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Health Technology Literacy and Adoption Intention across Older Adult Communities

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Abstract

The rapid digitization of healthcare infrastructure has created a profound digital divide, particularly affecting older adult populations who face distinct cognitive, physical, and socio-environmental barriers to technology adoption. This prospective cohort study investigates the relationship between health technology literacy and technology adoption intention among community-dwelling older adults over a twelve-month tracking period. Utilizing a sample of four hundred and fifty-two participants aged sixty-five and older across diverse urban community centers, we measured baseline health technology literacy using the electronic Health Literacy Scale alongside structural constructs adapted from the Unified Theory of Acceptance and Use of Technology. Longitudinal analysis revealed that baseline health technology literacy is a powerful predictor of subsequent technology adoption intention. This relationship is significantly mediated by perceived usefulness and technology self-efficacy, while being heavily moderated by available social support systems. The cohort tracking demonstrated that digital health literacy is dynamic rather than static, with participants engaging in structured community support programs exhibiting significant positive shifts in adoption intention. These findings highlight the necessity of designing age-friendly digital health interfaces and establishing sustainable, community-level digital mentoring initiatives to mitigate health inequalities stemming from the digital gray divide.

Keywords: Health Technology Literacy; Older Adults; Cohort Study; Adoption Intention; Older Adult Communities

1. Introduction

1.1 Background and Context

The intersection of global demographic aging and the rapid digitalization of healthcare systems has emerged as one of the most critical socio-technical challenges of the twenty-first century. Worldwide, the population of individuals aged sixty-five and older is expanding at an unprecedented rate, placing immense strain on traditional healthcare delivery models [1]. In response, healthcare providers and policy makers have increasingly turned to digital health technologies as a primary mechanism to enhance care efficiency, improve patient self-management, and reduce clinical costs. These technologies encompass a wide spectrum of digital innovations, including telemedicine platforms, wearable health monitoring devices, electronic patient portals, and mobile health applications. While these innovations offer substantial potential to support independent living and chronic disease management among older adults, their efficacy is fundamentally contingent upon the target population's ability and willingness to adopt and utilize them.

Despite the theoretical benefits of digital health solutions, their rapid deployment has exposed a profound disparity in digital accessibility and utilization, frequently termed the digital gray divide [2]. This divide is not merely a matter of material access to hardware or internet connectivity; rather, it is deeply rooted in the concept of health technology literacy. Unlike general digital literacy, health technology literacy demands a complex integration of traditional reading skills, health comprehension, scientific reasoning, and digital navigation capabilities. Older adults, who are often the primary consumers of healthcare services, are paradoxically the least equipped with the specific skills required to operate modern health technologies. As clinical services increasingly transition to digital-first formats, older individuals lacking these competencies risk experiencing increased marginalization, compromised quality of care, and exacerbated health disparities.

1.2 Problem Statement

Existing research in gerontechnology and health informatics has primarily relied on cross-sectional survey designs to examine technology acceptance among older populations. While these studies have successfully identified various correlations between user demographic factors and immediate technology acceptance, they suffer from inherent limitations. Cross-sectional designs are structurally incapable of capturing the dynamic, temporal shifts in digital literacy and adoption intention that occur as older adults gain exposure to technologies over time. Furthermore, traditional technology acceptance models often treat technology literacy as a static baseline trait, failing to appreciate how intervention, social support, and experiential learning modify an individual's psychological willingness to engage with health technologies.

This scientific gap is particularly problematic given that the cognitive and physical profiles of older adults undergo continuous transition. Cognitive decline, sensory impairments, and changes in social integration can rapidly alter an individual's capacity to engage with complex digital interfaces. Consequently, there is an urgent need for longitudinal, community-based cohort studies that track the trajectory of health technology literacy and its direct, evolving influence on technology adoption intention over time. Without such longitudinal data, healthcare administrators and technology developers remain poorly informed about whether initial resistance to health technology can be overcome through sustained literacy development and community-level support structures.

