

Digital Divides and Structural Barriers to IoT-Enabled Healthcare in Older Adults: Public Health Implications

Obaida ELMODALAL, Eitan BRONSCHEIN, Andreas MÜLLER, Ferdinand SASVÁRY and Peter KIŠAC

St. Elizabeth University of Health and Social Work

Correspondence should be addressed to: Obaida ELMODALAL, obaida-elmodalal@gmx.de

*Presented at the 47th IBIMA International Conference, 29-30 June 2026, Madrid, Spain

Abstract

Populations are ageing rapidly and Internet of Things technologies are increasingly promoted to extend healthcare into the homes of older adults, to support independent living, and to prevent avoidable errors in geriatric care. Yet the people who stand to gain most from connected care are frequently the least connected. Much of the existing literature evaluates the technical capability or clinical efficacy of these systems, while the prior question of who can actually reach them is treated as secondary. This narrative review addresses that gap by reading digital divides and structural barriers through a public health lens rather than a technical one. Drawing on a corpus assembled through structured searches of bibliographic databases and screened in two stages, with 159 eligible studies retained, it synthesises empirical and review evidence on access to IoT-enabled care in later life. The evidence describes three connected layers of disadvantage: unequal access and connectivity, unequal digital and health literacy and unequal health outcomes. Reported uptake of internet-based and remote health services among older adults remains low across very different national settings, digital literacy declines steeply with age and unmet need persists even among those who do go online. Acceptance studies add barriers of trust, privacy, cost, infrastructure and human support. Taken together, the findings indicate that IoT-enabled care will widen rather than narrow inequalities unless access, literacy, and structural support are treated as design and policy priorities from the outset.

Keywords: digital divide; older adults; Internet of Things; healthcare access; digital health literacy; health equity

Introduction

Populations are growing older in almost every high-income and many middle-income countries, and health systems are under sustained pressure to provide continuous care for people living with chronic conditions. Connected technologies built on the Internet of Things have entered this picture as a practical response. Remote patient monitoring, wearable sensors, smart-home systems, ambient assisted living environments and voice-enabled assistants are all promoted as ways to keep older adults safe at home, to detect deterioration early and to prevent the kinds of errors that arise when care is fragmented or delayed. For a conference track concerned with IoT frameworks for geriatric care and error prevention, these promises are the natural starting point. The patient-safety case is concrete: a scoping review of emerging digital technologies for fall detection in aged care catalogues a growing range of sensor-based and ambient systems intended to catch falls early and shorten the interval before help arrives (Konara Mudiyansele et al., 2025), falls being among the most consequential and preventable harms

Cite this Article as: Obaida ELMODALAL, Eitan BRONSCHEIN, Andreas MÜLLER, Ferdinand SASVÁRY and Peter KIŠAC Vol. 2026 (7) "Digital Divides and Structural Barriers to IoT-Enabled Healthcare in Older Adults: Public Health Implications " Communications of International Proceedings, Vol. 2026 (7), Article ID 4733726, <https://doi.org/10.5171/2026.4733726>

in later life. There is, however, a recurring tension that runs through the literature. The older adults who would benefit most from connected care, those who are frailest, most isolated, or managing several conditions at once, are frequently the same people who are least able to obtain, operate and trust the technology. A monitoring system only prevents an error if it is switched on, worn correctly, understood and connected to a service that responds. When any link in that chain depends on internet access, on digital skills, or on reliable human support, the benefit of the technology is distributed unequally. The gap between those who can use digital health tools and those who cannot is usually described as the digital divide and in later life it is wide. This review examines how digital divides and structural barriers shape access to IoT-enabled care models for older adults and it reads those barriers through a public health lens rather than a purely technical one. The aim is not to catalogue devices but to ask a more uncomfortable question: if connected care is scaled up across whole populations, who is reached and who is left further behind. The argument developed here is that the divide is not a temporary problem that newer or cheaper devices will solve on their own and that without deliberate attention to access, literacy and support, IoT-enabled care risks reproducing existing inequalities in a new form.

