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AI-Enhanced Culturally Sensitive Public Health Messaging: A Scoping Review

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Abstract

Recent research has emphasized the growing use of artificial intelligence (AI) in public health communication. However, the effectiveness of AI in developing and implementing culturally sensitive health communication strategies is poorly understood. The complexity of cultural diversity in public health communication prompted a scoping review to systematically examine existing research on the use of AI in developing and implementing culturally sensitive health communication strategies that promote cultural responsiveness and enhance public health. The present study employed a scoping review methodology in line with the Arksey and O'Malley framework and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews. Data were collected from published studies from MEDLINE (PubMed), Scopus, and Google Scholar in the last five years. From the 933 studies initially identified, screening yielded 15 relevant articles spanning 2019 to 2024, assessing AI's impact of AI across diverse geographical contexts, such as the USA, UK, and China. These studies affirm AI's efficacy of AI in crafting public health messages that incorporate cultural nuances and ensure anonymity, thus addressing the specific needs of racially minoritized communities. However, varying levels of acceptance are often influenced by ethical concerns, resulting in low trust and patient acceptance of AI for culturally responsive communication in public health care. This scoping review underscores a significant uptick in AI-driven approaches to culturally sensitive public health communication. Despite notable advancements, the body of empirical evidence is limited and primarily focuses on AI systems with minimal decision-making autonomy. Persistent challenges in user acceptance, especially within culturally sensitive settings, indicate that cultural sensitivity

and trust-building are pivotal for the successful integration of AI in public health messaging. These findings necessitate further research to deepen the understanding and enhance the effective deployment of AI in diverse cultural contexts.

Keywords

Artificial Intelligence, Public Health Messaging, Cultural Diversity, Culturally Sensitive Health Communication

1. Background

Human interactions of any form involve certain underlying nuances which are dependent on cultural dynamics [1]. Hence, for comprehensive communication to occur, there is a need for a foundational understanding of cultural dynamics, which emanates from deeply ingrained social beliefs and practices, as well as norms and values which influence human behavior and expectations. In professional settings, the impact of these cultural dynamics is profound, affecting communication styles, decision making, conflict perception, management, and resolution. Consequently, recent literature has highlighted the critical role of cultural understanding in fostering effective workplace interaction and corporate messaging in a bid to harness the positives it adds to corporate communication while mitigating the consequences of misinterpretation.

Research indicates that public health messaging lacking cultural sensitivity can have detrimental effects on the quality of care and the overall satisfaction of patients and their families. Indeed, health communications lacking cultural sensitivity not only fall short of achieving intended health objectives, but also worsen inequalities in health access and outcomes [1]. Accordingly, there is a growing demand for culturally sensitive strategies that consider the cultural backgrounds of target populations to improve the effectiveness of public health interventions [2] [3].

Cultural sensitivity necessitates an understanding of varying cultural dynamics and perspectives, including how culture influences individuals' values, beliefs, and attitudes [4]. In public health messaging, cultural sensitivity entails the crafting of communication attuned to the cultural, ethnic, and linguistic context of target populations. While language is a component of culture, cultural sensitivity in public health messaging extends beyond language, but incorporates the understanding of cultural norms, values, and beliefs that influence health perceptions and behaviors [5]. Culturally sensitive public health messaging is more likely to be received and acted upon. Similarly, such messaging can enhance the prevention and management of illnesses by effectively influencing desired health-appropriate behaviors. Public health campaigns are more likely to reach the target audience and boost accessibility. Observing cultural sensitivity in public health messaging is therefore not only ethical, but also pivotal in reducing the public health burden.

Given how delicate healthcare is, it can be inferred that the consequences of the misinterpretation of public health messaging may be life-threatening, highlighting the need for strategies to enhance the cultural sensitivity of public health messaging.

The factors of cultural dynamics are fundamentally rooted in deeply ingrained social beliefs, practices, norms, and values that shape human behavior and expectations [4] [5]. These elements are critical for understanding how individuals from varied cultural backgrounds communicate, make decisions, perceive conflicts, and manage them. In professional contexts, such as public health messaging, these cultural dynamics significantly influence the formulation and reception of communications. Effective public health interventions hinge on cultural sensitivity, which necessitates a nuanced understanding of these cultural dynamics to ensure that communications resonate with diverse target populations. This approach not only aligns the health messages with the cultural norms, values, and beliefs of the audience but also enhances the likelihood of these messages being received and acted upon, thus improving health outcomes and reducing disparities [5].

With the recent emergence of Artificial Intelligence (AI) technology, this paper contends that harnessing its potential in public health messaging is commendable. The incorporation of Artificial Intelligence (AI) into public health messaging shows promise for enhancing cultural sensitivity and addressing longstanding issues within the field. AI technologies, through advanced data analytics and natural language processing, can tailor health communication to the linguistic preferences and cultural contexts of diverse populations [6]. AI can analyze demographic and cultural data to customize messages that resonate with specific cultural norms, values, and beliefs, thereby improving the clarity and reception of health information. Furthermore, AI can facilitate the real-time translation and adaptation of messages to different languages, ensuring broader accessibility and comprehension [7] [8]. This targeted approach not only improves the effectiveness of public health campaigns, but also fosters greater trust and engagement among multicultural audiences, enhancing overall public health outcomes.

