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Artificial Intelligence Revolution in Healthcare: Transforming Diagnosis, Treatment, and Patient Care

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ABSTRACT

Artificial intelligence has revolutionized healthcare, fundamentally altering the conduct of medical practice, research, and policy. This abstract provides an overview of the latest research, recommendations, and scientific updates regarding the ongoing revolution in the field of artificial intelligence. With the progress made in machine learning and deep learning, AI has the ability to analyse data, make predictions, and provide decision support. This has the potential to greatly enhance diagnosis, treatment, and patient outcomes in a wide range of medical disciplines. AI algorithms in diagnostics are highly proficient at detecting abnormalities in medical images, often surpassing human capabilities in certain instances. AI is revolutionizing the healthcare field by enhancing medical professionals' abilities to make quicker and more precise diagnoses. It enables

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early detection of cancer in X-rays and helps identify subtle neurological changes in MRIs. AI-driven predictive analytics are revolutionising the healthcare industry by accurately predicting disease progression, pinpointing at-risk populations, and optimising the allocation of resources. AI models have the ability to forecast the likelihood of developing certain diseases by analyzing extensive patient data. This empowers medical professionals to implement focused preventive measures and create personalised treatment strategies. In the field of drug discovery, AI algorithms play a crucial role in accelerating the process of identifying therapeutic targets, drug candidates, and repurposed compounds. Machine learning is used to analyse biological data, make predictions about drug interactions, and simulate molecular dynamics. This helps speed up the process of drug discovery and brings life-saving medications to market more quickly. Nevertheless, there are still obstacles to overcome. Ensuring data privacy, addressing algorithmic bias, and promoting accountability are crucial to establishing strong governance frameworks and transparent decision-making. Ensuring safety, efficacy, and equitable access for all patients is crucial when integrating AI into clinical workflows. This requires thorough validation, seamless integration, and continuous monitoring. To ensure responsible AI deployment, it is crucial to foster collaboration among various experts, such as clinicians, data scientists, ethicists, and policymakers. This multidisciplinary approach helps prioritise patient-centred care, equity, and privacy. In order to ensure widespread adoption and sustainable implementation of AI technologies in healthcare systems, it is crucial to invest in digital infrastructure, data interoperability standards, and workforce training. The future of AI in healthcare is promising, with ongoing innovation propelling progress in precision medicine, population health management, and patient engagement. Through the utilisation of AI, we can revolutionise clinical decision-making, improve healthcare delivery, and empower patients, ultimately making personalised, data-driven care accessible to everyone.

Keywords: Artificial intelligence, diagnosis; treatment; patient care; challenges; future; healthcare; patient care.

1. INTRODUCTION

The narrative of human existence is inextricably linked to the relentless desire for health. Humanity has fought illness since prehistoric times, from the use of therapeutic plants to modern wonders like robotic surgery and gene therapy [1]. However, despite these developments, the traditional healthcare sector has several flaws. Traditional healthcare is based on the doctor-patient connection. A skilled physician uses a scalpel of knowledge and experience to diagnose ailments and recommend treatments [2]. However, this approach has its limitations [3]. First and foremost, while human expertise is vital, it has inherent limitations. Doctors face exhaustion, cognitive biases, and access limitations to an ever-expanding ocean of medical data. Traditional diagnostics sometimes rely on subjective interpretations of tests and scans, resulting in potential mistakes. Furthermore, healthcare delivery systems are under strain as patient populations grow and expenditures rise. Against this backdrop of constraints, artificial intelligence (AI) emerges as a transformational force capable of revolutionising healthcare [4-10]. AI refers to machines' ability to mimic human cognitive capabilities, such as learning from data and making informed judgements. When applied to healthcare, AI has the revolutionary potential to supplement and expand human capabilities.

1.1 AI in Healthcare: Promise and Progress

The landscape of AI in healthcare is no longer a realm of futuristic fantasies. It's a space buzzing with ongoing research, development, and real-world applications. Here's a glimpse into the current state of AI in various healthcare domains.

1.2 AI-Powered Eyes: Seeing Beyond the Scan

Algorithms are becoming our collaborators in medical diagnostics, using images such as X-rays, MRIs, and CT scans to provide a window into the body. These AI-powered tools are transforming healthcare by spotting irregularities with unprecedented accuracy. According to research, artificial intelligence outperforms humans in detecting many illnesses, including breast and lung cancer. Aside from detection, AI helps radiologists analyse complex scans, considerably lowering interpretation time and the chance of error [10-20].

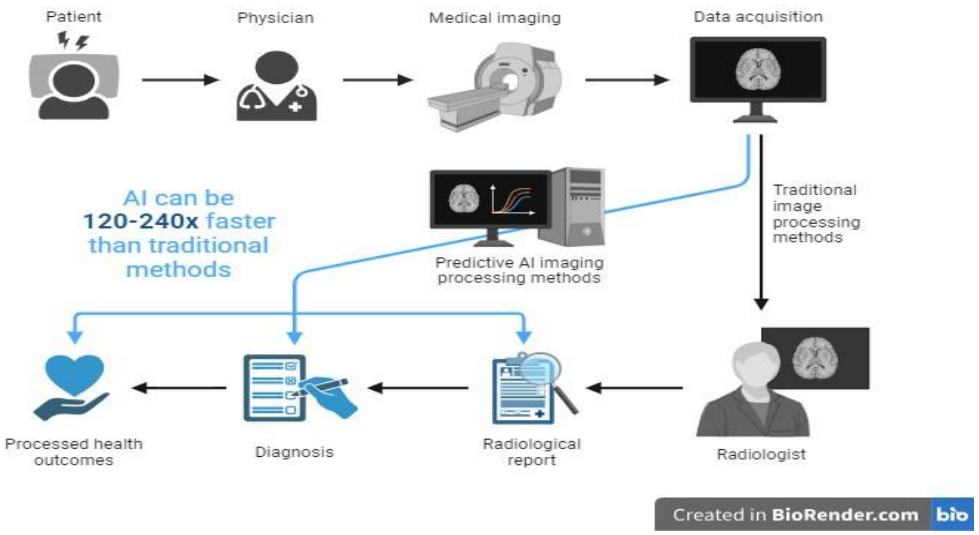

Fig. 1. AI in Healthcare

Drug Discovery and Development: The typical drug discovery approach is time-consuming and costly. AI is speeding up this process by analysing massive molecular datasets to find possible medication candidates. AI can also forecast a drug's potential efficacy and negative effects, expediting clinical trials and resulting in the faster creation of life-saving treatments [21-30].

Personalized Medicine and Precision Treatments: AI is paving the path for a future of personalised medicine, in which therapies are matched to each individual's genetic makeup. By analysing a patient's genetic data, AI can forecast their vulnerability to specific diseases and offer preventative actions. Furthermore, AI algorithms can use a patient's medical history, current health condition, and pharmaceutical reaction to tailor treatment programmes, resulting in better outcomes and fewer side effects [30-35].

Robot-Assisted Surgery: With the introduction of robotic surgery equipment, AI is changing the surgical landscape. These technologies, powered by AI algorithms, provide surgeons with more dexterity, precision, and minimally invasive treatments, resulting in speedier recovery periods and fewer issues for patients [36-40].

Patient Care and Support: People are turning to AI-powered virtual assistants and chatbots for a new kind of healthcare experience – one that fits in their pocket and is available 24/7.These chatbots are like having a friendly healthcare companion on call. They can answer your basic medical questions, schedule appointments, and even send you medication reminders. But it doesn't stop there. For those managing chronic conditions, AI assistants can become valuable partners, helping monitor health and empowering patients to take control of their well-being [41-45].

1.3 The Symphony of AI and Humans: Collaboration is Key

While AI offers a powerful toolkit for healthcare advancement, it's crucial to remember that AI is not a replacement for human expertise. The human element of empathy, compassion, and critical thinking remains irreplaceable. The future of healthcare lies in a collaborative model where AI serves as an extension of human capabilities. Imagine a doctor wielding the combined power of their medical knowledge and an AI assistant that can process vast amounts of data, suggest treatment options based on the latest research, and even identify potential complications. This collaborative approach allows physicians to focus on their strengths: developing relationships with patients, offering emotional support, and making nuanced therapeutic decisions based on a comprehensive grasp of the patient's situation [46-50].

Navigating the Ethical Maze: The increasing utilisation of AI in healthcare raises ethical challenges that necessitate meticulous deliberation. These considerations include:

1. Ensuring the confidentiality and privacy of patient data is of utmost importance in AI, since it primarily relies on this data for training and operation. Strong data governance structures are necessary to avoid unauthorised access to and misuse of sensitive medical information.

2. Algorithmic bias: The effectiveness of AI algorithms is directly dependent on the quality of the data they are trained on. Biases inherent in the training data can result in biased outputs produced by the AI system. Ensuring diversity and inclusion in healthcare datasets is essential to mitigating the potential bias in AI-driven choices.

2. AI DETECTIVES: UNVEILING DISEASES AND PREDICTING RISKS

A. AI in Diagnostics:

The narrative of human existence is intricately woven with the relentless pursuit of health. From the prehistoric utilization of medicinal plants to the contemporary miracles of robotic surgery and gene therapy, humanity has persevered in its fight against illness. However, the traditional healthcare landscape, despite these advancements, is not without its shortcomings [51].

2.1 The Pillars and the Paradoxes: A Look at Traditional Healthcare

The bedrock of traditional healthcare rests on the foundation of the doctor-patient relationship. A skilled physician, wielding a scalpel of knowledge and experience, diagnoses illnesses and prescribes treatments. However, this system is not without its limitations. Firstly, human expertise, while invaluable, has inherent limitations. Doctors contend with fatigue, cognitive biases, and access constraints to the ever-expanding ocean of medical data. Traditional diagnostics often rely on subjective interpretations of tests and scans, leading to potential inaccuracies. Furthermore, healthcare delivery systems grapple with the rising tide of patient populations and escalating costs, straining under the weight of these demands [52-60].

Table 1. This table provides a brief overview. AI applications in healthcare are constantly evolving and expanding.

