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Wearable Technology in the Management of Chronic Diseases: A Growing Concern

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ABSTRACT

Wearable technology in the management of chronic diseases has emerged as a significant and growing concern in healthcare. These technologies, including smartwatches, fitness trackers, and other sensor-based devices, offer continuous monitoring and real-time data collection for individuals with chronic conditions. The data collected can include vital signs, activity levels, sleep patterns, and more, providing valuable insights into a patient's health. This trend is particularly relevant in the context of chronic diseases, such as diabetes, cardiovascular conditions, and respiratory disorders, where continuous monitoring is crucial for effective management. Wearable devices empower patients to actively participate in their healthcare by facilitating self-monitoring and promoting healthy behaviors. Healthcare providers can also leverage the data generated by these devices to make informed decisions, personalize treatment plans, and intervene proactively. However, challenges exist, such as data security and privacy concerns, the accuracy of the collected information, and the need for effective integration into existing healthcare systems. Despite these challenges, the increasing adoption of wearable technology in chronic disease management reflects a promising avenue for improving patient outcomes and reducing healthcare costs through preventive and personalized care.

1 | Background

Wearable technology in healthcare has been on the rise in recent years, with a growing number of devices being developed and marketed to help individuals manage their chronic conditions. These devices, such as fitness trackers and smartwatches, can track and monitor various health metrics, including physical activity, sleep, heart rate, and medication adherence which can be useful for individuals with chronic conditions such as diabetes, heart disease, and obesity. Scheid et al. [1] published an editorial discussing the opportunities of using wearable technology to increase physical activity in individuals with chronic disease. They noted that wearables can provide real-time feedback on physical activity levels, as well as provide motivation and accountability for individuals to increase their physical activity. Lu et al. [2] reviewed the use of wearable technology in the management of allergic and asthmatic conditions and found that wearables can provide valuable information on symptoms, triggers, and treatment adherence, which can be used to improve patient outcomes. O'Keeffe et al. [3] published an editorial discussing the importance of distinguishing between physical activity and sedentary behavior in chronic disease management. They noted that while wearables have the potential to track and increase physical activity, they

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Summary

- Wearable technology enables continuous monitoring of vital signs, activity levels, and other health metrics for individuals with chronic conditions, empowering patients to actively participate in their healthcare. This self-monitoring promotes healthy behaviors and enhances patient engagement, contributing to better health outcomes and more personalized treatment approaches.
- Despite the advantages, incorporating wearable technology into clinical care is complex due to concerns over data privacy, device accuracy, and high costs. Additionally, effective integration requires addressing standardization issues in data collection and interpretation and maintaining patient trust by securing sensitive health information.

can also be used to track and reduce sedentary behavior. This is important because sedentary behavior has been linked to several health risks, including obesity, diabetes, and heart disease. Similarly, Phillips et al. [4] conducted a systematic review of the literature on the use of wearable technology and physical activity in chronic disease management. Wearable technology empowers people with long-term diseases to take control of their health. With diabetes, for instance, blood sugar levels can be tracked and individuals could also receive alerts for high or low levels. Wearables could also monitor calories burned, and other crucial health metrics [5]. Tracking sleep patterns and quality offers valuable insights into the causes of insomnia and other sleep problems among chronic disease patients. Wearables allow individuals to monitor daily activity levels, ensuring they stay within healthy ranges [5]. Medication reminders become convenient with wearable technology, as people with chronic conditions could be reminded to take their medications.

Wearable technology not only prevents but also treats serious diseases by keeping patients comfortable and connected during treatment. Real-time health and vital sign monitoring provides clinicians with critical information needed to make informed decisions. For example, the continuous glucose monitor has made life easier for children with diabetes by allowing them to check their blood sugar levels throughout the day without having to prick their finger multiple times [5]. Greiwe et al. [6] added that wearable technology has the potential to be integrated into clinical practice. The validity of wearables for remote monitoring of digital health and physical activity in multiple settings have also been reported [7–9]. Despite the widespread use of wearables, incorporating them effectively into clinical care remains a challenge, despite their numerous health benefits and potential clinical applications [10–12]. Some of the challenges with wearable technology include device accuracy, user engagement, and data interpretation, lack of standardization in the data collected, privacy concerns, affordability, and high cost of the device which are important factors that impact adoption and continuation [4, 13]. The purpose of this study is to provide an overview of the current usage of wearables in chronic disease management, highlighting the integration opportunities for optimal clinical care and challenges of using these devices in this context, as well as the potential for future developments in this field.

