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DIGITAL TRANSFORMATION IN HOSPITALS
Navigating the Path to Sustainable Healthcare

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Navigating the Path to Sustainable Healthcare

Dissertation presented as a partial requirement for obtaining a master's degree in Production and Systems Engineering, by the postgraduate Program in Production and Systems Engineering at the University of Vale do Rio dos Sinos (UNISINOS).

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ABSTRACT

Healthcare organizations are facing a transformative phase driven by the widespread adoption of digital technologies. The COVID-19 pandemic has amplified the importance of digital tools in healthcare, including drug delivery, remote monitoring, and wearable devices. This shift is forcing healthcare organizations to embrace emerging technologies to meet changing patient expectations and stay competitive, while also leveraging technology to provide care to underserved populations. This study explores the digital transformation (DT) of hospitals, focusing on the technologies utilized, and the expected impacts on service quality, patient experience, and operational efficiency. The research employs a qualitative case study approach, utilizing document analysis, semi-structured interviews, and participant observation to gain in-depth insights. The findings highlight the complexity of DT in healthcare, emphasizing the need for strategic planning, robust frameworks, and collaborative efforts to address financial, personnel, and infrastructural challenges. The study also underscores the importance of cultural change and the development of digital skills to harness the full potential of digital transformation in hospitals. Overall, this work provides crucial insights for the hospital sector, informing investment decisions and structural changes to drive digital transformation and improve healthcare outcomes.

Keywords: Digital transformation. Hospital. Service quality. Patient experience. Operational efficiency

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LIST OF ACRONYMS

B2C	Business to Consumer
B2B	Business to Business
CAPEX	Capital Expenditure
CT	Computed Tomography
DRG	Diagnosis-Related Groups
DT	Digital Transformation
HMV	Hospital Moinhos de Vento
ICT	Information and Communication Technology
MRI	Magnetic Resonance Imaging
RPA	Robotic Process Automation
SLR	Systematic Literature Review
VBHC	Value-based Healthcare

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1 INTRODUCTION

To establish a modern healthcare system that conforms to quality standards, enhancing the quality and availability of healthcare is essential. Considering factors such as an unstable financial state, expansive nations, limited resources, and a fluctuating demographic situation, it necessitates innovative technological solutions capable of scaling up to effectively tackle these challenges (WONG, 2015). Developed nations worldwide consider integrating technology and innovation into healthcare processes and business models as a promising approach to the future of medical and care services (ILIN *et al.*, 2022).

Hospitals play a key role in meeting the challenges of healthcare, so it is important to understand how technology is being developed in this segment. Over the past 150 years, hospitals have witnessed significant technological advancements that have revolutionized healthcare delivery and medication development (JUNAID *et al.*, 2022). Consequently, it is imperative to provide a concise overview of the major milestones that have facilitated the widespread adoption of technology in the hospital setting.

The rapid emergence of new technological milestones in healthcare highlights the accelerated pace at which changes are taking place. Milestones include the creation of the first image exam with the x-ray in 1895, the electrocardiogram in 1901, and the computed tomography (CT) and magnetic resonance imaging (MRI) in 1971 and 1977, respectively, which have advanced the field of diagnosis. These technological advancements have led to the need for trained professionals and technicians in hospitals, creating new expertise and the necessity for greater control and management of the new data generated and collected (BARRA, 2006). Figure 1 summarizes some of the advances that have been impacting medicine in the 30 years before the pandemic and that contribute to the understanding of future scenarios.

Regarding digital technologies, Senbekov et al. (2020) summarize eight groups of applications with different technologies. Telemedicine facilitates remote diagnostics, data exchange, and patient education, impacting healthcare, education, and disaster medicine. Virtual clinical trials streamline patient recruitment, data collection, and consent, particularly in rural areas. Medical education undergoes transformation through distance learning and administrative efficiency. Smart devices play a pivotal role in health monitoring, including cardiology, fitness, and sports medicine. AI is

applied in imaging, health monitoring, drug development, surgery, and personalized treatment. Big data management includes electronic health records, statistics, and genetics. Pharmacy optimization focuses on drug delivery, logistics, and health data integration. Blockchain ensures data security in medical records, research, and education. These key technologies collectively define the dynamic landscape of digital health.

Since 1990, digital technologies have progressively assumed a central role within healthcare organizations, especially within hospitals, leading to the inception of the term 'e-health', more commonly known as 'digital health' (ACETO *et al*., 2018; TORTORELLA *et al*., 2020). The term e-health refers to the use of information and communication technology (ICT) to enhance the efficiency, effectiveness, and quality of health services. Digital health involves the integration of ICTs with healthcare and management processes, offering patients and healthcare professionals tools to enhance communication, monitoring, and health management (WORLD HEALTH ORGANIZATION, 2005). Furthermore, this concept encompasses a diverse array of technologies, including health information systems, intelligent medical devices, health mobile applications, telemedicine, clinical decision support systems, and others that are increasingly interconnected (WORLD HEALTH ORGANIZATION, 2005).

Figure 1: Milestones of Digital Health

2018 — **Blockchain for data**
Estonia's eHealth Authority signs a deal with a blockchain company.

2017 — **VR for education and pain relief**
Microsoft Announces Hololens for medical education; First study oriif that VR therapy eases pain (Spiegel et. al.)

2013 — **AI for treatment recommendation**
IBM Watson Begins testing by oncologists to recommend treatment for lung cancer

2009 — **Access to patient data**
Patients demanding to see Cardioverter Desfibrilator's Data

2007 — **Mobile Apps**
Launch of the first iPhone and the App Store.

2004 — **Online patient groups**
PatientsLikeMe.com is founded to connect ALS patientes worldwide

2001 — **Werables**
FDA approves first non-invasive automatic glucose monitoring system (GlucoWatch)

2000 — **Digital robotic surgery**
Intuitive Surgical launches the Da Vinci robotic surgical system

1995 — **Online information for patients**
The Association of Cancer Online Resources (ACOR) launched

1989 — **Telemedicine**
First interactive telemedicine system

Source: adapted from Medical Futurist (2020)

Intensified by the Covid-19 pandemic, the adoption of connected new technologies was catalyzed, and the theme of digital transformation (DT) gained relevance, aiming to reduce health inequalities and increase population well-being (DELOITTE, 2021). In a complex segment, the future of health invariably involves structural changes in the current models of service delivery, digitalization, and care, with technology as an ally in this journey (GHOSH, 2022). Figure 2 was developed to link objectively the causes and consequences of some factors that together led to an increase in the health crisis.

The concept that anchors this study defines DT as a fundamental change process, enabled by the innovative use of digital technologies and accompanied by the strategic leverage of key resources and capabilities, aiming to improve an organization radically and redefine its value proposition (GONG; RIBIERE, 2021). In addition to that, it is important to mention that DT is an ongoing process, seeking to improve in three different ways: customer experience, streamlining operations, or creating new business models (YOO, 2010).

In the contemporary approach to the complex challenges faced in the health sector, Value-Based Healthcare (VBHC) and the Triple Aim triad are emerging as essential paradigms to guide care delivery strategies. Patient-centered VBHC proposes a holistic vision that transcends mere clinical evaluation, incorporating patient-perceived quality and long-term results (PORTER; TEISBERG, 2006). On the other hand, the Triple Aim, formulated by the Institute for Healthcare Improvement (IHI), advocates improving the patient experience, improving population health, and reducing *per capita* costs (BISOGNANO; KENNEY, 2012). Both concepts address the search for a more efficient, effective, and equitable healthcare system that overcomes contemporary health challenges, promoting a sustainable, patient-centered model.

VBHC seeks to address healthcare challenges by realigning the focus of the healthcare system towards delivering value to patients. This implies optimizing clinical results, improving the patient experience, and managing costs efficiently (PORTER; TEISBERG, 2006). Practically, VBHC emphasizes the collection and analysis of data related to treatment outcomes, considering not only traditional indicators, but also patient satisfaction and perceived quality of life. It also encourages the integration of different healthcare professionals into collaborative teams, promoting a more coordinated and comprehensive approach to care. By aligning financial incentives with the delivery of positive long-term results, VBHC seeks to transform the healthcare system by encouraging more effective, patient-centered, and sustainable practices (PORTER; TEISBERG, 2006).

In this quest to modernize and readjust current healthcare systems, the study of digital transformation in the context of hospitals is fundamental for several reasons, including the following: (i) improvement in the quality of care: improvement of care in hospitals, allowing greater efficiency in processes, reduction of medical errors and greater accuracy in diagnoses; (ii) cost reduction: the use of digital technologies in hospitals can lead to a reduction in operating costs, allowing financial resources to be

applied in other areas that require investments; (iii) access to information: patient information and data can be easily accessed by health professionals, allowing a faster and more accurate diagnosis, in addition to a better coordination of care; (iv) innovation: adoption of new technologies and innovative solutions in hospitals, improving the quality of services provided and generating new business and research opportunities; (v) patient satisfaction: improving the patient experience in hospitals, providing greater convenience and practicality in care, in addition to offering personalized services tailored to the individual needs of each patient (MARQUES; FERREIRA, 2020; IYANNA *et al*., 2022; STANIMIROVIĆ; DREV; RANT, 2022).

Based on this, the focus of this research is on hospital digital transformation. The subsequent sections will detail the research object and the problem at hand.

Figure 2: Health crisis explained
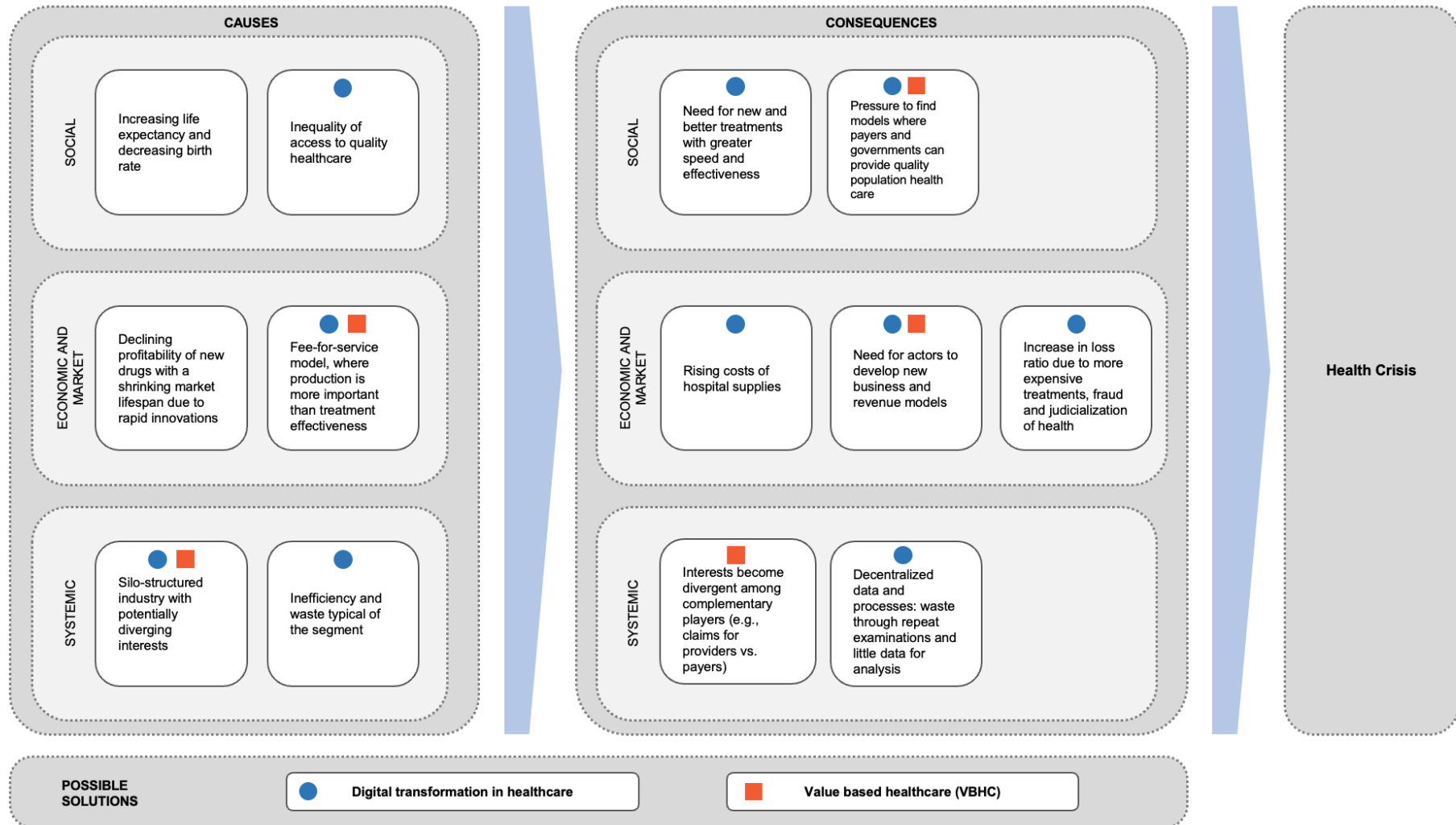
Source: author

1.1 OBJECT AND RESEARCH PROBLEM

There is an inherent complexity in the healthcare sector, given the volume of stakeholders that make up this market, as explained in Figure 3, including (1) government and agencies (regulatory agencies, accreditation bodies, and fomentation), (2) payers (health plans, cooperatives, and insurers), (3) industry and research (pharma industry, prosthetics industry, research, and teaching), providers (hospitals, clinics, physicians, and laboratories), and finally the patients. These actors do not necessarily have convergent interests, as stated in Figure 3. In a challenging scenario of medicine seeking greater effectiveness, different players also strive to maintain their market position by creating barriers to change (MRAK; SOKOLIC, 2019). Given this complexity, fragmentation, and volume of players, the segment does not have favorable characteristics for change and is constantly reorganizing rather slowly, at least until the shock of the pandemic in 2020 (COBIANCHI, 2020; STANIMIROVIĆ; DREV; RANT, 2022).

Figure 3: Stakeholders from the Health care sector.
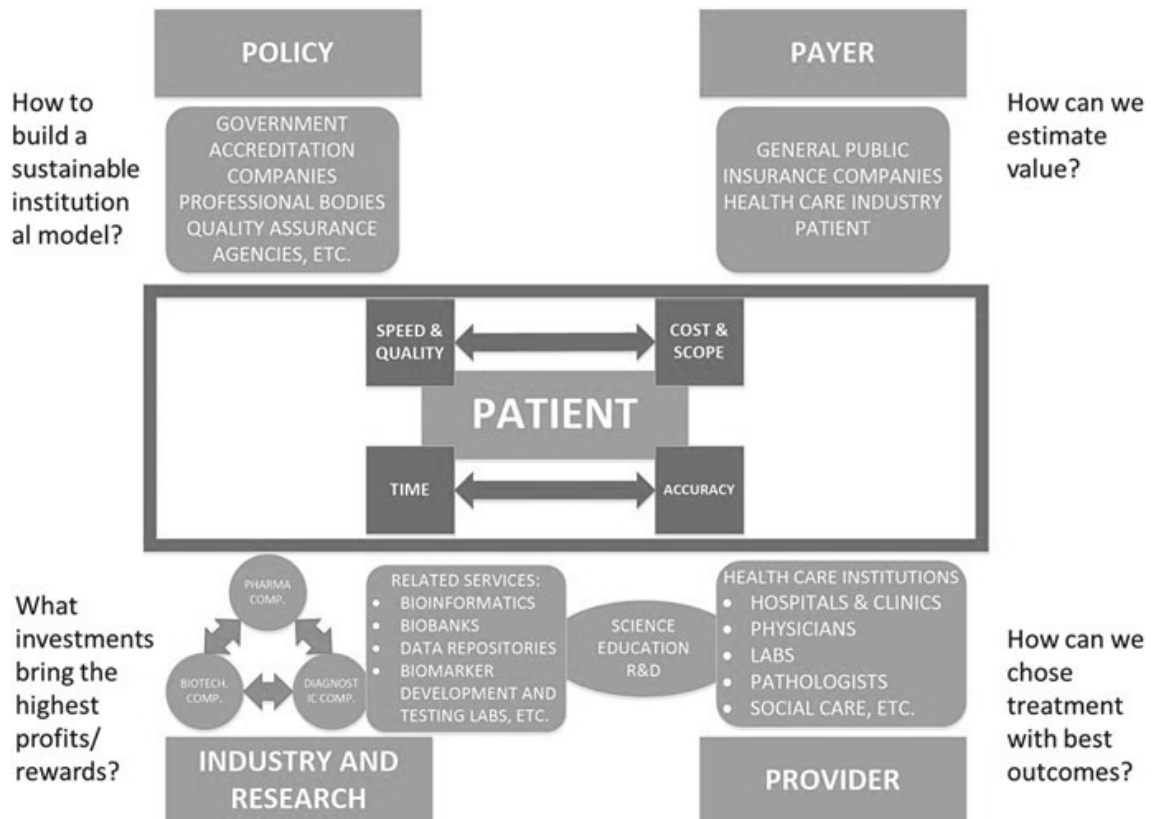
Source: Mrak and Sokolic, p. 153, 2019

A shift was already noticeable before COVID-19 in all segments, enhanced by various digital-centric experiences, which was reflected in the healthcare market (OXFORD, 2022). The COVID-19 pandemic highlighted the importance of digital technologies in healthcare, including drug delivery, wearable devices, and remote monitoring possibilities. But in this scenario, it becomes essential to have an approach that simultaneously considers political, social, cultural, and economic aspects (OXFORD, 2022; HERMES *et al.*, 2020).

During the COVID-19 period, the health industry witnessed a significant surge in investment, innovation, and the entry of new players from the technology, telecom, and consumer sectors. In 2021, global health innovation funding reached a staggering $44 billion, twice the amount invested in 2020 (WORLD ECONOMIC ORGANIZATION, 2022). Additionally, there was a 50% increase in acquisitions of health and health tech companies. While the convergence of technologies model is moving forward, questions remain lingering around the funding and business models, the digital capabilities required to reimagine care delivery, change management across the enterprise, and encourage the workforce to embrace the digital (DELOITTE, 2022).

Although it was a period of advances in healthcare solutions and technologies, the costs and margins already pressing healthcare as the whole chain were even more affected in the pandemic, with a cost escalation that impacted the sector in general (MCKINSEY, 2022). This increase in costs was largely driven by heightened demand for medical supplies and equipment, disruptions in supply chains, the need for additional protective measures, and the increased complexity of care for COVID-19 patients.

Besides the cost escalation, the health industry is experiencing consumerization. Consumerization in healthcare happens when patients, empowered by greater access to information, demand personalized and affordable care, integrate technology like telemedicine for better communication, and take increased responsibility for their health, a shift accelerated by the COVID-19 pandemic (ZERVAS, 2023). This shift into the expectations forces healthcare organizations to adopt emerging technologies to deliver optimal outcomes and stay competitive, while leveraging technology to provide healthcare to underserved populations can give organizations an advantage (OXFORD, 2022).

The pandemic's negative financial impact on hospital systems, causing delays in IT projects and digital initiatives, also brought about a heightened awareness of the necessity for digital and remote healthcare alternatives (OXFORD, 2022). Associated with the financial, business model, and complexity challenges described so far, a structural change that has been proposed, as demonstrated in Figure 4, from the alternation of the focus on "sick care", a term used for some time to define and contrast a health system focused mainly on treating diseases, harming what would be "healthcare", where the focus would be on health promotion and disease prevention (FRENK; GÓMEZ-DANTÉS, 2016). As proposed by the value-based healthcare (VBHC) model, the key priority is not to prioritize cost savings or limit access to healthcare. Instead, it is about "redesigning the system to deliver improved healthcare more efficiently" (PORTER; TEISBERG, 2006, p. 23)."

Figure 4: What changes from sick care to healthcare?

FROM SICKCARE	TO HEALTHCARE
REACTIVE	PROACTIVE
MANAGING DISEASE	PREVENTING DISEASE
MEDICINE SUPER-SPECIALIZATION	BODY AS A WHOLE
PATIENT DEPENDENCE	PATIENT EMPOWERMENT
MEDICINE IS FOUNDATION	LIFESTYLE IS FOUNDATION
SAVING LIFE IS GOAL	LONGEVITY IS GOAL
MASKS OR SURPRESSES SYMPTOMS	ADRESSES THE CAUSE OF THE PROBLEM
VOLUME OF SERVICE IS IMPORTANT	QUALITY AND OUTCOMES ARE IMPORTANT
FRAGMENTED DATA AND PATIENT INFORMATION	INTEROPERABILITY AND DATA ENHANCING DISEASE PROBABILITY

Source: author

In the complex environment of the healthcare sector, the adoption of digital technologies emerges as a crucial solution. However, the COVID-19 pandemic has further emphasized the need for healthcare organizations to embrace digital innovations. This has led to a significant surge in investment and innovation in health-related advancements (ZERVAS, 2023).

Despite some positive developments, hospitals and the industry still face challenges related to funding and business models, digital capabilities, change management, and encouraging the workforce to embrace technology (WEHDE, 2019). The pandemic has underscored the urgency for healthcare organizations to adopt emerging technologies and shift their focus from reactive "sick care" to proactive "healthcare." Consequently, the healthcare sector is undergoing a transformative phase, highlighting the importance of transitioning towards a value-based healthcare (VBHC) model to deliver improved healthcare outcomes efficiently (SADDIQUE; AL-KUDWAH, 2021).

Studies indicate that successful projects for digital transformation in health are critical in strategic terms for the future development of the health system, with far-reaching impacts on economic growth and social development (WOLFF *et al*., 2020). Based on research clusters identified by the authors, the aim of digital transformation in hospitals has become clear: enhancing operational efficiency for streamlined and accurate care; adopting patient-centered approaches for more personalized and humanized service; understanding organizational factors and their managerial implications for more effective management; refining workforce practices for improved training and adaptability; and acknowledging socio-economic aspects to ensure inclusiveness and equity in healthcare (KRAUS *et al*., 2021).

Considering the object of the study, the understanding of the factors that influence the effective implementation of digital transformation in hospitals, the research problem is defined. Therefore, the central question of this work is defined as: What are the main factors that influence the effective implementation of digital transformation in hospitals, and how do these factors impact the quality of service, the patient experience and operational efficiency?

1.2 OBJECTIVES

This section presents the general and specific objectives to be achieved throughout the research.

1.2.1 General objective

To investigate how digital transformation takes place in hospitals, identify the technologies utilized and the expected impacts on service quality, patient experience, and operational efficiency.

1.2.2 Specific Objectives

The specific objectives of this research, which jointly aim to achieve the general objective of this research, are divided as follows:

a) To identify the specific technologies that are being used in hospitals to support digital transformation.

b) To verify the expected impact of digital transformation on service quality, such as improvements in patient outcomes, reduced wait times, increased patient satisfaction, and operational efficiency.

c) To evaluate how digital transformation is empirically taking place within hospitals.

1.3 JUSTIFICATION

Recognizing the complexity of the healthcare sector and the imperative for restructuring to ensure its sustainability, digital transformation emerges as a critical ally in the pursuit of equilibrium. However, studies indicate that despite the significant investments, reaching double digits lately, a small percentage of nearly 20% of projects have been successful, that is, relying not only on the technical implementation of digital solutions, but also on their effective integration into daily processes, resulting in measurable and lasting benefits for organizations (ZHANG; XU; MA, 2023; GARTNER, 2023). In this scenario, research support is essential to increasing the success of these projects, particularly in the healthcare sector.

To make digital transformation projects more effective within hospitals, it is necessary to have replicable studies on the topic. The scientific contribution enables an increase in the success of projects, shortening the journey of researchers and companies through validations, best practices, and models with previous validation. However, there is a lack of generalizable cases regarding digital transformation in Hospitals, which creates opportunities for new research (RYAN *et al*., 2019; AL-KAHTANI *et al*., 2022)

Given that digital transformation is a theme that develops empirically, studies of this nature are important for the advancement of DT in the healthcare setting. Since DT develops through new business models and market recognition, studies of an applied nature are fundamental. Yet, there is a gap in empirical studies given that many studies focus on discussions about technology and the possibility of impacts while still leaving room for applied studies that enrich these discussions (IVANCIC; GLAVAN; VUKSIC, 2020).

Digital transformation is a process that cuts across organizations, and it is necessary to evaluate studies that approach the topic in the same way and not as one-off improvements. The existence of studies on the digitalization of processes, steps, or service functionalities in hospitals does not exhaust how the process should occur and how it can be implemented within different institutions to impact all areas and the business. Today, there are vast studies of specific best practices, but few direct how to conduct a digital transformation process holistically (IVANCIC; GLAVAN; VUKSIC, 2020; DENDERE; JANDA; SULLIVAN, 2021; KRAUS *et al.* 2021).

Brazil has been recognized as a leader in specialized healthcare, with 23 hospitals ranked among the world's best in the 2025 World's Best Specialized Hospitals report (NEWSWEEK, 2024). This achievement underscores the importance of studying the country's top hospitals, which are at the forefront of medical specialties, making them key subjects for understanding healthcare innovation and digital transformation in Latin America.

Regarding organizational aspects, different SLRs illustrated that most existing scholarly papers dealt with technological innovations, although DT covers a broader scope. Further investigations into the management of successful business model transformation and strategic courses that allow disruptive changes may be precious for future investigations (KRAUS et al., 2021).

Generalizable studies are important, but an in-depth understanding of the operational and organizational effects that DT generates in health institutions is fundamental. One of the ways to measure impact is through in-depth case studies, as they allow for detailed examination of real-life situations, with the researcher being immersed in different initiatives. Qualitative methods such as case studies, in-depth interviews and multiple case studies would be relevant in the search for detail and study of different levels of impact (KRAUS et al., 2021).

Besides the gaps and opportunities for research on this topic, there are also empirical challenges regarding DT in hospitals. A persistent difficulty in improving traditional healthcare value propositions and effectiveness is the challenge of measuring costs and patient outcomes, and information systems appear to be limited in their ability to support this reporting (GHOSH *et al.,*2022).

Part of the difficulty in improving and developing DT projects may lie in the fact that there are different understandings as well as different maturities within some contexts. It is evident from the literature that there is heterogeneity in the results across countries regarding digital transformation (BALTAXE *et al.* 2019).

As digital transformation is a crucial topic for the future of healthcare, it is essential to understand its implementation in hospitals better. Therefore, a systematic literature review (SLR) was conducted with three objectives: (i) to evaluate academic interest in searching databases for the theme of digital transformation in healthcare; (ii) to assess the extent to which research on digital transformation applies to the hospital segment; and (iii) to identify the main clusters of research, results, and existing gaps in current research. The SLR conducted used the method proposed by Dresch et al. (2015), which involved the steps of search, selection, coding, evaluation, synthesis, and presentation of results.

Sn SLR consolidates primary studies to find, evaluate, reduce, and add relevant results about a research question or topic (DRESCH; LACERDA; JÚNIOR, 2015). Additionally, Galvão and Ricarte (2020) state that the SLR focuses on the reproducibility of other researchers, showing bibliographic databases, search strategies for each database, as well as the selection of scientific articles, exclusion and inclusion criteria, and the analysis of each included article. Therefore, concisely, this study goes through four primary stages: (i) identification of the research, (ii) selection of studies, (iii) extraction and monitoring of data, and (iv) synthesis and results.

The initial databases used for investigation were Scopus, which presented 714 results, and Web of Science, with 414 results. The focus was on peer-reviewed articles found in journals and conference papers, allowing for higher quality and views from academia and practice. The keywords used were "digital transformation" and variations related to healthcare, such as 'healthcare', 'health management,' 'health care,' and 'hospital,' resulting in the string (TITLE-ABS-KEY ("Digital Transformation") AND TITLE-ABS-KEY (healthcare OR "health management" OR "health care" OR Hospital)). The search protocol, with definitions and justifications for each research choice, is described in Appendix A.

From the execution of database searches, the research resulted in 1,128 articles scattered across publications dating from 2000 to 2023. The time frame was left open in the research, so the first year being 2000 is due to the first publication resulting from the databases. The concentration of found research is divided into 57.9% of results from Scopus and 42.1% from Web of Science. The evolution of interest in the identification phase of the study is presented in Table 1.

Table 1: Evolution of publications on Digital Transformation

Period	Scopus	Web of Science	Search results
2000	1	—	1
2001	1	2	3
2002	3	2	5
2003	—	—	—
2004	2	—	2
2005	—	—	—
2006	—	—	—
2007	—	—	—
2008	—	—	—
2009	—	—	—
2010	1	1	2
2011	—	—	—
2012	3	2	5
2013	3	2	5
2014	—	—	—
2015	3	3	6
2016	9	6	15
2017	22	19	41
2018	48	32	80
2019	76	62	138

Period	Scopus	Web of Science	Search results
2020	133	91	224
2021	194	128	322
2022	153	125	278
2023	1	—	1

Source: author

Of these publications, there is evidence of a growth in the volume of articles on this topic lately, with 92% of the publications concentrated in the past five years. 2021, the year coinciding with the Covid-19 pandemic, had the highest incidence of publications, totaling 322. The upward trend of publications over the years can be seen in Graph 1, allowing for the identification of the annual volume and the total volume of publications up to the sum of the 1,128 found in the search string. With the help of the Rayyan software and already contributing to the first analysis filter, all duplicate publications resulting from the string were excluded. The result, both before and after the removal of duplicates, is reflected in Graph 1, which demonstrates the reduction in files to 763 unique publications.

