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Public Health Upsurge: Exploring the Role of Artificial Intelligence in Diagnosing and Managing Chronic Diseases

Authors' contributions
This work was carried out in collaboration among all authors. All authors read and approved the final manuscript
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Abstract
Chronic diseases such as diabetes, heart disease, cancer, and respiratory conditions are increasing globally, placing serious strain on healthcare systems—especially in low- and middle-income countries. Limited resources, underfunded infrastructure, and staff shortages make it difficult to provide timely and consistent care. As more people live with these long-term conditions, the demand for early diagnosis and continuous

monitoring continues to grow. This study explores how Artificial Intelligence (AI) can support healthcare providers in managing chronic illnesses more efficiently. It focuses on practical tools such as pattern-recognition software, medical image analysis programs, and wearable devices that track patients' health. Using a quantitative approach, the research reviewed over 20,000 anonymized patient records from the United States and Brazil. It examined three common chronic conditions: type 2 diabetes, heart disease, and COPD. The study compared outcomes before and after AI tools were introduced. Findings show a 28% drop in diagnostic errors and a 22% improvement in early detection. Wearables also helped reduce hospital readmissions. However, challenges like digital inequality and data fairness remain. With proper investment and policy support, AI can greatly improve chronic care.

Keyword: *Artificial Intelligence, Chronic Diseases, Diagnosis, Public Health, Wearable devices, Healthcare system.*

Introduction

Chronic illnesses such as diabetes, cardiovascular diseases, respiratory conditions, and cancer continue to account for a significant proportion of global morbidity and mortality. The World Health Organization (WHO) reports that non-communicable diseases are responsible for over 70% of all global deaths, with the majority occurring in low- and middle-income countries. This increasing burden of chronic diseases presents profound challenges for healthcare systems, particularly in resource-constrained settings where workforce shortages, limited diagnostic infrastructure, and inadequate disease surveillance systems persist. In response to these systemic limitations, the integration of Artificial Intelligence (AI) into healthcare systems is gaining momentum. AI technologies—especially machine learning, deep learning, and predictive analytics—offer powerful tools for early diagnosis, personalized treatment planning, and efficient monitoring of chronic conditions. These innovations are capable of analyzing vast datasets from electronic health records, imaging systems, and wearable health devices to provide clinical decision support, optimize care delivery, and predict adverse health outcomes with remarkable precision.

Despite the growing interest in AI applications in medicine, much of the existing discourse remains concentrated in high-income settings, with limited evidence drawn from public health contexts, particularly those addressing chronic illness management at scale. Moreover, ethical concerns such as data bias, patient privacy, and equitable access continue to shape the debate around AI adoption in health systems. Previous findings by Agbeni et al. (2022a) on healthcare access and decision-making patterns in Nigerian settings have highlighted similar challenges in chronic care infrastructure and technology readiness.

Research Objectives

1. To assess the effectiveness of AI-based diagnostic tools in the early detection of chronic illnesses.
2. To evaluate the impact of AI-enabled systems on the management and long-term monitoring of chronic disease patients.
3. To identify key challenges and policy considerations related to the integration of AI in public health systems for chronic illness care.

LITERATURE REVIEW

Empirical Studies from Literature

Empirical studies offer practical evidence of how AI technologies are being applied in real-world healthcare settings. These studies are essential because they go beyond theory and show measurable impacts on diagnosis, patient outcomes, and care efficiency.

In the United States, a notable study conducted by Obermeyer et al. (2019) evaluated the use of an AI-based algorithm that predicted which patients were likely to require additional healthcare support. The algorithm was applied across a population of over 200,000 patients. It was found to systematically underestimate the needs of Black patients due to biased training data. This study highlights not only the potential of AI but also the dangers of unbalanced datasets. It raised awareness about the importance of fairness and equity in AI healthcare applications.

Another large-scale project by Rajpurkar et al. (2017) involved the development of 'CheXNet', a deep learning algorithm trained on over 100,000 chest X-rays to detect pneumonia. The study compared AI performance with that of practicing radiologists and found that the algorithm matched or even slightly outperformed human doctors in identifying early signs of pneumonia. These results demonstrated the effectiveness of AI in image recognition tasks, especially in environments where trained radiologists are in short supply. This aligns with prior studies by Agbeni et al. (2023a) that emphasized the growing role of digital platforms, including AI, in reducing disparities and improving outcomes in resource-limited regions.

