

Journal of Biomedical Engineering Systems and Technologies for Low- and Middle-Income Countries

Hyperchat: An AI-Powered Chatbot for Hypertension Education on WhatsApp

Agbeve AE^{1*}, Abbey R¹, Afriyie SA¹, Adjei PE¹

¹Department of Computer Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

* Corresponding author: Audrey Agbeve (email: audreyagbeve02@gmail.com)

Abstract

Hypertension, a major cause of cardiovascular diseases like stroke and myocardial infarction, is a critical public health issue in Ghana. Limited access to healthcare professionals and resources hinders effective patient education. Patients have little understanding, and face difficulty following medication and lifestyle recommendations. This study explores the use of Artificial Intelligence to enhance personalised health education in Low- and Middle-Income Countries (LMICs) through the use of an AI chatbot integrated into a widely-used social media platform. The chatbot provides credible answers to hypertension questions and user-specific recommendations for self-management, improving health literacy and patient engagement. HyperChat relies on a Retrieval Augmented Generation pipeline developed with low-code automation services (Chatbase and Make.com) and OpenAI's GPT-4o model. Ghanaian hypertension treatment guidelines were embedded into a vector database to enable context-specific responses to queries on hypertension management, including dietary and lifestyle modifications, medication reminders, and correct blood pressure measurement procedure. The chatbot was deployed on WhatsApp using ManyChat as the messaging interface, while Make.com (formerly Integromat) handled the automation workflow between ManyChat and Chatbase for real-time interactions. A preliminary assessment was conducted on user (n=21) feedback regarding usability, response adequacy, and health management influence. Based on user testimonials, 90% of users (n=19) found the chatbot user-friendly, as it eliminated the need for additional application downloads. 81% of users (n=17) mentioned that the recommendations were personalized. 76% (n=16) found the information comprehensive, and 90% (n=19) were willing to implement the lifestyle recommendations. Overall, users found the chatbot satisfactory because it provided accurate information on demand. This study highlights the potential of social media platforms to improve health literacy and patient engagement, by providing context-specific health information on-demand. The idea of leveraging widely used social media platforms for health education holds promise for improving public health outcomes in LMICs.

Keywords; *WhatsApp Chatbot, Hypertension Management, Health Education, Artificial Intelligence, Retrieval Augmented Generation.*

1 Introduction

1.1 Background of Study

Hypertension is a medical condition characterized by elevated blood pressure (BP), where the force of blood against the walls of the arteries is consistently high. It is diagnosed if BP \geq 140/90 mmHg on two or more separate occasions, typically over weeks.¹

This is of concern because Hypertension is the major cause of cardiovascular diseases, the world's leading cause of death, according to the World Health Organization (WHO).² Currently, 1.3 billion people between 30 and 70 years old live with hypertension.³ Treating hypertension is a significant intervention to meet the Sustainable Development Goals (SDG) target 3.4, which is a one-third reduction in premature mortality from the leading noncommunicable diseases.^{3,4}

More than two-thirds of adults with hypertension live in low- and middle-income countries (LMICs), which includes Ghana.² Unfortunately, the health systems in many LMICs struggle to provide adequate, lifelong care for chronic conditions such as hypertension.^{5,6} As a result, effective coverage of hypertension care globally remains low; only one in five people with hypertension have their blood pressure under control.³ The projection of 23% CVD mortality by 2030 (Figure 1) understates the current burden: recent data suggest cardiovascular diseases now account for a higher share of global deaths, and the trend continues to grow.

Presenting with no symptoms, hypertension is appropriately labelled a “silent killer”. Almost half of the population with hypertension are oblivious of their condition until it develops into a more pronounced

cardiovascular disease, such as stroke or heart attack.

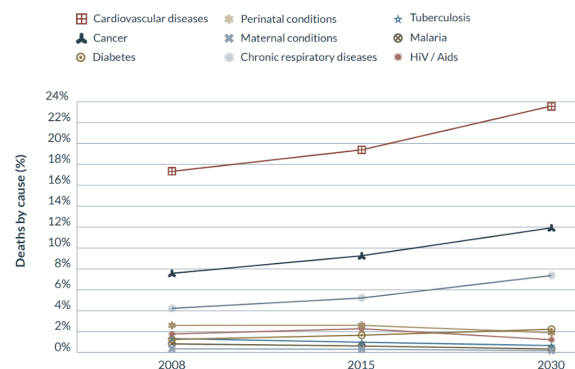


Figure 1. Projected mortality rate by WHO.