1.3 Objectives of the Cohort Study

This prospective cohort study was designed to systematically address these empirical gaps by tracking a cohort of community-dwelling older adults over a twelve-month period. The primary objective of this investigation is to quantify the predictive relationship between baseline health technology literacy and subsequent technology adoption intention. In doing so, the study seeks to explore the mediating roles played by cognitive factors, such as perceived usefulness and technological self-efficacy, and the moderating influence of community-based social support networks [3].

Additionally, the research aims to observe the naturalistic changes in health technology literacy that occur within a community setting over a one-year interval. By identifying the specific barriers and facilitators that drive or inhibit changes in adoption intention, this study provides actionable insights for clinical designers, public health policy makers, and community organizations. Ultimately, the goal is to establish an empirically validated framework for digital health inclusion that supports the healthy, active, and dignified aging of older adult populations in an increasingly digitalized world.

2. Literature Review and Conceptual Framework

2.1 Evolution of Health Technology Literacy

The conceptualization of literacy within public health has undergone a major paradigm shift over the past several decades. Early models of health literacy focused almost exclusively on basic reading and numeracy skills required to navigate clinical environments, such as understanding prescription labels or scheduling appointments. However, as the digital revolution restructured societal infrastructure, researchers recognized that traditional health literacy was no longer sufficient. This realization led to the development of electronic health literacy, defined as the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem [4].

Within the context of contemporary gerontology, electronic health literacy has evolved further into health technology literacy. This specialized construct encompasses not only information retrieval from websites but also active operational engagement with sophisticated digital interfaces, such as interactive wearable devices, continuous glucose monitors, and multi-layered patient portals. The Lily model of electronic health literacy conceptualizes this competence as a translation of six distinct literacy types: traditional, health, information, scientific, media, and computer literacy [5]. For older adults, who completed their formal education and career paths prior to the ubiquity of personal computing, these intersecting literacy domains represent a significant cognitive hurdle. The developmental trajectory of these competencies in later life is distinct from younger demographics, as cognitive processing speed, working memory capacity, and spatial reasoning naturally decline with age, altering the mechanisms through which digital tasks are mastered.

2.2 Models of Technology Acceptance in Gerontology

To understand how older adults form intentions to adopt digital health tools, researchers have long utilized theoretical frameworks from information systems, most notably the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology [6]. The primary components of these models suggest that technology adoption is directly determined by behavioral intention, which is in turn predicted by performance expectancy (perceived usefulness), effort expectancy (perceived ease of use), and social influence. While these models have demonstrated robust predictive power in corporate and young consumer contexts, their direct application to geriatric populations requires substantial refinement.

Gerontological adaptations of technology acceptance frameworks argue that older adults do not evaluate technology solely through a utilitarian lens of productivity or efficiency. Instead, their acceptance decisions are heavily influenced by age-specific variables such as physical and cognitive functional limitations, privacy anxieties, past technological socialization, and the perceived threat of technology replacing human warmth in care delivery [7]. Cognitive aging theories suggest that when an older individual encounters a new technological system, their perceived ease of use is heavily constrained by the cognitive load the system imposes. If the cognitive demands of an interface exceed the individual's fluid cognitive capacities, it leads to rapid frustration and a steep drop in adoption intention. Therefore, integrating health technology literacy as a core antecedent in these acceptance models is crucial, as literacy acts as the cognitive bridge that reduces effort expectancy and enhances self-efficacy.

2.3 Barriers to Digital Health Adoption

The literature identifies a diverse array of barriers that impede older adults from successfully adopting digital health technologies, which can be categorized into individual, technical, and socio-environmental dimensions. At the individual level, physiological challenges play a critical role. Normal age-related changes, including presbyopia, reduced contrast sensitivity, tactile degradation, and fine motor tremors, make interacting with small touchscreens or complex physical buttons highly challenging [8]. Cognitive barriers, such as memory lapses and reduced attentional focus, make it

difficult for older users to recall multi-step navigation paths or manage complex password requirements. Furthermore, psychological barriers, including computer anxiety and fear of making irreversible errors, often manifest as absolute technophobia, preventing initial engagement with digital tools.

Technological barriers stem primarily from a pervasive lack of age-friendly design principles within the software engineering industry. Most digital health platforms are designed by younger, technologically fluent developers who implicitly build systems based on their own cognitive schemas. Consequently, interfaces frequently feature small fonts, low-contrast color palettes, inconsistent navigation logic, and an absence of intuitive visual feedback. These design failures significantly inflate the cognitive load required to operate the systems, creating artificial barriers for older users.