Graph 1: Evolution of publications on Digital Transformation in healthcare and hospitals
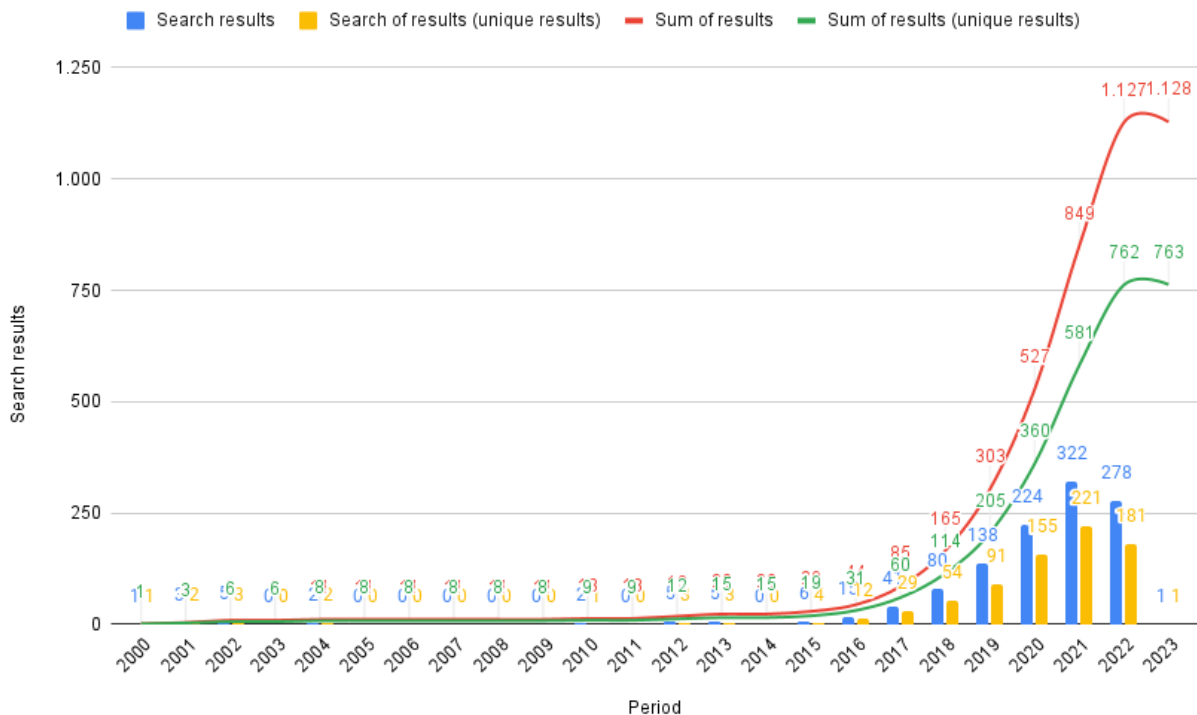
Source: author

The eligible unique articles were exported to the VOS Viewer tool to understand the relationship and main themes addressed within the universe of digital transformation in health care and hospitals. Through a co-occurrence analysis of all keywords in the articles, terms with at least 3 occurrences were filtered, excluding words that originated from the search string itself (digital transformation, health care, healthcare, Hospital), resulting in Figure 5, which was used as a premise for grouping the studies.

Figure 5: Co-occurrence analysis of all keywords (1.128 articles)
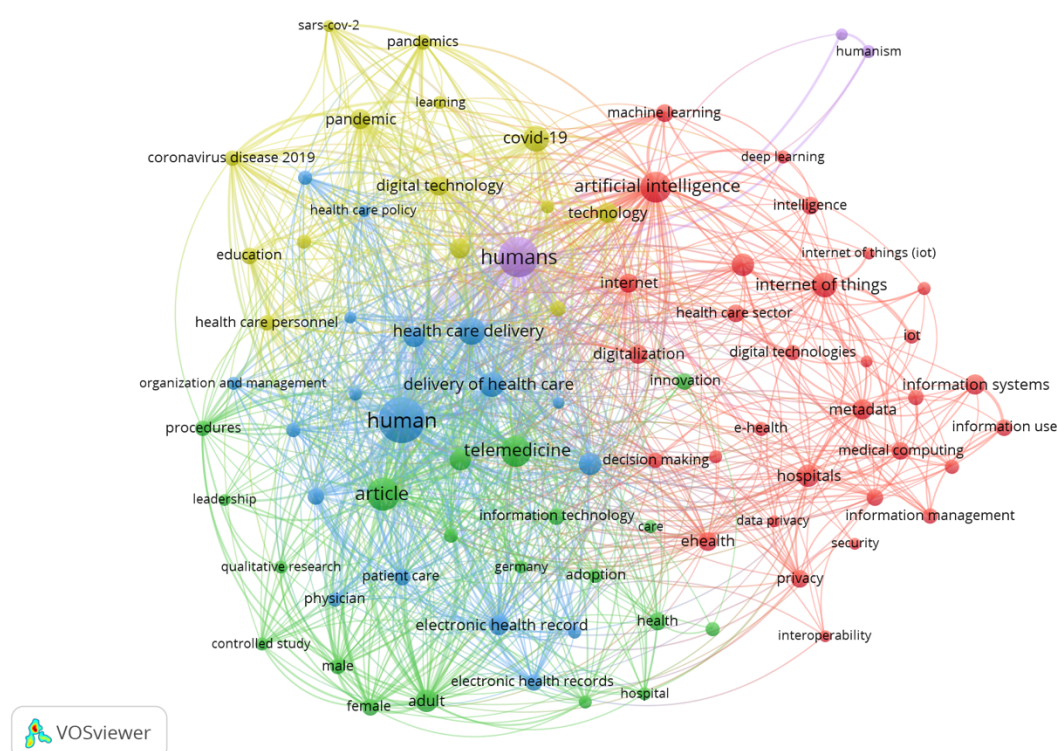
Source: author

From the groupings of keywords, the inclusion, and exclusion criteria were re-evaluated for the second stage of manual screening, where the reading of all titles and abstracts of the 763 articles was performed. To understand which topics are being researched in addition to those covered by the research protocol, and also with a view to future research, the excluded articles were categorized. Figure 6 summarizes all stages of the research as well as details the volume of articles in each rejected article group, where out of 772 articles, only 60 were included in this SLR.

Figure 6: Summary of research steps
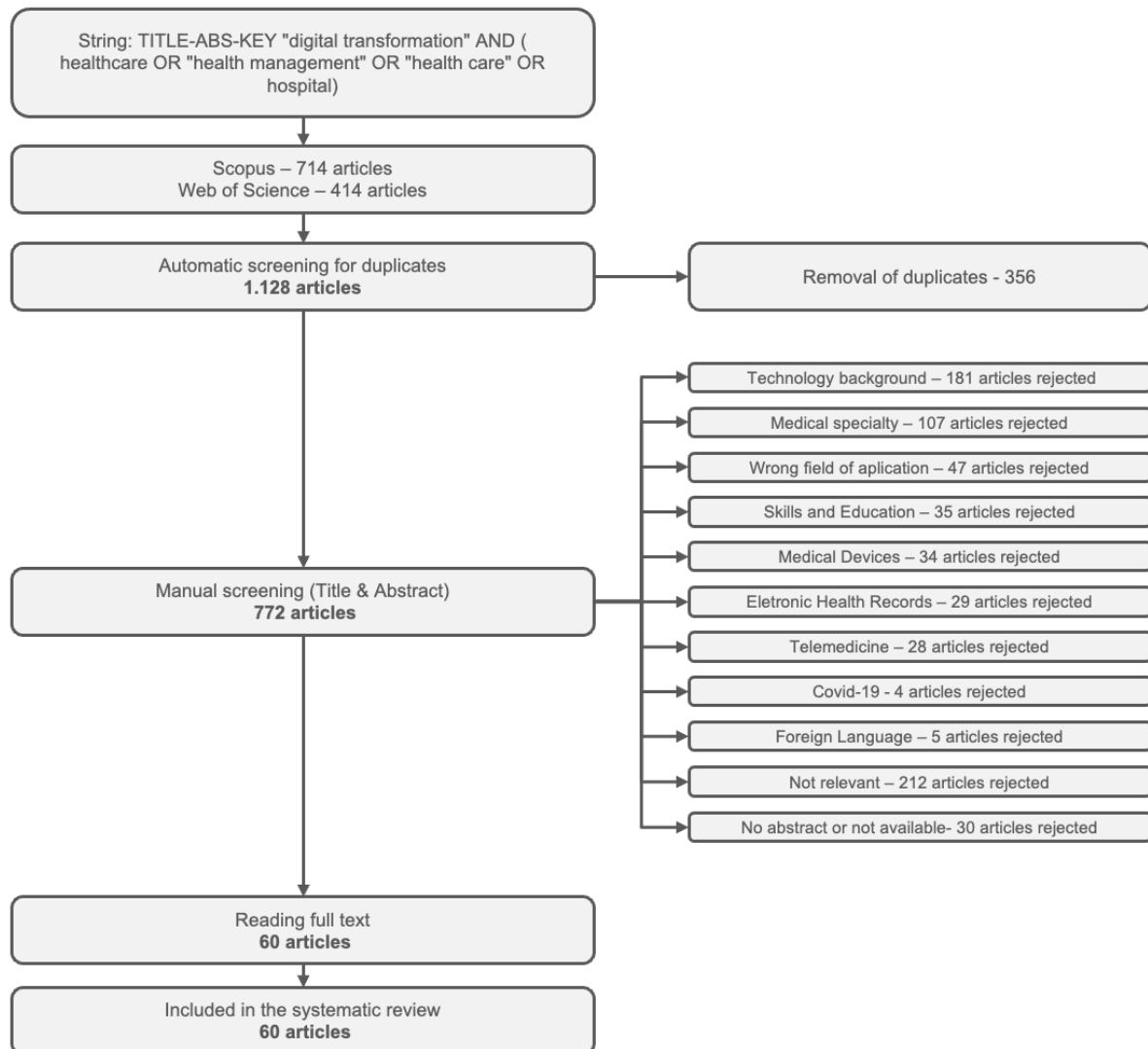
Source: Author

Given the results of the exclusion criteria, it was found that the largest grouping, comprising 24.6% of all non-included articles found, dealt specifically with technologies and their application to healthcare processes. Given that Healthcare 4.0 and DT in healthcare involve monitoring devices, smart devices, lifestyle tracking, interaction tracking, and mobility with storage and infrastructure technologies, enabling a viable and secure future of healthcare (ESTRELA et al., 2018; MOHAMED AND AL-JAROODI, 2019), the RSL also presents the results found within this cluster.

From reading the 181 articles in the 'Technology Background' group, an association of the incidence of each of the technologies cited as enabling some part or the whole in healthcare DT was created. In total, 19 technologies and themes were identified in 242 different incidences throughout the articles analyzed, and the volume of the sum in order of occurrences showed IoT, Data Management, and Cybersecurity

as the three technologies with the highest incidence of the total articles selected. Other points are described in Graph 2.

Graph 2: Technology vs. Occurrences
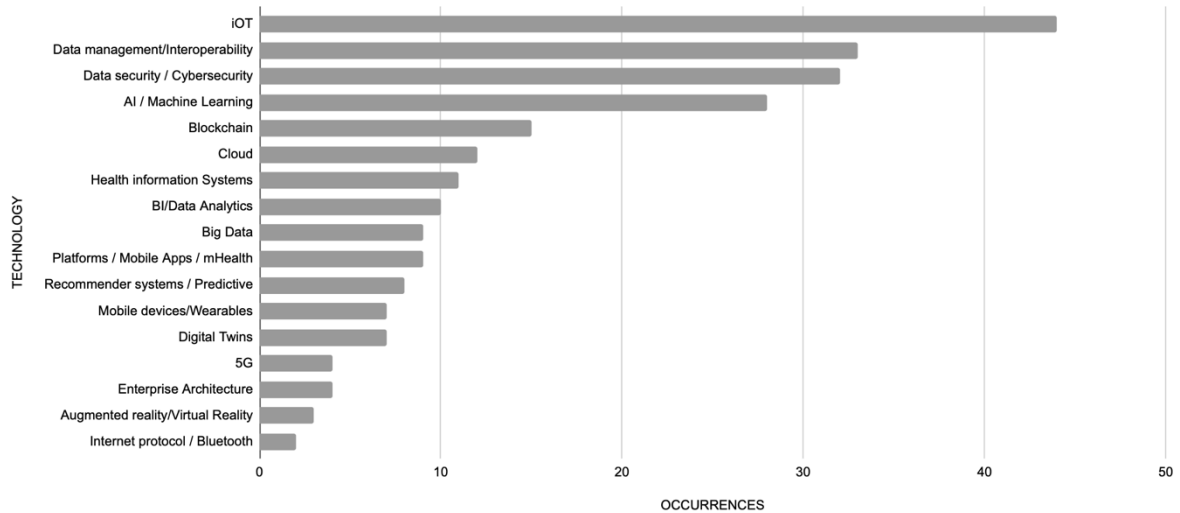
Source: Author

Deepening the analysis of the occurrences of each of the mapped themes and technologies, we also tried to understand by proposing a visualization of the acceleration or deceleration of each of the articles over the 14 years that the publication has been mapped. The result of this analysis is shown in Graph 3. Once the analysis is done, it is worth highlighting the theme of 'Data management and interoperability' that has maintained its relevance over the past 10 years and for blockchain and AI, which had no publications until 2017 and 2019, respectively, and today are representative of the other technologies.

Graph 3: Incidence of Technology Enablers in Healthcare DT during time

Incidence of Technology Enablers in Healthcare DT during time
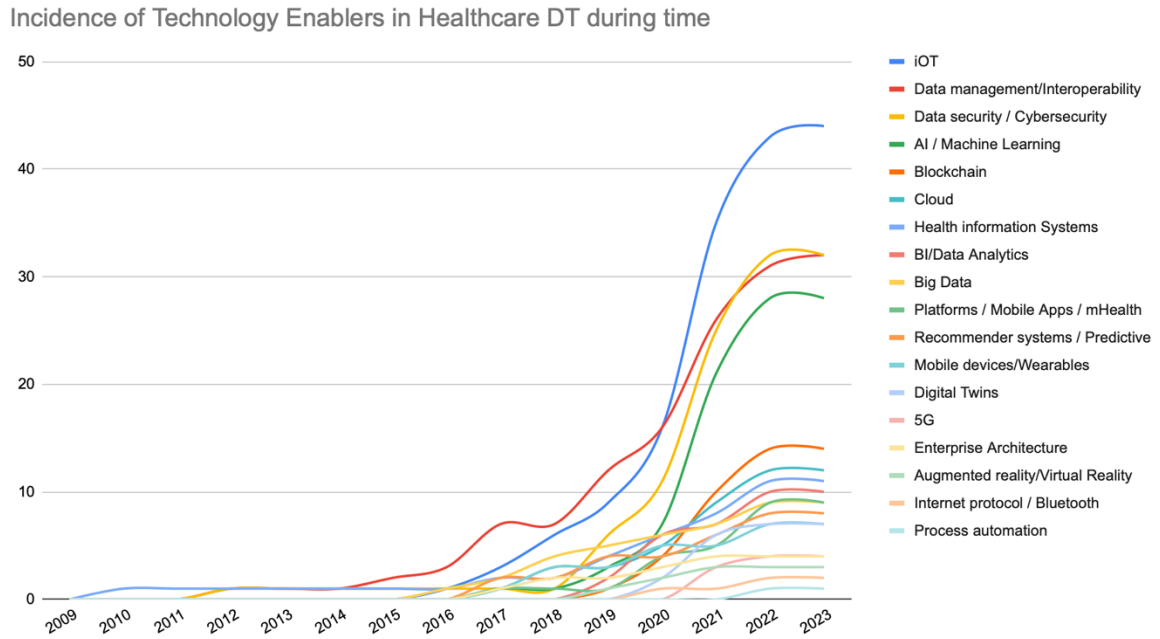
Source: Author

As a first step, after the in-depth reading of the 60 articles included in the RSL, a scientometric analysis of the articles was carried out to deepen the understanding of the research clusters that will be subsequently analyzed. VOS Viewer was used for a keyword co-occurrence analysis of all articles from terms that were identified at least three times and unifying terms of the same meaning, resulting in Figure 7.

Figure 7: Co-occurrence analysis of all keywords (60 articles)
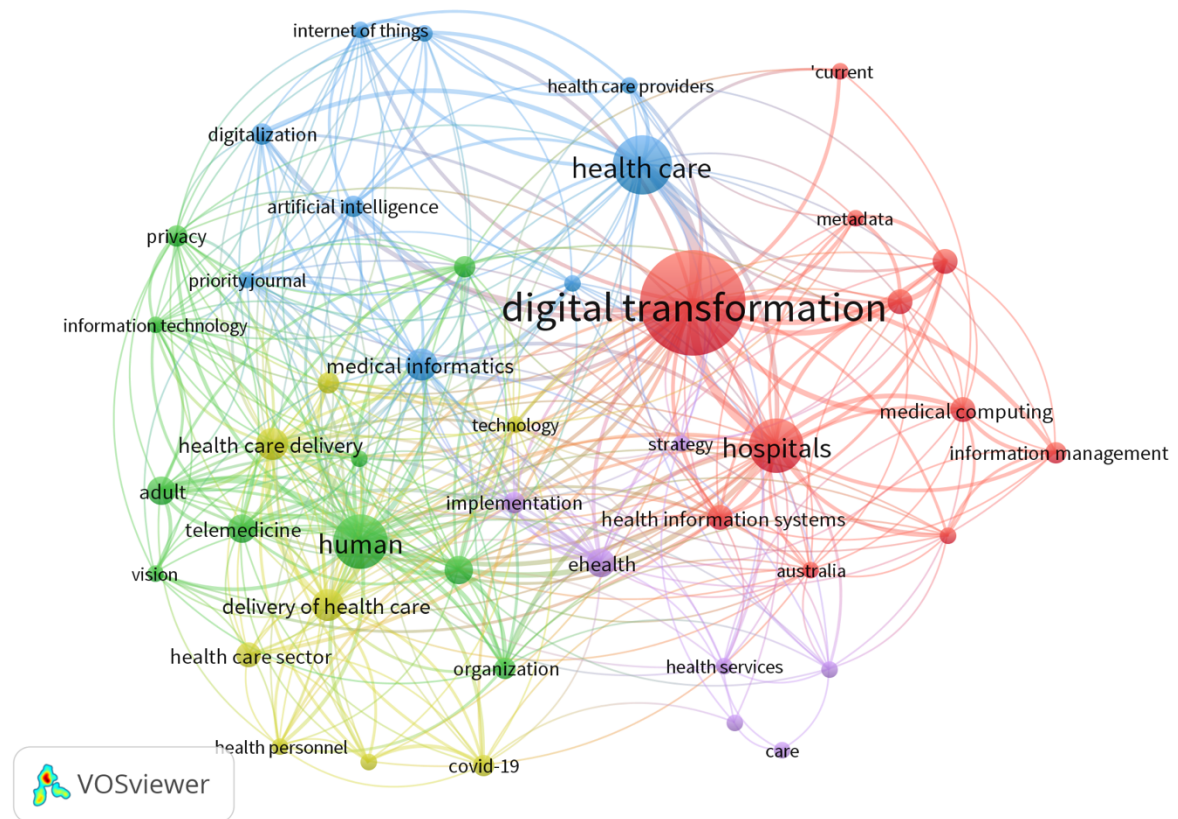
Source: Author

It is possible to identify clusters from the co-occurrence analysis that help in understanding the existing publications in the selected articles. As large groups are identified in Figure 7, one can see a large group related to people and professionals in the segment; another point is linked to medical and management systems; the third group is linked to services and digital health; and the last group connects to technologies in two different ways.

Derived from the scientometric analysis, complete reading, and analysis of the articles, five categories emerged, allowing to account for the totality of the articles. To synthesize the analysis of this RSL, these 5 categories are described based on the characteristics and content addressed, namely: (i) Digital Transformation in Healthcare Evaluation and Implementation; (ii) Technological Advancements and Applications in Healthcare; (iii) Regional Perspectives and Implementation Challenges; (iv) Leadership and Organizational Aspects of Digital Transformation; and (v) Implications and Impact of Digital Transformation in Healthcare.

Given the categories, the division of the selected articles is described in Table 2, each of them being allocated to the category of greatest adherence. Although there are intersections between more than one category, the studies were allocated to the category with the highest adherence.

The first category of "Digital Transformation in Healthcare Evaluation and Implementation" delves into the assessment and execution of digital transformation in healthcare, encompassing strategies for project management, challenges posed by institutional dynamics, and collaborative endeavors across interdisciplinary domains. The focus of the second category, "Technological Advancements and Applications in Healthcare", deepens into innovation within the healthcare sector, exploring different types of technological progress, the integration of artificial intelligence, the evolution of electronic health solutions, and the emergence of novel trends shaping the landscape of digitalization in healthcare. The third group of studies, "Digital Transformation in Healthcare: Regional Perspectives and Implementation Challenges", focuses more specifically on contextual nuances, highlighting regional disparities in digital transformation, highlighting context-specific hurdles, and highlighting the need for adaptable strategies. The fourth category, "Leadership and Organizational Aspects of Digital Transformation," delves into leadership dynamics and how leadership deals in the face of innovation challenges, crafts novel business models, and integrates conventional processes with digital paradigms. The last group, "Implications and Impact of Digital Transformation in Healthcare," probes the potential effects of the DT evolution, discussing the efficacy of system integration, shifts in care paradigms, and potential transformative responses to extraordinary events like the COVID-19 pandemic.

Table 2: Structure of the study

Categories	Rep. (%)	Articles included in the RSL
(i) Digital Transformation in Healthcare: Evaluation and Implementation	17 results *28.3%*	BINSAR et al., 2022
		DE MOOIJ, FOSS AND BROST, 2022
		DENDERE, JANDA AND SULLIVAN, 2021
		EDEN et al., 2018
		ILIN et al., 2022
		KIM et al., 2020
		KRUSZYŃSKA-FISCHBACH, 2022
		MUGGE et al., 2020

Categories	Rep. (%)	Articles included in the RSL
		PIHIR, TOMICIC-PUPEK AND FURJAN, 2019
		PONCETTE et al., 2019
		RICCIARDI et al., 2019
		RYAN et al., 2019
		SCOTT, SULLIVAN AND STAIB, 2019
		STANIMIROVIC, DREV AND RANT, 2022
		SULLIVAN AND STAIB, 2018
		SULLIVAN et al., 2020
		WILLIAMS et al., 2019
(ii) Technological Advancements and Applications in Healthcare	8 results *13.3 %*	CHANNI, SHRIVASTAVA AND CHOWDHARY, 2022
		DEL VECCHIO, MELE AND VILLANI, 2022
		GASTALDI ET AL., 2018
		GHALEB, DOMINIC AND SARLAN, 2020
		GOLDSACK AND ZANETTI, 2020
		ILJASHENKO, BAGAEVA AND LEVINA, 2019
		KRUMHOLZ, 2022
		TANNIRU AND SANDHU, 2018
(iii) Regional Perspectives and Implementation Challenges	9 results *15.0 %*	AL-KAHTANI et al., 2022
		ALAM, HU AND UDDIN, 2020
		DYDA et al., 2021
		EDEN et al., 2021
		KRASUSKA et al., 2021
		KREY et al., 2021
		NADHAMUNI et al., 2021
		RAIMO et al., 2022
		SULLIVAN ET AL., 2021
(iv) Leadership and Organizational Aspects of Digital Transformation	5 results *8,3 %*	BURTON-JONES et al., 2020
		CORSO et al., 2018
		EDEN et al., 2019
		GHOSH et al., 2018
		TANNIRU, KHUNTIA AND WEINER, 2018
(v) Implications and Impact of Digital Transformation in Healthcare.	20 results *33.0 %*	ADLER-MILSTEIN, 2021
		AL-JAROODI et al., 2022
		BEMGAL et al., 2019
		BURMANN et al., 2021
		CAVOSKI et al., 2022
		GHOSH et al., 2022
		GOPAL et al., 2019
		HAGGERTY, 2017
		HERMES et al., 2020

Categories	Rep. (%)	Articles included in the RSL
		ILIN, LEVINA AND LEPEKHIN, 2020
		IVANCIC, GLAVAN AND VUKSIC, 2020
		IVANOV et al., 2021
		IYANNA et al., 2022
		KRASUSKA et al., 2020
		KRAUS et al., 2021
		MARQUES AND FERREIRA, 2020
		MURILLO, SUGRAÑES AND HERNÁNDEZ, 2021
		RASTOGI, 2022
		RYAN et al., 2020
		STEPHANIE AND SHARMA, 2020

Source: Author

Upon the examination of the systematic review's corpus, it becomes imperative to delineate the scope and parameters of this research endeavor. Such critical demarcations are elucidated in the ensuing chapter on delimitations.

1.4 DELIMITATIONS

Given the proposed research scope, the delimitations are made explicit, specifying the aspects that fall outside the study's scope. This work focuses on identifying, verifying, and evaluating digital transformation within hospitals, with particular attention to the technologies utilized and the expected impacts on service quality, patient experience, and operational efficiency. It is acknowledged, however, that the challenges in healthcare extend beyond the boundaries of these institutions.

The work starts with the categorization proposed by Kraus *et al*. (2021), who ordered the studies of DT in health in 5 groups: operational efficiency by healthcare providers; patient-centered approaches; organizational factors and managerial implications; workforce practices; and socio-economic aspects. In this study, workforce practices and socio-economic aspects are not being considered.

Given the established scope, no quantitative assessments will be carried out regarding the impact of digital transformation on hospitals. This delimitation is given since the impacts can only be assessed on medium- and long-term horizons, going beyond the possibilities of this study. Having discussed the delimitations, the next section presents the structure of this research.

1.5 STRUCTURE OF THE STUDY

This research is divided into 6 chapters to achieve the general and specific objectives. To provide a clear view of the structure of the work, the table below has been drawn up, covering all the stages and their contents.

Table 3: Structure of the study

General objective	Specific Objectives	Chapter and scope
To investigate how digital transformation takes place in hospitals, identifying the technologies utilized and the expected impacts on service quality, patient experience, and operational efficiency.	a) To identify the specific technologies that are being used in hospitals to support digital transformation;	*Chapter 1: Introduction* Introductory aspects, research object, research question, general and specific objective, and justification for conducting the research together with the RSL of the topic to be studied.
		Chapter 2: Theoretical background Theoretical foundation on concepts of what is and what is not digital transformation and the understanding of the studies of the scope of the hospital sector.
	b) To verify the expected impact of digital transformation on service quality, such as improvements in patient outcomes, reduced wait times, increased patient satisfaction and operational efficiency;	*Chapter 3:* Research design, characterizing the research method used to carry out the study, as well as the phases and delimitations.
		Chapter 4: Presentation of the case study conducted at Hospital Moinhos de Vento.
	c) To evaluate how digital transformation is empirically taking place within hospitals;	*Chapter 5:* Discussions and results obtained from the study.
		Chapter 6: The final considerations of this research.

Source: author

2 THEORETICAL BACKGROUND

This section of the theoretical background will contextualize the main elements of this research. Initially, the conceptual understandings of Digitalization and Digital Transformation are qualified, and their application in health is presented. Subsequently, the benefits, challenges, and impacts of DT in healthcare will be discussed as the enabling technologies during this process.

2.1 DIGITIZATION, DIGITALIZATION, AND DIGITAL TRANSFORMATION

The concept of digital transformation lacks a clear attribution to a seminal author, but principal authors on the subject converge on its definition and pillars (WESTERMAN; BONNET; MCAFEE, 2014; BRYNJOLFSSON; MCAFEE, 2014; ROGERS, 2017). Points of agreement among these authors who are essential for the digital transformation process include (i) the importance of technology as a means, which involves adopting advanced digital technologies to improve processes, operations, and services; (ii) customer focus, which prioritizes the customer experience and creates new business models that add value; (iii) organizational changes, which require adjustments in culture, structure, and processes to take advantage of the full potential of digital transformation; and (iv) the innovation dimension, which is crucial in seizing opportunities and creating competitive and sustainable business models.

Over time, the concept of DT has undergone mutations, evolutions, and confusion, making it necessary to re-evaluate what fits and what does not within a comprehensive concept. To this end, Gobble (2018) explains what DT is precisely by distinguishing it from what it is not. He provides an example of the difference between DT and Digitization, which is simply the conversion of atoms to bits, such as transforming paper into electronic files, images into JPEGs, and music into MP3s. Regarding digitalization, it involves converting these digital bits into meaningful value offering cost savings, primarily through increased efficiency and fewer errors, but not necessarily altering the fundamental operations of a company or how it conceptualizes, generates, and provides value (GOBBLE, 2018). However, Digitization or digitalization alone, does not constitute DT (GOBBLE, 2018; O'LEARY, 2022). The DT requires transforming bits into value, manifesting as savings, efficiency gains, and reduced error

rates. However, it must also involve a fundamental change in how a company does business, thinks, creates, and delivers value.

In the search for the definition of a concept, Gong and Ribiere (2021) created, from the analysis of 2,520 articles and 134 different meanings, what was described as a unified definition of digital transformation as being:

> A fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity (organization, a business network, an industry, or society) and redefine its value proposition for its stakeholders (GONG; RIBIERE, p.12, 2021)

In drawing on the unified concept just described, it is valid to highlight some keywords that are determinant in understanding what is expected from DT. The first of these is that (i) DT is a process, (ii) enabled by digital technology, (iii) that generates strategic advantage by enabling a radical improvement in the firm, and (v) redefining the organization's value proposition to the parties involved.

Given the understanding of the concept, it is possible to establish a hierarchy of complexity between more manageable and more complex tasks, starting with Digitization, going through digitization, and finally arriving at Digital Transformation (O'LEARY, 2022). The search for the achievement of digital transformation is desired by companies because this path benefits the generation of innovation, increased efficiency, and a consequent competitive advantage (OLIVEIRA; TRENTO, 2021). Gobble (2018, p. 66) differentiates the concepts in a concise phrase:

> "[…] digitization is the conversion of atoms to bits—replacing paper with electronic files, pictures with JPEG images, music with MP3s. Digitalization is the transformation of all those bits into value. Digitization may deliver some savings, most commonly through efficiency gains and reduced error rates, but it doesn't change how the company does business—how it thinks about, creates, and delivers value"

It is relevant when we identify that this academic concept, sometimes misinterpreted, also has direct convergence with the concept found in the market, as Deloitte defines digital transformation as the use of digital technologies to radically improve the performance or scope of an organization. In a digitally transformed business, digital technologies enable improved processes, engaged talent, and new business models (DELOITTE, 2021).

