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Artificial intelligence applications in disease diagnosis and treatment: recent progress and outlook

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ABSTRACT

The use of computers and other technologies to replicate human-like intelligent behaviour and critical thinking is known as artificial intelligence (AI).The development of AI-assisted applications and big data research has accelerated as a result of the rapid advancements in computing power, sensor technology, and platform accessibility that have accompanied advances in artificial intelligence. AI models and algorithms for planning and diagnosing endodontic procedures. The search engine evaluated information on artificial intelligence (AI) and its function in the field of endodontics, and it also incorporated databases like Google Scholar, PubMed, and Science Direct with the search criterion of original research articles published in English. Online appointment scheduling, online check-in at medical facilities, digitization of medical records, reminder calls for follow-up appointments and immunisation dates for children and pregnant women, as well as drug dosage algorithms and adverse effect warnings when prescribing multidrug combinations, are just a few of the tasks that already use artificial intelligence. Data from the review supported the conclusion that AI can play a significant role in endodontics, including the identification of apical lesions, classification and numbering of teeth, detection of dental caries, periodontitis, and periapical disease, diagnosis of various dental problems, aiding dentists in making referrals, and helping them develop more precise treatment plans for dental disorders. Although artificial intelligence (AI) has the potential to drastically alter how medicine is practised in ways that were previously unthinkable, many of its practical applications are still in their infancy and need additional research and development. Over the past ten years, artificial intelligence in ophthalmology has grown significantly and will continue to do so as imaging techniques and data processing algorithms improve.

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INTRODUCTION

Artificial intelligence (AI) is the practise of using technology and computers to simulate intelligent behaviour and critical thinking that is comparable to that of a human being (Malik *et al.*, 2019). The general public has embraced intelligent medical technologies (i.e., those powered by AI) because they enable the 4P model of medicine (Predictive, Preventive, Personalised, and Participatory) and, consequently, patient autonomy, in ways that were before impractical. Smartphones can be used, for instance, to fill up and disseminate electronic personal health records, keep track of vital signs using biosensors, and promote health. With the development of advanced medical technologies, augmented medicine the use of modern medical technology to enhance various aspects of clinical practice has become possible (Briganti & Le Moine, 2020).

Artificial intelligence-enabled improvements in 3D cardiac imaging have brought in the concepts of virtual hearts and cardiac arrhythmia models (Nagarajan *et al.*, 2021). Artificial intelligence (AI) has been used for liver cancer treatment, prevention, diagnosis, analysis, and rehabilitation. Artificial intelligence (AI) techniques, such as machine learning (ML) and deep learning (DL) algorithms based on artificial neural networks (ANNs) and their variants, are being used to build a precise and cross-sectional depiction of clinical data.

Patients with prostate cancer are primarily diagnosed, risk-stratified, and monitored using datasets generated from PSA, MRI-guided biopsies, genetic biomarkers, and Gleason grading. However, assessing patients and further stratifying risks based on such diagnostic data frequently involve a large lot of subjectivity.

Thus, by reducing the subjectivity of the process, using an AI algorithm to the diagnostic data from a PC can aid in decision-making (Figure 1). This enables the service to be offered at a lower cost by requiring less human labour. This review's primary objective is to provide a comprehensive overview of the current AI algorithms utilised in the field of prostate cancer (PC) to diagnose and treat patients (Rabaan *et al.*, 2022).

Machine-Learning

Machine learning is the study and application of utilising statistical models and algorithms to infer patterns from data. ML represented a significant breakthrough from the days when only procedural languages were used to develop computer applications.

Artificial intelligence was created by machine learning (ML) techniques, which showed that not all information had to be given to computers in the form of laborious procedural steps but could instead be taught to infer, learn, spot patterns in data, and compute on their own. It proved that technology might generate knowledge (Chen *et al.*, 2019).

Classical Machine Learning Techniques

Algorithms can create a mathematical model from sample data using machine learning (ML) techniques, allowing them to carry out tasks that they have not been explicitly taught to carry out. To accomplish this, ML is often used to classify patients or predict outcomes based on input data. In supervised learning techniques (such as support vector machines, Bayesian networks, and linear regression), the data required to train the model is labelled. Then, algorithms discover the relationship between labelled result data and input data such as patient characteristics or medical images. Unsupervised learning methods (like principal component analysis or clustering strategies) do not label training data (Ahn *et al.*, 2021).

Deep Learning (DL)

The optimum usage for deep learning (DL), a more modern use of this technique (which employs multiple layers), is managing significant volumes of complex or highly dimensional data. Convolutional neural networks (CNNs) for image recognition or recurrent neural networks (RNNs) for predictive modelling tasks are two examples of recent breakthroughs in medical machine learning that rely on this methodology.

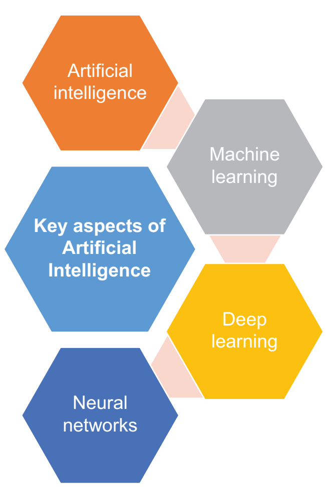

Figure 1: Key aspects of artificial intelligence (Khanagar *et al.,* 2021)

Increases in computer power and healthcare dataset sizes are to blame for this (Ahn *et al.*, 2021). An artificial neural network, which consists of nodes that resemble artificial neurons, is trained via deep learning. It has made significant strides in the processing of image, video, voice, and audio data up until this point. Deep learning is typically very powerful and works well for radiology or other types of medical imaging.

Artificial Neural Networks

Artificial neural networks (ANN), a branch of machine learning (ML), have received a lot of interest recently. Since they have multiple layers of coupled mathematical operations, ANNs closely mimic brain neurons in terms of architecture. The degree of links between functional units is managed as model training advances to lessen task inaccuracy. ANNs' recognition of complex non-linear relationships in data allows for difficult supervised and unsupervised learning tasks (Ahn *et al.*, 2021).

Application of Artificial Neural Networks

The use of ANNs in medicine include, but is not restricted to, diagnostic, imaging, back pain, dementia, and pathology and prognosis assessment of appendicitis, myocardial infarction, acute pulmonary embolism, arrhythmias, or psychiatric disorders conditions.

According to ANN, some advantages include: Neural networks can be used to train both linear and nonlinear models. Furthermore, statistical evaluations of neural network model accuracy are possible. Both partial and noisy data are acceptable to the neural network (Nagarajan *et al.*, 2021).

Neural network models are versatile and perfect for changing situations like the healthcare sector since they can be altered. ANNs are bad at showing the structure because they are black-box algorithms. Furthermore, even if it can extrapolate from a set of examples, if it only sees situations within a certain range, its forecasts will be inaccurate. Outside of these ranges, results could be completely wrong (Awwalu *et al.*, 2015).

Natural Language Processing

The goal of the "natural language processing" subfield of AI is to equip computers with the knowledge and abilities necessary to comprehend spoken and written English. It is necessary for a thorough study of the information, especially when using narrative data from medical professionals' electronic medical records (EMR).

Natural language processing tries to recognise entities common across texts, reveal relationships between the data of those entities, and provide meaningful answers to challenging inquiries. Although reading conventional texts and books makes this seem rather simple, deciphering handwritten charts and oral dictations can be challenging because of the usage of slang, emoticons, and sarcasm.