Area of Impact	Description	Example
Diagnostics	Artificial intelligence algorithms possess the capability to meticulously examine medical pictures such as X-rays and MRIs, exhibiting a remarkable level of precision in identifying diseases such as cancer in their early stages.	An AI system can analyse mammograms to identify suspicious lesions, flagging for further examination by a radiologist.
Treatment	AI can assist surgeons with robotic-assisted minimally invasive procedures, improving precision and reducing recovery time.	A surgeon can use a robotic arm guided by AI to perform a complex laparoscopic surgery.
Drug Development	AI can analyse vast datasets to identify potential drug targets and accelerate the process of drug discovery.	A pharmaceutical company uses AI to analyse genetic data and protein structures to find new drug candidates.
Personalized Medicine	AI can analyse a patient's medical history, genetics, and lifestyle to recommend personalized treatment plans.	A patient with a chronic illness receives an AI-generated plan that tailors medication and lifestyle changes to their specific needs.
Patient Management	AI-powered chatbots can answer patient questions, schedule appointments, and monitor vitals remotely.	A patient uses a chatbot to track their blood pressure readings and receive medication reminders.
Administrative Tasks	AI can automate administrative tasks like insurance claim processing and appointment scheduling, freeing up healthcare workers' time.	A hospital uses AI to automate insurance claim reviews, reducing processing time and costs.

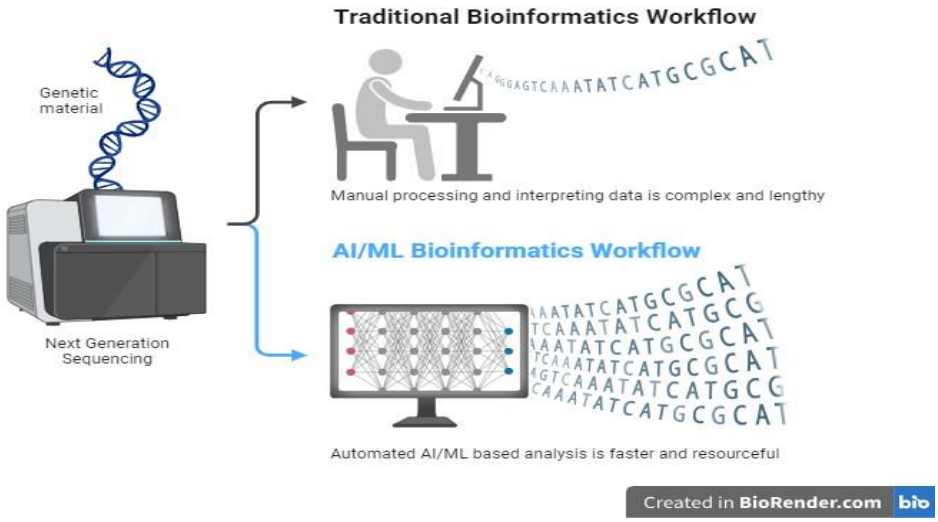

Fig. 2. Rise of artificial intelligence

2.2 The Rise of Artificial Intelligence (Ai): A Paradigm Shift in Healthcare

Against this backdrop of limitations, Artificial Intelligence (AI) emerges as a transformative force with the potential to revolutionize healthcare. AI encompasses the ability of machines to mimic human cognitive functions, such as learning from data and making informed decisions. When applied to healthcare, AI offers a revolutionary potential to augment and amplify human capabilities [61-65].

2.3 AI in Diagnostics: Unveiling Diseases with Machine Eyes

2.3.1 Real-time diagnostic support with AI assistants

Despite notable progress in the realm of health, accurately identifying diseases remains a significant challenge worldwide. Given the complex nature of illnesses' causes and symptoms, the ongoing challenge lies in developing advanced diagnostic tools for early detection. Artificial intelligence (AI) has the potential to profoundly transform various sectors in the healthcare industry, including the field of medical diagnostics. Machine learning is a crucial element of artificial intelligence that uses data as a valuable resource. The effectiveness of machine learning models depends greatly on the quantity and quality of the input data. This technique can effectively address problems and complexities in various fields, including diagnostics. In summary, machine learning enables decision-making, streamlines workflow, and automates activities in a highly efficient and cost-effective manner. In addition, deep learning incorporates layers that employ convolutional neural networks (CNN) and data mining techniques to identify data patterns. These have significant practical usefulness in identifying important patterns for identifying illnesses within large datasets. These technologies are critical in healthcare systems for diagnosing, forecasting, or classifying diseases. The topic of medical diagnosis using artificial intelligence is currently in its nascent stages. Furthermore, there is a growing body of evidence that supports the use of artificial intelligence (AI) in the detection of various diseases, including cancer. A sophisticated artificial intelligence (AI) system used a vast collection of mammograms in a recent UK study to accurately diagnose cases of breast cancer. This study found that including an artificial intelligence (AI) system for analysing mammograms led to a significant reduction in both false positives and false negatives, with decreases of 5.7% and 9.4%, respectively. South Korea conducted a comparative study to evaluate the accuracy of artificial intelligence (AI) versus radiologists in identifying breast cancer. Artificial intelligence (AI) has demonstrated more sensitivity in detecting breast cancer masses compared to radiologists, with a success rate of 90% compared to 78% for the latter. In addition, the AI demonstrated higher precision in detecting early-stage breast cancer, with a success rate of 91%, whereas radiologists had a lower accuracy rate of 74%. Moreover, a study emphasised the effectiveness of deep learning in detecting skin

cancer. The results indicated that an AI system based on convolutional neural networks (CNN) accomplished accurate diagnosis of melanoma cases and provided excellent treatment recommendations, outperforming dermatologists. Researchers have used artificial intelligence (AI) technology to investigate various medical conditions, such as diabetic retinopathy and abnormalities in EKG readings, as well as forecast the risk factors associated with cardiovascular diseases. Furthermore, researchers have employed deep learning algorithms to identify pneumonia in chest radiography, achieving a sensitivity of 96% and a specificity of 64%. This exceeds the performance of radiologists, who achieved a sensitivity of 50% and a specificity of 73%. A recent study used a dataset of 625 cases to examine the prompt identification of acute appendicitis and the forecasting of the need for appendix surgery using various machine learning algorithms. The findings demonstrated that the random forest algorithm outperformed previous methods, accurately predicting appendicitis in 83.75% of cases. The algorithm demonstrated accuracy, sensitivity, and specificity of 84.11%, 81.08%, and 81.01%, respectively. The enhanced methodology facilitates healthcare providers in making informed assessments on the diagnosis and treatment of appendicitis. Furthermore, the authors suggest utilising the same approaches to analyse photographs of patients with appendicitis or to detect infections such as COVID-19 using blood samples or images. AI solutions offer significant advantages over traditional diagnostic methods, including improved accuracy, cost reduction, and time efficiency. Moreover, AI has the ability to decrease the frequency of human mistakes and generate highly precise outcomes in a shorter period of time. In the future, medical professionals may employ artificial intelligence (AI) technology to perform immediate assessments and obtain vital information. Scientists are presently investigating the potential applications of artificial intelligence (AI) in the realm of medical diagnosis and treatment. This involves the analysis of various medical images, such as X-rays, CT scans, and MRIs. Artificial intelligence (AI) can assist in identifying anomalies, fractures, tumours, and other medical conditions by utilising machine learning (ML) methods. Moreover, it possesses the ability to provide precise quantitative measurements, leading to faster and more precise medical diagnoses. Clinical laboratory testing is essential for obtaining critical data to diagnose, treat, and monitor diseases. Contemporary healthcare largely depends on this element, as it continually integrates cutting-edge technology to enhance the process of making clinical judgements and ensuring patient safety. Artificial intelligence (AI) has the potential to revolutionize clinical laboratory testing by enhancing the accuracy, speed, and efficiency of laboratory procedures. Clinical microbiology is experiencing significant advancement and growth. We have created several machine learning algorithms to identify, acknowledge, and measure microorganisms, diagnose and categorise illnesses, and forecast clinical results. To generate AI diagnoses, ML systems use data from a variety of sources, such as genomic data of microorganisms, gene sequencing, metagenomics sequencing results of the original specimen, and microscopic imaging. Furthermore, the use of deep convolutional neural networks has been critical in precisely classifying gram positive or negative stains, as well as differentiating between cocci and rods. This technique has demonstrated a notable degree of sensitivity and specificity. Scientists have extensively analysed numerous machine learning algorithms to identify microorganisms and determine their antibiotic susceptibility. However, before using these models in clinical settings, it is crucial to recognise and correct their specific limitations. Using machine learning algorithms and digital in-line holographic microscopy (DIHM), researchers were able to find red blood cells that were infected with malaria without having to label them. This AI technology showcases its ability to diagnose malaria quickly, accurately, and at a low cost. Utilising artificial intelligence in clinical laboratories offers numerous benefits, such as enhanced efficiency and precision. Laboratories worldwide have widely embraced automated approaches for blood cultures, susceptibility testing, and molecular platforms, leading to a substantial improvement in laboratory efficiency. The integration of automation and artificial intelligence (AI) has greatly enhanced the effectiveness of laboratory procedures in various fields, such as blood cultures, susceptibility testing, and molecular platforms. This expedites a prompt and conclusive response during the initial 24 to 48 hours, streamlining the choice of an appropriate antibiotic therapy for patients who have tested positive in their blood cultures. Applying artificial intelligence in clinical microbiology labs can expedite the eradication of many infectious diseases by aiding in the selection of the most effective antibiotic treatment regimens. The field of medical machine learning has undergone significant

growth, offering significant prospects for aiding healthcare providers in the emergency department (ED), who are facing multiple challenges. These challenges include an increasing incidence of diseases, a greater demand for time and health services, higher societal expectations, and rising health expenses. Emergency department providers recognise the importance of incorporating artificial intelligence (AI) into their work processes to address these difficulties, as it can improve efficiency and accuracy, ultimately resulting in improved patient outcomes. Moreover, there is potential for algorithmic support and automated decision-making to enhance the efficiency of monitoring patient flow in the emergency department and distributing resources [30]. AI algorithms have the capability to analyse patient data and provide crucial assistance in classifying patients according to their level of urgency. This enables patients with a higher level of risk to be prioritized, resulting in shorter waiting times and improved patient flow. Introducing a dependable symptom assessment tool can help exclude other possible causes of illness, thus reducing the number of unnecessary trips to the emergency department. AI-enabled gadgets ask patients directly and then provide a comprehensive explanation to ensure accurate evaluation and strategic planning. Moreover, AI-powered decision support systems can offer healthcare providers prompt advice to assist in diagnosing and selecting treatments. Upon patients' arrival at the Emergency Department (ED), physicians often have the task of making crucial judgements with limited information and assessing the likelihood linked to risk stratification [66-70]. Accurate clinical data interpretation is essential in the emergency room to accurately assess the severity of the ailment and determine the need for intervention. Erroneously diagnosing patients poses a significant challenge for medical personnel and healthcare systems, with the potential for grave consequences. Errors in the diagnosis of medical