Approach to the Literature

This is a narrative review rather than a systematic review with pooled estimates. The distinction matters for how the evidence should be read. A narrative synthesis sets out to integrate heterogeneous sources, in this case population surveys, technology-acceptance studies, qualitative work with older users and their carers, engineering evaluations and earlier systematic and scoping reviews, into a coherent account of a problem. It does not weight studies statistically or claim a single effect size and the figures reported below should be understood as illustrations of consistent patterns across different settings, not as a meta-analytic result. The literature considered here was assembled through structured searches of bibliographic databases including Scopus and PubMed and was then screened in two stages. Records were first assessed on title and abstract, and the retrieved full texts were then read and adjudicated against a set of eligibility criteria that required each study to address older adults, to concern a connected, IoT-based, or otherwise digital health technology, and to speak to access, the digital divide, literacy, adoption, a structural barrier or equity. Studies that were purely technical proposals, protocols without results, or focused on clinical efficacy alone were set aside. The review that follows is selective by design and it draws on the studies that most directly illuminate the access question. Throughout this review the term older adults is used, following common public health convention, to mean people aged roughly 60 or 65 years and over. A number of the included surveys sample from age 50 upward, and where their findings bear directly on the access question they are reported with the relevant age threshold stated, so that the reader can judge comparability rather than assume it. To make the screening transparent in the spirit of reporting guidelines for reviews, the broad flow of records is documented as follows. After duplicate removal and title and abstract screening, 249 records remained for full-text consideration. Of these, 172 full texts were retrieved and read, while 77 could not be obtained and were therefore not assessable for eligibility; these unretrieved records are noted here for completeness and are not counted as part of the evidence base. Of the 172 full texts read, 159 met the eligibility criteria and 13 were excluded, the exclusions being five technical or proposal-only papers, five studies judged tangential to the access question, and three that did not in fact concern older adults. The narrative that follows draws selectively on this eligible set rather than on every record within it. A small number of additional sources are cited for framing rather than as evidence about access: foundational accounts of the digital divide and the inverse care law, and one scoping review used to illustrate the patient-safety promise of connected care. These framing sources sit outside the screened corpus and are identified as such where they appear, so that the boundary between the evidence base and its conceptual scaffolding stays visible.

The Digital divide in Later Life

It is helpful to read the evidence through an established framework rather than treating the divide as a single undifferentiated gap. Digital divide scholarship distinguishes three connected levels of inequality. The first level concerns physical access to devices and connectivity. The second concerns the skills and literacy needed to use them, a distinction that Hargittai (2002) introduced as the second-level digital divide and that van Dijk (2005) developed into a broader account of how material, skills, and usage inequalities reinforce one another. The third level, emphasised in more recent work, concerns the differences in tangible outcomes, including health, that follow once access and skills are unevenly distributed. Older adults are disadvantaged at each level, and the levels compound one another, which is why this review treats them in turn.

Access and Connectivity

The most basic form of exclusion is simply not being online. A systematic review of digital exclusion in the United Kingdom reports that, as of 2023, around 3.9 million people over the age of 65, close to 31 percent of that age group, did not use the internet at home, a figure far above the equivalent share among younger adults (Connolly et al., 2025). Low connectivity translates directly into low uptake of digital health services. In a cross-sectional survey of adults aged 50 and over in mainland China, only 17.14 percent reported using internet-based healthcare services at all (Wang, 2025). Among older adults in Taiwan, a national survey cited in work with indigenous elders found that fewer than one in five adults aged 65 and over frequently used the internet to obtain health information (Lee, 2025). Patterns of this kind led one analysis of information and communication technology in active aging to describe older people as both the first and the last movers, quick to be targeted by policy ambitions yet slow to be reached in practice (Vicente, 2022).

These numbers come from very different health systems and cultures, which is part of their force. The specific percentages are not comparable in a strict sense, but they point in the same direction: a large share of older adults remain outside the digital channels through which connected care is increasingly delivered. For an IoT-enabled care model that assumes a home internet connection and a willing user, this first layer of the divide is the foundational constraint.

