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Faculty of Business Economics

Master of Management

Master's thesis

Digital ecosystem management: How digital transformation is reshaping collaborative innovation in the healthcare industry

Elinor Abo Abie

Kainat Iqbal

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

SUPERVISOR :

Prof. dr. Jean-Pierre SEGERS



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Preface

We present to you our master dissertation "Digital ecosystem management: How digital transformation is reshaping collaborative innovation in the healthcare industry". The completion of this study finalizes our Master's degree in Business Strategy and Innovation Management at Hasselt University. The road to completing this journey has been a precious and unforgettable one for us. We started researching and writing this thesis from November 2021 to November 2022. The topic of research has allowed us to gain insights into an ever-evolving field of study and we are grateful to the university and the professors for granting us such an exciting opportunity.

Propelled by the changes brought about by the COVID-19 pandemic, there has been a surge in digital transformation and an increase in technology innovation in every industry including healthcare. Haven witnessed a shift from the traditional classroom lesson to virtual lessons in the education industry due to the crises. It was intriguing for us to research on how adoption of technologies and digital transformation as a whole has changed and facilitated innovation in the healthcare industry in particular, seeing how it affects other industries. There has been massive collaboration of other industries in the fight of COVID-9 and so understanding how these collaboration works from a healthcare ecosystem perspective was important to us. We find a common misconception that digital transformation is simply a technological innovation, whereas it involves a complete business transformation aided by digital innovation. This misconception to the best of our knowledge is one of the reasons some businesses are facing challenges in digital transformation. In the healthcare industry, Digital transformation has the potential to boost healthcare quality, optimize operations and hence provide patient-centric care by supporting stakeholder interaction and leveraging a large amount of data that could be used to make clinical decisions to enhance healthcare delivery. However, some countries and healthcare organizations are still facing difficulties moving past the misconception of digital transformation as merely an adoption of digital technologies to adapt to the new norms imposed by the pandemic, and fully benefiting from the advantages of digital transformation. It is for this reason that we decided to carry out this research to investigate the multi stakeholder collaboration taking place within healthcare ecosystems, in which novel digital health technologies & new business models can facilitate the development of innovative healthcare solutions. Accordingly, our study addresses three main research questions:

1. How does digital transformation result in collaborative innovation in the healthcare industry?
2. What new business models emerge as a result of collaboration within the digital health ecosystem?
3. What are the challenges faced by the stakeholders in the digital health ecosystem?

We hope that our study presents useful managerial implications for healthcare organizations that are struggling or facing challenges with the adoption of digital transformation.

By choosing an industry which is out of our comfort zone, we struggled to understand certain healthcare concepts although it was all very exciting to us as we got to also learn that struggling is a part of the entire process. We have also gained more experience and knowledge on healthcare systems, healthcare apps and devices that could benefit us, on the opportunities that can be generated as a result of collaborating with key stakeholders of a business. Therefore, this dissertation has taught us invaluable lessons both personally and professionally. We are therefore grateful for the excellent guidance of our Supervisor, the participants for sharing their insight and experience with us, and all others who supported us during our research.

Acknowledgements

This dissertation would not have been possible without the professional and personal support we received throughout our journey. We would like to take this opportunity to acknowledge and thank the people who helped make it possible.

First and foremost, we want to thank God Almighty for giving us the strength and courage necessary to face even the most difficult obstacles and succeed.

We would also like to thank our supervisor, Prof. Dr. Jean- Pierre Segers, for his immense support and invaluable advice during our research. Throughout the course of our growth as researchers, he consistently encouraged us and challenged us to expand our knowledge, not only within our own field, but also in a breadth of subjects. Along with highlighting his kindness and insightfulness during our conversations, we also want to show our sincere gratitude to him for all of the time and effort he offered to us during this endeavor.

This dissertation likely would never have come to fruition had it not been for the support of our parents and family for their unconditional love, contributions, wisdom, and understanding. We would like to thank our fathers for being our role models and a great source of inspiration. We thank our mothers who tirelessly supported us and helped us to discover a greater meaning in life. Our gratitude is also extended to our siblings and relatives for their encouragement.

A sincere thanks to Kainat's husband for his constant love, support and inspiration. Thank you for tirelessly supporting and being by her side throughout this journey. Without him this would not have been possible for her.

Finally, thank you to everyone who supported, encouraged, inspired, and collaborated with us in this research.

Executive Summary

Title: Digital ecosystem management: How digital transformation is reshaping collaborative innovation in the healthcare industry

Keywords: Digital transformation, Innovation, Healthcare, Healthcare ecosystem, Collaborative innovation, Business models, Value creation

What the study is about: Over the last few decades, digital innovation and the implementation of various digital healthcare systems have increased tremendously. Digital transformation is changing the structure of every industry, and industries that are ready to adapt, and adapt quickly, will thrive and prosper. The healthcare industry, like many others, is experiencing significant changes due to technological breakthroughs. The healthcare industry is constantly working to improve the efficiency and cost-effectiveness of patient treatment. Digital transformation has the potential to assist the industry not only in terms of operational efficiency but also across the entire value chain. The benefits of adopting technology are numerous, ranging from hospital management to patient care to managing reports to virtually supporting patients.

Digital transformation is also changing the narrative of how industrial firms collaborate to create and capture value. A digital health ecosystem aims to provide customers with more value by optimizing information and processes from various internal divisions, services, and processes as well as collaborating with external entities including clients, vendors, and third parties. This also implies that growing a digital health ecosystem opens up a diverse set of innovative business models and by acquiring customer insights and realigning the healthcare service offering, it is possible to deliver greater value. Patients, healthcare providers, universities, start-ups, physicians, corporate allies, technology entrepreneurs, insurers, regulators, and administrators are brought together through innovative collaboration to grasp the opportunities and challenges that need to be addressed. These kinds of coordination between the stakeholders in the health ecosystem aid in their understanding and adoption of new technologies, which in turn enables them to jointly produce value for the patients (Elia et al., 2020).

Problem statement: The majority of research investigating digital transformation mainly focuses on the changes to organizational procedures, goods, and services from an intra-organizational perspective (Kaltenecker et al., 2015; Hansen & Sia, 2015). However, we concur with other researchers that inter-organizational perspectives should be taken into account in research on digital transformation (Jacobides et al., 2018; Puschmann, 2017), especially given that digital transformation may significantly affect collaborations in ecosystems where value is co-created among numerous stakeholders (Sarker et al., 2012). Current studies fail to point out these changes and how they appear to have significantly affected the way the healthcare ecosystem has developed (Clemons, 2018). Our study takes an ecosystem-level approach to understanding digital transformation in healthcare rather than a firm-level one. As a result, rather than examining how digital transformation altered the procedures and organizational design of traditional health

institutions, we concentrate on the impact of stakeholder collaboration within health ecosystems that capitalize on the opportunities of digital transformation. Our research contributes to the debate on digital transformation in healthcare ecosystems by investigating how the desire for novel innovations is a driver for emerging business models, with stakeholders in a healthcare ecosystem collaborating to co-create value for their customers.

Research Objective: Our research follows this primary objective: to investigate the healthcare ecosystem as a collaborative system involving multiple stakeholders, in which novel digital health technologies & new business models can aid in the development of innovative healthcare solutions.

Research Questions: Accordingly, the study addresses three main research questions:

1. How does digital transformation result in collaborative innovation in the healthcare industry?
2. What new business models emerge as a result of collaboration within the digital health ecosystem?
3. What are the challenges faced by the stakeholders in the digital health ecosystem?

Research Methodology: In order to provide answers to the above research questions, this research adopted a qualitative approach with the aim to provide a thorough understanding of the dynamics of work practices in health organizations, rapidly innovating technologies, changing strategies in managing dynamic digital business models and value co-creation in the health ecosystem for various stakeholders and their customers. Nine semi-structured interviews were conducted with participants from different countries within and outside of Europe, involving medical directors, innovation experts, general practitioners and research managers. This data collection technique allowed us to collect the data in two ways, first by a purposeful conversation with questions prepared in advance, and second by having the freedom to ask another relevant question during the interview to enhance a more profound understanding.

Findings and Value of the study: Our study is a contribution to the debate on digital transformation of healthcare ecosystems by investigating how the desire for novel innovation in healthcare and a move from the traditional healthcare system to a patient-centric care system affects the collaboration of stakeholders in a healthcare ecosystem to co-create value. In doing so, we assign a central role to digital transformation as a trigger that alters the sensemaking of innovation in healthcare, opening up opportunities and new business models aimed at improving healthcare services. The findings suggest that digital transformation has changed the way firms manage information and knowledge. Closed systems in the traditional healthcare industry are evolving into open, adaptable ecosystems where top-down governance is being replaced by decentralized, collaborative, multi-stakeholder governance.

From the analysis, we identified several ecosystem stakeholders that include traditional healthcare providers, patients, policymakers, health professionals, government and regulatory bodies, health techs, and all other parties who have various roles to play in the innovation of healthcare systems. We also present a framework that conceptualizes and describes crucial strategic elements that

encourage innovation and value creation for patients in a healthcare ecosystem. This framework was designed as a result of the challenges and disparities facing healthcare innovation systems. Participants were asked to state the significant challenges faced in co-creating value for customers, and we identified several critical challenges such as data security concerns, issues of trust and transparency, diverse interest amongst stakeholders etc. Our research framework is meant to provoke discussion and provide readers an idea of how various components of the healthcare ecosystem might affect value creation and encourage innovation. It provides an important sequence of event that could be followed to create sustainable value for patients and stakeholders in a healthcare ecosystem by taking into account: (1) strategic activities that may be carried out to ensure a fruitful stakeholder collaboration, (2) use and management of information systems to drive efficiency within the healthcare ecosystem, and (3) the desired results they intend to achieve. This is very important given that value co-creation, delivery and capture is as a result of the interactions that go on amongst stakeholders in the healthcare ecosystem. It's imperative that these interactions and exchanges are carried out successfully to achieve innovation and value creation.

Limitations and future recommendation: We encountered a few challenges and limitations during our study. First of all, due to time and financial restrictions, we could only interview a limited sample of people, which precluded us from generalizing the results of our study. This dissertation advocates for additional research using both qualitative and quantitative measurements and involving larger populations so as to obtain deeper insights from a general perspective. Given that the health ecosystem system involves multiple stakeholders from different sectors, it would have been ideal to interview participants from every stakeholder group; however, that was not the case as most of our participants were mainly from the health sector. Future research should be conducted involving multiple stakeholders so as to weigh the significance of each findings separately in every stakeholder group.

Most participants deeply emphasized the importance of disease prevention rather than providing solutions to already existing diseases. We therefore recommend a detailed look into what strategies, programs and partnerships that are happening across the healthcare industry to increase the utilization of preventive healthcare. Participants also emphasized inequality in healthcare as a key challenge facing the healthcare industry. We, therefore, recommend further studies on how the challenge of inequality in healthcare can be addressed for a universal efficiency in healthcare delivery. Lastly, it would be fascinating to research how patients interact within dynamic customer-centered healthcare ecosystems, particularly in instances when there is knowledge asymmetry between the customer and the service provider. We recommend future research in this aspect in order to identify what new roles for participation could be created for the stakeholders in these situations.

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Chapter: 1 Introduction

1.1 Problem Statement

Many healthcare facilities around the world are constantly struggling to provide sufficient treatment options, for instance, due to continual demographic shifts and an aging society (Davis & Bartlett, 2008; Zhong, 2011), resulting in rising numbers of patients and a rise in age-related health concerns (Demiris & Hensel, 2008). Technology, data, and digital innovations are redefining people's perceptions of what is feasible in terms of improving population health, customer care, and efficiency. Professionals are failing to keep up with growing workloads, and the gap between supply and demand for healthcare is rising. Most governments are attempting to reduce this gap through digital transformation, but progress has been slow, and providers' digital readiness varies greatly both within and between countries.

The Covid-19 pandemic has caused thousands of deaths worldwide and is still ongoing. The COVID-19 crisis has brought to light the shortcomings of healthcare systems around the world, highlighting the vast opportunities for innovation and technological advancement (Guderian et al., 2021; Cooper, 2021; Cobianchi et al., 2020; Cobianchi et al., 2020b). Also, the numerous ties that exist across countries and the ease with which diseases spread pose a global risk and produce collective health concerns that are difficult to handle independently (Adivar & Selen, 2013). The future severity and scale of it or any other pandemic that will come will be determined by how successfully we use technology and innovation to establish flexible digital health ecosystems that enable collaboration, egalitarian care and effective medical decision-making. Partnerships and collaborations between healthcare institutions, customers, technology providers and other stakeholders across the world will be crucial in driving a more significant broad-based change as healthcare continues to transform.

To address such fundamental global challenges, short-term, isolated, single-stakeholder initiatives are no longer sufficient but rather collaborative innovation practices, governance, and policies encourage targeted effort to meet challenging objectives. According to WHO Global Digital Health Strategy 2020-2024, healthcare organizations should promote people-centered health systems, foster global collaboration, and increase the management of worldwide health practices. People-centered innovation services and digital health practices are highly required and such innovations should be built through collaboration with a range of stakeholders, including policymakers, healthcare professionals, company representatives, and intermediary organizations, to ensure the continuous transfer of digital health knowledge. The innovation system concept relies on the idea that innovation is the product of interactive and interconnected processes involving several players from various subsystems. Thus, from this systemic perspective, innovation is a collaborative process involving a variety of diverse players rather than an isolated process that occurs within an ecosystem.

A digital ecosystem aims to provide customers with more value by optimizing information and processes from various internal divisions, services, and processes as well as collaborating with external entities including clients, vendors, and third parties. In such a setting, every member of the ecosystem should be able to employ cutting-edge technology and systems to meet their distinctive

needs as well as create value for the customer. This also implies that growing an ecosystem opens up a diverse set of innovative business models and by acquiring customer insights and realigning the service offering, it is possible to deliver greater value to the customer. However, healthcare ecosystems are under unprecedented strain, and although the quantity and quality of care have improved over the years, the scope and complexity of healthcare needs have increased as a result of a growing and aging population, rising multimorbidity, and public expectations for more personalized and convenient services (Ricciardi W. et al., 2019). While every country expects its residents to have access to high quality healthcare at a reasonable cost, countries differ in their ability to deliver services, such as the number of nurses, doctors, and beds, as well as the percentage of GDP spent on healthcare (Ghana, 2020). Several industries have introduced cost-saving technological solutions combined with innovative business models to bring convenience and affordability to their customers, yet healthcare remains pricey and inaccessible because of the lack of business model innovation (Hwang & Christensen, 2008). Chaher, Belaud, and Pingaud (2017) emphasized that many healthcare systems use collaboration practices and open innovation techniques to boost their effectiveness in the era of digital transformation. These open innovation strategies must align with the organizational business models to manage the efficient and effective transfer of knowledge into and out of the firms. Therefore, in the context of digital healthcare, the study of emerging innovative business models and the digital health ecosystem is a promising future research direction to bring value-based healthcare solutions to patients.

The majority of research investigating digital transformation mainly focuses on the changes to organizational procedures, goods, and services from an intra-organizational perspective (Kaltenecker et al., 2015; Hansen & Sia, 2015). However, we concur with other researchers that inter-organizational perspectives should be taken into account in research on digital transformation (Jacobides et al., 2018; Puschmann, 2017), especially given that digital transformation may significantly affect collaborations in ecosystems where value is co-created among numerous stakeholders (Sarker et al., 2012). Current studies fail to point out these changes and how they appear to have significantly affected the way the healthcare ecosystem has developed (Clemons, 2018). Moreover, Foss and Saebi (2018) recommend future research to investigate the interdependency of business models with digital transformation. The authors also stress the need to analyze how changes in the business model of various stakeholders affect their collaboration within the ecosystem.

With this theoretical background and identified gaps in the literature, our study takes an ecosystem-level approach to understanding digital transformation in healthcare rather than a firm-level one. As a result, rather than examining how digital transformation altered the procedures and organizational design of traditional health institutions, we concentrate on the impact of stakeholder collaboration within health ecosystems that capitalize on the opportunities of digital transformation. Our research contributes to the debate on digital transformation in healthcare ecosystems by investigating how the desire for novel innovations is a driver for emerging business models, with stakeholders in a healthcare ecosystem collaborating to co-create value for their customers. In doing so, we assign a central role to digital transformation as a trigger that alters the sensemaking of innovation in healthcare, opening up opportunities towards other forms of innovation.

1.2 The Research Objective and Questions

Given the above background and our current gaps in understanding, there is a need for more fine grained discussions of how healthcare systems are adapting to both the opportunities and obstacles presented by the new wave of digital technologies. In this regard, the research follows this primary objective: To investigate the healthcare ecosystem as a collaborative system involving multiple stakeholders, in which novel digital health technologies & new business models can aid in the development of innovative healthcare solutions.

In order to throw light on these central issues, the study will address three main research questions.

1. How does digital transformation result in collaborative innovation in the healthcare industry?
2. What new business models emerge as a result of collaboration within the digital health ecosystem?
3. What are the challenges faced by the stakeholders in the digital health ecosystem?

We use the remaining section of this paper to answer these questions. The events of the Covid- 19 pandemic have highlighted significant societal challenges that require new types of innovations to address them. This, to the best of our knowledge, is only made possible by a complete transformation of an organization's culture, operations and value proposition. Hence, we provide a conceptual background on how innovative collaboration in digital healthcare ecosystems can aid in improving innovative outputs by generating new kinds of engagement practices with patients and other health ecosystem stakeholders, thereby introducing new business models to create value for the patients. This paper further addresses the challenges faced by various stakeholders in the healthcare ecosystem in adopting digital transformation.

1.3 Thesis Outline

This dissertation consists of six main chapters.

Chapter 1: Introduction. In this part of the thesis, we state the problem statement of this research describing the research background and gaps in the literature that this study will address, followed by the research objective and research questions.

Chapter 2: Literature review. This part reviews existing literature relevant to this study discussing various perspectives on digital transformation, digital health ecosystem, emerging business models for healthcare firms and challenges to stakeholders within the digital health ecosystem.

Chapter 3: Methodology. This chapter discusses the qualitative approach of in-depth interviewing that is employed in this study. The chapter also discusses the procedures utilized to recruit research participants, data collection and analytic methodologies.

Chapter 4: Results. This part elaborates the findings of this study using data collected through qualitative approach and uses the results to answer the research questions.

Chapter 5: Research conclusions and contributions. This chapter summarizes the research conclusions by evaluating the contributions of this research from the theoretical and methodological viewpoints and identifies the implications for business management practices.

Chapter 6: Limitations and future recommendations. This part discusses the limitations of this study and provides useful insights and recommendations for future research.

1.4 Research Approach and Technical Structure

Figure 1 displays the technical framework and research approach of this study. First, the introduction explains the gaps in the literature and followed by the background of this study and theoretical concepts on digital transformation, digital health ecosystem, emerging business models, value creation for customers and challenges for stakeholders in the digital health ecosystem. The research's focus is then established, and six semi-structured interviews and other qualitative analytical techniques are employed to identify the characteristics of digital transformation and value co-creation within the healthcare ecosystem. The research findings are then further examined, and their practical importance for the various actors in the digital healthcare ecosystem is presented.

