

Cultural Sensitivity in Health Technology Design

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ABSTRACT

As healthcare becomes increasingly digitized, the integration of cultural sensitivity in health technology design is essential to ensure equitable, effective, and inclusive healthcare solutions. This paper examines the critical need for culturally sensitive approaches in the development of health technologies, emphasizing the limitations of conventional biomedical models and universal design paradigms. Through the lens of historical exclusions, culturally competent frameworks, and user-centered principles, it highlights how design decisions when informed by diverse cultural beliefs, practices, and values can enhance usability, trust, and adoption across diverse populations. The paper examines practical frameworks, ethical considerations, and real-world case studies to demonstrate how health technologies can be aligned with patients' cultural realities. It also addresses barriers to implementation and offers strategic recommendations for stakeholders to promote culturally sensitive innovation. Ultimately, this work underscores that embracing cultural nuance is not merely an ethical imperative but a design necessity in achieving health equity.

Keywords: Cultural Sensitivity, Health Technology Design, Cultural Competence, User-Centered Design, Health Equity, eHealth, Telehealth, Assistive Technologies.

INTRODUCTION

The expectation to address patients' social needs has long been part of medical practice. Training for physicians typically covers interviewing techniques and adherence to treatment plans. Recently, however, there has been a call for greater cultural sensitivity in primary care. Diverse belief systems and customs shape healthcare experiences, and a physician unaware of cultural differences may misinterpret a patient's situation, resulting in misunderstandings. Many socio-cultural nuances remain unwritten, making the use of effective interviewing techniques essential for culturally sensitive patient encounters. This can start with simply integrating cultural topics into discussions. Physicians must appreciate the intricate cultural frameworks that influence individual social and medical lives. For instance, while an American physician might ask about a patient's origins as part of their social history, such questions assume that healthcare plays a central role in the patient's life, which may not be true for everyone. A physician accustomed to viewing illness purely through a biological lens might inadvertently dismiss a patient's beliefs in spiritual or alternative causes. Additionally, pain might be perceived differently across cultures sometimes linked to past traumas or societal repercussions. Understanding the cultural landscape that shapes a patient's experience can therefore enhance medical practice or lead to frustration in cases where patients feel marginalized [1, 2].

Importance of Cultural Sensitivity in Health Technology

Systems of care cannot be designed solely from the Western perspective; cross cultural issues must be taken into account if a credible account of the character and behavior of an efficient whole is to be devised. Oftentimes technology in the design and implementation of a system of care is not used when it entails an unintended cultural shift in the actions expected of its users. Examples of technology that challenges rather than complements culture can be seen in both health-related and non-health related arenas. Patients must be able to culturally fit the health technology design. Culturally appropriate technology is

consumer friendly technology that is mindful of cultural norms and fully cooperates with them. Designing technology services in health care that are culturally sensitive is a need in research and practice. The trend of patient-centered design is a challenge for the traditional, biomedical defect-oriented, psychiatric/normative model of mental health. Culturally-sensitive personalized health technology design processes and services were created to direct designers' awareness into cultural sensitivity throughout the phases in which health technology is designed. Applications of it in designing culturally-sensitive health technology for the Japanese society show that it could assist designers' cognitive processes in creating culturally-sensitive health technology. Specifically, the multi-layered attitudes to health practice customized for culturally-sensitive health technology design facilitate designers by enabling them to consider cultural differences not only in attitudes but also in the ways they would shape culture-specific technology. The adaptation of health technology design suggested in the case study indicates how culturally-sensitive PHTDPS might help participants to narrow down culture-adaptive design frontiers. The design principle and ethnographic guideline developed would also help designers broaden the dimension of the attitude that is focused on health technology design, successfully bringing practices besides self-monitoring under the observation of design. As cultural norms are related to expected action, and thus the design of interfaces, designers must be able to think of violations if they are to be guided in design by culture [3, 4].

