applications will be for digital supervision in hospitals to improve patient care.

Declaration of competing interest

None.

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