

AI IN HEALTH CARE

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COURSE TITLE

Artificial Intelligence

Submitted To

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Date:8 July, 2024

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# Acknowledgement

We’d like to express our special thanks of gratitude to our teacher Mr. Saroj Maharjan, who gave us the golden opportunity to do this wonderful project of Artificial Intelligence on AI in Health Care , who also helped us in completing our project. We came to know about so many things we are really thankful to him.

Secondly we’d also like to thank our friends and other people who helped us a lot in finalizing this project within the limited time frame.

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CSIT III Semester

**Abstract Page**

This report conducts extensive research and analysis of intelligent agents in the healthcare industry, emphasizing their transformational impact on medical practice. Intelligent agents driven by artificial intelligence (AI), machine learning, and natural language processing are rapidly being used to improve diagnostic accuracy, workflow efficiency, and patient care.

The article begins by defining intelligent agents in healthcare and discussing their roles and functions. It digs into the design of these agents, with emphasis on data gathering and processing, decision support systems, and patient contact mechanisms. The report is centered on thorough case studies of three key applications: IBM Watson for Oncology, Babylon Health, and PathAI. These case studies show how intelligent agents are used in real-world settings to improve healthcare delivery and patient outcomes.

The advantages of deploying intelligent agents in healthcare, such as improved diagnostic accuracy, personalised treatment, and more accessibility, are comprehensively examined. The research also discusses the hurdles that exist in this arena, such as data privacy concerns, regulatory compliance issues, and the complexities of integrating AI systems into existing healthcare infrastructure. Future trends in the use and progress of AI in healthcare are also studied, with an emphasis on technological improvements, broader applications, worldwide adoption, and increased industry collaboration.  
  
The findings highlight the enormous potential for intelligent agents to improve healthcare, while also emphasizing the critical difficulties that must be overcome. Overall, the analysis points to a bright future in which AI-powered healthcare solutions lead to better patient outcomes and increased efficiency in medical practice.

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**1 Intelligence Agents in Healthcare**

**1.1 Definition and Overview**

Intelligent agents in healthcare refer to software entities that perform tasks autonomously or semi-autonomously with minimal human intervention. These agents use artificial intelligence (AI) techniques to mimic cognitive functions such as learning, reasoning, problem-solving, and decision-making to improve healthcare delivery, patient outcomes, and operational efficiencies.

Intelligent agents can be classified based on their functionality, including:

**Reactive Agents**: Respond to specific stimuli without memory or internal state.

Deliberative Agents: Possess internal models and make decisions based on reasoning and planning.

**Hybrid Agents**: Combine reactive and deliberative capabilities for more sophisticated interactions.

**Collaborative Agents**: Work together with other agents or humans to achieve common goals.

**1.2 Role and Functionality**

Roles of Intelligent Agents in Healthcare:

**Clinical Decision Support**: Provide clinicians with evidence-based recommendations for diagnosis, treatment, and patient management by analyzing patient data and medical literature.

**Patient Monitoring and Management**: Continuously monitor patient health parameters, alerting healthcare providers to critical changes and facilitating timely interventions.

**Administrative Support**: Automate routine administrative tasks such as appointment scheduling, billing, and inventory management to reduce workload and improve efficiency.

**Personal Health Assistants**: Assist patients with medication adherence, health education, and lifestyle management by providing personalized advice and reminders.

**Telemedicine and Remote Care**: Enable remote consultations and follow-ups through virtual assistants and telehealth platforms, improving access to care, especially in remote or underserved areas.

**Medical Research and Data Analysi**s: Analyze vast amounts of medical data to identify trends, predict disease outbreaks, and support research and development of new treatments.

**1.2.1 Functionality of Intelligent Agents in Healthcare**:

**Data Collection and Integration**: Gather data from various sources such as electronic health records (EHRs), wearable devices, and patient self-reports to create a comprehensive health profile.

**Natural Language Processing (NLP)**: Understand and process human language, enabling agents to interact with patients and healthcare providers effectively through

chatbots or virtual assistants.

**Machine Learning and Predictive Analytics**: Use machine learning algorithms to analyze data, recognize patterns, and make predictions about disease progression, patient outcomes, and potential complications.

**Reasoning and Decision-Making**: Apply logical reasoning to assess clinical guidelines, patient data, and contextual information to provide recommendations and support decision-making.

