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Towards Digitalized Patient-Centered Integrated Healthcare in Finland

Examining the Future of Digitalized Healthcare

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Abstract

Over the past decade, the Finnish healthcare sector has witnessed a gradual digital transformation, where traditional delivery of healthcare services has been augmented with innovative digital tools, services, and channels. One viewpoint elevated by this digital transformation is a paradigm shift toward a more patient-centered integrated healthcare system.

This thesis aims to build an understanding of the interplay between digital health and patient-centered integrated care, a domain that has received relatively limited research today. The study draws its theoretical foundation from the affordance theory by examining potential affordances that emerge from the perceptions of ten interviewed e-physicians on the future of digital health in Finland. Using a grounded theory methodology alongside a speculative design mindset, the thesis presents a future vision of digitalized patient-centered integrated healthcare. Furthermore, the study explores the factors that facilitate the realization of the envisioned future.

The findings of the thesis show that digital health is an evolving multidisciplinary concept that has the potential to establish a more integrated, continuous, and personalized healthcare system, with shared value co-created in collaboration between different healthcare stakeholders. The generation of this value was identified to be bound to a transition in three distinct yet interconnected meta-level themes: 1) from a single system to a modular ecosystem, 2) from data silos to consolidated insights, and 3) from isolated to integrated care paths.

The envisioned future portrays an adaptable, participatory, and coordinated healthcare system, seamlessly blending the digital and physical worlds to deliver a cohesive and mutually supportive multichannel healthcare service system. The realization of the envisioned future necessitates progress in three categories: 1) enhancing multidisciplinary collaboration, 2) developing a shared vision, and 3) establishing ecosystems for testing and integrating solutions.

Keywords digital health, healthcare digitalization, eHealth, patient-centered care, integrated care, blended care, affordance theory, grounded theory, speculative design

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Tiivistelmä

Viime vuosikymmeninä Suomen terveydenhuollossa on tapahtunut asteittaista digitaalista kehitystä, jossa perinteistä palvelutarjontaa on täydennetty innovatiivisilla digitaalisilla työkaluilla, palveluilla ja kanavilla. Yksi tämän kehityksen mukanaan tuoma näkökulma on vallitsevan paradigman muutos kohti potilaskeskeisempää integroitua terveydenhuoltojärjestelmää.

Tämä tutkimus pyrkii lisäämään ymmärrystä digitaalisen terveyden ja potilaskeskeisen integroidun hoidon välisestä vuorovaikutuksesta. Tutkimuksen teoreettinen pohja rakentuu affordanssiteoriaan tarkastelemalla potentiaalisia affordansseja, jotka nousevat kymmenen haastattelun e-lääkärin käsityksistä digitaalisen terveyden tulevaisuudesta Suomessa. Hyödyntämällä grounded theory -metodologiaa yhdessä spekulatiivisen muotoilun kanssa, tutkimus esittää tulevaisuuden vision digitalisoituneesta potilaskeskeisestä integroidusta terveydenhuollosta. Lisäksi tutkimuksessa tarkastellaan tekijöitä, jotka mahdollistavat tämän vision saavuttamisen.

Tutkimuksen tulokset osoittavat, että digitaalinen terveys on alati kehittyvä monitieteellinen käsite, joka tarjoaa mahdollisuuden entistä integroidumpaan, jatkuvampaan ja yksilöllisempään terveydenhuoltojärjestelmään, jossa arvoa luodaan yhteistyössä terveydenhuollon eri toimijoiden kesken. Tämä jaettu arvonluonti tunnistettiin tutkimuksessa liittyvän siirtymiseen kolmessa toisiinsa liittyvässä teemassa: 1) yhdestä järjestelmästä modulaariseen ekosysteemiin, 2) siiloutuneista tiedoista konsolidoituihin oivalluksiin ja 3) eristäytyneistä integroituihin hoitopolkuihin.

Tulevaisuuden vision kuvastaa mukautuvaa, osallistavaa ja koordinoitua terveydenhuoltojärjestelmää, joka saumattomasti yhdistää digitaalisen ja fyysisen terveydenhuollon toisiaan tukevaksi monikanavaiseksi palvelujärjestelmäksi. Tutkimus osoittaa, että vision saavuttaminen edellyttää edistymistä kolmella keskeisellä osa-alueella: 1) monitieteellisen yhteistyön tehostaminen, 2) jaetun vision luominen ja 3) ekosysteemien luominen ratkaisujen pilotoimista ja integroimista varten.

Avainsanat digitaalinen terveys, terveydenhuollon digitalisaation, sähköinen terveydenhuolto, potilaskeskeinen hoito, integroitu hoito, blended care, affordanssiteoria, aineistolähtöinen teoria, spekulatiivinen suunnittelu

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Preface and acknowledgements

I would like to express my heartfelt gratitude to my thesis advisor, Annika Bengts, for her invaluable guidance, unwavering support, and expert insights throughout this journey. Her mentorship has been instrumental in the successful completion of this thesis. Annika's patient and constructive feedback, along with her ability to inspire critical thinking and provide steadfast assistance during the research process, has undoubtedly shaped the depth and quality of this thesis. I am profoundly thankful for her mentorship and support.

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Lastly, I would like to express my sincere appreciation to my friends and family. Your support throughout this thesis journey means the world to me. Thank you.

Helsinki, 24 October 2022
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Glossary of terms

Digital health
In this thesis, digital health is defined as the field of knowledge and practice associated with the development and use of digital technologies to improve health (WHO, 2021).

Patient-centered integrated care
In this thesis, patient-centered integrated care is defined as a state where every individual has access to healthcare services tailored to their life course needs and preferences and which are seamlessly coordinated across the care continuum and maintain high standards of safety, effectiveness, timeliness, efficiency, and quality (WHO, 2015).

Affordance
An action potential (a potential of use) for achieving an immediate concrete outcome, which emerges from the interaction between an IT object and a goal-oriented actor (Strong et al., 2014).

Modular ecosystem
A structure where several independent actors are interconnected through several subsystems that enable complementary value-adding services to be brought together (Blaschke et al., 2019).

Real-world data
Data regarding the health status of patients and the provision of healthcare regularly collected from a variety of sources (Liu & Panagiotakos, 2022).

Blended care
An integration of physical and digital touchpoints of healthcare into a seamless multichannel healthcare system (Toonders et al., 2021; Valentine et al., 2020).

Care pathway
In this thesis, a care pathway is defined as the stages and steps within the care cycle, illustrating the patient's transitions between various healthcare procedures, units, professionals, specialties, and more, encompassing diverse care actions (Lawal et al., 2016).

1 Introduction

1.1 Background to the study

Over the past decade, the Finnish healthcare sector has undergone a gradual digital evolution, witnessing the systematic integration of digital technologies across various dimensions of healthcare delivery. Telehealth technologies, facilitating remote communication between healthcare professionals and patients, have solidified their position as essential components of health-related interactions. Simultaneously, mobile applications utilized for monitoring, communication, and data sharing are swiftly gaining prominence. Additionally, diverse digital care paths have been introduced to complement the conventional physical care model, leading to a hybrid approach that empowers patients to navigate seamlessly between the realms of physical and digital healthcare (Reponen et al., 2021). Consequently, digitalization has engendered a profound transformation in how health-related services are provided and accessed today.

The term 'digital health' has emerged as a unifying concept to define the technologically driven healthcare of today (Meskó et al., 2017). While technology has been an integral element of the healthcare environment since the dawn of medicine, the multifaceted aspects of digital health extend beyond mere technological transformation (Fatehi et al., 2020). The democratization of medical knowledge, the sharing of and access to health-related data, the incorporation of digital touchpoints, and the establishment of health ecosystems have all become central embodiments of the ongoing revolution transforming healthcare for a new digital era (Győrffy et al., 2020; Ruokolainen et al., 2023). As a result, digital health is often referred to as an umbrella term encompassing different technologies and techniques aimed at making healthcare more accessible, equitable, and efficient through digital means (WHO, 2021).