2.2 DIGITAL TRANSFORMATION IN HOSPITALS

The use and adoption of health technologies have been seen previously to play an essential role since the 1990s, especially (TORTORELLA, 2020). Recently, however, the implementation of digital technologies has been exponential. In addition to being smaller and more affordable, technologies have supported the fight against the pandemic through remote triage, online consultations, remote patient monitoring, and text communication between patients and doctors (RASTOGI, 2022) (NÁO SÃO TECNOLOGIAS DA SAÚDE?).

The widespread adoption of technologies now faces a challenge: to target efforts for continuity and gains over the long-term horizon. This confrontation should seek as expected outcomes the reduction of disparities, making health care more accessible and efficient, and reducing complications and barriers (GOLDSACK; ZANETTI, 2020).

However, the possibilities generated by today's digital medicine have less to do with technology and more to do with the teams and people who develop, regulate, and implement these models (GOLDSACK; ZANETTI, 2020). Even for this reason, lately, several researchers and practitioners have engaged in research that understands the extent and interconnectedness between the different actors and the consumer (HERMES *et al*., 2020).

The systematic review of digital transformation in healthcare revealed that the current digital transformation in healthcare literature comprises various clusters. These clusters encompass operational efficiency among healthcare providers, patient-centered approaches, organizational factors, managerial implications, workforce practices, and socio-economic aspects. Consequently, the findings highlight the necessity for additional research on business model transformation and its implications for managing diverse interest groups (KRAUS *et al*., 2021)

Digital transformation in healthcare faces challenges not only in modeling new businesses and managing multiple stakeholders but also in capacity building and infrastructure. Challenges can be identified, including (i) lack of financial resources; (ii) Lack of personnel in specialties, which hinders the Digitalization of medicine; (iii) Underdeveloped digital health infrastructure; (iv) Threats to information security; and (v) a low level of intelligence development in expert medical systems (ILIN et al., 2022).

These challenges highlight the need for concerted efforts to address them and realize the full potential of digital transformation in healthcare.

In the pursuit of a successful digital strategy, numerous frameworks have been developed to cater to hospitals of various sizes and varying degrees of digital maturity. Within the context of Australia, one such framework, demonstrated in Figure 8, has been advanced, delineating four enduring dimensions and temporal horizons (SULLIVAN *et al.*, 2019). The complexity of effecting digital transformation in a healthcare system characterized by adaptability can be daunting. However, frameworks serve as indispensable tools in breaking down the extensive process of hospital and health service digitization into a coherent and systematic clinical procedure, structured across three strategic horizons (METRO NORTH, 2022). This structured approach empowers healthcare institutions to lucidly articulate the clinical prerequisites for each phase of digital transformation, ultimately facilitating the integration of digital technology into healthcare processes.

Figure 8: Digital strategy framework for digital transformation in Hospitals
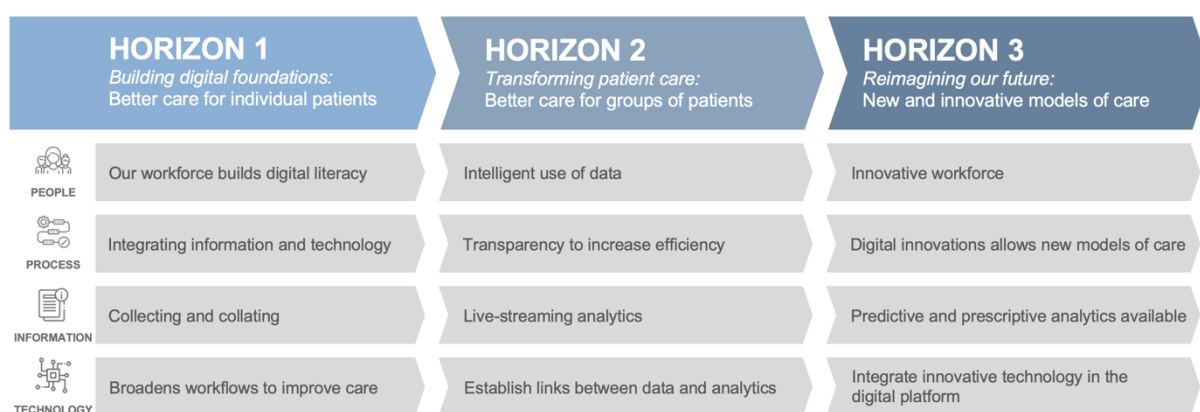
Source: adapted from Metro North, 2022

Digital transformation in hospitals is a complex process that requires strategic planning, robust frameworks, different technologies, and collaborative efforts to address financial, personnel, and infrastructural challenges. While technological advancements drive progress, the real impact comes from effectively integrating these innovations into healthcare practices and providing better outcomes. Overcoming these obstacles can enable the healthcare sector to achieve more efficient, accessible, and patient-centered care through digital transformation.

2.3 ENABLING TECHNOLOGIES FOR DIGITAL TRANSFORMATION IN HEALTHCARE

Every DT process is based on projects, processes, and technology. Aiming to describe the enabling technologies involved during a DT in healthcare, the following Table 4 provides an overview of various technologies and their applications in the digital transformation of healthcare. Each technology is briefly defined, highlighting its role in healthcare innovation (MENCIONAR QUE VEIO DA RSL E DO CORPUS DO TEXTO). Table 4 aims to describe how IoT, data management/interoperability, AI, and other cutting-edge technologies can enhance healthcare processes, improve patient outcomes, and drive the evolution of the healthcare ecosystem. It serves as a valuable resource for understanding the potential of these technologies in revolutionizing healthcare delivery and shaping the industry's future.

Table 4: Compiled summary of the enabling technologies for DT in Hospitals

Technology	Definition	Contribution to DT in Healthcare	Authors
IoT	Interconnection of physical devices, sensors, and objects through the internet, enabling data exchange and automated actions.	Facilitate remote patient monitoring, real-time health data analysis, and early detection of medical conditions. It can also improve operational efficiency through intelligent asset management and process automation, resulting in more patient-centric and efficient healthcare services.	DIMITROV, 2016; SMORODIN ET AL., 2018; ALHARBI, 2019; VEERAIAH, 2020; USLU, 2020; LIU, LI AND HAN, 2022
Data management /Interoperability	Organize, integrate, and ensure data compatibility across different systems and platforms.	Effective data management and interoperability enable seamless data exchange among healthcare providers, improving care coordination and facilitating data-driven decision-making. It supports integrating disparate health systems and technologies, enabling a comprehensive and unified view of patient data for better healthcare outcomes.	BRAUNSTEIN AND DETMER, 2016; KHUNTIA, MITHAS, AND AGARWAL, 2017; ŠENDELJ ET AL., 2020; QUAMARA, GUPTA, AND YAMAGUCHI, 2021
Data security / Cybersecurity	Measures and practices implemented to protect sensitive health data from unauthorized access, breaches, and cyber threats.	Robust data security and cybersecurity measures are critical for maintaining patient privacy, securing electronic health records, and ensuring the integrity and confidentiality of healthcare data. It builds trust among patients, healthcare providers, and other stakeholders, enabling the adoption and successful implementation of digital health technologies.	FRUMENTO, 2019; CHERNYSHEV, ZEADALLY AND BAIG, 2019; QUAMARA, GUPTA AND YAMAGUCHI, 2021; GARCIA-PEREZ ET AL, 2022

Technology	Definition	Contribution to DT in Healthcare	Authors
AI / Machine Learning	The field of computer science that focuses on developing systems that can perform tasks that typically require human intelligence. Machine learning is a subset of AI that involves training algorithms to learn patterns from data and make predictions or decisions without explicit programming.	AI and machine learning have the potential to revolutionize healthcare. They can analyze large volumes of medical data to identify patterns, diagnose diseases, and personalize treatment plans. AI algorithms can assist in medical imaging analysis, drug discovery, clinical decision support, and predicting patient outcomes. By automating and augmenting various tasks, AI, and machine learning can improve the accuracy, efficiency, and quality of healthcare delivery.	SCHÖNTHALER AND PRAUS, 2019; CHAUHAN ET AL., 2020; ABDEL-BASSET, CHANG AND NABEEH, 2021; SPATHIS ET AL, 2022
Blockchain	Decentralized and distributed ledger technology that records transactions across multiple computers, ensuring transparency, immutability, and security.	Blockchain can enhance data integrity, secure health records, streamline medical supply chain management, and enable the secure sharing of health information among different healthcare stakeholders.	NARIKIMILLI ET AL., 2020; MASSARO, 2021; NAWAZ AND KHAN, 2021; CERCHIONE ET AL, 2022; DE OLIVEIRA AND NASCIMENTO, 2022)
Cloud	Cloud computing involves the delivery of on-demand computing services, including storage, processing power, and applications, over the internet.	Cloud computing offers scalable and cost-effective infrastructure, enabling healthcare organizations to store and access large amounts of data, collaborate in real-time, and deploy applications more efficiently.	RAJAMÄKI ET AL, 2020; PHAM AND NGUYEN, 2020; SINGH ET AL, 2021
Health information Systems	electronic systems for managing health information, including electronic health records (EHRs), clinical decision support, and health analytics.	Health information systems enable efficient documentation, retrieval, and exchange of patient data, supporting coordinated care, clinical decision-making, and population health management.	KACZMAREK ET AL, 2020; LIU, LI AND HAN, 2022
BI/Data Analytics and Big Data	Business intelligence (BI), data analytics and big data involve the use of technologies and techniques to analyze and derive insights from large datasets to uncover patterns, trends, and actionable information	In healthcare, these technologies enable organizations to make evidence-based decisions, monitor performance, allocate resources efficiently, and manage population health. Big Data analytics handles vast and complex datasets, facilitating personalized medicine and predictive modeling by analyzing comprehensive health data beyond the capabilities of traditional data management tools.	ZHOU ET AL, 2020; MENDONCA AND DANTAS, 2020; KAPETANEAS, ET AL, 2022; KITSIOS AND KAPETANEAS, 2022
Platforms / Mobile Apps / mHealth	Platforms and mobile apps in the context of healthcare refer to software applications and digital platforms designed for healthcare delivery, patient engagement, and remote monitoring.	Enable easy access to healthcare services, remote consultations, health tracking, and patient engagement. They facilitate telemedicine, enhance patient-provider communication, and empower individuals to take an active role in managing their health.	YASSINE, SINGH AND ALAMRI, 2017; KOYDEMIR AND RAY, 2020; FISCHER ET AL, 2020; SULAIMAN ET AL, 2021; TALA ET AL, 2022

Technology	Definition	Contribution to DT in Healthcare	Authors
Recommender systems / Predictive	Use of data analysis techniques to provide personalized recommendations or predictions based on user preferences and historical data.	Help healthcare providers suggest personalized treatment options, preventive measures, and interventions based on patient data, medical guidelines, and research evidence. They can also support patients in making informed decisions about their healthcare choices.	SHARMA, SINGH AUJLA AND BAJAJ, 2019; SPOLADORE AND PESSOT, 2021; TALAAT, 2022;
Mobile devices/Wearables	Mobile devices and wearables refer to portable electronic devices, such as smartphones, smartwatches, fitness trackers, and health sensors, worn or carried by individuals.	Enable continuous monitoring of vital signs, physical activity, and health parameters. They provide real-time health data, facilitate remote patient monitoring, encourage healthy behaviors, and enhance the self-management of health conditions.	SCHOBEL ET AL, 2017; YOON, LEE AND SHIN, 2020; BABY ET AL, 2022
Digital Twins	Digital twins are virtual representations of physical objects, processes, or systems that capture real-time data, enabling simulation, monitoring, and analysis.	It can be used to model and simulate patient physiology, medical devices, and healthcare processes. They can aid in predictive modeling, treatment planning, and optimization of healthcare operations for improved patient outcomes and resource management.	AHMADI-ASSALEMI ET AL., 2020; EROL, MENDI AND DOGAN, 2020; DE MAEYER AND MARKOPOULOS, 2021; SHARMA AND GUPTA, 2021;
5G	5G is the fifth generation of wireless technology that offers faster speeds, lower latency, and increased capacity for data transmission.	5G enables high-speed, reliable, and real-time communication, facilitating telemedicine, remote surgeries, and remote monitoring. It supports the transmission of large medical imaging files, telehealth consultations, and data-intensive healthcare applications.	ABDEL-BASSET, CHANG, AND NABEEH, 2021; PRIYA AND MALHOTRA, 2021; TARIKERE, DONNER, AND WOODS, 2021;
Enterprise Architecture	Enterprise architecture refers to the framework and structure that align an organization's IT infrastructure, processes, and systems with its business goals and objectives.	Provides a structured approach to integrating and optimizing healthcare systems, data, and processes. It ensures interoperability, scalability, and alignment of IT initiatives with strategic objectives, enabling efficient and seamless digital transformation in healthcare organizations.	MASUDA ET AL., 2017; MASUDA ET AL., 2018; WICHMANN ET AL., 2020; MASUDA ET AL., 2021;
Augmented reality/Virtual Reality	Augmented Reality (AR) and Virtual Reality (VR) technologies create immersive and interactive experiences by overlaying digital information onto the real world (AR) or simulating a virtual environment (VR).	It can be used for medical training, surgical simulations, pain management, and patient education. They enable healthcare professionals to visualize complex medical data, enhance diagnostic accuracy, and improve patient engagement and rehabilitation experiences.	KLINKER, WIESCHE AND KRCMAR, 2020; ABDEL-BASSET, CHANG, AND NABEEH, 2021
Internet protocol / Bluetooth	Internet Protocol (IP) is the principal communications protocol for connecting devices on the internet, while Bluetooth is a wireless technology for short-range data transmission.	IP and Bluetooth facilitate seamless connectivity and data exchange between healthcare devices, sensors, and systems. They enable the integration of medical devices, remote monitoring, and real-time data transmission for telehealth and IoT applications.	VIDAKIS ET AL., 2020; DELGADO, 2022

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Technology	Definition	Contribution to DT in Healthcare	Authors
Process automation	Process automation involves using technology to automate repetitive tasks, streamline workflows, and improve operational efficiency.	Process automation can optimize administrative processes, appointment scheduling, billing, and claims management, reducing errors and enhancing productivity. It frees up healthcare professionals' time, allowing them to focus on patient care and improving overall healthcare service delivery.	TORTORELLA ET AL., 2022

Source: author

The integration of advanced technologies in healthcare holds the promise of transforming the industry into a more patient-centric and efficient ecosystem. From facilitating remote patient monitoring and real-time health data analysis to leveraging artificial intelligence for personalized treatment plans and predictive modeling, these innovations are poised to enhance healthcare outcomes significantly (ZERVAS, 2023). The emphasis on data security and interoperability builds trust among stakeholders, fostering the successful adoption of digital health technologies. Moreover, the structured approach to integrating and optimizing healthcare systems, coupled with process automation, ensures seamless operations and improved service delivery. As we navigate the evolving landscape of healthcare technology, it is evident that the synergistic implementation of these advancements will play a pivotal role in shaping the future of healthcare, promoting accessibility, efficiency, and patient engagement (WEHDE, 2019).

2.3.1 Barriers to technologies in healthcare

The assimilation of health information technology in the healthcare landscape encounters challenges and barriers, manifesting at various levels of the healthcare delivery ecosystem. At the individual practitioner level, resistance prevails, driven by entrenched professional norms that cast non-patient treatment tasks as administrative burdens (FICHMAN *et al*., 2011). Physicians, motivated by a desire to preserve professional autonomy and status, exhibit reluctance towards embracing new technologies, perpetuating a deterrent to the widespread adoption of health IT (WALTER; LOPEZ, 2008). Furthermore, the influence wielded by tech-averse physicians has a cascading effect, impeding the utilization of health IT by their peers (VENKATESH *et al*., 2011; DAVIDSON *et al*., 2018). Privacy concerns, stemming from the susceptibility of medical devices to hacking (MESKO *et al*., 2017) and the absence

of transparent app privacy policies (SUNYAEV *et al.*, 2015), contribute to the apprehension surrounding health IT adoption at the individual level.

Transitioning to the organizational realm, a critical barrier arises from providers' lack of incentives to implement health IT systems and share data, primarily due to competitive considerations (OZDEMIR *et al.*, 2011). This proprietary approach hampers the digital transformation of healthcare and restricts the exploitation of the full spectrum of patient data available across disparate systems (ROMANOW *et al.*, 2012). Additional organizational hurdles include the substantial initial and ongoing costs associated with health IT adoption (DESROCHES *et al.*, 2008; JHA *et al.*, 2009), technical support and concerns (KRUSE et al., 2016), the inevitable loss of productivity during the transition phase, and anxieties regarding the future obsolescence of invested health IT solutions (MCCLELLAN et al., 2013).

Even in instances where organizations overcome these barriers and integrate health IT, resistance persists at the individual level. Users, including healthcare professionals, often exhibit reluctance to engage with health IT solutions, representing a significant impediment to the realization of the technology's potential benefits (KANE; LABIANCA, 2011). In summary, the formidable challenges and barriers encompassing professional norms, privacy concerns, organizational dynamics, and individual resistance collectively pose substantial impediments to the widespread adoption and seamless integration of health IT in the healthcare domain.

2.4 IMPACT OF DIGITAL TRANSFORMATION IN HOSPITALS

In the ever-evolving sphere of healthcare, technological advancements and digital interventions have emerged as transformative forces, significantly influencing the modus operandi of hospitals. This transformation, while global in its reach, is inherently diverse due to the complex nature of the segment. Factors that influence these changes encompass both external elements, such as the cultural and socio-economic context of distinct geographical regions, and internal determinants, like the specific characteristics and internal processes intrinsic to individual organizations (TORTORELLA *et al.*, 2020a).

While navigating this complex digital transition, there is an increasing demand for novel digital skills that demand unconventional thinking, enabling entities to break traditional norms and envision beyond the conventional 'box.' This shift towards a

digitally enhanced approach in hospitals is more than just technological implementation; it is a paradigmatic shift in the core functioning of healthcare systems (SANTARSIERO, 2022).

Delving into the subject, the academia-driven discourse surrounding digital transformation in Hospitals underscores three pivotal facets: (i) the identification of the varied digital technologies being adopted, (ii) the tangible advantages stemming from such digital implementations, and (iii) the challenges and barriers that might be encountered during this transformative journey (TORTORELLA *et al*., 2020b).

The focus of digital transformation within the context of healthcare, specifically in hospitals, is well established and guided by the Triple Aim of Healthcare (BISOGNANO; KENNEY, 2012). This framework, endorsed by the International Institute for Healthcare Improvement, primarily aims to enhance the overall health of the population, encompassing two secondary objectives, namely, the enhancement of patient experience and the reduction of costs, both of which are instrumental in contributing to the attainment of the primary goal. Building upon the Triple Aim, the healthcare industry has extended its aspirations to encompass a Quadruple Aim, adding the goal of improving the work life of health care providers, including clinicians and staff (BODENHEIMER; SINSKY, 2014). This evolved model has the objective of achieving digital transformation aligned with better quality of care, better efficiency of care, better population health, and a better experience for our consumers and clinicians. This multifaceted approach underscores the intricate and interdependent dimensions of digital transformation in healthcare, acknowledging the fundamental roles it plays in improving the healthcare ecosystem.

The authors further elaborate on this by segmenting the digital transformation literature into several clusters. These encompass (i) operational efficiency among healthcare providers, (ii) patient-centric strategies, (iii) organizational determinants, (iv) managerial repercussions, (v) workforce practices, and overarching (vi) socio-economic considerations (KRAUS *et al*., 2021). Such a diversified and layered understanding underscores a crucial gap in the existing literature: the imperativeness of exploring the transformation of business models in healthcare and the subsequent managerial implications for navigating different stakeholders' interests.

In light of these scholarly insights, this chapter endeavors to comprehensively dissect the impacts of digital transformation in Hospitals across the main challenges that must be addressed based in the original Triple Aim Healthcare idea (BERWICK;

NOLAN; WHITTINGTON, 2008) which consists in: (i) Impact of Digital Transformation on the Quality of Hospital Services, exploring how digital transformation has revolutionized the healthcare landscape, aiming to enhance the quality of services rendered by hospitals; (ii) Impact of Digital Transformation on Patient Experience delving into the implications digital transition has on patient experiences, redefining their journey through healthcare establishments and (iii) Impact of Digital Transformation on Operational Efficiency, evaluating how digital initiatives have streamlined operations, leading to increased efficiency and improved service delivery in healthcare settings.

2.4.1 Impact of Digital Transformation on the Quality of Hospital Services

In addressing the implications of digital transformation, it is pivotal to integrate diverse perspectives to elucidate the multifaceted impacts on the quality of hospital services. There is a paradoxical reality in the healthcare sector, while most healthcare entities acknowledge the significance of digital transformation in enhancing service quality and propelling business development, a mere 2% are in the advanced stages of this transformative journey (ILJASHENKO; BAGAEVA; LEVINA, 2019). This underscores a glaring discrepancy between acknowledgement and actionable implementation within the sector.

The technical facets of the digital revolution in healthcare are instrumental in augmenting service quality. They contribute to the reduction of medical malpractices and bolster the evolution of predictive medicine and the efficiency of clinical research (ILJASHENKO; BAGAEVA; LEVINA, 2019). However, the transition is not devoid of challenges. There are concerns regarding the quality and safety of care amidst digital transitions, emphasizing the intricate balance required to maintain high-quality patient care during such transformative periods (SILLIVAN; STAIB, 2018).

In the perception regarding value creation through digital self-services, there is an agreement among physicians on the positive repercussions on service quality due to the types of services (TAIMINEN *et al*. 2018). However, the authors accentuated a prevailing notion: the healthcare industry remains in its nascent stages, rendering it immature for the seamless integration of digital self-services. This assertion resonates with prevailing research presumptions, suggesting a discernible alignment between

perceived potential and the current practical applicability of digital self-services within the healthcare sector.

When contemplating large national digitalization projects, intricate elements such as optimal timing, risk sharing, and procurement conditions ascend to prominence, necessitating well-informed negotiations to ensure both quality and price considerations are meticulously addressed (SULLIVAN; STAIB, 2018). This intricate negotiation process transcends mere technology evaluation, extending into realms of quality and fiscal deliberations, reinforcing the complexity of implementing large-scale digital transformations.

Digitalization brings forth substantial enhancements in diagnosis and patient care, as echoed by several studies (ACETO *et a*l., 2018; WANG *et al*., 2018; SANNINO *et al*., 2019). For instance, the digitalization of health records has not only refined the overall quality of healthcare but has also amplified the provision of care and patient safety (CAR *et al*., 2008). The implications of such transformations are profound, implying a shift from paper to computerized forms that can significantly elevate the quality and safety of healthcare delivery.

The initial phase of coordinating services may see a surge in costs; however, the ramifications are more nuanced. The enhancement in patient care and system productivity might not correlate with increased profits for traditional participants within the healthcare industry, due to a potential reduction in their roles and revenues as coordination costs escalate.

Moreover, the transparent articulation of data detailing patient journeys, bringing visibility to the whole process, unveils unprecedented opportunities to optimize the quality and efficiency of patient care (SULLIVAN; STAIB, 2018). By applying data-driven innovations and employing evidence-based decision-making, caregivers, and researchers can optimize outcomes for each patient (GOPAL *et al*., 2019).

In synthesis, the integration of the insights presents a comprehensive portrayal of the digital transformation in healthcare, emphasizing its potential to revolutionize service quality while acknowledging the nuanced challenges and considerations inherent in this transformative journey. The discernment of these aspects is instrumental in navigating the complexities of digital transformations in healthcare and realizing their potential to elevate the quality of hospital services, knowing that in the first moment it might not be cost-effective but crucial for a second moment of provision of care and patient safety.

2.4.2 Impact of Digital Transformation on Patient Experience

Delving into the digital transformation in hospitals and the experiences in which the patient and eventually its family are impacted must consider some sectors' unique characteristics, enhancing a comprehensive backdrop to the unfolding digital landscape. Historically, this sector has exhibited singular attributes in that patients traditionally had fewer self-service options compared to other sectors; however, the advent of digital technologies has dramatically altered this scenario, enhanced patient agency and enabled a shift towards a more participative approach to healthcare (ALAM; HU; UDDIN, 2020).

This empowerment is facilitated by digital advancements and has consequently transformed patients into active decision-makers in their medical care process (GRAY et al., 2013). This transformation is essential, allowing patients to play a more prominent role in their healthcare journeys. This signifies a shift from passive recipients of care to dynamic participants in healthcare delivery.

Extending this notion, portraying healthcare consumers as both "co-producers of service" and "partial employees," active entities who are indispensably involved in managing their health (MENDE, 2019). The perspective underscores the necessity for more research into patient-centric approaches, as these are in the embryonic stage but hold immense relevance for technological innovation in healthcare (MENDE, 2019). For instance, exploring the implications of implementing humanoid service robots is crucial, especially regarding their effects on elderly patients and the service companies catering to them.

This pivotal role of the patient in the healthcare service production suggests a broader transformation towards more personalized healthcare paradigms. Several studies indicate a trend towards greater personalization and real-time patient care, reflecting the dynamic intersections between healthcare delivery and digital innovations and devices becoming available and accessible (GARAI *et al.*, 2017; THUEMMLER; BAI, 2017; ACETO *et al.*, 2018; ALI *et al.*, 2018; PACE *et al.*, 2019; SANNINO *et al.*, 2019).

Machine learning and AI-enabled natural language processing (NLP) will suggest a patient translation of documents to simplify scientific terms into layman's terms, helping the understanding (GOPAL *et al.*, 2019)

The synthesis of these insights provides a multidimensional perspective on the ongoing digital transformation in hospitals. It underscores the evolving roles of patients, the significance of personalized and real-time care, and the need for continuous research to navigate the complexities and possibilities engendered by digital advancements in healthcare.

2.4.3 Impact of Digital Transformation on Operational Efficiency

The primary objectives of digital transformation are intrinsically linked to the efficient utilization of hospital resources and the attainment of improved efficiency, with a notable emphasis on time savings, cost reduction, and managerial simplification (GASTALDI et al., 2018). These transformations underscore a fundamental focus on enhancing patient outcomes while concurrently optimizing cost structures within healthcare establishments. Consequently, the trajectory of innovation in the healthcare sector is poised for a significant shift, driven by systemic alterations in the economics of care.

The pace of this advancement exhibits significant variability contingent upon the geographical location, the size of the healthcare institution, and the strategic approach adopted by the organization. Within the realm of healthcare providers, this variance manifests through the identification of four distinct maturity levels of digitalization expounded in Table 5 (NEJM CATALYST, 2018). These gradations, reflective of the organization's preparedness and commitment to digital transformation, denote the diverse rates at which hospitals are embracing this technological evolution and subsequently realizing the efficiency-enhancing potential inherent in digitalization.

Table 5: Maturity Levels of Digitalization in Hospitals

Level 1	Level 2	Level 3	Level 4
Paper-based	**Digitized**	**Intelligent**	**Value-based healthcare**
Patient data is captured in a paper-based fashion.	When data is digitized, it is possible to start reaping benefits from the data, and to gain more profound insights.	When digitalization is fully implemented, the organization can become intelligent, applying next-generation data management.	Systems of intelligence are now the core enabler for value-based healthcare.

Source: NEJM Catalyst (2018)

Due to each of these levels, there are different dimensions of impacts that might be projected (NEJM CATALYST, 2018). In the first level, it restricts the capacity for valuable data analytics, hinders productivity, and limits the efficient allocation of resources toward high-value tasks. Moving to the second level, despite the accelerated digitalization of health data facilitated by EMR systems, they predominantly resemble digital adaptations of traditional paper-based systems, offering limited capabilities for data mining and analysis. Transitioning to Level 3 involves the incorporation of analytics, machine learning (ML) and artificial intelligence (AI) technology, and novel service models aimed at addressing the challenge of enhancing business performance. Finally, in Level 4, the delivery model shifts to one in which healthcare providers can be remunerated based on patient health outcomes, rather than the traditional fee-for-service approaches that hinge on the volume of healthcare services provided.

In the context of digital transformation, where efficiency gains are intrinsically linked to enhanced data utilization, three fundamental pillars have been identified. The first pillar pertains to the reduction of expenses and the optimization of workflows. The second pillar focuses on increased automation and interconnectivity. The third pillar is associated with the reduction of waiting times. The connection between the pillars is described in Figure 9.

Figure 9: Impacts of DT in Operational Efficiency
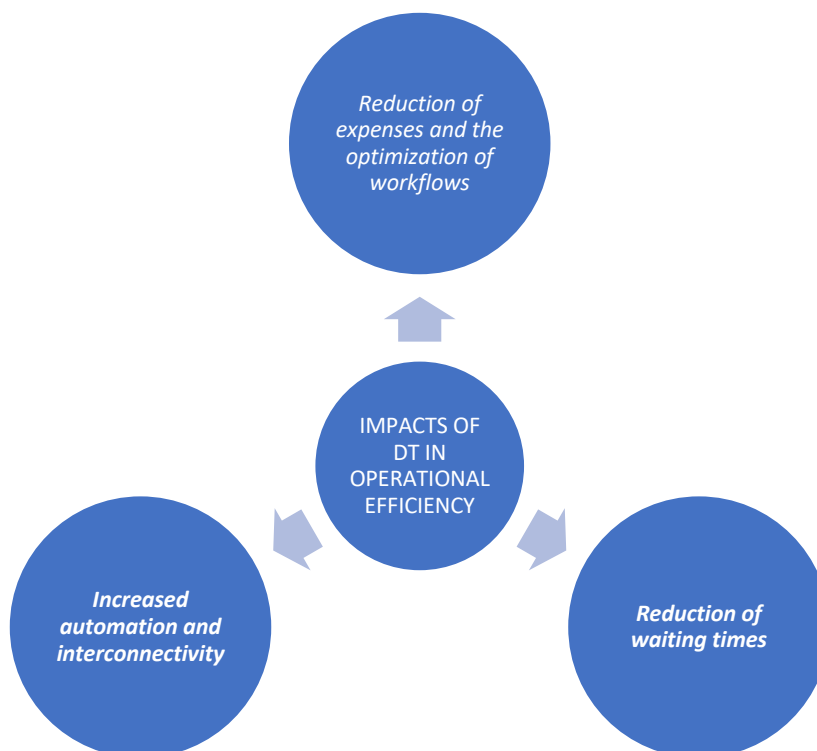
Source: author

One of the primary advantages of digital transformation (DT) concerning efficiency is its ability to optimize workflows, resulting in cost reduction and enhanced process effectiveness. The initial benefits associated with the adoption of digital technologies, as demonstrated in various studies within healthcare organizations, are characterized by cost reduction (SAKR; ELGAMMAL, 2016; ACETO et al., 2018; ALI et al., 2018; CHEN et al., 2018; ELHOSENY et al., 2018; WANG et al., 2018; AMATO et al., 2019; MUNZER et al., 2019; ONASANYA & ELSHAKANKIRI, 2021).

