

Assessing the Impact of Digital Technologies in Long-Term Care Organizations: A Systematic Literature Review

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Abstract

The long-term care (LTC) sector has been significantly influenced by the digital transformation of healthcare (WHO, 2024). However, standardized frameworks for evaluating the impact of digital health technologies (DHTs) on the performance and sustainability of LTC organizations remain underdeveloped (Kruse et al., 2017; Jacob et al., 2023).

This study conducts a systematic literature review to analyze existing measurement approaches, identify key variables, and highlight research gaps. Findings indicate that digitalization is increasingly recognized as a means to enhance both care quality and organizational efficiency, yet no comprehensive system to assess its impact on sustainability and care quality currently exists. The analysis identifies the *degree of digitalization* as the primary independent variable and *quality of care* as the main dependent variable, while highlighting *sustainability*—both economic and organizational—as a crucial yet underexplored variable. Notably, the literature review reveals a striking paucity of research contributions from the field of economic and management sciences, underscoring the need for interdisciplinary approaches.

To address these gaps, this study proposes a conceptual framework that integrates key variables, dimensions, indicators, and measurement tools for systematically evaluating the impact of digitalization in LTC organizations. The findings also emphasize the need for further research—particularly from economic and management perspectives—to develop standardized

indicators and robust measurement methodologies that can empower policymakers and LTC administrators to optimize digital transformation strategies for long-term sustainability.

Keywords: Digitalization, Measurement, Performance, Long-term Care.

1. INTRODUCTION

Demographic trends across OECD countries highlight a widespread aging population, accompanied by a progressive increase in non-self-sufficiency and the need for social and healthcare assistance (OECD, 2023a), including home care services. Globally, the rising demand for health and social care services has placed substantial challenges on health providers (OECD, 2023b).

Against the backdrop of ongoing transformations in Primary Care (WHO, 2018), there is an urgent need to rethink Long-Term Care (LTC) services by developing new operational archetypes (Rostad et al., 2023) that ensure greater sustainability from both an economic and an organizational perspective (WHO, 2022). On the one hand, the rising costs of LTC require innovative procurement strategies and alternative financial resources (OECD, 2023b). On the other hand, the shortage of healthcare workforce calls for a radical reorganization (OECD, 2020) that shifts toward more efficient care models (Hamel et al., 2021) capable of improving LTC organizational processes (EU, 2021).

Digital health technology (DHT), including artificial intelligence (OECD, 2023b), is widely regarded as a key driver of sustainable development in LTC from both economic and organizational perspectives (Tebbutt et al., 2016). It enables growth by fostering innovation and productivity, while simultaneously enhancing and attracting human capital over the long term (OECD, 2020).

Although significant interest in DHTs across academic and gray literature, the LTC sector is still lacking a universally agreed-upon definition of DHTs (Krick et al., 2019). This challenge arises from the continuous advancement of “digitalization”, as the range of potentially relevant DHTs for LTC is constantly increasing, complicating their classification (Krick et al., 2019). In this study, DHT is used as an ‘umbrella term’ that encompasses all products and technological solutions with a digital component that are potentially relevant to LTC. These technologies aim to enhance individual health and well-being as well as improve healthcare and social care systems (OECD, 2023b).

For several years, LTC policy programs have prioritized the implementation of DHTs as a critical and time-sensitive objective. However, their full potential remains largely underutilized in many countries (WHO, 2024). Despite this emphasis, recent analyses in the LTC sector indicate that providers perceive DHT innovations as having minimal impact on service delivery (Fosti et al., 2024). For instance, in Italy—the world’s second-oldest country after Japan in terms of its older adult population (OECD, 2023a)—the effectiveness of LTC services continues to hinge primarily on the provision of residential services within nursing homes (NHs) (Fosti et al., 2024). A recent survey reveals that the implementation of digitalization in the Italian LTC system appears to be largely confined to conventional operational tasks (e.g., digital medical records) rather than having a tangible impact on care delivery models (Furnari et al., 2024). Overall, ongoing efforts to advance digitalization in LTC remain inadequate (Fosti et al., 2024). This shortfall is further underscored by recent Italian regulatory measures (Legislative Decree No. 29/2024) and the objectives outlined in Mission 5 (Inclusion and Cohesion), Component 2 (Social infrastructure, households, communities, and the third sector), and Mission 6 (Health), Component 1 (Local

networks, facilities, and telemedicine for local healthcare) under the National Recovery and Resilience Plan (NRRP).

Despite extensive research on the effects of single DHTs on patient outcomes (Carini et al., 2021), their effectiveness and efficiency within healthcare organizations remain contested (Van der Roest et al., 2017). Since the mid-1990s, academic interest in evaluating the impact of a single DHT, such as Information and Communication Technology (ICT) systems, has grown in response to epidemiological trends that have increasingly challenged healthcare systems, prompting a focus on optimizing healthcare expenditure and improving care outcomes (Lorenzi & Riley, 1995). Early studies emphasized measuring technological ‘sophistication’ or ‘maturity’ by developing a system to assess ICT’s impact on the performance of Canadian and U.S. hospitals (Paré & Sicotte, 2001). However, the development of ICT measurement systems has not been extended to assessing the overall degree of digitalization and its impact on an LTC organization (Gagnon et al., 2012).

Despite the growing integration of DHTs in LTC, no consolidated systems currently exist to evaluate their impact on sustainability and organizational performance (Kruse et al., 2017; Jacob et al., 2023). Although prior studies have investigated the effects of digitalization, these analyses often lack a structured framework composed of standardized variables, indicators, and metrics (Antonicelli et al., 2023). This absence undermines the potential of digital technologies to support evidence-based decision-making in both policy and managerial contexts (Molinari-Ulate et al., 2023).

Recent empirical evidence further highlights the urgency of developing such evaluation systems. For example, a UK-based study on the Health Call application—designed to enhance digital communication between care homes and hospitals—reported a 25% reduction in emergency admissions and an 11% decrease in hospital length of stay across a cohort of 8,702 patients, resulting in an estimated annual savings of £6.3 million. When scaled nationwide, the potential impact could reach £247 million (Garner et al., 2024). These findings underscore how digital interventions, when systematically evaluated, can yield substantial clinical and economic benefits.