One viewpoint elevated by the proliferation of digital health is a paradigm shift towards more patient-centered integrated healthcare (Leijten et al., 2018). Patient-centered integrated care embodies a collaborative, continuous, and coordinated healthcare system that aims to address the limitations of the conventional medical approach by emphasizing comprehensive and personalized care across various healthcare settings and disciplines (Berntsen et al., 2018). While patient-centered integrated care is often associated with enhanced empowerment and involvement of patients, its intrinsic value stems from the broader vertical and horizontal integration of diverse healthcare touchpoints and stakeholders (Burdett and Inman, 2021). Facilitated by digital health's ability to connect stakeholders, generate

vast amounts of data, and support evidence-based decision-making, its potential to actualize the advantages of patient-centered integrated care has increasingly gained interest in recent discussions (Leijten et al., 2018).

Nevertheless, scientific efforts in the domain of digitally induced patient-centered integrated care still appear to be relatively immature. While both concepts have individually shown positive outcomes in enhancing certain aspects of the healthcare system, many of these studies have focused on specific technologies or services or have remained at relatively a speculative and abstract level (Gross et al., 2021; Shah et al., 2022). With the ongoing increase in technological penetration and exposure to digital services within and outside the healthcare sector, the need to understand the current and future implications of digital health in reorienting care models towards a more integrated, patient-centered, and holistic approach has been emphasized (WHO, 2015; WHO, 2016). Thus, this thesis seeks to augment current scientific knowledge, stimulate discussions, and prompt reflections by offering perspectives on the potential trajectory of digitalized patient-centered integrated healthcare in Finland.

1.2 Objectives and research questions

The theoretical foundation of the thesis is rooted in the stance of potential affordances of the affordance theory (Lanamäki et al., 2016). This theory seeks to elucidate the potential affordances (potentials of use) that arise through interactions between goal-oriented actors and (technological) objects within their environment (Strong et al., 2014). In essence, the theory posits that goal-oriented actors opt to engage with objects based on their perception of achievable outcomes rather than a set of features that are intrinsic to the objects and independent of the actors (Alshawmar, 2021). Thus, the perceptions of actors drive subsequent actions, underscoring the integral role of individual interpretation and anticipation in shaping the dynamics between actors and objects.

So far, in the context of digital health, the affordance theory has been mainly applied in the use of specific technology, such as electronic health records (Petrakaki et al., 2014; Strong et al., 2014) and bundle of traditional healthcare systems (Bygstad & Bergquist, 2018). However, less exploration of digital health has been done at a conceptual level and in connection with patient-centered integrated care. Particularly within the context of the Finnish digitalized healthcare landscape, it appears that the theory has garnered relatively limited attention.

Given the scarcity of existing research, this thesis employs a grounded theory methodology to establish connections among the somewhat fragmented disciplinary knowledge. The methodological approach of grounded theory, in synergy with the affordance theory, provides a suitable and attractive lens for generating new theories from a comparatively less explored and novel subject of digitalized patient-centered integrated healthcare. Additionally, from a designer's perspective, the thesis adopts a speculative design mindset as its overarching epistemological lens.

Considering the foregoing, the objective of the thesis is to investigate the phenomenon of digital health and its impact on enhancing patient-centered integrated healthcare in Finland. Additionally, the study aims to identify and analyze the factors influencing this transformation. The study derives its empirical data through interviews with ten digitally oriented Finnish physicians. Hence, the thesis aims to illuminate the perspectives of these physicians regarding the digital transformation's potential in fostering patient-centered, integrated, and holistic healthcare.

To meet the objective of the thesis, the following research question was formulated:

RQ1: *How can digital health promote the provision of patient-centered integrated healthcare in Finland?*

The following sub-research questions were established to complement the main research question:

RQ2: *What can the speculative future of digitalized patient-oriented integrated healthcare look like in Finland?*

RQ3: *What are the key factors influencing the achievement of the future vision?*

The outcome of the thesis is a speculative theory of digitally integrated patient-centered healthcare, aiming to provide a holistic vision of the potential of digital health.

1.3 Motivation

The motivation for this study stems from opportunities for digitalization to reshape the ways how health is being addressed. The rapid pace of technological advancements has led to widespread disruption across various aspects of modern life, giving rise to novel expectations regarding the accessibility, efficiency, and personalization of services. While we have

witnessed an increasing trend of technology-meditated and patient-oriented channels and solutions within the healthcare sector, the underlying potential of digitalization to meet similar expectations remains largely untapped.

I have previously researched the concept of mHealth (mobile health) within the context of delivering pharmacy services during my prior studies. Possessing prior knowledge of the healthcare sector and actively monitoring the progress of digitalization in this domain, it was a natural choice to delve into a topic that bridges technology and health. Nonetheless, constraining the concept of digital health to a singular technology or service appeared overly simplistic, potentially overlooking its broader significance on various healthcare stakeholders. Therefore, researching digital health on a broader conceptual level seemed like an intriguing approach for this thesis, allowing me to explore the multifaceted interactions between technology and health more holistically.

Furthermore, I see that the previous two years of learning the principles and methodologies in the International Design Business Management program provided a valuable mindset to go beyond a simple solution space and dive deeper into the intricacies of digitalized healthcare. As will be stated often in this thesis, healthcare is not a single entity consisting of clearly defined stakeholders and boundaries. Operating in such an interconnected and multidisciplinary environment inevitably requires finding innovative approaches, exploring unconventional solutions, and understanding the needs, desires, and behaviors of diverse actors. Hence, I see that adopting a designer mindset offered an invaluable framework for addressing these complexities and exploring the future of digitalized patient-centered integrated healthcare.

1.4 The structure of the thesis

This master's thesis is divided into six main chapters. The first chapter describes why the topic of the thesis is essential for research, introduces research questions, and presents the motivation for the study.

The second chapter introduces the concepts of patient-centered integrated healthcare and digital health and discusses the interconnection between them. It also reviews the main barriers to the wider adoption of digitalization in the healthcare sector. Lastly, the affordance theory and its utilization in the healthcare context will be presented.

In the third chapter, the thesis delves into the grounded theory methodology and explains why it was deemed suitable for this thesis. Furthermore, it

discusses the chosen overarching approach of speculative design and its synergies with the affordance theory.

The fourth chapter reviews the findings of the conducted semi-structured interviews and presents the transition from the current state to the envisioned future through identified potential affordances within three meta-level themes. Additionally, the factors influencing the future vision will be briefly discussed.

The fifth chapter discusses and reflects on the outcomes of this study in the light of existing literature and provides a speculative theory / future vision of digitalized patient-centered integrated healthcare. Moreover, the chapter reflects on the practical implications and limitations of the study and presents suggestions for future research.

Finally, the sixth chapter provides an overall conclusion of this thesis.

2 Literature review and theoretical background

2.1 Patient-centered integrated care

Patient-centered integrated care is a multifaceted healthcare construct that has garnered significant interest in healthcare research for several decades (Greenfield et al., 2014). The term is derived from two separate concepts: 'patient-centeredness' and 'integrated care'. Patient-centeredness emphasizes the importance of putting patients at the center of care by promoting shared decision-making between healthcare professionals and patients on care-related issues (Stewart et al., 2000). Over the years, patient-centeredness has been referred to by various closely related terms, such as patient-oriented care, partnership care, consumer-driven/directed care, and personalized care (Berwick, 2009; Joiner & Lusch, 2016). Regardless of the terminology used, the underlying goal of patient-centered care is to transform patients from passive recipients to active participants in their care (Burdett & Inman, 2021).

Accordingly, the latter term, integrated care, has been denoted by various terms such as coordinated care, comprehensive care, and seamless care (Kodner & Spreeuwenberg, 2022). Despite the variations in terminology, they all emphasize alleviating the patient journey across health services and empowering healthcare professionals and patients through enhanced coordination and continuity of care (Greenfield et al., 2014). Integrated care involves the sharing of information between healthcare stakeholders, the use of standardized care processes, and the provision of an individual care plan for each patient. Hence, the aim is to empower healthcare professionals and patients to provide and receive better care by reducing fragmentation and improving communication and collaboration between the different touchpoints of healthcare (Burdett & Inman, 2021).

