Ensuring Inclusive Design in Digital Health Interventions for the Aging Population: Expert Perspectives

Garantindo o Design Inclusivo em Intervenções Digitais em Saúde para a População Idosa: Perspectivas de Especialistas

Garantizando el Diseño Inclusivo en Intervenciones Digitales de Salud para la Población Envejecida: Perspectivas de Expertos

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Keywords: inclusive design, digital health interventions, aging population, usability, digital literacy

Abstract: This qualitative study examines expert perspectives on inclusive digital health interventions for older adults. Interviews with eight professionals highlight how adoption of those interventions depends on usability, accessibility, trust, emotional acceptance, and structural support. The analysis underscores the need for participatory design and flexible, user-centered approaches that accommodate the diverse needs of aging populations. Findings inform the development of inclusive design heuristics, with further validation through user studies and expert review in progress.

Palavras-chave: *Design inclusivo, intervenções digitais de saúde, envelhecimento da população, usabilidade, alfabetização digital*

Resumo: *Este estudo qualitativo examina as perspectivas de especialistas sobre intervenções digitais inclusivas de saúde para adultos mais velhos. Entrevistas com oito profissionais destacam como a adoção dessas intervenções depende da usabilidade, acessibilidade, confiança, aceitação emocional e suporte estrutural. A análise ressalta a necessidade de um design participativo e de abordagens flexíveis e centradas no usuário que acomodem as diversas necessidades das populações idosas. As descobertas informam o desenvolvimento de heurísticas de design inclusivo, com validação adicional por meio de estudos de usuários e análise de especialistas em andamento.*

Palabras *clave: Diseño inclusivo, intervenciones digitales de salud, envejecimiento de la población, usabilidad, alfabetización digital*

Resumen*: Este estudio cualitativo examina las perspectivas de los expertos sobre las intervenciones de salud digital inclusivas para los adultos mayores. Las entrevistas con ocho profesionales ponen de relieve cómo la adopción de esas intervenciones depende de la facilidad de uso, la accesibilidad, la confianza, la aceptación emocional y el apoyo estructural. El análisis subraya la necesidad de un diseño participativo y de enfoques flexibles centrados en el usuario que se adapten a las diversas necesidades de las poblaciones de edad avanzada. Los resultados aportan información para el desarrollo de una heurística de diseño inclusivo, que se está validando mediante estudios de usuarios y revisiones de expertos.*

1 Introduction

As digital health solutions become increasingly central to healthcare delivery, they offer significant benefits for prevention, management and treatment. These tools - ranging from mobile apps to wearables and telehealth platforms - are essential for supporting patients, hereafter referred to as digital health interventions (DHIs). However, older adults often face substantial challenges in adopting and navigating these technologies independently, which may lead to misunderstandings or patient safety risks (Shahid et al., 2022). Key factors such as accessibility, usability and health literacy are frequently overlooked in the design and implementation of these digital solutions (Hernandez et al., 2009). This oversight poses risks to patient safety, limits the effectiveness of interventions and creates barriers to equitable healthcare access (Staccini & Lau, 2022; Budhwani et al., 2022). Older adults encounter unique difficulties, including cognitive decline, physical impairments and a lack of familiarity with digital technologies. These challenges can greatly impact their ability to effectively use the DHIs. At present, there are limited comprehensive guidelines that specifically address the design of DHIs tailored to the needs of older adults, i.e. individuals at the of 60 or older.

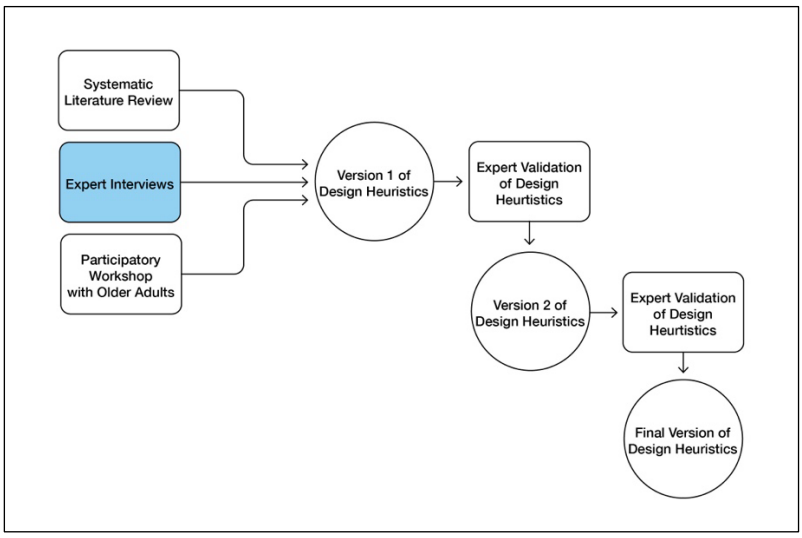
To address these challenges, this study develops inclusive design heuristics to improve accessibility, usability and user experience (UX) of DHIs for older adults. These evidence-based heuristics aim to support equitable DHIs and empower older adults to engage with technologies, promoting better health outcomes and quality of life. To achieve this, a multi-method approach was applied, including a literature search, expert interviews, user workshops with older adults and a workshop with experts to evaluate initial heuristics.