2. Rationale for the Review

Recent studies have highlighted the increasing use of artificial intelligence (AI) as a communication tool in public health practices, promising to revolutionize healthcare delivery by enhancing communication efficiency and effectiveness. Particularly in public health practice, where communication is often targeted at diverse communities with varying cultural backgrounds, AI has demonstrated relevance in augmenting public health messaging and communication. For example, demonstrated AI's ability to analyze demographic and cultural data to tailor health messages to specific cultural norms and values. Additionally, [8] illustrated how AI technologies facilitate real-time translation and adaptation of messages to different languages, ensuring broader accessibility and comprehension of health information.

Despite these advancements, the extent and efficacy of AI applications in developing and implementing culturally sensitive health communication strategies remain unclear. This uncertainty raises questions about how artificial intelligence technologies are used to develop and implement health communication strategies that are culturally sensitive, promote cultural responsiveness, and enhance public health [9]. Given the complexity of cultural diversity in public health practice, a scoping review was conducted to systematically map existing research in this area, aiming to identify gaps in the literature and provide valuable insights for optimizing AI utilization to promote cultural responsiveness and enhance public health outcomes.

The imperative to harness Artificial Intelligence (AI) in enhancing culturally sensitive public health messaging is increasingly acknowledged, notably by the World Health Organization (WHO) and the Organization for Economic Co-operation and Development (OECD), particularly given the complexity and diversity of global populations. While AI offers remarkable capabilities to tailor public health messages to culturally diverse audiences (thereby increasing message efficacy and engagement), its deployment raises substantive ethical issues, notably regarding privacy, biases, and equity for diverse cultural backgrounds [10] [11]. Patients from diverse backgrounds should feel comfortable participating in AI-enabled healthcare without fear of discrimination or exploitation [6]. These concerns necessitate rigorous scrutiny not only to optimize AI's benefits but also to mitigate its potential harm.

3. Theoretical Underpinning

The theoretical underpinning of this study is Hofstede's cultural dimension theory and technological determinism.

3.1. Hofstede's Cultural Dimensions Theory

The theoretical framework underpinning this study draws on Hofstede's cultural dimension theory, a seminal framework developed by Geert Hofstede. This theory delineates six dimensions (power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, long-versus short-term orientation, and indulgence versus restraint) that elucidate cultural variations across societies.

In the context of the current study of AI applications in culturally sensitive public health messaging, the dimension of individualism versus collectivism from Hofstede's cultural dimension theory is particularly salient. This dimension delineates the degree to which individuals prioritize personal interests over collective goals within society. In this sense, cultures with a higher emphasis on collectivism may prioritize community well-being over individual preferences, shaping attitudes towards AI-assisted healthcare communication. For instance, in collectivist societies, the acceptance of AI-driven healthcare messaging may be contingent upon its perceived benefit to the broader community rather than individual

preferences. Conversely, in individualistic societies, acceptance may hinge more on personal autonomy and trust in a technology's ability to cater to individual needs.

Understanding these cultural nuances is crucial for effectively implementing AI in public health messaging across diverse cultural contexts, and fostering acceptance and trust among various stakeholders, including healthcare providers and patients.

3.2. Technological Determinism

Technological Determinism posits that technology is an independent force that drives societal change and shapes human behavior [12]. This suggests that technological innovations have deterministic effects on society, influencing how people interact, communicate, and organize themselves. This provides insights into how AI influences cultural responsiveness and shapes health care practices. As AI technologies are increasingly being utilized to develop and implement culturally sensitive health communication strategies, they exert a significant influence on the dynamics of public health. By their very nature, AI-driven communication tools and platforms embody certain technological affordances and constraints that shape the way healthcare information is disseminated and received. Additionally, the integration of AI into healthcare communication processes may introduce new norms, practices, and modes of interaction that reflect technological determinants, rather than solely cultural considerations. This theory underscores the complex interplay between AI technologies and cultural dynamics, contributing to a deeper understanding of the relationship between technology, culture, and healthcare communication in diverse cultural contexts.

4. Cases of AI Usage in Public Health

Researchers have developed an Artificial Intelligence (AI) system that can rapidly detect COVID-19 using chest X-rays with more than 98% accuracy [13]. This new AI system, which employs a deep learning-based algorithm called Custom Convolutional Neural Network (Custom-CNN), stands out by swiftly and accurately distinguishing COVID-19 cases, normal cases, and pneumonia in X-ray images [13].

Furthermore, AI has been used to improve public health by analyzing social media and other online data to predict and respond to infectious disease outbreaks. This has been demonstrated by the use of AI to predict the spread of the Zika virus in Brazil and to monitor the spread of COVID-19 in several countries, including the United States and South Korea [14]. Additionally, there is an Electronic Health Record Analysis for Healthcare Resource Allocation in India. Electronic health records are leveraged to identify high-risk populations and optimize healthcare resource allocation in underserved regions [15].