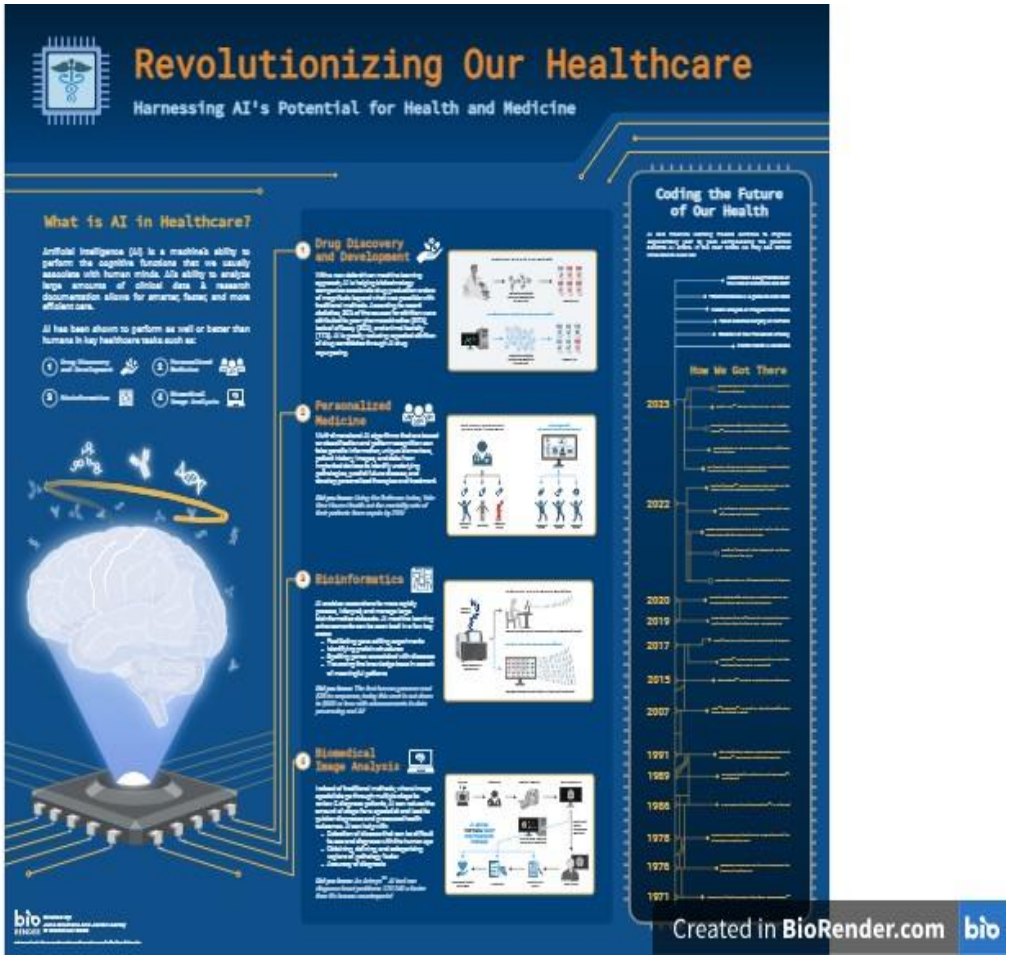

Fig. 3. Revolutionizing the healthcare

disorders within the healthcare industry can have serious consequences, such as imposing major financial costs and adversely affecting patients' well-being. Research has shown that diagnostic errors, especially for patients in need of immediate medical care, directly lead to higher mortality rates and longer hospital stays. AI can effectively aid in the early identification of serious diseases and promptly alert medical staff, guaranteeing that patients receive prompt medical care. Artificial intelligence has the ability to enhance healthcare resources in the emergency department by accurately predicting patient demand, optimising treatment options, and providing recommendations for the length of hospital stays. Through the examination of individual patient data, artificial intelligence (AI) systems can offer valuable insights into the identification of the most effective treatment, leading to enhanced efficiency and a reduction in overcrowding [71,72].

B. Predicting the Unseen: Disease Risk Assessment

2.4 Predicting the Unseen: Disease Risk Assessment with AI

The human body is a complex ecosystem, and the seeds of illness can often be sown silently, long before symptoms manifest. Traditionally, disease detection relied on reactive measures - waiting for symptoms to appear before taking action. However, Artificial Intelligence (AI) is ushering in a new era of proactive healthcare, with the potential to predict disease risk with remarkable accuracy. This allows for early intervention, prevention, and ultimately, a healthier future for individuals and populations alike [73].

2.5 Demystifying the Data: How AI Analyses Vast Datasets

AI in disease risk assessment works by harnessing the power of big data. Imagine vast repositories of medical records, genetic data, lifestyle information, and environmental factors - a sea of information that holds the key to unlocking individual disease susceptibility. AI algorithms, trained on these massive datasets, are able to identify complex patterns and correlations that might escape the human eye [74-78].

Here's a deeper dive into the process:

1. **Data Acquisition and Integration:** The first step involves collecting and integrating data from various sources. This can include electronic health records (EHRs), genomic data, wearable sensor data, and even social determinants of health like socioeconomic status and environmental factors [79].
2. **Data Pre-processing and Cleaning:** Real-world data is often messy and incomplete. AI algorithms require clean and structured data for optimal performance. This stage involves cleaning inconsistencies, handling missing values, and ensuring the data is formatted for analysis [80].
3. **Feature Engineering:** Not all data is equally important for disease risk prediction. AI techniques like feature engineering are used to identify the most relevant features (e.g., blood pressure readings, genetic variations) that contribute to disease risk [81].
4. **Model Training and Validation:** AI algorithms are then trained on the prepared data. This involves feeding the data into various machine learning models, such as logistic regression or deep learning models. As the models learn from the data, they develop the ability to identify patterns and relationships between specific features and disease risk [82-84].
5. **Risk Prediction and Interpretation:** Self learning AI models can then be used to predict the likelihood of an individual developing a particular disease. This risk score can be tailored to a specific person based on their unique data profile.

However, it's crucial to interpret the risk score correctly. A high risk score doesn't guarantee someone will develop the disease; it simply signifies an increased susceptibility. This information empowers the individual and their healthcare provider to take preventive measures and personalize treatment plans.

3. THE DAWN OF PERSONALIZED MEDICINE: AI AND PREVENTIVE HEALTHCARE

The ability to predict disease risk paves the way for a paradigm shift in healthcare – personalized medicine. Traditionally, a "one-size-fits-all" approach dominated healthcare, but AI empowers us to move beyond this. Here's how

AI personalizes medicine and preventive healthcare:

1. **Stratified Risk Assessment:** AI can categorize individuals into different risk groups based on their predicted risk score. This allows doctors to prioritize interventions for high-risk individuals, focusing resources on those who need them most [85].
2. **Tailored Preventive Measures:** Knowing a person's disease susceptibility allows for the development of personalized preventive measures. For example, someone with a high risk of heart disease might receive a personalized plan that includes dietary changes, exercise recommendations, and medication regimens [86].
3. **Early Intervention and Disease Management:** Early detection is key to successful disease management. AI-based risk prediction can help identify individuals at risk for developing chronic diseases like diabetes or hypertension. Early intervention, such as lifestyle modifications or preventative medications, can significantly improve outcomes and potentially delay or even prevent the onset of these diseases [87].
4. **Genomic Insights and Precision Medicine:** AI can analyse an individual's genetic data to identify variations that might predispose them to specific diseases. This allows for even more personalized medicine, where treatment plans are tailored not just to current health status but also to an individual's unique genetic makeup [89].

3.1 Real-World Examples: AI in Action

AI advancements in disease risk assessment are no longer confined to the realm of theoretical possibilities. Here are some real-world examples of AI successfully predicting various diseases:

1. **Cardiovascular Disease Prediction:** Studies have shown AI algorithms analysing blood pressure readings, cholesterol levels, and genetic data to predict heart disease risk with remarkable accuracy. This allows doctors to identify individuals who might benefit from preventive measures like cholesterol-lowering medications or lifestyle changes.
2. **Diabetes Risk Assessment:** AI models are being developed that analyse blood sugar levels, family history, and lifestyle factors to predict the risk of developing type 2 diabetes. Early detection allows for lifestyle modifications and potentially even preventative medications to delay or prevent the onset of this chronic disease.
3. **Cancer Risk Prediction:** AI is aiding in the analysis of vast datasets of medical images and genetic data to identify individuals at risk for developing various cancers. This can be particularly beneficial for cancers

4. AI-DRIVEN TREATMENT: FROM DIAGNOSIS TO PERSONALIZED PLANS

A. Beyond Diagnosis: AI-powered Treatment Planning

The traditional healthcare landscape often follows a reactive approach to treatment. Once a diagnosis is confirmed, the physician devises a treatment plan based on their knowledge, experience, and available guidelines. However, this approach has limitations. Individual genetic variations, past medical history, and response to medications can all influence treatment success. Artificial Intelligence (AI) is revolutionizing healthcare by offering a data-driven and personalized approach to treatment planning [90].

4.1 Harnessing the Power of Data: AI's Role in Treatment Recommendations

Imagine a physician armed not just with experience but also with the collective wisdom of countless medical studies, real-world patient data, and the latest scientific discoveries. This is the potential of AI in treatment planning. Here's a breakdown of how AI analyses data to suggest optimal treatments:

1. **Data Aggregation and Integration:** AI algorithms require vast amounts of data to learn and make accurate predictions. This data can come from diverse sources, including electronic health records (EHRs), clinical trial data, medical journals, and even genomic information.
2. **Data Cleaning and Pre-processing:** Real-world data is often messy and inconsistent. AI techniques

cleanse the data by identifying and correcting errors, handling missing values, and ensuring it's formatted for analysis.

