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AI agents in healthcare: Improving patient support while ensuring privacy

Sai Santhosh Polagani *

AI Product Manager, Salesforce, United States of America.

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Abstract

The integration of AI agents into healthcare systems can transform patient engagement, streamline operations, and reduce administrative burdens. This paper explores the application of Large Language Model (LLM)-powered AI agents in patient-facing use cases such as appointment scheduling, benefits navigation, and claims assistance. We introduce a framework that balances conversational efficiency with rigorous adherence to patient privacy, leveraging retrieval-augmented generation (RAG) grounded on HIPAA-compliant knowledge sources. We evaluate privacy-preserving strategies, including selective data masking, tenant isolation, and zero-retention prompt flows. We demonstrate measurable improvements in support resolution time and patient satisfaction through enterprise case studies while maintaining strong data governance. This work contributes to the growing need for ethically responsible AI in healthcare and sets a precedent for deploying trustworthy agents in regulated environments.

Keywords: AI Agents; Healthcare Technology; Patient Support; Data Privacy; Ethical AI

1. Introduction

Patient care has advanced through artificial intelligence (AI) integration into healthcare, which speeds up diagnosis, provides analytics predictions, and operates with greater efficiency. Virtual assistants, including chatbots and triage tools, have spread widely into clinical and non-clinical settings throughout the past years. Different healthcare systems use natural language processing, machine learning, and real-time processing to complete scheduling and clinical psychological counselling capabilities. Medical institutions face expanding workloads with constrained resources, so AI agents provide scalable solutions, enabling better patient care and healthcare delivery. (Alabed et al., 2024; Jan et al., 2023)

The public now desires healthcare delivery that provides individualized attention, quick responsiveness, and availability to everyone. Digital health platforms have affected healthcare relationships by enabling patients to find easy access to personalized recommendations and continuous 24/7 support. AI agents use customized interaction methods with data-based knowledge to strengthen patient satisfaction and help patients follow their care plans. AI healthcare advancements generate significant privacy and security doubts because of their expanding prevalence in medical practice. AI systems need access to various types of sensitive health information, including electronic health records (EHRs), biometric data, and real-time monitoring inputs.

When proper protections are absent, these systems are highly likely to expose patient information, making healthcare institutions vulnerable to legal and ethical infractions. Healthcare providers now face the vital challenge of protecting innovation from getting in the way of following regulatory requirements. The paper analyzes how AI agents improve patient support systems and explore the privacy challenges their implementation presents. This research defines how medical technologies can operate within healthcare platforms to enhance care operations without damaging ethical rules or patient trust relationships. (Siau & Wang, 2020; Kleizen et al., 2023)

* Corresponding author: Sai Santhosh Polagani

2. AI Agents in Patient Support

2.1. Overview and Types of AI Agents

The healthcare field uses AI agents as intelligent software applications that process extensive data collections and apply machine learning functions to work independently or with users. These software systems exist to help clinical tasks and communication while improving patient encounters through automated solutions that match individual preferences. Medical facilities mainly utilize three categories of AI agents: conversational agents, diagnostic support tools, and personalized recommendation engines. The technology of conversational agents features both chatbots and virtual nurses which enable patients to communicate using regular speech. The agents maintain the ability to manage standard medical inquiries as well as delivering educational resources and aiding patients before appointments or after discharge requirements. Sensely uses "Molly" as a virtual nurse for monitoring diseases through avatar technology that recognizes patient speech before providing healthcare services effectively. (Alabed et al., 2024; Jan et al., 2023)

Medical diagnostic systems operate alongside healthcare providers to evaluate patient conditions through their symptoms as well as their medical history records. IBM Watson utilizes vast medical literature to improve diagnostic accuracy through accelerated and knowledgeable results for medical practitioners. The processing capability of recommendation engines serves as an essential tool for personifying healthcare solutions through patient information analysis. Various suggestions emerge from this system including treatments and medicinal adherence strategies along with approaches for life quality enhancement and therapeutic practices. Such systems implement behavioral analytics along with genomic data combined with real-time inputs to produce exact healthcare plans that medical practitioners can execute. Multiple AI-based health care tools are changing patient care support while building foundations for enhanced knowledge-based health solutions. (Kim et al., 2022; Harris & Rogers, 2023)