Skills and Health Literacy

Being connected is not the same as being able to use connected services confidently. The second layer of the divide concerns digital and health literacy, and here too age is a strong gradient. A national cross-sectional study of digital health literacy using a task-based assessment found that 27.8 percent of adults demonstrated low digital health literacy, with the largest gaps concentrated among older participants (Yoon, 2025). A study of surgical patients that measured both digital and navigational health literacy reported median digital literacy scores falling from 87.5 in the youngest group to 31.2 among those over 65 (Valentim et al., 2025). The same work highlighted navigational literacy, the capacity to find one's way through a health system and its digital interfaces, as a distinct and often weaker competence. This layer is easy to underestimate because it is invisible in connectivity statistics. An older adult may own a smartphone and have a working connection yet still be unable to interpret an alert, complete a digital follow-up form or judge the reliability of online health information. In the context of error prevention, low literacy is not a peripheral concern. It is a direct mechanism through which a well-designed monitoring system can still produce mistakes, through misreading, non-use, or misplaced trust.

Differential Outcomes and Equity

The third layer is where the divide becomes a health problem rather than a technological one. Using data from the SHARE study covering 37,225 individuals aged 50 and over, one analysis found that roughly 15 percent of older Europeans reported unmet healthcare needs following the COVID-19 pandemic and that while almost one in three used telemedicine during that period, those who did so were in fact more likely to report ongoing unmet needs (Smolić et al., 2024). The authors concluded that telemedicine buffered only part of the access gap and left persistent inequalities for women, those living alone, and those in poorer health. This is an important corrective to the assumption that offering a digital channel is the same as closing a gap. Other work shows how uneven uptake maps onto social support and circumstance. In a study of telehealth use among older adults during the pandemic, only 20.6 percent used telehealth and use was closely associated with living with family or receiving technical help (Chung et al., 2021). Not every finding points the same way, and it is worth dwelling on one that appears to cut against the argument. A national analysis of telemedicine in the United States found that adults aged 80 and over used telemedicine more than the youngest adults in a direct comparison, at 27.63 percent against 18.44 percent for those aged 18 to 29 (Hung et al., 2023). Taken alone this looks like evidence that the oldest are not, in fact, the least reached. Two considerations qualify that reading. First, the comparison is one of utilisation conditional on need: the oldest group carries by far the heaviest burden of chronic illness and clinical contact, so higher telemedicine use among them can coexist with lower use relative to their need, which is the quantity that matters for equity. Second, raw uptake says nothing about who within the oldest group is reached and the same literature shows that use among older adults is concentrated among those with family or technical support (Chung et al., 2021) and that age-based disparities widened during the rapid shift to remote care (Qiu et al., 2024). The Hung finding is therefore a useful caution against treating age as a simple proxy for exclusion, but it does not overturn the broader pattern; it relocates the divide from age as such to the support and literacy that determine who, among the old, can actually use what is on offer. The concern that runs through this layer is an old one in public health, that those with the greatest need receive the least appropriate care, now expressed through a digital channel.

Structural Barriers and IoT-Enabled Care Models

The divide described above does not arise from age itself. It arises from a set of structural barriers that sit between older adults and the technology, and these barriers are the proper target for design and policy. The acceptance and implementation literature points to three clusters that recur across studies: trust and acceptance, privacy and surveillance, and the infrastructure of cost and human support.

Trust and Technology acceptance

Whether an older adult adopts a connected device depends heavily on perceived usefulness, perceived ease of use, and the anxiety the technology provokes, the familiar determinants of technology acceptance. An integrative systematic review of barriers and facilitators to health technology adoption by older adults with chronic diseases organised these influences across individual, technological, and contextual levels, and found that no single factor acts alone (Bertolazzi et al., 2024). Studies of attitudes toward mobile and wearable tools report that interest is real but conditional, shaped by whether the device is seen as relevant to the person's own health and life (Fowe, 2022). Work on connected health technologies in the home, on intentions to accept wearable devices, and on the comparative acceptance of voice assistants across age groups all converge on the point that older users are not uniformly resistant; they are discerning, and they withdraw when a technology feels imposed, opaque, or unhelpful (Etemad-Sajadi, 2019; Chen et al., 2023; Zhong et al., 2024).