Typical approaches employed across case studies involve gathering data, preparing it for analysis, utilizing advanced analytical methods, and interpreting

findings. Major findings include enhanced precision in disease surveillance, timely planning of interventions, tailored strategies for health promotion, and more efficient allocation of resources. The implications include a decrease in disease impact, enhanced efficiency in healthcare delivery, and an overall improvement in population health results [16].

Common methodologies across case studies include data collection, pre-processing, analysis using advanced analytics techniques, and interpretation of results. Key findings included improved disease surveillance accuracy, timely intervention planning, targeted health promotion strategies, and optimized resource allocation. The outcomes achieved included reduced disease burden, improved healthcare delivery efficiency, and enhanced population health outcomes.

While the above cases showed a high level of efficacy in its use in public health, there was little focus on the cultural responsiveness of the AI system.

5. Best Practices of AI Integration in Healthcare

Given that AI is still a developing concept, there is no one-size-fits-all best practice or approach to its use, particularly in public health communication. However, a few guidelines and frameworks (notably by institutions such as the Organization for OECD and Development (OECD) and these guidelines keep evolving. The current review aligns with World Health Organization guidelines. The guidelines provide the best practices for AI integration in healthcare practices that can be adapted to public health communications and cultural responsiveness.

The WHO AI in healthcare guidelines emphasizes the ethical use of AI in healthcare, stressing transparency, and intelligibility to uphold patient autonomy and ensure the accountability of AI-assisted decisions [17]. Moreover, the guidance advocates for a balanced approach, highlighting the need to mitigate risks such as data privacy breaches and biases, while maximizing benefits aligned with sustainability and public health goals. Governments are urged to play a pivotal role in regulating AI in healthcare by establishing frameworks to enforce standards, transparency, and compliance with ethical norms. Additionally, the guidelines recommend mandatory independent audits and impact assessments of AI systems, focusing on data protection, human rights implications, and the effects on diverse populations. Stakeholder engagement is emphasized to ensure that AI development processes are inclusive, equitable, and responsive (including cultural responsiveness) to the needs of all segments of society [17].

6. Methods

6.1. Study Design

This study employed a scoping review methodology in line with the Arksey and O'Malley framework [18] and reported according to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) checklist. Given that the state of extant literature on AI usage in enhancing culturally sensitive messaging in public health is unclear, with only a few

studies focusing on this domain; a scoping review enabled a mapping of the "extent, range and nature of research activity" in this emerging area of research.

6.2. Research Question

The research questions guiding this study were as follows:

1. What are the current applications of artificial intelligence (AI) in public health?

2. How culturally responsive are AI applications in public health communication?

3. What are the gaps in the literature regarding AI applications in public health communication and cultural responsiveness?

6.3. Identifying Relevant Studies

The search strategy was tailored to identify pertinent studies on AI-enhanced culturally sensitive public health messaging. Initially, iterative testing of synonyms was conducted for three primary concepts: artificial intelligence, public health messaging, and cultural sensitivity. To ensure precision, distinctions were made between various facets of AI, including algorithms, applications, and systems, using standardized Medical Subject Headings terms and subject headings specific to AI and its subcategories provided by the selected databases. Cultural sensitivity, defined within the context of public health messaging, encompasses a broad spectrum of cultural considerations pertinent to health communication. The synonyms for each concept were linked using the Boolean operator OR, and subsequently, these search strings were merged using the Boolean operator AND. For instance:

Search string for question 1: ("artificial intelligence" OR "Neural networks" OR "Deep learning" OR "Machine learning ") AND "public health" AND ("applications" OR "implementation" OR "use cases").

Search string for question 2: ("cultural responsiveness OR "cultural sensitivity") AND "artificial intelligence" AND ("public health communication" OR "public health engagement" OR "public health engagement messaging".

Search string for question 3: "gaps OR "Grey areas" AND "literature review" AND "artificial intelligence" AND ("public health communication" OR "healthcare communication" OR "health communication OR" health messaging) AND ("cultural responsiveness" OR "cultural sensitivity").

To cover the literature from both general and health-related sources, searches were performed across three electronic databases: MEDLINE (PubMed), Scopus, and Google Scholar.

6.3. Study Selection

All records were manually sorted to identify and eliminate duplicates. Subsequently, the titles and abstracts of the remaining records were thoroughly screened by the lead author. In instances of uncertainty or conflict, regular check-ins were scheduled to ensure consensus among all the authors, drawing upon their

diverse multidisciplinary backgrounds. A continuous review of the screening criteria was undertaken, with any questions or discrepancies promptly addressed to ensure consistent and universal application. Furthermore, a cautious approach was adopted, favoring inclusion when uncertainties arose. Full-text articles were independently screened by two reviewers, and any conflicts or uncertainties were resolved through comprehensive discussion until consensus was achieved.

6.4. Inclusion Criteria

1. Peer-reviewed studies were prioritized because of their enhanced credibility, resulting from expert scrutiny within the field.

2. Publications published from January 2019 to April 2024 were considered to capture recent advancements and ensure relevance.

3. Only studies published in English were included to reflect practical considerations, based on the investigators' language proficiency.