There is some research available on heuristics and guidelines to support inclusive DHI design for older adults. Most of them focus particularly on mobile health applications (mHealth apps) (Wildenbos et al., 2019; Silva et al. 2015; Gomez-Hernandez et al., 2023; Liu et al., 2021; Marcus et al., 2019; Harrington et al., 2017), while others address broader digital health technologies e.g. a checklist for the inclusive design of eHealth solutions for older adults (Prinzellner et al., 2022). Further studies have examined the needs of older adults and proposed design recommendations for telehealth platforms (Charness et al., 2011), digital interfaces (McLaughlin & Pak, 2020) or training programs (Czaja & Sharit, 2016). Further work explored adoption factors and challenges (Watt et al., 2022; Zhou et al., 2025). Our study extends these approaches by addressing the full DHI design process, including inclusive language, cultural, financial and physical accessibility, rather than focusing solely on interface design.

This paper specifically focuses on one part of our methodology, the expert interviews (see fig. 1), with which we want to get insights into best practices, usability challenges and design principles that support inclusive DHIs. We study how seniors use DHIs, what challenges they encounter and what design principles support the use of DHI. Thereby, we aim to answer the following questions:

- How do older adults currently use DHIs, and what factors influence their adoption?
- What challenges and barriers do older adults experience when engaging with DHIs?
- What design principles and best practices can support the accessibility and usability of DHIs for older adults?

Figure 1: Overview of the research process. This paper focuses on the expert interviews phase.



2 Methodology

Our study employed a qualitative research approach and used expert interviews to explore the principles of inclusive design for DHIs that target older adults. Interviews were conducted with experts in UX design, as well as experts in gerontology and age-related conditions, professionals with expertise in inclusive design and inclusive language to gather diverse perspectives on this topic.

Selection of experts

Experts were purposively selected from the author's academic network based on professional experience, academic contributions and involvement in DHI design or evaluation. Invitations were sent to professionals from academia, healthcare, public health and technology sectors. In total, eight interviews were conducted, including seven experts from Switzerland and one from the UK. The experts' fields of expertise, roles, sectors and countries are detailed in the Table 1. All interviews were conducted in February and March 2025.

Table 1: List of interviewed experts

Expert	Field of expertise	Function / position	Sector	Country
E1	Digital health & age	Specialist for innovation & digitalization	Public health sector	Switzerland

E2	Gerontology	Member of staff at the gerontological advice center	Public health sector	Switzerland
E3	Digital health & age	Researcher and head of continuing education	Academia	Switzerland
E4	Digital health & age	Head of competence center for technological innovations and ageing	Academia	Switzerland
E5	UX design & accessibility	Accessibility engineering lead	Tech industry	Switzerland
E6	UX design & health	Principal UX designer	Health industry	Switzerland
E7	Inclusive design & age	Researcher and senior lecturer in inclusive design	Academia	UK
E8	Inclusive language & accessibility	Researcher and senior lecturer in inclusive communication	Academia	Switzerland

Interview setting and data collection methods

An interview guide (see supplementary material) covered four sections: use of digital solutions by older adults, inclusive design requirements, best practices and innovations and future perspectives and policy recommendations for inclusive DHIs.

Interviews were conducted online via Microsoft Teams, recorded, and transcribed automatically. Transcriptions were reviewed by two co-authors (BK, LC) for accuracy. All interviews were conducted by the same researcher (BK) for consistency, with technical support from a second co-author (LC), who also took comprehensive notes.

All participants provided informed consent. Data were anonymized during transcription and analysis. The study was submitted to the cantonal ethics committee of Bern, which confirmed that no formal ethics approval was required for this type of research.