According to a WHO supported study among adults with hypertension in Ghana, only 54% were diagnosed with the condition, 42% were undergoing treatment, and only 21% had their BP controlled.⁷ This indicates (by projection) that of the billions of people living with hypertension, close to half of them have not been diagnosed. Of the few diagnosed conditions, even fewer have the expected treatment outcome.

1.2 Review of Related Works

The management of hypertension has evolved worldwide, with technological advancements integrated in the health sector. Several digital solutions have been proposed and introduced to tackle the complexities of hypertension at various stages of management. This section reviews some existing systems and solutions worldwide, identifying their strengths and limitations in the Ghanaian setting.

Electronic Medical Records (EMRs):

Hypertension monitoring Electronic Medical Records (EMRs) have been instrumental in streamlining patient data management by enabling healthcare providers to store and retrieve patients' health information efficiently. In hypertension management, EMRs enable continuous monitoring of blood pressure levels when integrated with

blood pressure monitors and wearables.⁹ This allows real-time monitoring of trends in blood pressure levels, flagging any anomalies to inform medical interventions. However, the lack of widespread digital infrastructure (EMRs, wearables) in LMICs, including Ghana, is a major limitation to the benefits of EMR systems. Healthcare facilities in rural and urban areas rely heavily on paper-based records because of the high cost of implementation and inadequate training of healthcare providers.¹⁰ This makes it challenging to adopt EMR systems on a national scale.

Mobile Health (mHealth) Applications:

mHealth applications are another group of hypertension management interventions. These allow users to monitor their blood pressure, track medication adherence and receive personalized recommendations. Studies have proven the effectiveness of mHealth apps in improving hypertension control through educational content, medication reminders, and lifestyle insights.¹¹ In Ghana, mobile health platforms like The Ahomka App¹² have been developed to provide health education and advice for managing various conditions, including hypertension. However, awareness about their existence is very low, and there is little to no widespread adoption. We anticipate that providing health education and assistance through common mobile applications that are already diffused in the society will have better reach and influence on health seeking behaviour in LMICs.

Telemedicine and Remote Monitoring:

Telemedicine provides significant advancement in the provision of healthcare by allowing patients to receive consultations and follow-up care remotely. In the management of hypertension, telemedicine enables remote blood pressure monitoring,

which is useful for patients who live in remote areas or have mobility difficulties. With the use of wearable devices, patients can track their blood pressure and share real-time data with healthcare providers. This intervention enables continuous monitoring while improving patient compliance and reducing the need for frequent hospital visits. Despite its benefits, telemedicine use in Ghana faces several challenges, including limited internet access and the high cost of data. Moreover, many healthcare professionals are not adequately trained to use these systems effectively, leading to underutilization of available technologies. A text-based system deployed on a widely used platform like WhatsApp can help overcome these barriers by minimizing data costs and reducing the need for specialized training. Additionally, it enables asynchronous access to health information, eliminating the need for real-time interaction between patients and providers.

1.3 Hypertension Management Framework in Ghana

The management of hypertension in Ghana involves coordinated efforts from the government/healthcare systems, physicians, and patients. They include:

Government and Health System Initiatives:

The treatment protocols adopted in Ghana are aligned with the WHO treatment guidelines. The Ministry of Health and the Ghana Health Service have published clinical guidelines for the management of cardiovascular diseases, including hypertension. These guidelines provide protocols for screening, diagnosis and treatment of hypertension at various facilities and levels of care to ensure standardized care across healthcare facilities. Antihypertensive drugs have been included in the Essential Medicines List to ensure affordability and easy access. Additionally, in

2023, Ghana enacted a 20% excise tax on sugar-sweetened beverages to reduce high sugar consumption and associated health problems (hypertension, diabetes and obesity).⁸

Health Worker Efforts: Health worker efforts include routine screening, diagnosis, treatment and counselling. Healthcare workers conduct routine blood pressure measurement during hospital visits to promote early detection of hypertension among the general population. Standard treatment protocols are followed to control the patient's blood pressure. These include dietary and lifestyle counselling, and prescription of antihypertensive drugs for more severe cases. Public health education programs are organized in hypertension prone communities for screening and education on best practices.

Patient Self-management: Lifestyle adaptations play a crucial role in managing chronic diseases, and a key aspect of hypertension management is the involvement of patients in their own care. The adopted protocol in Ghana encourages patients to monitor their blood pressure at home, adhere to prescribed medications, and maintain healthy lifestyle habits. Community health workers provide support and motivation for the patient. Patient education is a significant determiner of the success of self-management, and this study seeks to explore the feasibility of patient education through widely used social media platforms.