Finally, socio-environmental barriers involve the systemic lack of tailored educational infrastructure and technical support for older adults [9]. Traditional digital training manuals and customer service channels are rarely optimized for the learning paces or conceptual models of older generations. Additionally, social isolation, which is highly prevalent among older adults, deprives them of informal, household-level technical support that younger generations frequently rely on. Understanding these multi-dimensional barriers is essential for developing comprehensive literacy interventions that can effectively shift adoption intentions over the long term.

3. Methodology and Research Design

3.1 Cohort Selection and Sampling Framework

This study employed a prospective, longitudinal cohort design tracking older adults over a twelve-month duration. Participants were recruited from twenty-four distinct community-dwelling senior service centers, neighborhood organizations, and municipal recreation hubs across urban districts. A multi-stage stratified cluster sampling strategy was utilized to ensure a representative sample of older adults with varying socioeconomic backgrounds, educational histories, and baseline health statuses.

The recruitment process began with the identification of geographical clusters, followed by the random selection of community centers within those clusters. Information sessions were held at the selected centers to introduce the study, address privacy concerns, and obtain written informed consent. To be eligible for inclusion in the cohort, participants had to meet the following criteria: be aged sixty-five years or older at the time of recruitment, reside independently within the community rather than in institutional long-term care facilities, possess cognitive capacity sufficient to complete self-reported instruments (defined as a score of twenty-four or higher on the Mini-Mental State Examination), and have regular, unhindered access to a mobile device, tablet, or home computer. Individuals with severe, uncorrected visual, auditory, or motor impairments that physically precluded any interaction with digital interfaces were excluded from the study.

At the baseline stage, a total of five hundred and ten eligible participants were enrolled in the cohort. Over the subsequent twelve months, structured follow-up assessments were conducted at six-month intervals. Due to residential relocation, health deterioration, and loss of interest, fifty-eight participants withdrew from the study before its completion, resulting in a final longitudinal cohort of four hundred and fifty-two participants, representing an overall retention rate of eighty-eight point six percent. This high retention rate was achieved through regular telephone engagement, holiday greeting cards, and localized community workshops that maintained cohort cohesion.

3.2 Variable Measurement and Instrument Design

Data collection was executed using a comprehensive, multi-dimensional survey instrument administered through face-to-face interviews by trained research assistants. This interviewer-administered approach was selected over self-administered questionnaires to minimize cognitive fatigue, clarify ambiguous terminology, and ensure high data completion rates among participants with limited literacy or visual strain. The survey instrument comprised several validated psychometric scales alongside structured demographic and health questionnaires.

Table 1: Demographic Profiles of the Cohort Participants at Baseline

Demographic Variable	Subcategory	Frequency	Percentage
Age Group	65-74 years	234	51.77
Age Group	75-84 years	172	38.05
Age Group	85 years and older	46	10.18
Gender	Female	262	57.96
Gender	Male	190	42.04
Educational Level	Primary school or lower	108	23.89
Educational Level	Secondary education	244	53.98
Educational Level	Higher education degree	100	22.12
Living Arrangement	Living alone	98	21.68
Living Arrangement	Living with spouse	258	57.08
Living Arrangement	Co-residing with children	96	21.24
Chronic Diseases	None	62	13.72
Chronic Diseases	One or two conditions	278	61.50
Chronic Diseases	Three or more conditions	112	24.78

Health technology literacy was operationalized utilizing the electronic Health Literacy Scale, a widely recognized self-report tool adapted to evaluate an individual's perceived skills at finding, evaluating, and applying electronic health information to health problems [10]. The scale consists of eight items rated on a five-point Likert scale, ranging from strongly disagree to strongly agree, yielding an overall score range of eight to forty. Higher scores indicate superior health technology literacy.

Technology adoption intention was measured using a modified five-item scale adapted from the Unified Theory of Acceptance and Use of Technology framework, focusing specifically on the intention to adopt digital health monitoring devices and telemedicine services over the next year. This scale also utilized a five-point Likert format, with scores ranging from five to twenty-five.