Privacy, surveillance and the design of monitoring

IoT-enabled care depends on continuous data collection, and this places it in tension with privacy and autonomy. Research on privacy concerns and the acceptance of technologies for aging in place shows that older adults weigh the benefit of being monitored against the discomfort of being watched, and that this trade-off varies with the type of data and the perceived necessity of care (Schomakers & Ziefle, 2019). The risk is not only perceived. An analysis of assistive technology distribution programmes documented the unintended harms that IoT devices can introduce, including new dependencies and exposures that were not present before (Wilson, 2024). A scoping review of how adults aged 50 and over perceive smart-home surveillance describes the same careful balancing of safety against intrusion, organised around privacy, the purpose of data collection, risk and benefit, and personal safety (Percy Campbell et al., 2024). For error prevention, this matters because a system that feels intrusive is liable to be unplugged, worked around, or disregarded, which removes its protective value precisely when it is most needed.

Cost, infrastructure and human support

The third cluster is the most structural. Acceptance in principle does not produce use in practice without affordable devices, reliable connectivity, and human help. A study of ambient assisted living technology in rural settings found that acceptance was strongly conditioned by the surrounding infrastructure and support, not by the device alone (Choukou et al., 2021). The role of human intermediaries appears repeatedly: technical support and the presence of family were among the strongest correlates of telehealth use in the work cited above (Chung et al., 2021), and research on the adoption of assistive technologies highlights carers as central facilitators or, in their absence, as a missing link (Malden et al., 2025; Charness et al., 2016). Several systematic and scoping reviews of remote monitoring in primary care, of smart homes for older adults, of IoT and smart homes from an end-user perspective, and of the implementation of digital health technologies for this group all reach a similar conclusion: the technology is rarely the limiting factor, and the determinants of success lie in organisation, support, and fit with everyday life (Zakerabasali et al., 2022; Vrančić et al., 2024; Pal et al., 2018; Ji et al., 2022; Jutai et al., 2024).

Public Health Implications for IoT-Enabled Care Models

Reading these barriers together suggests that the digital divide should be treated as a determinant of health in its own right, alongside income, education, and geography, rather than as a technical detail to be resolved later. If connected care is deployed across a whole population without addressing access and literacy first, the most likely result is a digital version of the inverse care law, the principle first stated by Tudor Hart (1971) that the availability

of good medical care tends to vary inversely with the need of the population served. The studies reviewed here, taken collectively, make that risk concrete: low uptake among the least connected (Wang, 2025; Lee, 2025), steep literacy gradients (Yoon, 2025; Valentim et al., 2025), and persistent unmet need even among those who do go online (Smolić et al., 2024). Several implications follow for how IoT-enabled care models should be conceived. The first is that systems should be designed for the least connected user rather than the most capable one. This means universal and age-friendly design, simple and forgiving interfaces, and the deliberate retention of non-digital fallbacks so that a person who cannot use the digital channel is not thereby cut off from care. The second is that digital health literacy deserves to be treated as a public health intervention in itself, supported through training, intermediated access, and trusted local help, rather than assumed to develop on its own. Work on senior information exclusion frames this as a structural condition that policy can either entrench or relieve (Gil, 2025), and studies of continued participation in smart elderly care show that sustained use, not initial adoption, is where many programmes fail (Cao et al., 2023). A third implication concerns infrastructure and financing. Connectivity, affordable devices, and reimbursement models that pay for the human support around the technology are structural enablers without which design improvements have limited reach. A fourth implication is methodological and speaks directly to error prevention. Evaluations of IoT-enabled care should measure equity of access and the distribution of benefit, not efficacy alone, because a system that works well for those who already cope can still widen the gap for those who do not. Navigational difficulty, misreading of alerts, and non-use are themselves sources of error in geriatric care, and they are concentrated among exactly the users that connectivity and literacy statistics identify as most exposed (Valentim et al., 2025). These conclusions should be held with appropriate caution. Much of the evidence comes from acceptance studies in selected samples, and a substantial part of the access data was generated during the COVID-19 pandemic, a period that both accelerated digital health and distorted ordinary patterns of use. Cross-national comparison is limited by differing definitions and instruments, and the narrative form of this review means that the synthesis reflects judgement rather than statistical pooling. What the literature supports is a direction and a warning, not a precise estimate.