1.4 Identified Gaps in the Hypertension Management Framework of Ghana

While the framework for hypertension management in Ghana has potential, several gaps exist in the implementation of these strategies.¹⁴ Being a chronic disease, hypertension management relies heavily on

lifestyle changes, and the success of health policymakers' and health workers' efforts are dependent on the awareness and adherence of patients to recommendations provided. Thus, the patient has a major role to play in keeping their blood pressure controlled. *However, hypertensive patients in Ghana struggle with awareness and understanding of their condition, adhering to treatment, and accessing the costly healthcare system.*^{14, 15} This leads to a low effective health coverage of hypertension in the country, increasing the burden of the disease. There is a dire need for robust strategies to improve public awareness of the condition and continuous education of hypertensive patients. Increased education will equip the patients to better adhere to clinical recommendations and be actively engaged in the management of their condition. An AI health assistant deployed on WhatsApp, a widespread messaging platform, can educate patients on best dietary and exercise routines, provide the correct procedure for measuring blood pressure (BP), give instant feedback on BP readings, send medication reminders, and answer hypertension-related questions on demand. This will educate and equip users for self-management of hypertension.

1.5 Study Objectives

This study aims to demonstrate the concept of enhancing self-management of chronic conditions through personalized health education delivered on an AI-powered WhatsApp chatbot that:

- Educates users on hypertension basics.
- Provides recommendations for improved hypertension management.
- Sends reminders for taking medication and BP measurements.

2 Materials and Methods

For this proof of concept, we integrated third-party Software-as-a-Service (SaaS) tools –

ManyChat for the WhatsApp messaging flow, Chatbase for AI query handling via retrieval-augmented generation (RAG) and Make (formerly Integromat) for workflow automation and data exchange between the platforms.

2.1 Data Collection

The chatbot runs on OpenAI's GPT-4o model and uses a RAG pipeline to provide context-specific health education on hypertension management. The RAG knowledge base was constructed from authoritative Ghanaian and international sources, focusing on treatment guidelines prescribed by the Ministry of Health, Ghana. Data sources included:

- *Standard Treatment Guidelines* (Ministry of Health, 7th Edition, 2017)
- *National Guidelines for the Management of Cardiovascular Diseases* (Ministry of Health, 1st Edition, 2019)
- *Essential Medicines List* (Ministry of Health, 7th Edition, 2017)
- *National Medicines Policy* (3rd Edition, 2017)
- *DASH Eating Plan* (US Department of Health and Human Services, 2006)

Information extracted included:

- a. Terminology and Definitions:** Core hypertension concepts (e.g., systolic and diastolic pressure, stages of hypertension, cardiovascular complications).
- b. Blood Pressure Ranges:** Normal, pre-hypertensive, and hypertensive categories.
- c. Treatment Protocols:** Clinical management pathways and therapeutic objectives
- d. Lifestyle Recommendations:** Evidence-based dietary, exercise, and behavioural guidelines.

These data ensured Ghana-specific contextualization of hypertension management, minimizing hallucination in AI-generated responses.

2.2 Retrieval Augmented Generation (RAG) Pipeline

The collected documents were formatted as plain text and uploaded to Chatbase (chatbase.co) for pre-processing and embedding. Only de-identified and non-sensitive textual content was used in this proof-of-concept. No personal health data or identifiable information were uploaded, ensuring ethical compliance and data privacy. The following steps were applied:

- a. Text Cleaning:** Non-textual elements such as tables, duplicate headers, and special formatting were removed to ensure coherent text suitable for embedding.
- b. Document Upload:** The documents were uploaded to Chatbase which served as the platform for data storage and processing.
- c. Text Chunking:** The documents were processed and divided into smaller, semantically meaningful text chunks on Chatbase using its built-in text splitting functionality. Each text chunk was configured to contain approximately 300 – 500 tokens with an overlap of 20-50 tokens between consecutive sections to preserve context.
- d. Text Embedding:** Each chunk was converted into a vector representation using the OpenAI text-embedding-3-large model which generates 3,072-dimensional embeddings. These numerical representations encode semantic meaning, enabling the chatbot to identify and retrieve conceptually related information even if the exact words differ.
- e. Vector Storage and Retrieval Configuration:**

The generated embeddings were stored in Chatbase’s internal vector store, which supports semantic similarity search for use in the RAG pipeline. Chatbase retrieved the topmost relevant text chunks based on the user-specified temperature configuration.