3. **Feature Engineering and Selection:** Not all data points are equally relevant for treatment recommendations. AI algorithms, through feature engineering, identify the most valuable features (e.g., medication response data, genetic variations, disease stage) that influence treatment outcomes.
4. **Machine Learning for Treatment Prediction:** AI utilizes various machine learning algorithms, such as support vector machines or random forests, to analyze the prepared data. These algorithms learn from past treatment successes and failures, identifying patterns and relationships between specific patient characteristics and optimal treatment responses.
5. **Generating Personalized Treatment Options:** Once trained, the AI models can then analyze an individual patient's data profile and suggest the most promising treatment options based on their unique medical history, genetic makeup, and response to past medications.

4.2 Tailoring Treatment to the Individual: The Power of Personalized Medicine

The ability to analyze vast datasets allows AI to move beyond the one-size-fits-all approach to treatment. Here's how AI personalizes treatment plans for optimal patient outcomes:

1. **Stratified Medicine and Risk-Based Treatment:** AI can categorize patients into different risk groups based on their medical history, disease stage, and other factors. This allows doctors to tailor treatment intensity to individual needs. For example, a patient with a high risk of treatment side effects could be offered a less aggressive approach, while a patient with an aggressive disease might benefit from a more intensive treatment regimen [91].
2. **Genomic Insights and Precision Oncology:** Cancer treatment is becoming increasingly personalized thanks to AI. By analysing a patient's tumour's genetic makeup, AI can identify specific mutations that drive cancer growth. This allows doctors to select targeted therapies that attack these mutations, leading to more effective treatment and potentially fewer side effects [92].
3. **Predicting Treatment Response:** AI can analyse data on how patients from similar demographics and medical backgrounds responded to specific treatments. This allows doctors to predict an individual patient's potential response to different treatment options, enabling them to choose the most likely to be successful [93].
4. **Real-Time Monitoring and Treatment Optimization:** AI-powered wearable devices and sensors are paving the way for real-time patient monitoring. This data can be analysed by AI to track a patient's response to treatment and identify any emerging issues early on. Based on this information, doctors can adjust the treatment plan in real-time, optimizing care for the patient [94].

4.3 Surgical Precision and Minimally Invasive Interventions: AI-Assisted Surgery

AI isn't just transforming treatment planning; it's also revolutionizing the surgical landscape with AI-assisted surgery systems. These systems offer surgeons several advantages:

1. **Enhanced Dexterity and Precision:** Robotic surgical arms, guided by AI algorithms, offer surgeons enhanced dexterity and precision, allowing them to perform complex procedures with minimal tremors or human error. This can lead to smaller incisions, faster recovery times, and reduced complications for patients.
2. **Real-Time Guidance and Visualization:** AI systems can analyse medical images (CT scans, MRIs) and provide surgeons with real-time 3D visualizations of the surgical site. This allows for better pre-operative planning and intra-operative guidance, ensuring surgeons have a clear view of the anatomy and critical structures.
3. **Automated Tasks and Reduced Risks:** AI can automate some repetitive tasks during surgery, such as holding instruments or suturing. This frees up the surgeon's focus and reduces the risk of human error.

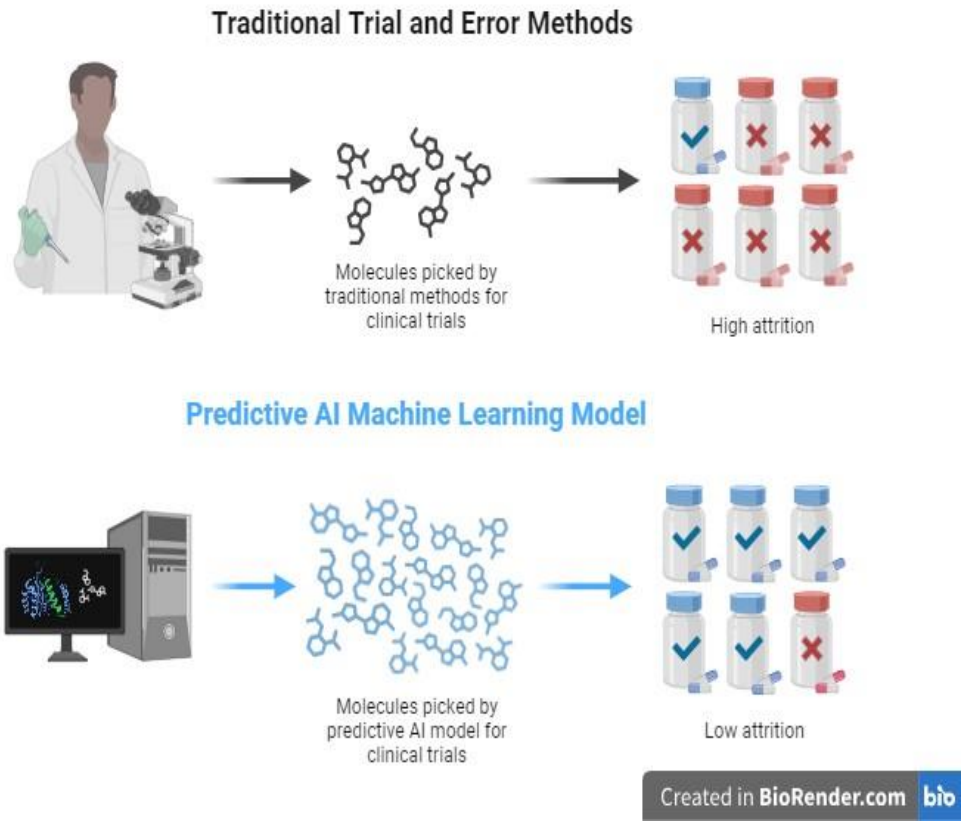

Fig. 4. Traditional trial and error methods

Table 2. Personalized medicine with AI

Aspect	Description	Recent Updates (as of May 2024)
Goal	Move beyond "one-size-fits-all" medicine to treatments and prevention plans tailored to individual patients.	Increased focus on using AI to analyse not just genetic data, but also lifestyle factors, environmental influences, and social determinants of health for a more holistic approach.
AI's Role	Analyse vast amounts of complex medical data (genomics, electronic health records, wearable sensor data) to identify patterns and predict disease risks, treatment effectiveness, and potential side effects.	Developments in AI, such as natural language processing, are being used to analyse unstructured data in medical records, leading to a more comprehensive understanding of patients.
Benefits	Early disease detection - More effective treatments with fewer side effects - Improved preventive care strategies	- Clinical trials are underway using AI to design personalized cancer therapies based on a patient's specific tumour mutations.
Challenges	Data privacy and security concerns - Algorithmic bias - Ensuring equitable access to precision medicine	- Researchers are actively developing methods to mitigate bias in AI algorithms used in healthcare.

4.4 Examples Highlighting the Power of AI-Driven Treatment

The potential of AI-driven treatment isn't just theoretical. Here are some real-world examples of AI making a difference in patient care:

B. The Power of Precision: Personalized Medicine with AI

For millennia, healthcare has sought a universal answer to illness – a single cure that vanquishes disease. However, the human body is a symphony of intricate variations, and a "one-size-fits-all" approach often falls short. Personalized medicine, with its focus on tailoring treatments to an individual's unique biology, holds immense promise. Artificial Intelligence (AI) is emerging as a powerful tool for unlocking the potential of personalized medicine, ushering in an era of precision healthcare [95].

4.5 The Promise of Personalized Medicine: Tailoring Treatments to Your Genes

Traditional medicine often relies on standardized protocols based on population averages. However, individual variations in genetic makeup, lifestyle factors, and environmental exposures significantly influence how a person reacts to disease and treatment. Personalized medicine seeks to bridge this gap by considering these unique characteristics to design treatments with optimal efficacy and minimal side effects [96].

4.6 AI as the Decoder Ring: Unlocking the Secrets of Your Genome

The human genome, with its billions of base pairs, holds the blueprint for health and disease susceptibility. AI acts as a powerful decoder ring, helping us understand the intricate language of our genes. Here's how AI empowers personalized medicine through genetic analysis:

1. **Genome Sequencing and Analysis:** Advances in technology have made genome sequencing, the process of determining an individual's complete genetic makeup, more accessible. However, analysing this vast amount of data requires sophisticated tools. AI algorithms can sift through the genome, identifying specific variations (mutations) associated with increased risk for certain diseases [97].
2. **Predicting Disease Susceptibility:** By analysing an individual's genetic makeup and comparing it to vast databases of genetic associations with diseases, AI can predict their susceptibility to specific illnesses. This allows for early intervention and preventive measures before symptoms even manifest [98].
3. **Identifying Drug Targets:** Genetic variations can influence how an individual metabolizes medications, leading to varying levels of effectiveness and potential side effects. AI can analyse a patient's genome to identify variations that affect drug metabolism and predict their response to different medications [99].
4. **Unlocking the Potential of Pharmacogenomics:** Pharmacogenomics is the study of how genes influence an individual's response to medications. AI can revolutionize this field by analysing vast datasets of patient responses and genetic information. This can lead to the development of personalized drug regimens with improved efficacy and reduced side effects [100].

5. EXAMPLES: AI IN ACTION – UNLOCKING PERSONALIZED MEDICINE

The potential of AI in personalized medicine isn't just theoretical. Here are some real-world examples of AI making a difference:

1. **Cancer Treatment with Genomic Insights:** Cancer is not a single disease; it's a diverse group of illnesses driven by specific genetic mutations. AI can analyse a patient's tumour's genetic makeup to identify the driver mutations. This allows doctors to select targeted therapies that attack these mutations, leading to more effective treatment for various cancers.
2. **Cardiovascular Disease Risk Assessment:** AI can analyse an individual's genome to identify variations associated with an increased risk of heart disease. This allows for early intervention with lifestyle modifications or preventive medications before the disease progresses.
3. **Optimizing Mental Health Treatment:** Mental health conditions like depression and schizophrenia have a complex genetic component. AI can

analyse a patient's genetic makeup to identify variations that might influence their response to specific medications, allowing doctors to personalize treatment plans for better outcomes.