Despite overlapping ethos and minor distinctions between the aforementioned concepts, they share the common objective of promoting seamless and personalized care paths that consider the individual's evolving needs, values, and preferences over time within the multifaceted healthcare system (Berntsen et al., 2018). In this thesis, patient-centered integrated care refers to WHO's (2015, p. 10) definition of "*a future in which all people have access to health services that are provided in a way that responds to their life course needs and preferences, are coordinated across the continuum of care and are safe, effective, timely, efficient and of acceptable quality.*"

As the value of patient-centered integrated care is derived from more vertical and horizontal integration of various healthcare touchpoints and

stakeholders, enabling a more personalized, coordinated, efficient, and equal service delivery, it attempts to address the limitations of the traditional medical approach criticized for its disease-centered perspective, uncoordinated care processes, and unilateral decision-making (Greenfield et al., 2014; see also Berntsen et al., 2018; Burdett & Inman, 2021).

The exploration into the effects of patient-centered integrated care has garnered significant attention at both micro and macro levels. Patients are increasingly inclined to participate in their care, positioning themselves as active partners with their providers. Additionally, the present era of medical consumerism and access to online medical information underscores patients' desire for optimal care and increased knowledge of their conditions and available treatments (Greenfield et al., 2014). Furthermore, the rising number of people afflicted by chronic and multimorbidity illnesses continues to strain the healthcare system's capacity. Such patients often have diverse and numerous requirements that necessitate a blend of services from various healthcare providers across different touchpoints in their care processes (Leijten et al., 2018). Patient-centered integrated care is widely recognized as a fundamental component for enhancing the quality and efficiency of care delivery processes (Berntsen et al., 2018). Consequently, the Institute of Medicine has identified it as one of the six essential domains of healthcare quality objectives that steer the development of healthcare services (AHRQ, 2022).

Although attempts have been made to establish the practical relevance of positive outcomes of patient-centered integrated care, efforts in this area remain rather inconclusive (Valentijn et al., 2015). However, a substantial body of research suggest that the adoption of patient-oriented care models is linked to various benefits, including improved adherence to treatment, perceived symptom improvement, increased patient satisfaction and participation, better overall health status, improved clinical outcomes, and enhanced cost-effectiveness due to decreased healthcare interventions (Camacho et al., 2010; Lathoura et al., 2022; Stewart et al., 2000).

In order to address the gap between the practical relevance and outcomes of patient-centered integrated care, the potential of digital technologies to realize the benefits associated with patient-centricity and integrated care has been increasingly emphasized (Leijten et al., 2018). WHO (2016) has highlighted the need to establish strategies for the broader utilization of digital technologies to reorient care models toward a more integrated, responsive, and holistic healthcare system. The proliferation of technological solutions has provided new means of connecting patients beyond traditional sparse clinical visits, generating vast amounts of health-related data for remote assessment of patients' conditions, promoting patient participation

in care-related decision-making, and moving from service silos towards more seamless care models that respond to real-world illness trajectories and dynamics (Iorfino et al., 2021; Luis-Martínez et al., 2020). Thus, underscoring the importance of research in adopting innovative technological approaches to improve continuous, accessible, empowered, effective, and patient-centered integrated care (WHO, 2015).

2.2 Digital health

2.2.1. Digital health and its components

The term digital health has attracted great interest in many stakeholders over the past decade, and especially since the outbreak of the COVID-19 epidemic, the discussion around the digitalization of healthcare has been particularly resonant (Giansanti, 2022). Although the concept dates back to the 1990s in scientific literature, there is still much uncertainty about the meaning and content of digital health. For instance, a recent study by Fatehi et al. (2020) shows the concept has evolved over time as a result of the many ways and purposes that diverse actors have used it for, and today nearly 100 unique definitions of digital health can be found.

Despite the existence of multiple definitions, it is commonly acknowledged that digital health pertains to the utilization of various technologies for designing and delivering healthcare services with the goal of improving patients' health (Kotskova, 2015), managing illnesses (Ronquillo et al., 2023), promoting well-being (Smits et al., 2022), deepening the patient-physician relationship (Győrffy et al., 2020), and engaging patients (Meskó et al., 2017) and their family members (Morley & Floridi, 2019) in shared decision-making regarding health-related matters.

This thesis applies the definition by WHO (2021, p. 11), which states that *"digital health is understood to mean the field of knowledge and practice associated with the development and use of digital technologies to improve health."* As the definition shows, even larger bodies such as the WHO have determined the term broadly and left much room for individual interpretations. On the other hand, this definition allows multiple viewpoints, brings a multidisciplinary perspective, and complements previously established concepts such as eHealth by including digital consumers as one main stakeholder in the design and consumption of health services (WHO, 2021).

Similar to its definition, the components that belong to and constitute digital health are not consistent across all sources but vary depending on the desired

perspective and depth of analysis. In addition, components can often be further divided into sub-categories, and additional components can be added, contingent on the given context (Iyawa et al., 2016). WHO (2021) determines digital health as an umbrella term encompassing numerous different technologies and technologically mediated services. Table 1 presents some of the technological components and concepts associated with digital health.

Table 1. Components of digital health. Reproduced and adapted from Iyawa et al. (2016); Manteghinejad & Javanmard (2021); The IQVIA Institute (2021).

Component	Description
eHealth	The use of information and communication technology in support of health and deliver health services
mHealth	The use of mobile (wireless) technologies for public health and provision of health services
Telemedicine / Telehealth	The use of electronic and telecommunications technologies to provide clinical (telemedicine) and non-clinical (telehealth) services
Personalized medicine	The use of an individual's genetic profile to make decisions regarding the prevention, diagnosis, and treatment of disease
Consumer wearables	The use of wearables devices, such as smartwatches, to enable patient self-care and remote monitoring of patient health by healthcare professional
Electronic Patients Records	The use of collected health records of a patient to improve health-related decision-making
Digital sensors and biomarkers	The use of sensors and digital biomarkers to track patient health across a range of diseases and vitals
Digital Diagnostics	The use of sensors on smartphones and other mobile devices to diagnose and detect patient's health conditions
Digital Therapeutics (DTx)	The use of software to treat, prevent, or manage a specific disease, usually with a narrow clinical indication
Digital Care (DC)	The use of software to treat, prevent or manage a specific disease, usually with a broadly defined clinical conditions

Health applications	The use of mobile applications to manage health and disseminate health information
Virtual & Augmented Reality (VR & AR)	The use of VR / AR to prevent, treat or rehabilitate patient
Health platforms	The use of platforms to connect different stakeholders and foster interaction between patients and healthcare professionals
Smart devices	The use of smart devices such as smart beds to monitor vitals, usually by utilizing a sensor technology
Self-tracking technologies	Implementation of various technologies to enable patients to monitor their health status at home

As shown in Table 1, digital health is a complex and multifaceted concept encompassing a diverse range of related terms, technologies, and data processing methods aimed at enhancing health prevention, management, treatment, and monitoring. However, the degree of maturity and the current level of utilization of these various components within each healthcare setting differ broadly (The IQVIA Institute, 2021).

In light of the above, the nature of digital health extends beyond technological factors and signifies a fundamental paradigm shift in the entire structure of healthcare systems. In the digital age, the collaboration between different stakeholders is increasingly important, decision-making is more proactive and informed by real-time insights gathered from heterogeneous data sources, patients are viewed as active partners in the planning and implementation of their care rather than passive recipients, and care is more personalized and targeted towards individual needs rather than generalized for the masses (Győrffy et al., 2020). Consequently, understanding how technology enables or restricts different healthcare stakeholders is often more important than focusing solely on the technology itself (Petrakaki et al., 2014). In fact, Fatehi et al. (2020) found in their study that different definitions of digital health emphasize the change in the provision of healthcare services and the health of patients more than purely technological perspectives.