To understand the cognitive and environmental pathways linking literacy to adoption, several secondary variables were measured. Perceived usefulness and perceived ease of use were assessed using scales adapted from the Technology Acceptance Model, each containing four items. Technology self-efficacy, representing an individual's confidence in performing digital health tasks independently, was evaluated using a three-item specialized scale. Finally, social support for technology use was operationalized by measuring the frequency and quality of assistance received from family members, friends, or community volunteers, categorized on a structured numerical scale [11].

3.3 Data Collection and Statistical Analysis Strategy

The data collection protocol was executed in three distinct phases: Baseline (T0), Six-Month Follow-Up (T1), and Twelve-Month Follow-Up (T2). At each phase, the research team re-administered the standardized psychometric instruments to track individual trajectories of literacy and intention changes. To ensure data quality, all completed surveys underwent rigorous double-entry verification by independent researchers, and any data discrepancies were resolved through direct reference to the original paper-based interview records.

Statistical analysis was performed using advanced quantitative modeling techniques. Descriptive statistics were computed to summarize the demographic characteristics, health statuses, and

baseline literacy levels of the cohort. Paired t-tests and repeated measures analysis of variance were utilized to examine the temporal changes in health technology literacy and adoption intention across the twelve-month study period.

To determine the predictive capacity of baseline literacy on future adoption intention, hierarchical multivariable linear regression models were constructed. These models sequentially controlled for baseline demographic characteristics, health status, and prior technology exposure, allowing for the isolation of the unique variance explained by health technology literacy. Mediation analysis was conducted using bootstrapping methods to test whether perceived usefulness and technology self-efficacy mediated the relationship between baseline literacy and twelve-month adoption intention. Finally, moderation analysis was performed to evaluate whether community-based social support significantly interacted with literacy to alter adoption trajectories over time. All statistical analyses were conducted with a significance threshold set at a p-value less than 0.05.

4. Empirical Results and Data Interpretation

4.1 Baseline Literacy and Adoption Intention Outcomes

At the baseline assessment, the cohort exhibited moderate but highly varied levels of health technology literacy and technology adoption intention. The mean baseline score for health technology literacy was twenty-two point four out of a maximum of forty, with a standard deviation of six point eight. This variation suggests that while a subset of older adults has achieved comfortable proficiency with electronic health resources, a significant proportion remains functionally illiterate in digital contexts. Technology adoption intention at baseline was also moderate, with a mean score of thirteen point eight out of twenty-five.

Table 2: Baseline and Twelve-Month Follow-Up Literacy and Intention Scores

Measurement Scale	Baseline Mean (T0)	Twelve-Month Mean (T2)	Mean Difference	t-Value	Significance (p)
Health Tech Literacy	22.42	24.18	1.76	5.82	p less than 0.001
Adoption Intention	13.84	15.62	1.78	6.14	p less than 0.001
Perceived Usefulness	14.22	15.98	1.76	4.96	p less than 0.001
Perceived Ease of Use	12.10	13.54	1.44	4.22	p less than 0.001
Tech Self-Efficacy	9.42	10.86	1.44	5.10	p less than 0.001

A detailed examination of baseline demographic correlates revealed that health technology literacy was significantly associated with age, educational attainment, and living arrangements. Participants in the youngest cohort group (65-74 years) scored significantly higher on baseline literacy compared to those in the oldest group (85 years and older), displaying a mean difference of six point two points.

Educational level was the strongest demographic predictor of baseline literacy, with participants holding higher education degrees scoring an average of nine point four points higher than those with only primary school education. Additionally, older adults living alone exhibited significantly lower baseline literacy scores compared to those co-residing with spouses or adult children, suggesting that daily access to familial support networks plays a structural role in maintaining digital skills [12].

4.2 Cohort Tracking and Temporal Transitions

The longitudinal tracking of the cohort over twelve months revealed a statistically significant increase in both health technology literacy and technology adoption intention across the entire

sample. As shown in Table 2, the mean health technology literacy score rose by one point seven six points, and the mean adoption intention score increased by one point seven eight points over the one-year study period. This upward trend indicates that older adults do not remain static in their digital capabilities; rather, constant exposure to a society that increasingly mandates digital engagement, coupled with community-level learning opportunities, fosters gradual competence and openness toward health technologies.

