

The application of Generative AI for Personalized Health Messaging to Promote Public Health Awareness in Nigeria

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Abstract

This research investigates the capacity of generative artificial intelligence (GenAI) to advance personalized health communication in Nigeria where public health issues continue rising. The paper consolidates current studies on the use of generative AI, specifically within health messaging, and assesses its efficacy in raising public health awareness. Results suggest that tailored health communications can markedly improve audience understanding; nonetheless, the adoption of generative AI for crafting these messages is a nascent area, and no current medical applications employ this methodology. This work pinpoints critical voids in existing research and underscores the importance of customized health information that is sensitive to Nigeria's varied cultural and demographic landscape. Additionally, it explores the potential of new technologies, including AI-powered platforms and mobile health (mHealth) solutions, in meeting the distinct healthcare requirements of diverse groups. In conclusion, the study stresses the immediate necessity for further investigation to evaluate the influence of generative AI on public health campaigns in Nigeria, especially regarding its ability to connect with marginalized groups and encourage preventative health measures. Harnessing generative AI presents an opportunity to transform public health outreach, thereby supporting better national health outcomes.

Keywords: *Generative AI, personalized health communication, digital health, mHealth, Nigeria.*

Introduction

Maintaining current and effective public health awareness in Nigeria is critically important due to the nation's significant cultural diversity and widespread technology adoption. The country's primary health challenges consist of communicable diseases such as malaria, hygiene-related diarrheal conditions, HIV/AIDS, tuberculosis, and issues surrounding child and maternal health, which are leading causes of mortality (Muhammad et al., 2017; Abubakar et al., 2022). Compounding these issues are low mental health literacy and treatment access, alongside substance abuse involving alcohol, tobacco, and codeine (Wada et al., 2021). Furthermore, Nigeria has experienced high COVID-19 mortality rates and considerable social and judicial stigmatization of individuals living with HIV and depression (Abubakar et al., 2022; Atoyebi et al., 2022). These public health complexities are not merely individual but are deeply rooted in communal, cultural, and infrastructural contexts, often obscured by prevailing stereotypes and gender dynamics (Dukuzumuremyi, 2020; Abubakar et al., 2022).

This research synthesizes available literature on the use of Generative AI (GAI) for creating personalized health messaging to improve public health awareness in Nigeria (Dukuzumuremyi, 2020; Ikerionwu et al., 2022; Jimoh et al., 2022). It examines key overviews and methodological approaches to public health in the Nigerian context, identifying characteristics essential for conceptualizing GAI-driven messaging that is tailored to the nation's diverse demographics—a prerequisite for effectiveness on a national scale. The study subsequently reviews existing work on artificial intelligence applications in public health, with a specific focus on generative models and the design of related health communication strategies (Yu et al., 2023; Evans et al., 2024).

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The study concentrates on the crucial setting of public health awareness in Nigeria, analyzing its influencing factors and surveying the landscape of needs-based health messaging. Although effective health communication is urgently needed, research on using generative AI to enhance public awareness via personalized messages remains limited in Nigeria. In light of the country's declining public health literacy and a shortage of localized data, this gap must be addressed with empirical evidence from controlled studies on personalized messaging.

Research Objective

The primary objective of this research is to explore the potential of Generative Artificial Intelligence (GenAI) in developing personalized public health messages to enhance health awareness across Nigeria.

Public health awareness in Nigeria is a critical priority, given the nation's substantial burdens, especially in maternal and child health. The country occupies an alarming position in global health rankings, standing 11th for under-five child deaths and 10th for the under-five mortality rate (Adesuyi et al., 2021; Osakede, 2021). This crisis is compounded by systemic underfunding, exemplified by a minimal 0.52% of the national budget allocated to health in 2016, which underscores the neglect of public health priorities (Mabuza, 2020). Although Nigerian health policy envisions comprehensive, affordable, and accessible care for all citizens, the reality is a fragmented system of approximately 23,640 public and private facilities that frequently fail to address the population's diverse needs. This disparity highlights an urgent requirement for innovative methods of disseminating health information and education (Ogu et al., 2023; Balogun et al., 2021; Ajegbile, 2023).