6.5. Charting the Data

A structured data extraction template was adapted from [19] to systematically chart the data pertinent to the research objectives. In delineating the concepts of AI, the study aligned with the November 2023 updated definition of AI by the Organization for Economic Co-operation and Development (OECD) AI Principles; that is, AI is "a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Different AI systems vary in autonomy and adaptiveness after deployment [20]. The extracted data encompassed the following dimensions.

1. General information, including details such as authors, publication year, country of origin, clinical setting, overarching study aims, and study design employed.

2. Types and applications of AI: This section delves into the specific AI technologies utilized, type of AI model employed, nature of tasks undertaken by the AI, degree of autonomy conferred upon the AI system, intended purposes of AI deployment, and targeted user base.

3. Implementation process: encompassing the research focus, underlying motives driving AI integration, constituent elements of the implementation process, and any frameworks or guidelines employed to guide implementation efforts.

6.6. Collating, Summarizing, and Reporting the Results

Data relevant to the exploration of current AI applications in public health (Objective 1) and the assessment of cultural responsiveness in public health communication (Objective 2) were meticulously examined and summarized. Additionally, a qualitative thematic deductive analysis, following the approach outlined by [21] was employed to scrutinize the literature for gaps in understanding the

elements in the context of AI applications in public health communication and cultural responsiveness (Objective 3). Each article underwent iterative readings, with initial insights categorized into distinct domains: the motivation behind implementation and elements in the implementation process. Subsequently, codes were derived from the data and compared to delineate the emerging themes within each domain. Collaborative coding and analysis were conducted, and discrepancies were resolved through consensus among the research team.

6.7. Results

The search yielded 923 records. After removing duplicates (n = 559), 364 records remained for title and abstract screening. This process led to the exclusion of 251 records, leaving 113 for a full-text eligibility assessment. Of these, 98 were excluded for the reasons detailed in Figure 1, resulting in 15 articles being included in the scoping review.

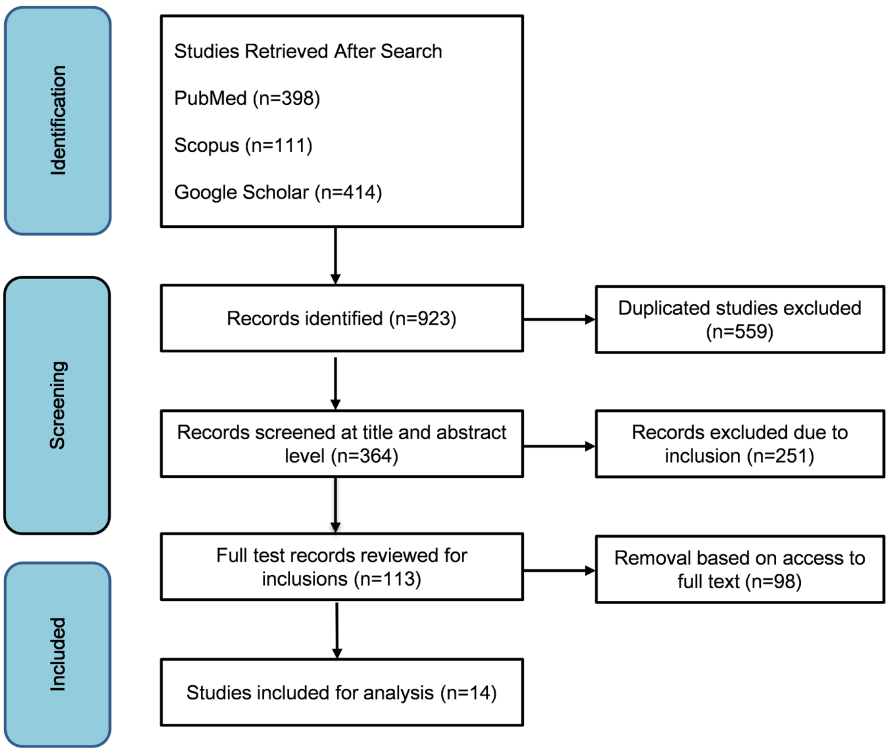

Figure 1. PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart.

6.8. Study Characteristics

As indicated in Figure 1, the included studies span from 2019 to 2024, with varying numbers of studies published each year. In 2019, two studies were identified. The year 2020 contributed three studies. One study was conducted in 2022. The most substantial number of studies, seven in total, were published in 2023. Finally, two studies were identified for the year 2024.

Figure 2 illustrates the distribution of studies by year of publication from 2019 through 2024. The graph shows a rising trend in the number of studies, peaking in 2023 with seven publications. These studies also encompassed a diverse geographic scope, including the United States [2], United Kingdom [7] and Asia [22] with notable contributions from each region. As indicated in Table 1, most of the included studies (11 of 15) did not indicate their study locations.