In terms of prescription drugs, Chen *et al*. (2019) Natural language processing (NLP) aims to automate the extraction of practical clinical elements from text. NLP-derived clinical characteristics can be applied in a variety of contexts, such as clinical monitoring or as an input feature for other modelling techniques. Despite the fact that research in the area is developing swiftly, there are currently just a few cases where artificial intelligence has been employed in front-line healthcare. Safe and continued use nevertheless faces numerous serious challenges (Awwalu *et al*., 2015).

Computer Vision

Computer vision is one of the most intriguing and rapidly evolving fields of AI. Computer vision is the term used to describe the automatic interpretation of images and movies.

It deals with how viewers gather knowledge and acquire new things from films and images. Applications for computer vision technologies include visual search, smart mirrors, social shopping, trend forecasting, virtual reality, and augmented reality.

Automated reading of imaging scans, reading and grading of sick tissue slides, and other key computer vision work in healthcare. Parsing handwritten charts and spoken dictations can be challenging because conventional textbooks and books frequently use slang, emoticons, and sarcasm (Chen *et al*., 2019).

Support Vector Machines (SVM)

SVM provides accurate classification results even when the input data cannot be divided linearly, according to its theoretical underpinnings.

The accuracy outcome is also unaffected by the level of human expertise used to select the linearization function for nonlinear input data. SVM, a non-parametric approach, has the disadvantage of having opaque findings. According to, the choice of kernel is the key limitation. It must be correctly established for every specific activity or situation in order to generate an accurate result (Awwalu *et al*., 2015).

Artificial Intelligence Algorithms Used in Personalized Medicine

Many machine learning and artificial intelligence algorithms are used in the field of medicine, especially in personalized medicine. By computing the probability of distinct alternatives, the Nave Bayesian (NB) algorithm, which is based on a probabilistic model, enables the principled capture of uncertainty in a model (Awwalu *et al*., 2015).

It bears the name of Thomas Bayes (1702-1761), the man who created it. In many systems nowadays, including text categorization, spam filtering, and recommender systems, NB is frequently used. It is used in both weather forecasting and medical applications. One advantage of NB is that it is robust to input data noise and only requires a small amount of training data (Awwalu *et al*., 2015).

According to, NB has various disadvantages, such as the following: a decrease in accuracy caused by the assumption of conditional independence and the assumption that the record with the new predictor category has no probability when no predictor is present in the training data (Awwalu *et al*., 2015).

Problems in Personalized Medicine

Personalized medicine may have problems, which can change depending on the illness being treated (Figure 2). Regulations governing the use of publicly available medical data and genetic research, healthcare workers' attitudes, knowledge, and education, IT deployment, and financial considerations are only a few of the general challenges that can be encountered (Awwalu *et al*., 2015).

The Problems in Personalized Medicine includes:
- Detect or Predict disease
- Achieve accurate diagnosis
- Optimize treatment

Key Objectives of Achieve accurate diagnosis includes:
- Speed
- Cost
- Accuracy

Multilayer Perceptron (MLP) Neural Network Model

MLPs are the easiest and most extensively used neural network design software due to their structural simplicity, excellent representational capabilities, accessibility, and availability with a large number of programmable algorithms. MLPs are feed-forward neural networks and universal approximates that were created using the backpropagation algorithm.

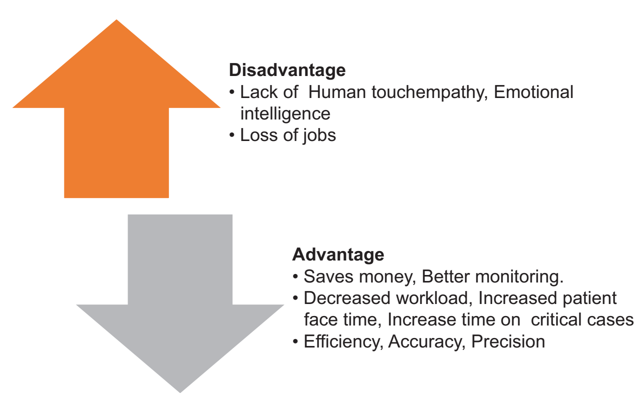

Figure 2: Advantages and disadvantages of artificial intelligence in medicine (Malik *et al.,* 2019)

They need to be taught the desired response because they are supervised networks. They are commonly used for pattern classification as a result of their ability to transform input data into the desired outcome. With one or two hidden layers, almost every input-output map may be roughly approximated. Three layers normally make up an MLP: the input layer, the output layer, and the middle or higher layer (Awwalu *et al.*, 2015).

Automatic Segmentation of Cardiac Cavity with Assistance of AI Technology

The left and right ventricles and left and right atriums of the heart are investigated for structure and function once the cardiogram section is determined. It's critical to understand the morphological changes in cardiac ultrasound images and to segment the images well for clinical diagnosis.

Many echocardiography machines have software that allows for semi-automatic segmentation of the heart chambers. Manual segmentation is random, time-consuming, and difficult. As a result, accurate and automatic segmentation has beneficial clinical effects and can lower the frequency of the aforementioned problems. Currently, the endocardial wall in two-dimensional (2D) or three-dimensional (3D) images can be used to automatically segment the left and right ventricles of the heart (Awwalu *et al.*, 2015).

Current Applications of Artificial Intelligence in Medicine

Cardiology

Atrial fibrillation

Having atrial fibrillation the early detection of atrial fibrillation was one of the first medical applications of AI. In 2014, the FDA approved AliveCor's mobile app Kardia, which provides smartphone-based ECG monitoring and atrial fibrillation identification. This enables you to share the outcomes via a smartphone with the doctor of your choosing. Many people have criticised the use of wearable and portable ECG technologies, pointing out drawbacks like the false positive rate brought on by movement artefacts artifacts and challenges implementing the technology in elderly patients who are more likely to experience atrial fibrillation (Briganti & Le Moine, 2020).

Cardiovascular risk

When applied to electronic patient data, AI has been used to more accurately forecast the risk of cardiovascular diseases including acute coronary syndrome and heart failure than traditional scales. The sample size used in a study report, however, may have an impact on the results, according to more current detailed evaluations. Pulmonary medicine in the realm of pulmonary medicine, the interpretation of pulmonary function tests is reportedly a promising area for the development of AI applications.

A recent study on deciphering pulmonary function test data found that AI-based software provides more accurate deciphering and serves as a decision-support tool. One of the study's many critiques was that pulmonologists' rates of accurate diagnosis were low. Participation in the experiment was much lower than usual compared to the country as a whole (Briganti & Le Moine, 2020).

Endocrinology Diabetes patients can use continuous glucose monitoring, which also provides information on the direction and rate of change of blood glucose levels, to view interstitial glucose measurements in real-time. Medtronic received FDA approval for its Guardian glucose monitoring device, which works with smartphones. In order to further assist their customers in preventing hypoglycaemia events based on frequent assessment, the company partnered with Watson (AI developed by IBM) for their Sugar.

IQ product in 2018. Although participants in a study on patient experiences with glucose monitoring expressed confidence in the notifications, they also revealed emotions of personal failure to control blood glucose levels. Patients can improve their blood glucose control with continuous blood glucose monitoring, which also helps to lessen the stigma attached to hypoglycemic episodes (Briganti & Le Moine, 2020).

Nephrology

Nephrology Artificial intelligence has been applied in a variety of clinical nephrology contexts. For example, it has been demonstrated to be useful in estimating the risk for developing IgA nephropathy and forecasting the reduction in glomerular filtration rate in patients with polycystic kidney disease (Briganti & Le Moine, 2020).