**Autonomous Action**s: Perform actions autonomously, such as adjusting treatment plans, sending alerts, or ordering tests, based on predefined protocols and real-time data analysis.

Collaboration and Communication: Facilitate communication and collaboration among healthcare team members, patients, and other stakeholders through secure messaging and information sharing platforms.

In summary, intelligent agents in healthcare enhance the efficiency, accuracy, and accessibility of healthcare services by leveraging AI technologies to perform a wide range of tasks autonomously or in collaboration with human professionals.

**2.Agent Architecture and capabilities in Healthcare**

**2.1 Data Collection and Analysis**

**Automated Data Collection:**

AI agents can significantly streamline the process of data collection by integrating seamlessly with electronic health records (EHRs), wearable devices, and remote sensors. This integration allows for the continuous and automatic gathering of real-time health data, effectively minimizing the need for manual data entry. This automation not only saves time for healthcare providers but also reduces the potential for human error, ensuring more accurate and reliable data.

**Data Integration:**

AI agents excel in combining structured and unstructured data from a myriad of sources. They leverage Natural Language Processing (NLP) to interpret clinical notes, medical literature, and other text-based information. By harmonizing diverse data formats, AI systems create a cohesive and comprehensive data repository that can be readily accessed and utilized for various analytical purposes.

**Data Analysis:**

Machine Learning (ML) algorithms are at the heart of AI-driven data analysis. These algorithms can identify patterns and trends within patient data, enabling predictive analytics to forecast potential health outcomes. Big data analytics further empowers healthcare providers to manage and analyze vast datasets, leading to insights that were previously unattainable. These capabilities facilitate early anomaly detection, prompt interventions, and the development of personalized treatment plans tailored to individual patient needs.

**2.1.1 Benefits:**

• **Enhanced Data Accuracy and Efficiency:** Automated and integrated data

collection reduces errors and increases efficiency.

• **Early Anomaly Detection:** Predictive analytics enable timely intervention,

potentially preventing adverse health events.

• **Personalized Treatment Plans:** Insights derived from comprehensive data analysis allow for more tailored and effective patient care.

**2.2 Decision Support Systems**

**Clinical Decision Support Systems (CDSS):**

CDSS play a crucial role in supporting clinical decisions by providing evidence-based recommendations. These systems aid in diagnosis and treatment planning by offering real-time alerts for potential adverse drug interactions and other clinical

considerations. By incorporating vast medical knowledge bases, CDSS enhance the decision-making process of healthcare professionals, ensuring that they have access to the latest and most relevant information.

**Diagnostic Assistance:**

AI-driven tools are revolutionizing diagnostic processes. Image recognition software, for instance, assists radiologists and pathologists in identifying abnormalities in medical images with high accuracy. Additionally, NLP tools can summarize patient

histories and extract critical information from clinical notes, aiding clinicians in making accurate diagnoses and improving overall diagnostic accuracy.

**Treatment Planning:**

AI algorithms are adept at suggesting optimal treatment plans by analyzing genetic, lifestyle, and clinical data. These algorithms can personalize medicine, recommending specific treatments that are most likely to be effective for individual patients. Moreover, they can dynamically adjust treatment plans as patient conditions evolve, ensuring that care remains responsive and effective.

**2.2.1 Benefits:**

**•Reduction in Diagnostic Errors:** AI assistance improves accuracy in diagnosis.

**•Streamlined Workflows:** CDSS and AI tools reduce the workload on healthcare providers.

**•Improved Patient Outcomes:** Personalized and accurate care recommendations lead to better health outcomes.

**2.3 Patient Interaction**

**Virtual Health Assistants:**

AI-powered chatbots serve as virtual health assistants, conducting initial patient assessments, answering health-related queries, providing information, and assisting with scheduling appointments. These chatbots enhance patient engagement by being available around the clock, offering immediate responses, and ensuring that patients receive the information they need promptly.

**Remote Monitoring:**

AI agents facilitate continuous health monitoring through wearable devices that track vital signs and other health metrics. Automated alerts for abnormal readings keep both patients and caregivers informed, ensuring timely interventions. This continuous monitoring supports adherence to treatment plans and helps manage chronic conditions more effectively.