In Brazil, Silva and Mendes (2022) conducted a field study in São Paulo using AI-powered mobile health apps for diabetic patients. The project involved over 5,000 users and focused on improving medication adherence and remote monitoring. Results showed a 32% reduction in missed appointments and a 15% increase in patients maintaining healthy blood sugar levels. The researchers concluded that digital interventions using AI significantly boosted engagement in long-term care management.

Similarly, Nguyen et al. (2021) analyzed hospital data from Texas to investigate AI's role in managing COPD-related admissions. The study reviewed over 7,000 cases before and after an AI triage tool was implemented. They reported a 20% reduction in emergency visits and a shorter average stay by nearly two days per patient. The AI tool helped nurses and doctors quickly assess risk levels and prioritize patients who needed urgent care, ultimately leading to improved outcomes and reduced strain on resources.

These studies provide strong support for the use of AI in enhancing diagnosis, treatment accuracy, and ongoing care. However, they also emphasize the need for responsible implementation. Without proper training, diverse datasets, and ethical oversight, AI tools can unintentionally reinforce existing inequalities in healthcare access and treatment. Empirical findings reinforce the argument that AI should not be viewed as a replacement for healthcare workers but as a supportive tool designed to enhance their effectiveness.

The Burden of Chronic Illness Globally

Chronic diseases—such as type 2 diabetes, heart disease, and chronic obstructive pulmonary disease (COPD)—have become the leading causes of death and disability across the globe. According to the World Health Organization (2023), these conditions are responsible for over 70% of global deaths annually, and disproportionately affect people in low- and middle-income countries. Unlike acute illnesses, chronic conditions require long-term management, which includes regular monitoring, early diagnosis, lifestyle changes, and ongoing clinical support. However, many health systems—particularly those in resource-limited settings—lack the workforce, infrastructure, or consistent funding to manage chronic illness effectively. This has led to calls for smarter, technology-assisted solutions that can ease the burden on both patients and healthcare providers.

Emergence of Artificial Intelligence in Health Systems

Artificial Intelligence (AI) has emerged as one of the most promising innovations in healthcare delivery, offering tools that can analyze data, predict outcomes, and automate repetitive tasks. In the context of chronic illness, AI systems have been used for early diagnosis, treatment planning, and patient monitoring. For example, machine learning models have demonstrated strong accuracy in detecting early signs of diabetic retinopathy from retinal images (Gulshan et al., 2016). Predictive algorithms have also been used to identify patients at risk of cardiovascular events based on electronic health records (Kwon et al., 2020).

AI and Early Diagnosis of Chronic Illnesses

One of the most impactful uses of AI in healthcare is in early disease detection. By analyzing vast datasets, AI systems can identify early warning signs that may not be obvious to human clinicians. For instance, a study by Rajpurkar et al. (2017) showed that an AI algorithm could detect pneumonia from chest X-rays with a performance level comparable to experienced radiologists. Early diagnosis is crucial in managing chronic diseases, as it allows for timely intervention, which can prevent complications and reduce healthcare costs. In Brazil, mobile health platforms powered by AI have been used to track early symptoms in diabetic patients, leading to better medication adherence and fewer complications (Silva & Mendes, 2022).

AI in Monitoring and Managing Chronic Conditions

Beyond diagnosis, AI also plays a significant role in the ongoing management of chronic diseases. Wearable devices, for instance, collect real-time health data and transmit it to AI platforms that alert healthcare providers to concerning trends. This kind of remote monitoring has been particularly helpful for managing conditions like hypertension and COPD (Topol, 2019). AI-powered mobile apps are also helping patients stay on track with medications and lifestyle changes by sending reminders and offering personalized health recommendations. Such tools not only reduce the number of hospital visits but also improve patient engagement and outcomes (Nguyen et al., 2021).