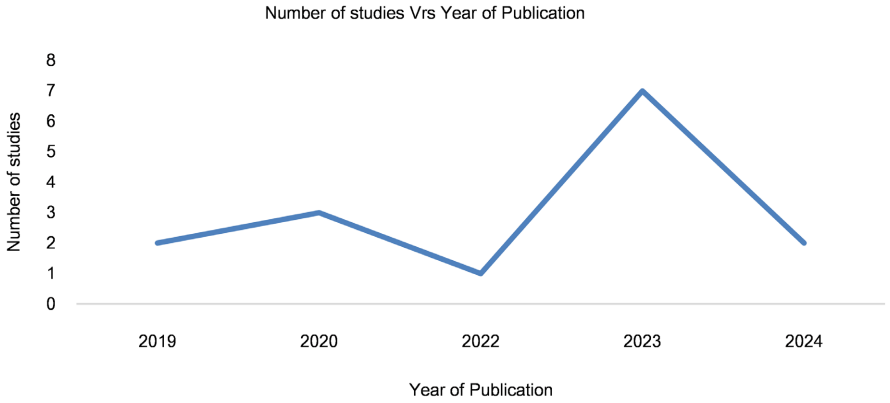

Figure 2. Year of publication of the include studies.

Table 1. Overview of studies reviewed.

Author, year, country	Study aim	Study design
(Wang *et al*., 2023), USA	Demonstrates how to combine human and Natural Language Processing (NLP) machine analyses to reliably extract meaningful consumer insights from tweets about COVID and the vaccine	Case Study
(Blessing, Potter and Klaus, 2024b), not stated	Examined social and cultural factors and their impact on perceptions of AI in end-of-life care scenarios.	A multidisciplinary approach, encompassing perspectives from healthcare, psychology, ethics, and cultural studies
(Ahmad *et al*., 2020), Asia	Use a Shallow SingleLayer Perceptron Neural Network (SSLPNN) and Gaussian Process Regression (GPR) to classify and predict confirmed COVID-19 cases across five geographically distributed regions of Asia.	Quantitative (Correlation analysis and regression)
(Yang *et al*., 2020), China	Integrate population migration and COVID-19 epidemiological data into the Susceptible-Exposed-Infectious-Removed (SEIR) model to derive the epidemic curve and predict epidemic peaks and sizes using an AI approach trained on 2003 SARS data.	AI-based modeling and prediction
(Ke *et al*., 2020), not stated	This study aimed to identify marketed drugs with potential for treating COVID-19 using AI technology.	An AI platform was established to identify potential old drugs with anti-coronavirus activities by using two different learning databases
(Khalifa, Albadawy and Iqbal, 2024), not stated	The study systematically reviews the role of AI in enhancing clinical decision support (CDS) systems across six domains: Data-Driven Insights and Analytics, Diagnostic and Predictive Modelling, Treatment Optimisation and Personalised Medicine, Patient Monitoring and Telehealth Integration, Workflow and Administrative Efficiency, and Knowledge Management and Decision Support	Four-step systematic review

Continued

(Akhtar, Kraemer and Gardner, 2019), not stated	To predict the geographic spread of Zika virus outbreaks in real time using a dynamic neural network model.	Dynamic modeling and sensitivity analysis
(MacIntyre *et al*., 2023), not stated	Review the role of artificial intelligence in epidemic surveillance, evaluating how AI can support early detection and response in epidemic management	Narrative review
(Jungwirth and Haluza, 2023), not stated	This study aimed to test the ability of GPT-3 to advance public health and to explore the feasibility of using AI as a scientific co-author.	Exploratory study
(Prakasam *et al*., 2023), not stated	Explore the use of artificial intelligence and chatbots in healthcare, specifically in the design and development of a diagnostic chatbot for managing medical appointments.	Descriptive study
(Schmaelzle, 2023), not stated	This study introduces and examines the potential of an AI system to generate health awareness messages.	Prompt engineering and computational analysis
(Nadarzynski *et al*., 2023), UK	To design principles for a culturally sensitive self-assessment intervention based on the disclosure of health-related information to chatbots.	Online survey and Follow-up interviews
(Karinshak *et al*., 2023), Not stated	Investigate the persuasive quality of AI-generated messages to understand how AI could impact public health messaging	Evaluation of series of studies and Qualitative approaches
(Şerban *et al*., 2019) not Stated	The aim was to describe a software system built on recent developments in machine learning and data processing for real-time syndromic surveillance based on social media data	Description of a software system development
(Rashid *et al*., 2022), not stated	Propose a novel augmented artificial intelligence approach using an artificial neural network (ANN) with particle swarm optimization (PSO) to predict five prevalent chronic diseases.	Comparative analysis of algorithms

In terms of study design, the included studies encompassed a wide spectrum of methodologies, ranging from exploratory studies and narrative reviews to more specialized approaches, such as prompt engineering and computational analysis. This diversity reflects the multifaceted nature of research on AI applications in healthcare, with each study design tailored to address specific research questions and objectives. For instance, [23] employed quantitative methods such as correlation analysis and regression to assess the efficacy of AI platforms in drug discovery and epidemic prediction. On the other hand, studies such as [24] [25] focus on systematic reviews, highlighting the need for a comprehensive synthesis of the existing literature to inform evidence-based practices in healthcare. This array of study designs underscores the interdisciplinary nature of research in this field, drawing from various disciplines such as healthcare, psychology, ethics, and cultural studies, to provide holistic insights into the utilization of AI in healthcare contexts.