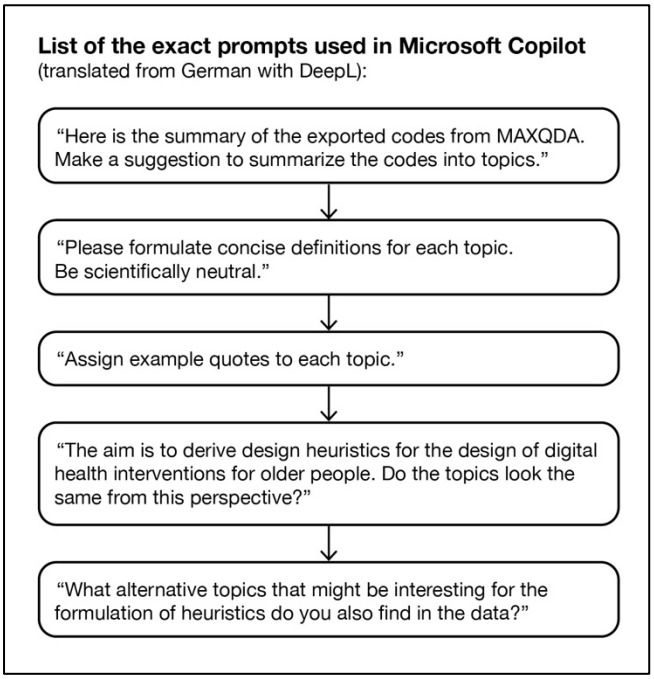
Data coding and thematic analysis

Data were analyzed using MAXQDA following Braun and Clarke's (2006) thematic analysis approach. After transcript review, two researchers (BK, LC) collaboratively developed the coding tree, incorporating feedback from a third co-author (KD). Each researcher independently coded four transcripts, followed by cross-checking and consensus meetings. Codes were refined as necessary.

To support thematic clustering, Microsoft Copilot was used to generate preliminary topic groupings, definitions and example quotations (Figure 2). The artificial intelligence (AI)-

generated suggestions were critically reviewed and adjusted by the research team. Final thematic clusters were consolidated and discussed collaboratively on a Miro board, leading to the final themes presented in this paper.

Figure 2: List of prompts used in Microsoft Copilot.



3 Results

Code System and Thematic Structure

The thematic analysis was guided by an iterative coding process based on the expert interviews. The initial coding system was developed prior to data coding and consisted of six primary thematic groups: (1) Use and Role, (2) Opinion and Attitude, (3) Access and Requirements, (4) Design and Communication, (5) Future Directions and Improvement Ideas and (6) Diversity of Age. While most themes were initially derived from literature review and theoretical frameworks, the code *Diversity of Age* was predefined as a cross-cutting category to capture diversity within the older adult population. The final coding tree and code frequencies can be found in supplementary material.

During the analytical process, two additional overarching themes emerged that cut across multiple coding categories and were deemed essential to fully capture the expert perspectives: (7) Trust, Data Privacy and Quality, and (8) Societal and Structural Conditions. These additional themes reflect systemic and ethical dimensions of digital health adoption that extend beyond individual usability or design features.

In total, the results are presented across eight interrelated themes, which reflect both the original coding framework and inductively derived insights from the analysis.

Use and Role

The theme *Use and Role* explores which digital tools older adults use and how they integrate them into daily routines. Many mentioned tools were not originally designed as DHIs but consist of general-purpose technologies, such as smartphones, smartwatches, or communication apps like WhatsApp. Communication apps were cited as particularly valuable for maintaining social connections, which indirectly support emotional well-being and mental health. As one expert summarized:

> "People like to engage with communication apps. For example, WhatsApp." (E7)

In addition to communication apps, experts reported that many older adults use simple reminder functions, step counters, alarm features, or calendar applications to support health-related tasks such as medication adherence, exercise monitoring, or scheduling medical appointments. This illustrates a use of familiar technologies to meet health needs.

Experts also discussed specialized DHIs that are more directly targeted toward older or vulnerable populations. For example, GPS-enabled emergency wristbands were mentioned as tools used for safety monitoring, fall detection, or location tracking in cases of cognitive impairment or disorientation. These devices are often installed by family members or care providers to support independent living while enhancing safety.

