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Digital Transformation: Digital Literacy in Healthcare

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Abstract

This investigation explores the critical role of leadership and digital literacy as integrated factors driving digital transformation (DT) within healthcare organizations. Recognizing a conceptual gap in models that articulate the interplay between organizational drivers and individual capabilities, we propose the 'Digital Literacy Box framework. This model maps the necessary foundational pillars (Leadership, Capability, Engagement, and Literacy) and operational competencies required to optimize health services and patient outcomes. Utilizing a focus group of five experienced healthcare professionals, the investigation employed qualitative content analysis to examine the perceived relevance and interconnections of these constructs. Findings offer conceptual support for the proposed framework, emphasizing that leadership is crucial for initiating DT, while digital literacy acts as a mediating factor that links organizational capacity to successful innovation and enhanced performance. The investigation contributes theoretical insights by proposing an integrated model and offers practical recommendations for the strategic management of DT, highlighting the need for targeted investment in both leadership and staff digital competencies.

Keywords: healthcare; digital intensity; digital transformation; digital literacy.

1. INTRODUCTION

In an era of rapid technological evolution, the healthcare sector is undergoing a profound Digital Transformation (DT). While DT promises significant advancements in operational efficiency and patient outcomes, its successful implementation is often hindered by challenges rooted in organizational and human factors, rather than technology acquisition alone. Simultaneously, however, lie opportunities waiting to be seized: the potential for enhanced patient engagement, streamlined processes, and the delivery of more personalized and efficient care (Albrecht et al., 2020). The convergence of technology adoption and digital intensity in the healthcare context unveils a tapestry of challenges and prospects, providing a rich foundation for valuable insights (Alami et al., 2019; Lubasch et al., 2021). From interoperability hurdles to data security concerns, the healthcare sector confronts a spectrum of obstacles that demand a thoughtful and comprehensive approach.

While the digital age ushers in a new era of targeted campaigns, data-driven insights, and virtual experiences, the essence of traditional practices remains integral. Striking the right balance between these two paradigms emerges as a critical factor in the success of healthcare organizations navigating this transformative journey(van Tonder et al., 2020). The ongoing evolution within the healthcare sector is emblematic of a broader societal shift toward a more interconnected, technologically driven world. Professionals must not only adapt to the new tools and platforms but also cultivate a deep understanding of the implications and opportunities these technologies bring(Fitzpatrick, 2023; Kajuna et al., 2023; Trier et al., 2023). It enables people to actively participate in digital transformation by contributing ideas, feedback, and insights on how to improve digital processes, products, and services. Against the backdrop of a rapidly changing healthcare landscape, the imperative for digital literacy becomes not merely a technological requirement but a strategic cornerstone (Lubasch et al., 2021; Maureen et al., 2020). Existing literature extensively covers technological adoption

but presents a conceptual gap regarding an integrated model that clearly articulates how leadership's strategic vision must align with organizational capabilities and the digital literacy of its staff to achieve sustained transformation.

Digital literacy refers to the ability to use, understand, and evaluate information in various digital forms. This includes skills such as navigating the internet, understanding online security, discerning the reliability of digital sources, and effectively using digital tools. Digital literacy also includes the ability to effectively use various digital tools and platforms. Individuals with these skills are better able to explore and take advantage of the functionalities offered by digital technologies, which can increase their online engagement contributing to playing an important role in digital transformation empowering people to adopt, use, and adapt to technological changes effectively.

Individuals with high digital literacy are more likely to collaborate on digital transformation projects, share knowledge, and work as a team to achieve digital goals. This includes troubleshooting technical issues, understanding error messages, safeguarding against cybersecurity threats, and taking corrective actions when technological problems arise. The more skilled people are at solving digital problems, the smoother the digital transformation process will be (Albrecht et al., 2020; Irimiás & Mitev, 2020).

Digital literacy empowers people to actively participate in the digital world in a constructive, informed, and safe manner. The more people understand and effectively use digital tools, the more engaged they tend to be online, contributing to a more vibrant and informed digital community(Fitzpatrick, 2023; Kajuna et al., 2023). Digital literacy empowers individuals to adopt and effectively use digital technologies. This includes understanding how to use applications, navigate the internet, communicate online, and utilize digital tools to perform personal and professional tasks.

On the other hand, digital engagement refers to people's active interaction and participation on digital platforms, such as social media, online forums, blogs, among others. People with good digital literacy are more likely to engage in debates and discussions online meaningfully and constructively. They can contribute well-founded arguments and reliable sources, thus enriching the digital dialogue(Albrecht et al., 2020) (Kajuna et al., 2023). Individuals with high digital literacy tend to feel more comfortable and confident when using and applying new technologies. This can lead them to participate more actively in online communities, contributing comments, posts, shares, and other forms of interaction.

As healthcare organizations strive to seamlessly integrate systems and embark on ambitious digital initiatives, a critical need emerges for a balanced approach to strategies The journey towards a digitally driven healthcare ecosystem needs to weave together the threads of tradition and innovation, empowering healthcare entities to navigate the intricate path towards a future shaped by the synergies of time-honored practices and avant-garde advancements (Schwarzmuller et al., 2018; Trier et al., 2023). As organizations grapple with the complexities of digitization, the call for a balanced and adaptive marketing approach echoes louder than ever. The goal is not just to understand the challenges posed by the digital revolution but to harness its potential for creating a healthcare landscape that is both future-proof and patient-centric.