**Telemedicine Integration:**

AI systems enhance telemedicine services by facilitating efficient remote consultations. They improve the delivery of telehealth services by providing real-time translation services, ensuring clear communication between patients and healthcare providers regardless of language barriers. This integration makes healthcare more accessible, particularly for patients in remote or underserved areas.

**2.3.1 Benefits:**

•**Increased Access to Healthcare Services:** Virtual assistants and telemedicine make healthcare more accessible.

•**Continuous Monitoring and Engagement:** Wearable devices and remote monitoring ensure ongoing patient engagement and timely interventions

•**Reduced Hospital Visits and Healthcare Costs:** By enabling remote care and monitoring, AI agents help reduce the need for hospital visits, lowering overall healthcare costs and improving patient care.

1. **Case Studies**

**3.1 PathAI: Transforming Pathology Diagnostics with Artificial Intelligence**

**3.1.1 Introduction**

PathAI is an innovative startup that uses artificial intelligence (AI) to transform pathology diagnoses. PathAI, founded in 2016 and headquartered in Boston, Massachusetts, aims to improve patient outcomes by increasing the accuracy and efficiency of pathology diagnostics. This study discusses PathAI's history, purpose, technological achievements, applications, and future possibilities.

**3.1.2 History of PathAI**

Dr. Andrew Beck and Aditya Khosla founded PathAI with the goal of using artificial intelligence to address issues in pathology diagnoses. The company immediately became known for its creative approach, drawing major investments and developing key alliances with top healthcare institutes and pharmaceutical corporations. PathAI has evolved into a dominant player in the AI-driven pathology market, constantly improving its technology and broadening its influence on healthcare.

**3.1.3 Purpose and Mission**

The primary goal of PathAI is to enhance patient outcomes by providing more accurate and efficient pathology diagnosis. Traditional pathology relies significantly on skilled pathologists manually interpreting pathology slides, a time-consuming and error-prone process. PathAI intends to improve this procedure by utilizing AI to examine pathology slides, identify abnormalities, and deliver detailed diagnostic information. This not only improves diagnostic accuracy, but also reduces pathologists' burden, allowing them to focus on more complicated cases.

**3.1.4 Technology and Architecture**

PathAI's technology is based on powerful deep learning techniques, specifically convolutional neural networks. Here is a summary of its technological framework:   
  
-**Data Collection and Annotation**: PathAI works with healthcare facilities to gather digital images of pathology slides. Expert pathologists annotate these slides, resulting in a high-quality dataset for training AI models.  
- **Deep Learning Models**: The annotated slides are used to train CNNs, which are extremely useful for image analysis. These models learn to recognize patterns and features in pathology slides that indicate different diseases and distinguish between normal and bad tissue.

- **Analysis and Interpretation**: Once trained, AI models may analyze new pathology slides, offering diagnostic information such as identifying regions of interest and recommending possible diagnoses. Pathologists analyze these results and use AI insights to make final diagnosis choices.   
- **Integration with Digital Pathology Platforms**: PathAI's technology works seamlessly with digital pathology platforms, allowing for efficient analysis and reporting. These platforms provide access to AI-generated results, enabling pathologists to effectively analyze and interpret findings.

**3.1.5 Applications and Impact**

PathAI's AI technology has a broad range of applications in pathology, with important implications for several parts of healthcare:   
- **Cancer Diagnosis**: PathAI's models can diagnose a variety of cancers, including breast, lung, and colorectal cancer. The AI can accurately recognize malignant cells and provide specific information on tumor features, allowing for early and exact diagnosis.   
- **Clinical Trials and Research**: PathAI works with pharmaceutical companies to facilitate clinical trials. The AI models examine pathology samples from trial participants, resulting in consistent and accurate data that speeds up research and drug development. PathAI's technology also helps with the discovery and validation of biomarkers, which are critical for creating tailored medicines.

- **Efficiency and Accuracy**: By automating pathology slide analysis, PathAI greatly reduces diagnostic turnaround time, allowing for speedier treatment decisions. The AI models are highly accurate in their analysis, lowering the chance of diagnostic errors and ensuring patients receive proper therapy.