Furthermore, independent organizations such as the Institute for Clinical and Economic Review (ICER) and the Peterson Health Technology Institute have emphasized the need for dedicated impact assessment frameworks for digital health technologies (Pearson et al., 2023). The unique characteristics of DHTs—marked by rapid innovation cycles, functional heterogeneity, and lack of cross-national regulatory alignment—render conventional evaluation tools such as Health Technology Assessment (HTA) insufficient (Pita-Barros et al., 2019). In addition, the absence of standard metrics, coupled with misaligned incentives between technology developers and healthcare payers, poses risks to adoption and reimbursement decisions. Without shared frameworks to assess clinical efficacy and economic value (e.g., avoided costs, ROI), healthcare organizations lack the tools to make informed and scalable decisions (Pearson et al., 2023).

A unified measurement framework would not only enhance accountability but also support multilevel governance by aligning local managerial choices with broader health system goals (Pita-Barros et al., 2019). Against this backdrop, the development of a structured, evidence-based evaluation system for DHTs in LTC emerges as a critical step toward improving the strategic adoption of digital innovation in care provision.

This study, therefore, aims to address the following research question:

What variables are needed to assess the impact of digitalization as a contribution to sustainability and performance of LTC organizations?

Drawing on established models for the adoption of digital healthcare technologies (Lettieri & Masella, 2009; Gagnon et al., 2012; Ammenwerth, 2019) and aligning with performance management system frameworks (Ferreira & Otley, 2009), this research develops a comprehensive set of variables, indicators, and measurement tools derived from a systematic literature review aiming at analyzing the different tools employed. These elements are intended to inform the development of a structured evaluation system capable of assessing the impact of DHTs on sustainability and performance in LTC organizations.

2. METHODOLOGY

A systematic literature review was chosen as the methodological approach to address the RQ, as it offers an exploratory qualitative framework for advancing knowledge in a specific domain through a structured, transparent, and replicable process, while minimizing redundancy in academic studies (Tranfield et al., 2003; Paul et al., 2024). Several of them have employed systematic literature reviews to identify key variables, risk factors, determinants, and indicators that define critical aspects of LTC services (Moore et al., 2019; Aloisio et al., 2021; Kormelinck et al., 2021).

Following the PRISMA protocol—which is widely recognized for its relevance and adoption in social and healthcare sciences (Moher et al., 2009; Liberati et al., 2009; Johnson & Hennessy, 2019)—the systematic literature review was carried out (Thorpe et al., 2005; Tranfield et al., 2003) to identify scholarly contributions that include variables and metrics capable of measuring the impact of digital technologies on the performance of LTC organizations.

1st Keywords	"aged care nursing homes" OR "aged care facilit*" OR "aged community-based" OR "assisted living" OR "assistedliving facilit*" OR "assisted-living facilit*" OR "care home*" OR "institutional care" OR "institutional* elderly" OR "living facilit*" OR "long-term care facilit*" OR "nursing care facilit*" OR "nursing home*" OR "residential care*" OR "residential aged care*" OR "residential facilit*" OR "skilled nursing facilities"
And 2nd Keywords	"digitalization" OR "digitalisation" OR "digital" OR "eHealth" OR "e-Health" OR "e health" OR "technology"
And 3rd Keywords	"measure*" OR "KPI" OR "indicator*" OR "metric"

Keywords within each search level were connected using Boolean 'OR' operator to capture alternative terminology. The three search levels were then combined using the 'AND' operator to ensure each result contained at least one term from each category within its title, abstract, or keywords. Using the "Limit to" function, only peer-reviewed articles published in English were selected. Grey literature, such as guidelines and clinical protocols, was not considered.

Table 1: Keywords used for the inquiry.

An initial search encompassing the broader LTC sector did not yield significant scientific findings. As a result, the scope was narrowed to focus specifically on NHs as LTC organizations providing residential care services (Sanford et al., 2015). The selected keywords, detailed in Table 1, were used as search queries in Scopus.com. Scopus was chosen as the primary source for literature retrieval due to its broader coverage of the social and healthcare sector compared to Web of Science (WoS) (Powell & Peterson, 2017; Martin-Martin et al., 2021), as well as the high quality of its indexed journals and the transparency of its search functionalities (Turzo et al., 2024), which exceed those of alternative platforms such as Google Scholar and Microsoft Academics (Powell & Peterson, 2017; Martin-Martin et al., 2021).