7. Current AI Application in Public Health

Current AI use in public health encompasses a diverse range of areas, including epidemic surveillance, disease prediction, drug discovery, diagnostic support, and patient management. Additionally, AI models have been utilized for drug

repurposing and identification, accelerating the search for potential therapeutics, particularly in combating pandemics, such as COVID-19 [24]. Studies have demonstrated AI's effectiveness in predicting disease outbreaks and epidemic peaks, thereby facilitating early detection and response [25]. In clinical settings, AI-based diagnostic tools and decision support systems have shown promise in improving diagnostic accuracy, personalized treatment planning, and patient monitoring, leading to enhanced healthcare outcomes [26]. Furthermore, AI-powered chatbots and telehealth platforms have emerged as valuable tools for remote patient care, appointment scheduling, and health education, promoting accessibility and efficiency in healthcare delivery [25] [26].

Advantages of AI in Public Health

Artificial Intelligence (AI) is transforming public healthcare by significantly enhancing diagnostic accuracy and streamlining resource management. By analyzing extensive medical data rapidly, AI uncovers critical patterns that improve diagnostic precision, crucial for effective treatment of various conditions. This advanced capability also aids in optimizing resource allocation within healthcare facilities, predicting patient inflow, and automating administrative tasks. Such efficiencies free up healthcare professionals to focus more on direct patient care, enhancing overall service delivery [27].

AI's role extends to personalizing medical treatments and boosting patient engagement through continuous health monitoring and tailored health education. Utilizing detailed individual health data, AI customizes treatments, enhancing efficacy and reducing side effects. Additionally, AI facilitates real-time public health data analysis and disease surveillance, accelerating responses to health crises. It also delivers culturally sensitive health education, addressing specific community health needs, thus playing a critical role in reducing healthcare disparities and promoting a more equitable healthcare system [27].

8. Cultural Responsiveness of Current AI Applications in Public Health Communication

Current AI applications in public healthcare communication have demonstrated varying degrees of cultural responsiveness. Studies have shown that AI-generated messages can effectively convey public health information, including vaccination promotions, with messages perceived as more effective and persuasive than those authored by human institutions [28]. However, there is a preference among individuals for public health messages originating from human sources rather than AI, suggesting a need for careful consideration of message delivery and labelling. Additionally, research highlights the cultural sensitivity of AI applications for sexual health, indicating that AI chatbots can be acceptable for self-assessment and professional advice among racially minoritized communities, based on their design with anonymity features and culturally sensitive language [28]. Moreover, the potential of AI systems to generate culturally appropriate health awareness

messages has been demonstrated, with AI-generated messages ranking higher in quality and clarity than human-generated messages, suggesting promise for culturally responsive communication [27] [28].

9. Key Issues in AI Generated Content

AI-generated content in public health communication faces significant challenges, primarily centered around the acceptance and trust among its users. Despite the effectiveness of AI in crafting culturally tailored messages, there remains a pronounced preference for messages authored by humans. This preference underscores the need for enhanced transparency and accountability in AI operations to build trust. Effective strategies might include incorporating mechanisms for user feedback and demonstrating the processes behind AI decision-making [29]. Furthermore, while AI can effectively integrate cultural nuances into its messaging, gaps remain in its ability to consistently deliver culturally sensitive content that resonates across diverse populations.

Ethical considerations in AI-generated content cannot be overlooked. The potential for AI systems to perpetuate existing biases is a significant concern, particularly in public health communications where the stakes are high. Ensuring that AI systems are free from biases and operate fairly requires rigorous testing and continuous oversight. The ethical deployment of AI also demands adherence to principles that prioritize human rights and equity. As AI technologies become more prevalent in public health settings, establishing regulatory frameworks to monitor these systems is imperative to prevent harm and ensure that they serve the diverse needs of the community equitably. Addressing these gaps requires a deeper understanding and integration of cultural elements to ensure the effectiveness of AI-generated communications in public health [30].

10. Improving Data Accuracy of AI Messages in Public Health Communication

10.1. Data Quality and Diversity

The foundation of accurate AI-generated messages lies in the quality and diversity of the training data. High-quality data sets that are representative of the target population's linguistic, cultural, and contextual diversity are crucial. These data sets should be meticulously curated to avoid biases and inaccuracies that could misinform AI learning processes. Ensuring data integrity involves rigorous data collection, preprocessing, and validation to reflect the nuances of language and culture accurately. This comprehensive approach helps AI models to better understand and replicate human-like communication in varied public health scenarios [7].

10.2. Continuous Learning and Interdisciplinary Collaboration

AI systems can significantly benefit from continuous learning mechanisms where they adapt and refine their outputs based on real-time feedback. Integrating

feedback loops allows AI to evolve in response to new information or changes in public health discourse, enhancing the relevance and accuracy of its messages over time. Moreover, collaboration across disciplines, combining expertise from public health professionals, linguists, cultural experts, and AI developers, ensures that AI-generated messages are both technically sound and culturally competent. This interdisciplinary approach not only enriches the AI's learning process but also ensures that the messages are contextually appropriate and effectively address public health communication goals [7] [31].