At the same time, several experts pointed to a notable gap in the uptake of more advanced or innovative health-specific DHIs. Technologies such as remote monitoring systems or AI-powered cognitive training apps were acknowledged but described as largely unknown and rarely adopted among the older adults - even among those who are otherwise digitally active. One expert observed:

> "It's not the general public who already knows and uses this." (E1)

Overall, this theme reveals a broad spectrum of technology use, ranging from widely adopted general-purpose tools with indirect health benefits to highly specialized DHIs that remain niche, but demonstrate a gap between available DHI and their actual dissemination and adoption in practice.

Opinion and Attitude

This theme captures the wide spectrum of emotional responses that older adults exhibit toward DHIs. According to the experts, perceived personal benefit plays a decisive role in technology acceptance. Tools that support safety, independence, or social connection are positively perceived by many older adults, particularly when aligned with personal goals. As one participant noted:

> "They want to be connected with family, friends, grandchildren [...] that is kind of motivation behind it." (E7)

However, rejection often occurred when tools were perceived as overly complex, burdensome, or irrelevant. One expert summarized this sentiment:

> “And if it doesn't work, there's rejection or ‘I prefer not using it’.” (E2)

Some participants described a sense of detachment among older adults, where digital health solutions were acknowledged as useful in general, but not seen as personally relevant. This shows also a certain externalization of aging, whereby individuals categorized themselves as not belonging to the group that would require such technologies. Instead, they implicitly referred to “others” as the primary beneficiaries of DHIs:

> “Because everyone thinks the solutions are good, but always for others and not for themselves.” (E4)

Privacy concerns further complicated emotional reactions and led to skepticism, particularly in response to unfamiliar or rapidly evolving technologies. Overall, these findings suggest that emotional comfort, self-perception, and perceived usefulness strongly influence adoption beyond technical usability.

Access and Requirements

The theme *Access and Requirements* addresses the personal, social, and technical prerequisites that determine whether older adults can access and use DHIs. Experts consistently emphasized that age-related health conditions, such as cognitive decline, sensory impairments and multimorbidity, present barriers to adoption. One expert described the compounded challenges as follows:

> “It gets increasingly complex the more multimorbid you become.” (E4)

In addition to health status, prior exposure to digital technologies plays a significant role. Experts noted that individuals who had experience using digital tools earlier in life were generally more comfortable adopting new technologies in older age, while late learners struggled to adapt:

> “But where I sometimes see a problem is that the younger employees are much better and understand things much faster.” (E6)

Frequent updates and rapid technological change also create frustration, even for those who initially succeeded in learning to use a device:

> “Yes, it's a gradual process, when you've learned something and feel comfortable with it, but then it changes and you're no longer able to adapt.” (E5)

The experts further highlighted that socio-economic factors - such as limited financial resources, education level, and language proficiency - significantly shape access to DHIs. Costs related to devices, internet access, or subscription fees may prevent some older adults from adopting certain tools. As one expert stated:

> “Finances are certainly also a point [...] for many older people, that's not something you can just afford.” (E1)

Language barriers and low literacy may additionally hinder comprehension and increase reliance on family or professional assistance.

In this context, social support networks were key. Family members and healthcare professionals often act as intermediaries who bring the DHIs to the elderly people, help set up devices, explain functionality and troubleshoot technical problems:

> “But they have support of family and so family can set up devices.” (E7)

The findings underscore the need for differentiated design strategies, recognizing diverse capacities and resources of the aging population.

Design and Communication

This theme addresses how DHIs should be structured and designed to ensure inclusive design for older adults. Experts consistently advocated for simple, intuitive and predictable design that minimizes cognitive load while supporting orientation and confidence. Key features include adjustable fonts, high contrast, compliance with standards, such as the Web Content Accessibility Guidelines (WCAG) and compatibility with assistive technologies,

Experts emphasized that inclusivity does not mean one-size-fits-all design but rather requires modularity and personalization, allowing users to customize interface elements according to individual preferences:

> “Inclusive design is modular. It doesn't need to be one solution that fits all but a modular solution.” (E7)

Inclusive language was another recurring issue. Experts highlighted the importance of plain, jargon-free, and cognitively accessible language, with many noting that simplified language benefits not only older adults but the general population:

> “It would help everyone [...] to use simple language.” (E8)

In addition, multilingual availability was identified as a key element for reducing language-based exclusion and fostering health equity across diverse user groups.