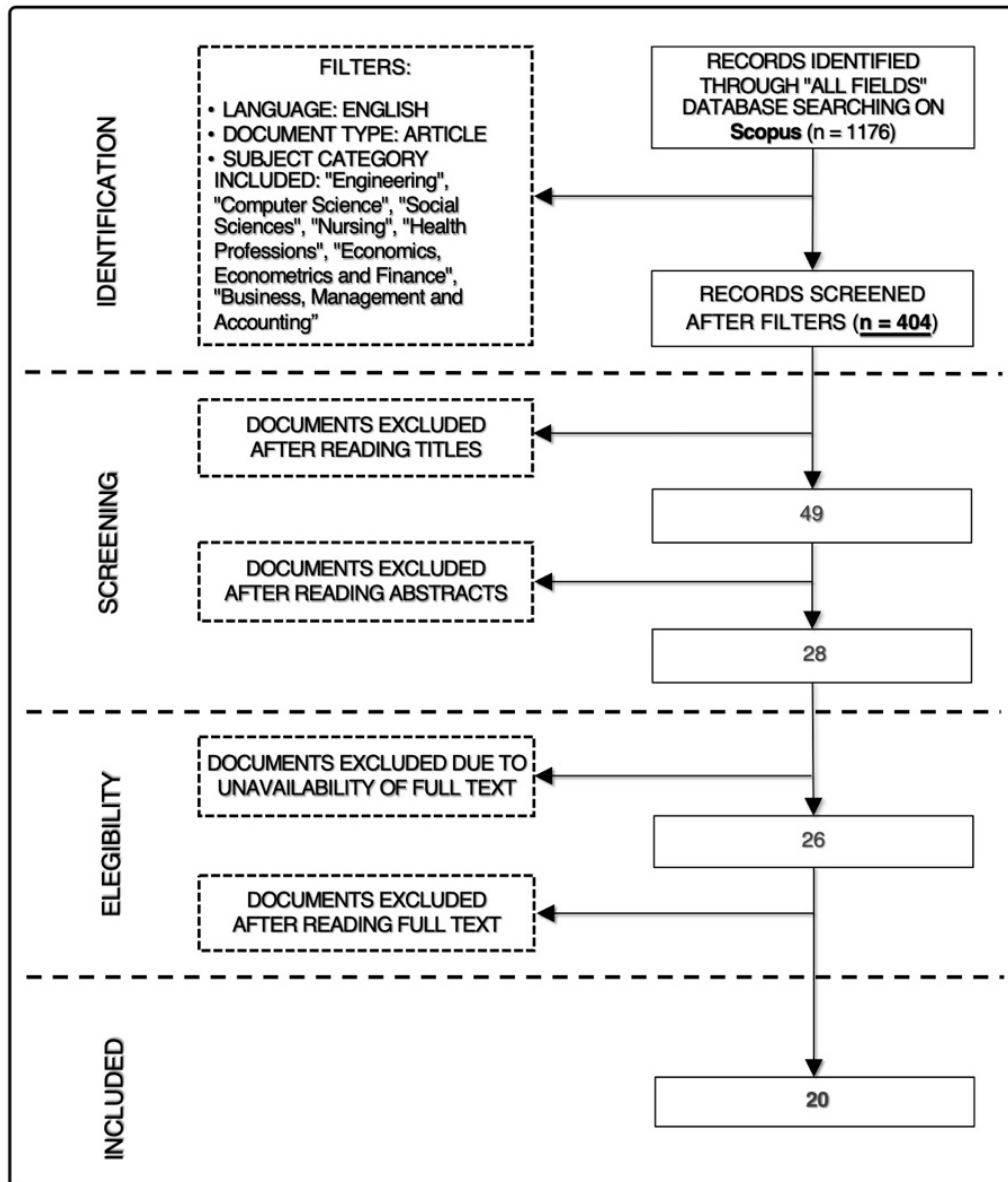


FIGURE 1: Paper selection and extraction template. Authors' elaboration from the PRISMA model.

Notably, keywords explicitly referring to “sustainability” and “performance” in LTC organizations were not included in the search criteria. Instead, the approach aimed to determine how these concepts were recognized and defined in the existing body of LTC literature selected during the screening phase. Figure 1 illustrates the evaluation and selection of articles according to the PRISMA protocol (Moher et al., 2009), resulting in a final dataset of twenty articles retrieved as of 30 July 2024.

A descriptive-quantitative analysis of the sample was performed by using a statistical descriptive tool within a spreadsheet-based metadata management system (Kotronoulas et al., 2023). This step was followed by a descriptive-qualitative and conceptual analysis (Thorpe et al., 2005; Tranfield et al., 2003; Doyle et al., 2020) intended to identify the key variables required to measure the study’s areas of interest: digitalization, sustainability, and performance in LTC organizations.

3. FINDINGS

3.1 Descriptive-Quantitative Analysis

Publications addressing the measurement of DHTs’ impact on the performance and sustainability of NHs began appearing in 2006. As shown in Figure 2, most studies have been published in the last decade, with 60% of them released in the past five years. This trend indicates growing academic interest in the topic, consistent with international reports emphasizing the challenges posed by aging populations and the delivery of LTC services (WHO, 2018; OECD, 2023a).

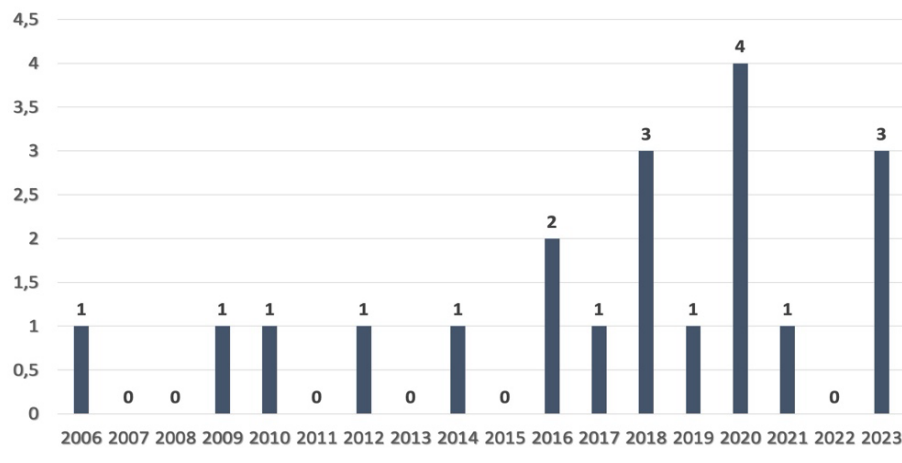


FIGURE 2: Documents by year. *Source:* Authors’ elaboration from Scopus.com (2024).

Data on document distribution by country (Figure 3) indicate that this topic is primarily examined and debated in highly industrialized OECD countries. The United States leads in contributions (15 articles), followed by Italy, Germany, the United Kingdom, and Taiwan (1 article each). This pattern reflects the more developed status of LTC services, such as NHs, in countries with higher public healthcare expenditure (Wilmoth et al., 2023). Notably, Japan – which has the highest percentage of older adults – and China – which has the world’s largest older adult population – are both absent from the dataset (OECD, 2023a).

