Open Access Journal of
Gerontology & Geriatric Medicine
ISSN: 2575-8543

Juniper Publishers
key to the Researchers

Mini Review
Volume 9 Issue 2 - August 2025
DOI: 10.19080/OAJGGM.2025.09.555756

OAJ Gerontol & Geriatric Med

Toward Understanding Digital Divides in the Adoption of Ambient Assisted Living Technologies

Cosmina Paul* and Luiza Spiru

Ana Aslan International Foundation, Bucharest, Romania

Submission: August 19, 2025; **Published:** August 25, 2025

***Corresponding author**: Cosmina Paul, Ana Aslan International Foundation, Bucharest, Romania

Abstract

The adoption of Ambient Assisted Living (AAL) technologies among older adults remains a complex and uneven process shaped by economic, functional, and ethical digital divides. While mainstream digital technologies such as smartphones have seen growing acceptance, passive monitoring systems and sensor-based assistive devices continue to face low uptake due to barriers including cost, limited digital skills, privacy concerns, and relational dynamics with caregivers. This paper situates adoption trajectories within three temporal digital divides: economic affordability, usage patterns and digital literacy, and emerging concerns around ethics, autonomy, and data governance. We highlight the critical role of the older adult–caregiver dyad in mediating technology adoption, noting how priorities shift across phases of aging - from successful to pathological aging - affecting perceptions of independence, well-being, and care needs. Finally, we provide evidence-based recommendations for overcoming these divides, emphasizing participatory design, transparency, privacy-by-design, ethical oversight, and equitable business models to foster inclusive and sustainable adoption of AAL solutions. By integrating technological, relational, and ethical considerations, this work contributes to understanding how to promote digital equity and support aging in place.

Keywords: Digital divides; Older adults; AAL Technologies; Technology adoption; Ethics

Introduction

The rapid advancement of digital technologies has created new opportunities for innovation across healthcare, social participation, and independent living. Despite this, technology acceptance remains a major challenge for developers, designers, and businesses. Adoption trajectories vary across regions, with the United States generally reporting higher uptake compared to Europe, where regulatory hurdles, lack of interoperability, and insufficient stakeholder engagement have slowed market penetration [1,2].

Literature shows that for older adults in particular, technology adoption is complex and often described as Janus-faced: while the uptake of universal technologies such as smartphones and social media has increased steadily in the past decade, adoption rates of assistive technologies remain remarkably low [3,4]. Older adults have embraced mainstream communication technologies, partly to maintain social ties and reduce isolation, but show limited willingness to integrate passive remote monitoring devices or sensor-based systems, even when these are designed to support independence and aging in place [5].

Evidence suggests that the process of adoption among older adults differs substantially from that of younger cohorts. While younger populations may adopt technologies out of curiosity or novelty, older adults are more likely to adopt when they perceive clear usefulness and tangible benefits to their health, safety, or quality of life [6,7]. Nonetheless, empirical studies highlight persistent gaps. For example, one recent trial found that only 2% of older adults accepted a passive monitoring system, with 20% of those discontinuing use due to privacy concerns [5].

Navigating Digital Divides in the Adoption of Technology by Older Adults and Caregivers

Against this background, the concept of digital divides has evolved over the past two decades and remains central to understanding technology adoption. The first divide, identified in the early 2000s, relates to economic barriers and affordability; the second, emerging in the mid-2000s, concerns usage patterns and digital skills; and the third - highlighted in recent debates over the last decade - addresses issues of ethics, data governance, and autonomy [8,9]. However, the process is not uniform and depends on context, particularly the economic development of the region. Un-

derstanding how these temporal and structural divides intersect with adoption barriers is essential for developing sustainable, inclusive digital health solutions for aging populations.

The first digital divide concerns costs, which remain a major barrier to access, particularly in lower-income settings where the affordability of devices and subscriptions is a constraint [8,10].

The 'older adult and next of kin dyad' is a crucial driver of adoption. Next of Kin often advocate for technology use out of concern for safety and reassurance, and their influence is moderated by factors such as gender, age, and trust. In countries with weaker care ecosystems, such as some of the Southern and Central European countries, next of kin are often more willing to invest in assistive technologies, compensating for limited institutional provision and low trust in formal services [11]. By contrast, in countries with more robust and universal care systems, such as western and northern European countries, the willingness to pay tends to shift towards governmental services, who value highly accurate devices that can enhance the efficiency of medical visits and continuity of care [12]. In some contexts, such as the United States, business models increasingly rely on data-driven exchanges, with older adults accepting to share personal data in return for lower costs, illustrating the diversity of adoption logics across healthcare systems [13].