By scrutinizing the evolving dynamics of technology adoption and digital intensity in the healthcare context, this article aspires to furnish professionals with actionable insights (Lubasch et al., 2021). By providing insights into the delicate balance required between traditional and innovative marketing methodologies, there's a compass for professionals seeking not just to survive but to thrive in this era of digital transformation (Albrecht et al., 2020; Irimiás & Mitev, 2020; Le-Dao et al., 2020; Pantielieieva et al., 2019; Tronvoll et al., 2020). Through a comprehensive examination of the intricate relationship between technology, marketing, and healthcare, our shared goal is to assist in steering organizations towards a future where the best of tradition seamlessly integrates with the promise of progress, ultimately enhancing the quality and accessibility of healthcare services (Ghosh et al., 2022).

This article addresses the research gap by proposing the 'Digital Literacy Box' framework. This model conceptualizes the essential foundational pillars and operational competencies required to manage the complexity of DT in healthcare. The central objective of this investigation is to qualitatively examine the perceptions of experienced healthcare professionals regarding the relevance and interconnections of these constructs, offering conceptual validation for the proposed framework. Using a focus group of five healthcare professionals, this investigation qualitatively examines the perceptions of these key terms and their relational importance. The findings offer a conceptual validation of the proposed framework, highlighting the need for visionary leadership and targeted development of digital literacy to navigate healthcare's digital challenges.

The paper is structured as follows: Section 2 reviews the literature and develops the conceptual framework; Section 3 presents the methodology; Section 4 details the findings; Section 5 discusses the results and their implications; and Section 6 provides conclusions, limitations, and practical recommendations.

2. LITERATURE REVIEW

The successful integration of technology in healthcare is not merely a matter of infrastructure but is deeply rooted in the synergy between organizational strategy and human proficiency. To understand this synergy, it is essential to examine the core dimensions of digital literacy and its role as a driver of transformation. Digital Transformation (DT) is an organizational phenomenon that requires a clear understanding of successful factors extending beyond mere technology acquisition. This section reviews the context of DT in healthcare, the indispensable role of leadership, and the crucial enabling factor of digital literacy (Geada et al., 2025).

2.1 Digital Transformation (DT) in the Healthcare Sector

Digital Transformation (DT) is defined as the process of utilizing digital technologies to create new business processes, culture, and customer (or patient) experiences, thereby responding to new market demands and optimizing operational efficiency (Hess et al., 2016).

In the healthcare context, DT is a strategic imperative driven by the need to improve diagnostics, personalize treatments, and increase service efficiency, all while facing an aging population and mounting pressure on resources (Fitzgerald et al., 2014). The scope of DT in healthcare is vast, encompassing everything from telemedicine and Artificial Intelligence (AI) in data analytics to the electronic management of patient health records. However, implementing this agenda faces significant challenges. These often include **organizational inertia**, cultural resistance from professionals to new workflows, the complex management of **legacy systems**, and the urgent necessity of ensuring data security and privacy (Li et al., 2020). Ultimately, the success of DT is determined less by the technology itself and more by the organization's capacity to adapt and mobilize its human capital.

2.2. The Critical Role of Leadership in Digital Change

Literature unanimously identifies Leadership as the most critical factor in steering any complex organizational transformation. In DT, leadership is responsible for translating the technological vision into an actionable strategy and managing the cultural change inherent in the process (Schwarzmuller et al., 2018). Effective leaders in the digital era must possess a strategic vision to allocate resources (financial and personnel) and create an environment that supports experimentation and innovation. Their primary function is to mitigate resistance and uncertainty by communicating the value of DT and empowering staff to participate actively in the process (Trier et al., 2023). Change management studies suggest that a transformational and inspirational leadership style is best suited for this task, as it fosters team motivation and trust, breaking down barriers across departments and hierarchies. Leadership thus acts as the primary engine of DT, establishing the necessary conditions for technological innovation to take hold.

2.3. Digital Literacy, Capability, and Innovation

Digital Literacy:

Digital literacy encompasses the ability to critically evaluate, create, and communicate information in digital formats. It involves understanding digital media, analyzing online content for credibility, and employing digital tools for problem-solving and decision-making. Digital literacy equips individuals with the skills needed to navigate the digital landscape responsibly and ethically.

Specifically digital literacy in healthcare plays a key role in digital healthcare, influencing it in four areas:

- **Digital Tools:** People with high digital literacy have a deeper and more effective understanding of the digital tools available. This facilitates active participation in online platforms, from browsing websites to using applications and services.

- **Critical Discernment:** Digital literacy also involves the ability to critically evaluate online information. Individuals with high digital literacy are more likely to distinguish between reliable and unreliable sources, identify fake news and better understand the ethical implications of sharing information online.

- **Participation in Digital Communities:** Digital literacy contributes to more meaningful participation in online communities. People who understand the norms of online behaviors, respect digital privacy and understand how to build positive virtual relationships are more likely to engage constructively in social networks and forums.

- **Digital Identity Management:** Digital literacy also includes the ability to manage one's digital identity, which involves creating and maintaining online profiles. Individuals with skills in this area can build an authentic and attractive online presence, contributing to greater digital engagement.

Digital Literacy (DL) is widely recognized as the foundation for individual and organizational success in DT. DL transcends the simple ability to use a computer, encompassing a multidimensional set of competencies that includes technical (knowing how to use tools), cognitive (knowing how to critically evaluate information), and ethical (knowing how to interact responsibly in digital environments) dimensions (Eshet-Alkalai, 2004).