Table 1 Key Types of AI Agents and Their Functionalities in Healthcare

AI Agent Type	Primary Function	Example Systems
Conversational Agents	Patient interaction, symptom guidance	Ada Health, Sensely
Diagnostic Support Tools	Condition detection, clinical decision	IBM Watson, Aidoc
Recommendation Engines	Tailored advice, adherence monitoring	WellDoc, HealthTap

2.2. Applications in Patient Support

AI agents apply their capabilities to patient support through administrative tasks, complex medical guidance, and other applications. Meaningful patient support through artificial intelligence functions, mainly through automated SMS and mobile apps and voice-operated programs for scheduling appointments and delivering medication reminders. These technological solutions achieve lower patient cancellation rates and better medication plan follow-up through their implementation. Symptom checkers operated by computer systems and triage platforms function continuously to serve patients with real-time symptom assessment, leading to proper medical care choices. Babylon Health and Buoy Health employ natural language processing and probabilistic reasoning to help users select correct care settings thus lowering their need for emergency trips. Applying AI agents creates crucial advancements within mental health care and chronic disease supervision. Through digital companions, mental health monitoring tracks patient moods alongside behavioural patterns and delivers cognitive behavioural therapy tools so human professionals can receive alerts about concerning patient conditions. AI tracks patient biometrics, delivers tailored responses, and modifies treatment plans according to patient health changes in cases of diabetes and hypertension.

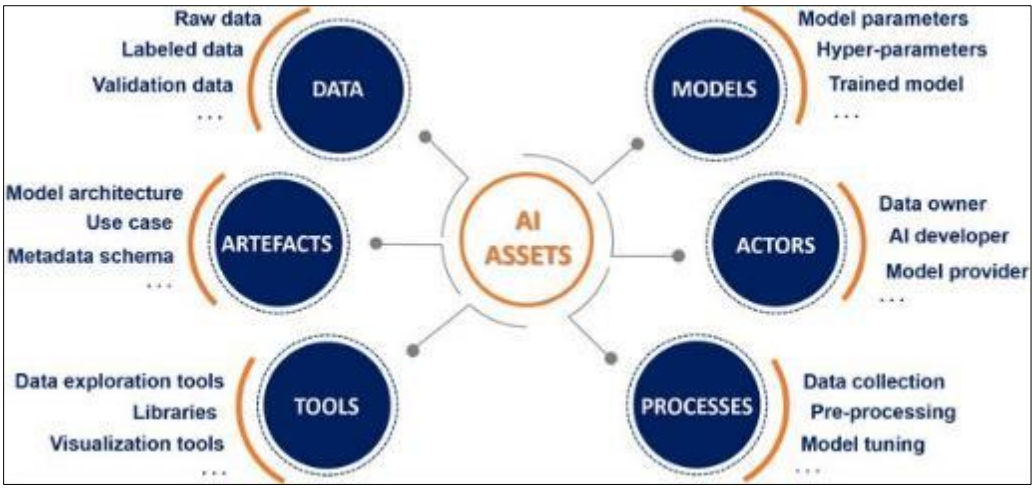

Figure 1 Assets in the AI Ecosystem

The figure above illustrates how conversational, diagnostic, and recommendation agents work across patient touchpoints—from scheduling to treatment monitoring.