Conclusion

IoT-enabled care models hold real potential for geriatric care and for the prevention of avoidable errors, and the technical literature continues to demonstrate what is possible. The harder lesson from the access literature is that potential is not the same as reach. Across diverse settings, the older adults with the greatest need are the least likely to be online, the least likely to have the digital and navigational literacy that connected care assumes, and the most likely to be left with unmet needs even when a digital channel exists. Trust, privacy, cost, infrastructure, and human support stand between these users and the benefit that the technology promises.

Treating the digital divide as a core design and policy problem, rather than an afterthought, is therefore not a peripheral equity gesture but a condition for IoT-enabled care to do what it claims. Systems built for the least connected user, literacy treated as a public health intervention, infrastructure and reimbursement aligned with support, and evaluation that measures who is reached would together change the trajectory. Without them, the most probable outcome is that connected care extends its benefits to those already well served and quietly deepens the disadvantage of everyone else. For a field concerned with geriatric care and error prevention, that outcome would be both an equity failure and a safety one.

References

- Bertolazzi, A., Quaglia, V., & Bongelli, R. (2024). Barriers and facilitators to health technology adoption by older adults with chronic diseases: an integrative systematic review. *BMC Public Health*, 24, 506. <https://doi.org/10.1186/s12889-024-18036-5>
- Cao, C. et al. (2023). How to promote the healthy development of continuous participation in smart elderly care. *Digital Health*, 9. <https://doi.org/10.1177/20552076231197425>
- Charness, N. et al. (2016). Supportive home health care technology for older adults: attitudes and implementation. *Gerontechnology*, 15(4). <https://doi.org/10.4017/gt.2016.15.4.006.00>
- Chen, J. et al. (2023). Research on elderly users' intentions to accept wearable devices based on the technology acceptance model. *Frontiers in Public Health*, 10, 1035398. <https://doi.org/10.3389/fpubh.2022.1035398>
- Choukou, M.-A. et al. (2021). Evaluating the acceptance of ambient assisted living technology (AALT) in rural settings. *International Journal of Medical Informatics*, 155, 104461. <https://doi.org/10.1016/j.ijmedinf.2021.104461>
- Chung, G.S. et al. (2021). The role of social support in telehealth utilization among older adults. *Telemedicine Reports*, 2(1). <https://doi.org/10.1089/tmr.2021.0025>