- f. Response Generation:** The retrieved texts and user’s prompt were compiled into a structured instruction template and passed internally to GPT-4o for generation. The generation prompt was specified:

“Answer the user’s question using only the information in the provided context from Ghana’s hypertension guidelines. If the information is not available, indicate that clearly”.

The entire RAG implementation pipeline is displayed in Figure 2 and summarised below

- a. User Prompt Input:** The chatbot receives a user’s query, typically questions about hypertension management, blood pressure ranges, dietary tips and exercise routines.
- b. Document Retrieval:** The system uses vector embeddings stored in the vector database to identify relevant text chunks based on semantic similarity to the user’s prompt.
- c. Response Generation:** The retrieved information, along with the user prompt, is passed to GPT-4o. The model then generates a comprehensive response based on the retrieved data.

This ensures that the chatbot’s responses are both accurate and contextually appropriate for hypertension management in Ghana.

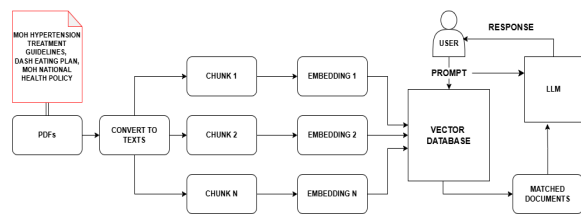


Figure 2. Illustration of the RAG Pipeline from document selection and chunking, to embedding, database querying, and augmented response generation.

2.3 Deployment on WhatsApp

HyperChat was deployed using a dedicated WhatsApp Business number connected to ManyChat for user interaction, and testing. The ManyChat workspace managed all the messages automation, button menus, and other user subscriptions. The system used ManyChat’s WhatsApp Business API integration to deliver responses via Make’s automated scenarios.

- **Inbound messages:** Captured through webhooks and processed by Make.
- **Outbound responses:** Returned to users through ManyChat’s “Send Message” module.
- **Multiplatform testing:** Functionality was validated across Android and iOS WhatsApp clients to ensure consistent performance.

A summary of the development tools and configurations is included in **Table 1**.

Table 1: Summary of Development Tools and Configuration.

Component	Tool/Platform	Description / Function
Embedding	OpenAI <i>text-embedding-3-large</i>	Converts text chunks into 3072-dimensional vectors for semantic retrieval
Vector Store	FAISS-type search engine (via Chatbase)	Stores and retrieves embeddings using inner-product similarity
Automation	Make (formerly Integromat)	Connects ManyChat, Chatbase, and GPT-4o via API calls
Messaging Interface	ManyChat (WhatsApp Business API)	Hosts conversation flows, user interactions, and button menus
LLM for Response Generation	GPT-4o (OpenAI)	Generates guideline-based responses using retrieved context

2.4 Chatbot Features

In addition to dynamic RAG-based question answering, the ManyChat interface offered button-based navigation for pre-defined educational modules. This dual approach supported structured learning and free-form user queries. The user interface is captured in Figure 3 and comprises four major features:

- a. **Hypertension FAQs:** Provided concise, evidence-based answers to common questions (e.g., definitions, causes, medications, prevention).
- b. **BP Measurement Guide:** Offered step-by-step instructions for home blood pressure monitoring, with optional links to illustrative videos.
- c. **Lifestyle Tips:** Included dietary recommendations, physical activity guidance, alcohol moderation, and smoking cessation advice.
- d. **Ask a Question:** Allowed users to pose personalized questions that were answered via the GPT-4o RAG pipeline.

All modules emphasized readability, cultural relevance and scientific accuracy. A disclaimer at the beginning of each session reminded users that the chatbot does not replace professional medical consultation.

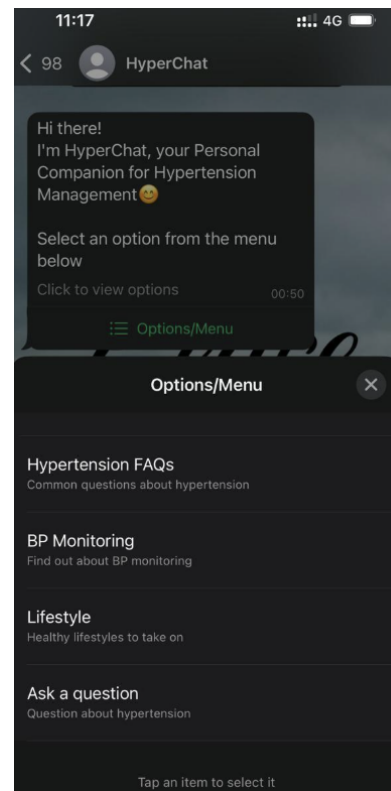


Figure 3. A screenshot of the HyperChat user interface on WhatsApp.