In the healthcare sector, high DL is a prerequisite for the organizational capability to adopt and integrate new technologies. Employees with higher digital literacy demonstrate greater confidence and engagement with digital tools, resulting in better assimilation of technology into daily work processes (Pantielieieva et al., 2019). This competency is particularly vital for process innovation, as it enables professionals to identify, evaluate, and contribute new ideas to optimize digital workflows and improve care delivery (Valenzuela et al., 2022). In essence, digital literacy translates the organization's technological potential into real value. So, and according to literature research, healthcare and digital literacy play a vital role in promoting better health outcomes for individuals and communities(Fitzpatrick, 2023).

Here's how these items can be functional to each of the constructs:

Leadership:

- Digital Tools: Digital leadership involves leading by example in the adoption and effective use of digital tools. Skilled digital leaders can empower their teams to make the most of available tools to enhance healthcare services(Schwarzmuller et al., 2018).
- Critical Discernment: Leaders in digital health must possess critical discernment skills to evaluate and promote accurate and reliable information, ensuring their teams are well-informed to make informed decisions.
- Participation in Digital Communities: Leaders must actively engage in digital health communities to stay updated with the latest trends and practices. This includes constructive interactions in forums, social networks, and other relevant platforms.
- Digital Identity Management: Strong leadership also involves effectively managing the organization's digital identity in healthcare, ensuring a consistent and authentic online presence that inspires trust in users(Schwarzmuller et al., 2018).

Digital Engagement:

- Digital Tools: Effectively utilizing digital tools can enhance user engagement on online healthcare platforms, facilitating interactive and personalized access to information and services.
- Critical Discernment: Solid digital engagement involves discerning between reliable and unreliable information, empowering users to make informed decisions about their health(Albrecht et al., 2020; Trier et al., 2023).
- Participation in Digital Communities: Engaging in digital healthcare communities allows users to share experiences, obtain support, and feel part of a support network, promoting deeper engagement with their health.

- Digital Identity Management: Effective management of digital identity can increase user trust in online healthcare services, resulting in higher engagement and utilization of available resources.

Digital engagement focuses on actively involving individuals in digital platforms and technologies. It emphasizes the importance of interaction, collaboration, and participation in online spaces. By encouraging users to engage with digital content and communities, this pillar promotes active learning and knowledge sharing, thus contributing to digital literacy development.

Digital Capacity:

- Digital Tools: A strong digital capacity involves mastering the tools available to provide and access healthcare services online effectively and efficiently.
- Critical Discernment: Digital capacity also includes the ability to discern between reliable and unreliable information to make informed health decisions.
- Participation in Digital Communities: Digital capacity involves understanding the norms and practices of digital healthcare communities for meaningful and constructive participation.
- Digital Identity Management: Managing digital identity is a fundamental part of digital capacity, ensuring users can interact safely and effectively in online healthcare environments.

Digital capacity refers to the skills and competencies required to effectively navigate and utilize digital technologies. This includes proficiency in using various software applications, understanding digital security measures, and adapting to technological advancements. Developing digital capability empowers individuals to leverage technology for personal and professional growth.

Since digital literacy in healthcare encompasses a multidimensional set of competencies ranging from technical tool usage to ethical discernment, its cultivation requires more than just individual effort. **Consequently, the 'Digital Literacy Box' model posits that these individual competencies are inherently tied to strategic vision and organizational guidance**. Effective leadership acts as the catalyst by ensuring that resources are allocated appropriately, policies are developed to support continuous learning, and stakeholders are meaningfully engaged in the process. In this framework, leadership sets the essential tone for prioritizing digital literacy, transforming it from a personal skill into a strategic cornerstone of the organization and the wider community. By applying these four constructs to the Literacy Digital Box framework to provide healthcare services, it's possible to create a value chain that promotes more effective and meaningful use of digital technologies to improve access and quality of healthcare.

3. CONCEPTUAL FRAMEWORK DEVELOPMENT

The literature review delves into the concepts of digital transition and transformation, underlining the adoption of Cloud and ERP systems as pivotal components. It also emphasizes the role of digital literacy in engaging broader communities in disease control efforts. This sets the stage for understanding the critical interplay between digital literacy and the overarching strategies for digital transition and transformation in healthcare.

In parallel, the subsequent discussion expounds upon digital literacy in the healthcare context. It elucidates how digital literacy influences healthcare in multifaceted ways, ranging from proficient use of digital tools to discerning the reliability of online information, fostering meaningful participation in digital communities, and managing digital identities. Digital transformation, as they spotlight the indispensable nature of digital literacy in steering effective digital engagement, capability building, and leadership within the healthcare landscape. Therefore, the exploration of digital literacy's significance in healthcare serves as a natural extension of the discourse on digital transition and transformation strategies, elucidating the nuanced ways in which digital literacy underpins and enhances the efficacy of digital initiatives in the healthcare sector.

So based literature, it is suggested a framework, *Literacy Digital Box* (Figure 1) that is the engine for the constructs: leadership, digital engagement, digital capacity, and digital literacy, to provide quality healthcare services. The 'Digital Literacy Box framework is proposed as a conceptual model illustrating how foundational organizational and individual pillars are transformed into operational competencies that ultimately drive Digital Transformation (DT) outcomes. The model aims to integrate critical success factors from literature into a cohesive, functional structure.

Each of these pillars contributes to the formation of the Digital Literacy Box, which further consists of digital tools, critical discernment, participation in digital communities, and digital identity management. These components collectively lead to the generation of outputs such as improved healthcare services, enriched resources, and better outcomes.