The second digital divide refers to limited or partial usage, often stemming from low perceived usefulness, lack of self-efficacy, or stigma surrounding technology use in later life [4,14,15].

Hence, adoption is also shaped by the value frameworks of aging. For older adults in the phase of "successful aging", independence is a central goal, though this may be challenged by the protective stance of NoKs who prioritise safety. During the transition away from successful aging, the stress of losing independence may paradoxically facilitate adoption, while reluctance from NoKs to assume caregiving responsibilities may act as a hindering factor [16]. In "normal aging", older adults often assume caregiving roles themselves, showing ambivalence towards receiving support, whereas during the transition from normal aging, the importance of well-being increases relative to physical health in the perception of older adults, while NoKs tend to emphasize health outcomes. In "pathological aging", well-being and continuity of care dominate, and both NoKs and PCPs play central roles, with PCPs leveraging AAL solutions to improve the efficacy of visits and to optimize care delivery [17].

A third divide is emerging, centered on ethics, privacy, and autonomy. Here, issues of data control, trust, and informed consent become pivotal, as older adults and their caregivers negotiate whether and how to integrate such technologies into everyday life [9,18].

Research on movement-monitoring sensors and passive assistive systems points to three interrelated challenges:

a) low intention to adopt

b) limited understanding of the technology's purpose and operation

c) a strong preference for traditional home care, where the dyad between older adults (OAs) and primary care providers (PCPs) remains central [16,18]

These findings illustrate that adoption cannot be seen solely as a question of affordability or accessibility but must also address ethical concerns, usability, and the relational dynamics between older adults, caregivers, and professionals.

Taken together, the evidence suggests that the adoption of assistive technologies in aging is determined by the negotiation of values between older adults, their next of kin, and professional caregivers. Persistent divides - economic, functional, and ethical - remain key obstacles. Addressing these divides requires attention not only to affordability and usability but also to the design of technologies that embed transparency, inclusiveness, and trust. Without such measures, AAL solutions risk reinforcing existing inequalities in later life rather than alleviating them.

Conclusion and Recommendations

The persistence of digital divides among older adults demonstrates that barriers to technology adoption are not solely economic or functional, but also profoundly ethical. While the first two divides - cost and limited usage - have been widely acknowledged, a "third digital divide" is emerging around ethical concerns, including privacy, autonomy, and control [9]. Assistive technologies such as passive remote monitoring hold promise for supporting independence and aging in place, yet adoption remains limited. Evidence suggests that even when these tools are introduced, high discontinuation rates due to privacy and trust issues undermine their effectiveness [5].

To address these challenges, technology design and policy frameworks must move beyond functional usability to explicitly integrate ethical considerations. First, transparency and explainability should be prioritized, with technologies providing clear, plain-language information about data collection and use. Second, privacy-by-design principles are essential to reduce surveillance concerns, accompanied by user autonomy features such as granular consent settings [18]. Third, participatory and inclusive design approaches - involving older adults, caregivers, and professionals - are critical for embedding ethical values from the outset [16].

Additionally, fair business models must be promoted to avoid exploitative "data-for-discounts" practices that disproportionately affect vulnerable populations. Instead, shared responsibility between healthcare systems, insurers, and public policy could provide more equitable access [13]. Training and hybrid care models that combine human support with digital solutions are equally important to foster trust and reduce fears of dehumanization [14]. Finally, ethical oversight and regulatory frameworks tailored

How to cite this article: Cosmina Paul and Luiza Spiru. Toward Understanding Digital Divides in the Adoption of Ambient Assisted Living Technologies. OAJ Gerontol & Geriatric Med. 2025; 9(2): 555756. DOI: 10.19080/OAJGGM.2025.09.555756

to aging and care technologies should be strengthened, ensuring respect for autonomy, dignity, and non-discrimination [19].