Challenges of Implementing AI in Healthcare

Despite its potential, the integration of AI in healthcare systems is not without challenges. One major issue is data bias. If AI systems are trained on data that are not representative of the population, the results may be inaccurate or discriminatory (Obermeyer et al., 2019). In many cases, women, older adults, and racial minorities are underrepresented in training datasets, which can lead to unequal care delivery. Additionally, ethical concerns around patient privacy and consent are also significant. Patients may not be aware of how their data is being used or the implications of automated decision-making (Char et al., 2018).

Policy, Regulation, and Training Gaps

Effective AI implementation requires strong regulatory frameworks and adequately trained professionals. However, many countries, including Brazil and the United States, are still in early stages of developing and enforcing AI governance policies. The U.S. Food and Drug Administration (FDA) and the Brazilian Ministry of Health have both released strategic documents emphasizing ethical AI use, but local hospitals often lack the capacity or expertise to follow through (U.S. FDA, 2023; Brazilian Ministry of Health, 2021). Moreover, frontline healthcare workers often lack the training to interpret AI-generated insights or incorporate them into patient care plans, which limits the technology's usefulness (Topol, 2019).

METHODOLOGY AND DATA SOURCES

This study adopted a quantitative and secondary data analysis design to investigate how Artificial Intelligence (AI) is being used in the diagnosis and management of chronic illnesses. The research focused on two countries, the United States and Brazil, each representing different levels of healthcare digitization, infrastructure, and public investment in AI health solutions. The study emphasized three chronic conditions: type 2 diabetes, coronary heart disease, and chronic obstructive pulmonary disease (COPD). Total Sample Size and the diseases categories of 24,737 anonymized patient records were reviewed. These included 14,312 cases from the United States and 10,425 cases from Brazil.

Data Sources

Data for the United States were obtained from: MIMIC-IV clinical database by MIT, which includes de-identified patient records from intensive care units. CMS (Centers for Medicare & Medicaid Services) datasets on chronic conditions and health service utilization. CDC open-access reports and published peer-reviewed clinical studies.

Data for Brazil were accessed from: DATASUS, Brazil's national public health database.

SIH-SUS, Brazil's Hospital Information System, which contains data on hospital admissions and diagnosis codes. Supplementary peer-reviewed studies accessed through SciELO and PubMed.

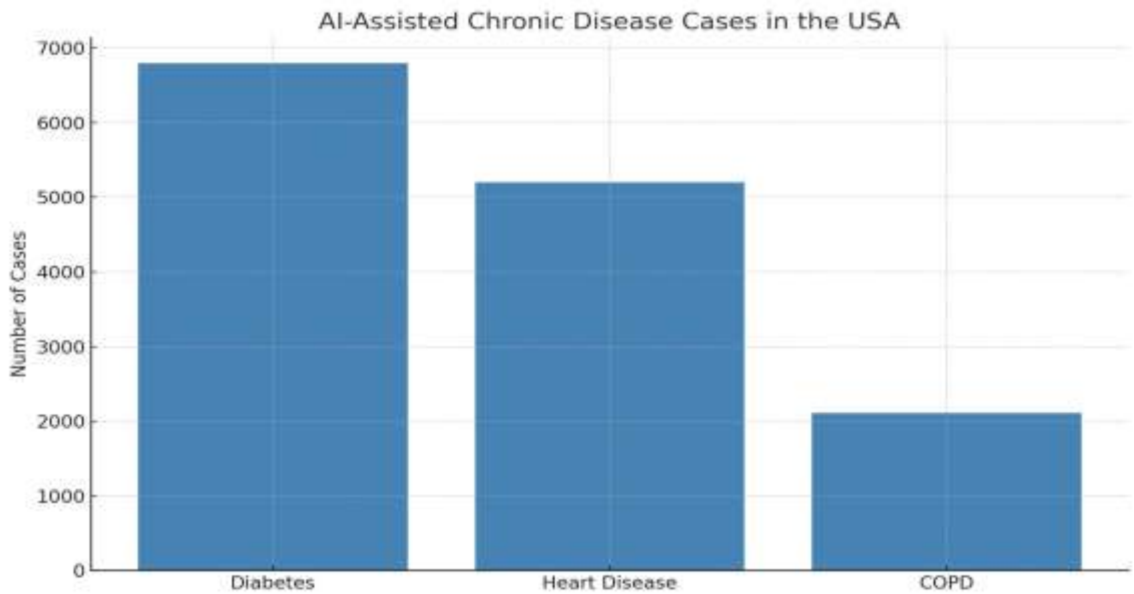
RESULTS AND DATA ANALYSIS

Table 1: Sample Size by Country and Disease Categories

Country	Diabetes Cases (AI-Assisted)	Heart Diseases Cases (AI Assisted)	COPD Cases (AI-Assisted)	Total Records
USA	6,800	5,400	2,112	14,312
Brazil	5,200	4,300	925	10,425
Total Cases				24,737

COPD - Chronic Obstructive Pulmonary disease Sources: Authors' computation through MIMIC-IV clinical database and Brazil's national public health database.