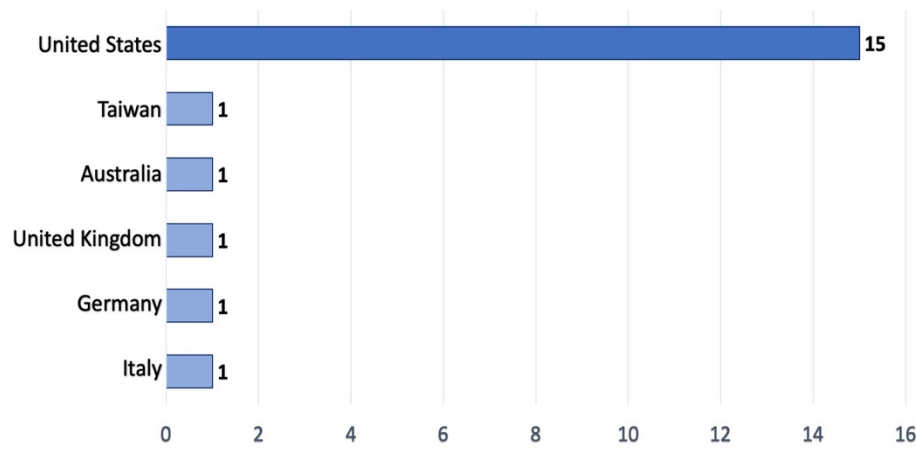


FIGURE 3: Documents by country. *Source:* Authors' elaboration from Scopus.com (2024).

The predominance of U.S.-based studies is unsurprising, given the existence of a centralized, computerized, and open-access database (*NH Compare*, now integrated into *Data.CMS.gov*). Within this system, NHs are required to regularly report on the quality of care provided for both quality monitoring and reimbursement under the U.S. national healthcare framework. These reports include periodic submissions of specific indicators, referred to as “quality measures” (CMS, 2024), ensuring the availability of extensive, quality-of-care data from thousands of NHs, and facilitating robust, multi-year longitudinal analyses.

The dataset comprises twenty articles, one of which is a scoping review. All selected studies employ methodologies to identify and measure variables that influence either the effective adoption of one or more digital healthcare technologies or the achievement of specific organizational and community-level outcomes. Nevertheless, only seven articles apply statistical investigation techniques to measure how technology adoption relates to organizational performance within a cause-and-effect framework. These findings highlight the potential of digital technology as a strategic tool, yet one that remains underexplored and insufficiently analyzed concerning its tangible impact on LTC services (Furnari et al., 2024).

The descriptive-quantitative analysis did not reveal any leading journal in terms of publication volume. Across a total of fifteen journals, both the *Journal of Gerontological Nursing* and the *Journal of the American Medical Directors Association* contributed with three articles each, while the *Journal of Medical Systems* accounted for two. The remaining twelve journals contained one article apiece. This distribution aligns with the thematic categorization provided by Scopus.com, which – as reported in Figure 4 – classifies the articles into six distinct scientific fields: medicine, nursing, health professions, social sciences, computer science, and mathematics.

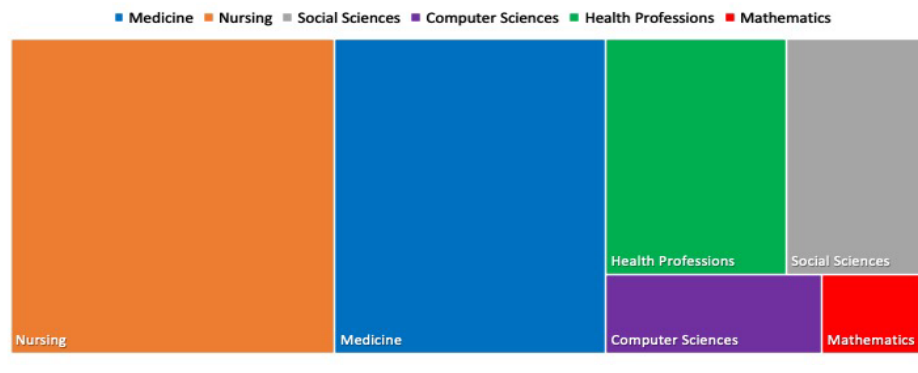


FIGURE 4: Subject Area from Scopus.com. *Source:* Authors' elaboration (2024).

Nursing emerges as the dominant field, confirming the significant role of nurses in providing LTC services (OECD, 2020). Notably, no articles fall under economic sciences. The absence of a leading journal, coupled with the interdisciplinary nature of these publications, underscores the fragmented nature of LTC literature (Fu et al., 2019).

Although most studies reflect collaboration among multiple authors, with an average of 4.05 authors per document (only two are single-authored), none involve international co-authorship. This suggests that service delivery in NHs remains deeply rooted in the specific context of LTC, pointing out the need for locally tailored solutions (Park & Yu, 2019; OECD, 2020).

Figure 5 presents an analysis of authors' affiliations, revealing the presence of a predominant research group. Out of the 69 authors included in the dataset, 29 are affiliated with the University of Missouri. Among them, *Gregory L. Alexander* stands out as the most prolific author, with eight publications, five of which were co-authored with *Richard W. Madsen*. Both authors, affiliated with the University of Missouri, have made some of the most significant contributions to the objectives of this study.

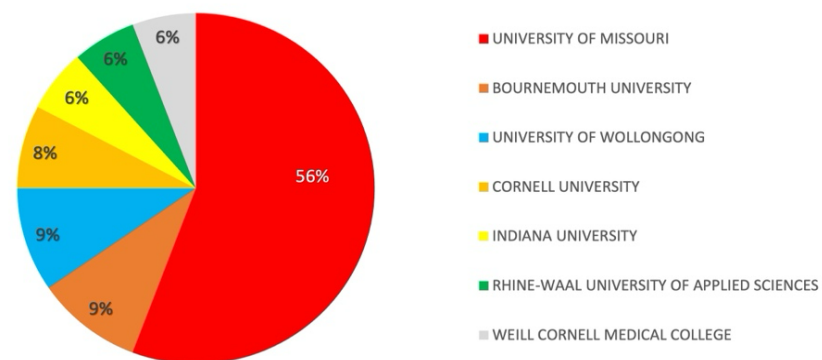


FIGURE 5: Most relevant affiliations. *Source:* Authors' elaboration from Scopus.com (2024).