**3.1.6 Conclusion**

PathAI is at the forefront of transforming pathology diagnosis with their AI-powered technology. PathAI improves patient outcomes dramatically by increasing diagnostic accuracy, lowering turnaround times, and assisting pathologists. While there are some obstacles to overcome, such as data protection and regulatory compliance, the potential benefits of PathAI's technology are enormous. As the company continues to innovate and grow, it is positioned to have a long-term impact on the healthcare industry, changing how diseases are detected and treated.

**3.2 Babylon Health: Revolutionizing Healthcare Access with AI**

**3.2.1 Introduction**

Babylon Health is a pioneering digital health service provider that uses artificial intelligence (AI) to provide accessible and cost-effective healthcare. Babylon Health, founded in 2013 by Dr. Ali Parsa and headquartered in London, aims to make health care accessible and inexpensive to everyone on the planet. This research looks at Babylon Health's history, purpose, technology underpinning, and applications in the healthcare sector.

**3.2.2 History of Babylon Health**

Babylon Health was formed with the objective of using digital technology and artificial intelligence to address global healthcare concerns. Recognizing the limitations of traditional healthcare systems, Babylon sought to develop a scalable and efficient solution capable of providing high-quality care to people all around the world. The company immediately found popularity, expanding its services to various nations and creating relationships with national and commercial healthcare organizations.

**3.2.3 Purpose and Mission**

Babylon Health's major goal is to democratize healthcare by improving accessibility, affordability, and efficiency. Babylon Health intends to alleviate the strain on existing healthcare systems by providing AI-powered telemedicine services such as quick medical consultations, individualized health evaluations, and continuous monitoring of health issues. The company's mission is consistent with the overarching goal of providing universal health coverage and improving health outcomes worldwide.

**3.2.4 Technology and Architecture**

Babylon Health's technology combines artificial intelligence, machine learning, and natural language processing (NLP) to provide full digital health services. The main components of its technological architecture are:   
  
- **AI-Powered Symptom Checker**: Babylon's AI-powered symptom checker lets users enter their symptoms and get a preliminary diagnosis. To deliver reliable assessments and indicate potential illnesses, the symptom checker draws on a massive archive of medical information and algorithms trained on large datasets.   
- **Virtual Consultations**: Babylon's mobile app allows users to schedule virtual consultations with human doctors. Patients can schedule appointments, have video consultations, and get medical advice, medications, and referrals without having to visit a physical clinic. The AI helps clinicians by giving pertinent information and offering possible diagnosis based on patient data.

- **Personal Health Records (PHR)**: The platform enables users to manage their personal health records, such as medical history, prescriptions, and test results. This allows for continuous health monitoring and individualized healthcare management.   
- **Health Monitoring and Management**: Babylon's AI collects user health data from wearable devices and other sources. The system promotes proactive health management by notifying users of potential health concerns, reminding them of prescription schedules, and recommending lifestyle modifications to improve overall well-being.

**3.2.5 Applications and Impact**

Babylon Health's AI-driven solutions have a substantial impact on the following aspects of healthcare delivery:

- **Primary Care Access**: Babylon Health addresses the problem of limited access to primary care by offering instant consultations and health evaluations via its mobile app. This is especially useful in areas with healthcare shortages and high wait periods for appointments.  
- **Chronic Disease Management**: Babylon's continuous health monitoring assists in managing chronic illnesses such as diabetes, hypertension, and asthma. The AI-powered system gives individualized guidance, monitors vital signs, and offers early actions to avoid issues.

- **Preventive Healthcare**: The platform focuses on preventive care, encouraging users to frequently evaluate their health and make informed lifestyle decisions. The AI analyzes user data to identify risk factors and make personalized recommendations for staying healthy.   
- **Cost Reduction**: By minimizing the number of in-person visits and hospital admissions, Babylon Health considerably reduces healthcare costs for both patients and providers. The digital platform makes healthcare delivery more efficient and cost-effective.

**3.2.6 Conclusion**

Babylon Health is a digital health pioneer, using AI to change healthcare access and delivery. Babylon Health offers AI-powered symptom screening, virtual consultations, and continuous health monitoring, providing a comprehensive answer to the issues that traditional healthcare systems face. The company's revolutionary strategy improves healthcare accessibility, efficiency, and cost, resulting in better health outcomes for people around the world.