3.1. Foundational Pillars (Inputs and Drivers)

To clarify the distinction between organizational and individual roles, the framework distinguishes **Leadership** as the primary strategic driver, while **Digital Literacy, Capacity, and Engagement** represent collective and individual capacities. In this model, Leadership is not a standalone pillar but the prerequisite that sets the conditions for the other three pillars to thrive. It is the responsibility of Leadership to provide the vision and resources (Inputs), which then empower the staff (individual level) to activate their digital competencies.
These pillars represent the strategic and inherent capabilities required to initiate and sustain DT. They function as the **inputs** into the framework's operational mechanisms:

1. **Leadership:** Identified as the primary driver, Leadership is responsible for providing strategic vision and allocating Resources (financial, technical, and human) required for digital initiatives. Effective digital leadership sets the tone for prioritizing digital literacy and developing supportive policies.
2. **Digital Literacy (DL):** The foundational individual skill set, encompassing technical, cognitive, and ethical dimensions.
3. **Digital Engagement:** The active involvement of individuals in digital platforms, emphasizing interaction, collaboration, and participation.
4. **Digital Capacity:** The organizational or collective skills and proficiency required to effectively navigate and utilize digital technologies for specific tasks.

3.2. The Digital Literacy Box (Operational Components/Mechanisms)

The components within the 'Digital Literacy Box' Digital Tools, Critical Discernment, Participation in Digital Communities, and Digital Identity Management are not merely a list of tools, but rather the Operational Mechanisms that translate foundational pillars into action. They are conceptually linked as a 'literacy suite': *Tools* provide the medium, *Discernment* ensures the quality of information, *Community Participation* enables collaborative innovation, and *Identity Management* ensures security and professional trust. Together, they form the functional bridge between organizational strategy and practical execution.
The *Digital Literacy Box* is the functional core of the framework. It translates the inputs from the foundational pillars into four measurable operational competencies the specific actions and processes that define successful digital application:

Operational Component	Function and Conceptual Link
Digital Tools	Access to and proficiency in using digital tools to perform tasks efficiently (e.g., specialized applications, productivity software).
Critical Discernment	The ability to evaluate online information critically, ensuring informed decisions about health-related information and mitigating misinformation.
Participation in Digital Communities	Engaging with online networks (professional forums, patient groups) to facilitate knowledge sharing, collaboration, and peer support.

Operational Component	Function and Conceptual Link
Digital Identity Management	Managing one's online presence, privacy settings, and sensitive information securely, which is paramount in healthcare contexts.

TABLE I. OPERATIONAL COMPONENTS

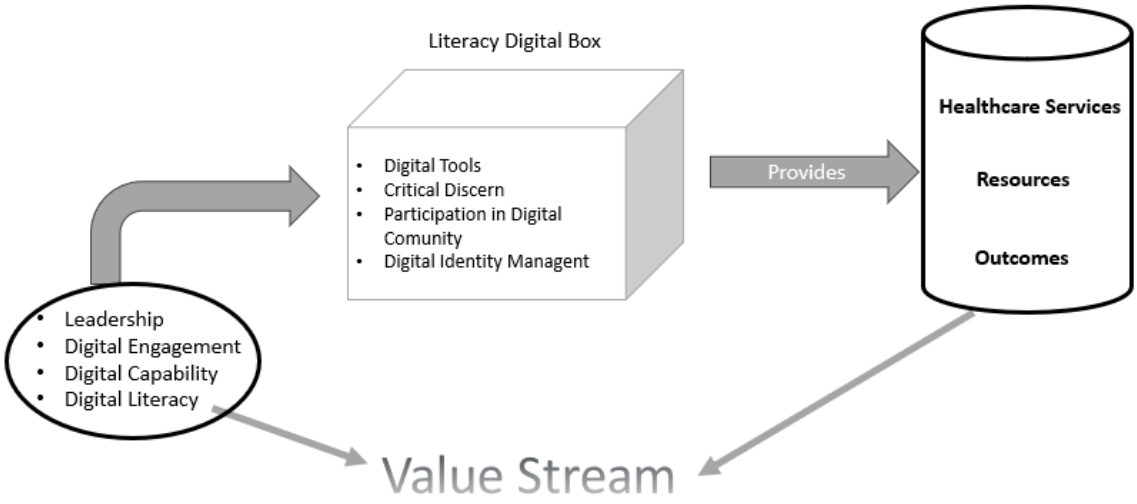


Figure 1. Literacy Digital Box Framework (Own elaboration)

3.3. Outcomes (Outputs)

Regarding the outcomes of the framework, the term 'Resources' has been refined to **Optimized Resource Utilization**. This clarifies that resources (human, financial, and environmental) are not the output itself, but rather that their *efficient management* is a direct result of successful Digital Transformation. Through streamlined digital workflows and increased staff literacy, the organization achieves a higher ROI and better allocation of its existing assets, transforming 'resource consumption' into 'resource optimization'.
Successful application of the operational components within the *Digital Literacy Box* leads directly to three measurable outputs, reflecting value generation and organizational improvement:

- **Improved Healthcare Services:** Enhanced service delivery through telemedicine, online consultations, and digital health platforms.
- **Better Clinical Outcomes:** Empowerment of patients to actively participate in their care and make informed decisions, leading to superior health results.
- **Optimized Resource Utilization:** Enhanced efficiency in managing existing resources (personnel, finances, technology) due to streamlined digital workflows.

Digital Literacy Box model provides a comprehensive framework for advancing digital literacy and capabilities, with specific relevance to improving health literacy and outcomes in the context of digital communications in healthcare. By addressing the foundational pillars and components outlined in the model, stakeholders can harness the power of digital technologies to enhance healthcare delivery, resource accessibility, and patient engagement (Fitzpatrick, 2023; Nuno-Solinis et al., 2022). The significance of the Digital Literacy Box model in improving health literacy and outcomes within the scope of digital communications in healthcare. This model serves as a comprehensive framework that addresses foundational pillars such as leadership, digital engagement, capability, and literacy, which are crucial for enhancing healthcare delivery and patient engagement through digital technologies.