Furthermore, there are reports that assess a positive correlation between operational innovation and patient satisfaction, ultimately leading to increased patient loyalty, primarily attributed to reduced expenses and enhanced workflow (HONG; LEE, 2017; RUBBIO; BRUCCOLERI, 2017; PIETROSI; RAGONESE, 2019).

Overall, the implementation of digital solutions has significantly increased the level of automation and interconnectivity, leading to substantial improvements in the efficiency of patient care and administrative processes (YANG, 2015; TORTORELLA *et al*., 2020a, 2022). Automation accelerates processes and allows healthcare professionals to focus on strategic tasks (BINSAR *et al*., 2022).

The digital transformation has distinguished itself through its significant impact on reducing waiting times, representing a fundamental evolution in optimizing patient

care. Various studies, such as those conducted by, have underscored the benefits of this transformation in reducing waiting and healthcare service delivery times (ALI *et al.,* 2018; PAN *et al.,* 2018; WANG *et al.,* 2018; PACE *et al.,* 2019; MUNZER *et al.,* 2019).

One essential aspect of this progress is the ease of archiving and accessing patient records and medical images, an advancement that not only streamlines processes but also reduces storage costs. Furthermore, cloud computing, as outlined by Gopal *et al.* (2019), holds the promise of more agile innovation cycles and more efficient collaboration in the healthcare sector. This, in turn, contributes substantially to enhancing telemedicine resources, which play a critical role in reducing waiting times and enabling more timely and effective healthcare delivery to patients. Thus, digital transformation emerges as an essential ally in reducing waiting times while simultaneously fostering significant improvements in healthcare service efficiency.

2.5 CHALLENGES AND OPPORTUNITIES FOR THE DIGITAL TRANSFORMATION IN HOSPITALS

In the ever-evolving landscape of healthcare, digital transformation stands as an indelible force, ushering in cost-effective and time-efficient care. Particularly within the realm of larger healthcare organizations, those affiliated with medical colleges and nursing schools, the imperative lies in adapting curricula to ensure that pre-service healthcare professionals, encompassing doctors, nurses, and clinical staff, receive comprehensive training in technology utilization within the healthcare sector. This educational shift becomes paramount in harnessing the potential of digital transformation for the betterment of patient care (LYANNA *et al.*, 2022).

This juncture in time serves as a pivotal moment to transcend the conventional fee-for-service paradigm. However, it necessitates a shift in perspective from merely pursuing digitization as an end goal to unlocking the transformative potential it harbors (DE MOOIJ; FOSS; BROST, 2022). The ongoing journey involves complex trade-offs, often navigating the delicate balance between potentially conflicting objectives such as affordability and quality. In this context, normative judgments from decision-makers become imperative (RICCIARDI *et al*., 2019).

A prevalent challenge emerges in the escalating costs associated with digital transformation efforts, further compounded by the difficulty in comprehensively assessing and monitoring their impact. There exists a notable dearth of systematic

evaluations, particularly those addressing the transformative facets of healthcare delivery at the organizational and operational levels (RICCIARDI *et al.*, 2019). Moreover, the conventional Maturity Models, designed to navigate the disruptions and dynamics of digital transformation, have faced criticism for their perceived focus on incremental development and static states (BURMANN; MEISTER, 2021).

The initial challenge materializes in the intricate task of configuring digital systems to accommodate the diverse needs of various hospitals and professional groups. Hospitals, despite their shared objective of patient care, exhibit distinct operational procedures and resist uniform, "recipe-based" healthcare practices (EDEN et al., 2021). Consequently, the diversity in the digital systems existing before implementation, tailored to specific hospital requirements, exacerbates resistance to change, contributing to varying levels of acceptance (EDEN et al., 2021).

In line with a logical framework, this figure, presented in Figure 10, aims to systematically enumerate challenges that hold more formative and foundational significance, particularly for individuals and entities already engaged in more advanced stages of DT processes. Based on the understandings of maturity presented by the authors (LYANNA et al., 2022; BURMANN; MEISTER, 2021), the scheme presents the growth of challenges to define them step by step, even though the theory emphasizes that at a greater or lesser level, the challenges are inherent to all degrees of maturity.

While training in technology use is advancing, comprehensive capacity-building remains necessary. Top management increasingly recognizes the need for DT investment, though further progress is required. The understanding of digitalization as a means rather than an end is spreading, yet broader adoption is needed. Efforts to develop generalizable DT frameworks show progress, but challenges persist. Measurement tools for tracking DT progress are still evolving, emphasizing the need for robust evaluation mechanisms. Overall, these dimensions reveal both progress and ongoing challenges in achieving effective DT in healthcare.

Figure 10: DT challenges for Hospitals and Healthcare Organizations
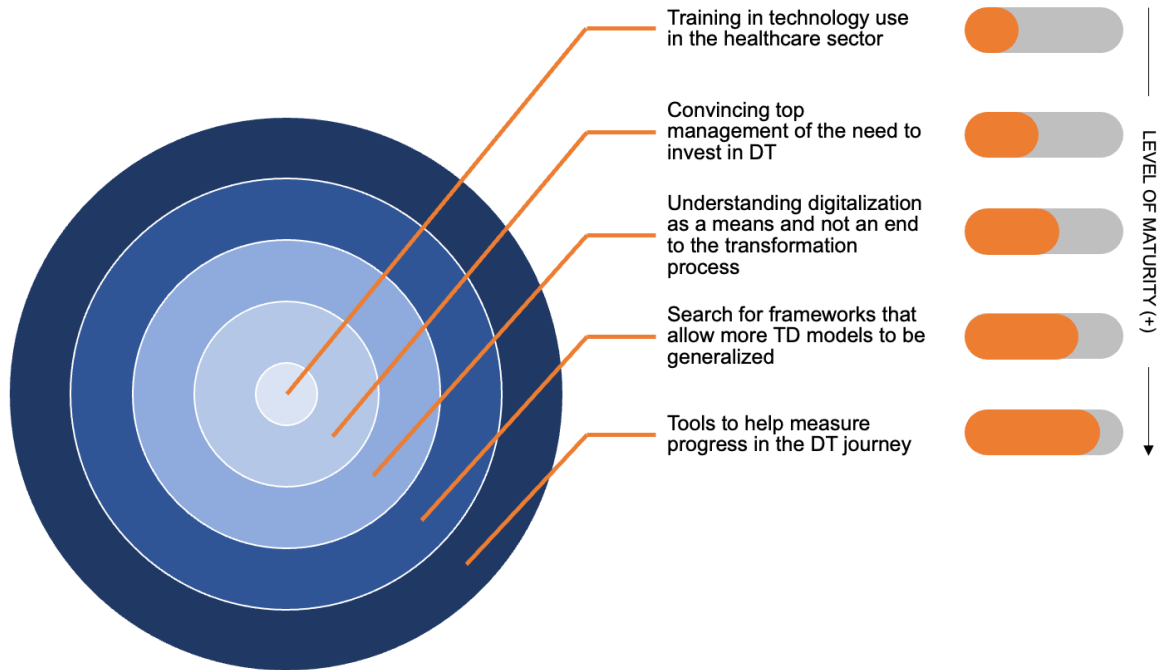
Source: Author

Furthermore, healthcare organizations encounter formidable obstacles in articulating the significance of digital transformation expenditures to their strategic boards. Even when the evidence attests to the pivotal role of digital transformation programs in addressing critical healthcare challenges (GASTALDI *et al*., 2018), misconceptions and uncertainties persist within hospital boards regarding the tangible impact of digital technologies. As a result, the potential of digital transformation to alleviate existing challenges remains underexplored and underutilized.

3 METHODOLOGICAL PROCEDURES

Given the need for validity and reliability in research, rigorous methodological procedures must be observed. In this study, with an emphasis on enhancing management, the research objective is to bridge theory and practice (DRESCH; LACERDA; ANTUNES, 2015). To meet this objective, this section aims to describe the techniques and methods that will be employed in the research.

3.1 CHARACTERIZATION AND STUDY DESIGN

The appropriate execution of the research methodology is one of the fundamental requirements for building dependable scientific knowledge (DRESCH; LACERDA; ANTUNES, 2015). According to the authors, the scientific method utilized in research should consider the theoretical gap, practical problems, or even direct observations of a phenomenon outside the research scope that must be elucidated, described, or explored.

Considering the proposed research, this study will be grounded in a positivist philosophy, which entails approaching the object of study by establishing assumptions that can and should be methodologically defined, and where the attainment of positive knowledge is only possible through established methods of the exact sciences (POPPER, 2008). In terms of approach, an inductive logic will be employed, whereby the construction of scientific knowledge is derived from the observation of phenomena and discoveries, leading to generalization (GIL, 2008).

Regarding the methodology, this study will be of an applied nature, aimed at generating knowledge for practical application towards solving specific problems with a qualitative approach. The research is characteristically descriptive, proposing the interpretation of phenomena and assigning meaning to them. The objective of this research is exploratory in nature, seeking to clarify problems and develop hypotheses.

Regarding the procedures employed, the starting point of this study was a Systematic Literature Review (SLR) on Digital Transformation in Health, as discussed in the previous chapter 1.3. This methodology groups previous works on a specific

theme, promoting the identification, evaluation, and interpretation of studies in each area through the analysis of concepts and practices.

To deepen and achieve the proposed objectives, this study will proceed through the realization of a case study. This will involve exhaustive, deep, and extensive research of a unit or situation that will be verified empirically, enabling broad and detailed knowledge and descriptions (TULL, 1976). The case study as a research method aims to understand a contemporary phenomenon in a real context and is carried out through empirical research (DRESCH; LACERDA; ANTUNES, 2015).

Case studies are categorized based on their content and final objective, and can be classified as exploratory, explanatory, or descriptive. They are further distinguished by the number of cases, either single or multiple (MIGUEL, 2007; YIN, 2015). Therefore, according to Yin (2015), it is important to differentiate between single-case study projects and multiple-case study projects. Likewise, it is important to define the "case" or unit of analysis to be studied. According to these criteria, this research is characterized as an exploratory single-case study.

The research strategy chosen for this study is an observational case study, specifically using participant observation as the method of data collection. The object of analysis will be combined by the organizational components and its relationships (RAUEN, 2002).

Figure 8 aims to provide concisely the methodological proposition of this study within the seven scopes defined by Saunders, Lewis, and Thornhill (2019), represented through the onion research model. This figure is intended to provide a

clear and visual overview of the research methodology to readers, highlighting the main components of the study and their relationship to the overall research framework.

Figure 11: Onion Research
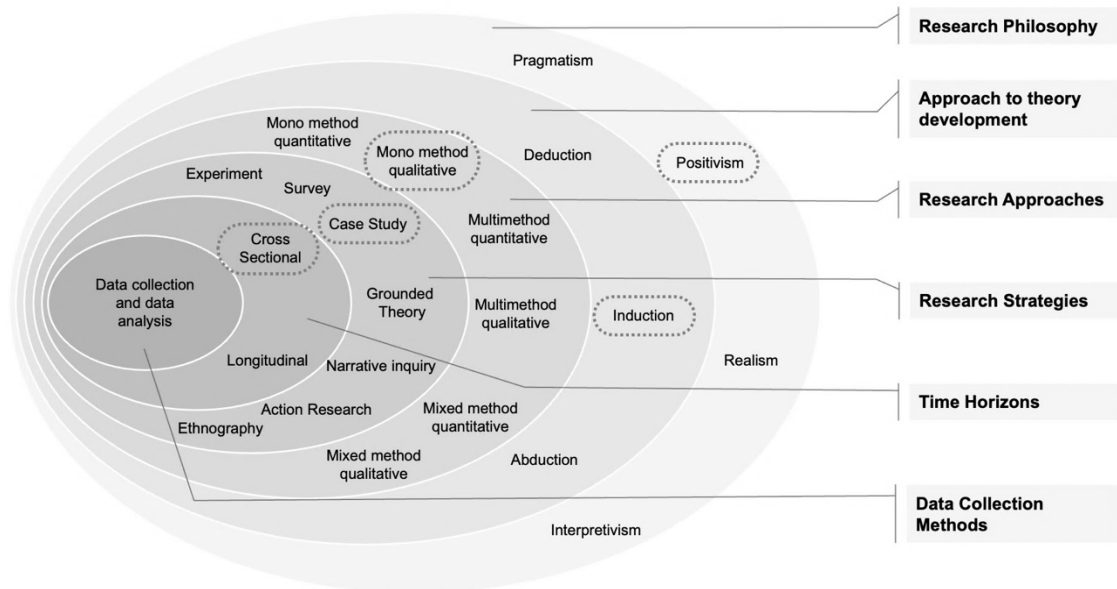
Source: adapted from Saunders, Lewis and Thornhill (2019)

3.2 WORKING METHOD

The working method aims to guide and support researchers throughout their study while ensuring the research's replicability. The researcher's method delineates the sequence in which logical actions are taken to achieve the research objectives (DRESCH; LACERDA; ANTUNES, 2015). A well-structured and faithfully adhered-to procedure is crucial for study replicability, besides facilitating validation through other researchers (DRESCH; LACERDA; ANTUNES, 2015).

From this viewpoint, based on Miguel (2007) and Dresch, Lacerda, and Antunes (2015), this research follows six major steps: i) define theoretical conceptual framework; ii) plan the case study; iii) conduct a pilot case study; iv) collect data; v) analyze data; and vi) produce reports. Figure 9 proposes content and sequencing for conducting the case study, illustrating the systematic stages to address the research question.

Figure 12: Working methods

1. Define theoretical conceptual framework

| Draw up SLR protocol | Define keywords | Perform the RSL | Identifying the problem and the research justification | Building the theoretical framework |

2. Plan the case study

| Developing the case study protocol | Defining the case | Define data sources and interviewees | Drawing up the data collection instrument | Define the analyses for the data collected |

3. Conduct the pilot interview

| Selecting the company for the case study | Apply the pilot interview | Analyze the difficulties faced by the interviewees | Evaluate the results | Adapt the interview if necessary |

4. Collect data

| Contact the selected interviewees | Collecting data | Prepare the memorandum as defined in the protocol | Prepare the memorandum as defined in the protocol |

5. Analyze data

| Organizing data | Coding the data collected | Evaluate de agreement from the interviews | Capturing patterns and deviations from the proposed codings | Compose the case analysis |

6. Produce reports

| Analyze and summarize data | Present implications and contributions of the case | Present evidence and patterns found | Synthesize results in relation to the research problem |

Source: author

3.3 STUDY CONTEXT

For this study, the central subject is the case study of Hospital Moinhos de Vento (HMV), located in Porto Alegre, Rio Grande do Sul, Brazil. HMV is a large philanthropic hospital in southern Brazil with 95 years of history and is currently recognized as the 3rd best in Brazil and 108th in the world (Newsweek 2023 Ranking). Two factors define the suitability of this organization for the objectives of this research: the first being the

existence of a structured guideline for the 2022–2026 strategic planning named "Promoting Digital Transformation", reinforcing the possibility of applying the study, and the second factor being the privileged availability of access to data by the researcher within the organization.

Aiming to deepen the understanding of the object of study, it is important to understand that the origin of HMV was due to the Germanic community present in the Porto Alegre/RS region, who sought the same standards of asepsis and hygiene present in Europe that were not found at the time. This Hospital was inaugurated in October 1927, and until 1942 it was called the German Hospital. Due to the war, it adopted the name of the neighborhood where it was located and was renamed Moinhos de Vento Hospital.

HMV has a structure that serves patients from several regions and is considered a national reference hospital for dozens of medical specialties. As relevant data, it is worth mentioning that the hospital currently has 485 beds, more than 4,400 collaborators, 3,700 physicians, 18 operating rooms, 4 external units, and a faculty of health sciences, generating a total built-up area of over 110 thousand square meters.

The national and international recognition of the protagonism in health is reflected in the pioneering of various technologies, research, and procedures performed within the Hospital, as well as in the awards and partnerships that are established. The Hospital has been accredited since 2002 by the Joint Commission International (JCI), the highest certification body regarding standardization of care processes; since 2009, it has been recognized as one of the six Brazilian Hospitals of Excellence listed by the Ministry of Health; and since 2013, it is affiliated with Johns Hopkins Medicine International, the international arm of the 4th best Hospital in the world. In addition, it has numerous certifications, such as ISO 9001 for its hospital management and ISO 14001 for its environmental programs and initiatives.

As for the business model, today HMV is positioned as a health care institution since it encompasses other services besides providing hospital services, such as clinical practice, education, and research. The first, and most relevant, of the activities is in clinical practice, where there is the hospital itself, four clinics outside the main site structure, e-health solutions, and corporate health management services. The second activity is research and innovation, where we find the research institute that runs projects and clinical studies, besides research in partnership, and Atrion, which is the hospital's innovation center. The third pillar is education, in which the Faculty of Health

Sciences of Hospital Moinhos de Vento is responsible for the undergraduate, postgraduate, residency programs, and technical courses. Finally, the performance through social-environmental responsibility, in which the projects of the Program for Development and Support to SUS (PROADI-SUS) and the Moinhos Social Institute (IMS), besides projects of environmental responsibility, fit in.

Giving a dimension of the growth of this organization in the past 10 years, the Hospital has grown 54% in the number of employees, 50% more operating rooms, and 37% more beds. Added to all these performance and growth activities, this results in a gross operational revenue of R$1.2 billion accounted for in the year 2023.

With a vision of being the best health institution in Brazil until 2029, Hospital Moinhos launched in 2022 a new cycle of strategic planning with the purpose of "Caring for people, integrating health, research, and education". From this planning, graphically represented in Figure 12, one of the strategic objectives stands out: "Promoting digital transformation." A series of projects will drive the achievement of the objective complement, and their structuring will serve as the basis of this study.

Figure 13: Strategic Map (2022 – 2026 cycle)
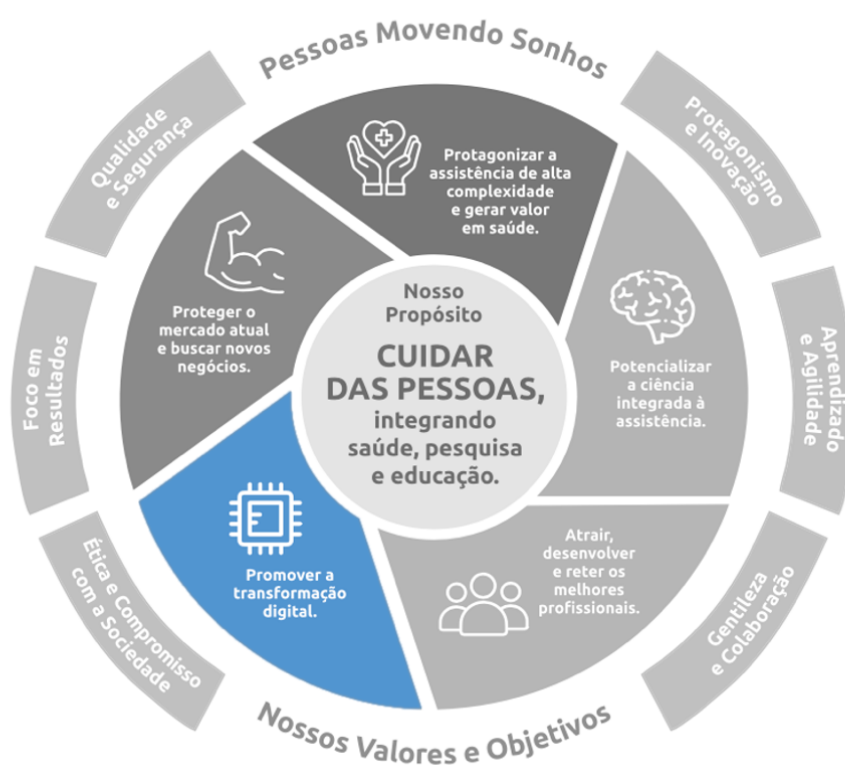
Source: Hospital Moinhos de Vento Strategic Map

3.4 DATA COLLECTION

To conduct the case study, it is necessary to collect relevant and reliable data to answer the research questions and objectives set. There are different types of data collection instruments that are used, each suited to the characteristics of the type of information that was sought during collection. In this case study, basically three data collection instruments will be used: document analysis, semi-structured interviews, and participant observation with the evidence described in Table 6.

Table 6: Sources of data from the case study

Source	Evidence
Documents	i. Map and strategic planning of the institution. ii. Opening terms of the strategic projects of the DT axis, containing the justification, scope, risks, metrics, deadline, and sponsor of each program and project. iii. Budget and investment for each project for 2023 – 2026. iv. Contracts for suppliers, technologies, and consultancies that have been hired to develop related projects.
Interviews	i. Executives (coordinators, managers, and superintendents). ii. Involved employees impacted by DT processes and projects. iii. Sponsors of strategic programs and projects.
Observation	i. Participative observation in project monitoring meetings. ii. Participative observation in project indicator meetings.

Source: author

Document analysis is a data collection tool that allows the researcher to examine documents relevant to the case being studied. Documents should include strategic projects, reports, plans, contracts, and policies related to digital transformation at HMV. Document analysis will enable the identification of patterns, trends, and relationships among the information collected. The documents will be

collected and analyzed with the interviews and participant observation to provide a more complete picture of the case study.

        The semi-structured interview is a data collection tool that allows a deeper and more detailed insight into the experience and opinion of the participants. The interviews will be conducted with the main collaborators and sponsors involved in the hospital's digital transformation projects and processes, especially the Information Technology and Strategy teams, but also with superintendents and executives who have the guiding vision of the business. The questions prepared according to the Appendix B enable the interviewer to have the flexibility to explore issues that may arise during the interview. The interviews will be recorded and transcribed for later analysis.

        For the interviews, as set out in Table 6, an initial selection criterion has been established, which will be based on an analysis of all the opening terms, listing all the names that are mentioned in some way as a sponsor, co-sponsor, project leader or technical manager. In addition to these interviewees, it is also necessary to interview the managers responsible for the strategy area, since this is the area that defines, controls, and invests in DT projects. It is natural in qualitative analysis processes, especially in observation, that it cannot be said from the outset that this criterion alone will exhaust the topic (SAMPIERI; COLLADO; LUCIO, 2013), so from the interviewees, non-probabilistic sampling called snowball sampling will be used, where the individuals selected to be studied invite new participants from their network of friends and acquaintances (VINUTO, 2014). A summary of the process and characteristics of the interviewees and their positions is shown in Figure 14.

Figure 14: Definition of Interviewees
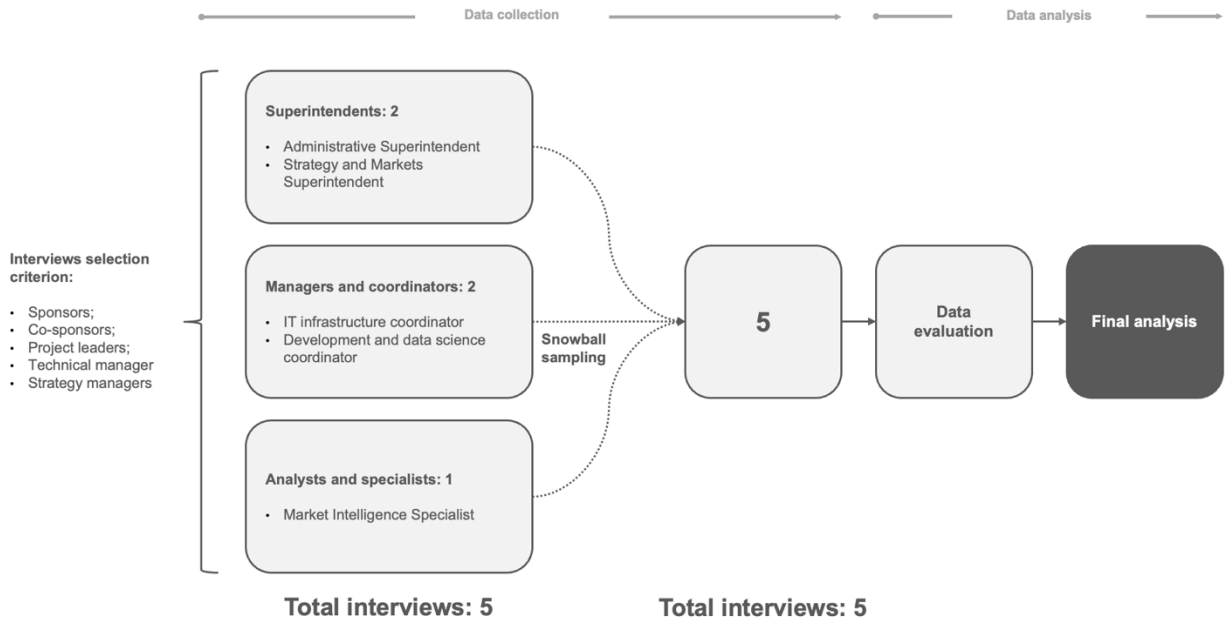
Source: author

These five interviewees together make up the group of managers in charge of technology, management, and the hospital's entire strategy. Consisting of two superintendents, two managers, and a specialist, access to these professionals will allow us to strategically assess the vision and perceptions of the main managers who interface with and make decisions affecting DT processes. On average, these professionals have been with the company for 11 years, which will also make it possible to understand how current visions have been built up and to assess points of impact, expectations, and perceived barriers.

Figure 15: Organization chart
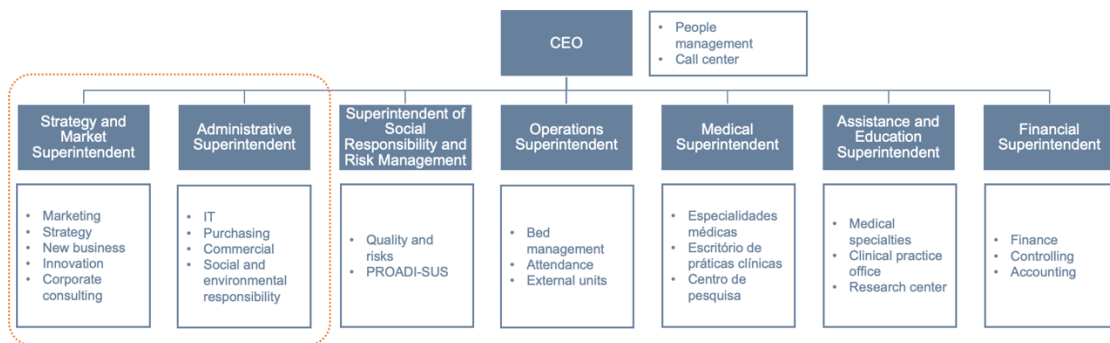
Source: author

Based on the criteria for defining the interviewees and snowball sampling, the description of the interviewees in order of interview, as well as their educational and career characteristics in the institution, is described in Table 7. For a more in-depth understanding of the structure and areas in which the interviewees work and how they relate to each other, Figure 14 shows the hospital's institutional organization chart with the interviewed areas highlighted.

Table 7: Interviews for the study case

Interviewee	Position	Time within the organization	Time in the position	Academic Background
Interviewee 1	Administrative	11 years	9 years	Business Administration
Interviewee 2	Strategy and Market	17 years	1 year	Public Relations
Interviewee 3	IT	9 years	2 years	Software Analysis and Development
Interviewee 4	IT	9 years	8 years	Computer science
Interviewee 6	Market Intelligence	10 years	6 months	Software Analysis and Development

Source: author

Based on the understanding of Dyer and Wilkins (1991), the interviewees chosen are strategic in the search for a more profound understanding to better capture the complexity and phenomena surrounding what, in this case, are DM processes. As a result, this study will value depth over breadth, as well as a focus on describing the context, points that are described as essential in the critique of superficiality described by Dyer and Wilkins (1991).

Interviews will be conducted utilizing Microsoft Teams, a digital communication platform that stands out not only for its capabilities in seamless connectivity but also for its adeptness in transcribing conversations in real-time, which can be downloaded through Microsoft Steam. This feature, which allows both the recording and immediate transcription of our discussions, facilitates a streamlined transition from data collection to data processing.

Finally, participant observation is a data collection tool that allows the researcher to directly observe the studied phenomenon in its natural environment (SAMPIERI; COLLADO; LUCIO, 2013). In this case study, observation will be performed by the researcher within the Hospital environment, participating in meetings, events, and activities related to the DT projects. The objective of observation is to collect information about the context, behavior, and interaction of the individuals involved. Notes will be recorded in a field diary to assist in data analysis.

Given the researcher's position with the object of study, direct observation will also be used as a source of data, especially as suggested by Sampieri; Collado; Lucio (2013) in an ideal scenario where 'complete participation' takes place, in which the researcher blends completely into the environment, becoming an additional participant. This model is not only feasible but also desirable within this study.

3.5 DATA ANALYSIS

In the current digital age, the tools and platforms leveraged for data collection are as instrumental as the data itself. The raw transcribed texts from the interviews will be imported into another software designed for coding and categorizing qualitative data. This ensures a systematic and organized approach to distilling insights and themes from the comprehensive dialogues held with the participants.

To analyze the interviews and assess the agreement between the interviewees, the Fleiss' kappa statistical technique was used, which lists a degree of free marginal Kappa varying between 0 and 1. When applied to the same subject or phenomenon, the analysis of agreement makes it possible to verify identical results (MIOT, 2016). In this sense, the application of Fleiss`Kappa is a way of measuring agreement between interviewees considering 'n' subjects through a scale that applies categories (FALOTICO; QUATTO, 2015).