3.2 Descriptive-qualitative Analysis

The analysis reveals a heterogeneous landscape of contributions regarding the measurement of the impact of digital technologies in LTC organizations. Three distinct clusters of studies have emerged. These groups are presented in the following subsections: (1) a foundational framework for assessing IT sophistication in U.S. nursing homes; (2) the centrality of quality of care as a key performance indicator; and (3) the limited and fragmented consideration of economic and organizational sustainability.

3.2.1 Assessing IT sophistication in U.S. Nursing Homes

The findings reveal that no consolidated framework currently exists for evaluating the impact of digital technologies on the sustainability and performance of LTC organizations. Among the reviewed studies, the most significant scientific contribution emerges from a group of seven articles co-authored by Gregory L. Alexander, who has, since 2009, extensively investigated the development of measurement tools to evaluate the impact of the IT variable termed “*IT sophistication*” (also referred to as IT maturity) on the quality of care in U.S. nursing homes (Alexander et al., 2021; Alexander et al., 2020a; Powell et al., 2020; Alexander et al., 2020b; Alexander et al., 2017; Alexander et al., 2016; Alexander & Madsen, 2009). The evaluation system developed in the above studies assesses the effectiveness of a single technology, IT, within NHs. The authors posit that the mere presence of ICT technologies in an NH does not automatically lead to improved organizational performance; rather, their effective and strategic integration into operational workflows yields measurable improvements in outcomes (Alexander et al., 2021). Drawing on evidence from the literature, the authors propose three key dimensions for analyzing IT:

1. **IT Capability:** it assesses the digitalization of internal processes in a specific area of investigation (e.g., the digitalization of internal pharmacy processes);
2. **IT Extent of use:** it evaluates the range of functions supported by an IT system (e.g., real-time and systematic digital monitoring of vital signs);
3. **IT Degree of integration:** it measures the interoperability between technologies within the facility, as well as their integration with the information systems of key external stakeholders (e.g., Local Care Systems integrated with internal systems of the NH).

Building on these three dimensions, the authors identified 27 indicators: 11 for capability, 9 for the extent of use, and 7 for the degree of integration (Alexander et al., 2020b). The tool designed to measure the degree of digitalization involves interviews with facility managers through a questionnaire that combines binary (presence/absence) responses with items rated on a 7-point Likert scale.

Economic and organizational sustainability, however, remains unaddressed in this framework. The critical conditions of care delivery and users’ dissatisfaction with LTC services in the United States have spurred over time increased attention to analyzing “*quality of care*” (NASEM, 2022). Recognized as a key dependent variable for assessing the performance of NHs, quality of care is gauged using qualitative indicators from the *Data.CMS.gov* database, from which the authors identify 18 care-quality conditions (e.g., “high risk of pressure ulcers”) categorized into two levels of care severity: short-stay and long-stay residents. After data collection, the authors investigate the impact of digital technologies’ adoption by tracking variations in quality of care (dependent variable) in response to changes in IT sophistication (independent variable) within an NH. The analysis follows a longitudinal design, where variables are repeatedly observed and measured over multiple time periods, typically spanning three years. Statistical techniques, such as correlation and regression analysis, are employed to determine the nature and strength of these

relationships. As a result, the proposed digitalization assessment system extends beyond the scope of individual organizational contexts, requiring collaboration with central government authorities to standardize nationally recognized quality-of-care indicators, and ensure data accessibility and comparability across multiple years.

Although these authors developed an initial system for evaluating the impact of digitalization, the challenge remains in its early stages. These findings confirm a positive relationship between digitalization and quality of care; however, the correlation is relatively moderate, with some NHs experiencing a decline in their IT sophistication over time. Such trends often require context-specific explanations, influenced by policy variations and different stages of organizational development (Alexander et al., 2017). In addition to identifying an independent and a dependent variable, the authors stress the need for using “*control variables*”. Since the impact of technology on organizational outcomes can be influenced by numerous factors, the authors employ control variables to isolate, as much as possible, the effects attributable to the degree of digitalization in a NH. Once measured, these control variables are analyzed in the discussions of the results concerning the impact of the DHT. In Alexander et al. (2020b), two control variables are identified:

- **Facility Characteristics:** organizational size (number of beds), ownership type (for-profit vs. non-profit), and regional location (rural, small town, urban, metropolitan);
- **Market Characteristics:** whether the NH is co-located with a hospital or classified as a special focus facility.

Depending on the research objective, different indicators may be selected for each control variable (e.g., whether the NH is a part of a chain, or if it uses a synthetic indicator, such as the CMS Five-Star Overall Rating, to assess care severity). The measurement of these indicators is facilitated by free access to national databases like *Data.CMS.gov* or the former *NH Compare*.

3.2.2. Quality of care as a central performance indicator in LTC research

A subset of eight articles, five of which deal with the U.S. context, evaluates the performance of NHs through the “*quality of care*” variable, reaffirming its central role as the primary expected outcome of LTC services. The concept of quality is further expanded to include the notion of “well-being,” encompassing both patients and their family members (Bradley et al., 2023). This perspective broadens the focus beyond the patients' health conditions to include additional quality dimensions, such as health inspection outcomes, staff assessments, and overall facility evaluations (Dulal, 2018; Pillemer et al., 2012; Lewis, 2007). Quality is typically measured via indicators either derived from existing literature or established based on national reference standards set by central administrations. Examples include the hospitalization rate of NH residents (Campion et al., 2023), the level of adherence to accreditation standards (Jiang et al., 2016), and the adoption of quality dimensions derived from established frameworks in the literature, such as the SERVQUAL questionnaire (Ko & Chu, 2020). This underlines the importance of close collaboration between NHs and healthcare institutions to define and standardize a shared definition of quality of care (Jiang et al., 2016; Ko & Chou, 2020). However, the relationship between the overall degree of digitalization and NH performance remains largely underexplored. Only two studies (Campion et al., 2023; Kranz et al., 2018) measure digitalization through the implementation of individual technologies (e.g., telemedicine and digital information systems) rather than treating it as an integrated system at the facility level. Their evaluations identify the range of benefits associated with their effective implementation, building on findings established in the reference literature. The measurement of both quality and degree of digitalization is conducted through questionnaires, capturing data about the presence/absence and prevalence of quality conditions, as well as the effective implementation of individual technologies through specific indicators.