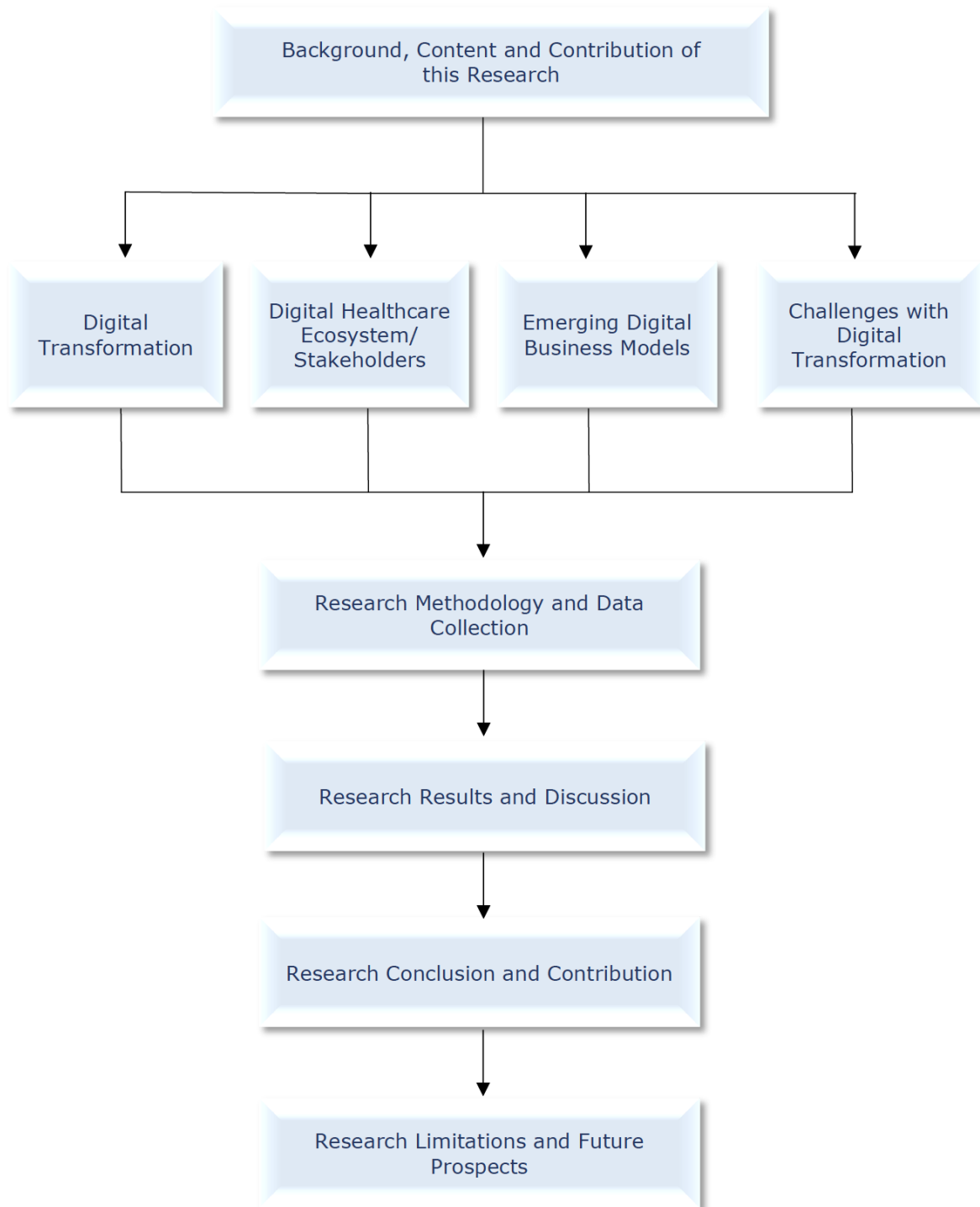


Figure 1: Technical Structure of Study

Chapter 2: Theoretical Background and Literature Review

2.1 Digital Transformation

2.1.1 Evolution of digital transformation

The topic of digital transformation is becoming more prevalent in discussions among academics and professionals nowadays. The world is migrating towards digital transformation and this phenomenon is observed at all levels. As the adoption of digital transformation is becoming more and more crucial, researchers and practitioners are showing huge interest in this topic, as seen by the rising number of publications (Reis et al., 2018). However, there is a lack of consensus on the precise definition of digital transformation in the broad literature from various researchers (Warner & Wäger, 2019).

Guinan et al. (2019) defined digital transformation as a company's potential to transform and adapt quickly to rapidly innovating technologies. In order to accomplish this, the authors stress that companies need new competencies and transformed business models to integrate digital technologies into their innovation processes. Hadjielias et al. (2021) complement this concept of digital transformation by stating that it impacts the entire organization and its business strategies, and in order to take advantage of the digital economy, an organization must redesign and digitally transform its business models, operational procedures and business culture (Schiopoiu Burlea, 2019; Ismail et al., 2017).

However, over the past years, the term 'digital transformation' has been confused with digitization and digitalization, and all three are frequently used interchangeably (Brennen & Kreiss, 2014). Digital transformation tries to overcome the confusion by assuming an umbrella function that includes digitization and digitalization, and views them as important components in the overall digital transformation of a company. At the very least, one must understand the differences between digitization, digitalization, and digital transformation, as well as the magnitude and scope of each. Figure 2 shows the difference between the three concepts and how they evolved from one stage to the next.

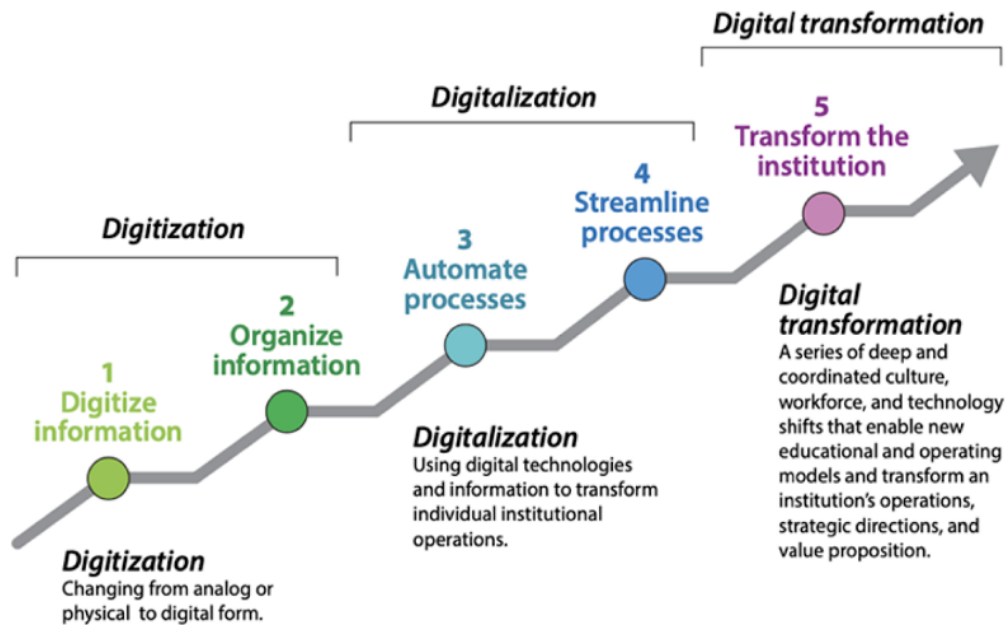


Figure 2: The three D's of Digital Transformation according to Betsy Reinitz (2020)

Borcan (2021) clarified the three concepts of digitization, digitalization, and digital transformation and created a consistent understanding of them. The study emphasized that there is a significant reliance between the three concepts, with each being necessary for the next one. Borcan (2021) explained the transition of data and information from analog to digital as "digitization" where analog or physical data like written documents, pictures or sound is converted into a digital version. Additionally, Saarikko et al. (2020) defined digitization as the process of capturing physical activities and converting them into virtual representations. This type of digitization allows items and equipment to gather and transmit digital data such as position, velocity, temperature, humidity, vibrations, and other measurements. When combined with advanced algorithms, such data provides valuable insights through smart applications enabling various autonomous operations (Porter & Heppelmann, 2014).

Digitization attracts the need for digital infrastructures, making it a crucial first stage in digitalization. Next, the concept of digitalization is about restructuring an organization's processes around digital communication and media infrastructures. In a deeper sense, the term "digitalization" refers to the adoption of digital tools that facilitate, improve, or change operational processes and activities. It also refers to the wider application of digitized data that has been transformed into usable knowledge to create value for the organization (Ismail et al., 2017). While the terms "digitization" and "digitalization" are frequently interchanged, there are significant conceptual differences between the two. While digitization discusses a technology or system of technologies in terms of what it is and what it can do, digitalization explains why it is relevant to a particular process or organization (Brynjolfsson & McAfee, 2014).

According to recent studies, the term "digital transformation" encompasses more than just integrating new technology; rather, it is seen as a tool for corporate change and business transformation (Yoo et al., 2010). Digital transformation is a multidisciplinary, corporate-wide initiative that entails enacting changes not only in technology but also in culture, governance, people, and processes. Borcan (2021) supports this statement by indicating that one of the implications of a successful digital transformation is the ability of the business models of firms to transform successfully through innovative digital solutions. This view holds that the digital transformation of business models depends mainly on value creation and proposition, strategic implementation of internal processes and interactions within the business ecosystem (Arnold et al., 2016). Based on the findings, Borcan (2021) identified that an innovative business model that produces the desired outcomes using novel digital technologies might be regarded as a milestone of digital transformation for an organization.

Other authors claim that digital transformation is more complex than just a simple technological change, incorporating more than just the digitalization of processes and value creation from digital assets (Parviainen et al., 2017), but it is more focused on the needs of the customer. It is more specifically a customer-centric approach, where the demands of the customer and their general satisfaction come first. In effect, all decisions and activities are motivated by the requirements of the client. In essence, digital transformation is the process through which a corporation develops a plan for implementing technology to improve business and fulfill the always-changing demands of consumers. The objectives of a digital transformation can include expanding the organization's reach, enhancing operational efficiency, changing the culture and image of the company, or all of the above.

Based on the understanding of broad literature, we can conclude that digital changes at several stages in a company, including the transformation of organizational procedures, company structure, technological innovation, and most importantly, the transformation of business models, are all included in the idea of digital transformation (Klewes et al., 2017). It involves the utilization of digital competencies and transforms several aspects of an organization: business model, customer focus, procedures, and corporate culture, in order to take advantage of the digital economy's potential (Schiopoiu Burlea, 2019; Ismail et al., 2017). Profitability is increased, and new business innovations are created (Savić, 2020; Sebastian et al., 2020).

Our focus in this thesis is on the terms digitalization and digital transformation. We use them interchangeably in this research, with digitalization referring to an organization's adoption of digital solutions and digital transformation referring to the impact of digitalization on an organization's strategy, processes, business model, and culture. Organizations respond to new challenges by speeding up digitalization (Kraus et al., 2020; Wang et al., 2020), rethinking corporate practices (Biron et al., 2021; Juergensen et al., 2020; Wang et al., 2020), or developing cost-effective solutions (Cankurtaran & Beverland, 2020). Chesbrough (2020) emphasizes the importance of collaborative innovation, where scientists, pharmaceutical companies, government institutions, non-governmental organizations (NGOs), communities, and individuals should join forces to mobilize knowledge, speeding up the creation, launch, and testing of potential solutions to eventually combat

societal challenges. In the face of advancing technology, traditional business practices are constantly put to the test, and it's critical for modern businesses to understand the potential of technology and embrace it when the moment for change has arrived. Therefore, those who do not adapt and join the digital transformation lose competitiveness and leave an open opportunity for competitors who do it.

2.1.2 Conceptualizing digital transformation in the context of healthcare ecosystems

Looking at technology through the lens of digital transformation is linked to an organization's ability to adapt and generate value in a continually changing environment (Vial, 2019). Digital transformation is changing the structure of every industry, and industries that are ready to adapt, and adapt quickly, will thrive and prosper. It entails doing things differently by creating entirely new business models. This approach varies from traditional perspectives, which consider digital technology solely a means to align with company strategy. Digital transformation, however, is seen as a generator of exciting and innovative opportunities for redefining how the organization creates economic value using advanced digital technologies (Bharadwaj et al., 2013). It makes use of current knowledge to transform an organization's foundation, its culture, managerial approach and operational structure, prioritizing the customer in all of its decisions and actions (Savić, 2019).

Over the last few decades, digital innovation and the implementation of various digital healthcare systems have increased tremendously (Yoo et al., 2010). As with many other industries, technology advancements are having a big impact on the healthcare sector. Understanding how the health sector has changed with technology and what role it plays in the prevention of diseases, increasing the lifespan of people, and promoting healthy lifestyles is becoming increasingly important. The healthcare industry is constantly working to improve the efficiency and cost-effectiveness of patient treatment and digital transformation has the potential to assist the industry not only in terms of operational efficiency but also across the entire value chain. The benefits of adopting technology are numerous, ranging from hospital management to patient care to managing reports to virtually supporting patients. Therefore, examining the potential of today's digital technologies to raise the standard and security of healthcare as well as to examine the new fields of digital health is becoming more and more crucial.

Several researchers acknowledge 'digital health' as the adoption of various healthcare technologies in the delivery of medical care to improve patients' health and wellbeing. Sonnier (2016) emphasizes that digital health not only improves patients' condition but also gives people a chance to help by keeping track of their loved ones' well-being. Additionally, a study by Iyawa et al. (2016) elaborated on the concept of digital healthcare by stressing that it must take into account the healthcare ecosystem and the stakeholders involved in it. The authors describe it as a technological advancement in the conception and delivery of healthcare services by various parties or stakeholders in the health ecosystem, utilizing health data and digital technology to track and enhance patients' health and to give individuals more control over their own and their families' health.

Marques et al. (2020) shed light on the potential of advanced digital technologies to raise the standard and security of healthcare systems, as well as examine the evolution of digital health. The

authors indicate the increased use of portable devices by healthcare professionals due to their simplicity of use and the flexibility they offer, allowing ease in wireless monitoring of patient care. Moreover, telemedicine is becoming more widely used and accessible, which gives patients more flexibility when scheduling sessions. Similarly, there is an increased evolution of technological advancements in medical imaging systems to provide equipment that enables healthcare professionals to examine health data remotely (Lee et al., 2008). According to Goldberg and Levy (2016), wireless blood pressure monitoring and mobile applications for hypertension can help patients stick to their drug regimens and regulate their blood pressure. Knake et al. (2016) pointed out that the adoption of electronic medical records in hospitals and healthcare facilities can enhance healthcare delivery by lowering the likelihood of mistakes, boosting productivity, enabling better coordination of treatment, and providing a valuable source of data for researchers. The authors also emphasized that all parties concerned within the health ecosystem, particularly policymakers, physicians, health equipment manufacturers, and patients, must cooperate in order to guarantee the successful implementation of new technologies (Goldberg & Levy, 2016).

Furthermore, researchers in recent studies have conceptualized the digital health ecosystem in many ways. As explained by Chang and West (2006), the digital health ecosystem is a novel and collaborative environment centered on user empowerment, providing an engaging platform for exchanging valuable health data and flexibility in healthcare delivery. Additionally, Carroll et al. (2007) defined a digital healthcare ecosystem as an ecosystem facilitated by digital technologies, which provides an adequate infrastructure to efficiently treat patients infected with acute diseases while protecting the health of employees involved in their care (Bashshur et al., 2020).

According to the co-evolution theory, several stakeholders have a continual impact on ecosystems by acting and responding to pressures and changes in the environment brought on by other stakeholders (Verdu et al., 2012). In this way, collaborative interactions, which are the inputs that encourage value co-creation in healthcare, are the elements that develop efficient health ecosystems. Co-evolution results from the necessity to provide specialized capabilities to the ecosystem in order to enhance healthcare and subsequently drive innovation in healthcare delivery. From the perspective of the stakeholder, it enables all participants in the health ecosystem to collaborate and contribute their core capabilities in order to create value for the patients. The realization of value creation and the effectiveness of collaboration depend on interactions, which are crucial factors for developing an ecosystem. Digital transformation helps with this, and it is an important driver for the successful interaction of stakeholders within an ecosystem (Appio et al., 2021).

Bhavnani et al. (2017) identified in their research that stakeholders from all sectors of healthcare have broadly agreed on the fact that innovative ideas and technological advancements have the power to transform healthcare into a more patient-centered and transparent model, improving outcomes and lowering costs. Patients, healthcare providers, universities, start-ups, physicians, corporate allies, technology entrepreneurs, insurers, regulators and administrators are brought together through innovative collaboration to grasp the opportunities and challenges that need to be addressed. These kinds of coordination between the stakeholders in the health ecosystem aid in

their understanding and adoption of new technologies, which in turn enables them to jointly produce value for the patients (Elia et al., 2020).

Galets et al. (2019) did a comprehensive evaluation of employing big data analytics in healthcare to demonstrate its usefulness for improving public health and resource allocation among the digital technologies supporting the healthcare ecosystem. Other technologies such as mobile services, social media, and robotics have all aided in the development of new standards and solutions as well as new methods of collaborating and managing resources to meet the rising demands and expectations of customers (Markus & Loebbecke, 2013). A massive ecosystem of digitized diagnostic procedures, electronic health records (EHRs), and portable health gadgets is being made possible by innovating technology and cloud computing. The combination of these factors is driving a shift in healthcare delivery from traditional hospital or office visits to virtual, on-demand, and patient-generated encounters using technology (Bhavnani et al., 2016). Such rapid change has radically altered the competitive landscape, reshaping established corporate strategies, models, and processes (Bharadwaj et al., 2013). New business endeavors and digital start-ups have been enabled by digital technologies, which utilize novel technology as a key component of their business models and operations (Elia et al., 2020).

2.2 Driving healthcare innovation through stakeholder collaboration in healthcare ecosystems

Innovation, according to researchers, is a concept with varied meanings and involves a constant amelioration of organizational processes and strategy (Baregheh et al., 2009; Lianto et al., 2018). It is centered on the complete transformation of an organization by developing new and augmented services, processes, strategies and business structures (Hess et al., 2016; Battistini et al., 2013; Salerno et al., 2015). Some other researchers, including Matt et al. (2015), Papa et al. (2018) and Santoro et al. (2018) also suggest that technology is a key instrument in the transformation of organizations. Hence, various businesses and industries are beginning to acknowledge the significance of digitalization and exploring its advantages in responding to new challenges (Kraus et al., 2020; Wang et al., 2020), in adapting and readjusting their organizational processes (Chanot, 2019; Chen et al., 2016; Biron et al., 2020; Juergensen et al., 2020; Wang et al., 2020), and also in developing cost-effective solutions (Cankurtaran & Beverland, 2020).

In the context of healthcare ecosystems, Innovation has emerged as an invaluable factor needed to bridge the gap between what is currently lacking and what could be augmented or improved in the delivery of healthcare. As such, the innovation has to be a brand-new concept of the business or significantly improved in order to bring about the changes needed (Thakur et al., 2012). In essence, innovation in healthcare should aim at improving the quality of patient care and experience, enhancing operational performance, and providing cost-effective solutions to healthcare problems by mainly setting new goals, new structures and routines and putting in place well-coordinated operations and plans (Omachonu & Einspruch, 2010). Furthermore, the 2015 report of the WHO on world aging, shows a 12% increase in the proportion of the elderly population to the overall

population, and this percentage is expected to increase to 22% by 2050. This growth in the elderly population is followed by an increase in chronic diseases and other health challenges that poses a concern in the healthcare sector (Demiris & Hensel, 2008; Agboola et al., 2013; Barr et al., 2012) and hence requires that novel innovations that can effectuate changes in these areas be put in place in order to provide efficient and optimized healthcare to patients (Agboola et al., 2013; Chouvarda et al., 2015).

Organizations are beginning to change their view on how to go about innovation. They no longer rely entirely on their internal research and development team, rather they are becoming open to the idea of open and inclusive innovation that involve various stakeholders (Dal Molin, 2011), in order to learn new strategies for coming up with innovative solutions (Huizingh, 2011) that could bring about the changes needed within the healthcare industry. Open innovation is recognized as an integrated innovation strategy that is concentrated on purposely regulating information flows across organizational borders with a focus on cross-sector collaboration in the creation and promotion of novel ideas (Chesbrough, 2012). This perspective of innovation places a strong emphasis on the value of broadening the organization's horizons while also acknowledging that not all creative innovations can come from within the enterprise (Chesbrough & Bogers, 2014). High rates of mobility of labor, dissemination of knowledge among businesses and individuals as well as the rise in the number of qualified candidates have all highlighted the importance of open innovation. Depending solely on internal expertise is no longer an ideal strategy for success in the recent market structure that is highly competitive (Andersson et al., 2011). The idea of open innovation was first coined in the early 2000s by Henry Chesbrough (2003), where he defined open innovation as 'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation'. In this regard, open innovation is a strategic approach that is more decentralized and participatory, aimed at accessing external knowledge and in finding novel methods of doing things and gaining competitive advantage Chesbrough (2003). One fundamental problem with open innovation however, is that the organization still places itself at the heart of the creative activity in most instances in order to exert control over it. Most of the time, innovation at these organizations still takes place internally. The organization can try to maintain control by bringing the outside activities as near as feasible to their borders or alternately, they could work with a direct partner. On the other hand, there's an upcoming innovation management system that involves an intricate web of business interactions and connections known as the open innovation ecosystems which is the center of our research. In the healthcare arena, we recognise an innovation healthcare ecosystem as one that permits not only two companies to develop together but also several companies or sectors to collaborate and exchange ideas by drawing on the networks of all partners to find innovative solutions and for the creation of value for patients (Aarikka-Stenroos & Ritala, 2017; Adner, 2017). An ecosystem involves a group of stakeholders that interact with one another with the aim of creating value for customers and for themselves (Adner, 2017; Jacobides et al., 2018). Open innovation ecosystems has been recognised by other researchers as an important tool that can be used to find solutions to healthcare problems and increase patient's participation, through the cooperation of several actors that permits the flow of expertized knowledge and ideas between them in the innovation process (Lundberg et al., 2013).