For the analysis, the tables of answers were entered into the tool called Online Kappa Calculator (http://justusrandolph.net/kappa/), informing the number of categories per question and how many answers each grouping had. With the results of the Free Marginal Kappa, the classification indicated by Landis and Koch (1977) was used, as shown in Table 8.

Table 8: Fleiss' kappa index classification

Index	Classification	Subtitle
K < 0	Insignificant	IN
K > 0,01 < 0,20	Slight agreement	SA
K > 0,21 < 0,40	Reasonable agreement	RA
K > 0,41 < 0,60	Moderate agreement	MA
K > 0,61 < 0,80	Strong agreement	AS
K > 0,81 ≤ 1	High agreement	HA

Source: adapted from Landis and Koch (1977)

Within the realm of qualitative research, Saldaña (2013) proposition offers an intricate blueprint for data analysis. Grounded in this theoretical framework, Figure 14 will be presented, delineating the specific codes and categories derived from the collected data. As articulated by Saldaña (2013), qualitative codes transcend mere descriptive labels; they serve as instrumental conduits that capture the quintessential facets and foundational elements of the research narrative. When these codes are systematically aggregated based on their inherent similarity and regularity, they facilitate the evolution of distinct categories and enable a profound examination of their interrelations. Consequently, this analytical trajectory propels our progression from rudimentary codes to elaborate categories, and subsequently to relationships, propositions, and overarching themes. In essence, this methodology underpins the transition from granular codes and categories to a more synthesized, theme-based, conceptual, and theoretical elucidation.

Figure 16: Codes-to-concepts for qualitative inquiry

Codes	Categories	Themes/ Concepts
13. Improvements in diagnosis and treatment	Quality of Care	(i) Impact of Digital Transformation on the Quality of Hospital Services
14. Digital intervention opportunities		
15. Increased access to health services		
14. Data for monitoring patient before and after the hospital journey		
10. Process optimization	Operational Efficiency	(iii) Impact of Digital Transformation on Operational Efficiency
11. Time-saving impacts		
12. Cost reduction		
1. Technical requirements	Digital Infrastructure	
7. Patient feedback on digital tools	Patient Experience	; (ii) Impact of Digital Transformation on Patient Experience
8. Impact on patient engagement		
8. Information access and transparency		
4. Digital training and upskilling	Workforce and organizational culture	(iiii) Managerial and organizational impacts
16. Change management		
6. Shifts in roles and responsibilities		
18. Leadership's role in driving digital change		
22. Popularly used tools and platforms	Digital Tools and Innovations	
23. Innovations on the horizon		
25. Aligning digital strategy with organizational goals	Strategic Implications	
26. Long-term digital visions		
28. Impact of regional socio-economic conditions	External Factors	
29. Cultural implications for digital healthcare		
30. Global trends and best practices		
29. Regulation and government decisions		
20. Financial constraints	Challenges and Barriers	
19. Technological challenges		
21. Regulatory and compliance hurdles		
9. Patient privacy and data security concerns		
2. Integration challenges		
5. Staff resistance to change		

Source: author

For the documents' analysis, a systematic document review protocol will be established, wherein documents will be scanned for relevant information, categorized by the nature of content (opening terms, policy guidelines, implementation reports, etc.), and critically analyzed for insights regarding the digital transformation journey.

4 ANALYSIS OF THE RESULTS

This chapter discusses the analysis results from the interviewees' perceptions of their understanding of the concepts, the expected contribution of the different technologies, and the challenges and expectations relating to digital transformation. Based on the descriptions, the critical elements are explored and analyzed, as well as agreements, relationships, and understandings in the view of different professionals of the proposed dimensions.

4.1 INTERVIEWEES' PERCEPTIONS OF DT CONCEPTS

Given that authors such as O'leary (2022) and Gobble (2018) suggest for the possible divergence of understanding of DM concepts, the first dimension of analysis was the professionals' view of the concept. Table 10 shows the results per statement made and the Fleiss' kappa results for both the individual and the group regarding understanding of DM concepts.

Table 9Results of the interviews' agreement on the understanding of DT

Ref.	Question	Agreement			Free marginal Kappa			
		A	D	NO	k		k	
1.1	Digital transformation is a process that requires continuous investment	4	1	—	0,2	SA		
1.2	The goal of digital transformation is the implementation of new technologies	1	4	—	0,2	SA	0,47	MA
1.3	Technologies are a means of enabling the digital transformation process	5	—	—	1,0	HA		

A: Agree; D: Disagree; NO: No Opinion; k: Fleiss`Kappa Index;
IN: Insignificant; SA: Slight agreement; RA: Reasonable agreement; MA: Moderate agreement; AS: Strong agreement; HA; High agreement

Source: author

There was moderate agreement among the interviewees when analyzed the block of questions relating to understanding the concept. Everyone agrees that technologies play a "means" role in the digital transformation process, but there are disagreements when it comes to evaluating the continuous investment made in digital

transformation and about the objective of digital transformation being to implement new technologies.

4.1.1 Interviewees' perceptions of continuous investment in DT

There was slight agreement with the analysis of the need for continuous investment. There was a consensus that it is necessary to invest in a digital transformation process, but it is necessary to correctly interpret when and where this investment will be made and with what expectations.

As an example of where investments should be made, some interviewees stressed the need to clarify that for digital transformation to take place, it is necessary to look at the management triad: people, processes and technology. The following statements exemplify this perception.

> "[…] *I understand that among the pillars of digital transformation, we can list three points: people, processes, and technology. Of these 3, only one requires an actual investment, which for me is the technology pillar. The other two pillars that support digital transformation for me are people and processes* […]". - Interviewee R

> "[…] *Maybe there's this triad where people have to understand, I as an institution have to want to, and there's the question of process from where the technology comes that will be the means in all situations of process or technology.* […] *I think this triad will always reveal itself. We'll always have to look at these three ends.* […]" - Interviewee P

> "[…] *Today, not only do few hospitals have the intellectual capacity in technology to leverage what the priorities are within the hospital. This goes beyond just physical investment in technology, hardware, and equipment. You know, intelligence, but also people, right?* […]" - Interviewee T

Regarding the hospital's specific situation, it was possible to understand that there has been a period of greater investment recently. This investment makes it possible to understand over a period what direction this budget item is taking and should take in the short and medium term, according to the interviewees.

> "[…] *If we think about the investments we've made in technology—robust investments, really investments that exceed 10 or 15% of the total annual capital expenditure (CAPEX), we're talking about no more than 5 years. Until those five years, we were talking about very small, very timid investments.* […]" - Interviewee E

> "[…] *If you look at the whole of Brazil, man, and we tried to do some research there during the pandemic, we tried to do some things here to identify where*

technology could be helping in this... and we saw that out of 7,000 hospitals, around 400 hospitals were those that, on their own, managed to make their own investments in technology. If we went deeper, we'd find events and institutions that are investing in people so that they take part in studies and participate in studies because they participate in new ideas. There are no more than 40 to 50 hospitals in Brazil. […]" - Interviewee T

DT requires continuous investment for different reasons, and an additional question was asked about the perception of the behavior of these investments over time. Figure 16 illustrates the understanding of the different interviewees. While interviewees T and P say that the initial investment is higher and should then be reduced because of maintenance, interviewee E says that both due to the dollarization of investments in technology and the greater need for updating, the investment should increase. *"It's a path of no return, and it's here to stay, and from here it will be on a ramp. I don't know if it will be for 5 years, 10 years, or 30 years, but I have the impression that in the short to medium term it will continue to grow"*(Interviewee E). Finally, interviewee M said that tactics are necessary, but that investment certainly can't and shouldn't be linear, showing moments of greater and other moments of lesser investment according to the challenges of each moment.

Figure 17: Perception of future investments for DT
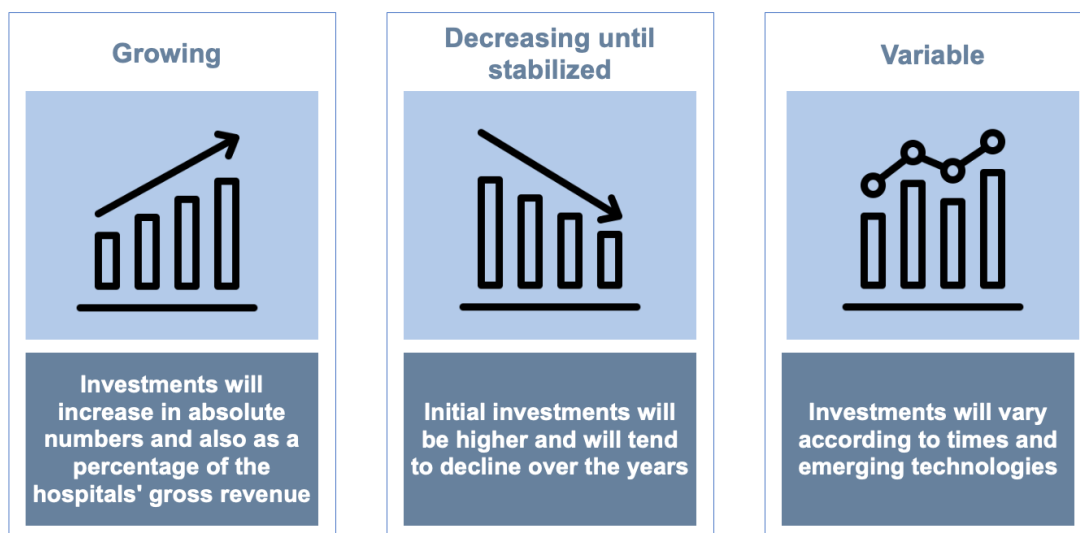
Source: author

In addition to investment behavior, Interviewee M has perceptions about cycles of change. This adds an equally relevant layer that the culture and type of organization can influence the way in which these investments take place.

"[…] we're talking about cycles of change, it's possible for the institutional culture to make the most abrupt move, let's say, investing in a very strong way, with training with technological changes, etc., and then cooling down, and then perhaps having maintenance, depending on maturity. But perhaps there are environments where security is important, where we must start more gradually. And the turning point comes in the middle of the process, you know? So, I don't think any one model is better, I think the culture will determine it. […] - Interviewee M

One of the reasons for the lack of investment in DT in some scenarios, as well as the perceived low priority given to the topic by all those interviewed, can be explained by the nature of the hospital sector in short term investments and avoidance of risks. According to Interviewee E, investment priorities are often given to things beyond the process that generate immediate gains in the perception of executives.

"[...] When it comes to defining an investment, right? The purchase of a CT scanner, the purchase of an MRI scanner, and the innovation of a robotic park speak louder than the actual thinking we do, and I'm not even talking about investments in intelligence and digital transformation, I'm still talking about the basic investment in pure technology. [....]" - Interviewee E

Interviewee R agrees that investment is necessary. The point of disagreement was regarding the fact that it is an ongoing investment, where he states that after an initial effort, maintenance is developed by the very structure of people and processes in DT.

"[…] That's why I don't agree that digital transformation necessarily needs investment. It does, doesn't it? For some specific points, it needs investment, but not for others. Because for me, digital transformation is much more than a technological increase, it's an institutional culture, a people process. […]" - Interviewee R

4.1.2 Interviewees' perceptions of technology as a goal for DT

There was slight agreement with the assessment of the objective of the transformation. According to the interviewees, there was a consensus that it is necessary to invest in a digital transformation process, but it is also necessary to correctly interpret when and where this investment will be made and with what expectations.

Regarding the interviewees who disagreed, there was an understanding among 4 of the 5 interviewees that technology is important, as exemplified in the answers in chapter 4.1.1, but that it is not specifically the aim of digital transformation. The statements also highlight that sometimes-existing technologies support the digital transformation process, but that they can be underused.

> *"[…] Anyway, I have to think about how I can make it work in a more intelligent way, and I don't necessarily have to bring in technology. I think that in a digital transformation, it needs a lot of that too. It's just that the expression digitize takes you back to a technological solution, but before you have a technological solution, I think there's always that previous step of looking at the processes. […]"* - Interviewee P

Part of the explanation for why these technologies are sometimes not used to their full potential may lie in the complementary view of Interviewees R and M, who reinforce the point that the institution is people-oriented and therefore change is slower. There are, however, opportunities that are generated from human capital, mainly in the development of teams and people in the DT process.

> *"[…] in a 95-year-old institution, we have a change of mindset when it comes to processes and people. Today, for me, Hospital Moinhos de Vento is a people-oriented company. A new sector opens up, and I need 10 people. […] When you think about a new service, you don't have to think about how many people there are anymore; we must get the manager to think about how this process will be integrated, how it's going to be integrated, and the care journey because today each area also thinks about its process, it doesn't think about the journey. [...]"* - Interviewee R

> *"[…] The goal is not to implement new technologies, it's to revisit the way systems work: systems in terms of the organization, people, individuals, and the individual's mindset, how they behave, how they relate, and how they solve problems. […]"* - Interviewee M

> *"[…] the technologies will have to be exploited, obviously, and they will bring about much of the digital transformation. But I think a lot lies in the development of people. […]"* - Interviewee T

Some interviewees said that for some areas, there should be a view that DT is aimed solely at implementing new technologies. This view covers what other possibilities should be evaluated and what should be expected in addition to technology.

> *"[…] in the institution where I work, there is still a lot of bias towards implementing technologies, which, I think, is the easiest part, and perhaps it could be a way to explore and take the first steps towards understanding. But*

I think that digital transformation happens if we can see a new way in which the organization works, which takes relationships to new levels and generates new solutions. […]" - Interviewee M

Regarding the interviewee who agreed with the statement, it was clear that even if he agreed, there is room for improvement or new uses of currently existing technologies. In short, they agreed that the DT process can also take place, or at least begin, without necessarily acquiring technologies that do not yet exist in the hospital.

"[…] So I agree in part. I think that not only the digital transformation, but it also comes to give new clothes to existing technologies. […]" - Interviewee E

Technologies play an important role in advancing DM processes, but it is reinforced by the majority of interviewees who emphasize that the real purpose goes beyond mere technological acquisition, involving a re-evaluation of organizational processes and the training of people. This understanding suggests that DT can also take place through the optimization and integration of existing practices, making the most of the potential of current technologies. Thus, DM is not just a technological update, but an opportunity to promote a deeper cultural and operational change, involving all levels of the organization and leading to a significant improvement in the provision of health services.

4.1.3 Interviewees' perceptions of technology as a means for DT

In the analysis of the understanding of technology as means to DT, there was a consensus among the interviewees that technology in isolation is not a solution, but part of the DT process. All the interviewees emphasized the need to use and apply technology correctly.

"Who are the people who will be able to access this technology, benefit from it, and bring benefits to our patients? So yes, technology is a necessary means for us to employ what the digital transformation is proposed to do." - Interviewee T

"[...] as an institution, I have to want it, and there's the question of process from which the technology comes that will be the means in all process situations or will need a technology. [...]" - Interviewee P

Given the understanding that technology is an essential means of enabling digital transformation, but not the only necessary element, the executives' vision

reinforces the other points that are part of it. Interviewee P refers to the triad of people, processes, and technology as fundamental and warns of the risks of a purely technological vision with the potential not to deliver results. According to him, "[...] does digital transformation only need technology? No, it needs prepared people and appropriate processes" (Interviewee P).

Not framing DT as just technology also warns of the complexity inherent in the process. Adding to Interviewee P's view, Interviewee E draws a parallel with other technologies: "[...] the digital transformation is very much about people, it's a journey of maturation, not an off-the-shelf purchase". The statement reinforces that, in addition to technology, human involvement and engagement are crucial.

Conceptually, interviewee R attributed the term "supporting processes and journeys" as the function of technology in DT. In agreement, Interviewee T complemented this with a use case, which is data interoperability, a concept that, technologically, he considered to be outdated, but which, due to a lack of interest and engagement and even due to the sector's current model, is not making progress in the healthcare market.

Adding to the impact of the complexity of the sector, the interviewees said that the current healthcare remuneration model could slow down DM processes. "The chain needs to be rewarded for efficiency to DM processes to advance. Today we need to repeat exams and consultations, and our business model, which profits from this, is running out of time" (Interviewee T).

The analysis of the interviews reveals agreement with the unified concept that technology is a means for digital transformation in hospitals, even though some interviewees also agreed with the previous statement about technology being the goal. The emphasis on what complements technology varies, with some interviewees putting more weight on the need to integrate people and processes and others more on investment. There is evidence of the view that, although technology is essential, its success depends on a well-balanced system of human resources and operational processes combined with technology.

4.2 INTERVIEWEES' PERCEPTIONS OF THE IMPORTANCE OF TECHNOLOGIES FOR DT

The analysis of the importance of investment according to the technology groupings was based on four different dimensions being assessed. Table 11 shows the results of individual agreement and the Fleiss' kappa index for each question, as well as the grouping of challenges found as a group.

Table 10: Results of the interviews' agreement on the technologies adopted for DT

Ref.	Question	Agreement			Free marginal Kappa			
		A	D	NO	k		K	
2.1	Data generation and capture (sensors, RFID)	3	2	—	-0,2	IN		
2.2	Data transmission (IoT, 5G)	3	2	—	-0,2	IN		
2.3	Data conditioning, storage, and processing (Big Data, Cloud Computing, Cybersecurity, Augmented Reality, Blockchain)	5	—	—	1	HA	0,4	RA
2.4	Data application (management systems, process automation, platforms, wearables)	5	—	—	1	HA		

A: Agree; D: Disagree; NO: No Opinion; k: Fleiss`Kappa Index;
IN: Insignificant; SA: Slight agreement; RA: Reasonable agreement; MA: Moderate agreement; AS: Strong agreement; HA; High agreement

Source: author

About agreement, it was possible to identify that the entire group had a Fleiss' kappa index of 0.4, showing reasonable agreement. In the 'data generation and capture' and 'data transmission' technologies, insignificant agreement was identified in terms of importance, with 3 of the interviewees considering it to be of high importance and 2 considering it to be of low importance. In the 'data conditioning, storage, and processing' and 'data application' groupings, however, there was a high level of agreement, with all the interviewees considering the importance of the investments to be high.

For an overview of the main milestones, the reports and data were used to map the main structuring investments in technology in recent years and these are listed in image 18. In recent years there have been more impactful events that converge on the potential for developing DT processes.

Figure 18: Technology implementation timeline
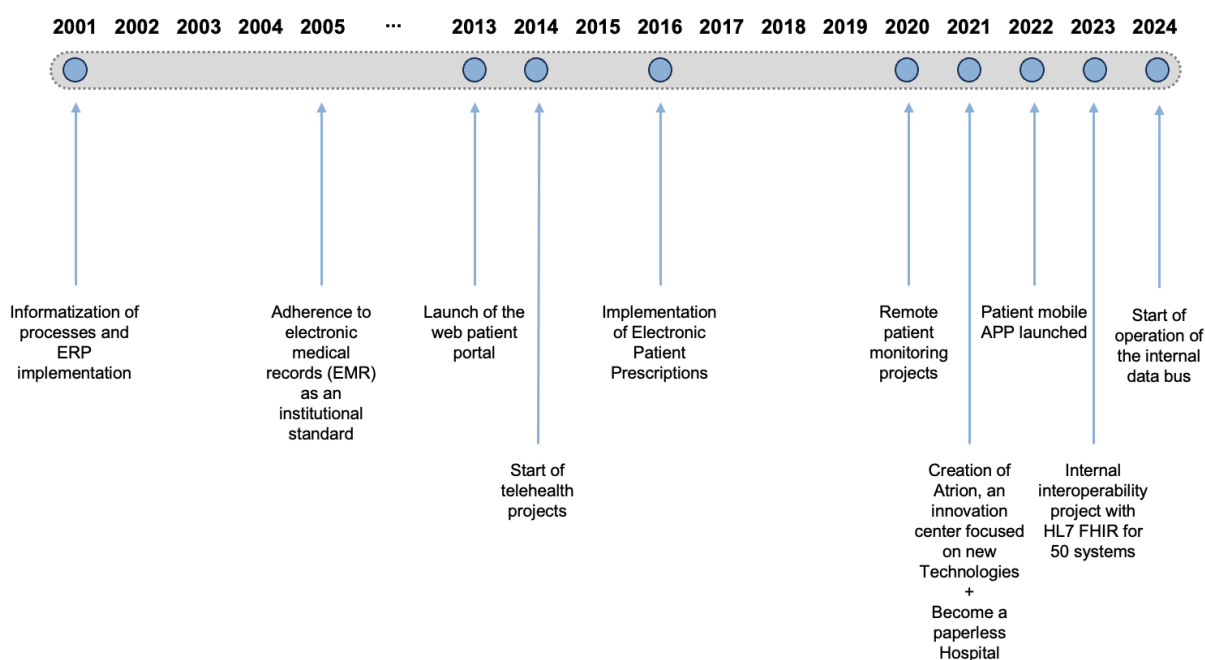
Source: author

The interviewees' analysis recognizes the importance of investing in data generation and capture technologies. They agree that it is necessary to direct resources to this area, although they may have different opinions on the level of priority or urgency of this investment.

> *"[…] speaking of capture and sensors, I think we have an importance in this. […] Security we can start to lower a little bit because we've made a very big investment, and now we can start to stabilize. […]"* - Interviewee R

> *"[…] We can improve in capturing, for example, taking things from the face, from images. It will help. You must invest, that's why it's high, but I don't think it's decisive in the current phase we're in. I think there are other groups that need greater priority at the moment. […]"* - Interviewee M

> *"[…] It has a minor impact; I'd say that if that was our whole problem, thinking about Capex, I wouldn't be satisfied because it's not really there; our big impact […]"* - Interviewee E

Moving on to understand the opportunities generated by data capture, the interviewees converge and agree that data capture is a crucial stage in the process of obtaining useful information. They recognize that effective data capture is fundamental to feeding analysis systems and subsequent decision-making.

There is a consensus among the interviewees that it is not enough just to capture data; it is equally important to use this information effectively. They emphasize

the need for analysis, interpretation, and application of the data captured to generate real value, highlighting this in their speeches, such as Interviewee M saying, "I think the current knot is more in the analysis, in the other group, not in the capture itself."

"[…] capturing it in a simple way is easy and cheap, but structuring it, generating information on top of that data is a bit more expensive, but then it can be stored, right? […]" - Interviewee T

Some understandings become clear from the analysis of this technology in the view of the interviewees, the first being that as much as more can be invested, this is not the biggest current pain, but at the same time the investment amounts are as well less significant, and in the capture and generation technologies, there may be room for a good cost-benefit ratio for the amounts allocated. The interviewees' view is that obtaining new data must go hand in hand with finding new and better uses for this data.

4.2.2 Importance of investing in technology for data transmission

After evaluating the responses in relation to the importance of investments in data transmission technologies, one can see perspectives that reflect different views and understandings of the issue and its need for prioritization. Part of the answer that motivates these different views on the subject was given by Interviewee T in the statement below.

"[…] it would be the point where we're being; I wouldn't be negligent, but I think it's where we're putting less intensity and importance at the moment. Obviously, I think we're still choosing what to do first. […]" - Interviewee T

As an example of the need to invest in these technologies, Interviewee R expresses an emphatic view on the importance of investment, highlighting the need for an approach focused on data-oriented services and big data. Directly linking data transmission to digital transformation, he stresses the importance of this area for modernizing and innovating processes based on the speed at which the different ends of the process connect.

However, Interviewee T makes a counterpoint by partially disagreeing with the priority given to investments in data transmission technologies. It is suggested that, although important, this area may have less intensity and importance compared to the

others. The interviewee stresses the need to choose carefully where to invest, suggesting a more measured approach. Adding to this view, he adds that although it is an area of potential investment, it is also important to note that these are comparatively lower costs than other technologies, given that they have many more standards.

In summary, the interviewees agree that there is a need to invest in transmission technologies, but to a greater or lesser degree, they all exemplify that this grouping is not the most urgent or important. Both Interviewee R and Interviewee M highlight the importance of data transmission as an integral part of the digital transformation, indicating agreement on the central role of these enabling technologies in the process.

4.2.3 Importance of investing in technology for data conditioning, storage, and processing

Analyzing both the tabulation of responses and the individual explanations of the five interviewees, there was a clear consensus that this group of enabling technologies is the one that deserves the most attention and investment from the hospital. As well as the importance of the investment, it is also clear that it is an area that has also seen several investments, demonstrating in the executives' view that it is an area of continuous maintenance in terms of the availability of resources.

> *"[…] That's why, for me, this concern is so heavy and so important, not only in terms of having a shield, the security of our data, but of having our data somehow flowing in an agile way, whether in a physical on-premise datacenter, or in a datacenter and cloud. Investing in these technologies is not only important, it's also expensive, okay? […]." - Interviewee E*

> *"[…] we've made a huge investment, and now we can start to stabilize. Look at my answer; we can't forget to invest. But we have invested heavily in security. We're doing very well, and I think we can now afford to maintain it and start looking to see if there are any different movements. […] And we also need to invest heavily in change, in renewing the technology park. […]" - Interviewee R*

These statements show that there is a need for investment, but they also begin to show more clearly that there are internal challenges to investing in structures that sometimes don't have a direct impact on the provision of services. Interviewee E reinforces the challenge of culture, for example, moving data that is currently in local *datacenters* to the *cloud*.

"[…] This idea of perhaps having a second datacenter in the cloud and us disabling a super expensive data center for us, that has a monthly cost, a monthly depreciation, so it enters an economic sphere as well. We're a bit more conservative as a German company, right? […]" - Interviewee E

In the same way that some points converged, Interviewee T took a broader perspective, highlighting the importance of data in the health area, where capturing and storing information is essential for proper diagnosis and treatment, attributing much of this to the importance of best practices and technologies. He emphasized the growing efficiency of storage technologies, which save space and costs, and pointed out that this is an important way of thinking about the consumption of health data, where it is still necessary in the first 30 days, but thereafter, it can be stored in a way that occupies less noble and faster disks. Following on from Interviewee R's statement, there is a more cautious approach to migrating to the cloud, preferring to keep a physical infrastructure in place given that the infrastructure is new.

"[…] So what the big tech companies do is work in tiers, where tier one is the most expensive tier, where you have the fastest disk, which is the one you have access to, generating reports and making statistics. There, you are searching for information all the time, at every moment. So you spend more money consolidating the smallest volume of information there, but the information that needs the fastest access and then throwing it onto disks where you won't have it, which you'll use for an annual report, to look up a statistic every now and then, so that'll be it. […]" - Interviewee T

"[…] And we also invest heavily in changes, in renewing our technology park. So all of our individual data centers are brand new, all under new warranty, however. […]" - Interviewee R

There is a consensus on the need for intelligent investments in this group of technologies, especially given that resources are finite, but the common point converges on practices to increase security and cyber protection. It was clear from the five interviewees that data security is a crucial concern and should be a priority in technology investments.

"[…] As far as this is concerned, the issue of security is one that keeps me awake. We've been trying to present the hospital board and the council with alternatives to make this more robust. […]" - Interviewee E

"[…] Large corporations need to invest heavily in information security. We have to make it more difficult, make the time (to carry out a successful attack) longer, so that cyber-attackers are not interested, right?" - Interviewee T

"[…] There's no point in just investing in capture, transmission, and systems technologies if we don't invest in this third party; it would leave a huge layer of risk in terms of invasion and security in the data that is being linked. […]" - Interviewee M

"[…] It doesn't have the quality or the security that I give because then I get to a question that isn't physical; it's: how is the security that I can give to all this infrastructure that this data is running on? […]" - Interviewee P

"[…] We have four security companies. We have well-implemented policies, we're very well shielded, so I think we can start. How can I say it, not being calm, but you don't need to be chasing so many things anymore. We can now look at and collect the results that these companies are giving us and see if it makes sense to apply them to anything else in the future." - Interviewee R

In contrast to the other interviewees, interviewee R believes that major investments in security have already been made, but it is clear to the others that this threat is likely to increase. Talks about security permeated all the approaches discussed, and one of the phrases used, even as a market tone for this theme, was brought up by Interviewee T, stating that "The concept is like this: grow or disappear, right? So, either you develop in information security, or you leave the scene because there's no more room for you."

In summary, while respondents recognize the importance of investments in data technologies, their opinions vary regarding the balance between these investments and other aspects, such as security, efficiency, and cost. However, there is a consensus on the need to prioritize data security, given the growing threat of cyberattacks and the extremely critical importance of data in decision-making and organizational operations.

4.2.4 Importance of investing in technology for data application

Evaluating the application of data, a grouping that included analysis of the importance of investment in the acquisition, purchase and updating of management systems, process automation, platforms, devices by the interviewees, as in the previous group, there was a consensus on their relevance and weight. All the interviewees recognize the importance of investing in data application technologies, although they vary in their degree of emphasis.

Given the consensus that digital transformation is a necessity, especially in healthcare, there was an understanding that integrating new technologies could bring significant improvements to processes and the quality of care. Interviewee T gives

some examples of how technology can interact directly with professionals, patients, and the journey.

> *"[…] So, these structures allow you to provide your first care, your first diagnosis, or your first guidance to the patient. Imagine patients arriving here fully trained and aware. With the procedure already done, I don't know, despite all the correct preparation. All of this could already be a technology that could be orchestrating this; it doesn't need to be people operationalizing it anymore; it could be well-defined. […]"* - Interviewee T

In the same way that the previous groups strongly support the security and objectives of internal teams, this group of technologies strongly supports making what the technology enables tangible for internal and external clients. As this is the part where, at the end of the day, everyone will interact in terms of the interface, these systems deserve to be the focus of both investment and management attention, given that a result that reaches the application justifies maintaining investment in the other three groups.

> *"[…] In the last layer, which is the application layer, you turn it into something, you know? It's about using it, either with artificial intelligence or with an application. It's transforming this world of things that have been transmitted and stored somewhere into something relevant. I think that's where we need to spend a bit more time at the moment. […]"* - Interviewee M

> *"[…] Artificial intelligence, generative language—it's what's most hip now because of Chat GPT or BARD because of Microsoft's Compress. There are several technologies that are already investing in this, but they are still little used. It's still very much for the academic world or to give you small insights, right? But, man, this knowledge phase is getting deeper. […]"* - Interviewee T

The interviewees highlighted the need for careful analysis and constant updating of technologies, recognizing that the technological landscape changes rapidly and misguided investments can result in early obsolescence. This was raised, both harming new working models and platforms and business models that change the modus operandi of the market.