2 | Optimization of Wearable Technology Through Integration With Artificial Intelligence (AI) and Blockchain

AI, blockchain, and wearable technology have the potential to revolutionize chronic disease management. The integration of these technologies can optimize existing models of care, with improved patient outcomes and reduced healthcare costs. As noted by Phillips et al. [4], wearables have the potential to provide real-time data on physical activity levels and other health-related information, which can be used to personalize treatment plans and improve disease management. Xie et al. [14] discussed the potential of integrating AI and blockchain in wearables to improve chronic disease management. AI can be used to analyze large amounts of data collected by wearables, providing insights into disease progression and identifying patterns that can be used to predict future health outcomes. For example, Lu et al. [2] conducted a narrative systematic review of the literature on wearable health devices in healthcare and highlighted the use of AI in wearables for disease diagnosis, treatment planning, and patient monitoring. Blockchain technology can be used to secure and protect sensitive health information, ensuring patient privacy and data integrity. This is particularly important as it pertains to electronic health records (EHRs) which are critical in chronic disease management. Blockchain technology can be used to create tamper-proof records, which is essential for maintaining trust in the medical system and promoting patient engagement. Xie et al. [14] also reported that blockchain can play an important role in creating an efficient and secure communication platform for telemedicine, which is becoming increasingly important in chronic disease management. In contrast to AI and blockchain, wearable technology is a mature technology that has been widely adopted in healthcare. However, the integration of these technologies with wearables can bring new opportunities for chronic disease management.

3 | Wearable Technologies in Telemedicine: Enhancing Chronic Care

Telemedicine has become an essential part of modern healthcare, particularly in the management of chronic conditions. As reported by Rowan et al. [15], telemedicine has the potential to improve access to care, reduce healthcare costs, and improve patient outcomes. Wearable technology can enhance telemedicine is several ways. First, wearables can continuously monitor patients' health status and provide real-time data on various health metrics, such as physical activity levels, heart rate, and sleep patterns. These data can be used to track disease progression and identify potential complications, allowing healthcare providers to intervene early and prevent adverse outcomes. Second, wearables can help patients self-manage their conditions, providing them with the tools they need to adhere to treatment plans and make lifestyle changes. This can improve patient engagement and empower patients to take control of their health. The integration of wearable technology with telemedicine can provide real-time data on disease progression and physical activity levels, which can be used to personalize treatment plans and improve disease management. One example of how telemedicine and wearable technology can

be integrated is in the management of inflammatory bowel disease (IBD) [15–18]. Wearable technology can be used to track symptoms and provide real-time data on disease activity, which can be shared with healthcare providers. This allows for more accurate and timely adjustments to treatment plans, which can improve patient outcomes. Additionally, wearable technology can be used to monitor medication adherence, which is a critical aspect of managing IBD. Another example of how telemedicine and wearable technology can be integrated is in the management of chronic heart failure. Wearable technology can be used to monitor heart rate and activity levels, which can provide early warning signs of exacerbations. This can allow healthcare providers to intervene early and prevent hospitalization. Additionally, telemedicine can be used to provide remote monitoring and support for patients with heart failure, which can improve patient outcomes and reduce healthcare costs. Overall, the integration of telemedicine and wearable technology has the potential to revolutionize chronic disease management. By providing real-time data and allowing for more accurate and timely adjustments to treatment plans, telemedicine and wearable technology can improve patient outcomes and reduce healthcare costs. However, as with any new technology, there are challenges that need to be addressed, such as data privacy, data security, and reimbursement. Nevertheless, the potential benefits of this integration are undeniable and it is likely that telemedicine and wearable technology will become an essential part of modern healthcare in the near future.

Few examples of the applications of wearable technology in chronic disease management include the management of allergic and asthmatic conditions, management of upper limb rehabilitation for stroke survivors, and video games for physical activity in older adults with chronic disease. The use of wearables in managing allergic and asthmatic conditions has been explored in recent studies. Greiwe et al. [6] reviewed the use of wearable technology in the management of allergic and asthmatic conditions, and found that wearables can provide valuable information on symptoms, triggers, and treatment adherence, which can be used to improve patient outcomes. Wearables can be used to track patients' symptoms and triggers, such as exposure to allergens, and provide alerts to the patient and the healthcare provider. Additionally, wearables can be used to monitor treatment adherence, which is crucial for the management of allergic and asthmatic conditions. The use of wearables in the management of upper limb rehabilitation for stroke survivors has also been evaluated in recent studies. Chae et al. [19] and Souza et al. [20] developed and clinically evaluated a web-based upper limb home rehabilitation system using a smartwatch and machine learning model for chronic stroke survivors. They reported that the use of the smartwatch-based system improved upper and lower limb functions and activities of daily living in the study participants. These studies highlight the potential for wearable technology to enhance rehabilitation for stroke survivors, allowing for more convenient and accessible home-based rehabilitation. The use of wearables and video games for physical activity in older adults with chronic disease has also been explored. Simmich et al. [21] conducted a study to investigate the perspectives of older adults with chronic disease on the use of wearable technology and video games for physical activity. They reported that the majority of the participants agreed that wearable technology and video games could be used to increase physical activity and improve health outcomes. Similarly, they highlighted that the use of wearable technology and video games could provide a fun and engaging way for older adults with chronic disease to increase their physical activity. There are many different types of wearable technology, such as medical earbuds, bands, patches, rings, smartwatches, and gadgets embedded in clothing. They improve the screening and treatment of cardiovascular diseases by using motion and biometric sensors to record a number of physiological parameters, such as temperature, step count, activity intensity, heart rate, heart rhythm, blood pressure (BP), oxygen saturation (SpO_2), sleep, and maximum oxygen uptake (VO_2 max) [22].