10.3. Advanced Techniques and Ethical Considerations

Employing advanced natural language processing (NLP) techniques can further refine the accuracy of AI-generated messages. These techniques, such as contextual understanding and sentiment analysis, allow AI to interpret the subtleties of human language and respond appropriately. Additionally, it's vital to implement ethical guidelines and bias mitigation frameworks to oversee AI operations. Regularly auditing AI systems for potential biases and ensuring adherence to ethical standards prevents discrimination and enhances the fairness and inclusivity of AI communications. Such practices not only improve the accuracy of the messages but also build public trust in AI-driven health communication tools [31].

10.4. Enhanced Model Training and Algorithmic Adjustments

The accuracy of AI-generated messages can be significantly improved by refining the training models and algorithms used. This involves not only the selection of appropriate machine learning models but also tuning these models to handle the specific nuances of public health messaging. By using more sophisticated algorithms that can process complex data structures and learn from non-linear relationships within the data, AI systems can generate more precise and relevant messages. Employing techniques like transfer learning, where a pre-trained model is fine-tuned with public health-specific data, can also enhance performance without the need for extensive data from scratch [32].

10.5. Use of Synthetic Data for Enhanced Scenario Training

In cases where data may be scarce or sensitive, synthetic data generation can be a valuable tool. This technique involves creating artificial data sets that mimic real-world data, which can help train AI systems in scenarios that are rare or have not yet been encountered. By expanding the diversity and volume of training scenarios, synthetic data allows AI models to explore a wider range of health communication challenges, enhancing their ability to respond accurately under various circumstances [31] [32].

10.6. Implementation of Multilingual and Multi-Dialectal Support

Considering the linguistic diversity of global populations, implementing multilingual and multi-dialectal support in AI systems is crucial for the accuracy of public

health messages. This approach ensures that AI-generated messages are accessible and understandable to people across different linguistic backgrounds. Training AI systems in multiple languages and dialects, and ensuring they understand the cultural nuances associated with each, can greatly improve the effectiveness and reception of public health communications [33].

10.7. Regulatory Compliance and Continuous Monitoring

Ensuring that AI systems comply with relevant health communication regulations and standards is essential for maintaining accuracy and trustworthiness. Continuous monitoring of AI performance and the adherence to guidelines from health organizations ensure that the messages generated meet the required standards of accuracy and relevance. Regular updates to the AI systems based on new health guidelines and research findings keep the messages up-to-date and scientifically valid [33].

11. Gaps in the Current Literature on AI applications in Public Health Communication and Cultural Responsiveness

While AI-generated messages are effective in conveying public health information, including vaccination promotion, surpassing human-authored messages in persuasiveness and effectiveness, there remains a preference among individuals for public health messages originating from human sources rather than AI, indicating a gap in acceptance and trust [33]. Moreover, research emphasizes the necessity of cultural sensitivity in AI applications for sexual health, suggesting that while chatbots are acceptable for self-assessment and professional advice among racially minoritized communities, there is a need for anonymity and culturally sensitive language to enhance user engagement and trust [7]. Additionally, although AI systems have shown potential in generating culturally appropriate health awareness messages and outperforming human-generated messages in quality and clarity, there is still a gap in understanding how to effectively integrate cultural nuances into AI-generated content for optimal communication outcomes [33].

12. Discussions

Question 1: What are the current applications of Artificial Intelligence (AI) in Public Health and Advantages:

Current AI applications in public healthcare exhibit a wide range of capabilities across various domains ranging from epidemic surveillance to patient management. Research findings highlight AI's pivotal role of AI in predicting disease outbreaks and epidemic peaks, facilitating proactive measures for early detection and response [34]. This predictive capability is particularly significant in combating pandemics such as COVID-19, where AI-driven approaches enable the swift identification of potential therapeutics through drug repurposing and identification

efforts. Additionally, in clinical settings, AI-based diagnostic tools and decision support systems contribute to improved diagnostic accuracy, personalized treatment planning, and enhanced patient monitoring, ultimately leading to better healthcare outcomes [35]. Furthermore, the emergence of AI-powered chatbots and telehealth platforms presents valuable resources for remote patient care, appointment scheduling, and health education, thereby enhancing accessibility and efficiency in healthcare delivery. These diverse applications underscore the transformative potential of AI in revolutionizing public healthcare and offering innovative solutions to address complex healthcare challenges.

The scope of AI applications in public healthcare reflects a paradigm shift in healthcare delivery, with AI technologies playing a central role in driving advancements across various facets of healthcare provision. The integration of AI-driven solutions not only enhances the efficiency and effectiveness of healthcare services, but also fosters greater accessibility and inclusivity in healthcare delivery. Moreover, the multifaceted nature of AI applications, spanning from epidemic surveillance to patient management, underscores the versatility and adaptability of AI technologies for addressing diverse healthcare needs. However, while AI presents promising opportunities for improving healthcare outcomes, it also raises important ethical, regulatory, and privacy concerns that warrant careful attention and scrutiny.