> *"[…] I'm looking at a solution that someone is presenting to me here and there. On the other side of the world, someone has already thought of something entirely different, so I have to be very careful where I put my investment. I can take something now, and in six months' time, there will already be something different on the market, and I'll be left behind. So, I think it's important, just again, to have an analysis, to have an IT sieve. To have a good perception of what's happening in the technology market so that I can decide about where I'm going to invest. [...]"* - Interviewee P

"[…] I think that investing in systems is also renewing the system, adding new technologies to the same tool is an update, isn't it? So there's no way not to keep up with it because we're always going to have a new working model, so it's this increase that's perennial within the institution, within the score." - Interviewee R

While some interviewees emphasize the critical importance of investments in technology, others take a more cautious approach, suggesting that investment should be made with discernment, considering the rapid changes in the market. Another point made by Interviewee T has a lot to do with the fast-moving market and new solutions. While some interviewees emphasize the need to invest in emerging and cutting-edge technologies, others stress the importance of assessing the return on investment and the long-term viability of the proposed solutions.

"[...] He looks at mine, that's my metric, and you can't compare. Then the guys go and tell your directors that you have 30% to 100% information security. Based on what? Understand? Then you go after 100%, and when you get to 90%, you change suppliers, and you drop to 18%. And then, man, there's no end to it, there's no end to this business, but you'd have to have metrics that give you a slightly more decent level of maturity on the horizon that you can practice because otherwise someone might get away with it. [...]" - Interviewee T

Finally, investments in data application technologies are recognized as crucial by all the interviewees, although their opinions vary regarding the extent of this importance and the approach that should be most appropriate for these investments. While some interviewees emphasize the need for a proactive and continuous approach, highlighting the benefits of being at the forefront of digital transformation, others take a more cautious stance, stressing the importance of careful analysis and prudence in any investment to avoid premature obsolescence and maximize the return on investment.

Finally, regardless of the differences of opinion, there is a consensus on the need to adapt to rapid technological changes and to promote a culture of innovation and constant updating to remain competitive in an increasingly digitalized scenario, but without losing the relevance of the applications, as Interviewee M rightly points out when he says that the company needs to, "[…] *create models in which we can have an effective impact on real life*". These different perspectives highlight the complexity and challenges involved in making decisions about investments in technology,

underscoring the importance of an integrated approach to increase the chances of success in modernization and digitalization efforts.

4.3 INTERVIEWEES' PERCEPTIONS OF CHALLENGES FACED BY DT

The analysis of the challenges encountered by DT in hospitals assessed the interviewees' perception of agreement on the impact of six different challenge dimensions. Table 12 shows the results of individual agreement, as well as the Fleiss`Kappa index for each question, and the grouping of challenges encountered as a group.

Table 11: Results of agreement between the interviews on the challenges faced by DT

Ref.	Question	Agreement			Free marginal Kappa			
		A	D	NO	k		k	
3.1	Lack of financial resources	4	1	—	0,2	SA		
3.2	Cultural resistance to change	4	1	—	0,2	SA		
3.3	Lack of personnel in specialties guaranteeing the transformation of the digitalization of medicine	3	2	—	-0,2	IN	0,53	MA
3.4	Underdeveloped digital health infrastructure	5	—	—	1	HA		
3.5	Threats to information security	5	—	—	1	HA		
3.6	Low level of intelligence development in specialized medical systems	5	—	—	1	HA		

A: Agree; D: Disagree; NO: No Opinion; k: Fleiss`Kappa Index;
IN: Insignificant; SA: Slight agreement; RA: Reasonable agreement; MA: Moderate agreement; AS: Strong agreement; HA; High agreement

Source: author

In terms of agreement, it was possible to identify a lack of financial resources and cultural resistance to change as concerns with moderate levels of agreement. These two points point to the need to further explore the financial and investment dynamics as well as the cultural challenges of the sector that influence the preparation and adoption of digital technologies in the hospital.

On the other hand, the shortage of specialized professionals who can effectively lead the digital transformation and the underdeveloped digital health infrastructure are perceived as significant challenges and show high levels of

agreement among all respondents. Similarly, threats to information security and the low level of intelligence development in specialized medical systems were also highlighted as areas of concern, with high levels of agreement. These results point to the complexity and breadth of the challenges faced by the hospital in advancing the digital transformation.

4.3.1 Impact of the lack of financial resources

As for the impact of the lack of financial resources and the view of this challenge within the hospital, 4 of the 5 interviewees considered this dimension to have a high impact on DM processes. There is general agreement that the lack of resources can have a significant impact on DM processes. However, there are nuances about the magnitude of this impact.

Regarding the importance of investment, the interviewees naturally emphasize that this investment is already being made, but stress the importance of further increases, as well as the need to maintain the values practiced. Interviewees M and E go into a little more detail about this growing and constant vision of the values that will be needed to keep moving forward:

> *"[…] It's not that we don't invest anything, you know? But yes, we could invest more. […] this is a discussion that has many points of view. But I think there is investment that is evolving, but we could evolve much faster, not least because of the speed of change. […]"* - Interviewee M

> *"[…] Everything has to be within this account of what has been released to us this year, so yes, the release of funds is very important and this is always a challenge. [...]"* - Interviewee E

Combined with the fact of their importance, the interviewees reinforce an understanding that these resources are competing with all the others, and occasionally this becomes a challenge for the acceleration of DT at the hospital. Interviewee P even talks in terms of an "investment portfolio," where "there has to be a reserve for this [investment in digital transformation]. I'm not saying that it must be significant amounts, but rather that the hospital has to have the money for it on an ongoing basis." Reinforcing the point of competition for the same resource, interviewee E points out how competing with investments that sometimes have a more direct impact on service provision also ends up being prioritized.

"[…] I'm talking about the pipes I have to change and the computers I have to change every year. We're competing with a single pocket. From the same pocket that has to pay for the new building, it's the pocket that has to pay for the 3 CT scanners, it has to pay for everything. Everything we invest in is an IT investment. […]" - Interviewee E

Just as the need for investment is necessary to keep moving forward, the lack of resources generates a perception of the opposite, addressing the risk and impact that can affect progress and competitiveness.

"[…] Without resources, you can't get ahead, right? You can even have benefits going forward, but if you don't have the resources now to put into today, you won't reap them tomorrow. […]" - Interviewee T

In the case of the interviewee, who had a low-impact view of the lack of financial investment, the approach taken was that the challenge, rather than investment, lies in people, returning to the triad also addressed by this interviewee that DT necessarily needs processes — people — technology. Interviewee R said that "you don't necessarily need a technological increase to make a digital transformation".

According to a survey conducted by FGV-EAESP, IT Usage Survey, carried out in 2023 and analyzing the spending and investments of hospitals linked to the National Association of Private Hospitals (ANAHP), a sector was identified that invests almost half as much as the other segments. According to the study, 4.6% of annual net sales in healthcare is invested in IT, compared to the overall average for companies (services, industry, and commerce) in the full survey (8.0%).

Graph 4 shows HMV's investment in relation to the health segment and the market in general. It is clear that, percentagewise, the organization's investment is below the averages presented, but in the face of discussions this data is questioned by hospital executives, given that this data is self-declared by the companies and there are many differences in what each organization includes in the amount reported.

Graph 4: of the revenue invested in IT
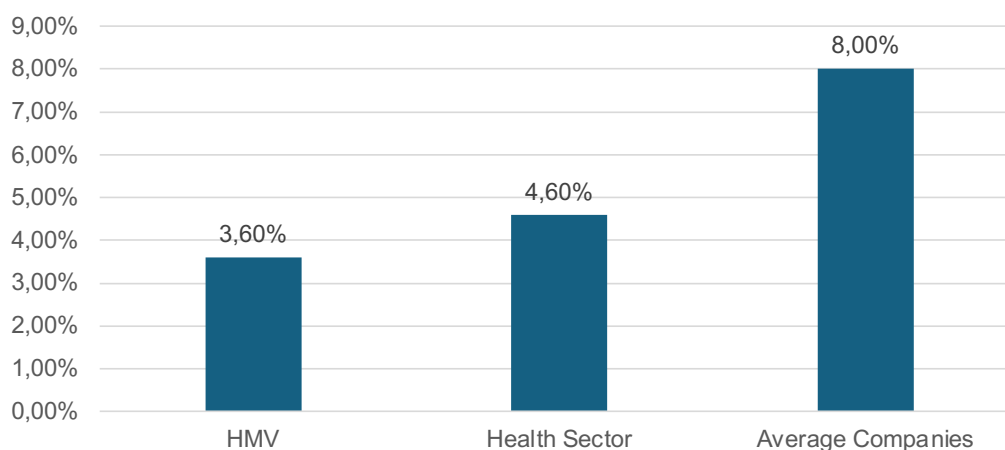
In short, there is general agreement about the importance of financial resources and the challenges faced due to the lack of adequate investment in the hospital, but there are differences of opinion about the extent of this impact and the need for more investment to effectively boost DM. Analyzing the perception of the challenge, it is essential to always consider that this resource competes with others and is not characterized as an investment disconnected from the reality of the institution.

4.3.2 Impact of the cultural resistance to change

As for the impact of cultural resistance to change and the view of this challenge within the hospital, 4 out of the 5 interviewees considered this dimension to have a high impact on DM processes. There is general agreement that a lack of resources can have a significant impact on DM processes. However, there are nuances about the magnitude of this impact, given that sometimes cultural issues can be considered a simplification of the reasons for not moving forward.

Regarding the view that cultural resistance is a hindrance to progress in DT, the interviewees who agree point out that the challenge is significant. Among the views, it is exemplified that this resistance is rooted in issues such as risk aversion, lack of understanding of what digital transformation is, and fear of replacement by technology. About risk aversion, it is important to note that this does not belong to a specific group and that it is also reflected in the processes in Interviewee M's view.

> *"[...] culturally, we have attributes that are very closely linked to information security. And we have a lot of risk aversion from the very top. In governance,*

there is an aversion to risk, and in management, this is replicated all the way to the top." - Interviewee M

Complementing the view of resistance, some interviewees pointed to cultural resistance, also associated with their fear of the risk of losing relevance or having their tasks and jobs replaced. There are already processes of robotization and digital improvement that are inherent in the replacement of professionals by their use, increasing possible resistance, as interviewees R, E and T report.

"[…] when you empirically want to promote a digital transformation where the agents of the transformation don't think about what I call the 3 pillars— processes, people, and technology — and think only about technology, this attacks the person who is receiving it. The information that we're going to carry out a digital transformation in their area or in their process means that the first thing they think is, "I'm going to be replaced by something I can't compete with". And if it were someone else, I'd compete in a healthy way, trying to do better than they're doing." - Interviewee R

"[…] it's difficult to convince a professional who for 20 years has been checking off each item on the sheet, and at the end of the day, he's only done a bundle of sheets, so that can be done in 15 minutes by a feature created in the system. It's difficult to convince even his leadership to do this, so the digital transformation process also involves acculturating the organization. […]" - Interviewee E

"[…] People are afraid of losing their jobs because of technology, and they don't realize that losing their jobs means doing repetitive, uncreative work. They don't value their own work. […]" - Interviewee T

Presented as an alternative, capacity building, training, and the evolution of the culture are important pillars after a very representative view that the fear of losing jobs and the obsolescence of the professional's activities are considered a risk. In Interviewee E's view, therefore, it even depends on the corporate education areas taking action, even if these are not short-term gains.

"[…] The digital transformation process also involves the organization becoming acculturated. It doesn't happen overnight, we have to have corporate education involved. […]" - Interviewee E

After analyzing the interviews conducted, the dimension of cultural resistance represents a multifactorial challenge for healthcare institutions. Risk aversion, lack of understanding of the pillars of digital transformation, and fear of replacement by technology emerge as some obstacles to be overcome. At the same time, the

complexity of quantitatively measuring this impact points to an opportunity for more studies and models to assess cultural resistance. It is important to note that the interviewees recognized that digital transformation is not limited to the implementation of technologies but requires a profound cultural change involving corporate education, acculturation, and effective communication. Therefore, strategies aimed not only at updating technology, but also at promoting a digital mindset, as Interviewee E metaphorically called it, "[…] *working on acculturation and changing the chip […] To a chip that is a little more digital, moving away from an analog logic*" and valuing creative work are crucial to mitigating the adverse effects of cultural resistance and boosting the success of advancing processes in hospitals.

4.3.3 Impact of the lack of personnel in specialties guaranteeing the transformation of the digitalization of medicine

Regarding the impact of the lack of qualified professionals on this challenge within the hospital, 3 interviewees considered this dimension to have a high impact on DM processes and 2 considered it to have a low impact. The Fleiss' kappa index shows insignificant agreement on the impact of the lack of professionals on DM processes, although certain agreements and disagreements can be highlighted.

Regarding those who consider the impact of the lack of qualified professionals to be high, there is broad agreement on the size of the challenge, but also that there are ways around it. The interviewees stressed that this problem must be mitigated with appropriate management and staff development strategies.

Given the view of Interviewee M, who points out that although many health professionals are not initially familiar with digital technologies, they have the intellectual capacity to learn quickly if the institutional culture is mature and the motivation (*the reason why*) is clear to them. About the case studied, he states that "*if the institutional culture was mature, we would be able to explain why, and we would get into their 'The Reason Why' and then they would mature quickly.*"

Interviewee E corroborates this view, emphasizing that the IT market has become extremely competitive, and that talent retention is crucial in this scenario. He mentions that "development, workforce training, and retention, especially retention strategies, have become fundamental for us at this time."

Also pointing to the importance of training and noting the need to maintain and develop new knowledge, Interviewee P strongly points to the responsibility and opportunities of the corporate education areas. According to the interviewee, "corporate education... should be providing training or giving provocations or lectures to make employees more prepared for the changes ahead."

Despite the consensus on the importance of qualifications, the other interviewees differed on the intensity of the impact and the approaches to overcoming it. Even though Interviewee M identified the impact as high, he believes that the main problem is not the lack of qualifications among professionals, but rather the absence of a clear institutional vision and adequate investment. He suggests that the problem is more about "institutional visions and investments" than the capacity of individuals.

On the other hand, Interviewee R sees the cultural challenge as more pressing than the lack of technical qualifications. He also argues that it is important to have agents of change within the different areas as well.

> *"[…] If you don't have the transforming agent who can make this culture permanent and peaceful, as I just said in the last question, we are doomed to the feeling of each other again, and then you can have an implicit defeat, when you go to do a rollout or a go live of a solution, a method, or a working model for this team that you are acting as a transformer. […]"* - Interviewee R

Interviewee T, on the other hand, adopts a more optimistic stance, suggesting that the problem is "manageable" if there is an adequate effort to train and develop existing staff. He notes that "*[…] if you can at least get hold of the people who don't have the knowledge today, but who you can train… you can solve it*", once again suggesting that the challenge may lie more in awareness or even in "*The Reason Why*" brought up by Interviewee M, than in the ability of the professionals.

In this dimension of the analysis of the interviews, there is a shared understanding of the importance of qualification in the process of digital transformation of hospitals. However, there are significant disagreements as to the degree of impact and the best strategies for addressing this issue. Perspectives range from the need for a clear institutional vision and adequate investment to an emphasis on transformational agents and continuous training. These different approaches highlight the complexity of the challenge and the need for a multi-faceted approach to mitigate the challenges related to the professionals who will drive the DT processes in hospitals.

4.3.4 Impact of the underdeveloped digital health infrastructure

Regarding the impact of underdeveloped digital health infrastructure within the hospital, all five interviewees considered this dimension to have a high impact on DM processes. There is therefore high agreement that the lack of this infrastructure causes significant impacts in the view of the interviewees.

Given the agreement of all the interviewees that underdeveloped digital infrastructure has a significant negative impact on hospitals' digital transformation processes, there are complementary approaches and views from different perspectives, positions, and areas. There is a collective understanding that the lack of technological readiness is a critical obstacle, and in the view of Interviewees M, T and E, it is emphasized that this is a problem that impacts both the sector and individual companies, suggesting that this, unlike other challenges, may be due to the tone and culture of the healthcare market itself.

> *"[…] Health, and I'm going to order it from the outside in: as a system, it's not interoperable, it's segmented, it has different maturities in different institutions, in different bodies, which complete what health is. Within the institution we're working in today, there's also complexity and a lack of readiness. […]"* - Interviewee M

> *"[…] I'd say that the healthcare segment, thinking of Brazil, still has a long way to go. If we consider the 6,500 hospitals that exist in the country, considering private and public hospitals, you can take out, I don't know, you don't get to 10%, let's say, that are in a state of minimal excellence towards excellence, you know? […]"* - Interviewee E

> *"[…] A digital health process where we have low investment, and we're no longer looking at the index, we're looking at the market. […]"* - Interviewee T

While still referring to the institutions' lack of technological readiness, Interviewee M highlights this gap as a potential obstacle to effective digital interaction and transformation, strongly linked to the information silos themselves and their barriers to access. *"[…] And there's no [digital readiness in the hospital]. Well, to get that [data, information, and indicators], someone has to talk, someone has to extract, and someone has to cross-reference. It's not ready to interact, to make things happen as a digital transformation."*

Faced with the apparent need for evolution and standardization to have a desired infrastructure, interviewee E stressed the precarious conditions of hospitals in Brazil and the need for evolution, both in hardware and software, to achieve a minimum

of excellence: "[…] *The health sector as a whole has a lot to evolve; it has a lot to grow, a lot to reinvent itself and copy from other sectors*" (Interviewee E).

Sharing this view of precariousness, Interviewee T also points to the lack of standardization and resistance to sharing information as significant barriers within the hospital's structure: "*Today it's a big challenge because we don't have standards. Everyone is developing their own [data and infrastructure model] and today there is also a lack of interest in sharing*" (Interviewee T).

Despite the general agreement on the negative impact and challenge of this dimension, there are some differences in the approaches suggested by the interviewees to overcome these challenges. Particularly noteworthy are the views on the correlation or not between investment and efficiency, as well as the view of the market and the possible duality between profit and the advancement of interoperability models.

Regarding investment to increase efficiency, interviewees R and P emphasize the need for high investment to improve digital infrastructure, while R also suggests that it is possible to do things differently even with low investment: "*You can do things differently! Even if you don't have [the resources], you can do things differently*" (Interviewee R), returning to issues linked to cultural factors. On the other hand, P firmly believes that a greater focus on technology, requiring investment, can accelerate medical progress:

> *"[…] In terms of technology in medicine, we could be far ahead if we had more investment or a little more focus on this. There should be a focus and investment in digital health infrastructure, and I think that the more this is slowed down, the slower the process of advancing medicine becomes. […]"* - Interviewee P

In summary, regarding the impacts of the current digital health infrastructure, the interviewees' understanding converges on the perception that this represents a major challenge for digital transformation in hospitals. However, there are divergent and complementary views on the solutions and approaches to overcome these obstacles. While some advocate robust investments and a focus on standardization and interoperability, others see the need for internal restructuring and greater efficiency with the resources available, bringing together perspectives that present possible paths for the evolution of digital health, one looking more towards a market effort and the other towards a more internal and autonomous effort by the institutions.

4.3.5 Impact of the threats to information security

Faced with the challenge of the impact of threats to information security on the hospital's digital transformation processes, once again, all five interviewees considered this dimension to have a high impact. There is therefore a convergence that threats, and cybersecurity are factors that today significantly affect the evolution of the hospital's digital transformation processes; however, there are variations in the perception of severity and in the approaches adopted to mitigate these risks.

The first point of agreement is the high level of relevance and attention paid to this issue, which was strongly emphasized by everyone. Interviewee M even mentions that this risk is mapped and disseminated institutionally through the Institutional Risk Matrix (Figure 16). "*In quality and safety, there are risk matrices that make up the entire hospital, and one of them, for example, is IT, another is supplies, and so on. […] cybersecurity, I remember, and it was a super high-risk and high probability because it's happening in general, so we must look at it and take effective and constant action on it*" (Interviewee M). Interviewee P agrees and reinforces the importance with phrases that reinforce his concern about the issue: "*It's high. Very high, right? When we discuss information security, it's very high.*" (Interviewee P) and even connects it to the market that has come to exist around the value of this health data. "It'*s a very high risk; it's become a big, big business. It's a worldwide big business, really, data piracy, having control of data to demand ransom or render an operation inoperable.*" (Interviewee E).

Figure 19: Risk matrix of Hospital Moinhos de Vento
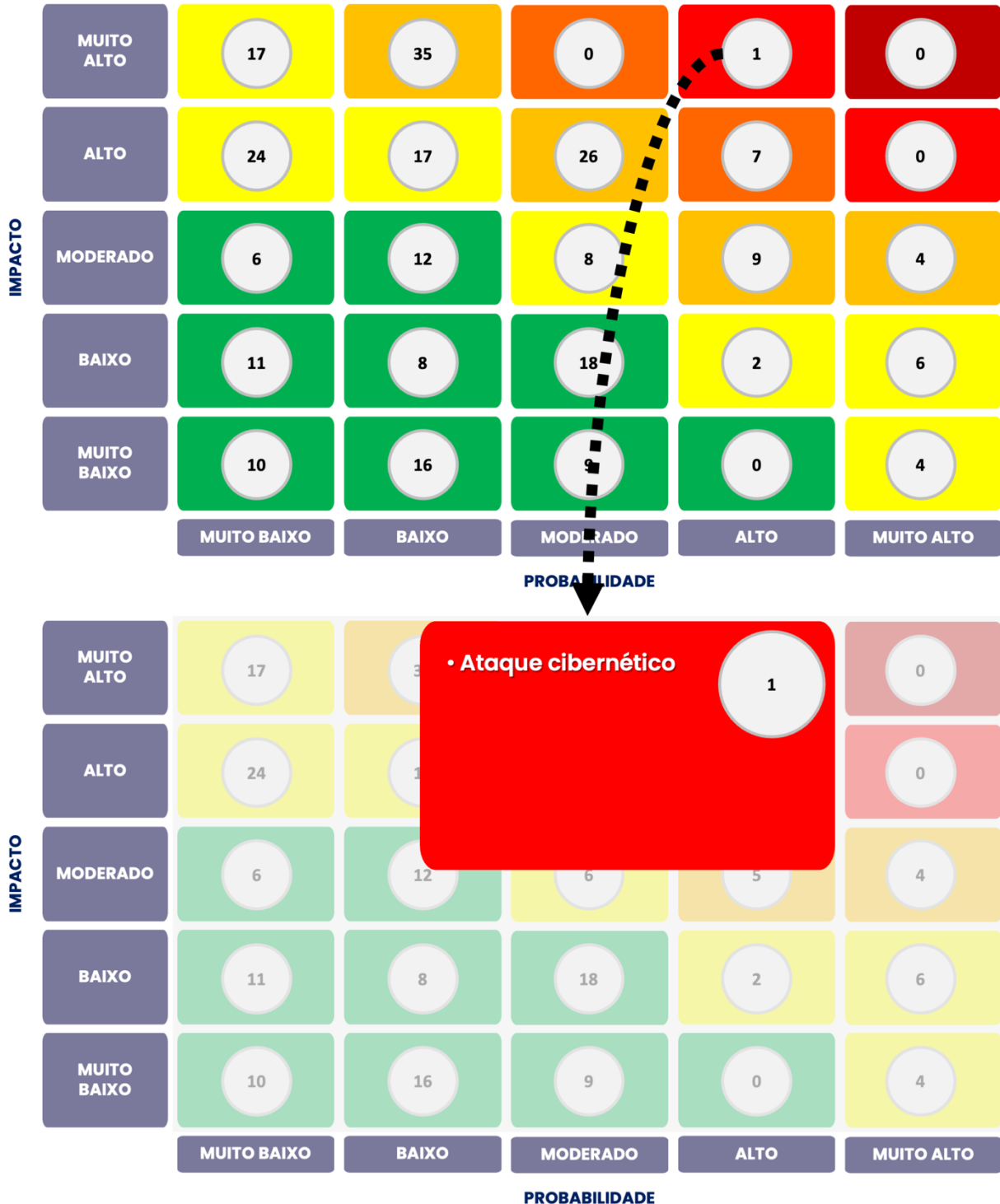
Source: HMV risk mapping executive report

Regarding the need for adequate investment and structure, there is a consensus on the need for continuous investment and the implementation of a robust infrastructure to guarantee information security. Interviewee M sees the need not only

to map and warn, but also to be proactive in relation to security risks. "So we have to look at it and take action on it" (Interviewee M). Interviewee E describes in his speech a little of the three layers that we currently only have at the level of partners and suppliers who act proactively to mitigate risk.

> *"[…] Today, we have three external layers of protection that help us on a day-to-day basis, as well as a network security team. We have one that focuses on a more basic layer, more on the shop floor with antivirus, and so on. So it works on that spam line—the very basic one. A second line of protection, which works on a more secure line of passwords and so on, and a third line that we recently added with a partner, which works on a line of protection with suppliers, thinking about protection from the door outwards, since the feeling is always that we owe, right?*
>
> *With the numbers that these 3 partners give us daily, the number of access attempts we have, either by phishing or spam, or viruses, or someone knocking on the door, or someone taking the bait of a honeypot we've installed, is a scary thing, you know? So it's not if, it's when. […]"* - Interviewee E

The motivation for the different layers of protection can be understood as not only proactive action and an understanding of the risks involved, but also a coherence and necessity for a business with uninterrupted operations in which the correct functioning of the systems is vital. Interviewee P's speech highlights the need for this prevention:

> *"[…] If I go digital, there's no point in having a modernized infrastructure, right? Modernized physical structure, right, if my digital is drifting, right? So, if I don't manage to be strong in security, this is a challenge, I think, for the world, if I don't manage to do it, I could lose everything, including digital security, so much for us to be able to continue working 24 hours a day and not suffer any data hijacking. […]"* - Interviewee P

Although everyone agrees that the threats are serious, there are variations in the perception of their seriousness. Interviewee R, for example, believes that the situation at Moinhos de Vento is relatively under control due to the investments already made: "For Moinhos de Vento Hospital, which is more grounded in this, […] I wouldn't say it's very high [the need for future investment] because there has already been a lot of investment, and we're already at another level of security."

In short, information security is a central concern that is consensually recognized as a challenge in the digital transformation of hospitals. The interviewees highlight more emphatically than in the other dimensions a need for continuous

investment, robust risk mitigation strategies, and a well-developed organizational security culture. However, the perception of seriousness and the specific approaches to dealing with these threats vary between the interviewees, reflecting different contexts and levels of preparedness in the healthcare market itself.

4.3.6 Impact of the low level of intelligence development in specialized medical systems

In the context of the impact of the level of development of expert systems weakening the hospital's digital transformation processes, once again, all five interviewees considered this dimension to have a high impact. There is a high level of agreement with this statement, based on the view that systems, especially specialist systems, make it difficult to adopt and advance integrations and improve the hospital's digital transformation processes, and this is the third of the dimensions where all the interviewees pointed to it as a high challenge.

More broadly, regarding the limitations of current specialist systems, the interviewees recognize the need for more advanced and intelligent systems to improve hospital processes and efficiency, clearly pointing to the market concentration, especially in Brazil, of ERPs operating in hospitals as an important factor. Interviewees T and E also point out that this system is representative in terms of the market, so it must be a common pain for many players in the segment.

> *"[…] Our ERP system is the market leader in Brazil today. We have problems every other day here, whether in any module we're talking about, in medical records, in prescriptions, or in the back office in all areas. There's something wrong every day. That's because they're the largest hospital management software in Latin America. […]"* Interviewee E

> *"[…] The systems we have available for use in Brazil reflect the conventional model of doctor-patient treatment. Today, we're simply reflecting on what we've been doing for a long time. […]"* - Interviewee T

Addressed as a second concern, most interviewees mentioned the dependence on systems that are not sufficiently developed to meet the current needs of hospitals, resulting in slow and inefficient processes.

> *"[…] in the end, we still pass it on through a residency, through monitoring, through a process that has been well-designed for a long time, and we don't use any platform or system to make it run more smoothly. […]"* - Interviewee T

As a result of these limitations, it is possible to identify that given the needs of the business, alternatives are sought or developed even for activities that were expected to be done by the contracted ERPs. Interviewee M even points out that for day-to-day things, solutions can't be found either in the current systems or sometimes on the market, and Interviewee E adds the volume of systems that are needed for a single hospital to operate.

"[…] There are a lot of technologies and a lot of alternatives, but then when we go for something, for example, if they're going to do the coding for the Diagnosis Related Group (DRG), I don't know what, then there's no coding for that. […]" - Interviewee M

"[…] There isn't a system on the market like the industry has, where it does everything. I came from industries where I didn't have 47 satellite systems like I have here. In addition to my ERP, I need 47 more systems to run this business. […]" - Interviewee E

Aggravating perceptions of this dimension, Interviewee E warns that, as a strategy, "the supplier has created small alternatives to make you even more dependent on the system". Interviewee P also gives an example of a lack of partnership in the development of new functionalities for the system suppliers in a case where it was even a regulatory and legal change in the market.

"[…] how can you have a system that doesn't comply with the law? I need your system to provide me with the report when I'm sending it, to have the evolutionary report. I'm not going to pay you to develop this; you, as a supplier, should comply with the law. You can't have a system that doesn't have an evolutionary report because that's the law. […]" - Interviewee P

Despite the rather negative perceptions and those related to the hospital's own base system, Interviewee T points out that these perceptions, which are also seen and perceived by other hospitals, have made the supplier itself seek to evolve: "There are still small initiatives that we see in Brazil […] they are starting to put a bit of artificial intelligence into the platforms".

The interviewees unanimously recognize the high negative impact that the low level of intelligence of expert systems has on digital transformation in hospitals. The need to evolve these systems to keep up with growing technological and legal demands is evident. There is a consensus on the urgency of improvements, although there are differences in expectations about the speed of these changes and the responsibility for implementing the necessary updates.

4.4 INTERVIEWEES' PERCEPTIONS OF IMPACTS EXPECTED BY THE DT

To clarify the objectives and expected impacts, the analysis of the impacts expected from the DT process in hospitals assessed the interviewees' perception of their agreement with the expectations of four different dimensions. Table 13 shows the results of individual agreement, as well as the Fleiss'Kappa index for each question and the grouping of expectations found as a group.