2.5. Conversation Example

A sample conversation with HyperChat is included here. Each user session began with an automated greeting message and the display of menu options. Beyond mitigating hallucinations through the RAG pipeline, the chatbot was also restricted to hypertension-

related queries to prevent misuse and off-topic interactions. User consent was obtained through an explicit prompt informing them that their messages could be used as context for generating responses. Users also had the option to unsubscribe, which deleted prior conversations and cleared stored data from memory.

HyperChat: *Hi there! I'm HyperChat, your personal companion for hypertension management. Select an option from the menu below.*

User: *Ask a question*

HyperChat: *What question do you have for HyperChat?*

User: *How are you doing?*

HyperChat: *As an AI, I don't have feelings, but I'm here and ready to help you with any questions or concerns you have about hypertension. How can I assist you today?*

User: *What is hypertension?*

HyperChat: *Hypertension, commonly known as high blood pressure, is a chronic medical condition in which the force of the blood against the artery walls is consistently too high. This condition can lead to serious health problems, such as heart disease, stroke, and kidney failure.*

User: *What is blood pressure?*

HyperChat: *Blood pressure is the force of blood against artery walls. It is measured in millimeters of mercury (mmHg) and recorded as two numbers—systolic pressure (when the heart beats) over diastolic pressure (when the heart relaxes between beats). Both numbers are important. Blood pressure rises and falls during the day. But when it stays elevated over time, then it's called high blood pressure. High blood pressure is dangerous because it makes the heart work too hard, and the high force of the blood flow can harm arteries and organs such as the heart, kidneys, brain, and eyes.*

User: *Is it good to smoke when you are hypertensive?*

HyperChat: *No, it is not good to smoke when you have hypertension. Smoking can raise your blood pressure and put you at higher risk of heart disease and stroke. In fact, one of the non-pharmacological treatments for hypertension is to avoid or quit smoking. It's important to maintain a healthy lifestyle to manage hypertension effectively.*

User: *Additional info*

Hyperchat: *Foods such as:*

-Taro leaves/ Cocoyam leaves (Kontomire)

-Beet greens (Stems of beet root)

-Garden eggs/ egg plants (Ntrowa)

-Okra (Nkrumah)

Are rich in most of the nutrients and vitamins needed to reduce high blood pressure. However, they are also rich in oxalates which could be harmful to your kidneys if not taken in moderation. To reduce oxalate in these, one has to boil them until partially cooked

HyperChat: *Are you satisfied with the answer?*

User: *Yes, I am*

HyperChat: *Great, you can always come back for more!*

User: *Unsubscribe*

HyperChat: *You were successfully unsubscribed from HyperChat. Type 'Start' to subscribe back anytime.*

2.6. Internal Validation

To validate the performance of the chatbot, a manual comparison was made between the chatbot's responses and the ministry of Health guidelines to ensure the accuracy of information provided. The time taken to retrieve relevant documents and the precision of the retrieved documents that match the user's query were monitored to ensure optimal performance of the vector store and the retrieval chain.

2.7. Preliminary Testing

A preliminary test was conducted among 21 randomly selected members of the Kwame Nkrumah University of Science and Technology (KNUST) community. Convenience sampling was employed; there was no definite criteria for selecting the participants. Participant ages were between 20 and 50 years, 9 male and 12 female. Users were introduced to the study and allowed to interact with the chatbot (Figure 3) at their convenience. The number and manner of interactions with the chatbot were not recorded. Using an online survey, users provided feedback on their experiences with the chatbot.

3 Results

Results from the preliminary usability test are presented below. The test involved a small group of users to obtain initial feedback on HyperChat’s functionality, user experience, and potential impact. Due to the limited sample size, the findings are not generalizable but provide valuable insights for refining the chatbot before broader deployment. The evaluation focused on four main areas: user experience, contextual relevance of recommendations, health literacy improvement, and anticipated influence on behaviour.