Trust, Data Privacy and Quality

This theme reflects the strong emphasis experts placed on the role of trust in the acceptance and sustained use of DHIs by older adults. According to the experts, on the sensitive subject of health concerns about data protection, data security and transparency are among the most frequently encountered barriers in their work with this population.

Many older adults feel uncertain about how their personal health data is being handled, who has access to it, and for what purposes it might be used. One expert articulated these concerns directly:

> "What happens to my data? Where is it stored?" (E1)

Another expert summarized:

> "I think that the content must be trustworthy." (E3)

Building trust requires technical safeguards and transparent communication to make privacy protections understandable and visible.

Importantly, trusted intermediaries, such as healthcare professionals and family members, play a central role in facilitating or inhibiting trust. Older adults often rely on these trusted figures to evaluate whether a digital health tool is safe and reliable. As one expert described:

> "If Spitex[1] recommends it, then I'll give it a try." (E2)

To build trust, experts recommended transparent communication about data protection measures, clear explanation of data use and visible quality assurance processes. These elements were seen as crucial for empowering older adults and addressing existing insecurities about DHIs.

Societal and Structural Conditions

This theme highlights the role of institutional, political and societal actors in shaping the conditions under which older adults engage with DHIs. Experts emphasized that individual adoption cannot be separated from systemic support structures.

One major recommendation concerned the creation of independent regulatory bodies to oversee and certify DHIs, similar to approval processes for medical devices. Such institutions ensure quality, safety and trust:

> "One of our key recommendations for action is that there should be an independent organization, similar to that for medical devices, which also reviews healthcare applications [...] and that this should be accessible to users." (E3)

In addition, experts called for public debate on emerging technologies, particularly AI, which introduces new ethical questions about the human-technology relationship in healthcare:

> "We really need to talk about the impact AI has on communication and human interaction." (E8)

Healthcare professionals were also identified as important gatekeepers who influence adoption, but who themselves require ongoing training to stay abreast of new developments:

> "The professionals need further training." (E1)

Finally, the experts underscored the need for structural support measures such as low-threshold training programs, public information campaigns and local support centers that can

[1] 'Spitex' is a Swiss-German term that refers to a system of home care.

assist older adults who lack personal support networks.

Future Directions and Improvement Ideas

The theme reflects expert visions for the further development of DHIs for older adults. While technological innovation is welcomed, experts emphasized that it must remain grounded in human-centered values and avoid tendencies toward depersonalization or over-surveillance. One expert claimed:

> "That the human being is not lost in this digital world, that it is really used as support and not as surveillance or control." (E2)

Particular interest was expressed in conversational interfaces and AI-supported personalization, which may offer new opportunities for individuals with cognitive or literacy limitations:

> "I can talk to the tool and the tool also talks to me in a normal, human, understandable language." (E1)

However, these technologies were seen as promising only if developed in ways that respect user autonomy, privacy and emotional comfort.

Experts further elaborated best practice principles that should guide future DHI development:

- Early and continuous co-design and participatory development involving older adults directly:

> "Co-design is very important because it helps to better understand the target group." (E4)

- User-centered understanding of real-world needs.
- Rigorous iterative testing and evaluation with users to verify usability.
- Compliance with recognized accessibility and ethical standards and tools, including WCAG, Figma accessibility check, or Oxford Inclusive Design Toolkit.
- Mainstream-oriented design that avoids stigmatizing medical aesthetics and fosters confidence.
- Establishment of quality assurance mechanisms to ensure both functional reliability and trustworthy content.

Several experts referenced existing frameworks such as the seven principles of inclusive design and international accessibility guidelines as valuable orientation for future work:

> "The seven principles of inclusive design are all important." (E7)

Altogether, these reflections illustrate that innovation and inclusion that innovation and inclusion are inseparable: technological progress in digital health will only succeed if it empowers, supports and respects the diverse realities of older users.

Diversity of Age

Finally, the cross-cutting theme *Diversity of Age* emerged as one of the central insights across all expert interviews. The experts consistently rejected any notion of “older adults” as a homogeneous user group. Instead, they emphasized that aging encompasses wide variation in cognitive abilities, physical health, digital experience, motivation, educational background, socio-economic status, language skills and support structures.