According to Chaheer and his co-authors (2017), there exist four categories of stakeholders in the healthcare ecosystem which includes healthcare professionals, patients, healthcare technology suppliers and policy makers. They interact with other external actors such as academic researchers, research centers, government bodies, NGOs, and public organizations, to generate information flows and co-produce value (Secundo et al., 2019). Healthcare professionals are the key stakeholders in healthcare processes and delivery (Gomes et al., 2017) and they include nurses, doctors, general physicians and specialists. The delivery of healthcare in an ecosystemic context places the patients at the center of every decision and data collection process (Chouvarda et al., 2015) hence they are the core stakeholders of a healthcare ecosystem. Several authors have classified patients into different categories such as patients with chronic diseases (Sardi et al., 2017), the aged groups (Gualtieri et al., 2018), patients suffering from dementia (McCallum, 2012), and a list of other diseases not forgetting patients who are interested in a healthy lifestyle and staying fit (Keung et al., 2013). Understanding these different groups of patients and their exact needs is important in making key decisions to improve their health and provide them with health care tailored to their needs. Barr and his co-authors (2012) also identified pharmacists as being very valuable in health care delivery as they play an important role as intermediaries connecting doctors and nurses to patients. They suggested that the availability of pharmacists reduces a lot of tension on nurses and doctors as a result of the frequent visits of patients to pharmacies. Another important stakeholder in a Healthcare ecosystem as mentioned by Chahler et al., (2012) are health technology suppliers. They help build the blocks that connect every stakeholder in the ecosystem (Gomes et al., 2017). Policy makers ensure the stability and sustainability of the ecosystem through the formation and implementation of policies that shape the actors and activities of the ecosystem (Chaheer et al., 2017). The success of healthcare ecosystems in value co-creation and patient centrality requires a top-down governance and policy making and one of the key roles of government and policy makers is to implement policies that guides stakeholders and encourage them to stick to data protection rules and standards, and report transparent patient and clinical outcomes (Ratalia et al., 2021). Other stakeholders such as NGOs, insurance companies, payers and funders also play an important role in healthcare ecosystems. Huge resources are needed in the realization of innovation within healthcare hence these stakeholders act as accelerators to healthcare institutions by offering them financial investments or expertise to boost innovations (Ploss et al., 2017). Academic and research institutions have generated interest in healthcare innovations. They facilitate the discovery and design of new medical aids by collaborating with healthcare institutions and technology suppliers (Jiang et al., 2022). Such partnerships have given birth to new medical devices. An example of it is a tech start-up in Uganda; WinSenga that designed a fetal heart rate monitor app (Ogoe et al., 2018). Furthermore, academic institutions provide training for the next generation of healthcare professional and IT experts, and also offer research and mentorship opportunities (Jiang et al., 2022).

There are several ways that open innovation ecosystems can be applied in the healthcare industry; Healthcare innovations, innovations in preventing disease, and innovations in promoting good health. This could take the form of novel services, goods, methods, regulations or new business models (Keller et al., 2013) and in the process of value co-creation (Aarikka-Stenroos & Ritala, 2017)

2.2.1 Emerging business models for healthcare innovation

Innovation is an important force for the growth of every industry including the healthcare industry. In the past, companies invested a lot in R&D for the development of new products and technologies in order to win competitive advantage (Gassmann et al., 2013). However, according to Chesbrough Henry (2007), investing in product and process development is not sufficient to have a competitive edge over competitors. Business model has been pointed out as a better alternative for competitive advantage (Paulus-Rohmer et al., 2016). The concept of business model as discussed in literature was introduced in the post dot.com era (Nielsen & Lund, 2014) and was defined by Joan Magretta (2002) as 'stories explaining the way an enterprise works'. A business model according to Magretta (2002) was used to show how a company makes money by identifying who the customer is and what the customer values, with a great importance on looking at the meaning of value from the customer's perspective. Hence, it is imperative to provide a unique value proposition to customers and indicate how this value proposition can be executed (Nielsen & Lund, 2014). According to Nielson and Lund (2014), this value proposition can take the form of a solution to a problem, a service augmentation, an improvement in performance or a reduction in cost and risk. Drawing on this aspect, some researchers have described a business model as a strategic management tool (Tannery, 2014), for the development of new innovations and new businesses (Doganova & Eyquem-Renault, 2009).

Many researchers have provided different definitions for a business model with a variety of meanings (Bahari et al., 2015; Zott et al., 2011) which are important to consider. According to Chesbrough and Rosenbloom (2002), a business model is a tool that connects technology and dynamic capabilities to meet customer needs and create value. They indicated the need for a value proposition and how firms can organize themselves in order to create value, with a focus on the customers (Chesbrough, 2007). Osterwalder and Pigneur (2010) also have a similar view as they referred to a business model as an organizational process for value creation, delivery and value capture. In this light, they proposed a business model canvas which is like a management tool that connects 9 key components of a business including customers, resources, revenue stream, value proposition, cost, partners and activities (Osterwalder & Pigneur, 2010). This framework is used to communicate the overall business idea of the firm by explicitly stating the value it brings to customers, the key partners involved in creating and delivering the value to customers and how revenue and profits can be generated (Osterwalder et al., 2005). Chanal (2011) suggested that a business model is used to describe how an organization can interact with other organizations in order to create and distribute value between them. Thus a business model has three important roles which include value creation, value delivery and value capture (Winterhalter et al., 2017; Baden-Fuller & Haefliger, 2013; Vaska et al., 2021).

Most of these discussions on the business model concept were centered around e-businesses, and how firms can create value and win competitive advantage (Gomes et al., 2017; Wirtz et al., 2016). A thriving part of literature has argued that past definitions and meanings of a business model were centered on a single firm level and did not consider the possibility of a multi-stakeholders interaction in an ecosystem to co-create value for customers and for themselves. (Wirtz et al., 2016; Bahari et al., 2015; Iivari, 2016; Xu, 2016). Zott and Amit (2010) introduced the idea of using a business

model concept in the context of an ecosystem as a vehicle to search for business opportunities. An ecosystemic perspective on business models is increasingly being used to research on how stakeholders can create value beyond the idea of a single firm. Research has shown that business models evolve through the collaboration and exchange of resources between stakeholders in an ecosystem (Bankvall et al., 2016). Furthermore, Covid-19 pandemic compelled many organizations including healthcare to reconstruct their business models into digital ecosystems (Vaska et al., 2021; Bagnoli et al., 2021).

In an ecosystem, the task of Value creation, delivery and capture are undertaken by a network of diverse stakeholders (Fu et al., 2022; Yi et al., 2022) who interact and exchange information in order for value to be created (Afuah, 2013; Biancone et al., 2019). Furthermore, Palo (2010) stated three key factors of an ecosystem business model which include the product and/or service, the stakeholders and their responsibilities, and lastly the exchange of resources amongst these stakeholders for value creation. Evidence from literature has shown that significant challenges in business cannot be easily resolved at the level of a firm, but rather at an ecosystem level (Westerlund et al., 2014). This lays emphasis on the need for various actors and roles to be identified within an ecosystem in the development of novel technological solutions and innovations (Laya et al., 2018). In order to achieve this, there is a need for all actors to know how they can benefit from the collaboration, by evidence of an attractive business model (Bouwman et al., 2008). Other researchers share a similar view by stating that for an efficient interaction and collaboration amongst stakeholders to be achieved, it entails that their business models are complementary and support each other in terms of their knowledge and capabilities (Chesbrough & Schwartz, 2007; Palo & Tähtinen, 2013).

Our study adds to previous literature to further show the use of business models in strengthening collaboration amongst stakeholders in the context of a healthcare ecosystem, in order to create value for customers and innovative solutions to healthcare challenges. The challenges faced by the healthcare industry can no longer be solved through single-stakeholder and short term initiatives, but requires collaborative innovation practices, governance, and policies in healthcare delivery, and a value proposition geared towards patient-centered care. Moreover, in order to meet up with the goals of the WHO Global Digital Health Strategy of 2020-2024, healthcare organizations are required to promote patient centricity, foster global collaboration and increase the management of worldwide health practices. People-centered innovation services and digital health practices are highly required and such innovations should be built through collaboration with a range of stakeholders. Hence, novel business models in healthcare are increasingly focused on ecosystem-based models that promote the collaboration of many stakeholders to improve healthcare. The world is moving away from single-product solutions and toward integrated solutions that solve customer needs and societal issues. This necessitates the development of ecosystems of digital offerings based on interoperable linked items, intelligent software, and data-driven services on common platforms (Hans Hofstraat, 2021).

Schiavone et al. (2021) highlighted the framework of value creation, delivery and capture within a healthcare ecosystem. According to them, Healthcare ecosystems can enhance patient's experience and satisfaction, and improve accessibility to healthcare through interaction between patients and

healthcare professionals (McColl-Kennedy et al., 2012). Also, healthcare professionals and clinicians can improve the outcome of clinical trials by enhancing the accuracy of resource integration and allocation. Furthermore, operational efficiency and service quality is improved through stakeholder collaboration in ecosystems, thereby maximizing resource utilization (Schiavone et al., 2021). In general, for quality improvement of healthcare and value creation for customers to be achieved, it requires the implementation of a business model that is composed of experienced stakeholders who are willing to interact and exchange resources effectively (Schiavone et al., 2021), and a value proposition towards achieving these healthcare goals. The innovativeness of a business model can be seen in its value proposition, ability to create, capture and deliver value to customers. In order to create value for customers by means of a business model innovation, it entails a significant change in the activity stream of the business model (Amit and Zott, 2012). Moreover, to develop a platform and attract stakeholders to join, an ecosystem requires a significant value proposition that addresses global health challenges and offers patient-centric care to customers (Pidun et al, 2021). Schilke et al. (2010) provided a 4C typology business models with varied value propositions that could be used by online businesses to structure their business models in ways that will enable them recognize their unique qualities and use them to create values for their customers. They include context, commerce, content and connection. In an ecosystemic context, stakeholders can offer each of these business models or as a whole (Yrjölä et al., 2015) in order to create value for customers. Rosalia et al. (2021) suggested four components of value creation for customers in healthcare ecosystems, based on the different meanings of value proposed by the The European commission panel of 2019. They include;

1. Technical value which entails making use of available healthcare resources to achieve the best results possible
2. Allocative value which means equitably allocating healthcare resources amongst every patient group
3. Personal value; that is improving healthcare delivery to provide patients' needs, and lastly
4. Societal value which entails connecting with other sectors to combat societal challenges.

Dwelling on the 4C typology of Schilke et al. (2010), healthcare ecosystem stakeholders can adapt their business models to provide customers with these 4 components of value proposition

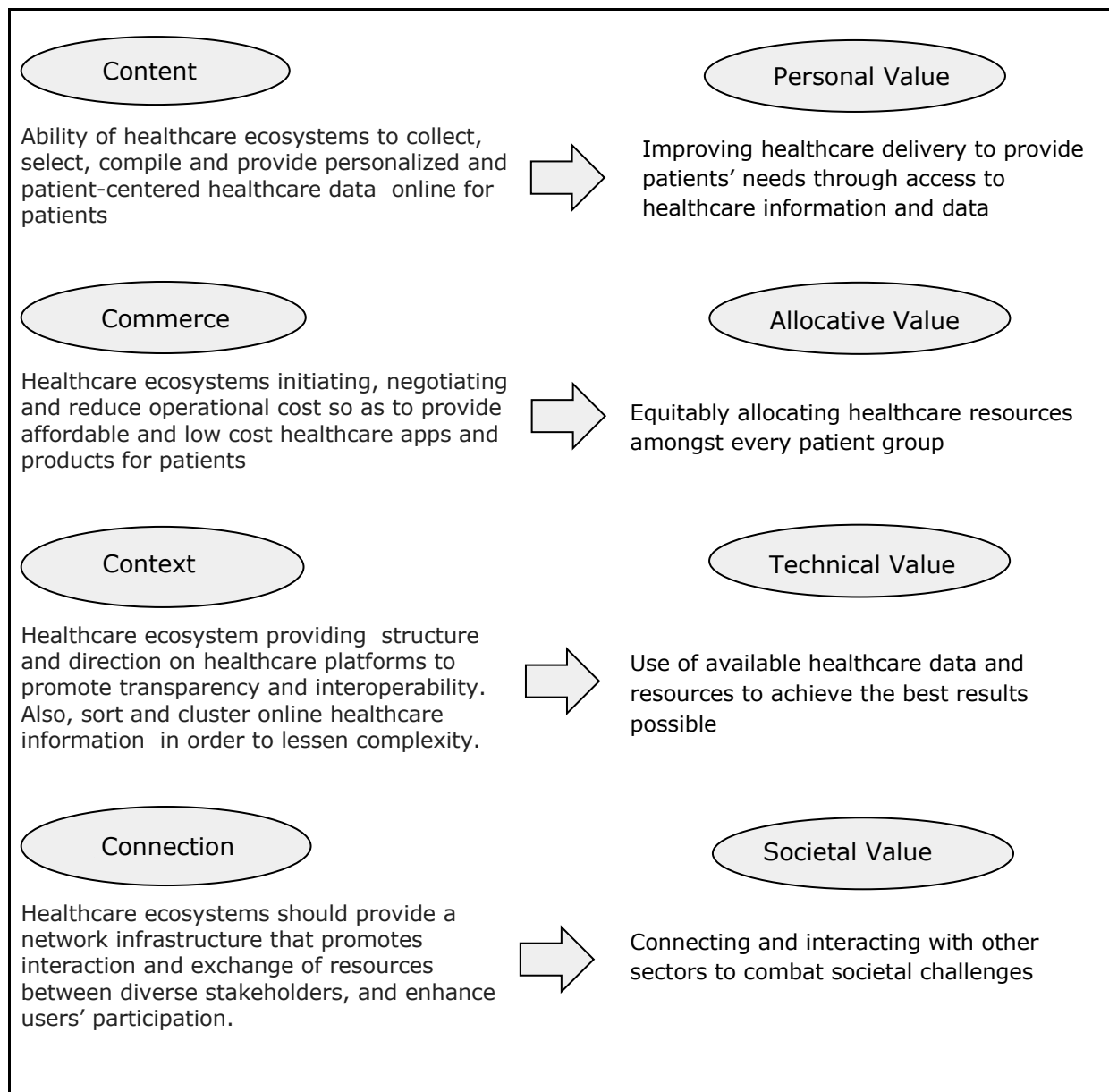


Figure 3: The 4C business model typology adapted from Schilke et al. (2010)

Based on this, healthcare ecosystems have redesigned their business models, offering varying value propositions targeting different healthcare issues and patient groups. There have been business model innovations in healthcare that address the issue of expensive healthcare costs mainly by redesigning the cost structure in order to offer affordable and available products and services to patients especially in countries with limited resources (Bhattacharyya et al., 2010). Low cost business models facilitate patients to meet up with healthcare demands while also providing value for them and the community (Cicellin et al., 2019). Cicellin et al (2019) argue that traditional healthcare business models were associated with very high prices which made it difficult for low income patients to afford. Meanwhile, Bhattacharyya et al. (2010) discovered that if healthcare business models could simplify their services it would reduce operating costs and hence reduce the burden of high prices on customers. Business models innovation also offers the possibility of

personalized medication to patients by the integration of a variety of data types from healthcare professionals, patients, health insurance companies, government bodies and other independent stakeholders (Denicolai & Previtali, 2020). By targeting an individual customer and offering treatment solutions based on their specific health problems, it could change the entire concept of the healthcare system to a value-based care system that meets the needs of patients. Also, business models can be used to propose valuable solutions to preventive care and wellbeing through the use of connected devices (van Velthoven et al., 2019) such as smartphones, wearable devices, sensors (Tuan et al., 2019), telemedicine (Shah et al., 2013) and the internet of things (Laya et al., 2018). Digitalization of healthcare systems improves service quality, delivery processes and enhances patient's safety (Chao et al., 2007). It also helps in lessening the human errors (Ball et al., 2003), and hence offers more precision healthcare (Kraus et al., 2021). Healthcare innovations are moving from a focus on treating diseases to preventive care where focus is on patients' well being, improving quality of life (Baudier et al., 2022) and promoting patient-centered care (Khodadad-Saryazdi, 2021). The rise of technologies such as telemedicine, electronic health and automated machines (Iizuka and Ikeda, 2021; Latifi et al., 2021; Biancone et al., 2021) have facilitated this movement. E-health consultation for example helps patients and care providers to interact and exchange health information online (Ghose et al., 2021) which enables frequent consultation (Baudier et al., 2022). Telemedicine on the other hand helps to reduce patients waiting time and also in reducing the cost of healthcare. Telemedicine technologies are also said to provide opportunities for improving care of the aging population and supporting them to live longer independently in their own homes by offering them safe methods of care (Flick et al., 2020; Cicellin et al., 2019).

2.2.2 Enabling value creation for customers in the healthcare ecosystem

Value creation has been greatly associated with the service dominant logic (Ciasullo et al., 2017; Bolti et al., 2020) that can be referred to as an extensive service-based system from an ecosystem perspective (Vargo & Lusch, 2016), whereby value is created through the interaction and integration of dynamic resources between various actors (Grönroos & Voima, 2013; Garriga, 2014). Service-based ecosystems continuously provide new ways of creating value (Aarikka-Stenroos & Ritala, 2017; Adner, 2017). Lusch and Vargo (2014, p.24) referred to a service ecosystem as "...a relatively self-contained, self-adjusting system of resource integrating entities that are connected by shared institutional logics and mutual value creation through service exchange". As such, the ecosystem exists as a result of various actors that integrate both internal and external resources and jointly participate in value creation and value capture (Ciasullo et al., 2017). A more diverse stakeholder network will result in a high potential for value creation (Panetto et al., 2016), and the success of the ecosystem, therefore, lies in the ability of the various stakeholders to interact and share their knowledge and resources (Breidbach & Maglio, 2016). Previous research has marked out essential features and processes (Hlongwane & Grobbelaar, 2022; Ciasullo et al., 2017) for setting up a successful ecosystem service (Thomas & Autio, 2012; Lush & Nambisan, 2015). The first feature is establishing a shared vision and coordinated relationship amongst the stakeholders, which entails recognising how and from where value can be created as each stakeholder provides unique and complementary resources that facilitate the value creation process and help to maintain a healthy ecosystem. The second is setting up a management framework or a governance mechanism for the

coordination of the stakeholders and the stability of the ecosystem. Lastly, it facilitates the smooth flow of information and cooperation among stakeholders. According to Hlongwane and Grobbelaar this set of rules and characteristics are essential as they give stakeholders room to redesign and alter the value creation process and for innovation and novel solutions to be realized (Hlongwane & Grobbelaar, 2022). Organizations are increasingly taking these actions and optimizing the opportunities of value co-creation in order to create more value for customers and themselves (Sabadosa & Batalden, 2014; Durugbo & Pawar, 2012).

In the healthcare industry, recent advancement in technology has facilitated a transformation of healthcare models from the traditional norm that was centered on healthcare providers to a patient-centered business model whereby both patients and healthcare providers, as well as other stakeholders collaborate to create value (Sabadosa & Batalden, 2014). Value co-creation in healthcare is aimed at providing patients with the best healthcare solutions (Willis et al., 2014), optimizing the quality of healthcare and patient's overall experience (McColl-Kennedy et al., 2012), increasing patient engagement for innovation to be achieved in the process of value creation (Holman & Lorig, 2000). As a result, there is a need for healthcare professionals to understand and take into consideration important elements that will promote an active role of patients in the delivery of healthcare (Ostrom et al., 2015). From the service ecosystem perspective, the healthcare ecosystem can therefore be referred to as a group of stakeholders who interact and are committed to sharing and incorporating their dynamic resources and knowledge based on a shared vision and value proposition that shapes and guides them (Frow et al., 2016; Siltaloppi et al., 2016; O'Grady et al., 2008). According to some authors, value co-creation in a healthcare ecosystem has gone beyond the traditional norm of patient-healthcare providers, but now takes a broader perspective and incorporates other collaborating stakeholders such as government, regulatory bodies, funding bodies, NGOs, health insurance, hospitals, clinics, pharmacies, healthcare professionals, families and the patients, all interacting in creating value for themselves (Hardyman et al., 2015). Palumbo et al. (2017) emphasized the need for this multi-stakeholder collaboration in order to adapt to a very complex and competitive environment and gain sustainability. In this perspective of an ecosystemic approach to value creation, emphasis is put on the contribution of each stakeholder and how they interact with each other (Thomas & Autio, 2014). It is, therefore, important to note that the key to value co-creation is embedded in the smooth and successful interactions between these stakeholders (Peters, 2016), hence a need for a pervasive approach and a coordinated system of value co-creation (Wieland et al., 2012). Furthermore, it is essential to recognise that it doesn't just suffice to adopt an ecosystem approach for value to be created, however the key to value creation is in how stakeholders participate and make use of the resources and opportunities available to create value (Hlongwane & Grobbelaar, 2022). Coordination amongst ecosystem stakeholders will enhance their performance and facilitate the exchange of resources and value creation and according to Jacobides et al. (2018), the main aspect of coordination is the basic structure put in place to connect all stakeholders. Several literature also highlight the significance of a positive interaction between healthcare stakeholders as health outcomes are as a result of the stakeholder's ability to interact and share resources (Ciasullo et al., 2017). The quality and effectiveness of healthcare services can be improved through these interactions (Chughtai & Blanchet, 2017; Ciasullo et al., 2017). In compliance with these points raised, it is important to understand the different contributions of the

various healthcare stakeholders in the value creation process, from where, and how they can collaboratively exchange their information and resources with each other (Hlongwane & Grobbelaar, 2022; Akaka et al., 2012; Frow et al., 2016).