To analyze the structural pathways through which literacy translates into long-term adoption intention, we evaluated a conceptual transition model tracking the cohort from baseline to the twelve-month endpoint. This model demonstrated that the effect of baseline literacy on subsequent adoption intention is not entirely direct; instead, it operates through a series of intermediate cognitive and social transformations.

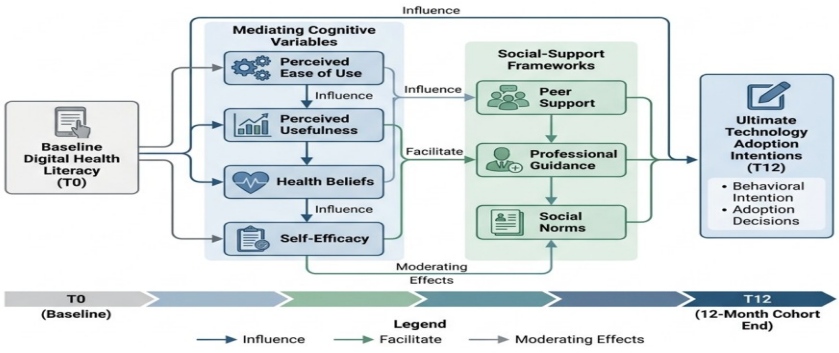

Figure 1: Conceptual Framework of Health Technology Literacy and Adoption Intention Transitions

The longitudinal analysis showed that individuals who entered the cohort with high baseline literacy were far more likely to experience positive gains in perceived usefulness and technology self-efficacy over the twelve-month period. These cognitive gains, in turn, directly predicted higher levels of adoption intention at the study's conclusion. Conversely, participants who started with low baseline literacy and lacked active social support structures showed negligible improvement in adoption intention, and in some cases, experienced a decline in motivation due to repeated, unassisted failures with technology interfaces.

4.3 Regression Analysis on Adoption Predictors

To systematically determine the independent predictive power of baseline health technology literacy on technology adoption intention at twelve months, hierarchical multivariable linear regression analyses were conducted. Model 1 established a baseline by entering demographic control variables, including age, gender, educational level, living arrangements, and the number of chronic conditions. This initial model explained twenty-two point four percent of the variance in twelve-month adoption intention, with younger age and higher educational level acting as statistically significant positive predictors.

Model 2 introduced baseline prior technology experience and baseline frequency of technology use into the regression. This addition increased the explained variance to thirty-one point eight percent,

indicating that prior familiarity with general computing devices serves as a vital foundation for developing health-specific technology intentions.

Model 3, the final comprehensive model, added baseline health technology literacy scores. The inclusion of literacy resulted in a highly significant increase in the model's explanatory power, raising the total explained variance to forty-six point two percent. In this final model, baseline health technology literacy was the most powerful independent predictor of twelve-month technology adoption intention, exhibiting a standardized beta coefficient of zero point four two (p-value less than 0.001). This finding provides strong empirical validation for the hypothesis that health technology literacy is a foundational cognitive resource that directly dictates an older adult's long-term willingness to adopt digital health solutions [13].

The regression analysis also demonstrated that the influence of literacy on adoption is heavily moderated by the presence of community-based social support. For participants who reported low levels of family or community assistance, the positive association between literacy and adoption intention was substantially weaker. In contrast, for older adults who had access to reliable, empathetic, and regular social support, even moderate levels of baseline literacy were sufficient to spark strong, sustained intentions to adopt new health technologies. This interaction highlights that technology adoption in older populations is a deeply socialized process, requiring both individual cognitive skills and supportive community ecosystems to succeed.

5. Discussion and Policy Implications

5.1 Synthesis of Findings and Theoretical Contributions

The empirical findings generated by this twelve-month cohort study provide critical insights into the dynamics of health technology literacy and adoption intention in older adult communities. Our research demonstrates that health technology literacy is not a fixed, immutable characteristic of older individuals, but a malleable set of skills that can evolve over time when supported by community environments. The significant positive shift in literacy and adoption intention observed across the cohort indicates that older adults possess substantial cognitive plasticity and adaptability, contradicting the persistent stereotype of universal geriatric resistance to technology.