With the current state of affairs, there is a great chance to improve diabetic care by utilizing cutting-edge AI techniques for diabetes management. In care settings, healthcare records from multiple resources are frequently underrepresented because they are generally diverse, sparse, and high-dimensional. Modern sensors, pumps, smartphone apps, and other AI innovations are reportedly making it easier and more effective for diabetics to manage their health, lowering the frequency of hypoglycemia episodes, raising patient satisfaction, and enhancing reported results [23].

4 | Patient Trust and Compliance in Digital Health

For wearable health technologies to be widely adopted, patient trust is essential, and worries about data security—particularly as it relates to AI—present serious obstacles. Healthcare providers should be aware of security procedures, explain them to patients, and update their procedures often to protect patient data. Building trust can be facilitated by giving patients control over their data. Educating and training patients and clinicians alike is necessary to address low digital literacy. To prevent health disparities, it will be necessary to ensure that technology is affordable, connectivity is dependable, and the public and private sectors work together to bridge the digital divide, which disproportionately affects marginalized populations [24].

Digital health technologies can revolutionize healthcare by generating personalized treatment plans, but healthcare organizations must respect patients' choices and data privacy to comply with strict regulations.

Physicians' adoption of EHRs driven by meaningful use incentives led to increased administrative work and decreased productivity. A recent study found doctors spend 33% of their time on clinical tasks and 49% on administrative/EHR duties, with 2 h on clerical tasks for every hour of clinical work [25].

5 | Prospective Obstacles and Priorities

In contrast to these specific applications, it is important to note that the use of wearables in chronic disease management is not without limitations. The accuracy of the wearable device, user engagement, and data interpretation are challenges that need to

be addressed to fully realize the potential of wearable technology in chronic disease management. Additionally, privacy concerns and the high cost of devices are also limitations that need to be considered when implementing wearable technology. Secondary diagnostic tools, such as wearables, have proven valuable in the prevention and day-to-day management of illnesses and chronic diseases such as obesity, panic disorders, posttraumatic stress disorders, asthma, depression, Parkinson's disease, and sleep apnea. However, as further highlighted by Canali et al. [26], wearable technology poses challenges relating to data quality, estimations, equity, and fairness. To address these challenges, the authors have proposed several recommendations including local standards of quality, interoperability, access, and representativity [26]. Additionally, there are risks associated with the use of wearables, such as cyber risk and criminal abuse, as well as technical issues such as low battery life and lack of encryption. Inconsistencies in data policies across countries can also create imbalances in the operation of data flow. Wearables are undoubtedly prone to reliability, validity, and accuracy issues, and inaccurate data may subject companies to medicolegal risk. Misinformation surrounding wearables, such as claims of causing cancer or headaches, has also been reported. All these issues need to be addressed and improved in the future. Despite these challenges, the wearable market is growing as new players enter the market with better offers and services. For wider acceptance and adoption, it is crucial that issues such as security, privacy, regulatory challenges, and technical shortcomings are addressed.

6 | Conclusion

Wearable technology in healthcare is gaining popularity for managing chronic conditions like diabetes, heart disease, and obesity. Fitness trackers and smartwatches can track health metrics, providing insights into disease progression and predicting future health outcomes. AI and blockchain can analyze data, while telemedicine can improve access to care, reduce costs, and improve patient outcomes. Integrating these technologies can optimize care models, improve patient outcomes, and reduce healthcare costs, ultimately leading to better healthcare outcomes.

Author Contributions

Victor Abiola Adepoju: conceptualization, supervision, validation, writing–original draft. **Safayet Jamil:** conceptualization, project administration, resources, writing–original draft. **Mohammad Shahangir Biswas:** methodology, resources, visualization, writing–review and editing. **ABM Alauddin Chowdhury:** investigation, project administration, writing–review and editing.

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The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

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