Gastroenterology

Gastroenterologists have utilised convolutional neural networks and other deep learning models to examine images from endoscopy and ultrasound and discover abnormal structures like colonic polyps. Artificial neural networks have been used to diagnose gastroesophageal reflux disease and atrophic gastritis, as well as to predict the prognosis of gastrointestinal bleeding, oesophageal cancer survival, inflammatory bowel disease, metastasis in colorectal cancer, and oesophageal squamous cell carcinoma (Briganti & Le Moine, 2020).

Neurology

Epilepsy

Intelligent seizure detection technology is poised to significantly improve seizure management through ongoing ambulatory monitoring. The wearable Embrace by Empatica, which uses electro dermal captors to detect generalised epilepsy episodes and report to a mobile application that can notify close family members and a trustworthy doctor with additional information regarding patient localization, obtained FDA approval in 2018 (Briganti & Le Moine, 2020).

Gait, posture, and tremor assessment

Tremor, postural, and gait evaluation Wearable sensors can help patients with multiple sclerosis, Parkinson's disease, Parkinsonism, and Huntington's disease by objectively analysing their stride, posture, and tremor (Briganti & Le Moine, 2020). AI facilitated the planning of endodontic treatment.

The review focused on obtaining and evaluating data about the techniques and models utilised (CNN [convolutional neural network], DCNN [deep convolutional neural network], and ANN), datasets used, and presented comparative efficacy regarding the use of AI in endodontic diagnosis. This review was carried out in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) reporting standards (Asiri & Altuwalah, 2022).

It's likely that publications in the engineering sector would turn up in a search of a non-medical/biological database due to the widespread application of AI in a variety of businesses. When searching for articles that discuss the use of AI in treating prostate cancer, PubMed provided a comprehensive, powerful, and incredibly relevant search engine. The two types of articles included in PubMed: I reviews and (ii) research papers, were extensively searched using the advanced search option. In the initial stage, the title section was initially searched for keyword strings (Rabaan *et al.*, 2022).

Assessment of the functional left ventricle with aid from artificial intelligence Functional evaluation indicators of the left ventricle systole (GLS) includes left ventricular ejection fraction (EF), left ventricular volume, left ventricular wall motion function, myocardial contractility, and global longitudinal strain (Briganti & Le Moine, 2020).

EF is the simplest and most widely used statistic for evaluating left ventricular systolic performance. Since it is a ratio when there is no segmental motion irregularity in the ventricular wall, the inner diameter ratio of the left ventricular end diastole to systole can be used to determine EF using an M-mode chart. When there are ventricular wall segmental motion problems, like myocardial infarction, the biplane Simpson method is a more precise way to calculate EF (Becker, 2019).

Some left ventricular segments' M-mode is unable to capture the motion of the complete left ventricle. The total volume must now be estimated using the Simpson approach. The cornerstones of AI technology have been Endocardial monitoring and automatic left ventricular segmentation.

High-accuracy 2D and 3D echocardiography readings are made possible by a number of commercial software programs that are currently available, further enabling the automated assessment of left heart function. AI technology can help with motion estimation, measuring, tracing the myocardial, detecting the typical apical views, and timing cardiac events. It was shown to have a close relationship with an established speckle-tracking application. Additionally, AI technology may facilitate novices' rapid acquisition of skills in high-quality diagnostic imaging to minimise inter- and intra-observer variability (Becker, 2019).

Medical imaging and validation of AI-Based technologies

A long-awaited meta-analysis compared the skills of radiologists with deep learning technologies in the area of imaging-based diagnosis (Figure 2). Although deep learning appears to be as effective as a radiologist for diagnosis, the authors pointed out that 99% of studies were found to not have a reliable design; additionally, only 1% of the papers that were reviewed validated their results by having algorithms diagnose medical imaging from other source populations (Malik *et al.*, 2019).

Objectives

AI in medicine: vocabulary, concepts, and current and future applications are covered. It aims to make primary care physicians more knowledgeable about and at ease using AI. In urologic disease diagnosis, treatment, and outcome prediction, artificial intelligence (AI) is used. Its advantages over traditional models and approaches are assessed (Chen *et al.*, 2019).

MATERIALS AND METHODS

Google and PubMed both accepted the search phrase "artificial intelligence." Additional references were found by cross-referencing the significant publications (Malik *et al.*, 2019). A literature evaluation of various AI models and algorithms for AI assisted endodontic diagnosis and planning was the goal of the current study issue.

With a search criterion of the original research paper, published in English, the search engine evaluated information on artificial intelligence and its function in the field of endodontics and included databases like Google Scholar, PubMed, and Science Direct (Rabaan *et al.*, 2022).

Artificial Intelligence in Medicine: Challenges and Future Directions

AI-Based technology validation: A replication crisis?

One of the most difficult challenges for AI in medicine in the next few years will be the clinical validation of newly established core ideas and technology. Even though many studies have already shown the value of AI with clear prospects based on optimistic results, there are a number of well-known and frequently recorded restrictions of AI studies that are likely to make such validation more difficult.

It has been established that the majority of research contrasting the efficacy of doctors and AI lacks primary replication, or the validation of the algorithms produced in samples from sources other than those used to train the algorithms. The application of AI in healthcare contexts is known to be constrained by retrospective designs and sample sizes. When models are created to match a certain data set as closely as possible yet fail to repeat the same results in other datasets (a problem known as over-fitting), selection and spectrum bias may be present in these designs (Briganti & Le Moine, 2020).

The ethical implications of continuous monitoring

Medical technology is one of the most promising markets of the twenty-first century, with a market value of about $1 trillion expected in 2019. A rising amount of the revenue comes from the retail of medical devices (such as heart monitoring devices) to a younger population, which is not the primary target customer profile.

This is because atrial fibrillation and other health issues are less likely to affect younger people. Due to this phenomenon, the Internet of Things (IoT) has redefined what a healthy person is as a combination of the quantified self (personal indicators programmed in the smartphone or wearable) and a number of lifestyle criteria offered by wearables (activity monitoring, weight control, etc.).

In order to coordinate a large-scale distribution of their products, a number of wearable companies have also negotiated important partnerships with insurance companies or governments during the past few years. These programs primarily aim to improve people's quality of life (Briganti & Le Moine, 2020).

The importance of educating augmented doctors

Numerous universities have started to create cutting-edge medical curricula, including a doctor-engineering, in response to the need to educate upcoming medical leaders about the challenges posed by artificial intelligence in medicine. These "augmented doctors" would use both clinical expertise and digital abilities to solve modern medicine's problems, assist in the development of digital strategies for healthcare organisations, manage the digital transition, and train patients and colleagues.

These experts might act as a safety net for all operations, including the application of AI in healthcare, as well as a driver for research and innovation, which would be helpful to society and healthcare organisations.

Therefore, in addition to traditional medical education, ongoing educational programs linked to digital medicine that are targeted at graduated physicians are required to enable retraining in this booming industry. These professionals are in charge of carrying out the tasks of the Chief Medical Information Officer (CMIO) in the vast majority of contemporary hospitals around the world (Briganti & Le Moine, 2020).

The ambient clinical intelligence promise: Avoiding technological dehumanisation

Electronic health records can be a considerable administrative burden and a reason for burnout, a condition that is becoming more prevalent among physicians, both recently graduated and seasoned, according to a number of studies.

Ambient clinical intelligence (ACI) refers to a sensitive, adaptive, and responsive digital environment that surrounds the doctor and the patient. ACI can assess the interview and automatically populate the patient's electronic health records, among other things. Even if artificial intelligence applications like Natural Language Processing are becoming more common, this is still the case (Briganti & Le Moine, 2020).

Will artificial intelligence replace doctors?