Theoretically, this study makes a major contribution to gerontechnology and information systems literature by integrating health technology literacy as a central, dynamic antecedent within established technology acceptance frameworks like UTAUT and TAM [14]. By tracking these variables longitudinally, we have shown that baseline literacy is a primary driver of long-term adoption intention, operating primarily by enhancing technology self-efficacy and lowering the cognitive barriers associated with perceived ease of use.

Our findings also emphasize that the traditional, highly individualistic models of technology acceptance must be expanded to include socio-environmental factors when applied to older adult populations. The powerful moderating role of social support identified in our analysis indicates that an older adult's decision to adopt a technology is rarely made in isolation. Instead, it is negotiated within a complex web of family relationships, peer interactions, and community-level support structures. Consequently, future theoretical models must treat geriatric technology adoption as a socio-technical process that is as much about social connection and trust as it is about interface design or functional utility.

5.2 Practical Interventions for Community Care

The practical implications of this study are highly relevant for healthcare administrators, public health professionals, and community developers aiming to build inclusive digital health systems. First, the strong predictive power of health technology literacy highlights the futility of deploying

digital health solutions without simultaneously investing in community-level educational infrastructure. Rather than simply distributing devices or expecting older patients to navigate complex online portals independently, healthcare systems must partner with local community centers to establish structured, age-friendly digital literacy training programs.

These training initiatives should move away from dense, technical manuals and instead employ hands-on, experiential learning models that allow older adults to practice using digital health tools in low-stakes, supportive settings. Incorporating peer-to-peer mentoring strategies, where technologically proficient older adults train their peers, has proven highly effective in reducing technology anxiety and building mutual confidence.

Second, the critical role of user interface and user experience design must be addressed. Technology developers must actively incorporate geronontological design standards into their software development lifecycles. This involves implementing adjustable font sizes, high-contrast color schemes, simplified navigation pathways, and robust, natural language voice-assistance systems that bypass complex keyboard and touchscreen commands.

Digital platforms should also feature simplified error-recovery mechanisms to prevent the user frustration and self-blame that often leads to technology abandonment. By designing interfaces that match the cognitive and physiological profiles of older adults, developers can significantly reduce the baseline literacy threshold required for successful system operation, thereby accelerating the adoption curve.

Finally, public health organizations must prioritize the establishment of community-based digital support networks to provide ongoing technical assistance. Because older adults frequently encounter novel software updates or hardware malfunctions that they cannot resolve independently, having access to local, trusted technical support is essential to prevent temporary difficulties from turning into permanent abandonment. Senior centers, public libraries, and local health clinics should serve as community hubs where older adults can receive personalized, patient technical support. This infrastructure would ensure that digital health tools remain accessible and useful over the long term.

5.3 Study Limitations and Future Research Directions

While this study offers valuable longitudinal insights, several limitations must be acknowledged when interpreting the findings. First, the cohort was recruited entirely from urban community centers, which may restrict the generalizability of the results to older adults living in rural or highly remote areas. Rural seniors often face distinct challenges, including limited broadband infrastructure, higher geographical isolation, and reduced access to community-based support services. These factors could alter the relationship between literacy and technology adoption. Future research should expand the cohort design to include diverse geographic regions, allowing for comparative analyses between urban and rural geriatric populations.

Second, the measure of health technology literacy used in this study, the electronic Health Literacy Scale, relies on subjective self-reporting rather than objective skill assessments. While self-reports provide valuable insights into an individual's confidence and perceived competence, they can sometimes be influenced by social desirability or cognitive biases.

Future longitudinal investigations should incorporate objective, performance-based tasks, such as observing participants as they complete specific tasks on a digital health interface, to provide a more precise, behaviorally grounded measurement of literacy [15]. Additionally, extending the tracking period beyond twelve months would allow researchers to observe whether initial technology

adoption intentions successfully translate into sustained, long-term use, and how this integration ultimately impacts clinical health outcomes.

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