A thriving part of literature exists on the importance of digitalization in the value co-creation process as they facilitate interactions between stakeholders and create new opportunities for value to be created (Elton & O’Riordan, 2016; Wang et al., 2018). Novel technologies create room for more value to be created which couldn’t not be achieved in the traditional healthcare system which was centered on patient-healthcare professional relationship (Van Oerle et al., 2016). They provide new opportunities for interaction and information exchange between patients and other stakeholders, and as well provide new sources of healthcare information to patients thereby creating room for a continuous healthcare delivery (Rantala & Karjaluto, 2016). Digitalization can indeed improve the participation of patients in their own healthcare through access to health information (Carrubbo et al., 2015), optimize quality of life and cut down on errors and cost (Schiavone et al., 2021; Payne & Frow, 2008; Lusch & Nambisan, 2015). Some researchers have highlighted the areas of healthcare that can be improved by multi-stakeholder collaboration. Chouvarda et al. (2015) indicated that digital health ecosystems can help in the prevention of diseases and in facilitating a healthy lifestyle, in treating and managing chronic diseases. In addition, this research identifies two other important factors including the ability to connect and enhance health delivery processes and promote innovation. Recent literature on sustainable value creation also emphasizes the importance of technology in creating sustainable innovation through the value co-creation process (Botti & Monda, 2020). According to Botti and Monda (2020), when new resources are created from the interaction and exchange of resources between stakeholders, that is termed as innovation. Technology is a tool in facilitating these interactions and when new products or services are generated from the additional resources, then sustainable value co-creation is generated (Lacoste, 2016). In light of this, patients must participate with other stakeholders in the vision of achieving sustainable innovation and value creation (Saviano et al., 2010). Figure 4 shows the various healthcare stakeholders that collaborate within the healthcare ecosystem to co-create value, the four main areas for value creation in healthcare, from where and how stakeholders co-create these values for the patients.

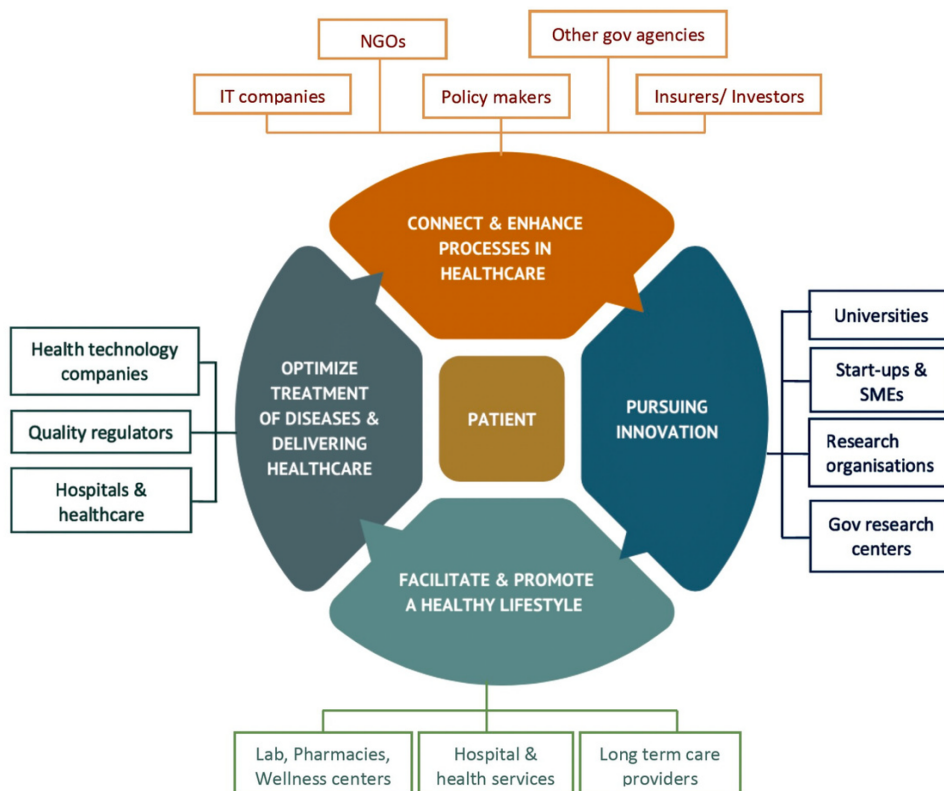


Figure 4: Key stakeholders, and four fundamental approaches to creating a digital healthcare ecosystem adapted from Pidun et al. (2021).

To summarize this, value creation is realized through the successful interaction and collaboration between the various healthcare stakeholders which are the essential elements for value co-creation in health ecosystems. This is made possible by novel technologies, as they facilitate interactions between stakeholders in a healthcare ecosystem (Appio et al., 2021).

2.3 Challenges faced by stakeholders in digital healthcare ecosystems

Digital transformation does not always result in better coordination and cost savings in healthcare ecosystems. It may also elicit varying opinions and challenges for which there is no single optimal solution, but rather a variety of options that may be beneficial to some but detrimental to others (Selander & Jarvenpaa, 2020). As a result, it can be termed as a phenomenon that includes not only possibilities and threats, but also a variety of conflicts, trade-offs, points of view, and ambiguities.

While there has been significant progress in increasing global health and well-being (Bardhan and Thouin 2013), numerous pressures are still placing healthcare systems under strain like increasing aging population and the need for patient-centric care models. Digital transformation has been very significant in driving progress in healthcare ecosystems and aiding collaboration amongst healthcare stakeholders, however several factors are preventing the adoption of digital technologies within the healthcare ecosystems. These factors present themselves in the form of technological and cultural challenges (World Economic Forum, 2022). These challenges affect the various healthcare stakeholders including patients, healthcare professionals, health insurance, health tech companies

and other relevant stakeholders since they all have different motivations as stakeholders (Jorge et al., 2021). Moreover, it takes collaboration amongst these stakeholders to promote the adoption of digitalization in providing patient-centric healthcare solutions. There are several reasons why healthcare has not reaped the same benefits from digitalization as other industries as shown in figure 5.

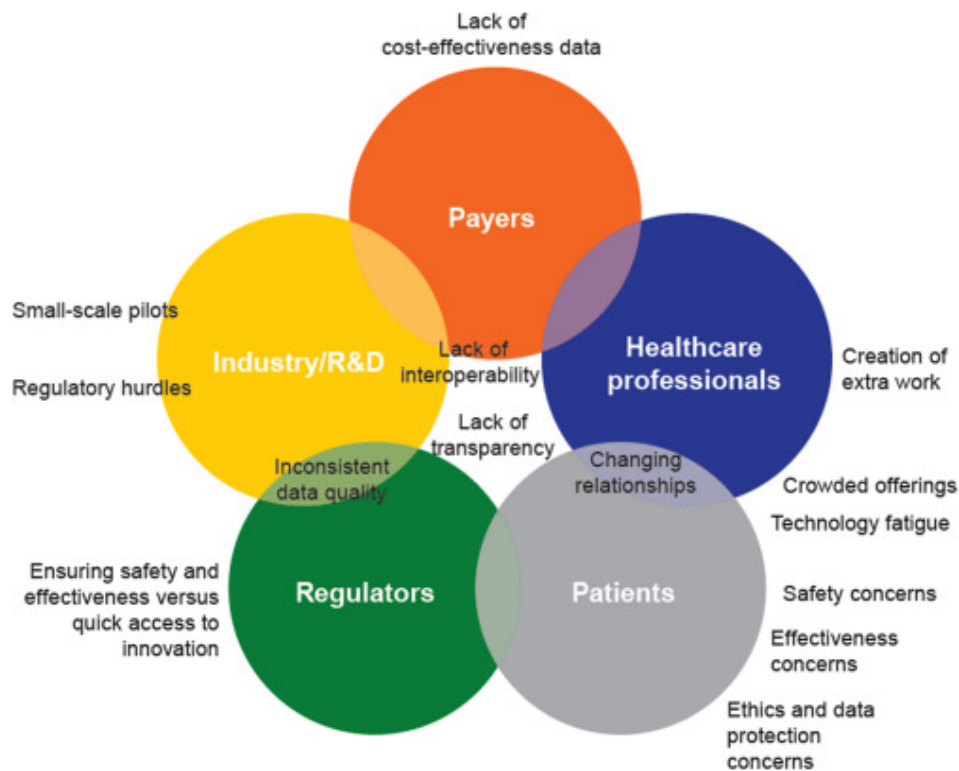


Figure 5: Challenges in the adoption of digital health solutions according to Jorge Cancela et al (2021)

There is an emergence of a new, empowered healthcare consumer with increasing demand for free access to healthcare data and quality of services. People want an easy, tailored, well-coordinated healthcare experience that protects their personal information. Organizations like the World Health Organization and the European Commission are working to increase citizens' digital literacy so as to encourage a greater adoption of healthcare technologies. However, many people lack digital skills and/or experience issues with accessibility and connectivity (Richter et al., 2019). Digital healthcare implementation may be problematic in older or more impoverished populations who lack digital literacy, even though these people are frequently the most in need. Additionally, Many people are also ignorant of how digital technology might assist them in keeping track of their personal records. inadequate knowledge on technology could ruin a patient's comprehension of diagnosis and medication provided by healthcare professionals which might lead to discouragement in the continuous use of health resources (Franzen et al., 2014). Technology illiteracy also prevents the patient from gaining meaningful knowledge from their collaboration within health ecosystems which could lead to their unwillingness to interact with other stakeholders within the healthcare ecosystem (Heijmans et al., 2015). Digital health literacy is affected by age, education, income, and rurality,

and those who might benefit the most are the least likely to be able to use digital tools efficiently. All governments should make closing the digital health literacy gap a top goal (WEF, 2022).

The rise of the 'healthcare consumer' serves as a driver for improving quality services in healthcare, however it poses a challenge to stakeholders of a healthcare ecosystem as they must adjust to the change (World Economic Forum, 2022). The healthcare system should integrate digital health solutions in a practical approach that encourages sustained patient engagement. Currently, rather than concentrating on the unique needs of each patient, health technology developers frequently concentrate on the high-level requirements of huge groups of patients. They might tend to create technologies without comprehending the difficulties posed by the illness (Spil & Klein, 2014). In addition to this, the proliferation of available treatments poses confusion and skepticism in patients (Tran et al., 2019) on the efficacy of digitized healthcare products in providing clinical solutions. Furthermore, safety and privacy concerns, interoperability and accessibility may also affect patients' decisions in using digitized healthcare products.

Data sharing has also been hampered by privacy restrictions given the fact that healthcare data are confidential. This makes access and data sharing difficult (Munro, 2015). This new trend is met with skepticism, particularly in terms of personal data privacy. According to a recent study, 35% of patients would refuse to utilize an AI-based tool or biometric monitoring gadget in their care due to concerns about data misuse (Tran et al., 2019). Therefore, there is an obvious need for tools to help patients choose acceptable technology and do so in an informed manner (Jorge et al., 2021). An example of such tools is the "NHS applications library" launched by NHS in the United Kingdom established where it offers a variety of therapeutic apps that have been checked and approved because of their accessibility, safeness and data privacy policies (Harris, 2020). Other efforts have also been launched with this goal in mind however, even with authorized health applications, there still exist gaps in compliance with data privacy standards, indicating the need for more actions to address these issues (Huckvale K. et al., 2015). Moreover, although data is being collected at an increasing rate, standardizing it and promoting interoperability have proven difficult (World Economic Forum, 2022).

Healthcare practitioners also encounter unique challenges when adopting digitalization in the delivery of healthcare. Moreso, doctors and patients alike fear that digital healthcare may jeopardize the traditional doctor-patient relationship although this change is good for healthcare delivery as it enhances accessibility of healthcare solutions. Given that healthcare in general should become more accessible, this move may not necessarily be bad for the patient. However, it might be difficult for healthcare practitioners to decide whether to treat patients based on their own clinical judgment or a recommendation from an app (Jorge et al., 2021). Furthermore, the specialized labor of highly skilled healthcare professionals is still crucial to the delivery of care. Healthcare professionals are required to have some kind of technological knowledge in order to easily operate health technologies. There's therefore the need for training of health personnels and this might be discouraging to some health care personnels (Spil & Klein, 2014).

The slow digital transformation of healthcare ecosystems is also largely due to health technologies itself. For instance, Few health IT suppliers, according to Spil and Klein (2014), produce technological

devices that are easy and straightforward to adopt. As a result, healthcare providers tend to be irritated at the extensive data entry required in using health technologies which tend to interrupt rather than assist their work. Such systems may also cause substantial harm to patients. For example Han et al. (2005) discovered that errors in the EHR implementation stage could result in an unexpected increase in patient death. Furthermore, the ability of digital health devices to provide trustworthy and quality data is still a question (Hermes et al., 2020) . For example, some researchers discovered inconsistencies in a popular blood pressure app (Mesko' et al., 2017; Plante et al., 2016). Another concern raised is the limited market penetration of some digital technologies such as those used in telemedicine, due to high regulation and inefficient payment structures (Keesara et al., 2020). According to a deliot study of 1800 physicians in some European countries including Denmark, Germany, Norway, the United Kingdom, Portugal, Italy, and the Netherlands, the adoption of Digital transformation in these countries was slow, complex, and bureaucratic (Deloitte September, 2020). The main challenges faced by these countries in the adoption of digital transformation included high cost of digital technologies, healthcare bureaucracy, and finding the suitable technology (Chawla et al., 2022). Clinicians in Italy and Portugal cited training personnel to use technology as a challenge, while those in the Netherlands cited data exchange as a challenge. This emphasizes the importance of enhancing digital training, education, and support measures.

Furthermore, The adoption of digital solutions across the EU is still hampered by cultural hurdles. There is still a lot of variation in healthcare systems. While around 50% of EU citizens support the idea of digital health services, use of e-Health services in 2019 varied between 50% of the number of patients in Finland and Estonia and 10% in Germany and Cyprus (EC-DESI Report, 2021). E-Health services were used by nearly half of EU general practitioners to exchange medical data. However, Although 98 percent of doctors in Denmark utilize EHRs, just about 20% of doctors in Poland do. While Poland has fully digitized its health information at the state level, Germany is still 1-2 years away (EU Commission, 2021).

On an ecosystem level, coordinating and managing relationships amongst stakeholders of a healthcare ecosystem may present major challenges given the complex nature of healthcare ecosystems and the diversity of the multi-stakeholders (Frow et al., 2016). Hajek (2013) also mentioned the problem of 'silos' in healthcare ecosystems that results in difficulty managing communication and collaboration between different stakeholders. This can be seen in the relationship between patients and healthcare providers who are likely to have conflicting aims (Upshur et al., 2010). While patients might be thinking about themselves and frustrated by the illness affecting them, healthcare professionals on the other hand adopt a third person perspective (Palumbo & Manna, 2018) which can cause them to be less effective (Wilson et al., 2007). As a result, there's a clash of beliefs in the delivery of healthcare and pose an obstacle to collaboration. Osei-Frimpong et al. (2016) stated that both patients and healthcare providers are complementors to each other, who interact and exchange resources with the aim to promote healthcare. Hence if there are diverging ideas and conflicting goals between them, it could lead to failed value co-creation and inadequate healthcare delivery (Palumbo & Manna, 2018). Tomes (2017) also adds that conflict between patients and healthcare providers could lead to inappropriate use of resources, leading to inefficient healthcare (Hardyman et al., 2015).

Chapter 3: Research Methodology

The research methodology employed to answer the research questions posed by this thesis is addressed in this chapter. Since healthcare systems are multidimensional, complicated, and include numerous stakeholders, it is suggested that qualitative methodology is an efficient research approach (Walsham, 1995). This study uses semi-structured interviews due to the proven efficacy of these approaches in examining cutting-edge ideas on changing user cognition and behavior.

3.1 Research Design and Data Collection

This research employed a qualitative approach to provide a detailed insight and thorough understanding of the dynamics of collaborative work practices in health organizations, rapidly innovating digital technologies, changing strategies in business model innovation, and value creation in the health ecosystem for their customers.

One of the most significant and frequently employed methods of data collecting among qualitative researchers is thought to be qualitative interviewing (Myers & Newman, 2007). According to Rubin and Rubin (2011), qualitative interviewing works like night lenses enabling us to observe what is generally hidden and examine what is looked at but seldom seen. Similarly, Schwandt (2001) describes interviews as living the people's experiences and feeling what they feel, enabling researchers to comprehend and articulate reality. Interviews offer a special tool to create thoroughly contextual, complex and honest visions of participants' experiences and how they understand them because a substantial portion of such experiences cannot be observed because they are unseen to others (Schultze & Avital, 2011). Because many components of the organization's digital transformation, knowledge and skills, and work practices were not obvious through observations, we used an interview approach as the primary data collection method.

We conducted six semi-structured interviews within Europe involving medical directors, innovation experts, general practitioners and research managers. This data collection technique allowed us to collect the data in two ways, first by a purposeful conversation with questions prepared in advance, and second by having the freedom to ask another relevant question during the interview to enhance a more profound understanding (Sekaran & Bougie, 2016). To carry out the interview, we first contacted the interviewees. We sent an email to some of them, and others were contacted by social media or through company websites. Then we considered the ethical aspects, so we sent them the information sheet and the informed consent to the individuals of the study. In these documents, we described the research's objective, the reasons why we chose them as potential participants, the instructions regarding confidentiality (how we would manage anonymity using pseudonyms), the voluntary participation (giving them the freedom to stop the study whenever they want), and we asked permission to record the audio. Additionally, we clarified that the results of the research would be used only for scientific purposes.

We conducted the interview online through the Google meet or Zoom application in a safe and socially distancing way due to the pandemic. We chose these applications because we already had them as part of the complementary tools in our student email account, and which are also very user-

friendly. Before each interview, we did some tests in Google meet or Zoom to get familiar with the application and defined the actions to be taken if there were internet connection issues. Additionally, we tested the cellphone's recording application to check if the computer's volume was enough to capture the interviewees' voices and checked the cellphone and computer's battery. Moreover, we checked that all interviewees sent the informed consent signed and that the ethical aspect was clear for them. The interviewee details are presented in Table 2. The interviews were all audio-recorded and transcribed. The average time of interviews was ranging from 45 to 60 minutes.

Table 1: Research Design Summary

Research Design	Qualitative Approach
<i>Data Collection</i>	Semi-structured interviews; Documents (EU websites, knowledge-sharing blogs, LinkedIn profiles)
<i>Sampling Method</i>	Purposive and convenience sampling
<i>Duration</i>	February - November 2022
<i>Data Analysis</i>	Thematic Analysis
<i>Results</i>	Themes to form the basis of the study

3.2 Sampling Design

The population of this study is all experienced professionals in healthcare facilities from various countries within and outside of Europe. Purposive sampling was the strategy employed in this research. With this sampling method, the researcher selects study samples based on a set of criteria. (Kemper et al., 2003). Therefore, to guarantee a deliberate selection of people for the interviews based on their experience and the role they play as innovation specialists and consultants for digital transformation in the healthcare ecosystem, the purposive sampling strategy was employed in this study. Supporting our selection, Silverman (2018) pointed out that purposive sampling seeks for individuals where features we are interested in are most likely to occur. Additionally, because we chose subjects who were easily accessible to us, this was also a convenience sampling. Table 2 (round 1) and Table 3 (round 2) lists the details of interviewees who participated in this study. Round 1 is the initial set of interviews conducted with several participants, whereas round 2 of interviews was conducted at a later stage to include few additional aspects to our scope of research.

Table 2: Interview Participants (Round 1)

Participants	Name	Age	Job Title	Company	stakeholder sector	Country	Total Job experience
Participant 1	Geert Jacobs	31	Project Manager/Innovation Expert	Agoria	Health Tech Company	Belgium	10 years
Participant 2	Paul Malisse	74	Retired Surgeon/Medical Director	Affiliated with KU Leuven	Healthcare provider	Belgium	40 years
Participant 3	Divine Tim	31	General Practitioner	Ekansa Hospital	Healthcare provider	United Kingdom	4 years
Participant 4	Emmerson Wegong	30	Medical Doctor/Chief Operation Officer/Grant and Research Manager	Hospital mobile services /swedish organization for global health	NGO/Healthcare provider	Cameroon / Sweden	8 years
Participant 5	Justin Lacko	35	Digital Transformation Consultant	Novo Nordisk	Pharmaceutical	Denmark	13 years
Participant 6	Michael Budzi	29	General Practitioner/ Medical Doctor/ volunteer & coordinator for health outreach	Cameroon Baptist convention health services/ Rural Doctors	NGO/Healthcare provider	Cameroon / Sweden	5 years

Table 3: Interview Participants (Round 2)

Participants	Name	Age	Job Title	Company	stakeholder sector	Country	Total Job experience
Participant 5	Justin Lacko	35	Digital Strategy Lead	Leo Pharma/ Ex-Novo Nordisk	Pharmaceutical	Denmark	13 years
Participant 7	Magha Chefor	31	Immunologist researcher	REFOTDE (Research Foundation in Tropical Diseases and Environment)	Research Organisations	Cameroon	6 years
Participant 8	Hilda Chi	31	Family Nurse Practitioner	Medstar Medical Group	Healthcare providers	USA	11 years

3.3 Data Analysis

The transcripts of the interviews themselves served as the data that we acquired for analysis. In this study, the participants were the unit of analysis, while the unit of observation was the conversations held with them. We applied a thematic approach to analyze our findings because it provides an orderly and logical way to analyze qualitative data (Silverman, 2018). In this line, we started coding our data in an excel spreadsheet using In Vivo coding (actual terms used by respondents). Then, we created a codebook to standardize and categorize the codes. After coding the interviews, we looked for categories to merge the different codes and then got the proper themes describing all the concepts. Keeping the research questions in mind, we identified three themes that merged all the codes we found in the collected data as answers to them. The themes are: 1) Collaborative Innovation in Digital Healthcare, 2) Patient centric business models, and 3) Digital Healthcare Challenges.