5.1 The Future of AI-Driven Drug Recommendations: Beyond Genetics

While genetics plays a crucial role in personalized medicine, it's not the only factor. AI is poised to further refine treatment recommendations by considering a broader range of variables:

1. **Individual Response and Risk Factors:** AI can analyse vast datasets of patient responses to different medications, incorporating factors like age, gender, and past medical history. This allows for continuously evolving drug recommendations based on an individual's unique response profile and potential risk factors for side effects.
2. **Real-Time Monitoring and Treatment Adjustment:** The integration of AI-powered wearable devices and sensors is paving the way for real-time patient monitoring. This data can be analysed by AI to track a patient's response to treatment and identify any emerging issues early on. Based on this information, doctors can adjust the medication dosage or switch therapies in real-time, optimizing treatment for the patient.
3. **AI-Powered Clinical Trial Design:** The traditional approach to clinical trials often involves a "one-size-fits-all" design. AI can analyse patient data to identify individuals with specific genetic profiles and tailor clinical trials to test the efficacy of drugs for these subgroups. This can lead to faster development of targeted treatments for specific patient populations.

6. AI IN THE WHITE COAT: TRANSFORMING PATIENT CARE AND MANAGEMENT

A. AI-powered Patient Care Assistants

The healthcare landscape is undergoing a paradigm shift, driven by the transformative power of Artificial Intelligence (AI). While AI's applications in diagnostics, drug discovery, and personalized medicine have garnered significant attention, another crucial area witnessing its impact is patient care. AI-powered patient care assistants, in the form of chatbots and virtual assistants, are emerging as a game-changer, offering patients 24/7 access to support, education, and information [101]. Traditional healthcare delivery models often face challenges in providing comprehensive and accessible

Table 3. Patient care assistants

Aspect	Description	Recent Updates (as of May 2024)
Function	Virtual assistants using AI and machine learning to support patients with various tasks.	New capabilities are emerging, such as medication adherence monitoring, appointment scheduling with integrated reminders, and mental health chatbots offering emotional support.
Benefits	- Improved patient engagement and education - Enhanced care coordination and chronic disease management - Increased access to healthcare services, especially in remote areas	- AI assistants are being piloted to support post-surgical recovery at home, reducing hospital readmission rates.
AI Techniques	- Natural Language Processing (NLP) for understanding patient queries and requests. - Machine learning for tailoring recommendations and health information based on individual needs.	- Integration with wearable devices is allowing AI assistants to collect real-time health data and provide biofeedback to patients.
Considerations	- Data privacy and security - Limited ability to handle complex medical emergencies - The need for human oversight and patient-provider interaction	- Regulations are being implemented to ensure the accuracy and transparency of AI-powered healthcare advice.

patient care. Long wait times for appointments, limited access to healthcare professionals, and a lack of readily available health information can leave patients feeling frustrated and uninformed. Furthermore, the growing burden of chronic illnesses and an aging population place immense strain on healthcare systems globally. AI-powered patient care assistants offer a promising solution, addressing these challenges and creating new opportunities for improved patient engagement and well-being [102]. AI-powered patient care assistants, often taking the form of chatbots or virtual assistants, are intelligent software programs designed to simulate conversation and provide various healthcare-related services. These assistants leverage a combination of natural language processing (NLP), machine learning, and healthcare knowledge bases to interact with patients in a user-friendly and informative manner. Natural Language Processing (NLP) forms the bedrock of AI-powered assistants' ability to interact effectively with patients. NLP allows the assistant to understand the intent behind a patient's query, even if it's phrased in an informal or ambiguous way. This understanding enables the assistant to provide accurate and relevant responses, fostering trust and building rapport with the patient. Machine learning algorithms empower AI assistants to learn and improve over time. By analyzing vast amounts of patient data, including past interactions, search queries, and healthcare knowledge bases, these algorithms enable the assistant to refine its responses, becoming more accurate and helpful with each interaction.

6.1 A Wealth of Knowledge at Your Fingertips: Healthcare Knowledge Bases

AI-powered patient care assistants are equipped with comprehensive healthcare knowledge bases. These databases encompass a vast array of medical information, including symptom descriptions, disease management strategies, medication details, and healthy lifestyle recommendations. By accessing this knowledge base, the assistant can answer patient queries accurately and provide evidence-based information [103].

6.2 Transforming Patient Care: The Diverse Applications of AI Assistants

AI-powered patient care assistants offer a range of functionalities that enhance the patient experience and empower individuals to take charge of their health:

1. **Answering Patient Queries:** Patients can utilize AI assistants to find answers to a wide spectrum of healthcare-related questions. From understanding symptoms to seeking information about specific treatments, the assistant can provide readily available knowledge, reducing reliance on lengthy internet searches or waiting for doctor consultations.
2. **24/7 Availability:** Unlike human healthcare professionals, AI assistants operate 24/7, offering patients access to information and support whenever needed. This is particularly beneficial for managing chronic conditions, offering reassurance and guidance outside of regular clinic hours.
3. **Simplifying Appointment Scheduling:** AI assistants can streamline the appointment scheduling process. Patients can utilize the assistant to view available slots with their physician or other healthcare providers, schedule appointments based on their convenience, and receive confirmation reminders.
4. **Medication Reminders and Management:** AI assistants can act as virtual pillboxes, reminding patients to take their medication at the prescribed times and dosages. This can be particularly helpful for individuals managing multiple medications or those prone to forgetting medication schedules.
5. **Promoting Preventive Care:** AI assistants can encourage preventive care by reminding patients about upcoming screenings, vaccinations, and other preventive health measures. Additionally, they can provide educational content on healthy lifestyle practices and disease prevention strategies.
6. **Post-Discharge Support:** AI assistants can play a crucial role in supporting patients following hospital discharge. The assistant can provide reminders for post-surgical care instructions, medication adherence, and follow-up appointments, ensuring a smooth transition back home.
7. **Mental Health Support:** AI assistants can offer basic mental health support by providing educational resources, self-help strategies, and facilitating connections to mental health professionals. These assistants cannot replace therapy, but they

can offer a readily accessible first point of contact for individuals seeking mental health information and support.

6.3 Latest Advancements and Emerging Trends in AI-Powered Patient Care Assistants

The field of AI-powered patient care assistants is rapidly evolving, with new features and functionalities constantly emerging. Here's a glimpse into some of the latest advancements and trending applications:

6.3.1 Integration with wearable devices

AI assistants are increasingly being integrated

B. Remote Monitoring and AI-driven Intervention:

The healthcare landscape is undergoing a metamorphosis, driven by the transformative power of technology. One of the most promising advancements is the integration of Artificial Intelligence (AI) with remote patient monitoring (RPM). This potent combination empowers healthcare professionals to keep a watchful eye on patients remotely, fostering proactive healthcare and timely interventions to prevent complications and improve health outcomes [104]. Traditional healthcare models often rely on a reactive approach – waiting for symptoms to manifest before taking action. This reactive approach can have limitations. By the time symptoms become apparent, the underlying disease may have already progressed, leading to potentially avoidable complications. Remote patient monitoring (RPM) with AI-driven intervention offers a paradigm shift towards proactive healthcare [105]. RPM utilizes technology to collect patient health data outside of traditional clinical settings. Patients wear various sensors and devices that capture vital signs, physiological data, and other health metrics. This data is then transmitted wirelessly to a secure platform, enabling healthcare providers to remotely monitor a patient's health status and identify any concerning trends.

6.4 The Power of AI in Wearable Sensors and Remote Patient Monitoring

AI plays a pivotal role in unlocking the full potential of RPM by analysing the vast amount of data collected through wearable sensors. Here's how AI is revolutionizing remote patient monitoring:

1. **Data Cleaning and Pre-processing:** Raw data from wearable sensors can be noisy and incomplete. AI algorithms can clean and pre-process the data by identifying and correcting errors, handling missing values, and ensuring it's formatted for optimal analysis.
2. **Feature Engineering and Selection:** Not all data points are equally relevant in identifying health changes. AI techniques like feature engineering help identify the most critical features (e.g., heart rate variability, blood pressure readings, sleep patterns) that signal potential health deterioration.
3. **Machine Learning for Anomaly Detection:** AI leverages machine learning algorithms, such as anomaly detection algorithms, to analyse the data and identify deviations from a patient's baseline health parameters. These deviations could indicate an impending health issue or worsening of an existing condition.
4. **Predictive Analytics for Early Intervention:** AI can go beyond simply detecting anomalies. Advanced algorithms can analyse historical data, patient demographics, and medical history to predict the likelihood of future health problems. This allows for early intervention and preventive measures before a condition worsens.

7. AI ASSISTANCE IN TREATMENT

Personalised therapy, also known as precision medicine or customised medicine, is a method that tailors medical care to individual patients, taking into account their unique attributes such as genetics, environment, lifestyle, and biomarkers. By providing targeted interventions that have proven to be more effective, efficient, and safe, this tailored strategy aims to improve patient outcomes. Artificial intelligence (AI) has become an indispensable tool in the development of tailored treatments. It possesses the capacity to assess complex datasets, forecast outcomes, and optimise treatment options. Personalized treatment is a cutting-edge area that demonstrates the immense possibilities of precision medicine. However, the ability to provide real-time suggestions relies on the advancement of machine learning algorithms that can forecast which patients may require specific