3.2.3 Economic and Organizational Sustainability

Economic and organizational sustainability remains an underexamined variable in most of the reviewed studies. In Rantz et al. (2010), for instance, within the context of assessing the impact of a single technology—Electronic Medical Records (EMRs)—sustainability is examined in relation to quality of care, highlighting the effects of cost-containment policies on resident care. In this study, sustainability is considered in its economic dimension and is measured through total daily costs per resident and staff costs per resident day, utilizing data from the *Medicaid* dataset (Rantz et al., 2010). Similarly, De Felice & Petrillo (2014) include sustainability in a broader performance management model inspired by the Balanced Scorecard approach. The authors propose evaluating the process of IT implementation in healthcare organizations, identifying financial sustainability as one of the key dimensions.

From an organizational perspective, sustainability is indirectly addressed through management strategies and calls to action aimed at overcoming cultural resistance to adopting new managerial policies, such as digitalization (Zarowitz et al., 2018). The authors conceptualize organizational sustainability through additional dimensions: job satisfaction, workforce adequacy, and staff retention. However, sustainability indicators are only explicitly proposed for workforce adequacy, drawn from existing literature or, in the case of U.S.-based studies, from the *Data.CMS.gov* database, which provides workforce-related data for NHs.

Findings indicate that sustainability has been secondary to quality of care as a dependent variable. Nonetheless, in evidence-based research, sustainability is closely linked to the collaboration between LTC organizations and central healthcare authorities (Rantz et al., 2010; Zarowitz et al., 2018). The availability of national databases containing data on economic and organizational performance is essential for measuring sustainability indicators and analyzing the impact of digitalization on healthcare performance. By contrast, degree of digitalization continues to be a frequently analyzed variable, though interpreted inconsistently. Studies often focus on the implementation status of individual technologies, with only limited efforts to establish correlations between digitalization and specific organizational performance metrics (Vest et al., 2019; Xavier Macedo de Azevedo et al., 2023). The results of the descriptive-qualitative analysis are presented in Table 2. Although authors have used various terms to indicate the level of technology adoption in NH (e.g., "IT sophistication," "IT maturity," "HIT capability"), this study adopts the term "degree of digitalization."

Year	Authors	Country	Technology Measurement			Sustainability Measurement			Measurement of Technology-Sustainability link	Performance Measurement			Measurement of the Technology-Performance link
			Variable	Indicators	Measurement tools	Variable	Indicators	Measurement tools		Variable	Indicators	Measurement tools	
2020	Alexander et al., 2020b	USA	Degree of digitalization	3 Technology Dimensions a) IT capability conditions b) IT extent of use c) IT degree of integration	Interviews with key informants: presence/absence, 7-point Likert scale	NA	NA	NA	NA	Quality	18 Quality conditions drawn from NH Compare, 13 long-stay residents and 5 for short-stay residents	Prevalence	Correlation and Regression
2020	Alexander et al., 2020a	USA	Degree of digitalization	For a total of 27 indicators investigated across three healthcare domains: resident care, support for healthcare staff, and support for administration activities.		NA	NA	NA	NA	NA	NA	NA	NA
2020	Powell et al., 2020	USA	Degree of digitalization			NA	NA	NA	NA	Quality	6 Quality conditions drawn from NH Compare	Prevalence	Regression
2021	Alexander et al., 2021	USA	Degree of digitalization			NA	NA	NA	NA	Lack of Quality	4 types of healthcare deficiencies drawn from NH Compare and categorized in 3 classes: isolated, typical and widespread	Severity Score	Weighted Correlation and Regression
2017	Alexander et al., 2017	USA	Degree of digitalization			NA	NA	NA	NA	NA	NA	NA	NA
2016	Alexander et al., 2016	USA	Degree of digitalization			NA	NA	NA	NA	Quality	18 Quality conditions drawn from NH Compare, 13 for long-stay residents, 5 for short-stay residents	Prevalence	Correlation (Spearman)
2009	Alexander & Madsen, 2009	USA	Degree of digitalization			NA	NA	NA	NA	Quality	7 Quality conditions drawn from NH Compare	Prevalence	Correlation (Spearman)
2010	Rantz et al., 2010	USA	NA	NA	NA	Economic Sustainability	Total costs and staff costs drawn from the Medicaid platform and facility reports	Total daily cost per resident, daily staff cost per resident	NA	Quality	25 Quality conditions drawn from internal case study data	Prevalence	NA

TABLE 2

Results from the articles included in the descriptive-qualitative analysis. *Source:* Authors' elaborations (2024). Table Legend; NA = not available.