2.2.2. A brief history of the digitalization of healthcare in Finland

The digitalization of healthcare has been a long process in Finland, and the road to digital healthcare has proven to be challenging. New technology has disrupted and changed the processes by which healthcare services are designed and delivered. Still, at the same time, the development has been remarkably fluctuating and subject to several political and economic forces (Kauhanen et al., 2012). Although digitization has made significant strides, the overall picture of digital health is still fragmented (Larsio, 2017).

The first steps in the digitalization of healthcare were already taken in the 1960s when the spread of information technology created new opportunities for maintaining and enhancing organizational operations. At that time, most digitization activities were aimed at improving healthcare administration tasks, such as payroll and financial administration, reporting and personnel management, while activities focused on patient care remained mainly less exposed to the effects of technology (Larsio, 2017).

In the early 1990s, attention shifted towards managing and controlling healthcare costs, which led to an increase in evaluating treatment practices and recording outputs. Although automation efforts were absent, structured data recording laid the groundwork for subsequent healthcare information systems. The emergence of personal computers and the internet during the early-to-middle 1990s spurred the development of care and service processes, streamlining operations, and creating various text entities and hierarchies. As departmental systems became more prevalent, the need to transfer information between these systems grew, prompting the development of information transmission between organizations. While mobile phones were in experimental stages, the need for mobile applications was not significant (Jääskeläinen, 2004; Larsio, 2017; Reponen et al, 2021).

In the mid-to-late 1990s, electronic patient records, regional databases, data sharing, and data protection gained traction. This period also marked the decision to establish seamless care chains involving citizens and patients as active participants. Notably, policies like virtual offices and personal data ownership held significant importance during this era (Jääskeläinen, 2004; Larsio, 2017; Reponen et al, 2021).

In the early 2000s, the Makropilotti project aimed to create seamless service chains by leveraging technology. This initiative led to the launch of a national health project in 2002 with the goal of making electronic medical records available by 2007. From the mid-to-late 2000s, the focus shifted toward full implementation of electronic patient records, led by The Social Insurance Institution of Finland (KELA). Furthermore, data protection issues gained

prominence, prompting tightened legislation to enhance data security. The Health Level 7 data transfer standard was introduced, and healthcare information system providers updated their software to meet technological developments. Investments were focused on electronic document archiving rather than information systems for operational activities (Larsio, 2017; Reponen et al, 2021).

During the 2010s, the digitalization of healthcare was strongly reflected in the development of shared infrastructure. Early in the decade, the national health archive, known as the Kanta system, was launched. This initiative facilitated digital service provisioning for diverse healthcare stakeholders, encompassing citizens, pharmacies, and health and social care providers. Among the Kanta system's digital advancements was the establishment of an electronic patient data repository. This innovation allowed healthcare providers in Finland to access patient data generated across various healthcare interactions. Moreover, the introduction of the MyKanta portal (OmaKanta) empowered Finnish citizens to review their electronic patient records and prescription details. This feat was achieved by transitioning traditional paper prescriptions into electronic format over the course of the decade. While consumerism and citizen engagement in healthcare services gained momentum, the actual services offered did not consistently align with these ideals. A majority of digital offerings directed at citizens primarily focused on health-related information dissemination or catered to specific customer segments. Notable digital services developed during this era included features like electronic prescription renewals, virtual hospitals, digital symptom and service need assessments, and electronic maternity cards (Larsio, 2017; Reponen et al, 2021).

Figure 1 illustrates the key phases of the digitalization of Finnish healthcare.

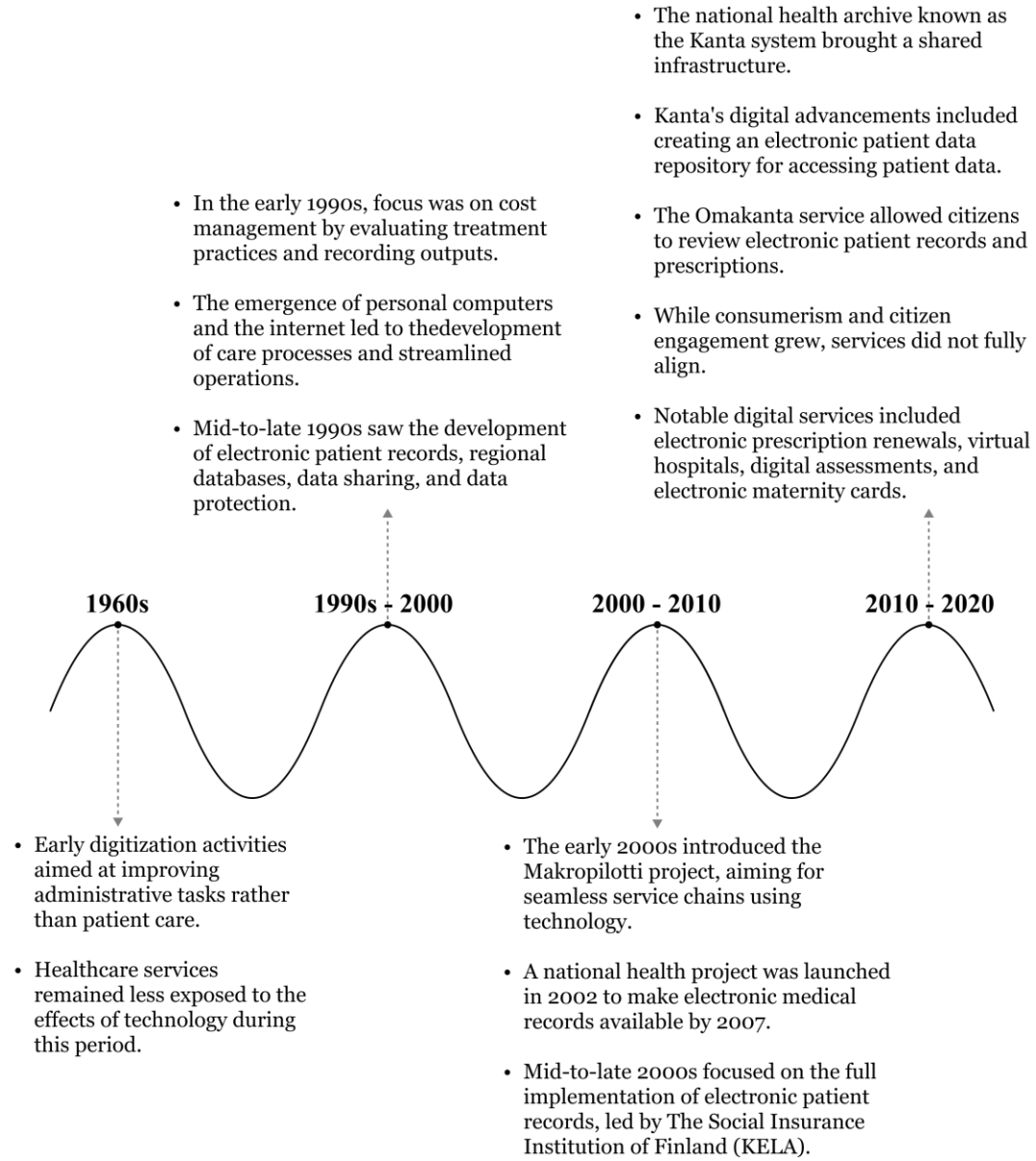

Figure 1. The key phases of the digitalization of Finnish healthcare. Adapted from Jääskeläinen (2004); Kauhanen et al. (2012); Larsio (2017); Reponen et al. (2021).