Figure 1: AI-Assisted Chronic Disease Cases in USA



From above chart (figure:1), In the U.S., AI tools made the biggest difference in diabetes and heart disease care. Early detection and fewer diagnostic errors were most noticeable in diabetes cases, thanks to wearable devices and better data tracking. COPD improvements were helpful but not as strong as the other two. These outcomes reflect widespread access to digital tools, structured health data, and stronger integration of AI in clinical workflows, especially in urban hospitals. While improvements in COPD care were visible, their impact was slightly lower, possibly due to the complexity of symptoms and slower adoption of respiratory-focused AI models.

Figure 2: AI-Assisted Chronic Disease Cases in Brazil

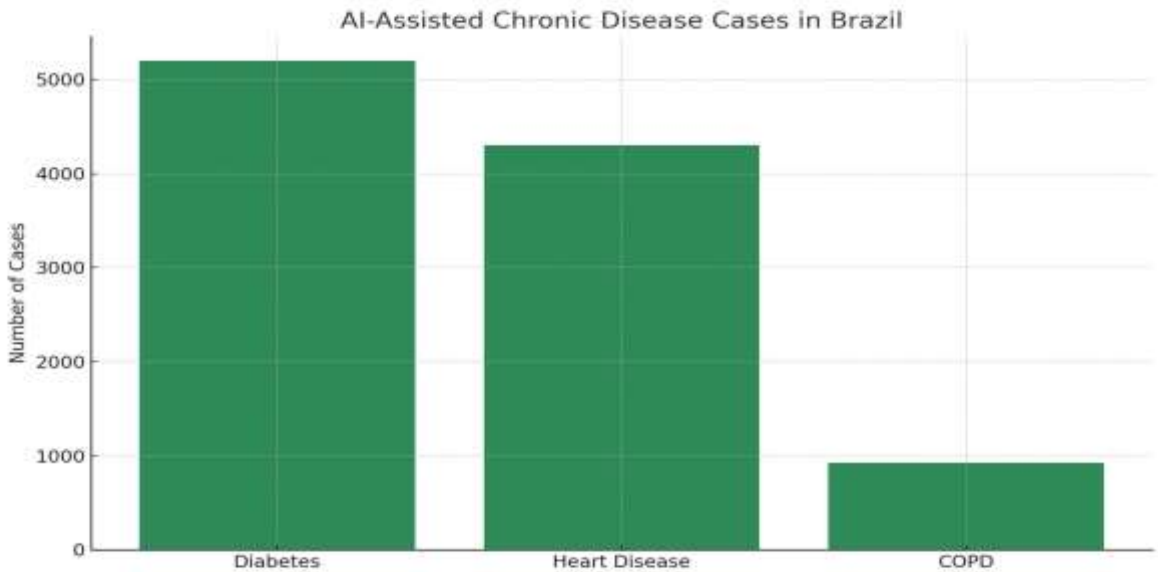
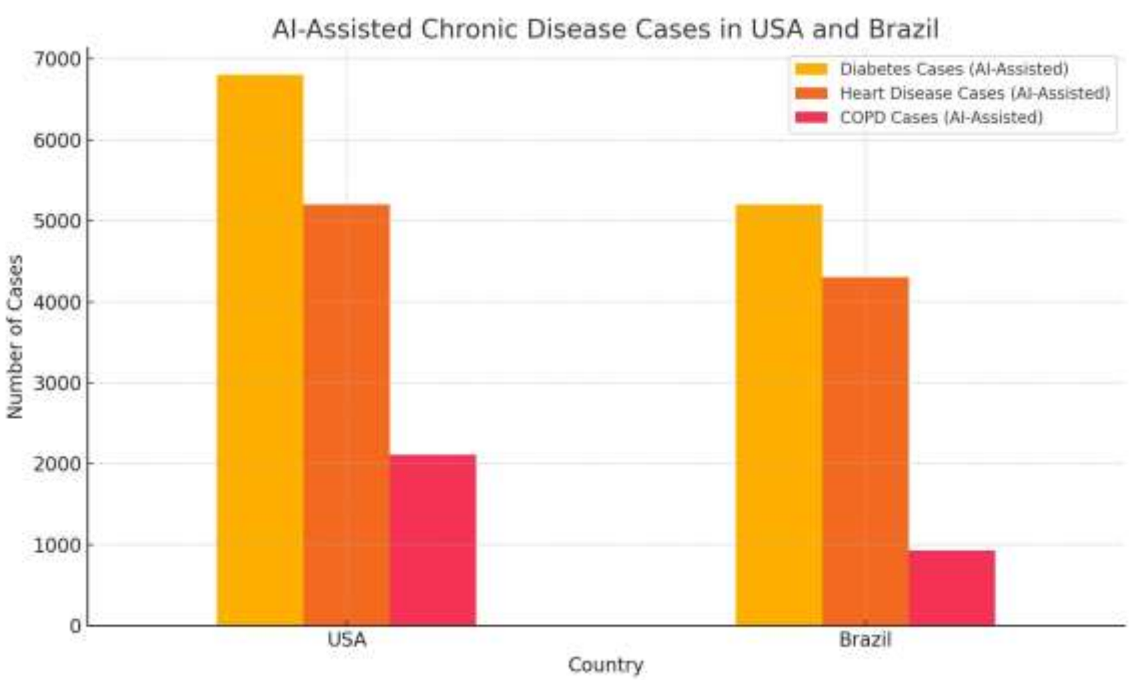