However, recent study has indicated that comparisons between medical experts and artificial intelligence solutions occur regularly, as if the two counterparts were competitors. Healthcare professionals are currently in a great position to welcome the digital transformation and be the main agents of change, even though a comprehensive revamp of medical education is necessary to equip future leaders with the capabilities to do so (Briganti & Le Moine, 2020).

Artificial Intelligence in Health Care

Machines mimicking human cognitive processes is how artificial intelligence (AI) is defined in the healthcare sector (Briganti & Le Moine, 2020).

In order for machines to perform as well as or even better than humans, artificial intelligence (AI) integrates the principles of sensing, recognising, and object identification. Artificial intelligence has been influenced by how natural neurons work. However, due to its intrinsic limits in articulation and insight development, AI cannot replace clinicians in the provision of healthcare (Figure 3).

AI frequently needs to be mixed with medical discretion because there are no industry standards that apply to everyone in healthcare. The medical history of the patient and clinical observations must be thoroughly linked in order to diagnose or monitor any sickness state.

Lateral and associative thinking are influenced by the doctor-patient relationship and can have an effect on managerial choices. AI also ignores the influence of a number of factors,

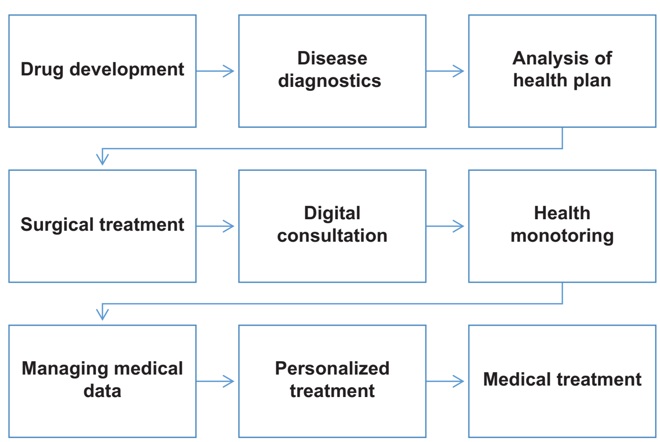

Figure 3: Applications of artificial intelligence in health care (Malik *et al.,* 2019)

including psychosocial and emotional ones, on the development of disease.

Even if robots have a lower risk of prejudice and can be more precise, trustworthy, and comprehensive, they cannot replace trust and empathy. A growing worry is that artificial intelligence (AI) systems, which practise frequently and learn via experience, may one day outperform humanity (Ellahham *et al.*, 2020).

Real-World Ai Application Cases in Healthcare

According to the World Health Organisation, 60% of the factors affecting a person's health and quality of life are lifestyle-related, including exercise, diet, sleep, and stress management, use of drugs and alcohol, and/or leisure activities (Ellahham *et al.*, 2020).

AI-assisted technologies and associated apps can now send reminders and lifestyle interventions throughout the day via digital devices based on a person's vital indicators. In order to increase the overall efficacy of patient outcomes, AI-based technologies are anticipated to fundamentally transform how healthcare organisations' healthcare systems operate, communicate with patients, and provide care services (Zhang *et al.*, 2022).

Diagnostic Assistance

It's believed that AI would make it simpler to diagnose people with specific conditions. Diagnostic mistakes account for 60% of all medical errors and result in 40,000-80,000 mortality per year in U.S. hospitals. As a result, the adoption of AI-based technology in a range of healthcare contexts can help reduce the amount of judgement errors brought on by human error.

The Mayo Clinic, a renowned healthcare organisation in the US recognised for its innovation in patient care and health technology, used AI to find precancerous abnormalities in a woman's cervix during cervical cancer screening. Using more than 60,000 cervical images from the National Cancer Institute, the AI-based approach uses an algorithm to identify precancerous signs. Researchers found that the algorithm has a far higher accuracy rate (91%).

A trained human specialist would have (69%). The National Health Service Foundation's (NHSF) Moorfields Eye Hospital in London, a speciality centre, has announced the creation of an AI solution to identify signs of eye disease just as precisely as the world's best doctors and specialists.

The AI-based method used optical coherence tomography to identify eye abnormalities using data gathered from more than 15,000 British patients. The AI-based solution, according to a statement from the hospital, "delivered the proper referral decision for over 50 eye disorders with 94% accuracy, matching world-leading eye experts." The number of eye scans being performed is increasing much more quickly than human experts can examine them.

When assessing the results of medical therapy after a year (2017), the medical team at the Gachon University Gil Medical Centre in South Korea and Watson had a 55.9% agreement rate. However, the consensus rate was only fulfilled by 40% of patients with stage IV stomach cancer.

Additionally, the Konyang University Hospital in South Korea reported in April 2018 that the agreement rate between medical professionals' decisions and Watson's treatment recommendations was 48% based on 100 patients with breast cancer.

"The number of eye scans we're conducting is growing at a rate significantly faster than human experts can evaluate them," Liang et al. examined the "assessment and accurate diagnoses of paediatric disorders using AI" at the Guangzhou Women and Children's Medical Centre, a large academic medical referral centre in Guangdong Province, China. The test used AI-based technology with deep learning techniques and 101 million data points from computerised records of 1.3 million outpatient visits to the medical centre.

The study divided the doctors into five groups based on their quantity of practising experience to compare the performance of the AI system and physicians. Senior resident doctors with more than three years of experience make up Group 1, junior doctors with eight years, midlevel doctors with fifteen years, attending doctors with twenty years, and senior attending doctors with more than twenty-five years make up Group 2.

The AI-powered model achieved an average accuracy of 88.5%. This score was lower than the scores of the three senior physician groups (G3, 90.7%, G4, 91.5%, and G5, 92.3%), but higher than the scores of the two junior physician groups (G1, 54.1%, and G2, 83.9%). While this "AI model may not always outperform experienced clinicians," it "may potentially assist junior physicians in diagnoses". The study also discovered that the AI system could diagnose ailments with an accuracy of 90 to 95% (Zhang *et al.*, 2022).

Nursing and Managerial Assistance

As is well known, healthcare staff are frequently overburdened with paperwork while providing care. As a result of this workload, the industry is transitioning to electronic systems that integrate and digitise medical records, with the assistance of AI-based technology. Furthermore, chatbots have been considered as a potentially effective tool for talking with hospital patients and their relatives (Bohr & Memarzadeh, 2020).

The Cleveland Clinic, a non-profit multispecialty academic medical facility in Cleveland, Ohio, began using Microsoft's artificial intelligence digital assistant Cortana in 2016. Cortana monitors "100 beds in 6 ICUs" via the Cleveland Clinic's e-Hospital system between the hours of 7 p.m. and 7 a.m. The AI-assisted system at the University of Pittsburgh Medical Centre may potentially listen to and learn from exchanges between medical staff and patients in hospital rooms (Bohr & Memarzadeh, 2020).

In March 2016, the non-profit academic medical institution Johns Hopkins University Hospital in Baltimore, Maryland, announced a collaboration with GE healthcare partners to implement predictive analytics based on AI technology to enable a more efficient operating flow. The Johns Hopkins Hospital Command Centre receives "500 messages per minute" and integrates data from 14 separate Johns Hopkins IT systems across 22 high-resolution touch-screen computer monitors (Bohr & Memarzadeh, 2020).

According to James Scheulen, Johns Hopkins' chief administrative officer for emergency services and capacity management, "emergency room patients are assigned a bed 30% faster; transfer delays from operating rooms have Ambulances are dispatched 63 minutes sooner to pick up patients from other hospitals, and the hospital's capacity to accept patients with difficult medical conditions from other regional and national hospitals has increased (Zhang *et al.*, 2022).