Historical Context of Health Technology

Technologies have been created for and about marginalized groups for centuries. While the earliest inventions such as the toothbrush and thermometers were made in different cultures and include cultural adaptations, advancements in the latter half of the 20th century were done without direct input from those in the populations being studied. Some technologies were only marginally successful with the groups they were designed for. In contrast, some completely offensive inventions targeted at African Americans perpetuated hidden discrimination, and exclusionary design left out certain groups entirely. The tendency for engineers to see universal representative landmarks and cloning behavior in others is an inherent issue with technology development that has made unwanted technologies for some marginalized groups. The design and implementation of health technology and behavior change approaches have not been developed in practice on the basis of a full understanding of relevant cultural beliefs, values, and supporting social contextual factors, as well as the barriers and facilitators related to its access and adoption. Past work in the health technology landscape has assisted providers and their patients with EHRs and telemedicine. However, the literature has not fully explained how the patient-level context and data access in near real-time by providers based on key measures have been used to benchmark and examine value outcome gaps. Patients have been presented with portals to public-facing data, choices, and efforts to empower them to use health data to understand and improve their outcomes comprehensively. There are significant gaps in the literature for historically underserved populations, including Black and other people of color, low-income people, LGBTQIA+ people, disabled people, and the elderly, in understanding their ability to access, use, and benefit from health information technology [5, 6].

Understanding Cultural Competence

Elaborate understanding of cultural background of communities is required for universal design and adequate utilization of technology in care services. Culturally Competent Health Technology Design is a design approach that considers the cultural aspects of users' lives and strives to enhance health technology adoption. A lack of cultural competence in health technologies can lead to their inappropriate adoption, which may lead to adverse effects on user health. On the contrary, healthcare technology with a well-executed culturally sensitive character can facilitate their acceptance by potential adoptors and subsequent technology success in intervention studies. However, designing health technologies with culturally competent characteristics is very challenging. It requires extensive knowledge of the cultural traits of the user's communities that are directly associated with health practices, prior attention to how such cultural traits vary among individuals and population groups, and machinery adaptation of technology behavior to cultural characteristics of the end-users. Cultural competence is an extensive and diverse notion that comes as one of the most widely used and validated cultural characteristics in health-related disciplines. Developing culturally competent robotics requires a detailed design methodology that can guide the understanding of cultures and the implementation of such knowledge in robotics design and assessment. Cultural competence poses a multitude of requirements for personal assistive robots, which comprise cultural familiarity, respectfulness, flexibility and openness, inclusivity, and adaptation regarding communication and behavior. Personal assistive robots should endeavor to be culturally competent since they deal with personal, social, and family issues concerning both health and safety. During their operating time in care services personal assistive robots will be traversing through personal belongings of users, executing home environmental manipulations, and simultaneously dealing with

sensitive health data. They should be aware of the general cultural traits of the specific user's community and such traits that vary among individuals within such a community [7, 8].

Frameworks for Cultural Sensitivity

ITo achieves the desired communication and information service quality among stakeholders, societal trustworthiness is essential. This involves a detailed exploration of trust within a health and medical framework, focusing on personal health and disease awareness, alongside cultural and regional issues in health information handling. Telehealth serves as a local solution to global problems, yet control over health information remains inadequate due to legislation and technology gaps. Research Question 1 investigates which socioeconomic factors and telehealth solutions encourage communities to share local knowledge about safety perceptions, lifestyles, and disease awareness. We must develop an incentive-driven, participatory approach to ensure privacy and engage autonomous sources with limited trustworthiness. Research Question 2 examines the necessary safeguards and trust mechanisms in areas with low technological adoption, requiring indirect studies with laypersons in targeted fields. Data on societal variables, trustworthiness, and telehealth expectations will inform preventive actions regarding health and safety issues. Research Question 3 focuses on telehealth education programs that ensure the identified solutions impact community mental states equally. Parallel pilot courses must align with decision support and societal convenience tools, addressing cultural differences impacting public health communication at both individual and community governance levels [9, 10].