To further explore the application of the Digital Literacy Box model in healthcare, a focus group involving five healthcare professionals from diverse fields was convened. The session, conducted via videoconference, allowed for an open and informal exchange of insights and perspectives on the impact of digital transformation on healthcare organizations' performance. The use of Zoom collaboration platform facilitated seamless communication and interaction among participants, ensuring that all viewpoints were captured effectively. The participants shared their experiences and perceptions, which were transcribed for qualitative examination. By delving into the participants' perspectives, the focus group aimed to elucidate how the principles of the Digital Literacy Box model could be applied to address challenges and leverage opportunities in healthcare delivery, resource accessibility, and patient engagement in the digital age(Fitzpatrick, 2023; Nuno-Solinis et al., 2022).

Mainly, the focus group session served as a practical application of the concepts discussed, demonstrating how stakeholders within the healthcare industry can utilize the Digital Literacy Box model to navigate digital transformations and improve overall performance and outcomes(Fitzpatrick, 2023; Nuno-Solinis et al., 2022). The session underscored the importance of digital literacy and capabilities in shaping the future of healthcare delivery and highlighted the potential for leveraging digital technologies to enhance patient care and engagement.

4. METHODOLOGY

4.1. Research Design and Qualitative Rationale

This investigation adopted a qualitative approach through a focus group to explore the perceptions and experiences of healthcare professionals regarding Digital Transformation (DT) and the role of digital literacy. Given the **exploratory and qualitative nature** of the investigation, the focus group guide was designed not to test causal hypotheses, but rather to **validate the perceived relevance** of the constructs proposed in the 'Digital Literacy Box' framework (Leadership, Digital Literacy, Engagement, Capability, etc.). The primary goal was to stimulate dialogue and gain a deeper understanding of the interconnections between these elements within the practical healthcare context.

4.1.1. Rationale for Question Format and Acknowledgment of Bias

The format and phrasing of the questions served a specific purpose:

1. **Exploratory and Inductive Nature:** The phrasing of the open-ended questions (e.g., "Do you consider...") was deliberately chosen to elicit a reflective discussion on relationships frequently considered crucial in the literature (such as leadership being a driver of change). Questions like Q2, Q3, and Q4 aimed to confirm whether participants, based on their practical experience, attributed the same importance to these constructs as suggested by theory, serving as a preliminary step in validating the practical relevance of our framework.
2. **Methodological Bias (Limitation):** It is recognized that the formulation of these questions might be perceived as leading, potentially introducing a bias. However, for the aims of this investigation—which is conceptual validation, not causal proof—this format was deemed appropriate for obtaining rich qualitative insights, allowing participants to define the form and type of the relationship (as reflected in Q6 and Q7) rather than merely confirming its existence.
3. **Terminology Contextualization:**
    - **Literacy of Digital Transformation vs. Digital Literacy (Q1):** This specific phrasing sought to contextualize Digital Literacy within the broader organizational process, referring to the literacy required to **act within** the transformation process.
    - **Mediation (Q5):** The term 'mediation' was used in a metaphorical and qualitative sense to explore the perceived 'bridging' or interconnection function of a concept, while acknowledging its primary statistical nature.

4.2. Participants and Procedures

- The focus group involved five healthcare professionals from diverse fields, providing a broad and diversified view on the topic:
- **Group Composition:**

- Assistant Graduated Doctor (Neurologist).
- Nurse, specialist in rehabilitation healthcare.
- Podologist, specialized in nail pathology, diabetic foot, and sports Podology.
- Superior technician in Diagnosis and Therapy - Neurophysiologist.
- Member of the hospital administration board.

	N =5	%
Level of Self-Declared Knowledge about Digital Literacy		
Very High	1	20,00%
High	1	20,00%
Intermediate	3	60,00%
Low	--	--
Very Low	--	--
Gender		
Men	2	40,00%
Woman	3	60,00%
Age (range)		
20-40	1	20,00%
40–64	4	80,00%

TABLE II. DESCRIPTIVE STATISTICS OF THE DIGITAL LITERACY FOCUS GROUP RESPONDENTS

Table II provides the descriptive statistics of the five focus group participants. The composition was intentionally diversified in terms of roles (ranging from clinical staff to hospital administration) to ensure a comprehensive, multi-perspective view on Digital Transformation challenges. Notably, most respondents were in the 40–64 age range and over half self-rated their digital literacy knowledge as 'Intermediate' or higher. This high self-assessed digital literacy is critical, as it confirms the participants' foundational familiarity with the concepts and terminology central to the 'Digital Literacy Box' framework, thus validating their suitability for contributing qualitative insights to this exploratory investigation.

4.2.1. Familiarity with Concepts

Participants were selected based on their experience and active involvement in the field of DT in healthcare. Most self-rated their digital literacy knowledge as 'Intermediate' or higher, indicating prior familiarity with the core terminology of the investigation. The moderator introduced and contextualized definitions as needed during the session, ensuring the discussion remained focused on the central concepts of the paper.

4.2.2. Data Collection and Analysis

The session lasted 1 hour and 30 minutes and was held in a relaxed, informal setting via videoconference (Zoom) to facilitate interaction and participant comfort. The discussion was recorded (audio and video) and subsequently transcribed for qualitative examination. Analysis of the transcribed data was performed using content analysis, utilizing the MAXQDA and QDA Miner Lite software to discern thematic categories and recurring motifs in participants' discourse. This approach allowed us to identify the frequency of construct mentions (as detailed in the Results section, Table I) and to gain a nuanced understanding of how digital advancements are reshaping the landscape of healthcare delivery.