AI Applications in Healthcare: Opportunities and Challenges

To improve the diagnosis accuracy of AI-applied systems, the market should construct systems for each specialist field utilising machine learning algorithms with a considerable number of examples that incorporate the ethnic and cultural features of patients. When more learning examples are provided by healthcare academics and practitioners, such AI systems may get wiser. The ramifications of medical AI systems, like any new technology, contain both utopian and dystopian features.

The utopian viewpoint provides numerous new opportunities to treat illnesses more successfully, provide better care and a better patient experience, encourage patients to participate in their own care, reduce medical errors and healthcare costs, and improve the managerial effectiveness of healthcare providers (Zhang *et al.*, 2022).

Opportunities with Artificial Intelligence Applications

The increasing usage of AI-based technologies in the healthcare sector has created a plethora of new possibilities.

Better Disease Treatments

The introduction of IBM Watson was a watershed moment in the field of data-driven medical research, sparking public interest in the potential benefits of leveraging cutting-edge digital technology to improve patient care and public health. As demonstrated in the real-world cases of AI applications in healthcare, advanced technologies are becoming increasingly important in boosting medical practitioners in virtually every element of patient treatment. The application of AI to improve the quality of care services for medical imaging has been shown to be especially successful with large amounts of radiological data. Patients will benefit significantly if AI-based software can improve the accuracy of medical diagnoses, but also Int. The job of medical personnel, age 18, is included in Res. 2021 Public Health, 18, 271 9.Using pictures or a microscope to assess the frequency of mitosis in cancer cells, for example, takes a lengthy time despite being a straightforward technique. AI software can accomplish this process more precisely and rapidly, supporting medical staff in their professional duties and removing some of the monotonous activities. AI-assisted medical software can become wiser as it learns from increasing amounts of data and new medical studies (Zhang *et al.*, 2022).

Patient Engagement and Participation Have Improved

Diet software that performs all of the responsibilities of a mobile diabetes prevention programme is one of the most popular smartphone-based health coaching programmes. "We work with clients all over the world to help them adopt healthier habits, reduce their risk of developing chronic health issues, reverse disease, and foster stronger connections with themselves," the company says.

A strong commitment to the course of action is essential for reaching the goals set when utilising this coaching programme. Patient involvement in medical treatment is critical for accurate disease diagnosis and patient safety. Furthermore, patients believe that attending meetings with medical professionals is a valuable and enjoyable experience for them. When patients are encouraged to participate in their medical treatment, they are more likely to be fully active in carrying out their part of the procedure, which improves their satisfaction with the level of care they receive (Zhang *et al.*, 2022).

Medical Error Reduction and Service Quality Improvements

In China, doctors who utilised artificial intelligence to aid with colonoscopy screenings discovered 20% more polyps than those who did not. The artificial intelligence-powered approach can detect early-stage or very small polyps (5 mm or less in size), which many gastroenterologists overlook during colonoscopy examinations (Zhang *et al.*, 2022).

As a result, AI technologies help clinicians remove potentially harmful microscopic polyps, improve patient care, and reduce the chance of medical errors. An AI system based on unique algorithms and order parameters is thought to have been developed by a research team at the University of Tokyo Medical School. When applied to a sample patient group, the best accuracy rate discovered when this strategy was paired with a deep-learning AI medical program was 83.5%.

The accuracy rate climbed to 87.3% when the system was integrated with a deep-learning and decision-tree AI system. Intelligent AI systems that have recently been developed have the potential to significantly reduce error rates and increase the standard of care. Radiologists are regularly identified as the medical professionals most likely to be supplanted by artificial intelligence. Each day, a radiologist can read 50-100 X-rays, whereas an AI-powered system can read 10-100 times more (Zhang *et al.*, 2022).

Increased Operational Efficiency and Cost Savings in the Medical Field

As previously stated, AI-enabled medical systems are capable of managing a wide range of diagnostic tasks without the need for human intervention. An AI-enabled pill-cam, for example, can substitute a time-consuming upper endoscopy to screen for stomach cancer. A new AI-based technique for screening for acute leukaemia that can substitute costly conventional procedures by assessing the peculiarities of the bone marrow structure. AI systems are not only employed in medicine. Certain AI solutions are created to aid with operational improvements that provide new or additional value to a healthcare organization's value chain (Zhang *et al.*, 2022).

Technological Advancements

There have been many technological advances in the domains of data science and artificial intelligence over the previous ten years. Despite the fact that AI research for a number of applications has been ongoing for several decades, the current wave of AI hype is distinct from previous ones.

A winning combination of faster computer processing, larger data banks for data collection, and a vast talent pool for AI has enabled the development of AI tools and solutions, notably in the field of healthcare. As a result of this, the degree of AI technology, its adoption, and its effects on society are all likely to shift substantially (Bohr & Memarzadeh, 2020).

Deep learning (DL) in particular has altered our perception of AI technologies and is primarily responsible for the recent excitement around AI applications. Finding previously difficult to render associations with earlier machine learning approaches is now possible with DL. This is mostly based on artificial neural networks, and DL networks have more than ten layers of connections, as opposed to prior neural networks, which only had 3-5 layers. This is the same as modelling millions of synthetic neurons. Many businesses, including Google's Deep Mind and IBM Watson, are leaders in this field (Zhang *et al.*, 2022).

These firms have demonstrated that their artificial intelligence can outperform humans in a variety of jobs and games, including go and chess. Many healthcare-related applications are now being used by Google Deep Mind and IBM Watson. Despite the fact that IBM Watson is being used to investigate improved cancer care and modelling, drug discovery, and diabetes management, it has yet to demonstrate therapeutic utility to patients. Deep Mind is also being tested for applications such as mobile medical assistants, medical imaging-based diagnostics, and patient deterioration prediction (Bohr & Memarzadeh, 2020).

Artificial Intelligence Applications in Healthcare

Precision medicine

Precision medicine enables healthcare actions to be personalized to particular patients or patient groups based on illness profiles, diagnostic or prognostic data, or therapy responses. Personalized treatment will consider genomic variants as well as other aspects of medical care such as age, gender, region, race, family history, immunological profile, metabolic profile, micro biome, and environmental vulnerability. At every level of a patient's medical care, precision medicine tries to employ individual biology rather than population biology. Obtaining patient data, such as genetic data, physiological monitoring data, or EMR data, and adapting their care to cutting-edge models is required. Precision medicine provides many benefits, including lower healthcare costs, less adverse drug reactions, and better drug action efficacy. Precision medicine innovations are predicted to significantly benefit patients while also revolutionising healthcare delivery and evaluation (Bohr & Memarzadeh, 2020).

Precision medicine activities are broadly divided into three clinical areas: complicated algorithms, digital health apps, and "omics"-based diagnostics.

Algorithms that are Complex

Machine learning algorithms are employed with massive datasets such as genetic information, demographic data, or electronic health records to forecast prognosis and choose the best treatment strategy (Bohr & Memarzadeh, 2020).

Applications of Digital Health

Healthcare applications record and process data from wearables, mobile sensors, and the like, as well as data provided by patients, such as food consumption, emotional state or activities, and health monitoring data. Several of these apps are classified as precision medicine since they use machine learning algorithms to find trends in data, enhance forecasts, and provide patients with personalised treatment suggestions (Bohr & Memarzadeh, 2020).

Omics-Based Tests

To find correlations and forecast each patient's response to therapy, machine learning algorithms are integrated with genetic data from a population pool. Machine learning is utilised in conjunction with various biomarkers, such as protein expression, gut micro biome, and metabolic profile, in addition to genetic data, to enable customised treatments (Bohr & Memarzadeh, 2020).