User-Centered Design Principles

Fundamental to human-computer interaction (HCI) is the belief that products should be designed for people. User-centered design (UCD) principles guide engagement with users during design processes. However, these principles can lead to unintended consequences in eHealth applications. UCD often promotes a narrow view of users, ineffective for applications with social complexity. To create effective products, a wide range of motivations, knowledge, and perspectives must be considered at all stages. Planning and integrating knowledge from diverse fields is crucial to avoid blind spots and dismissive attitudes in design. Sociotechnical assessments of products are equally important. While significant proposals, like regulatory frameworks, exist, many do not adequately address the role of design in technology adoption and use, particularly for marginalized groups. The technical commodification of technology has led to the obscuring of design processes, often taking place behind closed doors, limiting public engagement in decisions affecting collective lives. Who designs products significantly impacts what is created, highlighting the importance of social choices and political considerations in shaping future societal structures. In competitive markets, the focus on cost-cutting and rapid design often hampers the necessary reflectivity for assessing user participation and the implications of designed systems [11, 12].

Case Studies in Health Technology Design

The incorporation of health technologies into modern healthcare systems requires a focus on usability and safety. Regulatory bodies seek to minimize risks associated with medical devices and applications, ensuring adequate mitigation strategies for any existing risks. A major aspect of health technology design is to reduce error likelihood and provide recovery options. An outlined typology details the elements involved in health technology provision, emphasizing safety and usability for various stakeholders, including developers, healthcare professionals, and patients. Connected health devices, used unsupervised at home, monitor users' physiology through sensors. Reliable data from these devices can be remotely transmitted to healthcare systems for diagnosis and treatment, promoting accessible and effective care. However, safety is paramount; data inaccuracies can lead to misleading guidance for clinicians. Devices outside hospital settings also raise concerns regarding data integrity, potentially producing unreliable information. Thus, there remains a critical need to consider usability and user interactions with connected health devices. Particularly for users less experienced with technology, it is essential to design devices that simplify interactions to enhance usability and mitigate complexity [13, 14].

Ethical Considerations

Taking a culturally sensitive approach to designing health technologies is a new practice that may raise ethical concerns. A major worry is the risk of inadvertently reinforcing negative or oppressive cultural practices, beliefs, or stereotypes. Culture is a complex system of shared meanings, and understanding it in a specific context is no simple task. Designers should consider multiple levels of culture, such as national cultures, ethnic majorities and minorities, subculture domains, and workplace cultures, as well as informal institutions and cultural struggles. Taking a culturally sensitive approach to designing Health-IoTs may also raise practical concerns. Designers may be challenged to justify or ensure the validity and reliability of cultural assessments resulting from workshops or interviews. Stakeholders also may wonder how

cultural criteria would apply to products. How do designers assure stakeholders, design teams, and development teams that cultural criteria will be translated into system requirements? These concerns may seem particularly daunting for mass-produced health IoT devices that large companies countrywide or globally operate. Despite these challenges, potential benefits may motivate a focus on culture in health IoT devices. A notable upside of taking a culturally sensitive approach is the opportunity for user co-design. Experts suggest that participation may enrich the design process in several ways, including the elicitation of data and insights that would not otherwise be captured, and the development of shared understandings and commitments, leading to better designs and less post-deployment conflict. Ensuring comprehensive participation is more practicable in the context of designs for local markets than for global ones. Co-design may also facilitate ongoing development and improvement of designs, potentially increasing their effectiveness as health promotion interventions. In a participatory design setting where cultural understanding is essential, designers can facilitate deliberation among stakeholders, drawing on artefacts that make morals culturally sensitive [15, 16].