**3.3 IBM Watson for Oncology: Enhancing Cancer Care with AI**

**3.3.1 Introduction**

IBM Watson for Oncology is a sophisticated AI-driven technology developed by IBM to help oncologists provide individualized cancer care. IBM Watson for Oncology uses cognitive computing and machine learning to evaluate massive volumes of medical data to help oncologists make decisions. This research looks at the history, purpose, technology underpinnings, and uses of IBM Watson for Oncology in the healthcare industry.

**3.3.2 History of IBM Watson for Oncology**

IBM Watson for Oncology debuted in 2012 as part of IBM's larger commitment to bring Watson AI technology to healthcare. The project was created in conjunction with Memorial Sloan Kettering Cancer Center (MSKCC), a renowned cancer research and treatment facility. The team aims to use Watson's cognitive computing capabilities to evaluate and comprehend complicated medical data, ultimately enhancing cancer detection and treatment.

**3.3.3 Purpose and Mission**

The major goal of IBM Watson for Oncology is to improve cancer care by giving physicians evidence-based therapy recommendations. The AI system is intended to assess patient data, such as medical history, clinical records, and genetic information, and cross-reference it against a large body of medical literature and clinical guidelines. This allows oncologists to make more educated treatment decisions, which improves patient outcomes and optimizes care delivery.

**3.3.4 Technology and Architecture**

IBM Watson for Oncology makes use of modern artificial intelligence technologies such as natural language processing (NLP), machine learning, and cognitive computing. The main components of its technological structure are:

**- Data Ingestion and Integration**: The system accepts and combines a variety of data sources, such as electronic health records (EHRs), clinical trial data, medical literature, and treatment guidelines. This broad data collection allows Watson to gain a comprehensive understanding of the patient's condition.   
**- Natural Language Processing (NLP)**: Watson's NLP skills enable it to comprehend and analyze unstructured data from clinical notes, research articles, and other text sources. This allows the system to collect relevant data and find critical insights that guide therapy suggestions.

**- Machine Learning Algorithms**: The AI system uses machine learning algorithms to evaluate patient data and uncover trends that could point to the most successful treatment alternatives. These algorithms are always learning from fresh data, increasing their accuracy and relevance over time.   
**- Evidence-Based Recommendations**: Watson's study leads to evidence-based treatment recommendations for oncologists. The suggestions are supported by a confidence score and a discussion of the supporting information, allowing oncologists to assess the options and make educated judgments.

**3.3.5 Applications and Impact**

IBM Watson for Oncology had a substantial impact on the following aspects of cancer care:   
- **Personalized Treatment Plans**: Watson helps oncologists create personalized treatment plans based on each patient's unique traits. The AI system helps discover the best relevant medicines by taking into account genetic mutations, comorbidities, and other factors.   
-**Clinical Decision Support**: The AI-driven system offers oncologists with vital insights and evidence-based recommendations to help them make clinical decisions. This improves the quality of care and ensures that patients get the most effective treatments.

**- Accelerated Research and Development**: Watson's ability to examine massive amounts of medical literature and clinical trial data hastens the discovery and development of new cancer treatments. The artificial intelligence system assists in identifying prospective drug candidates and suggesting novel therapeutic options.   
- **Better Patient Outcomes**: By providing oncologists with accurate and timely information, IBM Watson for Oncology improves patient outcomes. The system's recommendations are based on the most recent clinical evidence, ensuring that patients receive cutting-edge care.

**3.3.6 Conclusion**

IBM Watson for Oncology is a pioneering AI-powered system that improves cancer care by offering individualized therapy recommendations and assisting with clinical decision-making. Watson uses cognitive computing, natural language processing, and machine learning to evaluate massive volumes of medical data to help oncologists provide evidence-based care. IBM Watson for Oncology has a significant impact on patient outcomes, research, and cancer therapy.

1. **Benefits of Intelligent agents**

**Diagnosing and Predicting Diseases:**By incorporating clinical data, intelligent agent-based medical applications have the potential to diagnose, predict, and treat diseases. In heart disease, machine learning algorithms have been used to calculate the 10-year risk of developing cardiovascular disease, resulting in more accurate cardiac risk scores. Moreover, intelligent agent-assisted prediction using clinical data records can be more precise than statistically-derived risk models, indicating that incorporating intelligent agents into medicine and healthcare could improve patient care by allowing for more accurate diagnoses and interventions.