3.4 Research Methodology Limitations

Due to the small size and the heterogeneity of our sample, the results of this study do not give a full understanding of the issue. Additionally, we did not get to the data saturation, where the results became repetitive (Silverman, 2018). Instead, we found mixed results that need further investigation to realize if they are extreme cases or belong to new patterns.

Additionally, due to the pandemic circumstances, we could not carry out our interviews in a face-to-face environment, facilitating the conversion's fluency. Besides, we are unsure if we lost meaningful information during the challenges we experienced with the internet connection issues. Even though we tried to come back with the topic quickly, the miscommunication period could have affected the results.

In qualitative interviews, interviewers can ask leading questions, which could compromise the validity of the study's results (Kvale, 1994). In our study, we also feared that interviewees might not be completely honest if we use leading questions; instead, they might decide to say what they think we would want to hear. We, therefore, made an effort to reduce this risk to the reliability of our study's findings by choosing open-ended, general questions to pose to our participants.

Chapter 4: Research Results

During the interviewing process, three broad themes were investigated and based on the collected data, several sub-themes (categories) were created. In this section, we deeply analyze the three themes to answer our research questions. The research questions outlined in Chapter 1 are shown in Table 4. These questions will be addressed in the following sections using the methodologies and approaches discussed earlier.

Table 4: The Outline of Research Questions

Research Questions	Addressed in
1. <i>How does digital transformation result in collaborative innovation in the healthcare industry?</i>	Section 4.1
2. <i>What new business models emerge as a result of collaboration within the digital health ecosystem?</i>	Section 4.2
3. <i>What are the challenges faced by the stakeholders in the digital health ecosystem?</i>	Section 4.3

4.1 Collaborative Innovation in Digital Healthcare

The first major theme identified through the analysis of participants' responses was collaborative innovation in the digital healthcare industry. The results indicate that digital technology is driving rapid, fundamental change in almost every aspect of our daily lives, especially in healthcare. The medical industry is undergoing a digital transformation and there is now more than ever a great deal of interest in using digital services and data to better the lives of people who have major chronic diseases. As a result, the industry has changed, and there is now a significant and unrealized potential for change. Companies will prosper in today's connected ecosystem through improved collaboration, innovation, and the ability to develop breakthroughs, and digital transformation is the key to this success. Figure 6 illustrates the coding tree for this theme, outlining the primary sub-themes and codes that we identified through our analysis. The sub-themes are discussed in detail in the subsequent sections.

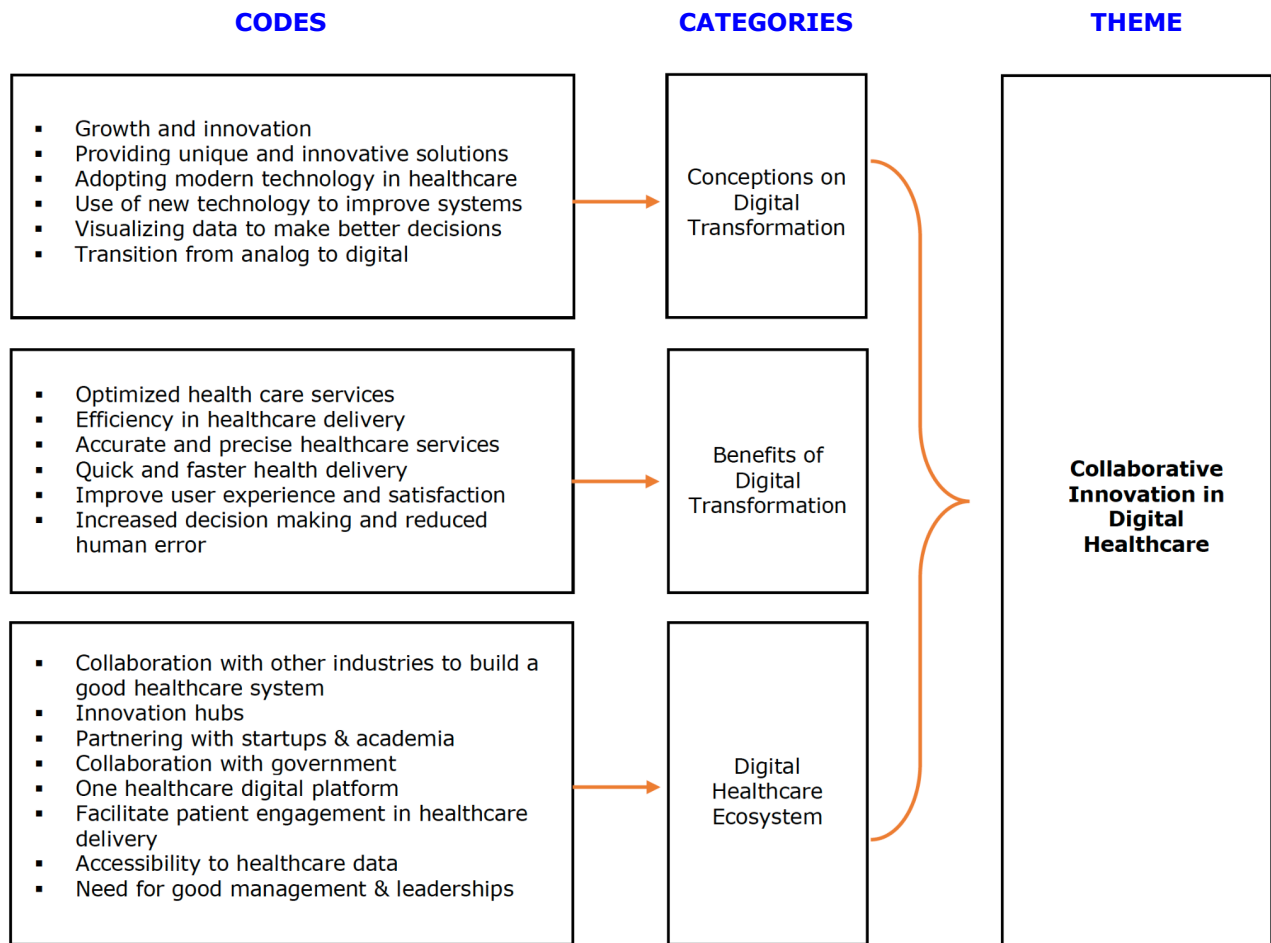


Figure 6: Coding Tree - Theme 1

4.1.1 Conceptions on Digital Transformation

During the interviews, we observed various conceptions of digital transformation from the interviewees. To some, digital transformation is an accelerator to growth and innovation, while others believe it is the use of new technologies to improve decision-making. However, all participants emphasized the ability of digital transformation to improve existing processes in healthcare, especially during this Covid'19 pandemic.

'(...) it's just about adopting new technology, maybe to assist in the provision of services or maybe to improve existing services just to create an additional value.' (Participant 3)

Some participants also argued that digital transformation is the use of data and digital technologies to transform our lives completely, changing how we live, work, and interact with one another. It helps to shape how people live, work, think, connect, and constantly seek to reform real-world experiences, and newly created services help to increase work efficiency. The use of contemporary technologies also helps leaders improve their capacity to predict and plan for the future in order to achieve the desired progress. With digital transformation, there is now a radical change in how people work based on the application of modern technologies.

'It means that you're increasing the connection between everybody with digital ways. You talk about data, how can you translate it, make it more analytical. And then you go on a higher level to visualize this kind of data in order to increase the possibility of making better decisions. You keep optimizing to make a decision on whether the best solution is possible.' (Participant 1)

Participants also stressed the need to digitally transform ahead of others in order to compete in this competitive market. Due to the advancement of digital technologies and their widespread adoption across all industries, society as a whole is experiencing radical transformation. Organizations are under pressure to adopt new technologies ahead of their competitors in order to survive and benefit from the competitive market. Any company that struggles with this process or does not change will eventually fall behind, collapse, and be unable to survive.

'When I think about what digital transformation is, to me, it's really about kind of showing the company that there are other opportunities on how we can grow, especially when you look at all the competition that's starting to come up. You need to adapt to new digital technologies in order to survive ' (Participant 5)

Although all participants have attempted to define the precise concept of digital transformation, there is no officially recognized definition, hence its boundaries are frequently unclear. However, it is crucial to point out that the implementation of digital technologies boosts businesses' competitiveness, which is accompanied by improved decision-making and increased value for the customer.

4.1.2 Benefits of Digital Transformation

The participants' various conceptions of digital transformation were accompanied by a variety of benefits. By discussing the three digital strategic goals of his company, Participant 5 brought attention to the significance of digital transformation and how it benefits the economy as a whole. The company has three aspirations for the use of digital technology: Optimize, Augment, and Explore.

'The main goal of Optimize is to make the pharmaceutical industry more effective. It entails streamlining our supply chain, accelerating the search for more efficient therapies, and examining how we may utilize data, automation, and robotics to improve our operations. Additionally, we want to Augment our portfolio, which entails using tools and therapies to improve patient outcomes. In addition to collaborating with universities and start-ups to invest in, Explore is about using new technology to generate value for our patients. So you see we are transforming the way we work to improve the life of patients we serve.' (Participant 5)

Thanks to digital transformation, more patients can obtain better medications and treatments, which can help reduce costs and risks for payers like hospitals. Several participants highlighted that

improved and more individualized patient care, reduced human error, global access to medical records, and more precise and effective services for better outcomes for patients, healthcare providers, and regulators are all features of a digital healthcare system.

'You need correct flows and processes which you can optimize with automation, with robots. 20% you need human intelligence which needs to be supported with digital things or technology. This 80-20 rule always applies in everything that you're doing. (...) by digitalization you optimize by building good relationships with all hospitals and making great decisions on a higher level and then you have something great. This will increase decision making and reduce human error. '

(Participant 1)

'prior to telemedicine, prior to information technology and digital technology, we would have to call patients and schedule them five weeks out six weeks out on file to see patients. patients were sitting at home with conditions that could easily be handled and waiting three months for visits. Meanwhile doing this for patients provides them the easier access to care, they can communicate with a variety of doctors wide on patient portals. Electronic health records are there for patients to be able to see, data is there for other providers to stick with this patient, we can do referrals right within the electronic medical system. And all of this has been afforded to us with digital transformation. So definitely a positive push forward for the healthcare system'. (participant 8)

By quickly and flexibly implementing new services and technologies, digital transformation promotes workflow efficiency, decreases technical faults, and enhances job quality and performance.

'It's important because really, it makes processes, you know, around the health system a little easier, things that are done manually could be automated, so it makes processes more efficient and it's time saving.' (Participant 4)

Moreover, Companies that prioritize digital transformation are rewriting the rules of the competition and adding value faster. Information is easier to access within such organizations. Continuously enhancing old traditional operating procedures to put new digital technologies into practice, encouraging staff to overcome the difficulties of outdated working practices with new procedures, and empowering individuals to work in new ways are in line with the objectives of digital transformation.

'Everything around you is evolving much faster. So if you want to catch up or you want to stay ahead, you need to actually have a transformation plan and the vision for the next year or how you will continuously invest in digital and you will continuously invest in IT just not to maintain but also to grow and to make your advantages.' (Participant 6)

Based on the responses from various participants, we can clearly state that healthcare organizations that operate with a digital-first mentality are incorporating the three levers of business

transformation: patient-centricity, quickly embracing cutting-edge technologies, and continuous business innovation in order to enhance outcomes for all stakeholders in the healthcare ecosystem.

4.1.3 Digital Healthcare Ecosystem

The health ecosystem shows how different actors collaborate to generate value, and this calls for the development of a certain structure of relationships. However, due to the digital transformation of the healthcare business, patient engagement and interaction with healthcare professionals, as well as patient self-involvement, have undergone a significant change. As an illustration, consider how healthcare providers interact with patients while employing telehealth services for online consultations and to evaluate the patient's health data.

'There's this level of collaboration and teamwork that has made it easier for doctors, nurses and every other person in the healthcare team to help in efficient care. Having access to information, having easy access to information within the team has really helped because everybody can participate in efficient care without necessarily seeing each other. And that has been made possible by digital transformation.' (Participant 3)

' They're easier ways for us to communicate with each other. Before it was doctors placing order nurses following the order, pharmacies transcribe the order, you know, like that. But now we see a lot more engagement, a lot more feedback, a lot more collaboration. We see multidisciplinary team support, we see interdisciplinary collaboration because of digital transformation. So we're seeing a lot more specialties coming together, whether it's nurses, doctors, pharmacists, physical therapists, occupational therapists, nutritionists, we're seeing a lot more collaboration working together to provide the best care for the patient. And that's all part of digital transformation'.
(participant 8)

Some participants argued that the number of entities that patients must deal with and the frequency of interaction has significantly increased. Patients contact healthcare professionals far more frequently than they did in the old traditional health system. Due to the digital services, this relationship is frequently engaging; as a result, patients must become online and digitally literate in order to use these services.

'What we want to do is to make people have informed decisions, to make people make final decisions about their care and this digital ecosystem makes it easier to reach out to people and give them exactly, every bit of information that they need to make those informed decisions about their care. It's improving healthcare. It's making healthcare better and we can, we can only improve and strive to achieve more, get to a level where everything is just good.' (Participant 1)

Digital services not only enhance the number of interactions between patients and healthcare professionals, but they also give people the chance to prepare themselves and take an active role in

those interactions. Patients can also practice self-care to evaluate their present state of health, actively locate a healthcare professional that meets their specific needs, and instantly share their health information. In other words, patients change from being merely consumers of healthcare services to being prosumers.

'I think partnership, building the right partnerships is really important. Using the right partnerships from the beginning, having those strong collaborations with different stakeholders it's really important.' (Participant 6)

Moreover, healthcare providers are collaborating intensively with other industries and partnering with startups and academic institutions to promote innovation and facilitate patient engagement in healthcare delivery. By digitally transforming the health ecosystem, all stakeholders can get transparency around the performance, and even utilize analytics to forecast and improve performance of healthcare.

4.2 New business models

Another significant finding from our research analysis was the growing trend in today's business models toward a more *patient-centric* mindset. All participants underlined the necessity of healthcare systems to follow a patient-centric business approach to establish meaningful partnerships between practitioners, patients, and their families in order to make decisions that are in line with patients' needs, wants and preferences. This includes giving patients the information and support they need to make these choices and take an active role in their own treatment. Patient-centered business models prioritize the needs and preferences of the patient to deliver the best treatment possible. The patient-centered care model is a well-liked evidence-based approach to healthcare that has been linked to higher patient satisfaction, better results, and improved communication.

Throughout the interviews, some themes and ideas that kept coming up and being discussed were noted as trends and patterns. We took into account these trends and patterns when creating the patient centric business models with four major factors. Figure 7 below illustrates the coding tree for this theme, outlining the primary codes and categories we identified through our analysis. The sub-themes are discussed in detail in the subsequent sections.

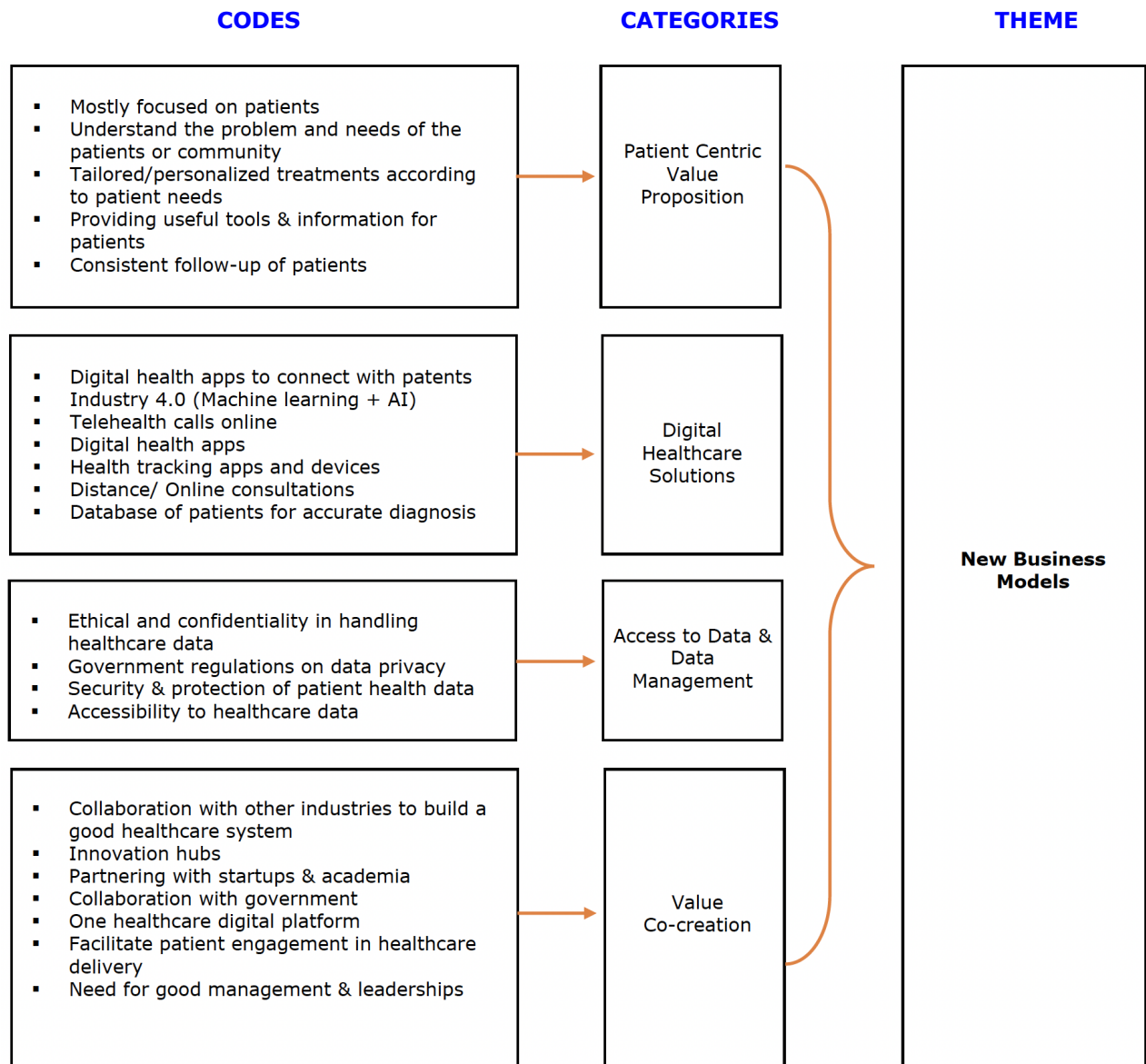


Figure 7: Coding Tree - Theme 2

4.2.1 Patient centric value proposition

Value creation for the end customer (the patient) is the primary requirement for successful value generation in an ecosystem. In a stabilized setting, the ecosystem provides the customer's needs with specific quality and user experience at a specific cost. If quality and user experience improve, value is created for the patients. Hence, it is crucial to be clear about the particular target audience, their needs, and the degree to which those needs could be more effectively satisfied through product and service innovation in comparison to currently available alternatives. All participants agreed that the foundation of high-quality healthcare is a patient-centered value proposition strategy.

'So in healthcare, we move towards patient-centered services you know. We consider the patient the client or the customer so it should be about the client. Because whatever we do in healthcare, we are just trying either to improve, to restore or prevent diseases, to restore health or prevent

disease for the patient or the customer if you can call it that way. So it should be focused on the patient or client'. (Participant 4)

The participants also asserted that unless you can develop a comprehensive picture and understanding of the patient, you cannot accomplish a patient centric value proposition. Understanding the needs of patients is the first step to creating value for them.

'Let's say, for example, if the problem of your population is headaches, and then all your services are targeting tummy ache it's not going to work. So you need to understand the problems in that community in that population. You need to understand what the people in that particular population feel about their problems. You need to understand what they want to be done about that' (Participant 3)

*'When we search to know the needs, and then when we know that needs, we now put them on a scale of preference. We say okay, these are the priority needs. And when we know the priority needs, we can be able to set up the system to meet those needs and eventually create value'.
(participant 7)*

'If we don't understand. If we don't understand our patients, then we're not going to get a ride on anything that we deliver. The hallmark of a ethically responsible healthcare company or pharma company is to always understand your patient. It's not to focus on the drug sales. Of course, it's important because you need to keep your bottom line going. But the reason that we're doing everything is because we're trying to help people that are living with in the case of my company, you know, skin diseases' (Participant 5)

If you cannot develop a comprehensive picture and understanding of the patient, you cannot practice patient-centricity. In order to do that, you must be able to use data from any source in your processes. Participants also mentioned that understanding consumer needs requires data and analytics that can provide insights that can be put to use. The state of the patient relationship will become more clear to organizations that adopt new measurements and implement the appropriate tools, and ultimately, their entire operational structure will reflect the voice of the customer, including their treatment preferences.