- Connolly, G., Costa-Font, J., & Srivastava, D. (2025). Did COVID-19 reduce the digital divide? A systematic review. *Health Policy and Technology*, 14, 100979. <https://doi.org/10.1016/j.hlpt.2025.100979>
- Etemad-Sajadi, R. (2019). Senior citizens' acceptance of connected health technologies in their homes. *International Journal of Health Care Quality Assurance*, 32(8). <https://doi.org/10.1108/IJHCQA-10-2018-0240>
- Fowe, I.E. (2022). Understanding older adults' attitudes toward mobile and wearable technologies to support health and cognition. *Frontiers in Psychology*, 13, 1036092. <https://doi.org/10.3389/fpsyg.2022.1036092>
- Gil, H. (2025). Senior info-exclusion 4.0: emerging digital technologies and the technological divide. *Lecture Notes in Bioengineering*. https://doi.org/10.1007/978-3-031-77282-5_41
- Hargittai, E. (2002). Second-level digital divide: differences in people's online skills. *First Monday*, 7(4). <https://doi.org/10.5210/fm.v7i4.942>
- Hung, M. et al. (2023). Telemedicine among adults living in America during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 20(9), 5680. <https://doi.org/10.3390/ijerph20095680>
- Ji, Y.-A. et al. (2022). Scoping review of the literature on smart healthcare for older adults. *Yonsei Medical Journal*, 63(S14). <https://doi.org/10.3349/ymj.2022.63.S14>
- Jutai, J.W. et al. (2024). Implementation of digital health technologies for older adults: a scoping review. *Frontiers in Aging*, 5, 1349520. <https://doi.org/10.3389/fragi.2024.1349520>
- Konara Mudiyansele, S.P. et al. (2025). Emerging digital technologies used for fall detection in older adults in aged care: a scoping review. *Journal of the American Medical Directors Association*, 26(1), 105330. <https://doi.org/10.1016/j.jamda.2024.105330>
- Lee, Y.-S. (2025). Determinants of digital health information use among indigenous older adults. *BMJ Open*. <https://doi.org/10.1136/bmjopen-2025-108819>
- Malden, S. et al. (2025). Patient and carer-related facilitators and barriers to the adoption of assistive technologies. *JMIR Aging*. <https://doi.org/10.2196/73917>
- Pal, D. et al. (2018). Internet-of-Things and smart homes for elderly healthcare: an end user perspective. *IEEE Access*, 6. <https://doi.org/10.1109/ACCESS.2018.2808472>
- Percy Campbell, J. et al. (2024). User perception of smart home surveillance among adults aged 50 years and older: scoping review. *JMIR mHealth and uHealth*, 12, e48526. <https://doi.org/10.2196/48526>
- Qiu, Y. et al. (2024). The effects of the COVID-19 pandemic on age-based disparities in digital health. *Journal of Medical Internet Research*, 26, e65541. <https://doi.org/10.2196/65541>
- Schomakers, E.-M., & Ziefle, M. (2019). Privacy concerns and the acceptance of technologies for aging in place. *Lecture Notes in Computer Science*. https://doi.org/10.1007/978-3-030-22012-9_23
- Smolić, Š. et al. (2024). Perceived unmet healthcare needs among older Europeans in the COVID-19 pandemic and beyond: the telemedicine solution. *Public Sector Economics*, 48(2). <https://doi.org/10.3326/pse.48.2.1>
- Tudor Hart, J. (1971). The inverse care law. *The Lancet*, 297(7696), 405-412. [https://doi.org/10.1016/S0140-6736\(71\)92410-X](https://doi.org/10.1016/S0140-6736(71)92410-X)
- Valentim, P. et al. (2025). Digital and navigational health literacy in surgical patients: vulnerability across age groups. *Healthcare*, 13(24), 3227. <https://doi.org/10.3390/healthcare13243227>
- van Dijk, J.A.G.M. (2005). *The deepening divide: Inequality in the information society*. Thousand Oaks, CA: Sage.
- Vicente, M.R. (2022). ICT for healthy and active aging: the elderly as first and last movers. *Telecommunications Policy*, 46. <https://doi.org/10.1016/j.telpol.2021.102262>
- Vrančić, A. et al. (2024). The role of smart homes in providing care for older adults: a systematic literature review. *Smart Cities*, 7(4). <https://doi.org/10.3390/smartcities7040062>
- Wang, Z. (2025). Internet-based healthcare services use patterns and barriers among adults aged 50 and over. *BMC Public Health*. <https://doi.org/10.1186/s12889-025-23338-3>
- Wilson, T. (2024). The unintended harm of IoT devices in assistive technology distribution programmes. *IEEE European Symposium on Security and Privacy Workshops*. <https://doi.org/10.1109/EuroSPW61312.2024.00080>
- Yoon, J. (2025). Digital health literacy in the general population: national cross-sectional study. *Journal of Medical Internet Research*, 27, e67780. <https://doi.org/10.2196/67780>
- Zakerabasali, S. et al. (2022). Remote monitoring systems for patients with chronic diseases in primary health care: systematic review. *Health Science Reports*, 5, e863. <https://doi.org/10.1002/hsr2.863>
- Zhong, R. et al. (2024). User acceptance of smart home voice assistant: a comparison among younger, middle-aged, and older adults. *Universal Access in the Information Society*. <https://doi.org/10.1007/s10209-022-00936-1>