**Predicting Acute Kidney Injury (AKI):**By incorporating physiological data from patients with renal diseases, intelligent agents can predict the incidence of acute kidney injury (AKI) within 48 hours of hospitalization and the post-operative risk of AKI surgery. In addition, the diagnostic accuracy of intelligent agent prediction models can be comparable to that of medical personnel, and their efficacy can be enhanced when combined with other tools.

**Alleviating Healthcare Congestion with Intelligent Agents:**Incorporating intelligent agents into healthcare can alleviate healthcare congestion in EU nations with insufficient medical personnel. By prioritizing patients based on their medical data and health status, predictive models utilizing intelligent agent algorithms can aid medical personnel in developing higher-quality surgical plans, thereby optimizing healthcare resources. Intelligent agents can also assist in analyzing emergency department patient arrivals, enabling the development of efficient resource allocation strategies.

**Mental Health Support:**In 28 EU countries, mental illness costs more than 4% of the gross domestic product. Intelligent agents can provide patients with conversational companionship and emotional support without healthcare personnel treating mental illness. Interactive chatbots can digitally monitor patients' emotions using voice and facial recognition sensors, providing patients with the emotional support they require.

**Reducing Administrative Burden with Intelligent Agents:**The bureaucracy of the healthcare system requires healthcare workers to spend fifty percent of their time on administrative duties, such as patient data acquisition and devouring valuable resources. By performing these duties more efficiently and precisely, intelligent agents can save healthcare professionals valuable time and reduce the staffing shortage.

1. **Challenges of Intelligent Agents**

**Lack of Established Laws and Regulations:**Utilizing intelligent agents in the healthcare industry presents numerous obstacles. As a comparatively new application, their use is not governed by established laws and regulations, which could potentially injure its users. In cases where patients are injured due to medical errors, the lack of traceability in medical intelligent agents makes it difficult to assign responsibility. Intelligent agents in the diagnosis or treatment process further complicate the relationship between physicians and patients, which could reduce their propensity to employ these technologies.

**Algorithmic Security Concerns:**Concerns over algorithmic security could threaten the viability of intelligent agent medical instruments. Unfortunately, in 2020, the AI company Cense AI was the victim of a cyber-attack, which exposed the sensitive information of more than 2.5 million patients worldwide, including personal diagnosis records, private addresses, and names. The risk of data security incidents makes it more challenging to promote medical intelligent agent tools because no one wants their private information, such as their name and address, to be extensively distributed.

**Ethical Considerations:**The ethical considerations of intelligent agent use further complicate the healthcare industry's propagation of these tools. Individual patient data is regarded as a commodity on the market from the perspective of surveillance capitalism, and sales strategies are devised to increase their purchases. In addition, the pharmaceutical industry uses patient data for drug development and marketing strategies, which may raise ethical concerns.

**Data-Level Errors:**Data-level errors can impact the precision of intelligent agent predictions. During the ultrasound scanning process, for instance, human error can cause the input data of intelligent agent tools to be discordant with the patient's actual condition, which can be understood as data noise. Due to operator ineptitude or uncooperative patients, data disturbance may exist.

**Insufficient Instruction for Clinicians:**There needs to be more instruction in extant curriculums that seeks to teach clinically trained physicians how to use intelligent agent tools. A study conducted at 19 institutions in the United Kingdom revealed that medical students are required to take only a handful of courses on intelligent agents. Healthcare personnel still need to gain the experience necessary to be the dominant consumers of these tools, so they cannot guide and assist patients and may generate data noise. A patient donning a wedding ring may position their hand on their chest during the scanning procedure. An X-ray technician may place an adhesive electrocardiogram electrode on the chest. These circular artifacts may be misidentified as one of the known thoracic lesions, resulting in false-positive results. The data pollution caused by these actions will result in algorithmic errors in intelligent agents and increase the risk of misdiagnosis. The risk of erroneous diagnosis due to improper application will impede the widespread adoption of intelligent agent tools in the medical and healthcare sectors.

**Lack of Knowledge Among General Population:**A 2021 survey of 6,000 people revealed that the majority of individuals need more knowledge of intelligent agents' use in daily life. This suggests a considerable danger of data disturbance when diagnosing patients from the general population using these tools.