Solutions Based on Genetics

Over the next ten years, it is expected that a considerable fraction of the world's population will be subjected to whole genome sequencing, either at birth or as adults. This genome sequencing will be a tremendous tool for precision medicine, generating 100-150 GB of data. Data on phenotypes and genomes are still being compiled. To take advantage of such genomics data and its benefits, the pharmaceutical system would need to be redesigned.

Drug Research and Development

From the identification of molecular targets to the approval and sale of a therapeutic product, the process of drug research and development is extremely time-consuming, costly, and complex, typically taking more than ten years. Each failure along the way has a substantial financial impact; in practise, the majority of drug candidates fail at some point during research and are never commercialised. On top of that, there are ever-increasing regulatory barriers, as well as the challenge of routinely identifying medicinal molecules that are much better than what is now accessible.

As a result, developing new drug products is difficult and inefficient, and once on the market, they are expensive (Bohr & Memarzadeh, 2020). The amount of information available for evaluating the activity of pharmacological agents and biomedical information has increased significantly in recent years. This is due to increased automation as well as the introduction of new experiments. Hidden Markov model-based text-to-speech synthesis and parallel synthesis are two examples.

To efficiently categorise potential pharmaceutical molecules, large-scale chemical data mining is required, and machine learning techniques have shown substantial promise. Models were developed in the 1990s to aid in the development of novel medications utilising techniques such as support vector machines, neural networks, and random forests. Because of the increasing amount of data and continual advances in computing power, DL has just recently begun to be implemented (Bohr & Memarzadeh, 2020).

Wearable Devices and Health Monitoring

For millennia, people have relied on doctors for information about their own bodies, and this practise is still practised to some extent today. Wearable technology, which is still in its early stages, is changing this. Future technology known as wearable health devices (WHDs) allows for continuous monitoring of specific vital markers under varying conditions (Vatansever *et al.*, 2021).

Its versatility as an application, which allows users to track their activity while running, meditating, or even underwater, was critical to its early popularity and success. By allowing people to analyse data and manage their own health, the idea is to give them a sense of control over their own health.

There is a medicine drink in the ancient Vedic tradition that grants its consumers “immortality,” as our race has always desired perpetual life.” We took soma, we became immortal, we came to the light, and we found gods,” according to the about 5000-year-old Rig Veda.

This is similar to the fabled drink known as Hoama in ancient Iranian culture, which is described in the Avesta, the Zoroastrian sacred book. This yearning for “enhancement” and “augmentation” has always existed, and we are progressively bringing these old ideals to fruition in the twenty-first century. This section will go through some recent innovations that employ AI to assist and improve human function (Bohr & Memarzadeh, 2020).

Neuroprosthetics

There is a medicine drink in the ancient Vedic tradition that grants its consumers “immortality,” as our race has always desired perpetual life. The approximately 5000-year-old Rig Veda states that “we took soma, we became immortal, we came to the light, and we found gods”.

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Neuroprosthetics are devices that supplement or enhance the subject’s own nervous system in both input and output. In order to cure patients’ neurological abnormalities, this augmentation or stimulation often takes the form of electrical stimulation (Deng *et al.*, 2022).

These crippling diseases can cause comorbidities and impair hearing, visual, cognition, sensory, or motor functions (Tripathi *et al.*, 2021).

Movement disorders, such as Parkinson’s disease or multiple sclerosis, are certainly progressive illnesses that can cause a painful and sluggish deterioration in the aforementioned abilities while the patient is always conscious of every change (Shan *et al.*, 2021).

Recent advancements in brain-machine interfaces (BMIs) have revealed that a system can be employed where the patients’ voluntary, planned aims are carried out (electroencephalogram, EEG). Information can be saved and learned (an AI) when a user “trains” an intelligent controller.

This training period enables the detection of errors in tasks deemed incorrect by the user, such as when a computer screen square is directed to move to the right when it should move to the left, or when the BMI is attached to a fixed robotic hand and the subject commands the device to move up but the signals are interpreted as moving down. Correct actions are saved, while the AI records brain signals associated with errors in order to adjust for future acts. The system may be able to store one to many control “policy” alternatives as a result of this “reinforcement learning,” allowing for patient customization (Bohr & Memarzadeh, 2020).

In Ongoing Patient Care

In terms of its application during active therapy, AI appears to be most beneficial in terms of supporting clinicians' efforts. A study examining the use of computer-aided detection (CAD) of brain metastasis on radiologists' diagnostic performance when reading three-dimensional brain magnetic resonance imaging (MRI) scans found that CAD assistance helps radiologists improve their diagnostic performance (Nishida & Kudo, 2023).

Researchers also employed AI to determine whether a patient's body morphometric age could endure major surgery or chemotherapy by measuring muscle mass. minimising the number of false-positive outcomes in chest radiographs when detecting nodules, clinical management of patients undergoing echocardiographic evaluation, collagen proportional area extraction during the liver biopsy, and assessment of neurological deficit in stroke victims (Becker, 2019).

In Clinical Research and Drug Development

Furthermore, AI is expected to accelerate healthcare diagnosis and research. Researchers in Japan used AI in cancer genome sequencing to more reliably identify patients with haematological malignancies and derive appropriate treatment information.

In addition to using machine learning to separate bacterial protective antigens (BPAs) from non-BPAs in reverse vaccinology, which may aid in the development of new vaccines, researchers used a systems biology approach and AI to find a neuroprotective agent for the treatment of peripheral nerve root avulsion Table 1.

Table 1: Description of the PICO (Population, Intervention, and Comparison-Outcome) elements (Khanagar *et al.*, 2021)

S. No.	Research Question	What are the advancements, results, and applications of artificial intelligence in dentistry?
1	Population	Patient diagnostic imaging for the oral and maxillofacial areas includes clinic images, radiographs, CBCT, confocal laser endomicroscopy (CLE) images, intraoral fluorescence images, cephalometric radiographs, and near-infrared-light trans illumination (NILT) images.
2	Intervention	AI-powered clinical decision-making, diagnosis, care planning, assessing the need for care, and prognosis prediction models.
3	Comparison	Expert opinions and benchmarks.
4	Outcome	PPV/NPV, ROC Z receiver operating characteristic curve, sensitivity, specificity, AUC Z area under the curve, and ICC Z intra class correlation coefficient are examples of results that can be assessed or predicted.

Prostate Cancer

Prostate cancer (PC), the second most commonly diagnosed disease in men, is the most common type of cancer in the United States. According to WHO cancer statistics from 2020, there were 1,414,259 PC cases in total. Furthermore, it was stated that PC is the most common illness among Afro-American races (Mayro *et al.*, 2020).

According to the National Institutes of Health (NIH), there were 34,500 PC fatalities globally in 2022, with 268,490 new cases reported. According to the study, the death rate increased as people aged, with people over the age of 66 being the most likely to die, accounting for more than 55% of all fatalities (Figure 4).

Prostatic hyperplasia (BPH) was discovered, a disorder in which the size of the prostate gland enlarges with age. According to data from the US population registry for surveillance, epidemiology, and end results, age (over 40) and race (more prevalent in Black or Afro-American races) were risk factors for PC. (SEER) (Kumar *et al.*, 2022).

PC has also been linked to the onset of other factors such as genetic BRCA2 gene mutations, family history, smoking, obesity, and eating high-fat meals. Prostate gland inflammation, a history of prostatitis, and the use of drugs that inhibit the enzyme 5 alpha-reductase, which is used to treat BPH, are all risk factors for PC (Mitsala *et al.*, 2021).