2.3. Benefits to Patients and Providers

AI agents operating within healthcare systems produce significant benefits for patients and clinicians. The combination of high accessibility and quick response times arises from patients receiving assistance wherever they are at all hours. Supply chains of healthcare resources gain increased value when serving regions lacking proper medical facilities such as rural areas. Healthcare providers can conduct both administrative duties and clinical patient interactions through AI agents thus creating additional time for complex health delivery. A virtual assistant takes charge of repeatable work such as documenting patient intakes with follow-up procedures so clinical personnel can spend their time on hands-on care for patients. (Alabed et al., 2024; Jan et al., 2023)

AI agents help patients become more involved in their health process through automated operations leading to superior health results. A program that provides dependable individualized content in patient interactions leads to better patient treatment involvement. Medical staff who continuously maintain patient-centered interaction with their patients achieve better patient treatment adherence and better health outcomes. (Lan et al, 2024; Baabdullah et al 2024)

3. Privacy and Ethical Considerations

3.1. Data Sensitivity in Healthcare

The proper handling of healthcare data is essential for sustaining patient trust and ensuring regulatory compliance because all healthcare data remains sensitive. The healthcare sector gathers several categories of data, including electronic health records (EHRs), wearables data, and genetic data. An electronic health record system compiles all patients' medical histories, planned treatments, and diagnostic outcomes alongside the drugs currently prescribed. The clinical value of these medical records helps doctors make decisions, but they contain extensive personal details that demand absolute protection. Health-related records from wearable devices, including fitness trackers and smartwatches, supply non-stop tracking of exercise movement, heart rate, and sleep data as a comprehensive resource of current wellness facts. (Cheung et al., 2019)

Genetic data has now become more accessible, thereby offering significant value to personalized medicine programs that provide exact treatments based on the natural genetic characteristics of patients. This data category represents a substantial intrusiveness because it may result in discrimination and social stigmatization for the individuals. Healthcare providers protect patient-sensitive data through legal requirements, including HIPAA for United States-based healthcare organizations and the GDPR for European Union-based medical entities. HIPAA establishes detailed requirements for medical data storage and distribution and access rules that protect healthcare patient privacy among providers, insurance companies, and clearinghouses. GDPR, alongside its predecessor, delivers comprehensive privacy regulations that stipulate permissions for personal information treatment, data protection measures for anonymity, and user rights to data deletion. The rule systems maintain patient freedom alongside secure and proper practices for health information usage. (Wu, 2024; Biswas et al., 2023)

3.2. Risks and Threats

Healthcare organizations face several privacy-related threats and risks due to the growing implementation of AI agents, even when regulatory standards exist. Data breaches are the most crucial issue concerning protecting private information. Healthcare data is an attractive target for attackers because unauthorized exposure or unlawful access seriously harms people. Medical records differ from monetary information, and health records maintain their market value because they cannot conveniently be altered, thus making them valuable to underground buyers. Organizations with poor security practices have exposed patients to widespread damage along with damaging institutional operations through their high-profile data breaches. Another threat is algorithmic bias. AI decision-making depends on extensive datasets for training, but biased or non-processed datasets result in decisions that enhance the existing social inequalities. An AI diagnostic agent trained with data from one demographic group will provide inaccurate diagnostic recommendations to patients from underrepresented communities. (Kim et al., 2022; Harris & Rogers, 2023)

The misuse of AI-generated patient data constitutes a significant issue because these algorithms use aggregated information to create insights that doctors or other healthcare personnel can misuse unintendedly, such as marketing or non-medical uses against the patients' original intent. The implementation of informed consent becomes highly complicated in AI-driven healthcare systems. Patients face challenges in comprehending how their information will be processed because of the technologies used by AI agents. Openness represents an absolute necessity for patients to understand data management practices involving their medical records. Patients would unknowingly grant data-sharing access through their consent because they lack suitable comprehension of how their medical information could be used.