Epidemiological data further reveal a dire public health situation. While there has been

some advancement in combating child mortality and communicable diseases, critical deficiencies persist in the access to and quality of maternal healthcare (Boerma et al., 2018; Amouzou et al., 2020). Programs like "Safe Motherhood" have been hampered by insufficient infrastructure and cultural obstacles, particularly in rural areas with limited healthcare access (Storeng, 2010). A pronounced urban-rural divide exists; urban centers may have better services, whereas rural communities encounter significant barriers to essential care. The enduringly high prevalence of preventable diseases like malaria and HIV/AIDS points to a systemic failure: the lack of public health awareness stems not from ignorance but from profound inequities in access to information and services (Mabuza, 2020; Osborne et al., 2021). Bridging this gap demands effective strategies that utilize media for health education and foster community participation (Mao et al., 2023). Ultimately, addressing these challenges holistically will necessitate substantial investment in healthcare infrastructure and a dedicated commitment to cultivating an informed citizenry equipped to make healthier decisions.

Current State of Public Health in Nigeria

Enhancing public health awareness in Nigeria is a fundamental prerequisite for improving national health outcomes and strengthening preventive strategies. A robust healthcare approach must integrate clinical services, such as immunization and primary care, with equally vital population-level interventions, including preventive medicine and health promotion campaigns. Existing literature identifies significant knowledge gaps in healthcare delivery within Nigeria, pointing to a critical need for more comprehensive strategies (Ibeneme et al., 2020; Ajisegiri et al., 2021). Key organizations, including the World Health Organization (WHO), the Nigerian Federal Ministry of Health, and various governmental and non-governmental bodies, are instrumental

in disseminating public health information. Their collective efforts—spanning local health counseling, mass media campaigns to combat stigma, and programs targeting infectious diseases and health insurance—collectively underscore the persistent importance of public health for the nation's well-being (Muhammad et al., 2017; Ibeneme et al., 2020).

Challenges and Opportunities in the Nigerian Health Landscape

The Nigerian public health system, while facing considerable impediments, also presents significant opportunities for transformative improvement (Tumba, 2023).

Opportunities for Advancement:

Digital and community-based channels are increasingly recognized as powerful tools for health promotion, especially in vulnerable regions (Muhammad et al., 2023). The 2010 Ebola response demonstrated the efficacy of community engagement, where organized meetings were used to sensitize the population (Abdulkadir, 2022; NCDC, 2023). This strategy highlighted the influential role of community opinion leaders; individuals persuaded by these figures demonstrate a higher likelihood of adopting healthier behaviors (Anthony et al., 2023). Engaging these leaders can create a cascading effect, promoting widespread behavioral change. Furthermore, the limitations of generic, one-size-fits-all health messaging are now apparent; modern communication must be tailored to diverse audiences to be effective (Ilesanmi et al., 2021). The advent of advanced data analytics and computing offers a pathway to such personalization, enabling the delivery of customized health insights that can boost public engagement.

Persistent Challenges:

Despite these opportunities, the health landscape remains fraught with obstacles. Pervasive misinformation erodes public trust,

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leading to delays in seeking care and reduced healthcare utilization (Iyorza & Ojorgu, 2020). Systemic issues within public healthcare facilities—such as unreliable power supply, dilapidated infrastructure, ineffective communication strategies, and low staff morale—further cripple service delivery (Asemah, 2021). Deep-seated cultural beliefs also present a unique challenge, as health issues are often perceived through a spiritual or supernatural lens rather than a medical one. This underscores the urgent need for credible, verifiable health information to guide individuals toward informed decisions on preventive measures like vaccination (Olumade et al., 2020).

Personalized Health Messaging

Personalization in health communication is the practice of customizing health-related information for individuals using a combination of objective metrics and subjective insights (Fawibe, 2023). Within the African context, the reception, dissemination, and comprehension of these messages are profoundly shaped by cultural norms and economic conditions. Studies suggest that personalized messages can be as impactful as campaigns fronted by influential celebrities or religious leaders in promoting public health (Menschen, 2023). Despite this potential, there remains a significant scarcity of research on the systematic use of personalized messaging for health promotion and disease prevention across Africa. The rising burden of infectious and preventable diseases on the continent has, however, spurred growing interest in adopting personalized approaches to strengthen public health initiatives designed for African audiences (Andigema et al., 2024).