Challenges in Implementing Cultural Sensitivity

Cultural factors are essential for culturally sensitive healthcare interactions. Pediatric residents feel comfortable discussing providers' roles in cultural care but struggle with patients' roles. Language barriers impact care quality, and using interpreters alone is insufficient. There's debate on whether clinicians should learn about different cultures. While stereotyping hinders patient relationships, knowledge of patients' cultures can enhance communication and care interpretation. Misinterpretations often arise from cultural differences in terminology. Even when speaking the same language, confusion can occur because children might not grasp medical jargon understood by parents. Clear explanations and checking for understanding are crucial. Communication fails due to differing styles; physicians must adapt their style according to the patient's background. Beginning with relaxed inquiries can help. Data collection aids knowledge of specific cultures, while online research and language schools are beneficial. Efforts to understand culture can foster rapport and trust with patients. However, providers should ensure patients understand immediately; faking knowledge about a culture can be disreputable. Stereotyping poses significant barriers. Understanding patients' views on care is vital. Regional and social contexts should be considered, and practitioners should ask patients about their care preferences rather than making assumptions. There are significant challenges to effective cultural sensitivity in clinical practice. Implementing it is complex due to a lack of knowledge, limited training resources, and narrow definitions of cultural sensitivity. There's minimal involvement from patients or communities in training processes, and institutional support is often lacking, which undermines the focus on cultural sensitivity [17, 18].

Strategies for Enhancing Cultural Sensitivity

This section offers practical recommendations on cultural sensitivity in design practices, varying in ease of implementation. Stakeholders are prioritized by their role in technology design and development. A. Funding Agencies: Prioritize culturally sensitive projects. To enhance health technology and decrease disparities for underserved populations, agencies should initially support culturally competent designs. This establishes awareness of equity implications within their field, recognizing that while other projects may deserve funding, they carry less urgency. B. Technology Developers: Increase awareness of cultural aspects. Stakeholders involved in technology development need to understand cultural dimensions in their work. Their desires and motivations are shaped by social constructs influenced by culture, which, if ignored, could lead to poor design outcomes. Cultivating awareness of diverse perspectives promotes engagement in culturally inclusive practices, benefiting collaboration and user experience in technology design. C. Stakeholders: Embrace and adapt culturally sensitive design frameworks. User-focused stakeholders are encouraged to adopt available culturally responsive frameworks, which may require adapting to specific contexts. The onus of health technology design should not rest solely with technologists. Involving community partners and health providers can help amplify underrepresented voices in promoting culturally responsive practices. D. All Stakeholders: Foster cousin knowledge. Health equity in technology challenges traditional norms, and the concepts of cultural competence can be complex. As the field develops, creating and sharing cousin knowledge documents is essential. These resources are quicker to produce than research articles and can help address existing gaps in understanding [19, 20].

Future Trends in Health Technology

The evolving health technologies landscape poses risks of deepening disparities among vulnerable populations. The adoption of these technologies mirrors concerns seen in telehealth, particularly regarding the digital divide and inequitable health outcomes. Population health researchers can help

alleviate these risks, with recent calls to action underscoring the urgency of the issue. Community advisory boards have highlighted that many individuals would benefit from devices or apps to manage their health, yet concerns remain that the most disadvantaged may not gain access. Often, they are unaware of available technologies that could assist them. Educating lower-income and elderly populations about these resources requires significant effort, as many lack knowledge and exposure to how these technologies can help them. Those unable to visit a doctor may also lack the skills to access online care. It is essential to publicize health and wellness technologies before evaluating their public health impact. Researchers are investigating policies and strategies to increase awareness, such as collaborating with local health providers to educate communities about available technologies. These partnerships can also provide insights into the willingness to use the technology. Future research should focus on the diffusion of these technologies and the readiness for public use, similar to formative evaluations in low-knowledge communities. Evaluating impacts will require comparison groups of non-enrolled populations. Social media's role in disseminating public health information is growing but needs closer examination to determine its effectiveness in reaching lower-income and underserved populations, ensuring access barriers do not hinder their engagement [21, 22].

Role of Policy in Health Technology Design

Innovative health technology has the potential to enhance health equity among underserved populations. Yet, many health technologies lack user-friendliness and cultural sensitivity, leading to underutilization and worsening health disparities. It's crucial to create culturally informed health technologies that meet the needs of diverse user groups. Employing formative research methods like surveys, focus groups, and interviews can help identify these needs and reduce biases in technology evaluations. Financial incentives should be offered to healthcare organizations to adopt health IT for underserved populations, addressing cost barriers related to purchase, implementation, and maintenance. Developing technologies for underserved populations requires consideration of their unique barriers. Trust and cultural relevance are significant obstacles for African Americans, Latinos, and others, necessitating further research on how cultural specificity in health technologies influences trust and adoption. With the widespread use of mobile technologies, there's a pressing need for health solutions that enhance communication and provide culturally relevant content. Comprehensive evaluations are essential to assess the impact of these technologies on adherence, access, and health outcomes in community settings, supported by collaborations with experienced providers. Effective policies should promote the integration of these technologies into the healthcare system [23, 24].