Year	Authors	Country	Technology Measurement			Sustainability Measurement			Measurement of Technology-Sustainability link	Performance Measurement			Measurement of the Technology-Performance link
			Variable	Indicators	Measurement tools	Variable	Indicators	Measurement tools		Variable	Indicators	Measurement tools	
2023	Campion et al., 2023	USA	Degree of digitalization	Type of technology	Presence/Absence	NA	NA	NA	NA	Quality	Hospitalization rate within 60 days of admission	Prevalence	Correlation
2023	Bradley et al., 2023	UK	NA	NA	NA	NA	NA	NA	NA	Wellbeing	Frameworks drawn from the literature	Direct observation and interviews	NA
2020	Ko & Chouu, 2020	Taiwan	NA	NA	NA	NA	NA	NA	NA	Quality	23 conditions articulated in 5 dimensions	SERVQUAL questionnaire	NA
2018	Kranz et al., 2018	USA	Degree of digitalization	6 e-health usage conditions	Presence/Absence	NA	NA	NA	NA	Quality	3 chronicity conditions	Presence/Absence	Logistic and Linear Regressions
2018	Dulal, 2018	USA	NA	NA	NA	NA	NA	NA	NA	Multidimensional Quality	16 quality indicators	Health inspections, staff evaluation	NA
2016	Jiang et al., 2016	Australia	NA	NA	NA	NA	NA	NA	NA	Quality	National accreditation standards	Presence/Absence	NA
2012	Pillemer et al., 2012	USA	NA	NA	NA	NA	NA	NA	NA	Quality	Patient satisfaction in relationship with facility and staff satisfaction	Direct observation and interviews	NA
2014	De Felice & Petrillo, 2014	Italy	NA	NA	NA	Economic Sustainability	12 indicators	Prevalence	NA	NA	NA	NA	NA

TABLE 2 (continued)

Results from the articles included in the descriptive-qualitative analysis. *Source:* Authors' elaborations (2024). Table Legend; NA = not available.

Year	Authors	Country	Technology Measurement			Sustainability Measurement			Measurement of Technology-Sustainability link	Performance Measurement			Measurement of the Technology-Performance link
			Variable	Indicators	Measurement tools	Variable	Indicators	Measurement tools		Variable	Indicators	Measurement tools	
2023	Xavier Macedo de Azevedo	Germany	Ergonomics of digital technologies	6 dimensions: acceptance, safety, workload optimization, controllability, adaptability, perceptibility	Patients' surveys: 7-point Likert scale	NA	NA	NA	NA	NA	NA	NA	NA
2019	Vest et al., 2019	USA	Effective adoption of EHR in NHs	4 conditions: send, receive, integrate, retrieve data	Interviews: presence/absence	NA	NA	NA	NA	NA	NA	NA	NA
2018	Zarowitz et al., 2018	USA	Degree of digitalization	11 indicators	Prevalence	Organizational Sustainability	31 indicators of an inadequate workforce	Prevalence	NA	NA	NA	NA	NA
2007	Lewis, 2007	USA	NA	NA	NA	NA	NA	NA	NA	Quality	3 Domains: health (8), mental health (3), social well-being (2)	Interviews and direct observation	NA

TABLE 2 (continued)

Results from the articles included in the descriptive-qualitative analysis. *Source:* Authors' elaborations (2024). Table Legend; NA = not available.

4. CONCLUSIONS

The impact of DHTs on LTC organizations remains insufficiently explored. NH management tends to place limited emphasis on digitalization (Furnari et al., 2024), given the information gap regarding the effects of DHTs on LTC services. Although public institutions have encouraged the adoption of DHTs in healthcare and LTC settings (WHO, 2024), the absence of consolidated systems to measure their impact on sustainability and organizational performance increases the risk of ineffective investments (Molinari-Ulate et al., 2023).

This study addresses that gap—and answers the research question— by conducting a systematic literature review and qualitative-conceptual analysis of twenty articles, which led to the identification of two key variables:

- Degree of digitalization (independent variable)
- Quality of care (dependent variable)

Sustainability, in both economic and organizational dimensions, emerges as a further dependent variable, though it has received limited attention in the reference literature. Notably, none of the articles reviewed were affiliated with economic sciences, despite the pressing financial constraints (OECD, 2023b) and workforce shortages (OECD, 2020) affecting the LTC sector. These challenges underscore the interdependence between sustainability and quality in LTC service provision (WHO, 2022).

Quality of care remains the primary outcome in NHs (NASEM, 2022), while the use of control variables highlights the complexity of evaluating digitalization and the potential influence of additional contextual factors (Van der Roest et al., 2017). The body of research developed at the University of Missouri has provided a foundational model for understanding how variations in digital maturity affect care quality, supported by longitudinal, open-access U.S. datasets, that have been a critical factor in assessing how variations in the degree of digitalization influence the quality of care.

Building on these contributions, this study proposes a theoretical framework to assess the impact of digitalization grounded in digital health adoption models (Lettieri & Masella, 2009; Gagnon et al., 2012; Ammenwerth, 2019) and performance management systems (Ferreira & Otley, 2009). As illustrated in Figure 6, the framework divides the measurement process into three phases:

- Phase 1: identification and measurement of control variables;
- Phase 2: assessment of the degree of digitalization;
- Phase 3: evaluation of quality of care and sustainability.

Once the data are collected, the impact of digitalization on performance and sustainability can be determined by using statistical techniques such as correlation and regression analyses. The proposed list of indicators is illustrative rather than exhaustive, as it primarily reflects the U.S. experience in delivering LTC services. A comprehensive series of longitudinal data on quality of care and active collaboration with NHs administrators are two additional key elements to ensure the effectiveness of the measurement model.