2.2.3. Digital health and patient-centered integrated care

Digitally induced patient-centered integrated care. In the Finnish healthcare system, digital health is more prominent today than ever. While the strategic visions from 1996 aimed at fostering patient-centered service chains persist in guiding current initiatives, the conditions for digital breakthroughs have significantly improved (Reponen et al., 2021). Technological progress has paved the way for pioneering digital health solutions, and the widespread use of digital services in various domains has elevated societal readiness, fostering favorable conditions for the broader

adoption of digital healthcare services as well (STM, 2016; Reponen et al., 2021). By considering progress in both of these domains, digital advancements have opened up avenues for healthcare services to transition into a progressively patient-centered integrated model, in which patients, healthcare professionals, and other stakeholders collaborate to co-create shared value within the multifaceted healthcare system (Aghdam et al., 2020; STM, 2016).

Connecting key healthcare stakeholders via digital health applications and platforms has been considered to laying the groundwork for patient-centered integrated care (Shah et al., 2022). Mobile technology and applications have revolutionized data generation, supported health interventions, facilitated diagnoses, and managed health outcomes. Shared platforms and electronic health records promote care integration by allowing various stakeholders to access vital information and share it in real time. Telemedicine services enhance care accessibility by enabling communication between patients and healthcare providers irrespective of location and time. Remote monitoring equips healthcare professionals with patient health information beyond the clinic and encourages patients to take proactive steps to maintain and improve their health (Gross et al., 2021; Shah et al., 2022). Hence, technology has the potential to facilitate a holistic perspective on an individual's health and well-being, provide pertinent information in the management of their care processes, and thus establish a more seamless and connected healthcare system.

Yet, evidence on the impact of digital health technologies remains limited to date, and there is a need to focus more on understanding the interconnected nature of digital health and patient-integrated care (Gross et al., 2021). In response to this pressing need, Leijten et al. (2018), on behalf of the European Commission, have developed a conceptual framework for evaluating patient-centered integrated care programs among multi-morbidity individuals (Figure 2).

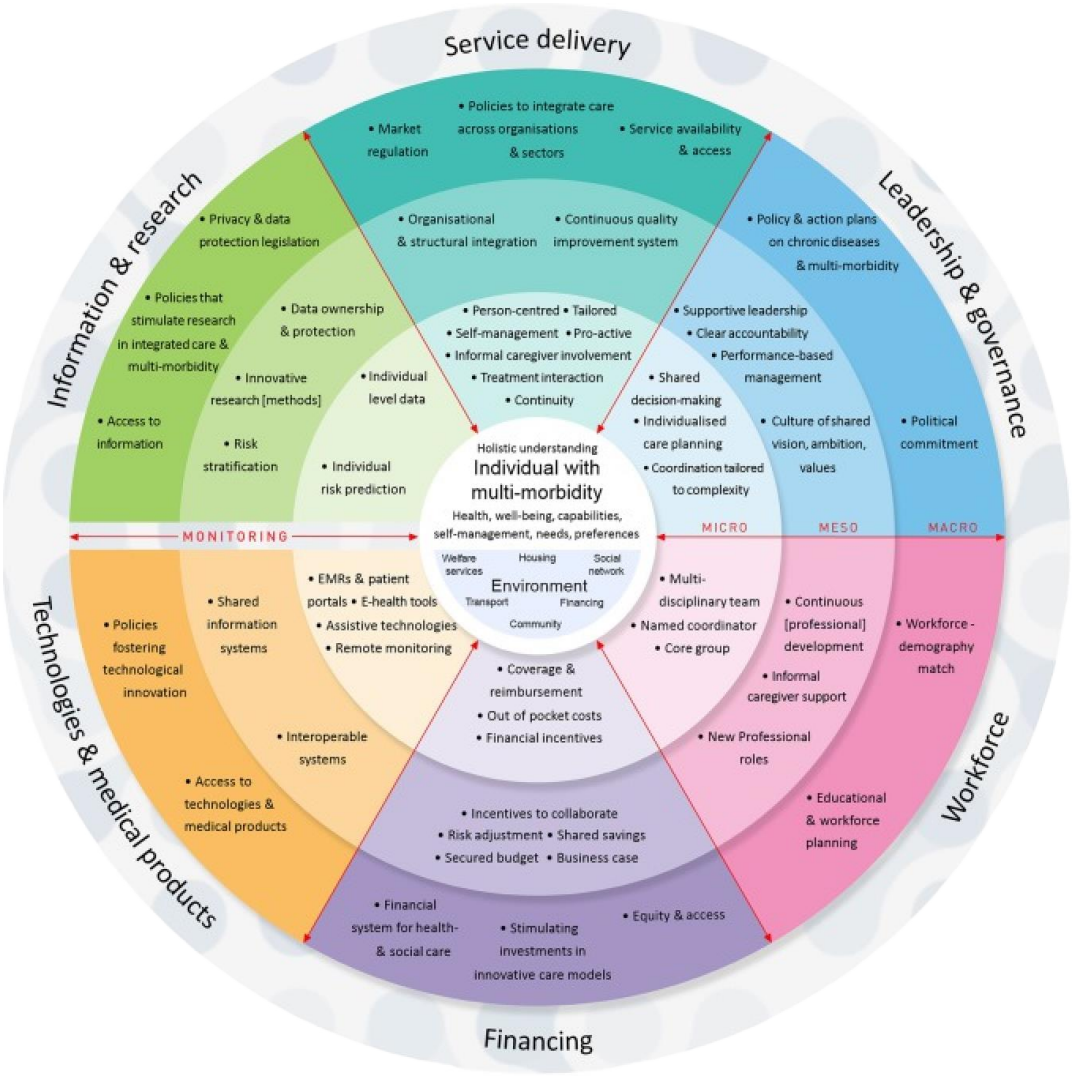

Figure 2. A Framework for patient-centered integrated care (Leijten et al., 2018).

As illustrated in Figure 2, the framework comprises six interconnected components that collectively provide a holistic view of the micro, meso, and macro-level factors of the networked environment of patient-centered integrated healthcare. Notably, the framework emphasizes the need for the adoption of novel technologies to enhance and support the delivery and planning of care in the shared healthcare ecosystem. Leijten et al. (2018) argue that technologies can foster closer collaboration among stakeholders, enable proactive response to changes in patients' health status, provide support for patients coping in their living environment, and facilitate evidence-based interventions through the collection of patient health data. Consequently, the value generation between digital technologies and patient-centered integrated care results from the collaborative efforts of multiple stakeholders seeking to enhance health outcomes across the entire continuum of care (Leijten et al., 2018). As mentioned previously, similar

attributes are also associated with the value generation of digital health (Győrffy et al., 2020), indicating clear synergies between the two concepts.

Digital health ecosystems in patient-centered integrated care. The ever-increasing and interconnected digital world has brought about conditions that promote the process of value co-creation. According to Kohtamäki et al. (2021), value co-creation is a collaborative endeavor among actors within a shared ecosystem. Such ecosystems enable the interaction and sharing of resources between various network actors, leading to the creation of mutual value. Technology has played a significant role in changing the way networks are established, allowing the formation of digital ecosystems that act as intermediaries in the value co-creation process (Vargo & Lusch, 2015). In a complex healthcare environment, the importance of digital health ecosystems that integrate various healthcare actors and allow the exchange of resources has been emphasized (WHO, 2021). Nonetheless, empirical research concerning this realm remains relatively limited today (Dinsmore, 2021).

Ruokolainen et al. (2023) propose that digital ecosystems are increasingly essential for increasing innovativeness and value creation in the healthcare sector. Digital ecosystems are often characterized by their modular and flexible nature in which several independent actors are interconnected through a technological intermediary. Indeed, digital ecosystems are rarely considered as fixed systems but rather as modular structures built on top of several subsystems that enable complementary value-adding services to be brought together (Blaschke et al., 2019). Since the purpose of patient-centered integrated care is to facilitate collaboration between different stakeholders by creating seamless and personalized care paths, the surrounding technological system should allow for services to be removed, added, and adapted to the prevailing and changing individual needs of relevant actors (Ruokolainen et al., 2023). Consequently, increasing the flexibility, modularity, and user orientation of the digital ecosystem has been recognized as one of the key strategic information management guidelines for the healthcare sector in Finland (STM, 2016).