The study of health messaging is a well-established domain within communication research. Fawibe (2023) conceptualizes personalized health messaging as a strategy that synthesizes an individual's behavioral traits,

decision-making patterns, and environmental context to craft communications aimed at facilitating behavior change. Complementing this, scholars like Menschen (2023) have investigated related factors, including target behaviors, obstacles to effective personalization, and reasons for a lack of motivation in response to preventive messages. Empirical evidence indicates that tailored communications produce a modest but statistically significant improvement in health behaviors across various domains when compared to generic alternatives. This underscores that the strategic benefits of personalization—achieved through meticulous content adaptation—could be crucial for realizing meaningful impacts in both policy implementation and practical interventions (Owolabi & Adam, 2023). Ultimately, personalized health campaigns hold the potential to elevate public awareness and increase the efficacy of interventions by offering nuanced insights into the determinants of health behavior within specific demographic groups.

Importance and Benefits of Personalized Health Messaging

The COVID-19 pandemic has left a profound global health legacy, fundamentally altering public consciousness regarding health issues both in Nigeria and worldwide (Ayenigbara, 2020; Usman et al., 2024). While the immediate threat of the virus persists, the crisis has fostered a heightened, more sustained awareness of health among the populace (NCDC, 2023). This shift has cultivated a public expectation for personalized health alerts that can translate the lessons of the pandemic to other health contexts, delivered through diverse digital platforms (WHO, 2024). In Nigeria, specific trends—such as the interest in local herbal remedies, pockets of skepticism about COVID-19, and delays in vaccine uptake—highlight unique public health challenges (UNDP, 2020). Personalized health messaging

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emerges as a critical tool to address these nuances, guiding the public toward sustained health vigilance both during and beyond the pandemic.

Empirical evidence confirms that tailored health communication can effectively enhance public health awareness across varied demographics, geographies, and health conditions (World Bank, 2020). Different population segments demand customized information that resonates with their specific health risks, socioeconomic circumstances, and cultural contexts (Okoronkwo, 2020). In Nigeria, however, health campaigns are often generalized, failing to accommodate the nation's immense diversity and thereby limiting their impact. Consequently, advancing contextually relevant, personalized messaging is imperative for the success of public health initiatives. The emergence of sophisticated artificial intelligence models offers an unprecedented opportunity to develop and

deploy these tailored strategies at scale, promising to significantly improve public health engagement and outcomes.

Methodology

This section outlines the systematic approach for designing and implementing the proposed personalized health messaging system.

Research Design

A comprehensive review of more than thirty-two (32) relevant peer reviewed journals was conducted. Key Findings, Methodology and Limitations of each paper was gathered and compared. Finally, a research gap was identified and research direction was proposed. This comprehensive approach facilitated both the technical creation of the AI-driven messaging system and a robust assessment of its feasibility and impact. Figure 1 shows the impact of GenAI on personalized health messaging.

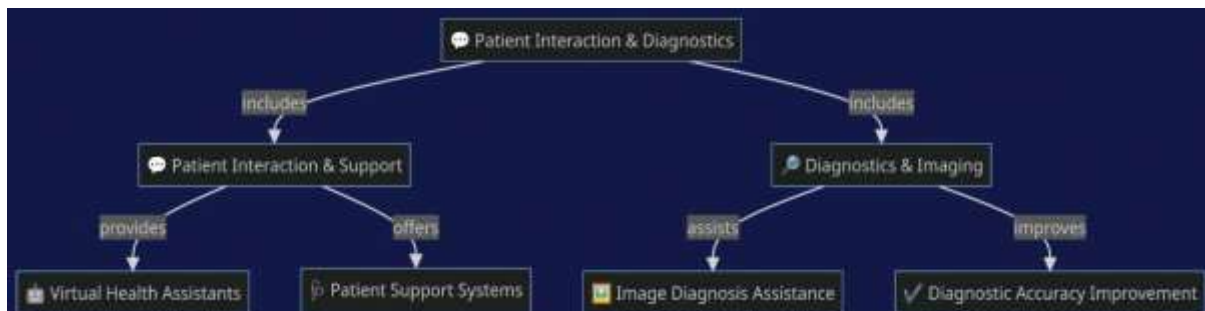


Figure 1: AI on knowledge management and operational efficiency

Limitations of GenAI in Personal Health Messaging

Generative AI (GenAI) systems depend on Large Language Models (LLMs) trained on extensive datasets from sources like Google, Wikipedia, and GitHub. A significant concern, however, is that internet-sourced data may contain inaccuracies and misinformation, often contributed without expert validation. Consequently, LLM-based tools are susceptible to generating biased or incorrect outputs. For

instance, an evaluation of ChatGPT-4's radiology-related information found only 65% of its responses to be accurate [11]. Similarly, although the model passed a medical licensing examination, its score of approximately 60% indicates a potential error rate exceeding 30%.