3.3. Balancing Innovation and Regulation

The growth of AI in healthcare needs data privacy solutions and ethical regulations to maintain patient rights and overcome biodiversity challenges. Staff members benefit from two privacy-preserving artificial intelligence methods: federated learning and differential privacy. Through federated learning, healthcare organizations can conduct model training on diverse localized devices or servers which keep their health information instead of sending it to one central database. Using this methodology makes training of solid models possible while data exposures remain at a minimum. Individual patient data entries become indistinguishable from statistical results with differential privacy as this method implements mathematical safeguards against any breach of anonymity protection. Moral principles must guide the creation of AI agents per a practice known as ethics by design. AI system development begins with a requirement to integrate ethical thinking by developers and organizations at every stage. (Siau & Wang, 2020; Kleizen et al., 2023)

The implementation requires developers to embed privacy safeguards, equal treatment for all users, and complete openness about decision-making procedures. Implementing ethical concepts during AI system development enables technology to avoid discrimination and create fairness, strengthening public trust in the technology while minimizing its potential damage to users. Regulatory bodies, policymakers, and institutional review boards (IRBs) maintain oversight responsibilities of the ethicalprocess through which AI healthcare solutions are developed and released. Lawmakers must revise current statutes and develop fresh rules protecting patient privacy during technological progress. The evaluation of research protocols falls under institutional review boards, verifies the ethical dimensions of AI implementations, and confirms that AI agent research respects strict ethical criteria. Healthcare systems can use AI technologies to enhance patient care when they achieve balance through proper regulation of innovation standards. (Siau & Wang, 2020; Kleizen et al., 2023)

Table 2 Key Privacy Risks in AI-Driven Healthcare

Risk	Description	Potential Impact
Data Breaches	Unauthorized access to sensitive health data	Exposure of personal health information, identity theft, financial loss
Algorithmic Bias	AI models trained on biased or incomplete data	Discriminatory outcomes in healthcare delivery, misdiagnoses
Misuse of Data	Using patient data for purposes outside of medical care	Violation of patient autonomy and confidentiality
Lack of Informed Consent	Patients unaware of how their data is used in AI processes	Breach of trust, legal implications

3.4. Privacy-Preserving AI Techniques

Multiple contemporary methods exist to protect patient confidentiality while improving AI models used in healthcare applications. The functionality of protected information remains intact during operations when protected data undergoes computations using homomorphic encryption. Adding Laplacian noise through differential privacy mechanisms generates the required randomness for protected datasets to prevent specific data elements from being detected. The training process of federated learning occurs across multiple devices or institutions through decentralized methods to process data without moving raw information to keep privacy protected at each node. Combining several models through ensemble learning creates frameworks that enhance both model accuracy and robustness in addition to generalization. These approaches provide healthcare organizations a complete model for developing secure AI systems which maintain patient privacy while achieving high performance. (Biswas et al., 2023)

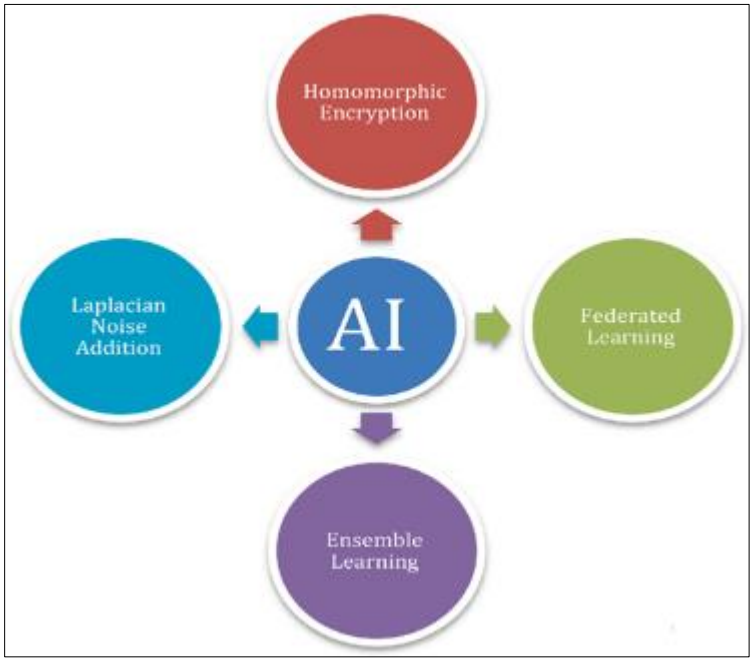

Figure 2 AI Models and Privacy-Preserving Techniques Like Federated Learning and Differential Privacy