However, ecosystems often extend beyond technological issues and form socio-technical phenomena wherein diverse actors serve both members of the ecosystem and contributors of resources. These actors possess distinct resources to offer the ecosystem and have varying needs and expectations about what belonging to the ecosystem should serve (Blaschke et al., 2019). Adner (2016) suggest that the discourse on digital ecosystems can be understood from two complementary perspectives. The first perspective is the ecosystem-as-affiliation, which aims to balance the accessibility of the ecosystem to obtain new resources when required and the need to stabilize

actors, interfaces, and activities to maintain collaboration and value creation. The second perspective is the ecosystem-as-structure, which highlights the importance of a value proposition as the foundation for creating activities that support mutual value creation. Thus, the ecosystem is considered to be built around the central value proposition rather than a central firm (Adner 2016).

Given that healthcare encompasses multiple stakeholders, including patients, healthcare professionals, private and public service providers, and other external actors, the demands of these stakeholders on the healthcare ecosystem and the resources they contribute also vary. Instead of concentrating solely on the technological aspects of a central system, the digital health ecosystem should prioritize the value proposition and resource exchange that ecosystem participation affords its diverse actors (Ruokolainen et al., 2023). Ultimately, the core value of the digital health ecosystem is determined by its ability to diversify health services and enhance their accessibility for patients, enable value co-creation among ecosystem members through resource exchange, and improve the efficiency and quality of care delivery (Győrffy et al., 2020; Ruokolainen et al., 2023).

Blended care pathways in digitalized patient-centered integrated care. Despite the nascent development of digital health ecosystems, digital advancements have brought about novel services that facilitate patient-centered integrated care within the contemporary healthcare environment. These services not only transform traditional care procedures but also generate complementary value-adding functionalities by establishing digital touchpoints for patient engagement and interaction (Győrffy et al., 2020; Roberts & Roberts, 2021). Valentine et al. (2020) describe the integration of digital and physical touchpoints as a blended care model, which allows harnessing the potential to leverage the evidence-based characteristics of each modality while surpassing their individual effectiveness. This integration serves to bridge the gap between online and offline care and reflect more seamless, integrated, and patient-centered care pathways (Toonders et al., 2021; Valentine et al., 2020).

Hägglund et al. (2022) and Reponen et al. (2021) illustrate the evolving landscape of healthcare delivery, where physical services have been progressively augmented and partially substituted by digital services. Within this paradigm, patients traverse between digital and physical dimensions throughout various stages of their care journeys. For instance, patients can self-evaluate their symptoms and assess the need for care via digital solutions, communicate with healthcare professionals via chat and video services, and access online self-care materials and instructions to help maintain their health beyond clinical settings.

Furthermore, Tuomikoski et al. (2022) examined the impact of digital care paths designed for specialized medical care in Finland. Their findings underscored the substantial influence of transitioning from physical to digital channels on the nature of healthcare tasks and operational workflows. The digital treatment path spans the entire patient journey, with tasks and functions related to treatment, monitoring, and guidance partially transferred from traditional channels to digital means. The integration of diverse digital communication channels, remote receptions, and electronic collection of patients' health information across different stages of care holds the potential to imbue healthcare services with a patient-centric orientation. This transformation enhances patients' engagement in decision-making while optimizing operational processes through the efficient allocation of healthcare professionals' time and interventions to the right needs in a timely manner.

Similarly, multiple studies have demonstrated that the utilization of digital care paths and patient portals can result in heightened work efficiency among healthcare professionals, enhanced collaboration, improved comprehension of patient health status, increased patient participation and dedication to their care, and more economically efficient delivery of healthcare services (Avdagovska et al., 2020; Das et al., 2015; Laukka et al., 2020).

Data as a shared resource in digitalized patient-centered integrated care. The proliferation of digital tools has brought to the fore the use of patient-generated health data (PGHD) in healthcare. The essence of PGHD revolves around enabling healthcare stakeholders to access the substantial repository of real-world data generated by patients. Enabled by novel technologies and consumer devices, patients can now collect information about physiological measurements like blood pressure, heart rate, and oxygen saturation, along with broader indicators of well-being such as social information, physical activity, sleep quality, and nutrition. This wealth of data has the potential to enrich the existing knowledge base and unveil novel insights into the health of patients (Demiris et al., 2019; Liu & Panagiotakos, 2022).

The patient-centric nature of PGHD stems from the consensus that patients are the primary entities responsible for collecting and storing information about their health and well-being, and for deciding with whom to share it and how it can be used for different purposes. Consequently, patients are being granted increased control and responsibility for managing their health. This involvement can engage them more actively in care by generating information that amplifies their influence within the care process (Demiris et al., 2019). Hult et al. (2019) characterize this patient-centric

transformation as "flipped healthcare," where the generation of health-related information is no longer solely dependent on the measurements and procedures performed by healthcare professionals. Instead, patients assume the role of care co-creators by contributing resources that benefit various stakeholders throughout the healthcare system.

Enhancing patients' participation in their care processes, for example, by allowing them to populate medical records and share health-related information does not imply that healthcare professionals should abdicate control over patients. Stewart et al. (2000) point out that a common misconception about patient-centered integrated care is that it involves ceding medical decision-making authority to patients or obligating healthcare professionals to fulfill every desire of patients. Just as increased data sharing can bolster patient empowerment in care, the integration of health information from diverse internal and external healthcare sources can furnish healthcare professionals with the insights needed to steer decision-making (Demiris et al., 2019).

Leijten et al. (2018) suggest integrating real-world data into care processes can enhance the collaboration between patients and healthcare professionals. Information about a patient's health status can assist healthcare professionals in gaining a deeper understanding of necessary interventions and devising optimal care strategies, thus facilitating the provision of more personalized and integrated care for patients. Incorporating such information into clear and visually comprehensible dashboards, interactive patient personas, defined alerts, and recommendations can boost healthcare professionals' ability to proactively respond to changes in patient's health at different care stages while simultaneously facilitating a more individualized and cost-effective targeting of interventions (Aalto University, 2022; Demiris et al., 2019; Holch et al., 2017; Turk et al., 2022). Although there is a dearth of information regarding the long-term advantages of PGHD, studies have indicated that the use of patient-generated health data has yielded positive outcomes in the management of several conditions, such as cancer, asthma, and diabetes care (Demiris et al., 2019).

2.2.4. Obstacles to the broader adoption of digital health

Despite its revolutionary potential, the underlying value of digital health remains largely untapped (D'Anza & Pronovost, 2022). Maier et al. (2021) present that the intricate and multifaceted healthcare environment poses a multitude of challenges to the broader adoption of digital services and solutions within the healthcare sector. Drawing insights from existing

literature, these challenges can be broadly categorized into three distinct groups.

Medical and regulatory factors. Medical and regulatory factors pertain to the unique attributes of the healthcare environment. The prevailing paradigm in the healthcare sector centers on robust clinical evidence, underscoring the significance of informed decision-making and patient safety. However, many companies have encountered challenges in clinically substantiating that their digital approaches can yield positive impacts on patients' health. While some pilot programs have showcased the effectiveness of these solutions in their early stages, such trials have often been conducted under specific conditions, and cannot be readily implementable within a standard healthcare delivery system (Maier et al., 2021).

Demonstrating clinical efficacy is also a pivotal requirement for digital health solutions due to regulatory considerations. The healthcare sector is inherently characterized by a stringent regulation, leading to an arduous path for solution validation that often spans several years (Maier et al., 2021). Nevertheless, a notable gap still exists in the availability of comprehensive and agile frameworks and ecosystems designed to assess the usefulness, clinical, and safety criteria of solutions. For instance, the first European-level quality standard for mobile applications was only established in 2021, and various entities are currently developing evaluation methodologies, such as Finland's Digi-HTA method (Reponen et al., 2021). This dearth of standardized frameworks has resulted in a fragmented landscape of evaluation methods, and navigating the regulatory complexity has generated frustration among digital health technology companies accustomed to agile and fast-paced development cycles (Mathews et al., 2019).