treatments based on their genomic data. Prior knowledge of individuals' genetic composition is essential for tailoring treatments and dosages. Many have extensively recognised AI's potential applications in assisting doctors with treatment decisions, particularly in predicting therapy responses. Huang et al. performed a study in which they utilised patients' gene expression data to create a machine learning model. This model accurately predicted the outcome of chemotherapy treatment [106]. In this work, the scientists examined the gene-expression patterns of 175 cancer patients in order to ascertain their response to several standard-of-care chemotherapies. The research produced remarkable outcomes, with a prediction accuracy of over 80% for several medicines. These findings emphasise the capacity of artificial intelligence (AI) to forecast treatment responses. Sheu et al. conducted an independent investigation in which they used the electronic health records (EHR) of 17,556 patients and artificial intelligence (AI) to forecast the response to different categories of antidepressants. Our AI models carefully examined the critical features necessary for predicting treatment selection, minimizing any possible aspects that could cause confusion or bias. The results exhibited exceptional predictive capability. The study demonstrated the accuracy of forecasting the effectiveness of antidepressant treatment using real-world electronic health record (EHR) data and artificial intelligence (AI) modelling. This suggests the potential for developing clinical decision support systems to enhance the process of choosing appropriate treatments. Although there has been notable progress in using AI algorithms and genomes to forecast treatment results, it is still essential to carry out both prospective and retrospective clinical research and investigations. These efforts are critical in gathering the comprehensive data required to effectively train the algorithms, ensure their reliability in practical scenarios, and advance AI-powered clinical decision aids. Enhancing the dosage and assessing the efficacy of medicinal medications is a crucial aspect of this process. Artificial intelligence plays a crucial role in optimising medication dosages and predicting negative drug reactions, offering significant benefits in strengthening patient safety and improving treatment results [107]. Healthcare providers can use AI algorithms to improve medication dosages for individual patients and predict any potential drug side effects. As a result, there is a reduction in potential hazards and a general improvement in the quality of healthcare provided to patients. We undertook a research project to develop an artificial intelligence-driven prediction model for the prothrombin time international normalised ratio (PT/INR). The goal was to create a decision-assistance system that would optimise warfarin maintenance doses. After evaluating data from 19,719 inpatients across three institutions, the researchers discovered that the system outperformed professional physicians in accurately forecasting future PT/INRs. In addition, the algorithm produced a dependable, personalised warfarin dosage. Contrary to commonly held opinion, curate. The AI system is an advanced dose optimisation system that uses artificial intelligence to dynamically adjust chemotherapy doses in response to specific patient data. We performed an open-label, prospective trial on patients with advanced solid tumours who were receiving three distinct chemotherapy regimens in order to authenticate this method. By analysing the relationship between changes in chemotherapy dosage and tumour marker measurements, I calculated individualized doses for future treatment cycles. Implementing CURATE. The integration of AI into the clinical workflow has demonstrated significant success, showing the potential to decrease chemotherapy doses and enhance patient response rates and durations in comparison to the standard of care. These results make it clear how important it is to do randomised clinical trials to prove that AI can improve chemotherapy doses and lower the number of undesirable drug effects. Therapeutic drug monitoring (TDM) improves the administration of drugs to individual patients by adjusting the dosage. Primarily, we use it for medications with a limited therapeutic range to avoid both inadequate doses and hazardous conditions. Our goal is to ensure that patients receive the appropriate medication at the optimal time to achieve the desired therapeutic effect while minimising any possible side effects. Artificial intelligence (AI) has the potential to transform pharmaceutical monitoring and prescription in Total Drug Management (TMM). AI algorithms can effectively forecast an individual's response to a particular medicine by examining their genetic profile, medical history, and other relevant data. The personalised approach to medication therapy has the capacity to lead to more efficient treatments and enhanced patient outcomes. The use of machine learning algorithms to forecast drug-drug interactions is an example of artificial intelligence in therapeutic drug monitoring (TDM). These systems can discover potential drug interactions.

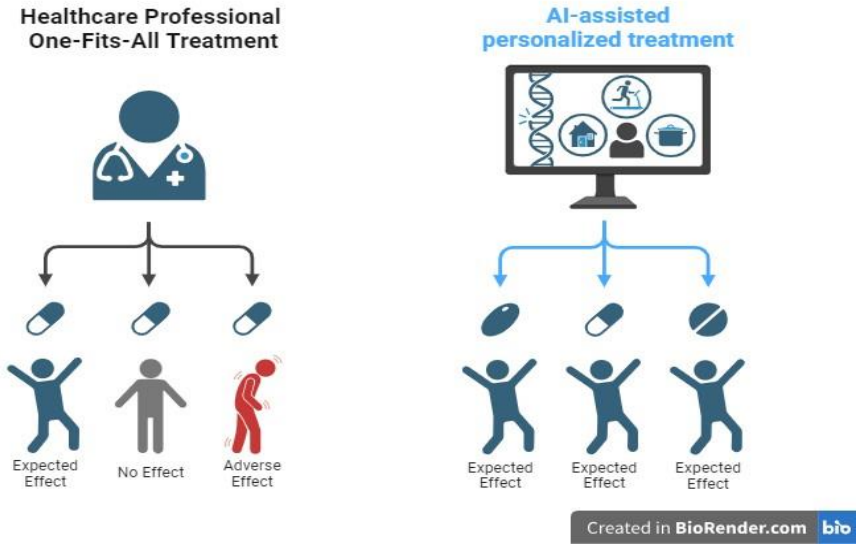

Fig. 5. AI assistance in treatment

This can aid in reducing the frequency of adverse drug responses, decreasing costs, and improving patient outcomes. Predictive analytics, a further implementation of artificial intelligence in therapeutic drug monitoring (TDM), assists in identifying patients who have a higher vulnerability to experiencing negative reactions to medications. By analysing patient data and identifying potential risk factors, healthcare providers can take proactive measures to prevent adverse occurrences before they occur. Overall, the use of AI in TDM has significant potential for improving patient outcomes, lowering healthcare costs, and increasing medication dosage accuracy and efficiency. As AI technology advances, we anticipate that it will have a greater impact on the field of TDM.

8. CONCLUSION: THE FUTURE OF AI IN HEALTHCARE

The healthcare landscape is undergoing a dramatic transformation fuelled by Artificial Intelligence (AI). AI is shifting the paradigm from reactive disease treatment to proactive prevention and personalized care. It tackles the limitations of the traditional model, such as delayed diagnoses, limited accessibility, and fragmented data, by offering a multitude of ground-breaking solutions. AI can analyse vast datasets to predict disease susceptibility, enabling early intervention and personalized screening. Remote consultations and AI-powered virtual assistants bridge geographical gaps in healthcare access. By gleaning valuable insights from patient data, AI empowers healthcare professionals to develop personalized treatment plans with optimal efficacy and fewer side effects. AI algorithms surpass human accuracy in analysing medical images, leading to earlier diagnoses and improved treatment planning. Remote patient monitoring with AI allows for continuous health data collection and early detection of potential issues. Additionally, AI automates administrative tasks, freeing up valuable time for healthcare professionals. Real-world examples showcase AI's potential, from AI-assisted cancer detection to AI-powered robotic surgery. While challenges like data privacy and security require careful attention, AI offers a future filled with immense potential to revolutionize healthcare delivery, improve accessibility and affordability, and ultimately create a healthier world for all.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Almutairi TH, Olatunji SO. The utilization of AI in healthcare to predict no-shows for dental appointments: A case study conducted in Saudi Arabia. Informatics in Medicine Unlocked. 2024;46:101472.
2. Baumgart DC. An intriguing vision for transatlantic collaborative health data use and artificial intelligence development. NPJ Digital Medicine. 2024;7(1):19.
3. Awosanya OD, Harris A, Creecy A, Qiao X, Toepp AJ, McCune T, OzanneMV. The utility of AI in writing a scientific review article on the impacts of COVID-19 on musculoskeletal health. Current Osteoporosis Reports; 2024.
4. Föllmer B, Williams MC, Dey D, Arbab-Zadeh A, Maurovich-Horvat P, Volleberg RH, Dewey M. Roadmap on the use of artificial intelligence for imaging of vulnerable atherosclerotic plaque in coronary arteries. Nature Reviews Cardiology. 2024;21(1):51-64.
5. Waisberg E, Ong J, Masalkhi M, Zaman N, Sarker P, Lee AG, Tavakkoli A. Google's AI chatbot "Bard": A side-by-side comparison with ChatGPT and its utilization in ophthalmology. Eye. 2024;38(4):642-645.
6. Ali R., Connolly ID, Tang OY, Mirza FN., Johnston B, Abdulrazeq HF, Doberstein CE. Bridging the literacy gap for surgical consents: An AI-human expert collaborative approach. NPJ Digital Medicine. 2024;7(1):63.
7. Chakraborty C, Bhattacharya M, Lee SS. Need an AI-enabled, next-generation, advanced ChatGPT or large language models (LLMs) for error-free and accurate medical information. Annals of Biomedical Engineering. 2024;52(2):134-135.
8. Beam K, Sharma P, Levy P, Beam AL. Artificial intelligence in the neonatal intensive care unit: The time is now. Journal of Perinatology. 2024;44 (1):131-135.
9. Coskun BN, Yagiz B, Ocakoglu G, Dalkilic E, Pehlivan Y. Assessing the accuracy and completeness of artificial intelligence language models in providing information on methotrexate use. Rheumatology International. 2024;44(3):509-515.
10. Cocci A, Pezzoli M, Lo Re M, Russo GI, Asmundo MG, Fode M, Durukan E. Quality of information and appropriateness of ChatGPT outputs for urology patients. Prostate Cancer and Prostatic Diseases. 2024;27(1):103-108.
11. Ferruz N, Zitnik M, Oudeyer PY, Hine E, Sengupta N, Shi Y, Stella F. Anniversary AI reflections. Nature Machine Intelligence. 2024;6(1):6-12.
12. Cacciamani, Giovanni E, et al. Artificial intelligence and urology: Ethical considerations for urologists and patients. Nature Reviews Urology. 2024;21(1):50-59.
13. Stade EC, Stirman SW, Ungar LH, Boland CL, Schwartz HA, Yaden DB, Eichstaedt JC. Large language models could change the future of behavioral healthcare: A proposal for responsible development and evaluation. NPJ Mental Health Research. 2024;3(1):12.
14. Wu J, Biswas D, Ryan M, Bernstein BS, Rizvi M, Fairhurst N, O' Gallagher K. Artificial intelligence methods for improved detection of undiagnosed heart failure with preserved ejection fraction. European Journal of Heart Failure. 2024;26(2):302-310.
15. Li J, Dada A, Puladi B, Kleesiek J, Egger J. Chat GPT in healthcare: A taxonomy and systematic review. Computer Methods and Programs in Biomedicine. 2024; 108013.
16. Kim C, Gadgil SU, De Grave AJ, Omiye JA, Cai ZR, Daneshjou R, Lee SI. Transparent medical image AI via an image–text foundation model grounded in medical literature. Nature Medicine. 2024; 1-12.
17. Alhosani K, Alhashmi SM. Opportunities, challenges, and benefits of AI innovation in government services: A review. Discover Artificial Intelligence. 2024;4(1):18.
18. Islam T, Sheakh MA, Tahosin MS, Hena MH, Akash S, Bin Jardan YA, Bourhia M. Predictive modeling for breast cancer classification in the context of Bangladeshi patients by use of machine learning approach with explainable AI. Scientific Reports. 2024;14(1):8487.
19. Durrah O, Aldhmour FM, El-Maghraby L, Chakir A. Artificial Intelligence Applications in Healthcare. In Engineering Applications of Artificial Intelligence . Cham: Springer Nature Switzerland. 2024;175-192.
20. Waisberg E, Ong J, Masalkhi M, Lee AG. Open AI's Sora in medicine: Revolutionary advances in generative artificial intelligence for healthcare. Irish Journal of Medical Science. 2024;(1971-):1-3.