'You're treating a person who's suffering from something and every particular treatment is supposed to be personalized. What works for you might not work for another person and you need to have that flexibility. Tailor everybody's treatment according to their needs.' (Participant 3)

Participants also highlighted the fact that Patient-centric care entails providing accessibility to healthcare, improving health outcomes and overall patients' satisfaction. Participant 8 stressed on the fact that the success of every healthcare ecosystem evaluated in their ability to improve satisfaction of every stakeholder and hence an increase in turnover.

'We want to look at improved patient outcomes, improve patient satisfaction. We want to look at even improve revenue for the company. improve accessibility. Let's see. So we talked about patient outcome, even provider satisfaction, turnover rates. So those are all things that we can

use, see, evaluate whether or not we've successfully embrace digital transformation or whether or not the company's doing well with digital transformation.' (participant 8)

Other important value propositions of patient-centricity mentioned by the participants are summarized below:

- Positive patient experiences lead to greater provider trust and a decreased propensity to transfer doctors, which promotes greater continuity of care. Simply put, patients react better.
- Also, there are reduced total costs due to increased engagement with all stakeholders and efficiency in care delivery.
- Patients who have better knowledge and comprehension of their own health, wellbeing, and healthcare options receive better care, which reduces the incidence of illness. This greater understanding may also lead to improved post-discharge treatment, lowering the need for readmissions, hospital stays, and more consultations.
- Health professionals can make better choices for a patient's health by working together and involving people in the decision-making process.
- Increased competitive edge because more hospitals are now vying for patients on the basis of both cost and care quality.
- Patient and doctor satisfaction rises as a result of improved patient quality of life.

We identified six elements of patient-centered care based on responses from participants and this is shown in figure 8 below.

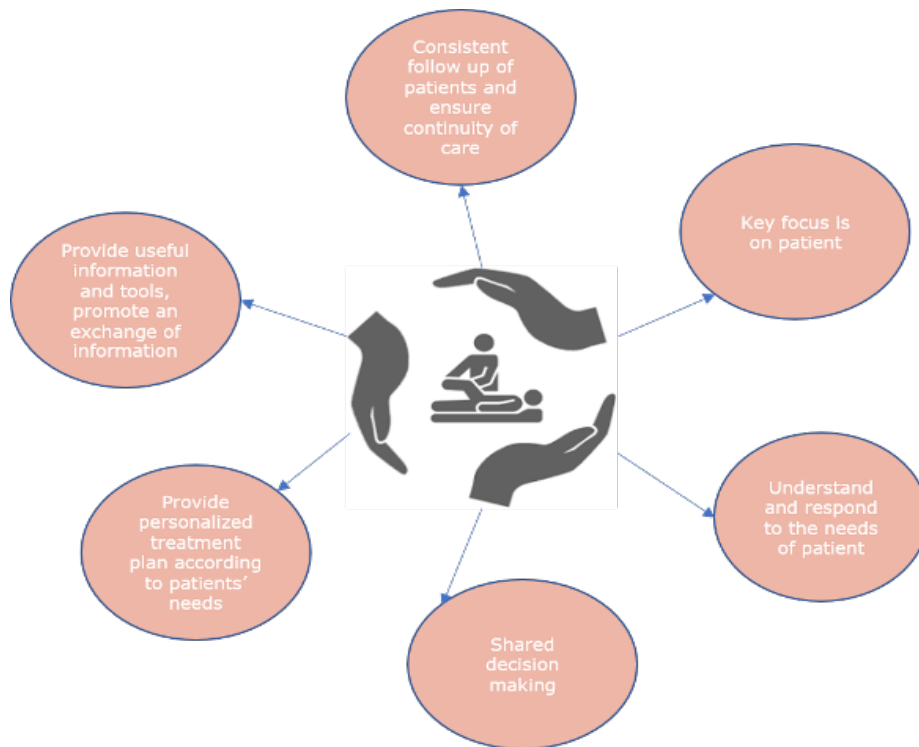


Figure 8: Six elements of a patient-centric care healthcare system

4.2.2 Digital healthcare solutions

The healthcare sector is currently embracing new technology quickly. Information technology is primarily utilized by healthcare ecosystems to enhance the delivery of healthcare services and offer patient centric healthcare services to patients

Digital health solution is the combination of medical expertise and IT programs or technologies with the goal of enhancing patient care and accountability. By doing so, it is feasible to use a smartphone to continuously check to see if a patient has taken their prescribed drugs and to track important data such as pulse, blood pressure, oxygen saturation, etc. Tools and data are crucial for the use of healthcare providers to prioritize the needs of their patients and create value for them. For instance, patient-centric practices are aware that the patient is the sole one who will be present for all of the patient's appointments and care. Joint decision-making, patient feedback systems, and multi-stage treatment plans can all be made possible with the correct technologies. All participants agreed that digitalization promotes patient centricity, improves healthcare processes and regulations, optimizes business processes, and helps to foster trust and confidence among all parties involved in the industry. They are important in our daily operations.

'Whatever we're doing, technology is very important. you know, we actually saw the real importance of technology during this COVID pandemic, where people, everybody now had to learn how to work in a different way and connect people more but it makes it easier to work with other people that may not necessarily be at the same place at the same time or the same setting you know, so it gives that possibility to connect that.' (Participant 3)

When making crucial medical decisions, medical professionals today successfully use electronic health records (EHR), specialized softwares, AI and other useful apps.. Patients can simultaneously handle basic medical issues with only a few taps on their smartphones. Participants mentioned a list of important digital health solutions used in optimizing healthcare and creating value for patients.

'Digital imaging, I think, is the most successful. digital imaging, CT, MRI but also the mix of isotopes with CT, eplexity, things like that. The processing I don't know if you've ever seen that but you can literally do everything with that. (...) There are apps now that track epilepsy, arrhythmia; that is irregular heartbeat. apps would track critical elderly people in the prevention of, in the fall prevention. There are continuous glucose meters for diabetic patients (...) You have remote ECG reading, an app that reads your ECG and immediately connects it to your doctor.'

(Participant 2)

'The NHS app in the UK is something that is really good because you have access to almost everything in the National Health System in that you can track your health, you can track everything about your health just using the app. During the Covid, just with the app, you could know whether you've been exposed to someone who tested positive for COVID or not. The app will say you've been in contact with someone who is positive for COVID, they can advise you to take a walk into a clinic and get a test done.' (Participant 3)

Telehealth, AI systems, machine learning, EHR, ehealth, digital diagnostic systems, and all the others described above are some of the primary improvements that digital transformation brought to healthcare. All of these developments give professionals extensive decision-making tools and increase patient access to healthcare. Interview respondents also identified several other areas in healthcare systems where digital health solutions offer opportunities for improvement. Technologies make it easier for people to get access to treatment and healthcare services, increase the number of healthcare facilities that are available, and offer patients the possibility to choose from a variety of specialists. Modern technological advancements assist healthcare workers in providing patients with treatment and making clinical judgments.

'So I think one of the greatest things that digital transformation and information technology has afforded us is the opportunity to be able to provide care for patients to have patients have better access to care to provide clinical services to patients to provide I would say patient centered care, improve communication with patients with our computers which is amazing. So telemedicine, for me, has been the greatest change and it's had a tremendous impact in the healthcare industry and the care we deliver to patients. We've had better patient outcomes. We've had better patient satisfaction and improved in so many ways due to telemedicine'. (participant 8)

'(...) using machine learning and AI to discover drugs in a more efficient way. You know, hiring more data scientists so that we can find more connection points with data models or, or offering new ways to connect with patients through digital health apps' (Participant 5)

Digital health solutions also expand the tools available for self-care and expand our understanding of specific medical issues. Indeed, patients now use the internet or online messaging instead of

phone calls or hospital visitation to settle routine healthcare issues, including appointments, prescription renewals, referrals, or quick consultations. The availability of electronic prescriptions is utilized by both patients and physicians. Doctors today utilize the whole range of available assistance, including telemedicine, computer-assisted self-help tools, digital diagnostic equipment, and decision-support software.

'It helps to improve delivery of services. Now, there's so many people in so many places that might probably not have access to healthcare but because of technology, everybody has access, I mean, it even brings healthcare to the people's hands, more to the users' hands. It helps to keep information and information is very important and storing information in technology placed devices, magnets. You have access to that for a very long time, which is the key when it comes to healthcare data and information.' (Participant 3)

'It makes life easy for everyone. In the hospital, for example, again, if you have trouble with the dosage of the medication, for example, you can just go to an app and everything is there. Maybe you have trouble with some sort of an algorithm or something and it's digitally available' (Participant 4)

'Before we used to have homecare nurses leave from the clinic or the patient's home and you know, administer this medication to the patients but now they have automated devices that will deliver certain doses of medications. Patients have implantable devices that deliver blood, insulin, or whatever. Usually they'd have devices that would automatically deliver certain doses of the medication to the patient while also monitoring the patient's levels at the same time. it's breathtakingly fast.' (participant 8)

Healthcare providers also use a plethora of programs to track the operation of the healthcare institution in terms of efficiency and treatment success rates. It facilitates healthcare processes and optimizes healthcare delivery. Additionally, government and federal institutions use IT technologies to evaluate the effectiveness and security of healthcare providers. Also, patients engage with doctors via mobile and wireless technologies by using a variety of health monitoring tools and apps to keep an eye on their vital signs.

'it makes processes, you know, around the health system a little easier, you know, things that are done manually could be automated, or something like that, so it makes it easier and makes it more efficient and it's time-saving. So I think it's important.' (Participant 6)

'So when I was working back home in the HIV program, we developed this software we call data manager. Data Manager was just a very good software because with HIV care and treatment we try as much as possible to have everybody who is HIV positive on treatment because once they're all on treatment, they attend viral suppression, they will not be able to transmit HIV anymore. So the challenge we had was that we were able to diagnose a lot of these patients, put them on treatment, but they became a lot to follow up (...) we decided to digitize and build this software where we have data clerks who input all patients in there (...) it tells you this person was supposed to come, they have not come and when they're even eligible to run their frequent lab

tests the viral load test, the system already tells you that okay, these 100 patients are going to be eligible for the next laboratory visit next month. So already you have a pool of those clients and it made it so easy.' (Participant 4)

'we have a platform called remote patient monitoring. Those patients have devices that our company has provided them and this is part of just the advancement with our digital embracement. Like we're, we're up there when it comes to embracing digital technology. We provide them with devices to monitor their blood pressures, their heart rates, the blood sugars for patients that are diabetic, so most patients for chronic conditions really we have devices to monitor this different aspects of the care' (participant 8)

Another key aspect, as pointed out by participants, is that technology helps to connect different stakeholders within the health ecosystem and helps facilitate data sharing for value creation within the ecosystem.

'If you look at the Sustainable Development Goals you see that almost everything is linked to healthcare, education is linked to healthcare, transport is linked to healthcare, and technology actually helps to bring, to connect these things together. You can have a platform where all these different sectors or these different stakeholders actually have a role to play, a contribution to make and through technology, to make better informed decisions with respect to not only health but how healthcare can assist in the different sectors.' (Participant 3)

With all that is mentioned above on the values of digital healthcare, it is also paramount to take into consideration in deciding whether to adopt any of the numerous modalities that make up digital health and whether they actually assist patients in improving their health. Does digital health services, for instance, add value to the clients they serve? Participants suggested that digital health solutions should make it possible for patients to easily access and manage their own health records, while taking security and trust issues into account. Providers can increase patient participation and promote better care with the aid of the appropriate technologies. More technological developments are being made in the health ecosystem, where healthcare apps and mobile phones do more than just data and information sharing; they also allow patients to have direct accessibility to their treatment plans and monitor their health progress. Therefore digital health tools should take a value-driven, not technology-driven, approach; focus on the patients' needs, not just the technology

'I think the number one thing is that it has to be useful for patients. We always put the patient at the forefront. That's, you know, without a question. If you're developing something with digital health. It's great if on our side, we can tick boxes and say like, yeah, we're offering this but what we really want to see is we want to see less people getting sick, less people developing diabetes or other serious chronic diseases and just leading healthier lives.' (Participant 5)

Another participant recommended that health technology developers should have a clear strategy and make information easily accessible to patients in order to provide better value for them.

'From my experience, people tend to go more to the apps that are focused on a particular problem. Okay. If you look at for example, a woman's phone there's always going to be an app that tracks her menstrual cycle. but they have general apps that give information about that but they are like no, I just want this particular thing that tracks this (...) So if I need this thing, I just go to it so I can see the information rather than going through tons of information.' (Participant 3)

4.2.3 Access to data and data management

Participants highlighted the fact that sharing information and knowledge, data accessibility and data management are crucial for the survival of healthcare ecosystems, and as a result it is a key element in value creation of healthcare ecosystems. Availability and access to healthcare data is essential in providing patient-centric care to patients. Lack of knowledge exchange can be damaging and negatively affects the effectiveness of the healthcare system hence it is imperative for stakeholders within healthcare ecosystems to interact and share data .

'Of course, the input of your data. That's key to the whole system (...) Every sector that puts in data is an added value for the others who access the platform. it's always an added value. And you can do research on data statistics for instance, you have a cancer registry, you have sickness registry, diseases or things like that, You can extract those data because the other players put those data in. So Input of the data is I think the most important. ' (Participant 2)

'Another thing they can do to create value to customers is, you know, having a database of their information. For example, If you've been going to the hospital to meet a doctor, we usually request for your medical history (...) if you document it in an electronic system, for example, when he comes back for a second time, you may not necessarily need to ask all of those questions again because you already have it in the database somewhere (...) we doctors actually rely a lot on gathering that information to be able to know what is wrong with you and how to proceed'
(Participant 4)

Additionally, if implemented properly, information systems can be used to promote knowledge and information exchange across stakeholders for value co-creation to take place within the ecosystem. The success of value creation depends on the exchange of information and knowledge, according to the response from participants. By streamlining the health system through information technology, sharing of information and expertise can add value. As a result, there is optimization of communication flows, healthcare procedures are effectively managed and resources are better allocated and distributed, all of which are crucial for providing healthcare services efficiently.

'if we can get a better handle on understanding the datasets that we have around the engagement with doctors and opinion leaders, then we can hopefully unlock some better insights so that we can reach more doctors and that fits well with us because again, we want to get more of our our drug out there. So I would say that that would be the biggest value proposition that we kind of unlock the the data and the insights for our sales staff to reach more doctors'. (participant 5)

It's having the data already, it's being able to see who a patient has seen for the past three, four or five months readily available for us. It's not having to call some hospital and have them fax data over a week to three weeks for the data drive. I think just having everything returned real time in the computer system for us having that access to data right away. That's what enhances the collaboration between care teams between nurses, doctors, physicians, pharmacists, nutritionists in all the other disciplines, being able to pull that together to provide care for the patients, not just any type of care, patient centered care '. (participant 8)

'I think it's really important because it gets everyone involved, even the patients themselves (...)

What we want to do is to make people have informed decisions, to make people make final decisions about their care and this digital ecosystem makes it easier to reach out to people and give them exactly, every bit of information that they need to make those informed decisions about their care. It's making healthcare better and we can, we can only improve and strive to achieve more, get to a level where everything is just good.' (Participant 3)

The availability of healthcare data is key in the development of healthcare solutions to address patients needs and health challenges. Healthcare statistics offer a preliminary ground on where to begin implementing health solutions, what areas within healthcare need a lot of attention, which country or areas are very much affected by diseases hence requiring a quick response. Participant 7 stressed on the importance of data in realizing these opportunities in healthcare.

'Well, most of these data gets into peer reviewed articles like for instance HCB record data or malaria record data, get into the World Malaria report every month every year, there is a World Malaria report, a world TB report (...) countries where you have the burden of malaria being very fuzzy result of these statistics that is collected, they make provision for distribution of pre mosquito nets and treatment of malaria for children below five years is free (...) You know such information could always help the stakeholders to make decisions and to know which diseases have public health importance'. (participant 7)

One of the participants also highlighted the fact that data has been very useful in addressing the issue of COVID-19 and other public health challenges . Data was utilized to identify and warn millions of people who were significantly at risk from the virus and to give them protective advice. Building data profiles based on the conditions that lead to COVID-19 has also been made possible by the virus' ongoing tracking and data analysis. The NHS app used in the UK has demonstrated the importance of public health data in this way, and has been a useful tool to evaluate risks and treatments on a worldwide scale.

'The NHS app in the UK is something that is really good because you have access to almost everything in the National Health System in that you can track everything about your health just using the app. During the Covid, just with the app, you could know whether you've been exposed to someone who tested positive to COVID or not that you actually get notifications. The app will say you've been in contact with someone who is positive with COVID, they can advise you to take a walk into a clinic and get a test done. You know, so it's really good.' (Participant 3)

'There have been different policies implemented as a result of our research findings, like a study that was carried out on those people who are infected with filarial worms, ivermectin was administered to them. And after a period of time their blood sample was collected again, to check if they're responding to treatment. And those who received ivermectin medications were responding to treatment. Meanwhile, those who declined had multiplied filaria load in their blood. So it led to mass drug administration of ivermectin in a lot of regions of Cameroon that were affected by filarial infections'. (participant 7)

Participants also pointed out a number of elements that are important for the adoption, utilization, and management of data, also in supporting the activities within the healthcare ecosystem in order for value to be generated and for patient-centricity. According to them, understanding how data can be generated and managed, and how it relates to the effectiveness of the healthcare ecosystem is necessary. Data security, as mentioned by the respondents, is one of the most important elements to consider for an effective flow and management of information and data sharing in the healthcare system. As Computers have progressively become a necessary component of our daily life, data security must now take the top spot on the list of priorities. Securing access to interfaces and computer systems that store sensitive data like medical records is a very crucial element to take into account, especially in the healthcare profession where thoughts are frequently centered on saving someone's life and rightfully so. Controlling access to information while enabling free and simple access to those who need it is the core principle of data security.

'What I think is most important when going for digital transformation is information and information security. In the health sector where I come from, we are very careful when it comes to information and information security because it has a lot of ethical considerations for us. Supposed to be almost 100% confidential just between you, the doctor and the patient you're caring for. So if you're embarking on into the digital world, or you're moving to a digital world, one of the key things you need to consider is if you're able to guarantee security for the information you're going to be sharing with your patient'. (Participant 4)

To lay emphasis on the importance of data privacy and security, one of the participants had this to say:

'You know, one of the main concerns when it comes to patient care and digital digitalization is how do you protect the person's Data? Data protection is very important (...) Data privacy is so big that almost everywhere and every time government regulators usually revise the data protection laws. How do I do this without compromising this person's information? What if my app crashes or goes into extinction what happens to that person's information? How do I prevent another person from accessing this person's information? These are some of the main concerns with respect to that.'
(Participant 3)

Although widespread information digitalization in the healthcare industry has made healthcare services faster and more effective, the risk to information security is nevertheless quite serious. Participants mentioned the fact that It is crucial for healthcare providers to have a strong and trustworthy information security service in place, given the sensitive nature of healthcare data. The

tactics should not only respond and safeguard patient information, but also foresee and stop any cybercriminals' attacks, also following all regulations on data protection.

'So really, it starts by you building a good system that guarantees security, and also the team members who are going to be using that system need to be trained on information security. Also, you need to work with experts who can, you know, build a solid system for you, a system that is not easy to penetrate.' (Participant 4)

'The company follows all the relevant rules and regulations that the EU sets out on data safety and GDPR, for instance, we make that very clear. The data that gets used within the company is and I'm speaking on what I think I know, it's anonymized that's to protect patients because we don't want to be able to you ever be able to say, oh, all this data is coming from this person'.
(participant 5)

Data can be used to improve patient care pathways and models of care, and the capacity to gather and evaluate this data will lead to more resilient care models. However, as pointed out by some participants, patients must be made aware of the importance of this information and how it may be applied to enhance patient outcomes all over the world.

'So usually counseling helps because the moment you sense that they are not giving you full information you need to be able to make the diagnosis and treat them. You can counsel them and tell them the importance they come to you right. They come to you for help and in order for you to help them you need the full information.' (Participant 6)

Participants also pointed out the importance of building trust amongst clients in order to guarantee a smooth flow of important information. Most patients are skeptical about giving out important health information, not only for security issues but also as a result of lack of trust in how it's handled. Therefore building trust and transparency is another important element that facilitates the adoption, use and management of information. Furthermore, in order to ensure that important stakeholders have access to free and unfettered information and knowledge, it is imperative to promote transparency within the healthcare system.