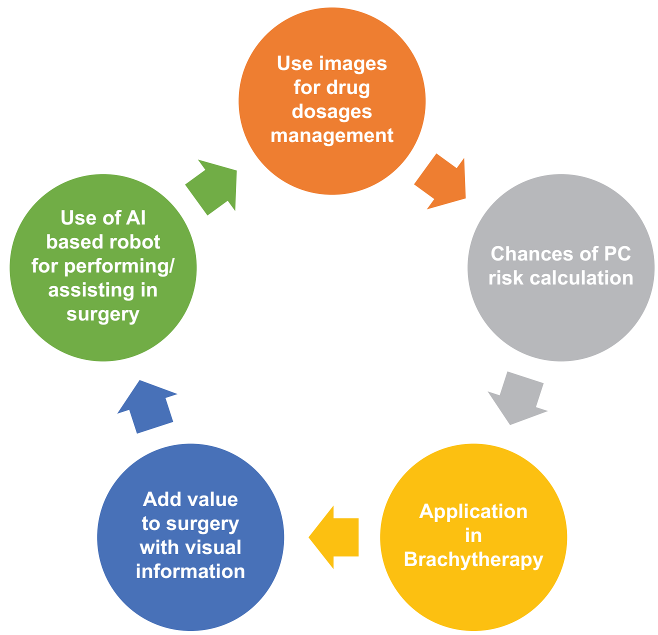

Figure 4: Summary of AI direct application and assistance in PC treatment (Chowdhury *et al.*, 2011)

Patients with PC rarely have significant symptoms in the early stages, with the exception of common complaints about frequent urination, frequent urgency, and nocturnal pee, which are symptoms similar to BPH (Table 2). Symptoms such as back discomfort and urine incontinence are frequent signs of the condition. Furthermore, back pain is an indication of PC's metastatic stage, indicating the disease's spread (Zhou *et al.*, 2021).

Artificial Intelligence and Safety

In the healthcare industry, safety refers to the reduction or elimination of risks and the unpredictability of hazardous

Table 2: Classification of biopsy methods used in the detection of PC (Tahvildari *et al.*, 2021)

S. No.	Biopsy Techniques	Summary
1	Needle Biopsy	Cells are retrieved from a suspicious site with this sort of biopsy by putting a needle into the skin. This operation is also known as a percutaneous tissue biopsy by doctors.
2	Endoscopic biopsy	During an endoscopic procedure, a flexible, thin tube (endoscope) with a light at the end is used to examine within bodily structures. Furthermore, sophisticated equipment is put within the tube to collect a small sample of tissue for analysis.
3	Skin biopsy	Cells are extracted from the skin's surface during a skin biopsy. It is mostly used to detect skin diseases like melanoma. The patient will have a skin biopsy, which will be determined by the type of cancer discovered and the quantity of suspicious cells.
4	Bone marrow biopsy	This method of collecting a biopsy is often used in reaction to the findings of blood testing or when doctors suspect a bone marrow malignancy.
5	Surgical biopsy	If other biopsy procedures fail or the results of the first tests are inconclusive, a surgical biopsy may be recommended.

situations. ML applications are classified as category A (such as medical diagnosis) or type B (such as speech transcription systems) based on their safety and risk reduction (Mayro *et al.*, 2020).

While safety is critical in type A applications, risk mitigation is more important in type B applications. Epistemic uncertainty the scientific uncertainty in the model is far lower in type B applications (Holloway *et al.*, 2021). Because errors are less common in type B applications, safety is less crucial (Pérez & Grande, 2020). In addition to risks and safety, the cost of unintended consequences is used to determine if an outcome is harmful (Owais *et al.*, 2019).

Opportunities and Challenges of AI in the Health Care Safety Context

AI is critical for increasing knowledge and improving results in healthcare. AI has various applications in medicine, including disease prediction and diagnosis, managing enormous volumes of data and synthesising insights, and increasing therapy effectiveness and outcomes (Nishida & Kudo, 2023). AI has been addressed for a number of illnesses and outcomes, including the detection and classification of malignant lesions, retinal diseases, pneumonia, and the prediction of sepsis in intensive care (Lang *et al.*, 2021).

Precision medicine has applied artificial intelligence principles to provide precise, safe, and customised treatments. AI has a variety of applications in diagnostics and decision-making (Table 3).

AI provides decision-makers with fast access to accurate and up-to-date information to help them make better decisions (Kapoor *et al.*, 2019). The application of artificial intelligence has revolutionised radiological diagnostics by boosting the utility

Table 3: Healthcare applications and their purpose (Mintz & Brodie, 2019)

S. No.	Healthcare applications	Purpose
1	Analysis and disease identification	One of the most important applications of machine learning and deep learning in medical therapy is the recognition and examination of diseases that are regarded to be difficult to diagnose.
2	Drug development	Machine learning and deep learning can make major advances in the early phases of the drug identification process. The advantage of standalone AI is that it can detect patterns in data without making predictions.
3	Customized medicine	Medication is most effective when applied solely to health-related conditions. Currently, based on the patient's personal history and the relevant data, a doctor's judgement of a patient's safety can err towards a lack of conclusion or an indeterminate threat.
4	Digital health records	They are adhering to the time-consuming and costly cycle of maintaining vital health records. As a result, they now play a critical role in supporting the data access measure.
5	Medical trials	It is based on machine learning and deep learning, and it employs expository analysis to find prospective clinical preliminary applications, allowing scientists to restrict their pool from a large amount of data.
6	Information crowdsourcing	Because the health area has openly embraced it, experts are using it to collect a large amount of data that consumers transfer.
7	Outbreak prediction	In order to predict the disaster, machine and deep learning-based procedures are utilised to screen and predict fare-ups around the world.
8	Medical imaging diagnostics	Simulated intelligence techniques become more extensive and successful at gathering more data from a wide range of clinical images.

and precision of image processing. Deep learning-based designs have enabled accurate analysis of digital pictures for the early detection of breast diseases (Hamamoto *et al.*, 2019). Another example is the use of DaTscan image analysis to train an ML software library to spot changes in Parkinson's disease (Shan *et al.*, 2021). This resource may be useful in clinical diagnoses (Yan *et al.*, 2019).

Approaches to Achieving Safety in Artificial Intelligence

Methods for Ensuring AI Safety Factors such as prediction accuracy, predictive model causation, and human effort to classify out-of-sample cases, as well as reinforcement and system learning, make applications safe for use in healthcare (Bender *et al.*, 2021). Safe design, safety reserves, safe fail, and procedural protections are the four key safety engineering principles that relate to the security of AI in healthcare. Inherently safe design suggests that potential dangers will be eliminated rather than simply controlled in systems (Zhavoronkov *et al.*, 2020).

Changing data domains remains challenging, despite the fact that doing so can improve system accuracy. AI applications should have sufficient safety reserves to handle average and maximum test mistakes, as well as to detect uncertainty in the training and testing systems. Systems must be designed to fail safely (that is, they must remain safe even if they fail in their intended operation). When the model is unable to make the intended prediction, it should be trained to reject with confidence (Meske *et al.*, 2022).

In the event of such rejections, human involvement can be used to make predictions. User experience design is one of the procedural safeguards that assist users in safely configuring and executing the program.

Security is considered to be improved by open source software and open data. Algorithms built on simple-to-obtain patient samples will not be optimal for patient safety when employed on bigger and more diverse populations (Velik, 2012). The severity and progression of diseases should be taken into account while designing and training algorithms. 57 Clear ethical norms will allow AI to be utilised more extensively while also assuaging fears that AI will surpass human abilities.

Societal benefits will accrue if AI tools are made open source, approachable, and have clear therapeutic and financial value (Paul *et al.*, 2021). The US Food and Drug Administration (FDA) and the European Medicines Agency (EMA) have formed working groups to develop and validate technology and digital health solutions (Farghali *et al.*, 2021).