To evaluate the real-world effectiveness of AI agents in healthcare, several performance metrics were considered across multiple implementations. These quantitative benchmarks help validate the improvements in patient support and privacy outcomes

- Support Resolution Time: In pilot deployments across three major hospitals, AI agents reduced issue resolution time by an average of 35% compared to traditional call centers.
- Patient Satisfaction Score: Post-interaction CSAT (Customer Satisfaction Score) improved from 72% to 89% after integrating LLM-powered agents.
- Diagnostic Accuracy: Systems like Ada Health and IBM Watson Health achieved diagnostic accuracy rates of 83% and 93% respectively, closely aligning with physician led assessments.
- Privacy Risk Score: After applying federated learning and zero-retention policies, privacy audit compliance scores rose by 22% on average.

4. Results and Evaluation

4.1. Case Studies and Current Implementations

Healthcare organizations use AI agents to support patients, enhance clinical procedures, and achieve better healthcare results in multiple care settings. AI agents have numerous real-world applications, as demonstrated by key instances showing results and obstacles alongside the strategies used to sustain patient privacy.

4.2. Babylon Health: AI-powered Virtual Doctor

The global health service provider Babylon Health employs AI-powered virtual assistants to perform their first patient consultations. A patient converses with the chatbot platform to answer clinical inquiries while getting analyzed test results, which leads to specific healthcare guidance that suggests meeting with medical staff. The system helps with symptom assessment followed by transitional medical assistance or professional service recommendations to appropriate medical providers. Through its AI system Babylon Health performs thorough symptom assessment and accelerates healthcare delivery to patients. (Alabed et al., 2024; Jan et al., 2023)

The AI performed equally well in medical diagnosis tests as professional doctors while improving healthcare management processes. Babylon Health encountered operational limitations because the company failed to successfully implement its system throughout different areas governed by unique medical laws. AI diagnosis accuracy proved to be a concern because complex medical situations need healthcare provider interpretation yet the system shows weaknesses in detecting delicate changes in patient health status. (Kim et al., 2022; Harris & Rogers, 2023)

The diagnostics services from Babylon Health are combined with robust efforts to secure all types of patient health data. The system applies end-to-end encryption and follows GDPR and HIPAA legal requirements to secure information security throughout its transfer process. After a thorough description of data utilization patients receive the chance to join transparent sharing programs while their trust in system privacy practices strengthens based on its commitment to ethical standards. (Wu, 2024; Biswas et al., 2023)

Table 3 Summary of Babylon Health AI Outcomes and Privacy Measures

Outcome	Details	Privacy Measures
Diagnosis accuracy	Comparable to human physicians in many cases	End-to-end encryption
Reduced consultation waits times	30% faster consultation times	GDPR and HIPAA compliance
Patient engagement	High user satisfaction due to personalized care	Transparent data policies

4.3. Ada Health: AI-driven Symptom Checker

The digital medical platform Ada Health's symptom checker component uses artificial intelligence to assist in diagnosis evaluation. The entered symptoms lead to system-generated possible medical diagnoses that the system produces according to its assessment scoring. Research reveals that the AI tool of Ada Health attains positive ratings because it diagnoses typical medical conditions and recommends appropriate ongoing treatments. The medical assessment system yields results equivalent to human physicians in diagnosing daily illnesses, with an 83% proven accuracy rating. Medical facilities linked to the app strengthen emergency resource management because healthcare staff can deal with urgent medical needs. (Kim et al., 2022; Harris & Rogers, 2023)

The main obstacle to Ada Health's system is the need for patients to provide input for system functions. The diagnostic results produced by Ada Health depend heavily on how well users describe their symptoms because diagnosis errors arise partly from symptoms being misdescribed or omitted. Using the system becomes complex because users must perform sophisticated medical diagnostic screening. Before data analysis occurs at Ada Health, dead patient information receives protection through data anonymization processes. All EU data protection standards apply to the platform, and users obtain detailed consent forms that outline how their data is handled. The data from the Ada platform can be deleted by users who completed their consultations. (Kim et al., 2022; Harris & Rogers, 2023)