21. Martindale AP, Ng B, Ngai V, Kale AU, Ferrante di Ruffano L, Golub RM, Liu X. Concordance of randomised controlled trials for artificial intelligence interventions with the CONSORT-AI reporting guidelines. Nature Communications. 2024; 15(1):1619.
22. Martindale AP, Ng B, Ngai V, Kale AU, Ferrante di Ruffano L, Golub RM, Liu X. Concordance of randomised controlled trials for artificial intelligence interventions with the CONSORT-AI reporting guidelines. Nature Communications. 2024;15(1):1619.
23. Singh AP, Batra J, Saxena S, Saxena R. A curse of Lassa fever: An update. Journal of Survey in Fisheries Sciences. 2023;1143-1150.
24. Terranova N, Renard D, Shahin MH, Menon S, Cao Y, Hop CE, Lu J. Artificial intelligence for quantitative modeling in drug discovery and development: An innovation and quality consortium perspective on use cases and best practices. Clinical Pharmacology and Therapeutics. 2024;115(4):658-672.
25. Omar M, Brin D, Glicksberg B, Klang E. Utilizing natural language processing and large language models in the diagnosis and prediction of infectious diseases: A Systematic Review. American Journal of Infection Control; 2024.
26. Wolf RM, Channa R, Liu TA, Zehra A, Bromberger L, Patel D, Abramoff MD. Autonomous artificial intelligence increases screening and follow-up for diabetic retinopathy in youth: The ACCESS randomized control trial. Nature Communications. 2024;15(1):421.
27. Habicht J, Viswanathan S, Carrington B, Hauser TU, Harper R, Rollwage M. Closing the accessibility gap to mental health treatment with a personalized self-referral Chatbot. Nature Medicine. 2024; 1-8.
28. Singh AP, Batra J, Saxena R, Saxena S. Susceptibility to Cervical Cancer: An Overview Ajit Pal Singh.
29. Boag W, Hasan A, Kim JY, Revoir M, Nichols M, Ratliff W, Sendak M. The algorithm journey map: A tangible approach to implementing AI solutions in healthcare. NPJ Digital Medicine. 2024;7 (1):87.
30. Adekugbe AP, Ibeh CV. Harnessing data insights for crisis management in us public health: Lessons learned and future directions. International Medical Science Research Journal. 2024;4(4):391-405.
31. Kasula BY. Advancements in AI-driven Healthcare: A Comprehensive Review of Diagnostics, Treatment, and Patient Care Integration. International Journal of Machine Learning for Sustainable Development. 2024;1(1):1-5.
32. Singh AP, Saxena R, Saxena S. Plasma apheresis procedure. EPRA International Journal of Multidisciplinary Research (IJMR). 2022;8(7):205-218.
33. Walter JR, Lee JY, Yu L, Kim B, Martell K, Opdycke A, Xu S. Use of artificial intelligence to develop predictive algorithms of cough and PCR-confirmed COVID-19 infections based on inputs from clinical-grade wearable sensors. Scientific Reports. 2024;14(1):8072.
34. Margetts TJ, Karnik SJ, Wang HS, Plotkin LI, Oblak AL, Fehrenbacher JC, Movila A. Use of AI language engine ChatGPT 4.0 to write a scientific review article examining the intersection of Alzheimer's disease and bone. Current Osteoporosis Reports. 2024; 1-5.
35. Masalkhi M, Ong J, Waisberg E, Lee AG. Google DeepMind's gemini AI versus ChatGPT: A comparative Analysis in ophthalmology. Eye. 2024;1-6.
36. Acar AH. Can natural language processing serve as a consultant in oral surgery? Journal of Stomatology, Oral and Maxillofacial Surgery. 2024;125(3):101724.
37. Batra J, Singh AP, Saxena R, Saxena S, Goyal K. Blood components and its usage: A clinical insight from diagnostic lens. Journal of Pharmaceutical Negative Results. 2022;1747-1750.
38. Brady AP, Allen B, Chong J, Kotter E, Kottler N, Mongan J, Slavotinek J. Developing, purchasing, implementing and monitoring AI tools in radiology: Practical considerations. A multi-society statement from the ACR, CAR, ESR, RANZCR and RSNA. Insights into Imaging. 2024; 15(1):16.
39. Lee S, Park JS, Woo H, Yoo YK, Lee D, Chung S, Lee JH. Rapid deep learning-assisted predictive diagnostics for point-of-care testing. Nature Communications. 2024;15(1):1695.
40. Rana S. Exploring the Advancements and Ramifications of Artificial Intelligence. Journal of Artificial Intelligence General Science (JAIGS) ISSN: 3006-4023. 2024;2(1):30-35.

41. Tayebi Arasteh S, Ziller A, Kuhl C, Makowski M, Nebelung S, Braren R, Kaissis G. Preserving fairness and diagnostic accuracy in private large-scale AI models for medical imaging. Communications Medicine. 2024; 4(1):46.
42. Bellini V, Russo M, Domenichetti T, Panizzi M, Allai S, Bignami EG. Artificial Intelligence in Operating Room Management. Journal of Medical Systems. 2024;48(1):19.
43. Kim HW, Shin DH, Kim J, Lee GH, Cho JW. Assessing the performance of Chat GPT's responses to questions related to epilepsy: A cross-sectional study on natural language processing and medical information retrieval. Seizure: European Journal of Epilepsy. 2024;114:1-8.
44. Ueda D, Walston SL, Matsumoto T, Deguchi R, Tatekawa H, Miki Y. Evaluating GPT-4-based Chat GPT's clinical potential on the NEJM quiz. BMC Digital Health. 2024;2(1):4.
45. Singh AP, Saxena R, Saxena S, Batra J. An update on emergency contraceptives. IJFANS. 2012;11(2):65-70p.
46. Bilal M, Jamil Y, Rana D, Shah HH. Enhancing awareness and Self-diagnosis of obstructive sleep apnea using AI-Powered chat bots: The role of Chat GPT in revolutionizing healthcare. Annals of Biomedical Engineering. 2024;52(2):136-138.
47. Bakdash L, Abid A, Gourisankar A, Henry TL. Chatting beyond Chat GPT: Advancing equity through AI-driven language interpretation. Journal of General Internal Medicine. 2024;39(3):492-495.
48. Lee CL, Liu WJ, Tsai SF. Effects of AST-120 on mortality in patients with chronic kidney disease modeled by artificial intelligence or traditional statistical analysis. Scientific Reports. 2024; 14(1):738.
49. De Groat W, Abdelhalim H, Patel K, Mendhe D, Zeeshan S, Ahmed Z. Discovering biomarkers associated and predicting cardiovascular disease with high accuracy using a novel nexus of machine learning techniques for precision medicine. Scientific Reports. 2024;14(1): 1.
50. Abedi A, Colella TJ, Pakosh M, Khan SS. Artificial intelligence-driven virtual rehabilitation for people living in the community: A scoping review. NPJ Digital Medicine. 2024;7(1):25.
51. Nakaura T, Ito R, Ueda D, Nozaki T, Fushimi Y, Matsui Y, Naganawa S. The impact of large language models on radiology: A guide for radiologists on the latest innovations in AI. Japanese Journal of Radiology. 2024;1-12.
52. Marinovich ML, Wylie E, Lotter W, Lund H, Waddell A, Madeley C, Houssami N. Artificial intelligence (AI) for breast cancer screening: Breast Screen population-based cohort study of cancer detection. E Bio Medicine. 2023;90.
53. Singh AP, Batra J, Khan SS, Saxena R, Saxena S, Singh AP, Saxena R. (2022). Diagnosis and treatment of Wilson disease: An update. Cardiometry. 2022;(25):1397, 400.
54. Singh AP, Batra J, Saxena R, Saxena S, Kumar C. Alarming rise in professional Blood donors and its repercussions. Cardiometry. 2022;(25):1394, 6.
55. Ajit P, Rahul S, Suyash S. Cytopathology: An important aspect of medical diagnosis. Research and Reviews: Journal of Oncology and Hematology. 2024; 12(03):13-18.
56. Okoro YO, Ayo-Farai O, Maduka CP, Okongwu CC, Sodamade OT. The Role of technology in enhancing mental health advocacy: A systematic review. International Journal of Applied Research in Social Sciences. 2024;6(1):37-50.
57. Cheong RCT, Unadkat S, Mcneillis V, Williamson A, Joseph J, Randhawa P, Paleri V. Artificial intelligence chatbots as sources of patient education material for obstructive sleep apnoea: Chat GPT versus Google Bard. European Archives of Oto-Rhino-Laryngology. 2024;281(2):985-993.
58. Wang SC, Nickel G, Venkatesh KP, Raza MM, Kvedar JC. AI-based diabetes care: Risk prediction models and implementation concerns. NPJ Digital Medicine. 2024;7(1):36.
59. Yao S, Dai F, Sun P, Zhang W, Qian B, Lu H. Enhancing the fairness of AI prediction models by Quasi-Pareto improvement among heterogeneous thyroid nodule population. Nature Communications. 2024;15(1):1-13.
60. Wang Y, Liu C, Hu W, Luo L, Shi D, Zhang J, He M. Economic evaluation for medical artificial intelligence: Accuracy vs. cost-effectiveness in a diabetic retinopathy screening case. NPJ Digital Medicine. 2024;7(1):43.