Table 12: Results of agreement between the interviews on the impacts expected by the DT

Ref.	Question	Agreement			Free marginal Kappa		
		A	D	NO	k		k
4.1	Digital transformation to improve the quality of hospital services	5	—	—	1	HA	
4.2	Digital transformation in the patient experience	5	—	—	1	HA	
4.3	Digital transformation operational efficiency	5	—	—	1	HA	0,8 AS
4.4	Digital transformation to create new business models	4	1	—	0,2	SA	

A: Agree; D: Disagree; NO: No Opinion; k: Fleiss`Kappa Index;
IN: Insignificant; SA: Slight agreement; RA: Reasonable agreement; MA: Moderate agreement; AS: Strong agreement; HA; High agreement

Source: author

Regarding agreement, it was possible to identify that the fourth block of questions had a Fleiss'Kappa index of 0.8, representing strong agreement among the interviewees. About the expectation of improving the quality of hospital services, improving the patient experience, and increasing operational efficiency, the interviewees had a high level of agreement. As for the expectation of creating new business, there was only slight agreement, unlike the other dimensions of this block.

Even with a more cohesive block, to deepen the institutional and individual understanding of the interviewees, each of the 4 dimensions was evaluated and described individually below.

4.4.1 Expected impact of DT on improving the quality of hospital services

When it comes to the expectation of DM as a means of improving the quality of hospital services, all five interviewees considered this dimension to have a high impact.

There is therefore a high degree of agreement that the provision of health services is expected to improve as a result of DM processes.

Given the unanimity presented, it was possible to understand in depth which dimensions were being perceived as having an impact. The main one was the potential for progress in quality and safety aspects. Most of the interviewees believe that once all the processes that will be common to healthcare, such as "implementing bedside checks and the use of mobile tablets, increasing the accuracy of prescriptions, and patient safety" (Interviewee E), become more common.

Reliable data naturally increases the safety of the process. In this sense, Interviewee P also adds that, even if little is done to focus on service quality, it will happen as a consequence that "there is that which is an impact that will result from it. And the quality of the service is an impact that will happen. Still on the subject of quality, interviewee M warns that there will continue to be caution in health, but what will come will tend to have a positive impact: "There's a timeframe for things so we don't kill people. So that we can be sure it's effective".

In general, the interviews reveal agreement on the significant impact of digital transformation on the quality of hospital services, especially in terms of safety and efficiency. However, there are differences in the perception of the need for and pace of implementing these changes, given the risk of everything that impacts the health service itself. While some interviewees emphasize transformation as an essential and urgent element, others stress the importance of a more careful and gradual approach. These variations reflect the different experiences and perspectives on integrating new technologies into hospital processes, which are also common in the other dimensions analyzed.

4.4.2 Expected impact of DT on the patient experience

Regarding the expectation of DM as a means of improving the patient experience, all five interviewees agree that this dimension has a high impact. There is again high agreement, according to the Fleiss`Kappa index, that a positive increase in the experience of the journey for patients and even their families is expected about the advancement of DM.

Initially, everyone recognizes that digitalization can improve specific aspects of care and make the process more efficient and pleasant. There is a consensus that the

pandemic has accelerated the need to digitize hospital services, and that hospitals that don't adopt these changes run the risk of becoming obsolete. Interviewee E also draws parallels with other industries that haven't been able to adapt: "*[...] it's the way forward, and the hospital that takes too long to do this will be run over, just like the hotel industry, just like taxi drivers, etc.*"

Interviewee M emphasizes the defense of high expectations in this dimension, pointing out that, of all the dimensions, it is the most manageable.

> *"[…] patient experience is in our hands. So, all we have to do is want it; we go out there and change the team, guarantee it, change the process flow, and people are asking us for it. So the market is demanding that it be more cost-effective. And for it to be more agile and simpler, a more pleasant experience. […]"* - Interviewee M

The potential for improving the experience was attributed to increasing the efficiency and transparency of processes, generating patient satisfaction during their diagnostic or treatment journey. There are many examples of how the experience could potentially be improved, with Interviewee T pointing out that digital transformation makes it possible to take hospital services to the patient's home, improving the overall experience. Interviewee E mentions the implementation of technologies such as self-registration totems and parking self-checkout, which "*[…] initially faced resistance [thinking that the older public wouldn't join in], but are now well accepted and improve user satisfaction*". Interviewee P brings up other points that can be facilitated and also reduce the need for teams dedicated to certain activities.

> *"[…] their experience or their relationship with the hospital has to be digital. They have to make an appointment before coming here. I don't need a call center with 100 positions, I need them to have an easy way to make an appointment. […]"* - Interviewee P

Not directly related to resistance, but rather to institutional priority, Interviewee M points out that despite the expectation of changes in the DT experience in the patient experience, these advances happen more as a consequence than as a cause. "*The digital transformation of the patient experience is a consequence of operational improvement; an efficient operation is the main focus, and the patient experience benefits indirectly from this.*" (Interviewee P).

In summary, the interviewees agree that digital transformation has the potential to significantly improve the patient experience. The successes of current advances

seem to move this dimension in the direction of more results, including allowing the reduction of staff and also optimizing services, which is the next dimension analyzed.

4.4.3 Expected impact of DT on operational efficiency

When analyzing the expectation of DT as a means of increasing operational efficiency, all five interviewees considered this dimension to have a high impact. There is therefore a high degree of agreement and convergence that efficiency gains are expected from the advancement of DM processes in the hospital.

One statement relating efficiency and DT demonstrates the vision of this dimension, which is "*Because when we talk about digital transformation, we talk about efficiency.*" (Interviewee R). In this sense, it is possible to understand that improvement was seen not only as a consequence, but also as a cause of the quest to transform processes.

In line with this statement, in a system that seeks cost-effectiveness and viability, interviewee M places significant emphasis on the need for the business to be economically viable. "*The urgent problem of the urgent health system is to make it viable, then you'll save a lot more people.*" For him, digital transformation is crucial to making the healthcare system economically sustainable.

Providing practical examples of this cost-effectiveness, interviewee E comments on the professionals dedicated to implementing robotic process automation (RPA). One of the applications was in the operating room; "he *said that it will make his life much faster, both in terms of speed in scheduling and accuracy of information*" (Interviewee E). This emphasis on automation and precision suggests a specific focus on implementing advanced technologies to improve efficiency.

A very relevant point that is repeated in the interviewees' speeches in different ways is that it has become unfeasible for the hospital for every new process to necessarily require more people, so DT is also a way of reducing the need to always increase staff and do more with the current structure. "*A reduced process, a short process, a process with fewer people involved, which impacts on fewer control points, so to speak* […]" (Interviewee R). "[…] *if I can optimize or do much more than I'm doing while maintaining the same infrastructure I have*" (Interviewee P).

Analysis of the expectation of efficiency gains reveals a strong consensus on the positive impact of DT. Automation, the patient journey, economic viability and

organic growth are crucial aspects addressed by the interviewees, reflecting the complexity and importance of this dimension in the hospital.

4.4.4 Expected Impact of DT on Creating New Business Models

When analyzing the expectation of DM as a means of boosting the creation of new business models, 4 interviewees considered this dimension to have a high impact and 1 considered it to have a low impact. In this dimension, there is a slight agreement with the expectation that the diversification of revenue and the creation of new business models will depend on the advancement of DM processes in the hospital.

About the potential for creating new models, all the interviewees recognize, to a greater or lesser extent, that digital transformation has the potential to generate new business models in the hospital sector. Interviewee E points out that telemedicine and other digital innovations can transform the patient experience, citing concrete examples of new business with B2B, creating protected zones with health monitoring, and B2C offering remote health products.

Adding to the potential, Interviewee R cites examples that can be followed from other countries that can offer new service models as a result of a more advanced DT process. Interviewee R recognizes that digital transformation can promote new businesses and services, mentioning the concept of a digital hospital in Israel and de-hospitalization as trends that could emerge and should be observed in the Brazilian scenario.

There was also an understanding of the strategic importance of progress in the face of the challenges facing the health sector. In Interviewee R's view, "[…] *digital transformation is one of the main pillars for creating new businesses […]*", and Interviewee T reinforces the idea that digital transformation is "*knocking on the door*", indicating that health, like other areas, needs to adapt quickly to new technologies.

Interviewee M expects a very high impact of DM on new models, although he admits that his expectation may be more of a wish than a certainty. In contrast, Interviewee P, who sees the impact as low, attributes this view to the institution's caution and slowness in adopting new technologies, which is a more common expertise when it comes to medical technologies.

"[…] there's a cautiousness or a slowness in the house when it comes to embracing new technologies. And I think that's fine, we really have to be cautious, don't we?

But it happens, so it's going to happen. It's the same, but it's different from when I buy the best MRI or the best radiotherapy equipment. […]" - Interviewee P

When analyzing the responses, the lack of consensus on the relevance of digital transformation in the creation of new business models is due to the clear and existing expectation, but a distrust of the fear of cultural resistance from the institution itself. Opinions vary from a very high impact, with significant transformations in the patient experience and the creation of new services (Interviewees E, T, M), to a more moderate and cautious view of the adoption and impact of new technologies (Interviewee P). Among all the dimensions evaluated, the differences in perspectives can also be attributed to the different positions and responsibilities of the interviewees within the hospital, which makes it rich to understand that everyone wants to contribute to more sustainable business models.

5 DISCUSSIONS OF RESULTS

This chapter synthesizes the literature and the analysis of the interviews that portray the case studied, presenting a confrontation between the theoretical perspective, showing advances in what has already been studied. Finally, the contributions from a practical perspective are discussed, looking for advances and potential extrapolations to the empirical field addressed,

5.1 UNDERSTANDING OF DIGITAL TRANSFORMATION

Hospitals' adoption of and investment in digital transformation processes has seen significant increases, intensified by the Covid-19 pandemic, especially reflected in the changes between 2020 and 2021 (DELOITTE, 2021). Given the investments, the importance of understanding and clarifying the concepts related to DT naturally arises to understand how far and where these investments should go.

Through the clarity of Gobble (2018), synthesizing the differentiation between digitization, digitalization and digital transformation, added to the definitive concept proposed by Gong and Ribiere (2021), an understanding to be achieved was established. The concept should be defined as a process of fundamental change, made possible by the innovative use of digital technologies accompanied by the strategic leveraging of key resources and capabilities, with the aim of radically improving an organization and redefining its value proposition.

Given this understanding, the applied research sought to validate some central points of this concept with a few questions so that we could assess whether the most basic part of the concept, which ends up equalizing the institution's expectations on the subject, was converging. A total of three questions were sought to gain this understanding, based on the visions of whether DT is a process that requires continuous investment and whether DT is aimed at implementing new technologies or whether technologies are a means of enabling the digital transformation process.

The Fleiss'Kappa Index of this block of questions indicated moderate agreement, signaling what was later reinforced in the in-depth analysis. There are different understandings of the concepts of DT, especially its objectives. From Interviewee R's perspective, for example, we can understand that within the technology area itself, there is a view that there is no need for continuous investment in DM

processes, and it is perceived by the same interviewee as a long trajectory by the institution. This in itself diverges from Yoo's (2010) initial logic of the inherent importance of a continuous process of advancement and investment in DT for the potential to generate the results that are considered fundamental.

Adding to the points of disagreement, Interviewee E also has a different view from the others regarding the objective of DT being focused on new technologies.

> *"[…] The digital transformation comes to perhaps give a new look, a new brushstroke to things that already exist, things even to technologies here that were passed down, that have already been launched, that have already been used for some time. […] I think that the digital transformation also brings new clothes to existing technologies. […]"* - Interviewee E

This vision, given the potential of DT, is potentially dangerous because it strongly reduces the concept and progress of DT, seeing it as a strategy that is much more about digitization. This perspective, when passed on to the institutional level, has the potential to reduce DT to what is conceptualized as digitalization, where it is basically the computerization of processes by replacing manual activities with digital ones, without adding value, integration, or agility for the teams and the institution.

Part of Interviewee E's statement about the difficulty of investing in DM can also be explained by the different understandings of the breadth of the concept of DM: *"The purchase of a CT scanner, the purchase of an MRI, and the innovation of a robotic park speak louder than the actual thinking, and I'm not even talking about investments in intelligence and digital transformation."* Given the clear challenges facing the sector, especially those brought up by Goldsack and Zanetti (2020), such as the need to diversify revenue, the search for greater cost-effectiveness, and offering quality healthcare to more people, which were made clear in the literature and in the interviews, DT is presented in their proposal as a path that could potentially be as effective as the medical technologies mentioned and which currently have priority for investment.

There is a convergence of authors such as Goldsack; Zanetti (2020), and Hermes et al., (2020) signaling the current widespread adoption of technologies in hospitals, which would allow us to be at a time of advances in the long-term vision of health gains. Despite the claims made in the literature, no consistent adoption of technologies was identified in the case studied, on the contrary, the scenario of the other hospitals appears to be even more backward. According to Interviewee T himself,

"*we tried to do some research there […] and we saw that out of 7,000 hospitals, around 400 were those […] who managed to make their own investments in technology […] and those who participated in new ideas, there are no more than 40 to 50 hospitals in Brazil.*"

It is understood conceptually that DM finds in technology an enabler for innovative uses of resources, allowing for consistent changes in processes (Gong; Ribiere, 2021), but clearly, when we evaluate it empirically, there are still some views of these technologies as an end rather than a means. This view was even reinforced by Interviewee M, where he said, "*[…] the institution I work in still has a lot of bias towards implementing technologies, which, I think, is the easiest part […]*".

The expectation of objectifying technology in the DM process is partly explained by the shortsightedness brought up in the provocative text by Gobble (2018) cited above where the author points out that there is confusion in the understanding between digitization, which aims to turn analogue processes into digital ones, and DM, in a broad context. This same confusion was evidenced in practice, where the quest to robotize activities, systematize steps, or add systems that digitize processes were considered to be DT gains, even though they did not change the activities, services, and routines that were already established.

Based on the understanding that health professionals themselves are catalysts or detractors of DM, Lyanna et al. (2022) stated the need to ensure that professionals in multidisciplinary teams (doctors, nurses, and clinical teams) receive comprehensive training to better utilize the potential of available technologies. This statement converges with statements directed exactly at this point in the assessment, for example, by Interviewee M, who warns of "*revisiting the way systems work: systems in terms of the organization, people, individuals, and the individual's mindset, how they behave, how they will relate, how they will solve problems,*" and also Interviewee T, who points out that to exploit the technologies that will bring about DM, "*[…] I think a lot lies in developing people*".

5.2 TECHNOLOGY ADOPTION

According to studies by Deloitte (2021), the adoption, understanding, and expectations of technologies that enable digital transformation processes by hospitals increased during and after the COVID-19 pandemic. All those interviewed agreed and

spoke about the changes in both the mental model of professionals and the business models made possible, especially by telecare models. Adding a standpoint on the volume of new technologies, Interviewee R pointed out that the investment made has been proportionally significant, to the point where it is even considered that investment volumes will be reduced in the coming years.

To gain a more in-depth understanding of the enabling technologies, Klingenberg; Borges; Antunes (2021) proposed the four major groups, and from these groups, the empirical evaluation of the case study interviewees originated. With the four groupings being (i) data generation and capture, (ii) data transmission, (iii) data conditioning, storage, and processing, and (iv) data application, we first assessed which of all the technologies found in the RSL were used or intended to be used during the interviews. Figure 17 lists in bold the technologies that were mentioned by the interviewees, while the others showed no signs of investment or focus from the reports made or from the secondary data obtained.

Figure 20: Technologies identified by cluster
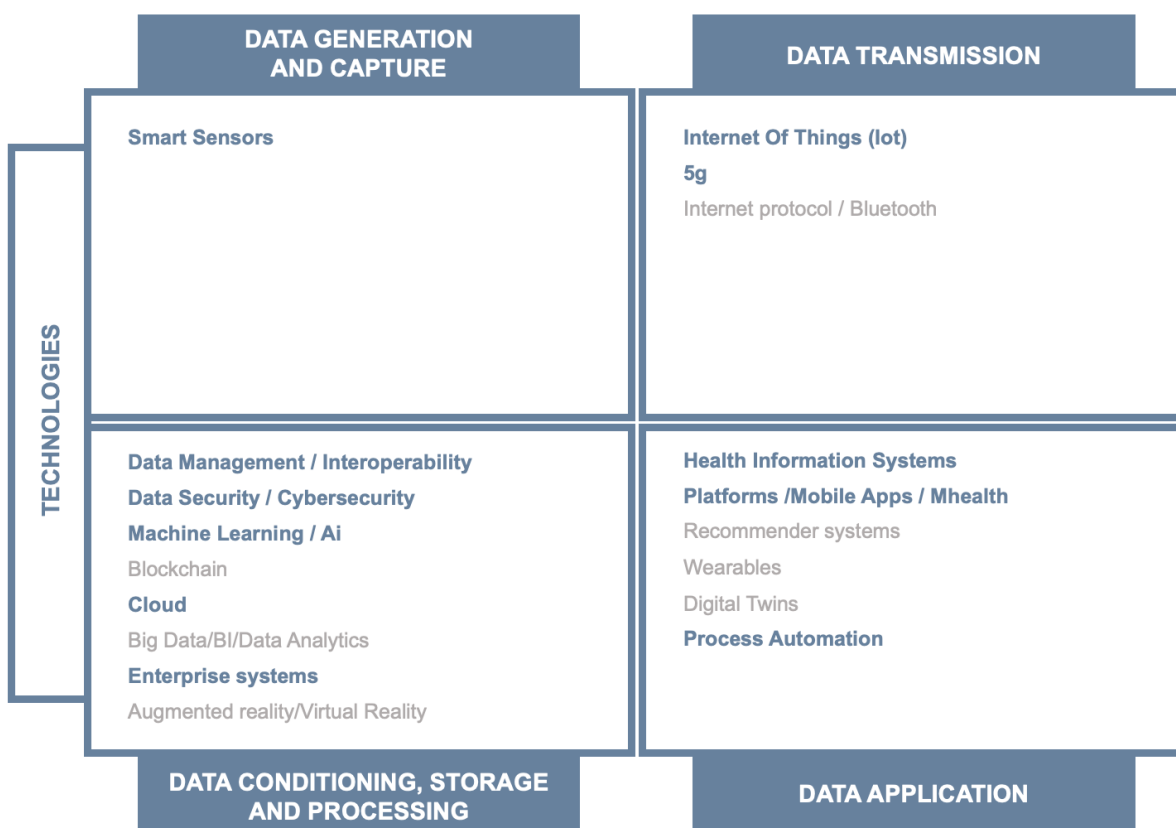
Source: author

The first group of technologies, relating to data generation and capture, includes technologies that generate and collect data on products, components, machines,

processes, and people. In this group, only intelligent sensors were mentioned by Interviewee R, who, with an IT viewpoint, pointed out that "for us in health, the more structured data, the better", so the non-manual capture of new information even for predicting events was signaled.

The second group, data transmission, is made up of technologies related to the transportation of data from its points of origin to the places where it will be stored or used. Among these technologies, both IoT and 5G were cited as technologies with great potential, with 5G allowing a better connection and low latency in environments with a limited signal, such as the operating room, and IoT as a way of monitoring items, patients and multiple pieces of equipment remotely.

The third group, data conditioning, storage, and processing, is made up of technologies related to the storage, maintenance, availability, and transformation of data, creating knowledge. In this group, internal data interoperability was a point brought up hastily due to the challenges of integrating the institution's 47 internal systems, with cybersecurity as a key factor of concern, therefore requiring continuous investment and attention, as well as AI with the potential to revolutionize the sector by improving error reduction and process optimization, also associated with the cloud, which allows greater access and availability of data.

The fourth group, data application, consists of technologies that represent the application of data, thus changing the activities of the value chain. In this category, automation robots were mentioned by interviewees R and E because of their impact on optimizing areas, platforms, and apps as a source of new models and solutions, and, finally, the Health Information System (HIS), which is the most relevant core of data storage and which sometimes prevents all DT from taking place in a more optimized way because, as Interviewee T points out, "their data is not structured or of high quality sometimes", which makes it difficult to apply this data.

Given the number of respondents who pointed out the importance of investing in each of the technologies, it was possible to assign an order of importance to the evaluation mentioned in Figure 18. After analysis, the view of Mesko et al. (2017), that the growing fears of the susceptibility of medical devices and data to hackers, means that there is a growing and relevant concern about privacy and cybersecurity, which directly reflects the most relevant theme being conditioning and storage.

The second dimension, also considered in need of greater investment, the application of data, is highly correlated with data processing, which is the application

of data to create value in systems and solutions. This is in line with the authors Romanow et al. (2012), who warn that the proprietary approach to data in systems restricts the exploitation of the available data, which was widely mentioned by all those interviewed, not knowing only whether this is a problem more specific to Brazilian ERPs but suggesting that this is a global challenge from the segment's perspective.

Figure 21: Investment priorities among technologies
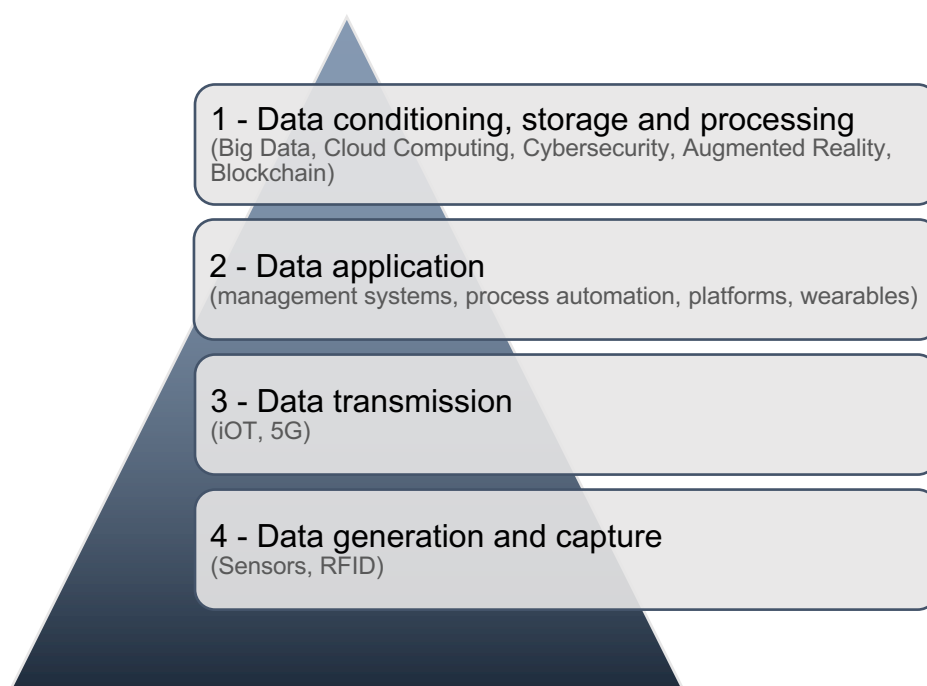
Source: author

As Interviewee R pointed out, given that in times of constant technological obsolescence, it is not economically feasible for everything you want to invest in to be authorized, so the logic of identifying this probable prioritization could be a relevant managerial vision. The literature did not identify any order of importance or emphasis of investments in relation to the maturity or priority of health actors, but it is possible to identify that the relevance brought also reflects what the RSL presented in the initial part of the study by the number of incidence of studies.

5.3 PERCEPTION OF DT CHALLENGES

Aspects relating to the challenges perceived by decision-makers in relation to the implementation, progress, and achievements of DM processes can guide where solutions and alternative paths can be explored. Ilin et al. (2022) have already outlined

some of what they consider to be the main challenges of DM in hospitals, which was validated by this case study, proving that the majority agreed with all the points raised: (i) lack of financial resources; (ii) lack of trained professionals, which hinders the digitization of medicine; (iii) underdeveloped digital health infrastructure; (iv) threats to information security; and (v) low level of development of expert systems.

As for the lack of financial resources, this is understood to be one of the greatest challenges for digital transformation (DT) in hospitals, reflected both in the literature and in the perceptions of professionals in the field, but it was not the one with the greatest impact. Studies indicate that the high initial and ongoing costs associated with the adoption of health technologies represent significant obstacles (DESROCHES et al., 2008; JHA et al., 2009), and the survey revealed that four of the five interviewees consider the lack of financial resources to be a factor with a high impact on DT processes, agreeing that, although investments are already being made, there is a need for increments and ongoing maintenance to keep up with technological demands. Interviewee M's words reflect this situation well: "*It's not that we don't invest anything, you know? But yes, we could invest more [...] I think there is investment and that we are evolving, but we could evolve much faster, not least because of the speed of change*".

The interviewees point out that resources compete with other essential needs of the hospital, such as physical infrastructure and the purchase of medical equipment, which makes financing DM a constant challenge. Interviewee P mentioned a metaphor of a specific "investment portfolio" for DM, even if it's not a significant amount, but one that guarantees continued progress even in more challenging times: *"[…] there has to be a reserve for this [investment in digital transformation]. I'm not saying that they have to be significant amounts, but rather that the hospital has to have the money for it on an ongoing basis*" (Interviewee P). Interviewee E complements this view with the statement that "*everything we invest in is an IT investment*".

In addition, the lack of resources not only prevents immediate technological advances, but also jeopardizes the future benefits that could be achieved with a robust digital infrastructure, which is the second block of challenges that was assessed by the interviewees. In this sense, Tortorella et al. (2020a) already warned of the critical obstacle, as the author said, due to the underdeveloped infrastructure base.

In agreement with the authors, all the interviewees agreed that the lack of an adequate technological infrastructure has a significant impact on DM processes.

According to Interviewee M, segmentation and different levels of maturity in institutions prevent interoperability and technological readiness: "*Health is not interoperable; it is segmented; it has different maturities*". Interviewee E adds that most hospitals in Brazil don't reach a minimum level of excellence: "The healthcare segment, thinking of Brazil, still has a long way to go."

The lack of technological readiness in healthcare institutions not only hinders digital transformation, but also prevents interaction and the efficient sharing of information, creating data silos (TORTORELLA et al., 2020a). Interviewee T points out that this gap is a clear obstacle, highlighting the lack of standardization and resistance to sharing information: "*Today it is a high challenge because we have no standard in the market*". Although everyone agrees on the negative impact of this underdeveloped infrastructure, the proposed solutions vary. Interviewee P defends the need for robust investment: "[…] *in terms of technology in medicine, we could be far ahead if we had more investment.*" In contrast, Interviewee R believes that it is possible to make progress with limited resources through innovation and internal efficiency: "*You can do things differently! Even if you don't have [resources], you can do things differently.*"

Given the perceptions regarding the lack of trained professionals as one of the challenges for digital transformation (DT) in hospitals, according to studies and evidenced by empirical research, this is a relevant point. According to the authors, it is essential that healthcare professionals receive comprehensive training on the use of technology, as this is crucial to improving adherence to solutions that can have an impact on the patient (LYANNA et al., 2022). However, the empirical research reveals low agreement among respondents on the impact of this challenge. Three respondents consider the lack of trained professionals to be a high-impact factor, while two see it as low-impact, resulting in the Fleiss`Kappa index indicating insignificant agreement on this issue, reflecting the complexity and varied perceptions of the problem.

Despite the disagreements, there is a consensus on the need for appropriate management and staff development strategies to reduce the potential for this to become a major challenge. Some interviewees point out that the intellectual capacity of health professionals allows them to adapt quickly to new technologies, provided there is a mature institutional culture and clear motivation, "*The Reason Why*", as stated by Interviewee M, who even cites the segment as one accustomed to keeping up to date with the demands of patients and the market itself. Others emphasize the importance of talent retention and continuous development, suggesting that corporate

education can play a vital role in this process of maintaining and advancing DT. However, there are also those who argue that the main problem is not a lack of qualifications, but the absence of a clear institutional vision, which can sometimes limit these employees.

The digital health infrastructure in hospitals represents a significant challenge for digital transformation (DT). Tortorella et al. (2020a) already pointed out that there are factors that influence the maturity of this structure, from the cultural and socioeconomic context of different regions, as well as internal determinants, such as the specific characteristics and internal processes of each organization. Empirically, the survey respondents unanimously pointed out that the lack of this infrastructure has a significant impact on DT processes, reflecting a collective understanding that technological readiness is still insufficient.

Interviewees M, T and E pointed out that this deficiency impacts both the sector and individual companies, suggesting that the problem may be inherent in the culture of the healthcare market. Complexity and a lack of technological readiness within institutions were cited as barriers to interoperability and efficiency in advancing DT processes. In addition, the precarious conditions of Brazilian hospitals, with less than 10% operating at minimum levels of excellence, were emphasized as a critical problem. Interviewee E commented on radiofrequency as an example of the fact that the hospital is still an advanced environment compared to the health segment, but that relative to the market, delays can be seen: "*I arrived here in 2014, coming from industry, and RFID for me was a solution that I had been practicing for at least 20 years in industry*".

Given that infrastructure is the enabler for progress on all other fronts, there were considerations as to possible solutions. The interviewees proposed different approaches, initially going through the need for investment and standardization of data and information, plus the search for greater efficiency with limited resources and internal restructuring to make room for infrastructure with the same investments.

When assessing the perceived challenges, cybersecurity stood out both in the RSL and in the empirical assessment. Mesko et al. (2017) already warned of the potential growth in information security concerns arising from the vulnerability of medical devices and the potential increase in cyberattacks. With the significant increase in the adoption of new and more technologies as alternatives and solutions to the challenges of the Covid-19 pandemic (RAIMO et al., 2022), the exposure and

volume of data has been proportional. This concern was evidenced in the RSL by the volume of scientific articles addressing the topic, which was the fastest growing of all those related to DM after 2019 when the pandemic began.

This growing concern about attacks and the need to protect the structure is reflected in the structure of the hospital, with a vision represented in the speech of Interviewee E, who points out that invasions are "not a question of if, but when, we will suffer attacks". These reports are in line with the literature on the increase in risks, as well as the aggravating factors and the lack of transparent privacy policies in health applications brought up by Sunyaev et al. (2015), which contribute to the reluctance to adopt health technologies.