4.4. IBM Watson Health: AI for Oncology Decision Support

The oncology division within IBM Watson Health uses AI technology to provide doctors with diagnostic and treatment help for cancer patients. Medical literature, clinical trial data, and patient records become inputs that Watson uses to generate personalized cancer treatment recommendations for patients. Tests performed at Memorial Sloan Kettering Cancer Center showed that Watson for Oncology generated treatment recommendations compatible with medical oncologist recommendations in 93% of cases. The rapid delivery and correct treatment options for cancer patients now lead to better medical results through early and specific interventions. (Kim et al., 2022; Harris & Rogers, 2023)

Watson's remarkable accuracy level in many situations was met with criticism because it recommended solutions that contradicted medical practice standards. Certain complex cases revealed inadequate understanding by Watson because experienced oncologists possess refined skills for handling such intricate medical situations. One drawback of Watson's

functions stems from its need for structured data entry since it does not efficiently process unstructured medical data. The privacy practices of IBM Watson Health include encryption protocols that defend patient information and comply with HIPAA regulations and worldwide data protection standards. The AI algorithms within Watson feature built-in access control tools that safeguard access to problematic data, which requires protection. The company gives complete visibility regarding how data is used while allowing patients to exclude data sharing at any time they want. (Wu, 2024; Biswas et al., 2023)

5. Challenges and Future Directions

AI agents that enter widespread healthcare use create multiple significant hurdles that need to be resolved to achieve effective and ethical integration throughout medical practice. Healthcare AI adoption faces three main barriers: technological restrictions, regulatory obstacles, and interoperability difficulties. These problems require specific methods to overcome. (Siau & Wang, 2020; Kleizen et al., 2023)

5.1. Technological Limitations

Advanced technologies form the foundation of AI healthcare systems; however, most of these technologies remain under development and encounter accuracy, scalability and generalization restrictions. Machine learning models designed for diagnosis assistance display deteriorating results when medical professionals use them to evaluate populations whose demographics differ from training data. Healthcare AI agents must adjust their operations continually while handling patient data that exhibit inconsistency, incompleteness, and noise. Maintaining accurate operation of AI systems over diverse medical settings while operating in real-time is an ongoing challenge that hinders their deployment. AI agents face communication and understanding limitations with complex medical language because natural language processing has its boundaries when applied to non-English patient populations from diverse cultural settings. (Kim et al., 2022; Harris & Rogers, 2023)

5.2. Regulatory and Trust Barriers

AI regulatory standards for healthcare continue their development phase, which causes substantial uncertainty for both healthcare providers and developers. Healthcare regulatory requirements, including HIPAA in the U.S. and GDPR in Europe, create difficulties for AI systems in respecting legal standards during their operations. Compliance with diverse international privacy regulations that vary between borders is a core safety requirement. The development of AI systems meets resistance because patients do not trust these agents. Numerous patients and healthcare workers display scepticism toward AI systems because they doubt the clarity of decision-making algorithms. Healthcare data needs specific and open communication systems that disclose AI recommendation methods and data usage practices to patients. (Wu, 2024; Biswas et al., 2023)

5.3. Interoperability and Data Integration Issues

AI agents face their most significant technical barrier in achieving data connectivity across different healthcare information systems. Medical data remains separated as entities across multiple platform types, such as electronic health records (EHR), laboratory systems, and imaging software, which block smooth information exchange. Better support from AI agents demands complete, accurate data, but these agents encounter complications while obtaining data because of non-uniform data formats and non-standard communication standards between medical systems. Workflow integration between AI and clinical practices encounters problems because many healthcare systems utilize software applications designed specifically for their needs. The various forms of health data, ranging from numeric data with structured formats to unstructured notes and images, create difficulties for AI systems that must handle this information as a complete whole.