As one expert clearly summarized:

> “The age is very heterogeneous, as is the affinity for technology, and it depends on which people I want to reach.” (E3)

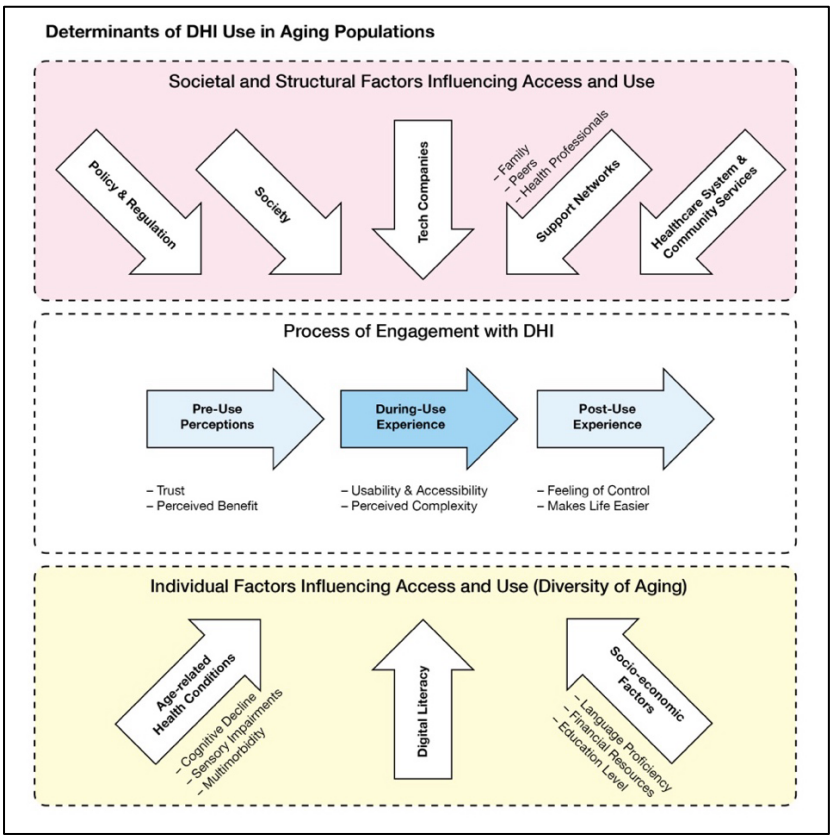
The experts stressed that designing DHIs for older adults requires differentiated strategies, considering subgroups with varying needs and capacities. Segmentation and personalization are therefore essential principles for inclusive digital health design. This heterogeneity cuts across all other themes - influencing access requirements, emotional responses, design preferences, trust concerns, and adoption patterns.

4 Discussion

Summary of Findings

This study explored expert perspectives on inclusive design for DHIs targeting older adults. The analysis identified eight interconnected themes covering individual, social, and systemic factors that shape adoption. Use is influenced by functional needs, emotional responses, digital skills, health status, socio-economic background, trust and structural support (Figure 3). Inclusive design must address accessibility, personalization, emotional acceptance and cultural sensitivity. Trust in data protection and professional endorsement plays a central role, alongside participatory design, stable user interfaces (UIs) and supportive societal structures.

Figure 3: Conceptual framework summarizing factors influencing the adoption, use, and acceptance of DHIs among older adults, based on expert perspectives.



Contribution to Existing Literature

This study extends existing research by offering a comprehensive expert perspective that goes beyond interface design, highlighting socio-technical and identity-related dynamics, including heterogeneity within the aging population. It also addresses the destabilizing effect of technological change, the importance of continuity and the role of trusted recommendations. Emotional factors such as frustration and fear strongly affect use, while positive experiences promote long-term engagement.

Implications for Design Practice

The findings point to several critical implications for future DHI design, which can be summarized as key design principles derived from the expert perspectives. Table 2 provides an overview of these principles and their corresponding design implications.

Table 2 Key design principles for inclusive DHIs for older adults

Design Principle	Design Implications
Participatory Co-Design	Involve older adults as co-designers throughout development to better understand diverse needs, promote acceptance, and avoid deficit-oriented design assumptions.
Flexible Personalization	Enable users to adapt tools to their evolving needs, including adjustable

	complexity levels, simplified views, and stability across software updates.
Simplicity and Stability	Provide clear, predictable, and stable UIs that minimize anxiety caused by frequent technological change.
Plain, Inclusive, and Multilingual Communication	Use simple, gender-sensitive language, culturally appropriate content and multilingual UIs to reduce comprehension barriers and foster inclusion.
Peer Learning and Group Training	Incorporate social learning environments and peer support to lower entry barriers and enhance digital confidence.
Trust-Building Features	Ensure transparency about data protection, offer visible quality standards, and leverage trusted professional endorsements to address privacy concerns.
Mainstream Aesthetic	Design DHIs to resemble mainstream consumer products rather than stigmatizing medical devices for “old” people, supporting confidence and self-esteem.
Supporting Autonomy Rather than Deficits	Frame DHIs as tools that promote independence and self-determination rather than compensating for deficiencies.