3.1 User Experience

One of the key findings from user feedback was the ease of use offered by HyperChat. 19 out of 21 users rated the chatbot easy to use, while 2 graded the ease of use as neutral (Figure 4). Generally, users verified that the chatbot offered a smoother and friendlier experience compared to traditional mobile health (mHealth) apps. Users did not need to download new software or create additional accounts. The elimination of sign-up

processes and the chatbot’s ability to function within an already familiar platform was particularly appreciated by users. This reduced the barriers to use, particularly the cognitive load associated with navigating new health apps, especially for older individuals or those with low digital literacy.

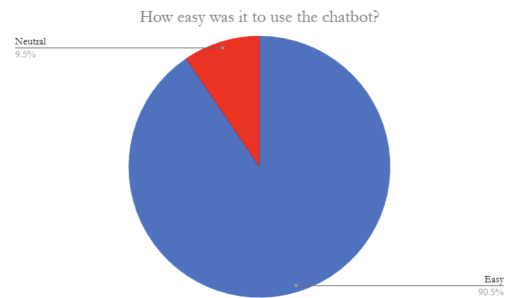


Figure 4. Usability feedback.

3.2 Contextually Relevant Recommendations

When asked whether the chatbot’s responses felt personalized and on-demand, 17 out of 21 users agreed, 3 responded “not really,” and 1 disagreed (Figure 5). Users noted that the chatbot provided relevant answers based on their specific questions and inputs. Several participants mentioned that this level of responsiveness improved their engagement with the health information provided. For example, when asked about dietary guidelines, the chatbot responded with advice tailored to local Ghanaian foods and cultural eating habits. Users reported that such relatable examples made it easier to understand and implement the recommendations in their daily lives.

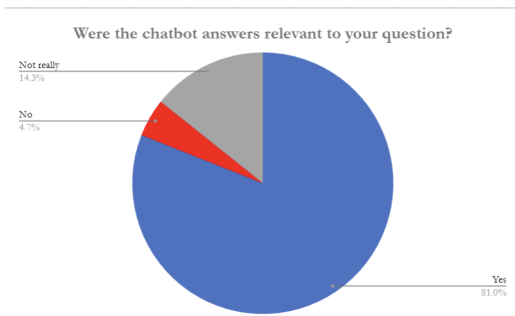


Figure 5. Feedback on contextual relevance.

3.3 Improved Health Literacy

The chatbot played an educational role, offering clear and on-demand information about hypertension. This helped increase users’ understanding of their condition, making it easier to adhere to health recommendations and better manage their condition. The accessibility of relevant information reduced their dependence on frequent hospital visits for routine consultations. When asked about the comprehensiveness of answers and their ability to understand the answers, 16 users indicated that the answers were comprehensive, 4 found it somewhat comprehensive, and 1 user did not find it comprehensive(Figure 6).

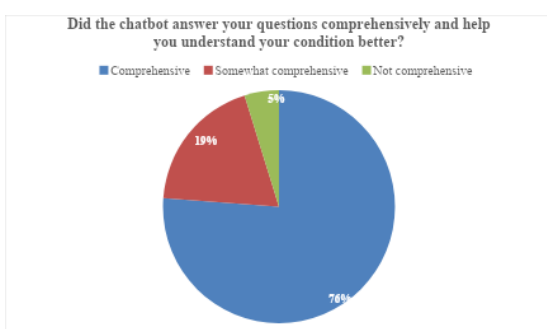


Figure 6. Feedback on comprehensiveness.

3.4 Potential Influence on Behaviour

In assessing the chatbot’s role in encouraging lifestyle modifications among users, a high proportion of participants (90%, n=19) expressed willingness to implement the recommended lifestyle changes, only 2 users

disagreed (Figure 7), suggesting that the chatbot not only provided guidance but also motivated users to take proactive steps to manage hypertension.

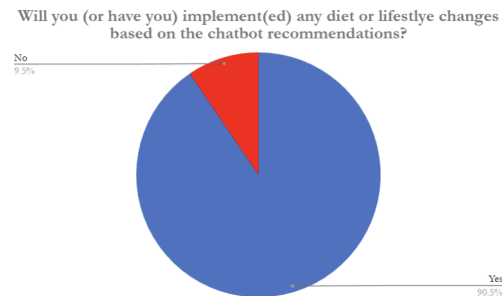


Figure 7. Anticipated behavioural influence.