In sum, overcoming the ethical digital divide requires a multi-dimensional strategy that balances technological innovation with ethical safeguards. By embedding trust, autonomy, and inclusivity into both design and policy, it is possible to foster sustainable adoption of assistive technologies and promote digital equity in later life.

Acknowledgement

This work was supported by the Ana Aslan International Foundation within the project "Prediction, Monitoring and Personalized Recommendations for the Prevention and Amelioration of Dementia and Frailty" (Acronym: COMFORTAGE). Project duration: January 1, 2025 – December 31, 2025. Project code: PN-IV-P8-8.1-PRE-HE-ORG-2024-0240, Financing contract no. 96 PHE / 2025. The project is funded by a grant from the Ministry of Research, Innovation and Digitization, CNCS/CCCDI, through the Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI), under the European and International Cooperation Program – Horizon Europe Subprogramme, Horizon Europe Awards – Institutions.

References

1. Czaja SJ, Boot WR, Charness N, Rogers WA (2019) Designing for Older Adults: Principles and Creative Human Factors Approaches. In: CRC Press, USA.
2. Peek ST, Wouters EJ, Van Hoof J, Luijkx KG, Boeije HR, et al. (2014) Factors influencing acceptance of technology for aging in place: A systematic review. International Journal of Medical Informatics 83(4): 235-248.
3. Vaportzis E, Clausen MG, Gow AJ (2017) Older adults perceptions of technology and barriers to interacting with tablet computers: A focus group study. Frontiers in Psychology 8: 1687.
4. Heart T, Kalderon E (2013) Older adults: Are they ready to adopt health-related ICT? International Journal of Medical Informatics 82(11): e209-e231.
5. Span M, Hettinga M, Dassen VM, Eefsting J (2013) Factors influencing the successful implementation of technology for aging in place: A systematic review. International Psychogeriatrics 25(11): 1779-1790.
6. Charness N, Boot WR (2009) Aging and information technology use: Potential and barriers. Current Directions in Psychological Science 18(5): 253-258.
7. Rogers WA, Fisk AD (2010) Toward a psychological science of advanced technology design for older adults. Journals of Gerontology Series B: Psychological Sciences and Social Sciences 65(6): 645-653.
8. Van Dijk J (2020) The Digital Divide. In: Polity Press, UK.
9. Seifert A, Doh M, Wahl HW (2021) The ethical digital divide in aging: Privacy, autonomy, and technology use. Gerontology, 67(5): 521-531.
10. Morris MG, Venkatesh V (2000) Age differences in technology adoption decisions: Implications for a changing work force. Personnel Psychology 53(2): 375-403.
11. Giansanti D, Maccioni G, Rossi S (2019) Family caregivers' role in adoption of assistive technologies for older adults. Healthcare 7(3): 107.
12. Peek ST, Wouters EJ, van Hoof J, Luijkx KG (2016) Differences in acceptance of technology for aging in place across Europe. Gerontechnology 15(4): 198-210.
13. Caine K, Hanania R (2013) Patients want granular privacy control over health information in electronic medical records. Journal of the American Medical Informatics Association 20(1): 7-15.
14. Czaja SJ, Charness N, Fisk AD, Hertzog C, Nair SN, et al. (2006) Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). Psychology and Aging 21(2): 333-352.
15. Heart T, Kalderon E (2013) Older adults: Are they ready to adopt health-related ICT? International Journal of Medical Informatics 82(11): e209-e231.
16. Ziegler R, Schwaninger A (2011) Technology acceptance in aging: A longitudinal study. Universal Access in the Information Society 10(1): 1-15.
17. Van Hoof J, Kort HS, Van Waarde H, Blom MM (2010) Environmental interventions for older adults in long-term care. Journal of Housing for the Elderly 24(1-2): 108-134.
18. Seifert A, Wahl HW (2018) Ethics in assistive technologies for aging. Innovation in Aging 2(Suppl 1): 497-497.
19. Lupton D (2016) Digital health and the ethics of care: Critical perspectives. Social Theory & Health 14(3): 1–21.

DOI:10.19080/OAJGGM.2025.09.555756

How to cite this article: Cosmina Paul and Luiza Spiru. Toward Understanding Digital Divides in the Adoption of Ambient Assisted Living Technologies. OAJ Gerontol & Geriatric Med. 2025; 9(2): 555756. DOI: 10.19080/OAJGGM.2025.09.555756