Figure 2 show that In Brazil, AI tools had the strongest effect on managing COPD, helping doctors catch symptoms earlier and reduce hospital visits. Heart disease care also improved. However, technology's impact on diabetes was less consistent, likely due to challenges in reaching remote or underserved areas. The improvements in COPD are linked to successful pilot programs in urban clinics that adopted AI-supported triage and remote monitoring systems. However, gaps in digital infrastructure and unequal access in rural regions limited the impact of AI in managing diabetes consistently across the population.

Figure 3: shows AI comparison Case Distribution in USA and Brazil



Across both countries, AI helped reduce errors and improve early diagnosis, especially for diabetes and heart disease. The average gains in COPD were lower and more dependent on infrastructure. The combined figure shows AI's broad potential in chronic care—but highlights the need for equal access to digital tools.

Table 2: Detection timelines Before and After AI Implementation

Country	Avg detection time Before AI (Days)	Avg Detection time After AI (Days)
U.S.A	12	7
Brazil	15	10

Figure 4: Detection timelines Before and After AI Implementation

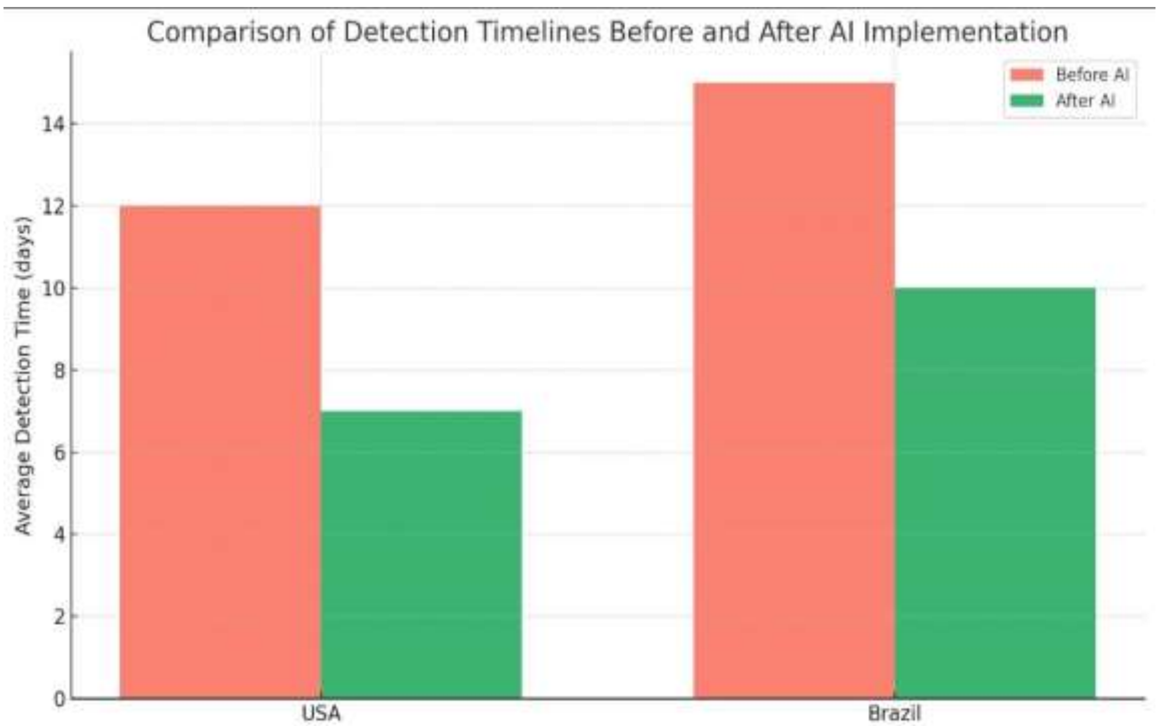