Each of the participants brought to the discussion their experience and knowledge in the health area, allowing a broader and more diversified view on the theme in question. The methodology used to conduct the focus group was based on a pre-established script with eleven suggested open-ended questions as follows.

Questions Discussed in the Focus Group	
1	Do you consider that **literacy** of digital transformation depend on leadership and the change proces
2	Do you consider that **literacy** has a direct impact on technological innovation?
3	Do you think there is a positive relationship between **digital capability** and performance?
4	Do you consider that **leadership** is a critical factor in leveraging digital transformation?
5	Are you of the opinion that **Literacy** will mediate the relationship between organizational leadership capabilities, Digital Identity Management that benefits healthcare organizations?
6	Do you think there is a positive relationship between digital transformation and innovation?
7	How important is **digital literacy** in the strategy of healthcare organizations?
9	How can **digital transformation** increase diagnostic and surgical capacity?
10	How can digital transformation influence the **engagement** of healthcare organizations?
11	How can **leadership** in the organizational context play an inspiring role in digital transformation?

TABLE III. INVESTIGATION QUESTIONS -QUESTIONS DISCUSSED IN THE FOCUS GROUP

5. DISCUSSION

The qualitative findings from the focus group provide rich insights into the organizational dynamics and human factors influencing Digital Transformation (DT) in healthcare. The discussion is structured to interpret these findings in the context of theoretical literature. Crucially, the thematic analysis of the participants' contributions provides empirical evidence that supports the 'Digital Literacy Box' framework developed in Section 3.

6.1. Leadership and Digital Literacy

The analysis of responses to Question 1 ("Literacy of Digital Transformation... depends on leadership and the change process") strongly validates the theoretical premise that Leadership is a foundational pillar (*Input*) for successful DT. Participants consistently positioned leadership as the primary catalyst for Digital Literacy, responsible for providing strategic vision and planning and allocating resources to continuous learning. As one participant stated, *"Effective leadership is crucial because it sets the tone for how digital tools are embraced."* This aligns directly with the literature identifying transformational leadership as necessary for mitigating resistance and ensuring organizational resource alignment (Schwarzmuller et al., 2018). Furthermore, the emphasis on Change Management highlights that the success of the 'Digital Literacy Box' relies not just on the presence of the inputs, but on a structured process that supports the development of the *operational mechanisms*.

6.2. Digital Literacy and Foundational Relationship

The insights from Question 2 (Impact of Literacy on Technological Innovation) confirmed a strong, direct relationship between Digital Literacy (a foundational pillar) and innovation (a key component of the desired *Outcomes*). The finding that Digital Literacy is the core of innovation and a foundation for new technology adoption validates the need to place DL at the heart of the proposed framework. Literate staff are viewed as Empowered to contribute to continuous improvement, thus translating abstract technological potential into real-world efficiency gains. This aligns with the literature stating that DL enhances problem-solving capabilities and facilitates the smooth integration of complex technologies, crucial for achieving the framework's output of Optimized Healthcare Services.

6.3. Conceptual Support for the Digital Literacy Box Framework

The qualitative analysis directly validates the 'Digital Literacy Box' by mapping participant insights to the framework's components. For instance, participants' frequent mentions of 'cybersecurity awareness' and 'data privacy' provide empirical support for the **Digital Identity Management** mechanism. Similarly, the consensus on the 'need for clear strategic direction' validates **Leadership** as the primary Foundational Pillar. These findings move the framework from a theoretical proposition to a validated model, where each operational component is mirrored by the real-world challenges and priorities identified by healthcare professionals.

The qualitative findings from the content analysis do not merely list term frequencies but offer direct conceptual support for the structure and logical flow of the Digital Literacy Box framework.

6.3.1. Validating Inputs and Leadership-Driven Mechanisms

A key finding from the study is that mechanisms such as Digital Identity Management (DIM) function as a shared responsibility. While the reviewer correctly notes that Leadership must create a secure environment through governance and policy, the data suggests that this environment is only effective if staff possess the Digital Literacy to adhere to these protocols. Therefore, DIM is validated as an interplay where Leadership provides the 'secure architecture' (Input) and staff provide the 'responsible execution' (Capacity).

Participants perceptions validated Leadership (an Input pillar) as the key catalyst that allocates resources and establishes the need for specific operational components.

- **Critical Discernment:** The repeated need for leadership to foster a culture of informed decision-making and enhanced problem-solving supports the inclusion of Critical Discernment as a central operational component (mechanism) of the *Box*.
- **Digital Identity Management (D I M):** For instance, quotes concerning leadership's role in "creating a secure environment" and ensuring "Compliance and Security" directly support the inclusion of Digital Identity Management as one of the framework's leadership-driven mechanisms. These findings confirm that DIM is not just an inherent skill, but a competency established and maintained through organizational governance set by the Leadership input.

6.3.2. Confirming the Mediating Function of Digital Literacy

The analysis of Question 5 (Mediation) was crucial. Participants expressed a strong belief that Digital Literacy acts as a critical mediator in the relationship between Organizational Leadership Capabilities and Digital Identity Management. Participants consistently articulated that Literacy is the factor that translates strategic Leadership vision into tangible innovation and service outcomes, thereby validating the conceptual flow of our model. As noted by one participant, *"Digital literacy bridges the gap between leadership's vision and the practical implementation of digital identity management."* This suggests that Digital Literacy is the necessary internal mechanism that ensures Leadership's strategic efforts (Inputs) successfully drive the operational components (like DIM) to achieve the desired Outcomes (security, efficiency, and compliance).