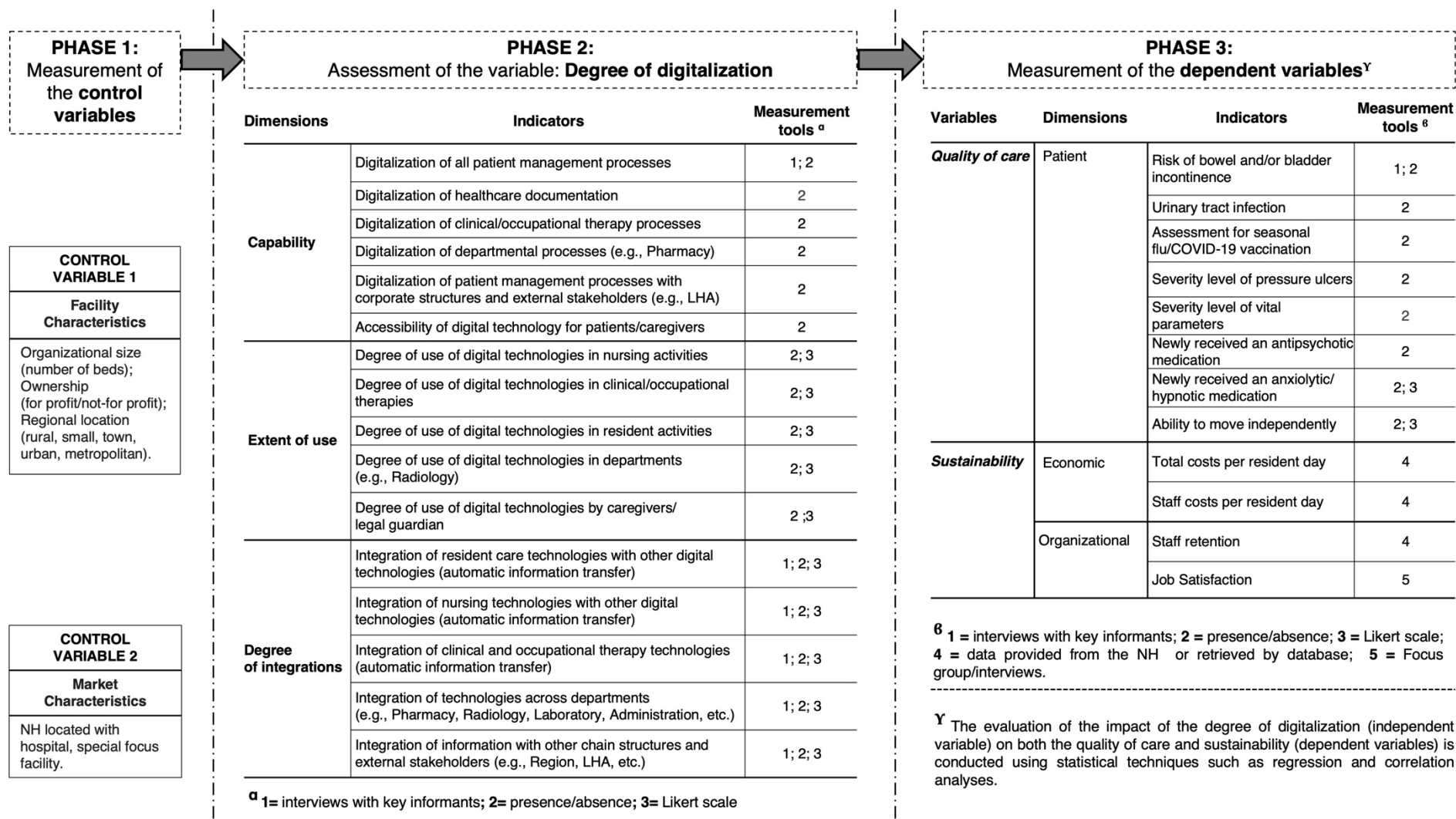


FIGURE 6: Set of Variables, Indicators, and corresponding Measurement tools. *Source:* Authors' elaboration (2025).

This study differs from previous research. The impact of digitalization is evaluated through two key variables: quality of care and sustainability, providing a structured set of dimensions, indicators, and measurement tools. It incorporates multi-stakeholder perspectives, including workforce-related indicators such as staff satisfaction and retention (OECD, 2020) offering a systemic view of digitalization's impact. Moreover, the measurement of digitalization is based on the overall digital capacity of an NH, and not on the adoption of a single DHT.

The resulting framework provides valuable insights into the impact of digital technologies in NHs to guide strategic decisions by administrators and policymakers, enabling data-driven decision-making for both investment strategies and healthcare planning particularly in view of the demographic shift and the increasing reliance on digital care solutions (OECD, 2023a; WHO, 2022). The study underscores a critical priority for policymakers: the establishment of national, open-access, longitudinal databases that systematically track care quality in LTC organizations.

4.1 Implications for Theory, Practice, and Editorial Debate

Theoretically, this study contributes to the emerging literature on performance measurement in LTC by proposing a replicable framework that connects digitalization, quality of care, and sustainability—three interrelated variables that have rarely been examined together.

Practically, in addition to supporting more effective investment decisions and encouraging the development of national, open-access databases, the framework promotes standardized evaluation of digital technologies (Pearson et al., 2023). This, in turn, contributes to the desired alignment between organizational-level investment choices and central policy priorities (Pita-Barros et al., 2019). As a result, managerial decisions may become more consistent with national reimbursement schemes, facilitating a faster and more cost-effective implementation of DHTs (Pearson et al., 2023).

This article also aims to expand the scholarly conversation on Health Care Management—specifically in the field of LTC—within the editorial scope of the *International Journal of Business Research and Management*. Although Health Care Management remains an underrepresented area in the journal's current agenda (Cristofaro et al., 2021), several contributions within the Technology and Innovation Management stream align with the objectives of this study. Notable examples include research on IT process implementation (Sarosa, 2012), the impact of IT investments on organizational performance (Durst & Ståhle, 2013), and critical success factors in IT implementation (Suárez-Barraza, 2010), which could inform the development of indicators and measurement tools aimed at assessing the degree of digitalization in LTC services.

4.2 Limitations and Future Research

Limitations of this study stem from its reliance on a single database (Scopus.com) and the use of qualitative research methods, which involve researchers' interpretation and therefore potential cognitive biases (Owens, 2021). The proposed model requires validation through case studies conducted in collaboration with NH administrators. Moreover, empirical evidence will provide valuable insights into additional variables that may help to isolate the impact of digitalization within LTC organizations. Further research and empirical studies are crucial to examining the effects of digitalization on sustainability. The existing literature remains limited and lacks a standardized framework having its own indicators and measurement tools for assessing its economic and organizational dimensions. Future literature reviews may identify publications from mid-2024, particularly in the field of economic sciences, that evaluate the impact of digitalization on sustainability through empirical case studies. This approach will enable the measurement of sustainability by means of a validated set of indicators and assessment tools,

thereby supporting an informed decision-making process for both nursing home administrators and policymakers.

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