Effective personalized healthcare incorporates factors unique to an individual's health status, typically evaluated through diagnostic procedures such as pulse measurements, blood tests, imaging, and cultural assessments. Although GenAI can generate health suggestions based on detailed textual prompts, its recommendations are inferred from

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generalized datasets that may not align with specific patient contexts. Moreover, these tools often lack the nuanced understanding of cultural and racial factors essential for tailored healthcare. Therefore, it is strongly advised that outputs from GenAI be verified by qualified healthcare professionals to ensure clinical accuracy and relevance.

Individual Incapacity to Evaluate Health Information

Health literacy, the ability to assess information accuracy, and knowledge of reliable sources are essential for individuals to evaluate specific health information and use it effectively. Individuals who possess these skills can maximize the benefits of GenAI technology. However, racial and ethnic minority groups, who often experience lower levels of health literacy and lack the skills needed to evaluate health information, may be disproportionately deprived of these technological advantages.

Limitations of Access to GenAI Tools

Despite approximately 85% of Nigerian adults having internet access, equitable utilization of Generative AI (GenAI) tools is not universal. Significant barriers persist for individuals with limited health literacy, language differences, or financial constraints. A primary obstacle is the prevalent subscription-based model for advanced AI services; enhanced accuracy and functionality are often locked behind paywalls. For example, the paid subscription service ChatGPT Plus provides markedly more reliable responses than its free counterpart, ChatGPT 3.5, effectively creating a tiered system of access to quality information.

Lack of Skills in Prompt Development

The efficacy of Generative AI (GenAI) is contingent upon the user's skill in prompt engineering—the strategic construction of precise textual inputs. Individuals adept in techniques such as formulating open-ended

queries and incorporating relevant keywords can optimize the utility of these tools. In contrast, those with limited educational backgrounds, low health literacy, or insufficient digital skills may find it challenging to formulate effective prompts, thereby hindering their ability to leverage GenAI and potentially exacerbating existing disparities in access to advanced health information.

Potential Health Disparity Through GenAI

Health disparity denotes differences in health outcomes among socially disadvantaged groups—such as low-income populations, racial and ethnic minorities, and women—who systematically experience poorer health status and higher risks compared to more advantaged groups. In the digital health domain, these disparities are exacerbated by limited access to information technology, low health literacy, language barriers, and insufficient digital skills, including the ability to effectively browse and evaluate online content.

Within the emerging era of Generative AI (GenAI), such disparities are likely to be perpetuated. Disadvantaged groups face significant challenges in evaluating AI-generated outputs and developing effective prompts. Current usage patterns reflect this divide; ChatGPT users are predominantly college students (43%) and employees of Fortune 500 companies (80%), segments typically from higher socioeconomic strata. Equipped with superior education, communication skills, and technological adaptability, these groups are better positioned to leverage GenAI for health information, thereby accruing greater health knowledge and improved outcomes. This dynamic aligns with the knowledge gap hypothesis, which suggests that higher-status individuals assimilate information more rapidly than their lower-status counterparts. Consequently, disparities are amplified as the privileged use technology for purposeful gains, while the less educated

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often engage with it primarily for entertainment.

Mitigating these inequities requires a multifaceted approach that extends beyond mere technology availability. Initiatives must prioritize enhancing accessibility, building digital literacy, fostering meaningful engagement, and cultivating trust in AI systems [3].

Conclusion

This study provides an overview of major health communication mediums on the internet, their practices, and the limitations of traditional web-based health communication tools for health purposes. It highlights GenAI as a new avenue for health promotion while addressing its potential to exacerbate health disparities. These discussions offer valuable insights for researchers, educators, and health professionals focusing on internet-based health communication and health promotion practices.

Although this research lacks extensive evidence-based claims, it serves as a foundation for further empirical studies, such as interviews and surveys with marginalized communities, to better understand health disparities in the era of GenAI. The study could be further enhanced by conducting a systematic review to provide a more comprehensive understanding of communication mediums, their health-related practices on the internet, and health disparities in the rapidly evolving context of GenAI.

Moreover, policy makers and health educators should implement targeted programs to familiarize disadvantaged groups with the latest technologies and their benefits. Efforts should focus on reducing health disparities by improving digital literacy, enhancing prompt development skills, and increasing access to technology for underserved populations.

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