'Another thing they may just be suffering from is distrust. They don't trust you enough to get that information. So you need to build that rapport and build that trust. All right, make them understand that whatever information they give to you remains confidential. You need to also present that nonjudgmental attitude towards them because they are people that the moment they feel judged, they just shield themselves to protect themselves from anyone judging them.'
(Participant 4)

'So on an internal perspective, you know, digital transformation is also about delivering transparency.' (Participant 5)

'They cannot have distrust because we ensure confidentiality. That's one of the first things that we ensure when we get their information. It is confidential, we cannot share it. We have no right to share with any other person'. (participant 7)

From the above analysis, It is therefore obvious that better patient diagnosis, treatments, and outcomes can be achieved through the analysis and application of global healthcare data. Even in the fight against COVID-19, the significance of health data was demonstrated, and this change has the potential to reap the rewards. Therefore, access to patient data can result in considerable improvements in preventative treatment and the overall state of world health. However, health data must be secured and handled confidentially.

4.2.4 Value co-creation

Today, there is a much deeper level of patient participation, which calls for improved communication and teamwork among patients, healthcare professionals, pharmaceutical corporations, and other sectors within health ecosystems. Participants offered an overview of how a healthcare ecosystem might operate and what needs to be taken into account to foster a collaborative atmosphere. This kind of atmosphere is crucial in order to bring together many stakeholders with various stakes in the healthcare system and cooperatively develop innovative solutions while still providing a platform for economic growth. According to the participants, each component of the healthcare system plays a part in the process of creating value. The structure and initiatives of the healthcare system may become insufficient if this role is not given enough consideration and acknowledgment. Therefore, it is crucial to take cognizance of all its constituent pieces to appreciate how interconnected they are and to get a better knowledge of where and how value can be created.

'I think everybody that is involved in the healthcare system is equally important. Because you cannot, the healthcare system is like a unit. You take out one part and everything falls apart. You know, everybody is equally important from the developers, to the providers, to the users, to the stakeholders in the community, everybody that plays a role within healthcare is equally important and having them connected, having them work as one particular unit is actually a big win in healthcare so everybody's equally important.' (Participant 3)

According to participants, the goal of a digital health ecosystem is to build learning networks inside healthcare systems that promote institutional growth and continual practice improvement. Hence they stated that importance should be given to searching for the right partners in creating a healthcare ecosystem and identifying their roles and responsibilities within the ecosystem in order to provide patient-centric care for patients

'A digital health ecosystem or just from the word ecosystems it's an interconnection of various services to attain an objective. In healthcare for example, the various services are required to be able to offer services to the patient. For you to be able to give patients what they need there are a lot of things you need to put together. So it's an interconnection of all of those to offer the healthcare you want to offer to your patient.' (Participant 4)

The healthcare system offers a setting for learning and knowledge exchange, collaboratively developing new technologies, and creating value. In such a setting, it is crucial for collaborative networks to exist since they are essential for ensuring that these goals are achieved through the ongoing use of value creation techniques. The latter must be deliberately implemented because it is

crucial for the healthcare organization to engage in these value creation techniques to grow within its ecosystem and to gain a competitive edge and spur innovation. Stakeholder engagement is a crucial value creation enabler since it depends on stakeholder interactions.

To improve healthcare services, it was crucial to investigate how value can be created through the involvement of numerous stakeholder groups and all participants agreed that having all stakeholders on one platform, collaborating and sharing data and information is a win in healthcare.

'If you look at the Sustainable Development Goals you see that almost everything is linked to healthcare, education is linked to healthcare, transport is linked to healthcare (...) You can have a platform where all these different sectors or these different stakeholders actually have a role to play, a contribution to make and to make better informed decisions with respect to not only health but how healthcare can assist in the different sectors.' (Participant 3)

There's the usual thing like patient focus groups and working with key opinion leaders, people that are kind of experts in their field. And research and stuff like that, to to understand the disease and then to understand how people live with it. I hope to see in terms of understanding our patients better is really tapping into the digital space and seeing how we can explore that, you know, business to business to patients connection (...) how we support them, not only with the product, but also with you know, improving your life or looking at aspects of your lifestyle to find out why you may be suffering from this specific cause'. (participant 5)

'You know, we do collaborate a lot with pharmaceutical companies, with the educational system. That's a big one too, because a lot of what we do relies on the education, the strong foundation and clinical background that we have for educational systems as well. But most of the collaboration that I see in healthcare will be with informational technology' (participant 8)

The idea of "healthcare innovation ecosystems" extends far beyond the world of technology and digital startups. The notion that health systems can address population health and community well-being on their own has lost favor in favor of working with other stakeholders who have an influence on the overall environment and the complete path toward healthcare. Participants unanimously agreed to this as some of them had this to say:-

'Yes, cooperation with different sectors is very important. And then it's just something that so many people, so many healthcare systems are getting it wrong, because they want to they want to function as a standalone organization, but we need all these other sectors to be able to have that strong and resilient.' (Participant 6)

'We have to collaborate with every other sector to be able to have a successful workplace. We need transport, We need good collaboration with transport, the environment, you know, education. They all play a very big role in developing a good healthcare system. Here. For example, we have these transport links. My hospital is at the center of the city. You know, these big cities and traffic, It might be difficult to get to the hospital on a typical day. But then, in collaboration with the local council and government they are actually transport links that give access to the hospital.

We're able to build that network that makes it easier, and then the services more accessible to the public' (Participant 3)

'So without collaborating with outside sectors, like information technology, they're making the computers that we use and they're creating the software that we use and even business, business managers, and business organizations are collaborating with this. They're helping us in terms of like strategizing, creating business plans, creating our visions, objectives for setting up our businesses setting up our platforms that we'll use instead of not just digital technologies that we'll use I think that type of collaboration is what prepares or fosters the health care that we provide to our patients'. (participant 8)

'I don't have any IT knowledge. It's the IT guys we collaborate with. It's the business guys we collaborate with to help us have what we need. To provide the care that we need for our patients' (participant 8)

In order to better support the delivery of care, health organizations are expanding their skills and adopting or learning other skills that complement their field of expertise. According to some Participants, it is important to create ideal partnerships, take advantage of one another's knowledge, and address the requirements of all users, including physicians and end users. When providers, buyers, payers, the public sector, communities, and entrepreneurs work together toward a common goal while performing complementary but autonomous roles in health improvement, value is created. To put it another way, for a healthcare ecosystem to succeed, it must provide a common purpose, vision, and values while also fostering individual creativity and innovation to spur transformation and value creation.

'Nowadays, we are driving from your driving out of the space where you focus on gaining knowledge just in your field. I am a medical doctor, but I'm equally trained into IT.. I'm learning web designing, I'm learning data analysis. The moment I have knowledge in different fields I become multidisciplinary. That way, in my day to day life, it's easy for me to read things that can easily be done once I have an idea. Once I've mastered it, it's always easy to develop a lot of great things. (Participant 4)

Some participants also considered digital health ecosystems to be an enabler of all manner of innovations. It is important to recognize players outside the four walls of your organization that also serve patients and communities. An “ecosystem” is a way to systematically integrate these stakeholders into how healthcare organizations can innovate at scale.

'Collaboration alone is very important because there are some things, I'm a healthcare provider, I'm not an IT expert. There are some things that I may not know that could be done until I sell my idea to an IT expert or I sell my idea to an engineer. If I sell it to an engineer based on his own knowledge, you realize that okay, I think with the availability of these tools, I can be able to build, you know, this device for you. so it's key to that collaboration. There's that meeting point, where ideas meet and then you know, we can achieve a lot from that.' (Participant 6)

'Some examples can be like the government because the government has a part to play with health care delivery. I think there's some other stakeholders like NGOs that come into play, insurance in the US Yeah, big holders will be health care agencies, centers of Disease Control.

There are several organizations that fund the health care system they push for digital transformation. So major stakeholders will be those agencies like CDC, CMA, CNS' (participant 8)

4.3 Digital Healthcare Challenges

The final theme discovered in this study was the challenges and drawbacks of digital transformation in the healthcare ecosystem. The participants emphasized that while digital transformation brings about many benefits for healthcare, it also poses a number of challenges. The coding tree in Figure 9 below outlines the major codes and sub-themes identified in our analysis which are further explained in the sections that follow.

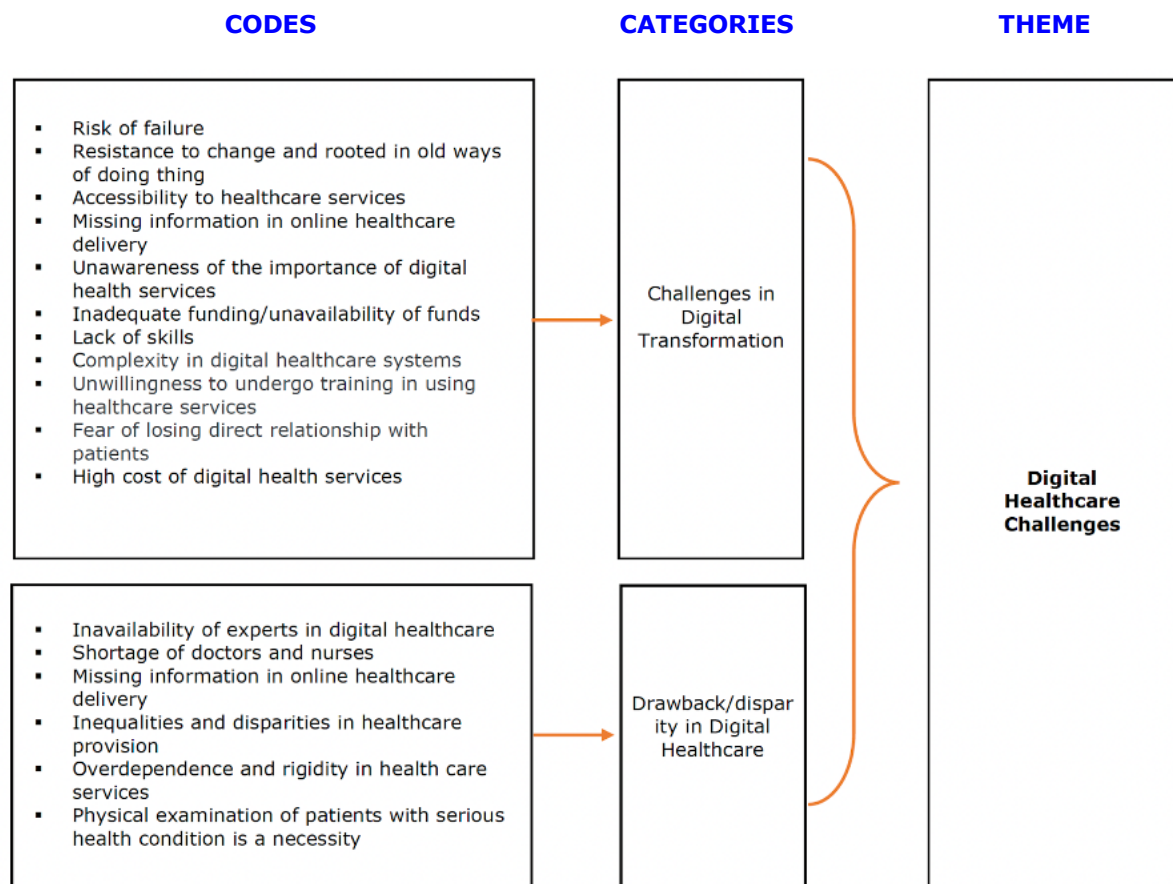


Figure 9: Coding Tree - Theme 3

4.3.1 Challenges in Digital Transformation

One of the major challenges addressed by most participants is the lack of skills in the workforce to work in digital environments. Most healthcare providers do not have a solid information technology foundation, and neither do their executives, nor their employees have the necessary digital thinking, knowledge, skills, or abilities to implement digital transformation properly. The main reason is that they are resistant to change and unwilling to abandon their outdated, established systems.

'First, one of the reasons why it's taken this long, because people are kind of resistant to change, you know, used to the old way of doing things. And accepting something like that you have a lot of groundwork to do you have a lot of research and a lot of research to do you need to understand the market or consumers preferences, the people you're trying to reach you need to understand it that services that they want, how they want their services to be deliver.' (Participant 3)

'Barriers like I said, accessibility right, everything you need to put in place may not be available. (...) And equally, the mindset, the mindset of the people is also important. They should have that receptive mindset. You know, you should be ready for change. When change comes everybody should be dynamic enough to embrace. And the second reason is ignorance. Some people don't know about it and how useful it can be, you know they have a click on the old ways of doing

things, it's been working well for them and they don't seem to know that there could be a better way.' (Participant 4)

Another major concern raised by participants was the rising expense brought on by the constant creation of new digital systems and services. These new systems minimize the duties of traditional players while increasing the costs of coordination for those actors in health systems. The treatment provided to patients, including prediction and preventative care, is anticipated to be considerably improved by these new services, which will simultaneously diminish the old traditional methods while also raising the costs of coordination.

'Now that there are more actors involved in a digital health ecosystem, coordination between them demands additional cost. All this improves efficiency, however, it is also raising prices.'
(Participant 3)

'(...) making sure that drugs are affordable for people. It can also be, you know, convincing people that they need to pay attention to their health. That's especially a hard one, I would say, because nobody wants to think about being sick. Nobody wants to, you know, know that they're sick and they just brush it under the carpet. I think those are the two big challenges.' (Participant 5)

Furthermore, incorrect data interpretation due to online consultations might result in inaccurate knowledge and misinformation, which can cause major problems with the delivery of healthcare.

'The general concern is that having an online conversation or not being able to see a person you know in person can possibly cause certain information to be missed. And I think that's what, like the legislation that's happening with telehealth around the world.' (Participant 5).

Aside from the misinterpretation of data, online consultation is also faced with the challenge of providing care to patients with critical health concerns. As pointed out by some participants, telehealth cannot provide effective care to patients suffering from chronic diseases.

'There are limitations in the sense that telehealth isn't meant for critical things (...) Telemedicine isn't here to replace in person care because there's simply no way that it can do that because there are critical needs patients presenting with cardiac illnesses that require us to do maybe an ECG to evaluate patient's heart we need to run bloodwork to find out exactly what's going on with the patient. patients presenting with things like abdominal pain that require excessive workup. You can't just say 'where's the pain and make a decision from there'. (participant 8)

The way private patient data is managed, according to some participants, is another significant barrier to digital transformation in healthcare. Some of the biggest issues facing digital healthcare are patient privacy, data security and the complexity of digital health systems. Other concerns involved financial challenges due to limited resources and inadequate funding to meet the rising costs of digital health services.

'Government rulings are always the barriers, inadequate funding of course, and the lack of stakeholders, lack of collaborations, misunderstandings. Things like that. And of course, skilled

people (...) there are many, many stakeholders but not everyone has let's say a direct interest in inputting the data.' (Participant 2)

'The main problem that we face is just the complexity of the whole system. You know, to start understanding, you need to start learning from scratch. You know trying to do that is hard. I think that's basically it, you know, the most difficult thing because once you get hold of the system it becomes easy.' (Participant 3)

Participants suggest that leaders must acquire digital skills, quickly adapt to new technology and procedures, and deal with urgent difficulties in order to successfully overcome the challenges of digital transformation. Digital innovations like artificial intelligence (AI), telemedicine, and industrial automation all promise to help relieve increasing resource pressures while preserving a high standard of patient care. Participants also recommended that a strong and adaptable IT data infrastructure in healthcare systems can adapt to changing and particular needs and ease the transformation to digitization. Moreover, when it comes to the acceptance and adaptation to new digital tools and ways of working, adequate training and active engagement of all actors in the healthcare ecosystem are crucial considerations.

'the first thing I think is education and training. Like if digital transformation has to be taken to a particular place, the people in that sector should be educated on why it is important, and they should be given examples of how it is being used in other areas because even though there's digital transformation in Cameroon, there are US cities and countries that are more advanced than Cameroon' (Participant 7)

'Organizations are having a hard time catching up with the new technologies and new advancements, because it's just so rapidly and rapidly changing. By the time you're catching on to something, it's changing and changing up and a lot of us are stuck with our old ways (...) The new innovations and new changes are so rapid so I think those are some of the challenges that organizations are facing.' (Participant 8)

The response from participants address various challenges faced by the healthcare industry in adopting digital transformation. Protection and privacy of patient data, security concerns regarding digital technology, willingness to adapt to new digital ways, and budgetary and time constraints are among the most emphasized difficulties faced by organizations in the healthcare ecosystem. For the healthcare sector to fast restructure and to maintain its competitiveness, more radical strategies are required. Also, in order to improve patient care and build confidence among ecosystem participants, communication channels must be improved for better interactions between patients, healthcare professionals, and other stakeholders.

4.3.2 Drawbacks/ Disparities in Digital Healthcare

Aside from the challenges faced by healthcare ecosystems in adopting digital transformation, participants also highlighted the inequalities and disparities in healthcare.

'But trust me the issue of health inequalities, limited access to resources is a big problem'
(Participant 4)

One of the major disparities addressed by the participants is the fact that different countries or population groups are affected by diseases differently. As a result of this, healthcare resources are allocated differently and unequally, healthcare regulators turn to pay more attention to certain areas than others and as a result, the level of innovativeness is not the same across regions and countries.

'The distribution of diseases or the way healthcare affects different populations is different. The way there's just these inequalities and disparities when it comes to healthcare and healthcare organizations have to understand the trends of these different diseases or disparities or inequalities, to be able to have that mission or something that can be sustainable.' (Participant 3)

'Now most of the time our ideas are influenced by our context, you look at cancer to be so much of a big problem in developed countries because they don't have a lot of those things people in low- and middle-income countries are dying from. For example, in Europe, you won't find malaria. It's not a problem. So yes, you shift to things that are a problem, cancer is a problem. But somebody who's working in a remote setting in Cameroon, for example, you realize that 50-60% of people who died in your hospital died because they came down with malaria at a very late stage. So when you look at it from that perspective, you realize that you would want to solve that One that you perceive as the measure thing.' (Participant 4)

Furthermore, healthcare resources are unequally distributed. There are limited resources in certain parts of the world than in others; hence while some parts of the world are enjoying the benefits of digital transformation, others are lagging behind.

'So it's really difficult to scale it up to some places because we don't have the resources to get them functional in those places.' (Participant 6).

'When you find yourself in a developed country like many European countries and all of that, you realize that it is almost fully integrated because all nearly most of the services are automated, you know, they actually rely on it, you know, to run day to day activities, patient care and stuff like that. But in low- and middle-income countries in developing countries, most of the time we don't even have working networks. So equally with limited resources, you're unable to afford all what is required to to make use of those services' (Participant 4)

One major drawback with the digital transformation of healthcare delivery pointed out by participants is the fact that healthcare providers turn to over-depend on technology and could become rigid. This is an issue as they sometimes neglect their roles and become inefficient in the delivery of health services.

'You know, you have all the resources that you need in one go. Why I said it might not be so cool is, You might have this tendency to over dependence and rigidity' (Participant 3)

'Yes, you will see if you ever got to emergency, they will not examine you. Remember that they will not. Mostly they don't. what they do is when you have pain in your stomach they do X ray, ultrasounds. They don't examine you anymore' (Participant 2)

Additionally, online consultations are not always 100% effective as they sometimes might lead to faulty knowledge and incorrect data interpretation, which can seriously affect how healthcare is delivered. Participants also recommended the use of online consultations only for cases that are not severe. Online consultations are only effective for less chronic health issues or during a follow up routine. They argue that a physical pre-examination is very important and can't be effective during an online consultation.

'There are limitations in the sense that telehealth isn't meant for critical things. We're not going to see a patient that has critical needs that require in person evaluation on telehealth. Telemedicine isn't here to replace in person care because there's simply no way that it can do that because there are critical needs patients presenting with cardiac illnesses that require us to do maybe an ECG to evaluate patient's heart we need to run bloodwork to find out exactly what's going on with the patient. patients presenting with things like abdominal pain that require excessive workup. You can't just say where's the pain and make a decision from there' (participant 8)

'Because this is definitely a concern right now with like, you know, doctors and patients like they feel some well, some I wouldn't say all I don't have the numbers. So I'm just kind of being general here. But you know, the general concern is that having an online conversation or not being able to see a person you know in person can possibly cause certain things to be missed.' (Participant 5)

'Recently as last week, I had an old friend of ours who is in treatment for 3 to 4 months with pills and whatever. He has cancer but they didn't see it...First time for a customer who they want to put a stoma on, you can imagine and it was not needed (...) It's only interesting for follow-up for cardio Gritton, or for diabetes or something like that. Follow up a patient who is already known to the doctor and have to report how it goes or discuss how it goes or the dose of your diabetic medication, that's alright. But for a serious problem, especially for a first consultation, I absolutely oppose it' (Participant 2)

Another drawback pointed out by some participants is the fear that technologies are replacing healthcare professionals, there's that aspect of fear that technology can disrupt the relationship between healthcare providers and their patients.