The absence of frameworks and ecosystems has also presented significant challenges in formulating sustainable business models around digital health solutions. Demonstrating clinical efficacy and ensuring patient safety is not only essential for convincing the medical community but also for seeking reimbursement for the use of solutions for health-improving purposes (Mathews et al., 2019). For instance, in Germany, a reimbursement procedure for digital health solutions has been introduced, enabling their cost coverage through the health insurance system. However, a similar system has yet to be established in Finland, despite ongoing studies on the subject (Reponen et al., 2021). Without reimbursement for the solutions, patients are unlikely to be inclined to pay the full cost out-of-pocket, and physicians may be hesitant to recommend their use to patients, as reimbursement has been shown to significantly influence physicians' decisions when selecting appropriate treatment options (Ruotsalainen et al.,

2021). This intricate interplay between clinical validation, reimbursement, and patient interest forms a complex dynamic that influences the viability of business models in the digital health domain.

Human factors. Human factors encompass individuals' capabilities, acceptance, and perceptions of digital health utilization. Despite the generally favorable readiness for adopting digital services in Finland, Pirhonen et al. (2020) have revealed notable disparities among various user groups in assimilation to the digital era. This issue assumes particular significance among older age groups as they constitute the most considerable consumer demographic for healthcare services, where limitations in their digital capabilities and the adequacy of available support resources can impede the broader integration of digital health solutions. Additionally, Sormunen et al. (2021) have found that one-fourth of Finnish university students encounter challenges in assessing the reliability of digital information. Such deficiencies in the capacity to process digital data or insufficient skills in utilizing digital devices can potentially pose hurdles in implementing digital health solutions and deriving accurate interpretations of the information they generate.

Recent research has placed considerable emphasis on healthcare professionals' attitudes towards digital health. While the prevailing sentiment in Finland generally reflects positivity, with healthcare professionals displaying openness to the adoption of digital health technologies, a significant proportion has also conveyed reservations and uncertainty concerning the integration of these technologies into their daily clinical practices. Challenges may arise when digital solutions necessitate specialized device knowledge, are integrated into patient care processes, or when traditional healthcare approaches are augmented or replaced by digital technologies (Jarva et al., 2022). Additionally, research conducted by Adjekum et al. (2018) has underscored that the absence of clinical evidence and demonstrated effectiveness in digital health solutions has prompted concerns among healthcare professionals regarding the quality of digital information and the reliability of service providers, which further highlights the aforementioned barriers caused by the medical and regulatory factors.

One argument, whether justified or not, suggests that medicine, as a field, can be relatively conservative and resistant to embracing new initiatives and change (Petrakaki et al., 2014). This perspective is understandable, considering that physicians and other healthcare professionals are highly educated experts accustomed to making decisions based on their gathered expertise. However, this resistance to change can impede the adoption of technological innovations within the healthcare sector. For example, in a study conducted by Turja et al. (2018), it was found that healthcare

professionals in Finland exhibited more cautious attitudes toward using robotics in medicine compared to the general population. This cautiousness was partly attributed to concerns about the potential loss of responsiveness, human touch, and attentiveness in patient care. Nevertheless, in light of the above discussion, it can be argued that resistance to change may also play a role in shaping these attitudes.

Extensive prior research has demonstrated that the implementation of digital health services reshapes the dynamics between healthcare professionals and patients, necessitating healthcare providers to acquire novel skills in response to evolving patient needs and a changing environment. Among these competencies, healthcare professionals must be proficient in tailoring digital health solutions to diverse situations and patient requirements, effectively communicating through digital channels, and seamlessly integrating digital and physical realms at various stages of the patient care journey (Jarva et al., 2022). Győrffy et al. (2020) show that in the era of digital healthcare, patients proficient in digital technologies are growingly conscious of the significance of monitoring and managing their health through digital tools. This shift necessitates a fresh paradigm in the patient-physician relationship, one characterized by collaboration, inclusivity, and a pursuit of mutual goals. They labeled the term e-physicians to describe the next generation of physicians who adeptly integrate digital health solutions into their daily practice and have cultivated the necessary competencies to cater to the needs of such digitally oriented patients.

Technological factors. Lastly, a significant barrier to the widespread adoption of digital health lies within the technology itself. In contemporary healthcare settings, professionals encounter a multitude of IT-based systems designed to assist or enable practicing their profession. Paradoxically, these systems often suffer from inadequate integration into the surrounding operations and processes. While stand-alone systems may yield success within a limited context, they frequently falter when deployed in a complex broader multi-stakeholder environment, leading to inflexible, unintegrated, and non-user-centric outcomes (Borell, 2016, pp. 36–41). The repercussions of subpar integration typically manifest as significant demotivating factors in the adoption of digital health solutions, leading to frustration, increased work-related stress, and a reluctance to utilize these solutions (Borell, 2016, pp. 36–41; Kaipio et al., 2015; Safi et al., 2018). For example, a study by the Finnish Medical Association (2021) revealed that more than half of approximately 4,600 surveyed Finnish physicians believed that information systems did not adequately support the smooth execution of routine tasks. Additionally, less than a fifth of the respondents felt that these systems effectively facilitated the flow of information within organizations, and only

a third believed that they contributed to the seamless implementation of telemedicine services.

While various factors contribute to subpar integration, one primary issue is the insufficient design of solutions. As previously mentioned, the healthcare environment is characterized by its multiple stakeholder environment, necessitating the consideration of various perspectives in technology design. However, a disconnect has persisted between developers and users of digital health solutions, with much of the design process occurring in isolation and lacking significant user input (Solomon & Rudin, 2020). Borell (2016, pp. 36–41) argues that the root of the problem may not be in the design process itself, as systems often meet their intended specifications, but rather in the analysis of system requirements. Therefore, the digital health landscape could greatly benefit from enhanced multidisciplinary collaboration between healthcare professionals and solution engineers (Kostkova, 2015). This collaboration is especially crucial given that the user experience of solutions emerges as the paramount success factor in digital health, even surpassing perceived health benefits (Choueiri et al., 2020).

Finally, as healthcare continues its digital transformation, there is a corresponding surge in the volume of data within healthcare systems. Recent estimates suggest that as much as 30% of global data volume is generated by the healthcare sector. This data encompasses patient demographics, medical encounters, diagnoses, laboratory tests, post-therapy care, and various documents, all contributing to this growing pool of information. Nevertheless, the proliferation of data brings about challenges regarding its integration with current systems and its conversion into actionable insights (Gopal et al., 2018). Shah et al. (2022) argue that a significant challenge today is the fragmentation of patient data across various healthcare databases and systems. The dispersion of data prevents the seamless tracking of a patient's journey in different healthcare touchpoints, obstructing the ability to follow patients longitudinally and impeding timely interventions in response to early signs of disease or deterioration. Furthermore, in some cases, the data influx may result in increased manual work for healthcare professionals (Safi et al., 2018) and incur additional costs associated with establishing a secure data storage and processing environment compliant with data protection regulations (Kostkova, 2015).

Table 2 provides a summary of the identified obstacles and hindrances in the adoption of digital health.

Table 2. Identified obstacles and hindrances in the adoption of digital health (Adjekum et al., 2018; Borell, 2016, pp. 36–41; Choueiri et al., 2020; Gopal et al., 2018; Jarva et al., 2022; Kostkova, 2015; Maier et al., 2021; Mathews et al., 2019; Petrakaki et al, 2014; Pirhonen et al., 2020; Reponen et al., 2021; Safi et al., 2018; Shah et al., 2022; Solomon & Rudin, 2020; Sormunen et al., 2021; Turja et al., 2018).