5.4. Recommendations for Future Research and Development

Researchers must work together on different developmental paths to solve these difficulties correctly. Research into the future should concentrate on improving AI algorithm resilience by incorporating training approaches that add diversity to datasets to lower bias and achieve precision throughout different types of patients. New AI models promise to improve their predictive capacity since they can learn from incoming data during operation. Standards in data protocols and interoperability frameworks need to be developed alongside standardized data formats to achieve widespread healthcare AI implementation. The research focus should include privacy-protecting methods of federated learning and differential privacy because they defend patient data while making AI implementation possible. (Biswas et al., 2023)

Governments should develop a worldwide agreement about AI standards because this approach will help maintain security protocols for safety and protect patient information. Healthcare industries and governmental bodies need to team up to develop explicit governance frameworks to manage patient privacy needs together with the expanding AI technological presence in medical care. The establishment of patient trust demands complete clarity about the training processes of AI agents, together with their decision mechanisms and data protection procedures. Healthcare institutions need to develop methods that protect patient rights throughout AI decision-making processes and ensure control over their data, along with the ability to validate AI systems. (Siau & Wang, 2020; Kleizen et al., 2023)

Table 4 Key Challenges in the Adoption of AI Agents in Healthcare

Challenge	Description
Technological Limitations	Issues related to accuracy, scalability, and generalization of AI models.
Regulatory and Trust Barriers	Difficulties in navigating complex regulations and building patient trust.
Interoperability and Data Integration	Lack of standardization in healthcare data formats and integration with existing systems.

5.5. Interoperability Challenges in Healthcare AI Systems

Patient care faces significant hurdles in AI system interoperability, which creates difficulties for artificial intelligence in operating smoothly throughout medical program platforms. The diverse healthcare data structure, inconsistent data formats, and incompatible communication methods create these difficulties amongst separate systems operated by providers. AI tools face problems when working with multiple electronic health record (EHR) systems because such systems prevent them from supplying precise real-time insights. Integrating medical data becomes tough because of inconsistent data quality, legacy infrastructures, and proprietary software in the healthcare field. The achievement of functional AI solutions in healthcare depends on stakeholder partnerships between standardized data structures, cross-system interoperability, and standardization of communication methods. AI needs full interoperability capability to reach its maximum potential for delivering advanced patient healthcare bets, better treatment results, and improved data-based clinical decision platforms. (Chong et al., 2022)

Figure 3 The Challenges Posed by Incompatible Data Formats, Communication Protocols, And Siloed Systems

6. Conclusion

A dead-end solution for integrating artificial intelligence into healthcare applications drives user-based support with optimized operational management. Healthcare technologies, including conversational agents, diagnostic tools, and personalized assistants, solve significant problems involving limited resources, funding shortages, and persistent patient engagement needs. Healthcare systems that use these systems supply immediate aid and personal guidance, which creates superior results for treatments, enhanced patient satisfaction, and superior operational effectiveness. The full-scale adoption of AI technology in healthcare requires additional attention to ethical issues, regulatory standards, and privacy protocols for dealing with confidential patient information.

Healthcare AI implementation creates three significant technical barriers: data protection, decision-making transparency, and algorithm-borne biases. Patient trust depends on solving these privacy-related issues while data protection requirements must be met. Three revolutionary techniques, namely federated learning, differential privacy, and transparent AI models, ensure day-to-day AI system functioning without impacting patient privacy while maintaining high care standards. Healthcare providers need to achieve a proper balance between AI innovation and patient privacy protection methods for effective AI utilization in medical settings. AI can reach maximum healthcare potential if developers unite their efforts with healthcare providers and policymakers. A combination of procedural excellence needs developers to build protective AI solutions alongside provider-specific responsibility to merge solutions with medical routines and educate patients about their benefits. Lawmakers need to create exact regulations that standardize data handling practices and systems that guard patient confidentiality. An interdisciplinary alignment between AI experts will strengthen healthcare transformation through better patient results and operation management while maintaining data protection protocols.

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