'There is always that fear....very soon we're going to be out of our jobs because telemedicine and everything digital health is currently taking our jobs away (...) Now, if you replace everything with tech Okay, let's just create some robots to do all these things there's no fun No....You need to be able to feel what you're doing, you need to have that connection, that emotional connection that social interaction with your service users, as a provider, you're supposed to have that interaction that connection the users place.' (Participant 3)

In order to address these inequalities, participants recommended that the healthcare regulators take it upon themselves as a good mission to embark on, solving the inequalities, making healthcare resources available to everyone and everywhere, both in developed and developing countries. This could help in resolving the issue of shortage of healthcare staff in certain areas.

'A good mission healthcare can embark on is getting everyone on board. Let's get everyone on board, distribute the resources in a way that you know, when that digital ecosystem exists in one place, It should exist everywhere (...) So I think globalization, globalization like everyone should be brought on board.' (Participant 4)

'so it might also address the problem of the shortage of doctors and nurses that industry is facing these days.' (Participant 5)

4.3.3 Strategic factors and activities for a successful collaborative healthcare ecosystem

From literature and interviewees, we identified certain areas or trends that can be considered in designing and implementing an effective strategy for a successful collaboration of stakeholders within a healthcare ecosystem, in order to achieve innovative outcomes and value creation for patients and other stakeholders. In this section, We develop a framework for a value creation system with the intention of including elements that may handle the complexity of healthcare systems. We also sought to ascertain how value might result from collaboration between stakeholders who interact and exchange resources in a digital healthcare ecosystem.

To define and rethink how a healthcare ecosystem functions, having a strategic approach and well coordinated activities are crucial. In this category, we share ideas that were carefully put together in response to drawbacks and discrepancies in the healthcare system that have an impact on innovativeness and value creation. These ideas were based on replies from interviews and from the literature review. With the help of this section, users will be better able to collaborate and support one another while generating value. Our main goal is to draw attention to important ideas that should be taken into account while analyzing the characteristics of a healthcare ecosystem that is aimed at fostering innovation and value creation for patients, the success of stakeholder involvement in value creation and the elements that affect information and knowledge exchange. These ideas are summarized and represented in figure 10.

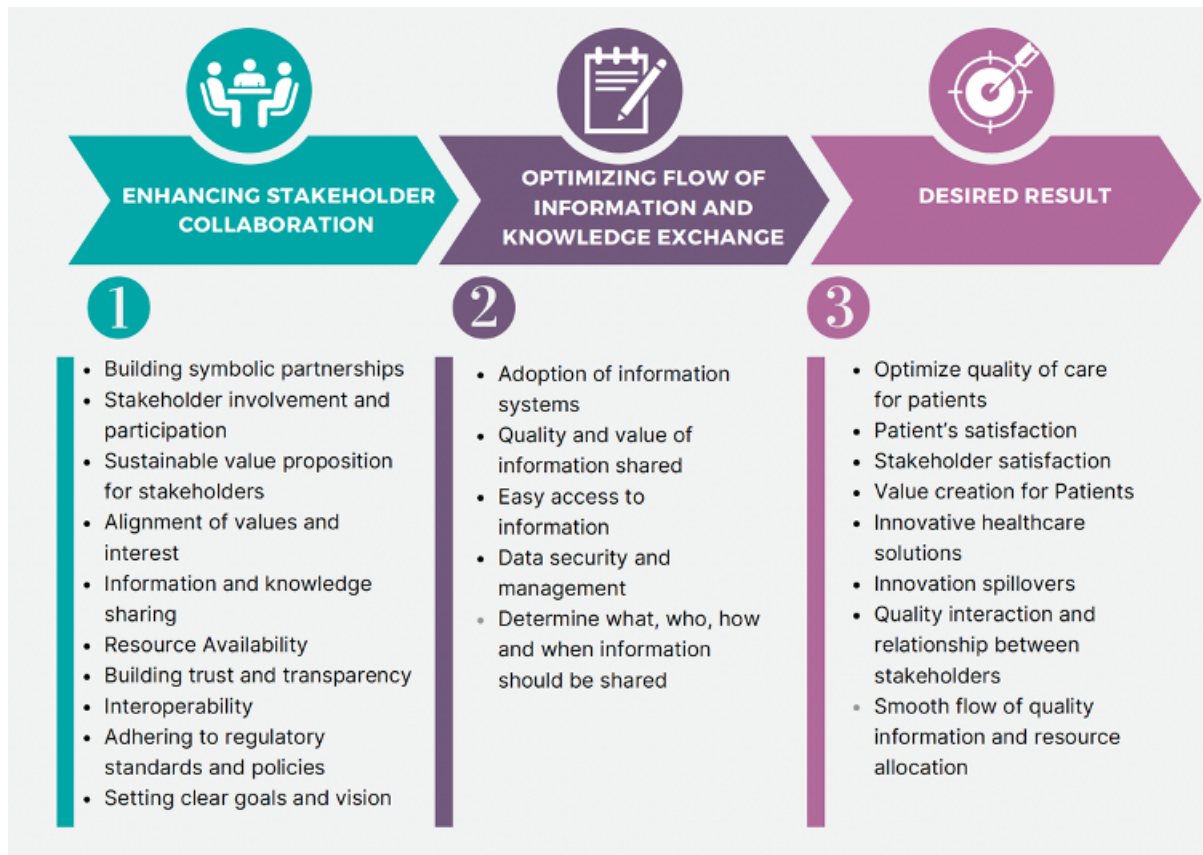


Figure 10: Strategic factors for carrying out an innovative collaboration in a healthcare ecosystem

The role of governance and proper management in the healthcare system is the first trend we identified. They are a function of value creation in a healthcare ecosystem as they coordinate the activities within the ecosystem for a better flow of information and interaction. In order to control the healthcare system, there are procedures and laws that guide stakeholders and the overall decision making processes of the ecosystem. Governance is crucial for the success of the healthcare system (Fennelly et al., 2020) since it affects how the ecosystem functions. They exercise power and authority to govern the behavior of stakeholders in a healthcare ecosystem through standards and policies. The operations, activities, procedures, and structures of the healthcare system and its parts are managed following these standards and recommendations. Governance can be in various forms:

- Scientifically based governance that supports the ecosystem in maximizing their full capacity to meet up with policies and standards. For example government regulators like WHO that provides policies and recommendations for Health ecosystems to follow and monitor their performance. (Participant 3).
- Hierarchical governance that affects the design and implementation of policies and standards within the ecosystem. Participant 5 for example mentioned that the best course of action for success

is widened by involving pertinent and positive stakeholders in making decisions, and in the creation and implementation of the standards and guidelines of the healthcare ecosystem.

- Adaptive collaborative governance that places a strong emphasis on knowledge building, group learning, and change sensitivity. 'Having management that has confidence in what you're doing and doesn't need to micromanage every single part, I think is also very important.' (Participant 5)

Furthermore, while creating standards is vital, its real value rests in how simple and successful their execution is in achieving the desired goals and objectives. Participant 3 also agreed to this by highlighting the importance of a strategic implementation procedure and follow-up. Most Organizations fail to follow up or have KPIs that monitor the progress of their health ecosystem's goals and missions and hence crumble easily.

'There is a whole standard operating procedure that you need to follow (...) project implementation is very important. From conceiving the idea to implementing the proposed solution to that particular problem and monitoring. Most people do not follow up and that's why so many people fail. It's a cycle. You have the idea, you implement, monitor and follow up, you go back to the idea. revisit the idea, do a few changes, a few innovations implement that monitor follow up. If the small ecosystems want to succeed at solving a particular problem, that's something that they have to do and it's very important not to skip them.' (Participant 3)

The next strategic trend we identified includes understanding the significance of data availability and the use of information systems, hence ensuring a smooth exchange of data and resources. Sharing knowledge and data is crucial for making important healthcare decisions, improving healthcare systems, co-creating value, and enhancing patient centric care. Having access to health data encourages government bodies and healthcare institutions to find solutions to challenges and health issues. *'Well, most of this data gets into peer reviewed articles like for instance TB record data or malaria record data, and gets into the World Malaria report every month, every year(...) as a result of these statistics that are collected they make provision for distribution of pre mosquito nets and treatment of malaria for children below five years is free. You know such information could always help the stakeholders to make decisions and to know which diseases have public health importance (participant 7).'*

Insufficient data exchange can be damaging and play down on the effectiveness of healthcare ecosystems hence, it requires that a fundamental system of resource integration and interoperability be put in place. In order to harness the full value of information and knowledge sharing, it has to be accurate, trustworthy, clearly stated and current. Also, the stability of Information systems needs to be established, it needs to be resilient when faced with disruptions so as to prevent system failure or information loss. Making sure information systems are versatile enough for users to embrace them has benefits. The following questions therefore need to be addressed for the creation of more benefits out of information sharing within healthcare ecosystems; What ought to be shared? To

whom should it be shared? How and when should it be shared?. Providing quality answers to these questions will help the healthcare ecosystem in minimizing duplication, lowering the cost of data exchange, providing greater security and data protection, and in increasing the accuracy of the information. Data privacy and security, as we have seen, are very important elements to take into account and having the right answers to the questions above will help in addressing the issues surrounding data privacy.

Having a well outlined healthcare profile at the beginning of a value creation process is another important element to consider in order to successfully co-create value in healthcare ecosystems. This is crucial since each of the elements that make up the healthcare profile has ramifications that must be taken into account when designing the healthcare profile and in the choice of stakeholders to collaborate with. It is important to identify the type of healthcare system because doing so will highlight particular characteristics of its strategy and policies. The second element that defines the healthcare profile is the goals and objectives, the scope of the healthcare system. This is important as it helps to align the stakeholders' characteristics and innovation strategy with respect to the size and scope of the healthcare ecosystem.

'And to be able to do that we need to have a clear vision. needs to have an innovative way, an innovative approach in solving a particular problem. It's all about innovation. Everybody's trying to solve a problem, you have more failing than those who are succeeding' (Participant 3)

'Research, what type of data transformation Do you want to do? What type of services do you want? (...) you know, so the first thing is to know exactly what you want to do, what type of transformation you want. And that's one of the biggest steps to take. If you want to do digital transformation especially in healthcare, we've seen a lot of digital services emerge and then disappear with the initial plan because there is no clear vision, you know, so they need that clear vision of where they want to start.' (Participant 3)

The next set of trends is related to the collaborative effort for value creation in healthcare ecosystems. After defining the healthcare type and size, the next thing to consider is the stakeholder profile. Stakeholders are those who collaborate and exchange resources for value creation within the ecosystem. Hence the success of the ecosystem is significantly influenced by the effective collaboration of the stakeholders. Stakeholders are crucial to the healthcare ecosystem because they continuously act and respond to pressures and changes in the environment brought on by other stakeholders and other influencing variables. They have the power and capacity to influence the productivity and innovativeness of the healthcare ecosystem. This is mostly determined by the degree of participation of each stakeholder which might fluctuate due to the fact that different stakeholders have distinct agendas and goals for the value creation process, the goals of value creation vary among interacting stakeholders. Others may have financial objectives, while some may want an improvement in healthcare systems, procedures, and an enhancement in patients'

satisfaction and overall experience. Because of this, stakeholders might act solely in their own interests rather than the interests of the healthcare ecosystem. To identify which pertinent stakeholders should be taken into account, the stakeholder profile must be defined. Value creation, capture and delivery are based on the diversity of stakeholders in a healthcare system. As a result, the choice to involve or not to involve particular stakeholders may have an effect on how well the value creation mechanism works and the level of innovativeness. One of the participants also agreed on the importance of building the right collaborations.

'I think partnership, building the right partnerships is really important. Using the right partnerships from the beginning, having those strong collaborations with different stakeholders it's really important. And, having access to information, making the, building the ecosystem in such a way that everybody has access to what they need, even the regulators everyone.' (Participant 3)

Chapter 5: Research conclusion and contribution

Our study is a contribution to the debate on digital transformation of healthcare ecosystems by investigating how the desire for novel innovation in healthcare and a move from the traditional healthcare system to a patient-centric care system affects the collaboration of stakeholders in a healthcare ecosystem to co-create value. In doing so, we assign a central role to digital transformation as a trigger that alters the sensemaking of innovation in healthcare, opening up opportunities and new business models aimed at improving healthcare services. Digital transformation has caused a paradigm shift in the way that businesses manage information and knowledge. Closed systems are evolving into open, adaptable ecosystems where top-down governance is being replaced by decentralized, collaborative, multi-stakeholder governance. This holds true for every industry, including the healthcare sector. Significant changes are already apparent in the new position of patients as collaborators in the delivery of their own healthcare, from research to prevention, diagnosis, and treatment. From the analysis, we identified several ecosystem stakeholders who all have varied roles to play in the innovation of healthcare systems. Ecosystem actors such as research institutes for example collect and analyze health data that is used to determine health challenges faced by patients, areas that are highly infected by certain diseases which results in finding measures to address those concerns. The health technology companies were identified as key stakeholders in a digital healthcare ecosystem. They are responsible for setting up information systems and healthcare platforms to manage EHRs, and all the wonderful healthcare technologies are created as a result of collaboration with health tech companies. Results also show a great collaboration with pharmaceutical companies, government bodies, academic institutes, insurance and funding companies, policy makers, who all have unique roles to play in value creation for patients. There's every reason to believe that collaboration between these stakeholders will benefit patients and even result in unforeseen future innovations in the healthcare industry. Furthermore, we observed that there are other opportunities that can be generated from stakeholder interaction in healthcare ecosystems. Value can be generated for each stakeholder. From our discussion with participants, we observed different motivations on why they join the healthcare industry and how they participate in the healthcare ecosystem. One of the key motivating factors was the love for creating value for patients. Moreover, Value creation for patients leads to value capture for the participants and the healthcare ecosystem and additionally, participants felt that co-creating, delivering and capturing value with other stakeholders had added advantages. Furthermore, businesses like device manufacturers, NGOs and pharmaceutical companies that are not quite related to healthcare find collaboration within healthcare ecosystems as an opportunity to explore a new business market.

One major factor that facilitates these stakeholder collaborations is access and management of health-related knowledge and information, which is increasingly made possible by the rise of new technologies. There are emerging services and technologies that facilitate communication between patients and healthcare providers, and between other stakeholders. Technologies such as AI,

wearables, machine learning for example make it possible for patients and healthcare professionals to communicate and collaborate in safe, reliable, and quick networks by means of a continuous stream of data, thereby creating smart and individualized health services for patients everywhere. Digital technologies help to build effective and healthy networks in which several types of health-related information and knowledge are combined and managed within healthcare ecosystems, thereby facilitating the delivery of digitally enabled and knowledge-based healthcare to patients (patient-centric care).

This study is an addition to the increasing knowledge and research on how to better understand and manage innovation and value creation from a healthcare ecosystemic context (Barile et al., 2020; Botti & Monda, 2020; Autio, 2021), which is very significant for healthcare innovation systems and stakeholders. We present a framework that conceptualizes and describes crucial strategic elements that encourage innovation and value creation for patients in a healthcare ecosystem. This framework was designed as a result of the challenges and disparities facing healthcare innovation systems. Participants were asked to state the significant challenges faced in co-creating value for customers, and we identified several critical challenges such as data security concerns, issues of trust and transparency, diverse interest amongst stakeholders etc. Through a combination of our theoretical understanding and results from the analysis, we came up with the strategic factors in Figure 10 that can be significant in carrying out a successful innovative collaboration in healthcare ecosystems. The framework presented consists of interconnected elements that were found in previous research and the interviews carried out, integrated, and arranged into a useful management tool. Our research framework is meant to provoke discussion and provide readers an idea of how various components of the healthcare ecosystem might affect value creation and encourage innovation. It provides an important sequence of event that could be followed to create sustainable value for patients and stakeholders in a healthcare ecosystem by taking into account: (1) strategic activities that may be carried out to ensure a fruitful stakeholder collaboration, (2) use and management of information systems to drive efficiency within the healthcare ecosystem, (3) the desired results they intend to achieve. This is very important given that value co-creation, delivery and capture is as a result of the interactions that go on amongst stakeholders in the healthcare ecosystem. It's imperative that these interactions and exchanges are carried out successfully to achieve innovation and value creation.

Chapter 6: Research limitations and future recommendations

Like most research studies, our current study has some limitations too. Firstly, we were only able to interview a small sample of participants due to time and negative feedback on our invitation to respondents, which prevented us from generalizing the findings of our study. This dissertation advocates for additional research using both qualitative and quantitative measurements and involving larger populations so as to obtain deeper insights from a general perspective.

Additionally, this paper does not present a deep evaluation of specific findings or elements that have been observed. This dissertation aims to identify and explore digital transformation in healthcare by investigating how the desire for novel innovations triggers stakeholders' collaboration in the healthcare ecosystem to co-create value. However, even though the findings provide detailed insights into some of the key aspects of digital healthcare, this dissertation does not take a distinct and in-depth look at all stakeholders in the digital healthcare ecosystem. The Qualitative analysis was limited due to the small number of participants who also had diversified backgrounds. A larger number of participants from various stakeholder sectors and backgrounds could possibly have led to a different and better result. Given that the health ecosystem system involves multiple stakeholders from different sectors, it would have been ideal to interview participants from every stakeholder group; however, that was not the case as most of our participants were mainly from the health sector. Hence, there was the absence of an in depth investigation of several concepts from the perspective of every stakeholder's perspective. We therefore recommend that future research be carried out taking into consideration every key stakeholder of a healthcare ecosystem for more significant results.

Moreover, the qualitative analysis of this research was carried out twice. We made changes to our initial research and added a new scope on emerging business models that required further research and interviews. However, most of the participants were not available for a follow up interview hence our study doesn't present in depth information on essential elements of emerging business models as a result of collaboration between stakeholders of a healthcare ecosystem.

The participants in our study deeply emphasized the value of business models for the prevention of diseases in the healthcare industry. The idea of preventing diseases rather than treating people after they get sick is becoming the new goal of most healthcare systems. Our study addresses experience-based insights that would be valuable to future researchers to have a detailed look into the strategies, programs, and partnerships happening across the healthcare industry to increase the utilization of preventive healthcare. Participants also emphasized inequality in healthcare as a key challenge facing the healthcare industry. Healthcare resources are unevenly distributed, some countries or areas are very backward in digital transformation, some countries are greatly affected by certain diseases than others. We recommend further studies on how the challenge of inequality in healthcare can be addressed for a universal efficiency in healthcare delivery. This is important as

we have already seen with the case of COVID 19 and Monkeypox how easily diseases can be transported to other areas. A challenge in one area or country can affect the global healthcare system. A novel business model with value propositions that offers solutions to these challenges would be fascinating.

Lastly, it would be fascinating to research how patients interact within dynamic customer-centered healthcare ecosystems, particularly in instances when there is knowledge asymmetry between the customer and the service provider. We recommend future research in this aspect in order to identify what new roles for participation could be created for the stakeholders in these situations.

Authors' Contributions

Both authors conceived the original idea and eventually discussed and agreed with the main focus and ideas of this paper. Both authors conducted all interviews together, collected the data, and performed the coding and analysis together. Writing of different sections of this thesis were split between the authors and the contributions of each author is mentioned in the table below. At the end, both authors approved the final version of the thesis and agreed to be held accountable for the content therein.

Table 5: Authors' contribution

Sr.#	Content	Author
1.	Preface	Elinor
2.	Acknowledgements	Kainat
3.	Executive Summary	Kainat
4.	Chapter 1: Introduction	
	1.1 Problem Statement 1.2 The Research Objective and Questions 1.3 Thesis Outline 1.4 Research Approach and Technical Structure	Kainat
5.	Chapter 2: Theoretical Background and Literature Review	
	2.1 Digital Transformation 2.1.1 Evolution of digital transformation 2.1.2 Conceptualizing digital transformation in the context of healthcare ecosystems	Kainat
	2.2 Driving healthcare innovation through stakeholder collaboration in healthcare ecosystem 2.2.1 Emerging business models through stakeholder collaboration 2.2.2 Enabling value creation for customers in the healthcare ecosystem	Elinor

	2.3 Challenges faced by stakeholders in digital healthcare ecosystems	Elinor
6.	Chapter 3: Research Methodology	
	3.1 Research Design and Data Collection 3.2 Sampling Design 3.3 Data Analysis 3.4 Research Methodology Limitations	Kainat
7.	Chapter 4: Research Results	
	4.1 Collaborative Innovation in Digital Healthcare 4.1.1 Conceptions on Digital Transformation 4.1.2 Benefits of Digital Transformation 4.1.3 Digital Healthcare Ecosystem	Kainat
	4.2 New business models 4.2.1: Patient centric value proposition 4.2.2: Digital healthcare solutions 4.2.3: Access to data and data management 4.2.4: Value co-creation	Elinor
	4.3 Digital Healthcare Challenges 4.3.1 Challenges in Digital Transformation 4.3.2 Drawbacks/ Disparities in Digital Healthcare 4.3.3 Strategic factors and activities for a successful collaborative healthcare ecosystem	Kainat + Elinor
8.	Chapter 5: Research conclusion and contribution	Elinor
9.	Chapter 6: Research limitations and future recommendations	Elinor

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