**Incorrect Classification Due to Dataset Quality:**Moreover, data collected from different hospitals and machine learning models used to differentiate between distinct populations may result in incorrect classification by intelligent agents due to changes in the dataset's quality. This implies that the data model will reduce the accuracy of predictions even in the absence of data disturbance. Using optical coherence tomography (OCT), DeepMind has created an intelligent agent digital model system that can automatically diagnose retinal diseases. However, the diagnostic error increases from 5.5% to 46% when the system obtains data images from multiple devices.

**Lack of Input from End-Users:**As it is typically designed by computer and data scientists, the development of medical intelligent agent technology often needs more input from end-users such as patients, nurses, and physicians. This absence of involvement can make it difficult for users to comprehend and employ these tools effectively, increasing the likelihood of human error when using intelligent agent tools.

**Lack of Transparency in Development Process:**In addition, the development of medical intelligent agent tools involves a large number of participants, resulting in a lack of transparency in the development process, which further inhibits the use of intelligent agent tools in diagnostic methods by users who do not comprehend how these models operate in the real world. This lack of transparency makes it difficult to determine who is responsible for possible errors, whether developers, data administrators, physicians, or others.

**Complexity of Informed Consent and Transparency of Algorithms:** Moreover, the complexity of informed consent procedures and the lack of transparency of intelligent agent algorithms may necessitate that patients comprehend how their data is utilized and shared, posing potential ethical risks. Establishing data protection laws to ensure the responsible use of intelligent agent tools in healthcare is crucial.

1. **Future Trends of Intelligent Agents in Healthcare**

“Imagine a world ,where your doctor is available 24/7,where diseases are detected before symptoms appear and where surgeries are performed with pinpoint accuracy by robots.”

Isn’t that amazing? The AI (artificial intelligence) in healthcare refers to the application of complex algorithms and software to intercept complex medical data and assist healthcare providers in making informed decisions.

Healthcare is considered as one of the most relevant, most impactful ,most laborious industry. However, it has often been portrayed as slow to change & in some cases this is true. Yet if one looks at the last couple of decades, many major transitions have occurred that has totally change the structure of healthcare. With the previous scenarios, we can predict that ,the upcoming years are projected to witness a more promises to be a period of unprecedented transformation, driven by marvelous digital healthcare trends.

As we step into the year 2024,the landscape of the healthcare is undergoing massive changes. Rewinding few years back,we all know that how the COVID-19 pandemic has put the global healthcare system under enormous pressure. However, this pandemic catalyzed an even greater acceleration of changes in the healthcare industry. And today we can see the result, how it has led us to an advanced landscapes of the healthcare trends.

Stepping into the world of cutting edge technology; Here, we’re going to unveil how intelligent agents-powered by Artificial Intelligence(AI) & Machine Learning(ML) could be a potential game changer in more efficient healthcare ,especially in circumstances where transforming the landscape of healthcare like never before. The future trends of intelligent agents in healthcare encompass a wide range of applications, from diagnostics and treatment to patient monitoring and administrative tasks.

Some of the key trends that are expected to reshape healthcare in the future are:-

**Advanced Diagnostics & Predictive Analytics:**

Advance in genomics are paving the way for personalized medicine,where treatments and drugs are tailored to an individual’s genetic makeup. Similarly, predictive analytics uses past data to foresee future health accident ,resulting early intervention.

**Robotics and Automation:**

Surgical robots:- Robotic-assisted surgery offers precision and minimally invasive options, leading to faster recovery times and reduced risk of complications .The use of robots in surgery will expand, covering more complex procedures.

Automation in Hospitals:- Automation will streamline administrative tasks, reduce errors, and improve efficiency in hospitals. This includes automated drug dispensing, inventory management, and patient check-in processes.

**Telemedicine and Remote monitoring:**

The COVID-19 pandemic accelerated the adoption of telemedicine. In the future, telemedicine will become a staple in healthcare delivery, offering remote consultations, follow-ups, and continuous patient monitoring.Wearable devices and smart sensors will enable continuous health monitoring. Patients with chronic conditions like diabetes, heart disease, and hypertension will benefit from real-time data collection and transmission to healthcare providers.

**Drug discovery and Development:**

The future of drug discovery and development is being reshaped by a convergence of advanced technologies and innovative approaches. Artificial intelligence (AI) and machine learning (ML) are at the forefront, enabling the rapid analysis of vast datasets to identify potential drug candidates and predict their efficacy and safety profiles.