6.4. DL's Impact on Strategic Outcomes (Outputs Validation)

The insights derived from Question 7 directly validated the three primary Outputs (Improved Services, Better Outcomes, Optimized Resource Utilization) of the 'Digital Literacy Box' framework. Enhanced Patient Care and Outcomes & Operational Efficiency: Participants highlighted that DL underpins the successful execution of strategic initiatives and leads directly to enhanced patient care and improved operational efficiency by streamlining processes and reducing errors. This confirms the link between the framework's operational effectiveness and its intended outputs. Staff Engagement and Decision-Making: The discussion on enhanced staff engagement and support for data-driven Strategic Decision-Making confirms that the framework's benefits extend beyond clinical care to crucial organizational functions, reinforcing its utility as a comprehensive strategic model.

The discussion indicates that digital literacy is of paramount importance in the strategic framework of healthcare organizations. It underpins successful strategic initiatives, enhances patient care, drives innovation, improves operational efficiency, supports strategic decision-making, boosts staff engagement, and ensures compliance and security(Albrecht et al., 2020; Bittner et al., 2020; Kajuna et al., 2023). The insights from the participants underscore the necessity of integrating digital literacy into the core strategy of healthcare organizations to achieve overall success and sustainability (Ayman et al., 2020).

6. CONCLUSIONS

This investigation utilized a qualitative focus group to provide conceptual support for the 'Digital Literacy Box' framework, investigating the interconnected roles of Leadership, Digital Literacy, Digital Engagement, and Digital Capability in healthcare organizations. The analysis confirmed the centrality of these human factors in driving successful Digital Transformation (DT). Digital Literacy emerged as the cornerstone for successful DT. Participants repeatedly emphasized that without a strong foundation in digital literacy, staff cannot effectively engage with or leverage new technologies, which is essential for operational efficiency, patient care, and innovation. Furthermore, the analysis conceptually validated the **mediating** function of digital literacy between Leadership's strategic vision and the practical implementation of operational components, such as Digital Identity Management. Leadership was identified as the critical factor in driving DT and fostering digital literacy, responsible for setting the vision, allocating necessary resources, and ensuring adequate training. The commitment to role modelling and continuous learning was viewed as vital for encouraging staff to embrace digital tools and innovations.

In summary, the findings confirm the conceptual relevance and logical flow of the 'Digital Literacy Box' framework: strong leadership (Input) provides the direction and resources necessary for staff to develop the requisite digital literacy, capability, and engagement (Pillars), which are then translated into specific operational competencies (Mechanisms) that ultimately lead to enhanced patient care and organizational performance (Outputs).

7. LIMITATIONS AND FUTURE RESEARCH

7.1. Limitations

The qualitative methodology of the focus group inherently presents limitations. While the design was intended to be exploratory and prompt in-depth debate, we explicitly acknowledge that the phrasing of some questions could be perceived as leading or biased. This potentially guided participants toward validating relationships already suggested by the framework. Although this approach was valuable for confirming the perceived relevance of the constructs in the clinical environment, it limits the generalizability of the findings across the broader healthcare sector and prevents their interpretation as definitive proof of causal relationships.

Further limitations include the small sample size and specific composition of the group, which may not fully represent the diverse perspectives of all healthcare organizations, and the temporal constraints inherent to the rapidly evolving nature of digital transformation.

7.2. Future Research

Building on these findings, future work must address the identified limitations by adopting broader, more quantitative, and longitudinal approaches:

- **Quantitative Studies:** To validate the findings and establish causal links, future research should employ statistical analyses, such as Structural Equation Modelling (SEM), to empirically test the dependency and mediation relationships suggested within the 'Digital Literacy Box' framework.
- **Longitudinal Studies:** A longitudinal approach would help track the long-term impact of interventions targeting digital literacy and leadership on operational efficiency and patient care.
- **Cross-Sector Analysis:** Comparative studies across different healthcare sectors (e.g., public vs. private) could provide a more nuanced understanding of how contextual factors influence the constructs studied.
- **Focus on Emerging Technologies:** Future research should explore the role of emerging technologies (e.g., AI, IoMT) in enhancing digital literacy and transforming healthcare practices.

8. Managerial Implications

The investigation's findings provide several actionable recommendations for healthcare executives steering their organizations through digital transformation:

- **Prioritize Digital Leadership Investment:** Leaders must be seen as active role models and commit strategically to continuous learning for their teams, ensuring adequate resources are allocated to digital skill development.
- **Digital Literacy as a Core Strategy:** Investment in digital literacy should be treated as fundamental to the organizational growth plan, recognizing it as the foundation for innovation, operational efficiency, and staff engagement.
- **Holistic Framework Application:** Organizations should use the 'Digital Literacy Box' model to identify gaps in the four foundational pillars and focus development efforts on strengthening the four associated operational competencies (e.g., Critical Discernment and Digital Identity Management) to achieve strategic and sustainable outcomes.

Abbreviations

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There is no known conflict of interest to disclose.