Measuring Cultural Sensitivity in Health Technology

In an increasingly global society, health technology must reflect cultural aspects and preferences to enhance its effectiveness in health organizations. A crucial initial step is evaluating the cultural sensitivity of design features. The Mediterranean Sensitivity Scale (MSS) was translated into English and expanded to include Mediterranean cultures. After preliminary validation, exploratory factor analysis reduced the original 73 items to 47 across 9 scales, ready for further validation and criterion checking. Cultures vary in their expression of individualism and collectivism. South Mediterranean cultures often emphasize social selves, while Northern and Western cultures encourage individuality. This individualism-collectivism continuum highlights how cultures frame personal goals and behavior explanations. Group dynamics can overshadow individual perceptions, influencing cognitive and emotional activities as culturally specific. The effects of culture on product reception, including health technology, are well-documented, proving that cultural factors can be as impactful as income and education in health decision-making. Adapting technology for cultural usability can enhance effectiveness, aligning with the advice to know one's audience. The global society has beneficially influenced the health technology industry, with advancements capable of improving organ transplant processes and providing real-time updates for patients. Thus, health technology design must incorporate a global perspective, accommodating and reflecting diverse cultural sensitivities [25, 26].

Collaboration across Disciplines

Experiences with health technology teach us that these systems do not live in a vacuum. When planning their design and implementation, developers must take into account factors such as usability and user perspective. At a more macro level, local health policy, organizational structures and cultural differences may also have a decisive impact on the success of health technology. Cultures are not monolithic entities; therefore, research addressing cultural dimensions should try to disentangle its various components. Local health systems are usually deeply influenced by the development conditions of the country in question. Most developing countries struggle with multiple dilemmas in the introduction of technology into their health systems. The challenge essentially lies in creating an appropriate technology mix that

considers local conditions and reflects the nation's health needs. Globalization introduces new technological systems, and it is essential to locally evaluate their usability. Similar technology does not mean similar culture; studies on conflicting user needs should be conducted before adaptation. Another major challenge is the design and sustainability of applications in low-resource settings. These applications often meet a large gap in the specified need due to the lack of proper organizational structure and processes. These issues call for considerable innovations in the design of the technologies, including the proper prioritization of design components. Besides working with technologists and health workers, behavioral scientists and anthropologists should also be part of the design process. The contribution of these members to the design and deployment of any new technology in the health sector will be vital. Collaboration across disciplines is not simple. Organizational and basic differences between disciplines have to be negotiated to reach a common understanding. Developers and health workers are acquainted with designs based on certain basic assumptions, while sociologists and anthropologists come from different paradigms, making it difficult to conduct creative discussions and reach consensus. Development programs would yield more effective results if such interdisciplinary approaches could be followed [27, 28].

CONCLUSION

Designing culturally sensitive health technologies is not just a progressive aspiration but a practical requirement in a diverse and globalized world. Historical neglect and one-size-fits-all design models have led to exclusion and mistrust among underserved populations. This paper has demonstrated that culturally competent health technology design enhances user engagement, builds trust, and leads to more effective health outcomes. To realize this potential, developers must move beyond surface-level inclusion and adopt frameworks that recognize the deep-seated cultural dimensions of health practices and beliefs. By embracing participatory approaches, respecting local knowledge, and prioritizing inclusivity, stakeholders can co-create solutions that resonate with diverse users. Ethical vigilance is essential to avoid reinforcing cultural stereotypes while striving for equity. Ultimately, embedding cultural sensitivity into every phase of technology design and implementation is a foundational step toward building a healthcare future that is just, accessible, and responsive to all.

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