In addition to these technical and communicative aspects, the findings highlight an important identity-related resistance among older adults. Many individuals externalize aging and do not perceive themselves as target users of technologies aimed at older populations, even when they meet objective age-related criteria. This psychological distancing influences both adoption and motivation. Therefore, inclusive design must not only address functional needs but also consider how older adults are framed and addressed in communication strategies to avoid triggering resistance based on self-perception.

These principles require a holistic, adaptive, user-centered design approach that integrates functional, emotional, and social dimensions of technology adoption in later life and align with and extend existing accessibility standards and established frameworks like the Seven Principles of Universal Design (Center for Universal Design, 1997).

Policy and Structural Implications

Beyond design aspects, the findings underscore the importance of supportive system-level interventions that create an enabling environment for inclusive digital health adoption. One key recommendation emerging from the expert interviews is the establishment of independent quality assurance bodies that certify the safety, effectiveness, and ethical standards of DHIs. Such regulatory institutions would strengthen user trust and provide clear benchmarks for both developers and healthcare providers, like existing certification procedures for medical devices.

Furthermore, the experts emphasized the need for proactive public discourse addressing the ethical implications of integrating AI into DHI. As AI-based personalization and automation increasingly shape healthcare delivery, it becomes crucial to ensure that these technologies serve human-centered values and do not compromise privacy, autonomy, or the quality of human interaction in care processes.

Healthcare professionals also play a central role as mediators and facilitators in the adoption

of DHIs. The experts stressed that these professionals require ongoing training and continuing education to keep pace with rapidly evolving technological developments and to competently support older adults in the adoption and sustained use of DHIs.

In addition to professional training, the importance of accessible support structures was highlighted. Publicly funded services such as community-based digital assistance centers, peer mentoring programs and locally available training opportunities were described as essential, particularly for those older adults who cannot rely on family support or have limited prior experience with digital technologies.

Finally, the experts pointed to significant gaps in public awareness and dissemination. Many highly specialized DHIs remain largely unknown to both healthcare professionals and older adults. Consequently, targeted dissemination strategies are required to bridge this awareness gap and ensure that available innovations are effectively integrated into everyday healthcare practices.

Limitations

This study has some limitations. We collected input from only eight experts. Besides this small number, only two countries were represented (Switzerland, UK). Given this limitation, these results cannot entirely reflect all inclusive design aspects. As this is just one part of our methodology, we will collect additional aspects, also from other countries, by applying the other methods listed in section 1. Such broader study may help to capture culturally diverse needs and regulatory frameworks. Finally, while the present study focuses on design-related factors, future research may further explore the implementation phase of DHIs — including dissemination strategies, training programs and healthcare integration processes — that ultimately determine real-world accessibility and sustained usage.

5 Conclusion

This study provides comprehensive expert-based insights into the design, adoption, and implementation of inclusive DHIs for older adults. Through the thematic analysis of expert interviews, we identified key individual, social, and systemic factors that influence how older adults engage with DHIs. Our findings highlight that successful adoption is shaped by a complex interplay of physical and cognitive abilities, digital literacy, socio-economic background, trust, and emotional responses, as well as by the broader healthcare system and policy environment in which DHIs are embedded.

Inclusive design must go beyond technical accessibility to address diversity within the aging population, personalization, emotional acceptance and cultural sensitivities. Trust in data protection, content quality, and professional recommendations strongly shape attitudes towards DHIs. Furthermore, the findings highlight the importance of participatory co-design, interface stability, clear communication, peer-based training, and supportive structures for equitable

digital health inclusion. In future work, we will align these results from expert interviews with results from a scoping review and the perspectives of older adults themselves collected in focus groups and workshops. As a result, we will formulate practice-oriented design heuristics for inclusive DHIs targeting aging populations that again will be validated by experts in the field.

Supplementary material

The interview guide: Interview guide

The coding tree: Coding tree

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Use of generative AI

To improve readability of the text, we used OpenAI ChatGPT 4o.

To translate the quotes, we used DeepL.