In addition, the European Patent Office has updated its patent application criteria for ML and AI-based technologies. 60 The FDA approved Arterys' medical imaging platform, the first deep learning clinical platform, in 2017. The FDA supports clinical studies that use real-world data and an adaptive design to assess the efficacy and efficiency of AI in healthcare. 50 Regulatory changes are essential to make data sharing and exchange more effective and secure (Deng *et al.*, 2021).

Applications of Artificial Intelligence

After a diagnosis is made, AI apps can help with ongoing patient care. Beta Bionics, Inc. (Boston, Massachusetts, USA), a medical technology firm, is developing the world's first autonomous bionic pancreas (Mak & Pichika, 2019). The business recently gained investigational device exemption certification, allowing it to continue recruiting adults and children for tests at home using its innovative Bionic Pancreas System. Although this indication has not yet been FDA-approved, alive or has previously hailed the release of medical research demonstrating the potential use of the company's AI technology as a viable replacement to surgically implanted heart monitors.

A professional AI therapist uses scientifically backed psychological treatments to try to reduce the negative psychological and physical effects of hot flashes in users.

Notal Vision is also developing an optical coherence tomography technology powered by AI for geriatric home monitoring of wet age-related macular degeneration. Although AI's integration into medicine has progressed tremendously since its conception, it still has a long way to go before totally replacing human doctors (Tripathi *et al.*, 2021).

In fact, it's possible that this will never happen. Despite the fact that there are numerous potential uses for AI in clinical research, diagnosis, and therapy, the industry is beginning to plan for the future by forming working groups, guidelines, and other organisations.

For example, the American Medical Association has approved its first set of "augmented intelligence" policy guidelines, stating five goals towards which the organisation will work. Because younger individuals are more likely to accept AI, future medical instructors are beginning to consider its potential ramifications (Mnih *et al.*, 2015).

The two key categories in the medical industry are virtual and physical AI applications. Machine learning (ML) and deep learning (DL, a subset of ML) comprise the virtual component of AI. Machine learning algorithms are further classified as supervised, unsupervised, and reinforcement learning (Awwalu *et al.*, 2015).

Type of multilayer artificial neural network that is exceptionally successful for image classification. The advancement of neural network models has had significant success in the field of medicine thus far. In addition to the virtual component, the da Vinci Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA) and nanorobots for targeted drug distribution are examples of medical equipment and robots that are part of the physical branch of AI (Berdigaliyev & Aljofan, 2020).

This cutting-edge technology has made major contributions to the treatment and diagnosis of several malignancies, including colorectal carcinomas. Recent study has shown that AI-guided care can play an important role in clinical practises by improving screening, diagnostic, and therapy approaches for patients with colorectal cancer (CRC). Recently, scientists developed AI models to improve CRC screening outcomes and reduce the frequency of missed adenomas and cancer risk. Computer-aided identification and characterisation systems are gaining popularity and attention these days (Vatansever *et al.*, 2021).

Endoscopists may benefit from AI assistance during colonoscopy for colorectal polyp detection and visual diagnosis. CRC treatment is now entering a new era, thanks to robotic surgery and other computer-assisted drug delivery systems. At the same time, personalised or precision medicine is rapidly expanding in healthcare. Machine learning models have the potential to transform medicine and aid in personalised cancer treatment. Our review here tries to provide an in-depth overview and analysis of AI applications in CRC screening, diagnosis, and treatment based on recent literature. Furthermore, we study the relevance of current breakthroughs in AI systems in medical diagnosis and therapy, with a number of promising results (Malandraki-Miller & Riley, 2021).

The public has embraced intelligent medical technologies (AI-powered ones) in part because they enable the 4P model of medicine (predictive, preventive, personalised, and participatory) and, as a result, patient autonomy in previously inconceivable ways. Smartphones, for example, are increasingly being used to build and distribute electronic personal health records, as well as to monitor vital functions using biosensors (Zhang *et al.*, 2022). Fourth, because there is currently no global legal framework that creates culpability in the adoption or rejection of algorithm recommendations, the use of AI by doctors exposes them to potential legal ramifications.

Due to a dearth of education in this subject, numerous private medical schools are preparing their future medical leaders for the challenge of augmented medicine by either integrating digital health literacy or teaching digital health literacy. And incorporate into a more advanced curriculum, or by merging the medical curriculum with the engineering curriculum (Lee & Yoon, 2021).

In recent years, there has been an increase in study into the use of artificial intelligence (AI) technology in cardiovascular imaging, which has the potential to reduce treatment costs and eliminate unnecessary testing (Zhang *et al.*, 2022).

AI is rapidly being utilised to process a wide range of image modalities, including radioactive myocardial perfusion imaging, cardiac computed tomography (CT) detection, and auxiliary electrocardiograph diagnosis. For the detection and management of heart problems, AI techniques have been used in electrocardiography, vectorcardiography, echocardiography, and electronic medical records (Ellahham *et al.*, 2020). As a non-invasive image detecting method for cardiac anatomy and functional evaluation, echocardiography technology has some limitations (Bohr & Memarzadeh, 2020).

Long procedures (more than 20 minutes, even if no abnormalities are discovered), multiple measurement values that increase duration complexity and user subjectivity, complex evaluation analyses, high standards for individualised assessments, high operator subjectivity, and broad observation ranges and differences between observers that persist even under standardised conditions are examples of these (Ahn *et al.*, 2021).

RESULTS

The most recent advances in AI technology and their current medical applications have been thoroughly examined. AI is already being used in the medical field for a variety of tasks such as online appointment scheduling, online check-in at medical facilities, digitization of medical records, reminder calls for follow-up appointments and immunisation dates for children and pregnant women, drug dosage algorithms, and adverse effect warnings when prescribing multidrug combinations.

AI could considerably assist radiologists, particularly in high-volume situations and hospitals with limited human resources, by not only detecting abnormal tests but also promptly identifying negative exams in computed tomography, X-ray, and magnetic resonance images.

The data from the review supported the conclusion that AI can play a significant role in endodontics, such as identifying apical lesions, classifying and numbering teeth, detecting dental caries, periodontitis, and periapical disease, diagnosing various dental problems, assisting dentists in making referrals, and assisting them in developing more accurate treatment plans for dental disorders.

DISCUSSION

AI is making inroads into public health, and it will have a significant impact on all aspects of primary care. With the use of AI-enabled computer programmes, primary care practitioners will be better able to identify patients who require special attention and administer tailored regimens for each individual.

Clinical trials to investigate and develop pharmacological remedies for a specific condition can take years and cost a lot of money. To give a recent example, artificial intelligence was used to accelerate the years-long process of evaluating existing medications that could be used to battle the expanding Ebola virus threat.

In classifying skin lesions, AI systems surpassed dermatologists. This is because AI systems can learn more from subsequent cases and can be exposed to a large number of cases in a short period of time, far more than a physician could study in a mortal lifetime. Many aspiring and practising physicians are concerned about the dwindling job opportunities created by the increased usage of technology.

CONCLUSION

Although artificial intelligence has the potential to transform medical practises in previously unthinkable ways, many of its practical applications are still in their infancy and require additional research and development. Artificial intelligence in clinical settings is a promising area of research that is rapidly emerging alongside other cutting-edge disciplines such as precision medicine, genomics, and teleconsultation. AI has been widely employed in urology. When it comes to massive data cohorts, AI techniques are more exploratory and accurate than classical statistics. Clinicians now have access to an increasing number of patient data libraries. Artificial intelligence in ophthalmology has grown rapidly in the previous 10 years and will continue to expand as imaging methods and data processing algorithms improve.

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