4 Discussion

4.1 Overview of Key Findings

This preliminary usability evaluation demonstrates the feasibility of delivering context-specific hypertension health education through an AI-enabled WhatsApp chatbot. Overall, users responded positively, indicating that *HyperChat* effectively provided relevant and personalized guidance to support hypertension management. The chatbot’s seamless integration into a familiar platform such as WhatsApp eliminated the need for new app installations or account creation. These factors are often cited as barriers to adoption in low-resource settings.²⁰

A particularly notable finding was the contextual relevance of the chatbot’s responses. Seventeen out of 21 users agreed that the chatbot’s recommendations were tailored to their specific questions, underscoring the potential of conversational AI to enhance engagement and health literacy. When users inquired about diet, for instance, the chatbot referenced Ghanaian food examples such as plantain, kontomire, and millet, making the recommendations relatable and actionable.

This ability to provide real-time, adaptive responses differentiates *HyperChat* from more structured mobile health tools, such as the Luscii NCD Care app, which rely on pre-defined data entry and rule-based feedback¹⁶. While these systems are useful for clinical monitoring, *HyperChat*'s interactive nature supports autonomous health-seeking behaviour and continuous learning, reinforcing prior evidence that conversational AI can foster sustained engagement in chronic disease management.

4.2 Interpretation and Implications

Previous studies report a significant impact of social media on health-seeking behaviour and highlight the need to expand the reach of digital health interventions among underserved populations.¹⁷ The findings demonstrate the potential of AI chatbots embedded in social messaging platforms to improve the accessibility of health education interventions. WhatsApp's widespread use in Ghana presents a unique opportunity to extend hypertension education and self-management support to populations that may otherwise be excluded from traditional mHealth applications.

User-reported improvements in understanding of hypertension and willingness to implement lifestyle changes suggest that *HyperChat* can play a complementary role in health promotion. The chatbot's contextual intelligence supports the growing recognition that localization is essential for digital health tools in Africa.

However, the pilot's small and digitally literate sample limits generalizability. The positive responses, though encouraging, reflect early feedback rather than measurable behavioral outcomes. Thus, these results should be interpreted as evidence of feasibility rather than efficacy. Future

iterations should employ more rigorous evaluation frameworks to assess longitudinal impact on blood pressure control, medication adherence, and healthcare engagement.

4.3 Limitations

This study represents an early-stage beta test of *HyperChat*, conducted with a limited sample of participants from KNUST. While valuable for initial feedback, the results may not reflect experiences across different demographic or socio-economic groups. The study also relied on third-party automation tools (ManyChat, Chatbase, and Make) to build the chatbot prototype. This setup constrained full control over data management and system customization, raising concerns about data privacy and compliance with Ghana's national IT and data protection framework.

Although the chatbot did not store sensitive health information, its dependence on foreign-hosted platforms (e.g., WhatsApp and OpenAI) limits adherence to the Data Protection Act, 2012 (Act 843) and Ghana's eHealth Strategy. Addressing these issues will require developing locally hosted or open-source models and engaging with national regulatory bodies such as the Data Protection Commission and the Ghana Health Service.

Additionally, the absence of a culturally adapted, medically validated dietary framework for hypertension management constrained the chatbot's nutrition recommendations. While the globally recognized DASH (Dietary Approaches to Stop Hypertension) plan provides a scientific foundation, it does not fully align with Ghanaian food systems and availability.¹⁸ Finally, language limitations prevented users from interacting in indigenous languages, which may have excluded individuals with

limited English proficiency.

4.4 Future Work

Building on these findings, future work will focus on the end-to-end development of HyperChat without third-party applications, ensuring complete control over data handling, security, and compliance with Ghana's IT governance frameworks. This locally developed version will enable alignment with the National Cybersecurity Policy and promote data residency within Ghana, thereby improving user trust and regulatory compliance.

Efforts will also prioritize the integration of a DASH-inspired Ghanaian dietary plan, combining the scientific rigor of DASH with the practicality of Ghana's Food-Based Dietary Guidelines (FBDGs). This adapted framework will emphasize the use of culturally familiar foods such as kontomire, millet, plantain, and dawadawa, ensuring that hypertension dietary recommendations remain both evidence-based and locally attainable.

To further enhance accessibility and inclusivity, future versions of *HyperChat* will incorporate local language support (Twi, Ewe, Ga) and multimodal interaction, including voice-based queries. Such features will enable users with limited literacy to engage with the chatbot naturally and align with Ghana's oral communication culture.¹⁹

5 Conclusion

This study provided an early demonstration of the feasibility of using an AI-powered WhatsApp chatbot to deliver hypertension-related health education in a culturally relevant and accessible manner. The positive user reception highlights the promise of conversational agents as tools for public health education and chronic disease self-

management in Ghana and similar low-resource settings.