When evaluating this reluctance perceived in the empirical assessment, an important point is the already consolidated view of the interviewees that "*today we have 3 external layers of protection that help us on a daily basis, as well as a team for network security*" - Interviewee E, added to statements such as Interviewee R's, "there has already been a *lot of investment, and we are already at another level of security*" signaling that the investments that could be made have been made. Even so, it is possible to identify that culturally, and in addition to the fact that information security is the main item on the hospital's risk matrix, barriers are naturally created that are sometimes non-existent for adherence to DT processes on the grounds of security risk, which leads to Interviewee M's statement that "*it's complicated to transform because for me the culture isn't ready yet*".

The empirical data reveals that information security effectively requires continuous investment in robust infrastructure. The implementation of several layers of protection and a culture of proactivity in relation to risks, with some highlighting the seriousness of the impact of these threats. As an example, Interviewee M brings up the importance of continuous and effective actions to manage risks, while Interviewee E describes a multi-layered approach to protecting against potentially malicious access attempts. Despite the consensus on the need for rigorous security measures, there are still variations in the perception of the seriousness of threats, reflecting different levels of preparedness and investment between different hospitals. In short, information security is vital to the operational continuity and integrity of digital health systems, requiring constant attention and adaptive strategies by players in this segment.

The implementation of health IT systems faces barriers due to the lack of incentives for providers, who are reluctant to adopt and share data for competitive

reasons (OZDEMIR et al., 2011). This theoretical scenario is empirically corroborated by the case study conducted, in which all interviewees highlighted the negative impact of underdeveloped expert systems on hospitals' digital transformation. They pointed out that current systems, dominated by market-leading ERPs in Brazil, are insufficient to meet the contemporary needs of hospitals, resulting in slow and inefficient processes.

Interviewees indicated that this limitation generates an excessive dependence on multiple satellite systems, 47 specifically, in the case studied according to Interviewee E, and often the need to develop alternative solutions in-house. Examples include regulatory compliance failures and the lack of essential functionalities, highlighting the desire and need for more advanced and intelligent systems, especially in terms of the possibility of integration. In addition, the perception that suppliers create intentional dependencies to maintain control over clients exacerbates this situation, so a relevant enabler for the advancement of DT processes is that systems keep pace with technological and legal demands, guaranteeing efficiency and quality in hospital services.

Sorting by whether they agree with the five challenges presented by Ilin et al. (2022), Figure 19 shows the five main challenges faced by the case study in the context of digital transformation, ranked in order of importance. The first to stand out is the low level of intelligence development in specialized medical systems, followed by threats to information security. These factors were determined based on the interviews and reflect the main barriers to the effective implementation and progress of digital transformation at the hospital in the view of the executives.

Figure 22: Ranking of the challenges assessed in the case study
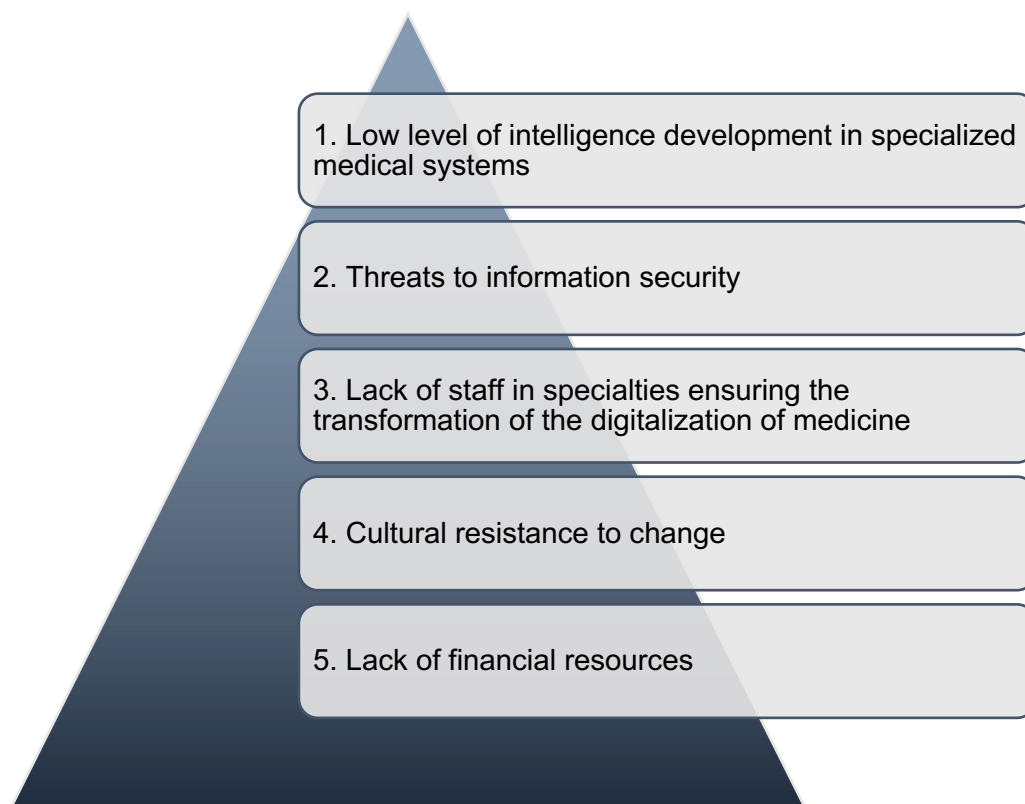
Source: author

5.4 MOTIVATIONS AND EXPECTED IMPACTS OF DT

Originating from the vision of the authors Berwick; Nolan; Whittington (2008) and Gong; Ribiere (2021), four impacts from the DT process were analyzed: (i) Digital transformation to improve the quality of hospital services; (ii) Digital transformation in the patient experience; (iii) Digital transformation in operational efficiency; and (iv) Digital transformation to create new business models. These expectations and needs are in line with the theoretical references and the perceptions of the professionals interviewed.

Given the importance of understanding the context and timing of the case study and understanding that expectations are related to the maturity of the institution, Metro North's digital strategy framework (2022) was used to assess what evidence was found at the hospital through secondary data, interviews, and analysis. Based on the analysis, Figure 22 identifies in gray, from the evidence and reports, the maturity of each of the dimensions (people, process, information, and technology) relative to horizons 1, 2, and 3 brought up by the theory.

Figure 23: Evidence found related to horizons

	HORIZON 1 *Building digital foundations:* Better care for individual patients	HORIZON 2 *Transforming patient care:* Better care for groups of patients	HORIZON 3 *Reimagining our future:* New and innovative models of care
PEOPLE	Our workforce builds digital literacy	Intelligent use of data	Innovative workforce
PROCESS	Integrating information and technology	Transparency to increase efficiency	Digital innovations allows new models of care
INFORMATION	Collecting and collating	Live-streaming analytics	Predictive and prescriptive analytics available
TECHNOLOGY	Broadens workflows to improve care	Establish links between data and analytics	Integrate innovative technology in the digital platform

Source: adapted from Metro North (2022)

Several authors complement the potential impacts of the DM process in healthcare, including Goldsack and Zanetti (2020), who state that the widespread adoption of technologies aims for continuity and long-term gains, seeking results such as reducing disparities, greater accessibility, and efficiency in healthcare, as well as minimizing complications and barriers. Sullivan and Staib (2018) add that the transparent articulation of data detailing patient journeys opens unprecedented opportunities to optimize the quality and efficiency of care. Gopal et al. (2019) argue that data-driven innovations and evidence-based decisions can optimize outcomes for every patient. Yang (2015) and Tortorella et al. (2020a, 2022) note that the implementation of digital solutions significantly increases automation and interconnectivity, resulting in substantial improvements in the efficiency of patient care and administrative processes. Binsar et al. (2022) point out that automation accelerates processes, allowing healthcare professionals to focus on strategic tasks.

Throughout the work, the perception of HMV and its executives that the DT process will have a significant impact on the quality of hospital services is evident. The main expectation is the improvement of quality and patient safety aspects, such as the implementation of bedside checks and the use of mobile tablets, increasing the accuracy of prescriptions and patient safety. Despite the unanimity in the perception of a positive impact, some interviewees warn of the need for caution in implementation, given the risk inherent in changes to healthcare processes, which is also partly why adherence in this segment is said to be slower.

This perception is in line with the theoretical references that point to DM as a means of optimizing the quality of care, especially the operational process, which is sometimes permissive to error daily (Sullivan and Staib, 2018; Gopal et al., 2019).

There is, however, a need for a careful and gradual approach, mentioned by the interviewees, reflecting a caution that is not explicitly addressed in the theoretical references, but which is crucial in the practical context of a hospital.

There was a high level of agreement among the interviewees about the positive impact of DT on improving the patient experience. Digitalization is seen as a means of making care more efficient and pleasant for the hospital, especially given the volume of touchpoints between clients and their families during the hospital journey. The pandemic has accelerated the need to digitize services, and most respondents recognize that hospitals that do not adopt these changes run the risk of becoming obsolete in the short term. Practical examples include the use of self-service totems, apps for scheduling and monitoring exams, tele-service for various needs and everyday uses such as the possibility of a self-checkout for parking, all of which improve user satisfaction.

This view is in line with theoretical references that highlight DM as a tool for improving the patient experience by making processes more efficient, supporting ease of access and speed, and transparent, enabling a more profound understanding of times, requirements, and needs (Goldsack and Zanetti, 2020; Sullivan and Staib, 2018). It is pertinent to note, however, that some interviewees consider these improvements in experience to be more of a consequence than a main cause of the DT process, a perspective that can add nuance to theoretical expectations.

There is agreement and a view that DT processes will have a significant impact on the hospital's operational efficiency. Factors such as the automation of processes with RPA and the implementation of advanced technologies are considered ways to increase the accuracy and speed of services, reduce the need for staff, allow for an increase in patients seen, and improve the hospital's economic viability, especially in challenging times such as the current market is facing. DT is perceived as crucial to the economic sustainability of the health system, especially in the shift from what Interviewee R called a "people-oriented company", where every new service being considered culturally makes managers think first about how many new employees they need rather than whether or what technologies can be added to avoid costs.

This perception and expectation is in line with theoretical references that highlight automation and interconnectivity as key factors for improving operational efficiency within hospital structures (Yang, 2015; Tortorella et al., 2020a; Binsar et al., 2022). However, the interviewees' emphasis on the search for economic viability for

each new implementation adds a practical dimension that complements theoretical expectations and can be a counterpoint if a solution generates improvements but makes the process more cumbersome.

The expectation of creating new business models with DT, one of the fundamental pillars of the transformation process, shows slight agreement among the interviewees and of all the expectations was the only one where there was a greater divergence. While some see a high potential for diversifying revenues and offering new services, such as telemedicine and remote health monitoring, others are more cautious, citing institutional slowness in adopting new technologies and treating this expectation as more medium and long term.

This variation in expectations reflects a difference in the positions and responsibilities of the interviewees within the hospital, indicating a diversity of perspectives on the integration of new technologies. Although the theoretical references do not directly address the creation of new business models in healthcare, they do emphasize the optimization of processes and the improvement of results, which can indirectly support innovation and the diversification of services. As with the challenges and expected impacts, Figure 23 describes a potential order of expected impacts in the case study by the number of professionals and their agreement, serving as a representation of the institutional vision.

Figure 24: Investment priorities among the technologies
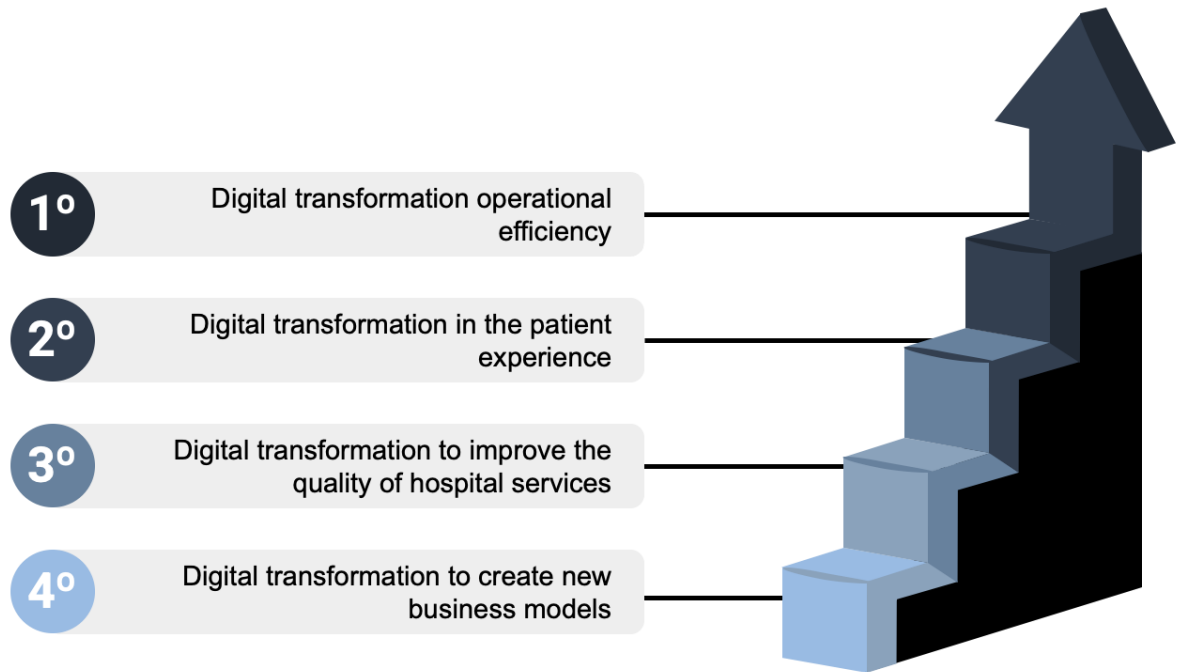
Source: author

As a way of synthesizing the different degrees of relevance expected in the data survey, as well as the prioritization of activities, it was proposed that a figure be developed to cover all the dimensions of the case study proposed in this study. Figure 25 illustrates the main elements of digital transformation (DT) in hospitals, highlighting the motivations, challenges, and associated technologies. The further towards the center of the figure, the greater the relevance, importance, or expectation of each of the dimensions, all based on the responses obtained during the survey.

Figure 25: Drivers for Hospital Digital Transformation
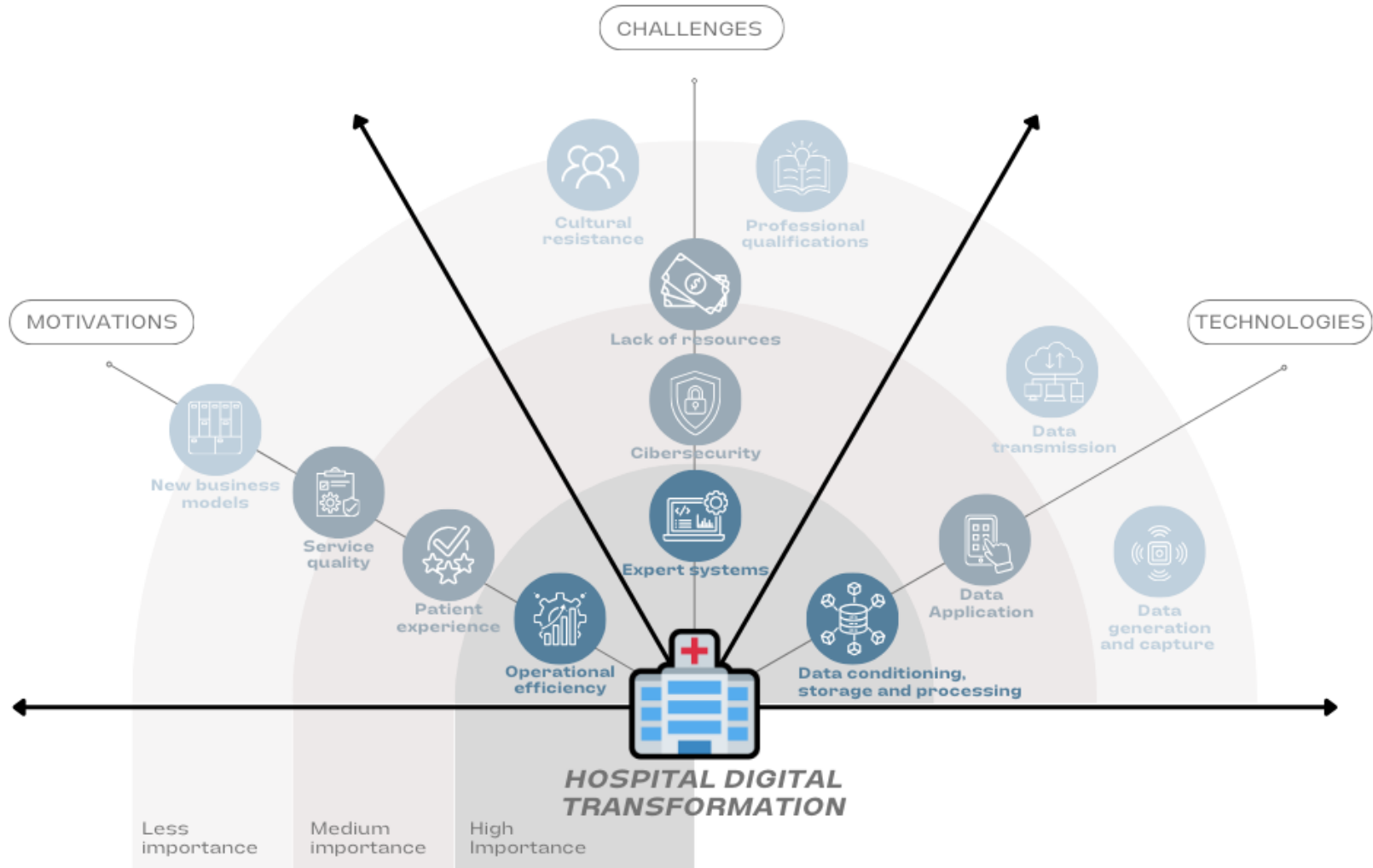
Source: author

The case study at Hospital Moinhos de Vento reveals significant convergence with theoretical expectations about the impacts of digital transformation, especially in the dimensions of service quality, patient experience and operational efficiency, with greater or lesser emphasis on each of these dimensions. Divergences regarding the creation of new business models could be seen, reflecting different institutional and even cultural perspectives, but without ceasing to be considered a path to be developed by the institution. These variations highlight the importance of considering both theoretical expectations and practical realities when implementing digital transformation in hospitals.

6 FINAL CONSIDERATIONS

Hospitals and the health sector are facing structural challenges that require different solutions and approaches to speed up a rapid reorganization efficiently. DT processes show significant potential as a solution, both in the literature and in empirical studies, to optimize the sector and make quality healthcare more accessible.

The study showed that, despite the boost to DT processes generated by the Covid-19 pandemic, there are still differences in the interviewees' perceptions of the understanding and objectives of these investments. The lack of clarity in the concepts of digitization and DT is common, which limits the transformative potential of the initiatives. This reinforces the importance of adequate training for healthcare professionals, which is considered crucial to the success of DT. If there are conceptual differences, it will be more difficult to achieve consistent investments aligned with clear and common objectives.

Technologies are necessary but not sufficient for DM. In the hospital context, DM involves embracing new technologies but is not limited to technical implementation. The existence of and investment in enabling technologies is fundamental, but it is essential to have a strategy that considers organizational culture, ambition for new business models and security, so that technology is not underused, and DT is not just about digitizing existing processes.

The problems and challenges facing healthcare are not just technical or technological. The study revealed, according to the view of all the executives interviewed, that there is already solid and recurring investment in new medicines, treatments, and tests, and that the health system's greatest challenge is to become viable to continue saving more lives. The literature presents various technical paths that can be adopted, but the system needs to be viable and accessible.

DT is also a question of survival. Digitizing journeys and experiences allows institutions to reduce their biggest cost, which is personnel, and optimize the results generated by technology. Although the company is "people-oriented", DT allows these people to be allocated where care is really needed and adds value, as well as allowing revenue diversification with the same existing structure.

The case study at Hospital Moinhos de Vento revealed that although the digital transformation is underway, there are still significant challenges. The lack of integration between systems and the dependence on ERPs that consolidate and gain strength

from this fragmentation were identified as the main obstacles. In addition, investments in enabling technologies are often limited or compete with short-term needs, such as the acquisition of more up-to-date medical equipment, which sometimes generates results in a more tangible and measurable way.

The findings of this study are crucial for the hospital sector, highlighting the direction of investments and structural changes that drive digital transformation in hospitals, associating them with the expected impacts, foreseen challenges and the technologies involved. The in-depth understanding of the scenario and the critical areas that need technological advances allows managers and health professionals to be guided in making more strategic decisions, based on a reference hospital that has already made consistent progress on the subject. In addition, the results contribute to advancing knowledge about the implementation of new technologies in healthcare, as well as a model for diagnosing and prioritizing investments.

It is important to recognize that this study has limitations, such as the restriction of the case study to just one hospital, which does not prevent, but may limit, the generalization of the results to other health institutions, especially those of a public nature or of a smaller size and investment capacity. In addition, the lack of access to detailed and longitudinal data on the implementation of the different technologies in the hospital may impact the depth of understanding of some analyses and the extent of the impact of these investments. These limitations highlight the need for future research that addresses a more diverse sample of hospitals and incorporates a more detailed analysis of the systems and technologies used globally.

Based on the limitations identified, it is suggested that future studies expand the sample of hospitals analyzed, allowing for a more comprehensive view of the challenges and opportunities of DM in hospitals, including institutions of different sizes, legal natures, and countries. In addition, a DM readiness or maturity framework that delves not only into technological aspects, but also into the analysis of healthcare professionals, cultural aspects, advances, and market comparisons in relation to DM processes, could drive and assess the impact of technological changes on the patient experience, as well as provide insights for the continuous improvement of healthcare services in the current scenario. Investigating the impacts of DM in the face of the potential implementation of emerging technologies, such as artificial intelligence and the Internet of Things, could also be a promising area for future research.

This study has highlighted the importance of digital transformation in hospitals and healthcare, emphasizing the need for integrated and assertive strategic approaches to overcome the challenges of a vital sector. It is hoped that the results of this research will inspire new and greater research and visibility for the subject of DT, combining existing studies with empirical application, leveraging the healthcare segment to make it more viable and accessible. DM is essential and promising for improving the quality of healthcare services, optimizing processes and providing a better and safer experience for patients, families, and healthcare professionals.

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APPENDIX A - SYSTEMATIC LITERATURE REVIEW PROTOCOL

CHARACTERISTIC	DEFINITION	JUSTIFICATION
OBJECTIVE	The main objective of this research will be to assess how to implement digital transformation in healthcare and what its paths and impacts are in the industry.	This study seeks to understand the best practices and technologies that contribute to digital transformation in healthcare companies and what are the possible impacts of these possible paths
CONTEXT	Healthcare and hospitals	The application context will be in healthcare, with a focus on hospitals
TIME FRAME	Without limitations	Since it is still an emerging theme, the time horizon will not be limited
THEORETICAL CURRENTS	Digital transformation; Digitalization; e-health;	The research aims to understand how digital transformation occurs in healthcare environments and its related themes
LANGUAGE	Searches are limited to documents in English and Portuguese	English texts will be used as the main source due to the greater relevance of publications
REVIEW QUESTION	How does the digital transformation process take place in healthcare, and what factors positively impact the adoption of new technologies and the creation of new business models?	
REVIEW STRATEGY	Configurative	It aims to explore the topic more broadly
SEARCH CRITERIA	Inclusion criteria	1 - Research that contains the analysis of digital transformation development cases 2 - Research that contains an analysis of technologies that enable or accelerate the digital transformation process 3 - Research that proposes or evaluate DT frameworks applied to healthcare
	Exclusion criteria	1 - Duplicate surveys 2 - Non-availability of documents 3 - Health surveys directed to segments other than hospital services 4 - Studies focused only on technologies or specific specialties

CHARACTERISTIC	DEFINITION	JUSTIFICATION
SEARCH STRING	"digital transformation" AND (healthcare OR "health management" OR "health care" OR Hospital)	The choice of search terms was made according to the research objectives. The defined terms should be present in the title or abstract or keywords of the documents searched in the databases.
SEARCH DATABASES	Scopus; Web of Science	Search sources defined according to the research topic.

APPENDIX B – INTERVIEW SCRIPT FOR THE CASE STUDY

INTERVIEW SCRIPT

A crescente complexidade das demandas médicas, o aumento da expectativa dos pacientes e a necessidade de eficiência operacional têm impulsionado a adoção de tecnologias inovadoras nos ambientes hospitalares. A transformação digital emerge como um catalisador fundamental para enfrentar tais desafios, proporcionando melhorias significativas na qualidade do atendimento, otimização de processos internos e uma gestão mais eficaz dos recursos. Neste contexto, buscamos explorar as percepções e experiências dos profissionais da saúde em relação à incorporação de soluções digitais, visando compreender de que maneira essas mudanças estão impactando e moldando a prática médica contemporânea.

ENTENDIMENTO RELATIVO À TRANSFORMAÇÃO DIGITAL					
EM RELAÇÃO AO PROCESSO DE TRANSFORMAÇÃO DIGITAL, QUAL SEU NÍVEL DE CONCORDÂNCIA EM RELAÇÃO AS AFIRMATIVAS ABAIXO?	Concordo plenamente	Concordo	Discordo	Discordo Plenamente	Não posso opinar	**Fonte**
A transformação digital é um processo que necessita investimento contínuo						YOO, 2010
Com relação as afirmativas anteriores, em caso de concordância, justifique sua resposta.						
O objetivo da transformação digital é a implementação de novas tecnologias						
Com relação as afirmativas anteriores, em caso de concordância, justifique sua resposta.						
As tecnologias são um meio para viabilizar o processo de transformação digital						(GONG; RIBIERE, p.12, 2021)
Com relação as afirmativas anteriores, em caso de concordância, justifique sua resposta.						

TECNOLOGIAS ADOTADAS					
QUAL A IMPORTÂNCIA DE INVESTIMENTOS DO HOSPITAL RELATIVO A CADA UMA DESSAS TECNOLOGIAS, TENDO EM VISTA O PROCESSO DE TRANSFORMAÇÃO DIGITAL?	**Muito alta**	**Alto**	**Baixo**	**Muito baixo**	**Não posso opinar**	
Geração e captura de dados (sensores, RFID)						(KLINGENBERG; BORGES; ANTUNES, 2021)
Com relação as afirmativas anteriores, em caso de haver importância, justifique sua resposta.						
Transmissão de dados (internet, iOT, 5G, protocolos e padronizações)						(KLINGENBERG; BORGES; ANTUNES, 2021)
Com relação as afirmativas anteriores, em caso de haver importância, justifique sua resposta.						
Condicionamento, armazenamento e processamento de dados (AI, Big Data, Computação em nuvem, Cybersegurança, Realildade aumentada, Blockchain)						(KLINGENBERG; BORGES; ANTUNES, 2021)
Com relação as afirmativas anteriores, em caso de haver importância, justifique sua resposta.						
Aplicação de dados (Sistemas de gestão, automação de processos, plataformas, wearables)						(KLINGENBERG; BORGES; ANTUNES, 2021)
Com relação as afirmativas anteriores, em caso de haver importância, justifique sua resposta.						

DESAFIOS						
QUAL O IMPACTO DESTES ASPECTOS NOS PROCESSOS DE TRANSFORMAÇÃO DIGITAL DO HOSPITAL MOINHOS?	**Muito alto**	**Alto**	**Baixo**	**Muito baixo**	**Não posso opinar**	
Falta de recursos financeiros						(ILIN ET AL, 2022)
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Resistência cultural à mudança						
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Falta de profissionais qualificados para garantir a transformação digital da medicina						(ILIN ET AL, 2022)
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Baixo desenvolvimento da infraestrutura de saúde digital (sistemas de armazenamento e compartilhamento de dados; padronização e interoperabilidade interna e externa, tecnologias)						(ILIN ET AL, 2022)
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Alto nível de ameaça à segurança das informações						(ILIN ET AL, 2022)
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Baixo nível de desenvolvimento da inteligência dos sistemas médicos especializados						(ILIN ET AL, 2022)
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						

IMPACTOS ESPERADOS						
QUAL O IMPACTO ESPERADO DA TRANSFORMAÇÃO DIGITAL CONSIDERANDO CADA UMA DAS DIMENSÕES ABAIXO?	**Muito alto**	**Alto**	**Baixo**	**Muito baixo**	**Não posso opinar**	
Aprimoramento da qualidade dos serviços hospitalares						BERWICK; NOLAN; WHITTINGTON, 2008
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Melhoria na experiência do paciente						BERWICK; NOLAN; WHITTINGTON, 2009
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						
Aumento da eficiência operacional						BERWICK; NOLAN; WHITTINGTON, 2010
Com relação as afirmativas anteriores, em caso de haver impacto, justifique sua resposta.						

Potencial de criação de novos modelos de negócios						GONG; RIBIERE, 2021

APPENDIX C – DIGITAL TRANSFORMATION STRATEGIC PROJECTS

Strategic Dimension	Program	Project	Deliverable
Promote digital transformation	Information Security and Technological Infrastructure	Infrastructure security	IT Infrastructure Continuity Program
		Information Security	Full digitization of the hospital, making it paperless (validation by HIMMS 7)
			Review, adherence and adaptation to LGPD standards
			Security Scored Card compliance service Level A Score 99%
			Implementation and adaptation of processes for ISO 27001 accreditation, which seeks to identify, assess, and mitigate information security risks
		Data governance	Assessment to evaluate level of maturity and plan for progress in data governance
			Implementation of a Data Governance program
			Structuring the database using a Data Lake
	Digitalization of Customer Experience and Process Efficiency	Digitization with a Focus on Patient Experience	Development of a Patient Portal
			Development of a Patient App
		Digitization with a Focus on Cost-Effectiveness	Data structure for use in robotization and APIs via buses
			Development of an RPA for Legal Litigation
			Development of an RPA for Concierge Service