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For instance, privacy concerns emerge due to the circulation of sensitive healthcare data across unauthorized channels, necessitated by the vast data requirements for training AI algorithms [35]. Moreover, the opaque nature of AI decision-making, often referred to as the "black box" raises transparency issues, undermining patient autonomy and trust [35]. Furthermore, AI has been shown to perpetuate existing biases within healthcare systems, leading to deceptive predictions, discrimination, and inequities. This has become a global concern for many stakeholders. Indeed, the WHO Director-General (Tedros Adhanom Ghebreyesus) said " *… The future of healthcare is digital, and we must do what we can to promote universal access to these innovations and prevent them from becoming another driver for inequity.*" [17]. Therefore, addressing these ethical dilemmas is extremely critical for the sustainability of AI usage in healthcare delivery This may require a multifaceted approach involving stakeholders, policymakers, patients, and healthcare providers to ensure that AI technologies are ethically developed, applied, and implemented in public health messaging.

Question 2: How Culturally Responsive are AI Applications in Public Health Communication

Culture plays a significant role in shaping communication style and worldview. Just as cross-cultural human interactions can lead to miscommunication, users from diverse cultures who interact with conversational AI tools may feel misunderstood and experience them as less useful, particularly in public health practices [36]. While AI-generated messages have demonstrated efficacy in conveying public health information, including vaccination promotion, surpassing human-authored messages in terms of perceived effectiveness and persuasiveness, there exists a preference among individuals for messages originating from human sources rather than AI platforms [14]. This finding is corroborated by evidence from a survey in the USA conducted by [37] where the public strongly preferred human medical professionals to make medical decisions, while at the same time believing that they are more likely to make culturally biased decisions than AI. This suggests a need for careful consideration of message delivery methods and labelling strategies to bridge the trust gap between AI-generated content and end users.

Existing literature underscores the significance of cultural sensitivity in AI applications for sexual health, particularly among racially minoritized communities. Chatbots designed with anonymity features and culturally sensitive language have shown acceptance for self-assessment and professional advice in these communities, highlighting the importance of tailoring AI systems to diverse cultural contexts. This potential of AI systems to generate culturally appropriate health awareness messages is evident, with AI-generated messages ranking higher in quality and clarity than human-authored content [24]. This suggests the promise of

culturally responsive communication in public health care settings. However, to fully leverage this potential, further research and development are warranted to enhance AI's understanding and integration of cultural nuances. By refining AI algorithms to account for diverse cultural backgrounds and preferences, health care professionals can harness the power of AI to deliver more effective and engaging public health messages tailored to the needs of specific communities. Thus, while current AI applications demonstrate varying degrees of cultural responsiveness, there is room for improvement in optimizing the efficacy of AI in culturally sensitive public health communications.

Question 3: What are the gaps in the literature on AI Applications in Public Health Communication and Cultural Responsiveness?

While studies have shown that AI-generated messages effectively convey public health information, such as promoting vaccination, and are more persuasive than messages authored by humans, there remains a strong preference among people for messages written by humans. This highlights a significant gap in acceptance and trust that needs to be addressed. Exploring strategies to close this gap includes improving the transparency and accountability of AI-generated messages and incorporating feedback mechanisms to build trust in AI-driven communication platforms. Furthermore, the research points out the critical need for cultural sensitivity in AI applications, especially in sexual health communications, where chatbots have been effective but must ensure anonymity and use culturally appropriate language to foster user engagement and trust. Despite these advancements, challenges still exist in integrating cultural nuances effectively into AI-generated content to optimize communication outcomes [38].

Addressing the gaps in the current literature on AI applications in public healthcare communication and cultural responsiveness requires a multifaceted approach. Major frameworks, such as the Cultural Formulation Interview (CFI) and the Cultural Formulation Approach (CFA), offer valuable guidance in incorporating cultural considerations into healthcare practices [39]. This framework can help to systematically assess and address cultural factors in the development and deployment of AI-driven healthcare communication tools, thereby enhancing their relevance and effectiveness across diverse populations. Interdisciplinary collaboration between computer scientists, public health experts, and social scientists is essential for developing comprehensive solutions that account for both the technical and sociocultural aspects of AI application in healthcare communication. Ultimately, to ensure that AI applications in public healthcare communication are culturally responsive, a concerted effort is required to integrate cultural competence into both the design and implementation phases of AI-driven interventions, thereby maximizing their impact and acceptance within diverse communities.

13. Conclusion

This review provides insights into the current landscape of AI applications in public healthcare communication and highlights the varying degrees of cultural

responsiveness observed. While AI technologies demonstrate effectiveness in diverse healthcare domains, such as epidemic surveillance, drug discovery, and patient management, challenges persist regarding the acceptance and trust of AI-generated messages compared to those authored by human institutions. Additionally, the review underscores the importance of cultural sensitivity in AI applications, particularly in sexual health contexts, and emphasizes the need for anonymity and culturally sensitive language to enhance user engagement and trust among racially minoritized communities. Despite the potential of AI systems to generate culturally appropriate health awareness messages, there remains a gap in the understanding of how to effectively integrate cultural nuances into AI-generated content for optimal communication outcomes. Future research should address these gaps by exploring innovative approaches and frameworks to enhance the cultural responsiveness of AI applications in public healthcare communication.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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