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REFERENCES

Alami, H., Gagnon, M., Ahmed, M., & Fortin, J. (2019). Digital health: Cybersecurity is a value creation lever, not only a source of expenditure. *HEALTH POLICY AND TECHNOLOGY*, *8*(4), 319–321. https://doi.org/10.1016/j.hlpt.2019.09.002

Albrecht, S. L., Connaughton, S., Foster, K., Furlong, S., & Yeow, C. J. L. (2020). Change Engagement, Change Resources, and Change Demands: A Model for Positive Employee Orientations to Organizational Change. *Frontiers in Psychology*, *11*. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.531944

Ayman, U., Kaya, A. K., & Kuruc, U. K. (2020). The Impact of Digital Communication and PR Models on the Sustainability of Higher Education during Crises (dagger). *Sustainability*, *12*(20), 8295. https://doi.org/10.3390/su12208295

Bittner, V., Szarek, M., Aylward, P., Bhatt, D., Diaz, R., Edelberg, J., Fras, Z., Goodman, S., Halvorsen, S., Hanotin, C., Harrington, R., Jukema, J., Loizeau, V., Moriarty, P., Moryusef, A., Pordy, R., Roe, M., Sinnaeve, P.,

Tsimikas, S., … ODYSSEY OUTCOMES Comm. (2020). Effect of Alirocumab on Lipoprotein(a) and Cardiovascular Risk After Acute Coronary Syndrome. *JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY*, *75*(2), 133–144. https://doi.org/10.1016/j.jacc.2019.10.057

Fitzpatrick, P. J. (2023). Improving health literacy using the power of digital communications to achieve better health outcomes for patients and practitioners. *FRONTIERS IN DIGITAL HEALTH*, *5*, 1264780. https://doi.org/10.3389/fdgth.2023.1264780

Geada, N., Alturas, B., & Anunciação, P. (2025). Investigating the interplay between organisational change and digital transformation healthcare. *International Journal of Healthcare Technology and Management*. https://www.inderscienceonline.com/doi/10.1504/IJHTM.2024.149025

Ghosh, K., Dohan, M., Veldandi, H., & Garfield, M. (2022). Digital Transformation in Healthcare: Insights on Value Creation. *JOURNAL OF COMPUTER INFORMATION SYSTEMS*. https://doi.org/10.1080/08874417.2022.2070798

Irimiás, A., & Mitev, A. (2020). Change Management, Digital Maturity, and Green Development: Are Successful Firms Leveraging on Sustainability? *Sustainability*, *12*(10), 4019. https://doi.org/10.3390/su12104019

Kajuna, F., Mwang'onde, B., Holst, C., Ngowi, B., Sukums, F., Noll, J., Winkler, A. S., & Ngowi, H. (2023). Effects of a Digital Health Literacy Intervention on Porcine Cysticercosis Prevalence and Associated Household Practices in Iringa District, Tanzania. *PATHOGENS*, *12*(1), 107. https://doi.org/10.3390/pathogens12010107

Le-Dao, H., Chauhan, A., Walpola, R., Fischer, S., Schwarz, G., Minbashian, A., Munro, A., D'Arcy, E., Allan, J., & Harrison, R. (2020). Managing Complex Healthcare Change: A Qualitative Exploration of Current Practice in New South Wales, Australia. *Journal of Healthcare Leadership*, *12*, 143–151. https://doi.org/10.2147/JHL.S274958

Lubasch, J., Voigt-Barbarowicz, M., Lippke, S., De Wilde, R., Griesinger, F., Lazovic, D., Villegas, P., Roeper, J., Salzmann, D., Seeber, G., Torres-de-la-Roche, L., Weyhe, D., Ansmann, L., & Brutt, A. (2021). Improving professional health literacy in hospitals: Study protocol of a participatory codesign and implementation study. *BMJ OPEN*, *11*(8). https://doi.org/10.1136/bmjopen-2020-045835

Maureen, I. Y., van der Meij, H., & de Jong, T. (2020). Enhancing Storytelling Activities to Support Early (Digital) Literacy Development in Early Childhood Education. *International Journal of Early Childhood*, *52*(1), 55–76. https://doi.org/10.1007/s13158-020-00263-7

Nuno-Solinis, R., Urizar, E., Merino, M., Del Barrio, J., & Rodriguez, M. (2022). Validation Study of a Value-Based Digital Health Questionnaire. *INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH*, *19*(12). https://doi.org/10.3390/ijerph19127034

Pantielieieva, N., Zaporozhets, S., Nagaichuk, N., & Bartosh, O. (2019). TRANSFORMATION OF FINANCIAL INTERMEDIATION IN THE CONTEXT OF SPREAD OF DIGITAL TRENDS. *BULLETIN OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN*, *3*, 144–152. https://doi.org/10.32014/2019.2518-1467.80

Schwarzmuller, T., Brosi, P., Duman, D., & Welpe, I. (2018). How Does the Digital Transformation Affect Organizations? Key Themes of Change in Work Design and Leadership. *MANAGEMENT REVUE*, *29*(2), 114–138. https://doi.org/10.5771/0935-9915-2018-2-114

Trier, M., Kundisch, D., Beverungen, D., Müller, O., Schryen, G., Mirbabaie, M., & Trang, S. (2023). Digital Responsibility. *Business & Information Systems Engineering*, *65*(4), 463–474. https://doi.org/10.1007/s12599-023-00822-x

Tronvoll, B., Sklyar, A., Sorhammar, D., & Kowalkowski, C. (2020). Transformational shifts through digital servitization. *Industrial Marketing Management*, *89*, 293–305. https://doi.org/10.1016/j.indmarman.2020.02.005

van Tonder, C., Schachtebeck, C., Nieuwenhuizen, C., & Bossink, B. (2020). A framework for digital transformation and business model innovation. *Management : Journal of Contemporary Management Issues*, *25*, 111–132. https://doi.org/10.30924/mjcmi.25.2.6