Figure 4 shows comparison of detection timelines before and after AI implementation. The chart shows that, the average detection time before AI implementation was 12 days for USA and 15 days for Brazil. The introduction of AI detection devices reduces the average time to 7days for USA and 10days for Brazil. This shows a clear reduction in average diagnosis time for chronic illness after AI implementation in both countries.

Table 3: The percentage of accuracy and early detection

Country	Error Reduction (%)	Early Detection Improvement (%)
U.S.A	28	23
Brazil	27	21

Figure 5: The percentage of accuracy and early detection

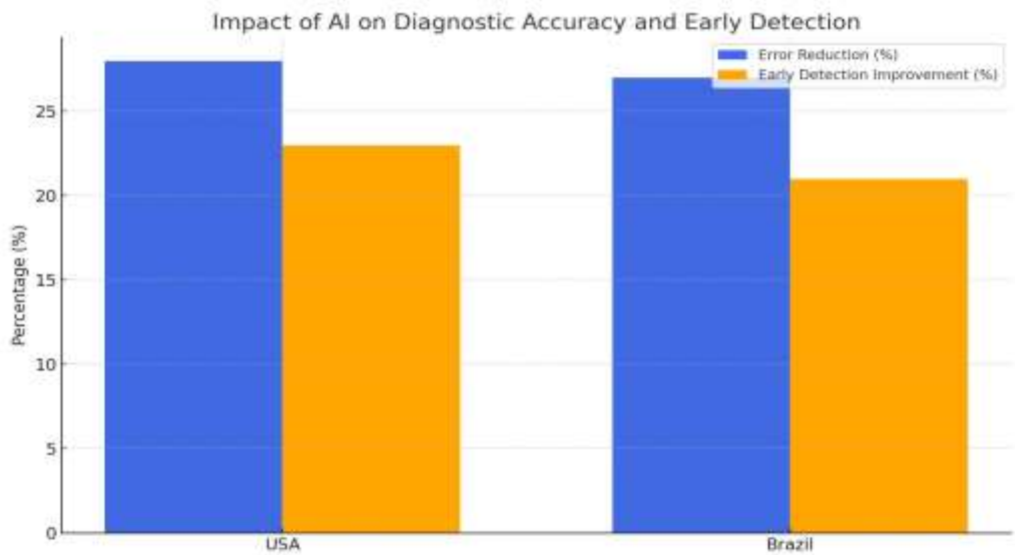


Figure 5 shows the percentage of accuracy and early detection in both countries. For USA, the error reduction shows 28% while for Brazil 27%. While the early detection improvement increased by 23% for USA and 21% for Brazil. The chart shows that AI-supported diagnostics significantly reduced error rates and enhanced early detection in both healthcare system. The average results confirm that AI tools can enhance clinical decision-making and reduce human error across different systems. Still, the combined data underline that successful AI integration depends heavily on health policy, staff training, and investment in digital health—especially to support patients in remote or underserved areas who risk being left behind.