61. Singh AP. Covid-19 pandemic its impact on earth, economy and environment. Asian Journal of Current Research. 2021;6(2):37-41.
62. Singh AP, Saxena RAHUL, Saxena SUYASH. Hemoglobin estimation by using copper sulphate method. Asian Journal of Current Research. 2022;7(1):13-15.
63. Singh AP, Saxena RAHUL, Saxena SUYASH. A study on the working of blood bank. Journal of Medicine and Health Research. 2022;7(1):1-5.
64. Rahman HA, Singh AP. Section Cutting in Histopathology: An Update. Research and Reviews: A Journal of Health Professions. Section Cutting in Histopathology: An Update Rahman and Singh STM Journals. 2024;14(1):29–34p.
65. Rath DP, Singh AP. Comprehensive Perspective on Coronary Heart Disease: A Review. Research and Reviews: A Journal of Neuroscience. Comprehensive Perspective on Coronary Heart Disease Rath and Singh STM Journals. 2024;14(1):26–40p.
66. Guevara M, Chen S, Thomas S, Chaunzwa TL, Franco I, Kann BH, Bitterman DS. Large language models to identify social determinants of health in electronic health records. NPJ Digital Medicine. 2024;7(1):6.
67. Padmapriya ST, Parthasarathy S. Ethical data collection for medical image analysis: A structured approach. Asian Bioethics Review. 2024;16(1):95-108.
68. Katsoulakis E, Wang Q, Wu H, Shahriyari L, Fletcher R, Liu J, Deng J. Digital twins for health: A scoping review. NPJ Digital Medicine. 2024;7(1):77.
69. Talyshinskii A, Naik N, Hameed BZ, Juliebø-Jones P, Somani BK. Potential of AI-driven chatbots in urology: Revolutionizing patient care through artificial intelligence. Current Urology Reports. 2024;25(1):9-18.
70. Eppler M, Ganjavi C, Ramacciotti LS, Piazza P, Rodler S, Checcucci E, Cacciamani GE. Awareness and use of ChatGPT and large language models: A prospective cross-sectional global survey in urology. European Urology. 2024;85(2):146-153.
71. Singh AP, Mouton RJ, Sharma MK, Ihotu-Owoicho AI. When will this pandemic end? A review. Journal of Basic and Applied Research International. 2021;29(27): 10.
72. Singh AP. Importance of papanicolaou staining in gynecologic cytology. EPRA International Journal of Multidisciplinary Research (IJMR). 2022;8(9):216-219.
73. Cheong RCT, Pang KP, Unadkat S, Mcneillis V, Williamson A, Joseph J, Paleri V. Performance of artificial intelligence chatbots in sleep medicine certification board exams: Chat GPT versus Google Bard. European Archives of Oto-Rhino-Laryngology. 2024;281(4):2137-2143.
74. Kurniawan MH, Handiyani H, Nuraini T, Hariyati RTS, Sutrisno S. A systematic review of artificial intelligence-powered (AI-powered) chatbot intervention for managing chronic illness. Annals of Medicine. 2024;56(1):2302980.
75. Mariño RJ, Uribe SE, Chen R, Schwendicke F, Giraudeau N, Scheerman JF. Terminology of e-oral health: Consensus report of the IADR's e-Oral Health Network Terminology Task Force. BMC Oral Health. 2024;24(1):280.
76. Busis NA, Marolia D, Montgomery R, Balcer LJ, Galetta SL, Grossman SN. Navigating the US regulatory landscape for neurologic digital health technologies. NPJ Digital Medicine. 2024;7(1):94.
77. Kucirkova NI, Zuckerman B. Generative AI for children's digital health: Clinician advice. Journal of Developmental and Behavioral Pediatrics. 2024;45(1):e86-e87.
78. Badrulhisham F, Pogatzki-Zahn E, Segelcke D, Spisak T, Vollert J. Machine learning and artificial intelligence in neuroscience: A primer for researchers. Brain, Behavior, and Immunity. 2024;115:470-479.
79. Chiauzzi E, Williams A, Mariano TY, Pajarito S, Robinson A, Kirvin-Quamme A, Forman-Hoffman V. Demographic and clinical characteristics associated with anxiety and depressive symptom outcomes in users of a digital mental health intervention incorporating a relational agent. BMC Psychiatry. 2024;24(1):79.
80. Savage T, Nayak A, Gallo R, Rangan E, Chen JH. Diagnostic reasoning prompts reveal the potential for large language model interpretability in medicine. NPJ Digital Medicine. 2024;7(1):20.
81. Funk PF, Hoch CC, Knoedler S, Knoedler L, Cotofana S, Sofo G, Alfertshofer M. Chat GPT's response consistency: A study on repeated queries of medical

examination questions. European Journal of Investigation in Health, Psychology and Education. 2024;14(3):657-668.
82. Ahmed F, Abbas S, Athar A, Shahzad T, Khan WA, Alharbi M, Ahmed A. Identification of kidney stones in KUB X-ray images using VGG16 empowered with explainable artificial intelligence. Scientific Reports. 2024;14(1):6173.
83. Truhn D, Müller-Franzes G, Kather JN. The ecological footprint of medical AI. European Radiology. 2024;34(2):1176-1178.
84. Maloca PM, Pfau M, Janeschitz-Kriegl L, Reich M, Goerdt L, Holz FG, Denk N. Human selection bias drives the linear nature of the more ground truth effect in explainable deep learning optical coherence tomography image segmentation. Journal of Biophotonics. 2024;17(2):e202300274.
85. Swiatek L, Galloway C, Vujnovic M, Kruckeberg D. Humanoid artificial intelligence, media conferences and natural responses to journalists' questions: The end of (human-to-human) public relations? Public Relations Inquiry. 2024; 13(1):113-121.
86. Chow JC, Wong V, Li K. Generative pre-trained transformer-empowered healthcare conversations: Current trends, challenges, and future directions in large language model-enabled medical chat bots. Bio Med Informatics. 2024;4(1):837-852.
87. Tripathi S, Sukumaran R, Cook TS. Efficient healthcare with large language models: Optimizing clinical workflow and enhancing patient care. Journal of the American Medical Informatics Association, ocad258; 2024.
88. Mihan A, Van Spall HG. Interventions to enhance digital health equity in cardiovascular care. Nature Medicine. 2024;1-3.
89. Naik K, Goyal RK, Foschini L, Chak CW, Thielscher C, Zhu H, Gobburu J. Current status and future directions: The application of artificial intelligence/machine learning for precision medicine. Clinical Pharmacology and Therapeutics; 2024.
90. Ho CH. Secondary use of health data for medical AI: A cross-regional examination of Taiwan and the EU. Asian Bioethics Review. 2024;1-16.
91. Singh AP, Saxena R, Saxena S. Protocols for blood collection in a blood bank. Journal of Medicine and Health Research. 2022;7(2):16-21.
92. Jo H, Park DH. Effects of Chat GPT's AI capabilities and human-like traits on spreading information in work environments. Scientific Reports. 2024; 14(1):7806.
93. Miao J, Thongprayoon C, Suppadungsuk S, Krisanapan P, Radhakrishnan Y, Cheungpasitporn W. Chain of thought utilization in large language models and application in nephrology. Medicina. 2024; 60(1):148.
94. Garcia Valencia OA, Thongprayoon C, Jadlowiec CC, Mao SA, Leeaphorn N, Budhiraja P, Cheungpasitporn W. AI-driven translations for kidney transplant equity in Hispanic populations. Scientific Reports. 2024;14(1):8511.
95. Satpathy S, Khalaf O, Kumar Shukla D, Chowdhary M, Algburi S. A collective review of Terahertz technology integrated with a newly proposed split learningbased algorithm for healthcare system. International Journal of Computing and Digital Systems. 2024;15(1):1-9.
96. Issa H, Jaber J, Lakkis H. Navigating AI unpredictability: Exploring technostress in AI-powered healthcare systems. Technological Forecasting and Social Change. 2024;202:123311.
97. Jebali F, Majumdar A, Turck C, Harabi KE, Faye MC, Muhr E, Portal JM. Powering AI at the edge: A robust, memristor-based binarized neural network with near-memory computing and miniaturized solar cell. Nature Communications. 2024; 15(1):741.
98. Abbaoui W, Retal S, El Bhiri B, Kharmoum N, Ziti S. Towards revolutionizing precision healthcare: A systematic literature review of artificial intelligence methods in precision medicine. Informatics in Medicine Unlocked. 2024;101475.
99. Zheng Y, Wu Y, Feng B, Wang L, Kang K, Zhao A. Enhancing Diabetes Self-management and Education: A Critical Analysis of Chat GPT's Role. Annals of Biomedical Engineering. 2024;52(4):741-744.
100. Skorburg JA, O'Doherty K, Friesen P. Persons or data points? Ethics, artificial intelligence, and the participatory turn in mental health research. American Psychologist. 2024;79(1):137.
101. Bavli I, Ho A, Mahal R, McKeown MJ. Ethical concerns around privacy and data

security in AI health monitoring for Parkinson's disease: Insights from patients, family members, and healthcare professionals. AI and SOCIETY. 2024;1-11.

102. Dhasarathan C, Shanmugam M, Kumar M, Tripathi D, Khapre S, Shankar A. A nomadic multi-agent based privacy metrics for e-health care: A deep learning approach. Multimedia Tools and Applications. 2024;83(3):7249-7272.
103. Pancholi S, Wachs JP, Duerstock BS. Use of artificial intelligence techniques to assist individuals with physical disabilities. Annual Review of Biomedical Engineering. 2024;26.
104. Li S, Guo Z, Zang X. Advancing the production of clinical medical devices through Chat GPT. Annals of Biomedical Engineering. 2024;52(3):441-445.
105. Agarwal P, Swami S, Malhotra SK. Artificial intelligence adoption in the post COVID-19 new-normal and role of smart technologies in transforming business: A review. Journal of Science and Technology Policy Management. 2024;15(3): 506-529.
106. Xu J, Chen D, Wu W, Ji X, Dou X, Gao X, Xiong D. A metabolic map and artificial intelligence-aided identification of nasopharyngeal carcinoma via a single-cell Raman platform. British Journal of Cancer. 2024;1-12.
107. Evans H, Snead D. Why do errors arise in artificial intelligence diagnostic tools in histopathology and how can we minimize them? Histopathology. 2024;84(2):279-287.

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