While this proof-of-concept confirms the usability and contextual relevance of HyperChat, it also emphasizes the need for further development and rigorous evaluation. Future iterations will prioritize data privacy, local hosting, and integration with Ghana's IT governance framework, alongside the incorporation of a DASH-inspired Ghanaian dietary plan and local language support.

Overall, the findings suggest that culturally tailored conversational AI, when ethically and contextually deployed, can complement traditional health systems by empowering individuals with accessible, personalized, and trusted health information.

Authors' Contributions

The study was conceptualised collaboratively by all authors. AEA led the study, developed and performed the chatbot experiments, analysed the results, and wrote the manuscript. RA contributed to the literature review and chatbot development. SAA assisted with the literature review and developed a visual project timeline. PEA supervised the project throughout, refining the idea, scope, and methods. All authors reviewed and approved the final manuscript.

Declaration of Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. World Health Organization. A global brief on hypertension. Geneva: World Health Organization; 2013. Report No.: WHO/DCO/WHD/2013.2.
2. World Health Organization. Global report on hypertension: the race against a serial killer. Geneva: World Health Organization; 2023.
3. World Health Organization. Hypertension

- [Internet]. Geneva: World Health Organization; 2023 [cited 2024 Jun 24]. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>
4. Ezzati PM. NCD Countdown 2030: pathways to achieving Sustainable Development Goal target 3.4. *Lancet*. 2020;396(10255):912–24.
 5. Lay K. Africa’s medical system risks collapse in next few years, warns health leader. *The Guardian* [Internet]. 2025 [cited 2025 Jun 24].
 6. Wozniak G, Khan T, Gillespie C, Safford M, Rogers C, Wall H, et al. Hypertension control cascade: a framework to improve hypertension awareness, treatment, and control. *J Clin Hypertens (Greenwich)*. 2016;18(3):232–9.
 7. Calys-Tagoe B, et al. Individual awareness and treatment effectiveness of hypertension among older adults in Ghana: evidence from the World Health Organization study of global ageing and adult health wave 2. *Pan Afr Med J*. 2020;37:264.
 8. Laar A. Making food-related health taxes palatable in Sub-Saharan Africa: lessons from Ghana. *BMJ Glob Health*. 2023;8.
 9. Lee DR, et al. A multisite electronic record integrated remote monitoring intervention for hypertension improvement: protocol for a randomized pragmatic comparative effectiveness trial. *National Library of Medicine* [Internet]. 2023.
 10. Dovia CK, et al. Utilisation of Information Technology (IT) in healthcare delivery among healthcare providers in Ghana. *Academia*. 2020.
 11. Almasi S, et al. Mobile health technology for hypertension management: a systematic review. *Acta Med Iran*. 2020;58(11).
 12. Caputo J. Mobile app tracking blood pressure helps patients. *TuftsNow* [Internet]. 2025.
 13. Boadu RO, et al. Healthcare providers’ perception towards utilization of health information applications and its associated factors in healthcare delivery in health facilities in Cape Coast Metropolis, Ghana. *PLoS One*. 2024.
 14. Kokutse F. Critical gaps in hypertension management in Sub-Saharan Africa. *Nature*. 2023;12(3):45–56.
 15. Okai DE, et al. Patient-level factors influencing hypertension control on adults in Accra, Ghana. *BMC Cardiovasc Disord*. 2020.
 16. PharmAccess Foundation, Lusicii. NCD Care mobile app eases access to hypertension and diabetes care in Ghana. *Citi Newsroom* [Internet]. 2022 Sep [cited 2025 Jun 24]. Available from: <https://citinewsroom.com/2022/09/ncd-care-mobile-app-eases-access-to-hypertension-and-diabetes-care-in-ghana/>
 17. Vereen RN, et al. Are social media interventions for health behaviour change efficacious among populations with health disparities? A meta-analytic review. *Health Commun*. 2021;36:133-40.
 18. Wang VH-C, et al. Are recommended dietary patterns equitable? *Public Health Nutr*. 2021;24:464-70.
 19. Peprah P, et al. Lessening barriers to healthcare in rural Ghana: providers and users’ perspectives on the role of mHealth technology. A qualitative exploration. *BMC Med Inform Decis Mak*. 2020.
 20. Hengst TM, Lechner L, Dohmen D, Bolman CA. The facilitators and barriers of mHealth adoption and use among people with a low socio-economic position: a scoping review. *Digit Health*. 2023;9.