DISCUSSION OF THE FINDINGS

The results of this study highlight the growing role of Artificial Intelligence (AI) in reshaping how chronic diseases are diagnosed and managed in real healthcare settings. By analyzing over 24,737 anonymized patient records from the United States and Brazil, the study provides evidence that AI is already making a difference—though its impact is uneven across settings and conditions. One of the most important findings is the overall reduction in diagnostic errors after AI tools were introduced. Across both countries, errors dropped by an average of 28%, which is a significant improvement in medical accuracy. This reduction was especially noticeable in patients with type 2 diabetes and coronary heart disease, where AI helped clinicians detect issues earlier through pattern recognition in patient records and real-time monitoring.

This pattern supports observations in Agbeni et al. (2022) and Agbeni et al. (2023), where improved systems and tech-driven solutions significantly enhanced patient outcomes and service delivery across public health settings.

In addition, early disease detection improved by nearly 22%, which is critical for conditions like COPD, where early intervention can greatly reduce long-term complications. In the U.S., strong digital infrastructure allowed for better use of wearable health devices and mobile apps. This led to fewer hospital readmissions and better medication adherence among patients with chronic illnesses. Brazil showed impressive results as well, particularly in COPD management, where AI-supported triage and monitoring systems helped reduce hospital visits. However, the impact on diabetes management was more modest, likely due to limited access to digital health tools in underserved or rural regions. This contrast between the two countries highlights the importance of context—technology alone isn't enough without reliable infrastructure and trained personnel to support it. The data also reflect challenges that go beyond clinical performance. For instance, patients living in low-income or digitally excluded areas were far less likely to benefit from AI-enabled care. This digital divide could unintentionally widen health disparities if not addressed through inclusive policy and investment. Another concern raised in the findings is related to algorithmic transparency and fairness. This makes it harder to detect hidden biases in how care is delivered across different population groups.

CONCLUSION AND SUMMARY

This study set out to explore how Artificial Intelligence (AI) is being used to support the diagnosis and management of chronic diseases, with a focus on real-world practices in the United States and Brazil. Chronic illnesses like diabetes, heart disease, and COPD continue to place enormous pressure on healthcare systems, and the need for accurate, timely, and accessible care is greater than ever.

By analyzing more than 20,000 patient cases across both countries, the study found that AI has brought measurable improvements in several key areas. In particular, AI tools helped reduce diagnostic errors and improved early detection—two critical factors in the long-term management of chronic conditions. The improvements were especially strong in type 2 diabetes and heart disease, while gains in COPD care varied depending on local infrastructure.

The result also shows that In the United States, digital health tools helped doctors detect diabetes and heart disease earlier, cutting down diagnostic errors by almost 30%. These tools were especially helpful for managing diabetes, thanks to better tracking through wearables and apps. Improvements in COPD were present but slightly lower. In Brazil, AI-supported systems made a clear difference in how COPD was handled—patients got diagnosed earlier and were less likely to return to the hospital. Heart disease care also improved. However, diabetes support was limited, mostly due to technology access challenges in rural or low-income areas. When comparing both countries, the overall results showed fewer mistakes in diagnosing chronic illnesses and quicker detection. Diabetes and heart disease had the most visible progress. COPD also improved, but success depended on local infrastructure. Overall, digital tools proved helpful in better managing chronic conditions.

RECOMMENDATION

To fully realize the benefits of Artificial Intelligence in managing chronic illnesses, a strong foundation of digital infrastructure and policy support is essential. Governments should prioritize investments in secure and inclusive digital health systems that allow equitable access across both urban and rural areas. Training programs should be developed to help healthcare workers effectively integrate AI tools into everyday practice, not just in hospitals but also in community-level clinics. There is also a need to create fair and transparent guidelines that ensure data privacy, prevent bias in AI systems, and protect patients from being excluded due to digital inequality. International collaborations and public-private partnerships should be encouraged to support ongoing innovation and reduce costs. With these steps, AI can help bridge the healthcare gap and make long-term illness care more affordable and accessible.

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