At last, The adoption of future trends in healthcare invites several significant challenges. The increasing reliance on digital health solutions and interconnected devices raises concerns about safeguarding patient data against breaches and cyber threats.AI algorithms can inadvertently perpetuate biases present in training data, leading to disparities in healthcare delivery. Implementing and maintaining cutting-edge technologies can be costly, requiring healthcare systems to balance innovation with financial sustainability and cost-effectiveness.

Despite these challenges, the future of healthcare is bright with possibilities.These trends will not only improve patient outcomes but also drive unprecedented insights on the healthcare systems globally . However, it will be essential to address the regulatory,ethical and infrastructural challenges to fully discover the potential of these innovations.

1. **Conclusion**

Intelligent agents in healthcare are revolutionizing the industry by providing advanced tools for diagnosis, treatment, and patient management. These technologies, driven by sophisticated algorithms and vast datasets, are poised to transform every aspect of healthcare delivery, from early disease detection to personalized treatment plans and efficient patient monitoring. The integration of AI into healthcare systems is not just a technological advancement but a paradigm shift that promises to improve patient outcomes, reduce healthcare costs, and increase accessibility to medical services.

One of the most significant benefits of intelligent agents in healthcare is their ability to enhance diagnostic accuracy. AI-powered systems, such as PathAI, can analyze medical images and pathology slides with a level of precision that surpasses human capabilities. By identifying subtle patterns and anomalies that may be overlooked by human eyes, these systems can provide earlier and more accurate diagnoses, which are crucial for conditions like cancer. This leads to timely interventions and better prognosis for patients.

In addition to diagnostics, intelligent agents are transforming treatment methodologies. AI can process vast amounts of data to recommend personalized treatment plans based on a patient's unique genetic makeup, medical history, and current health condition. For instance, IBM Watson for Oncology uses AI to assist oncologists in identifying the most effective treatment options for cancer patients, considering the latest research and clinical trials. This personalized approach ensures that patients receive the most appropriate and effective treatments, reducing trial-and-error in therapy selection.

Patient management is another area where intelligent agents are making a substantial impact. AI-driven platforms like Babylon Health provide continuous health monitoring and virtual consultations, making healthcare more accessible, especially in underserved regions. These platforms can track patients' vital signs, medication adherence, and lifestyle factors in real-time, offering proactive healthcare solutions and early warnings for potential health issues. This not only improves patient engagement and compliance but also alleviates the burden on healthcare facilities by reducing the need for in-person visits.

Despite the numerous benefits, the integration of intelligent agents into healthcare comes with challenges that need to be addressed. Data privacy and security are paramount concerns, as AI systems rely on vast amounts of sensitive patient data. Ensuring that this data is protected from breaches and misuse is critical to maintaining patient trust and compliance with regulations. Additionally, there is the challenge of integrating AI into existing healthcare workflows. Healthcare providers need to be trained to work alongside AI tools, and the technology must be seamlessly incorporated into daily operations to be effective.

Another significant challenge is the potential for bias in AI algorithms. If the data used to train AI models is not representative of diverse patient populations, the recommendations and diagnoses provided by these systems could be biased, leading to disparities in healthcare. Continuous monitoring and updating of AI systems are necessary to ensure fairness and accuracy in patient care.

Furthermore, the regulatory landscape for AI in healthcare is still evolving. Developing comprehensive regulations that ensure the safety and efficacy of AI tools without stifling innovation is a delicate balance that policymakers must achieve. Thoughtful regulation will be crucial in fostering an environment where AI can thrive and benefit healthcare systems globally.

In conclusion, intelligent agents are set to revolutionize healthcare by enhancing diagnostic accuracy, personalizing treatment, and improving patient management. The potential benefits of these technologies are immense, offering the promise of better patient outcomes, reduced healthcare costs, and increased accessibility. However, to fully harness the potential of AI in healthcare, it is essential to address the challenges of data privacy, integration, bias, and regulation. Continued research, development, and thoughtful policymaking will be key to ensuring that intelligent agents become a valuable and trusted component of healthcare delivery. As the technology evolves, the collaborative efforts of technologists, healthcare providers, and policymakers will be essential in realizing the full potential of AI in transforming healthcare for the better.

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