Identified barriers	
Medical and regulatory factors	• Lack of clinical evidence, efficacy, and safety • Strict and inflexible regulation • Lack of unified frameworks and ecosystems for evaluating solutions • Reimbursement and cost allocation
Human factors	• Inadequate skills and capabilities • Concerns about the quality, efficacy, and security of solutions • Conservatism and resistance to change
Technological factors	• Poor integration and design of solutions • Siloed design process and lack of user-centeredness • Volatility, variety, and protection of data • Siloed data across various healthcare databases and systems • Increased manual workload

2.3 Theory of affordance

This thesis utilizes affordance theory to examine physicians' perceptions of the future potential of digital health in fostering patient-centered and integrated healthcare. Affordance theory originates from the work of ecological psychologist James J. Gibson, aiming to explain how and why humans interact with objects in their environment (Volkoff & Strong, 2017). Gibson's original premise posits that humans decide to interact with objects in their environment based on their perceptions of what those objects can offer rather than merely responding to the set of features inherent to the objects and independent of the individuals involved (Alshawmar, 2021). However, the term 'object' should not be limited to its material and physical attributes in this context. Instead of emphasizing their materiality and physical properties, objects are defined in this thesis as a combination of

different components linked to the concept of digital health (see section 2.2.1), acting as technical mediators in the value creation and delivery process of digital health.

Evans et al. (2016) argue that the definition of affordance, described as potentials for action, encompasses a multidimensional structure of the relationship between objects and users. Consequently, there is not a single approach to addressing affordance theory. Instead, its content is dynamic and contingent on factors such as the users in question, the materiality of objects, and the contextual environment where the object-user relationship occurs. Therefore, the affordance theory can be seen as complementing the previous discussion around digital health by providing a framework to study how physicians perceive the potentials of digital health and which factors affect the realization of these potentials without going too much into the details of one particular technology.

2.3.1. Backdrop of affordances

Since its inception, affordance theory has sparked debates among multiple researchers, each offering a slightly different ontological perspective. According to Volkoff and Strong (2017), three primary orientations have enriched the discourse and contributed to a better understanding of the concept of affordances. Turvey (1992) emphasized that affordances are dispositional properties of objects, which are relative to the actor's capabilities for realization. This perspective introduced the dimension of the actor's knowledge and skills to the theory. Stoffregen (2003) argued that affordances do not inherently reside within objects or actors but rather emerge from the relationship between these two systems. The actor system refers to the skills and capabilities of the actor, while the object system describes the features and functionalities of objects. Lastly, Chemero (2003) expanded on the previous views by suggesting that the emergence of affordances is influenced by the surrounding environment in which actors and objects are situated. Therefore, the opportunities and barriers within the environment impact the affordances that arise in the interaction between actors and objects.

Consider a fictional situation of reading a book as an illustrative example of affordance theory and the previously mentioned views. A book provides a literate adult with the opportunity to read without the need to consciously assess the book's properties, such as the letter size, font weight, or paper material. However, the book does not offer the same affordance of 'reading' to an illiterate toddler who may use it as a means to reach a table. Furthermore, if the book's features or the surrounding environment change, the affordance of 'reading' may no longer be available to the adult. For

example, if the font is too small or there is insufficient light to see the pages. Nonetheless, the affordance of reading exists whether the adult can see the pages or not. It emerges in the interaction between the adult and the book.

2.3.2. The two plus one prevailing schools of thought in the information systems context

While the discussion about the underlying nature of affordance has continued, affordance theory has concurrently found applications in the field of information technology. Two predominant schools of thought have adopted the theory in slightly different ways (Alshawmar, 2021).

The first school. The first school has adopted Gibson's view, according to which users evaluate IT objects in the light of what they perceive these objects can afford to them. In other words, users decide to interact with the objects after they have perceived what they can achieve by using them. As a result, objects' value and usefulness are determined by perceptions of what they can be used for rather than by their features and design (Alshawmar, 2021). Volkoff and Strong (2017) emphasize that affordances emerge from the interaction between users and objects, and features should not be confused with affordances. Technical objects do not possess inherent affordances but are formed in relation to goal-oriented users. However, this relational nature implies that features act as mediators, enabling affordances to manifest. Affordances become apparent when goal-oriented users interact with the features of technology (Markus & Silver, 2008). Therefore, affordances are potentials of use, or as Strong et al. (2014, p. 69) define it: *"The potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors."*

Furthermore, Strong et al. (2014) distinguish three distinct processes within affordance theory: 1) affordance itself (the potentials of use for goal-oriented actors), 2) the actualization of affordance (the actions taken), and 3) immediate concrete outcomes (the results of those actions). For example, using an IT system may reveal an affordance of 'monitoring,' but when this affordance is actualized, it leads to an immediate concrete goal of 'visibility' (Volkoff & Strong, 2017). Affordances can also be nested and bundled, and more sophisticated affordances often emerge from the actualization of simpler ones (Strong et al., 2014). Building on the previous example, the affordance of 'monitoring' may result from actualizing the simpler affordance of 'inputting data.' Therefore, affordances can not only be nested but also actualized at different times or consecutively (Volkoff & Strong, 2017).

Another interesting characteristic of affordances is that they can be enabling and constraining. This was made clear by Zammuto et al. (2007, p. 752) who stated that: "*an affordance perspective recognizes how the materiality of an object favors, shapes, or invites, and at the same time constraints, a set of specific uses.*" In their study on the impact of technology on organizational change, Zammuto et al. (2007) demonstrated that the social context can influence how individuals utilize IT tools within an organization, triggering common affordances that enable some while limiting others. Volkoff and Strong (2017) further elaborated that triggering an affordance may even enable and constrain the same individual. For instance, an individual using an enterprise system to record daily activities required for payroll may find that the affordance of 'recording' simultaneously enables transparency and constrains the ability to hide non-work-related activities.

Finally, as recognized in the early days of affordance theory (see Chemero, 2003; Stoffregen, 2003), the first school of thought also acknowledges that affordances are shaped by the capabilities and skills of the actor, as well as external factors specific to the environment, such as rules, regulations, legislation, culture, and social forces (Sittig & Singh, 2010). Since actors may possess different capabilities and interact with the same IT objects in diverse settings and contexts, each actor may perceive different affordances, which may not align with others' perceptions (Alshawmar, 2021).

The second school. The views of the second school have been deeply influenced by Norman's (1999) understanding of affordance theory. As opposed to the first school, which emphasizes the underlying generative mechanisms and action possibilities of affordances (Volkoff & Strong, 2017), the second school focuses more on the visible features of the objects that could indicate their canonical use (Chong & Proctor, 2019). Therefore, the second school's views on affordances have been adopted predominantly in the field of design and human-computer interaction (Lanamäki et al., 2016).

Similar to the first school, the second school acknowledges that affordances are relational, depending on both objects' properties and users' capabilities (Masoudi et al., 2019). However, Norman (1999) diverged from Gibson's views, arguing that an individual's perception can influence affordances. He categorized affordances into two types: real and perceived. Real affordances occur when users perceive that IT objects offer action possibilities, and the objects deliver on those possibilities. In contrast, perceived affordances are recognized by users but not necessarily fulfilled by IT objects. For instance, Norman (1999) explained that a touch-sensitive display affords users the ability to click on it, and the display responds as a real affordance. However, all displays allow touching, even if they do not respond, which represents a

perceived affordance. Nevertheless, whether perceived or real, such properties can still be considered affordances.

One helpful way to distinguish between the two schools is that the first school sees affordances as more related to the usefulness of objects, while the second school emphasizes their usability (McGrenere & Ho, 2000). The focus of the first school is, therefore, on the potential actions that emerge in the relationship between users and objects — what could be achieved by using the objects — rather than on the details of these actions or the technology, as seen by the latter (Volkoff & Strong, 2017). An important difference, as pointed out by Lanamäki et al. (2016), is that the second school believes affordances can be embedded in IT objects by designers rather than emerging in the interaction between users and objects. In theory, all the affordances of particular objects should be listable in advance by designers, and no new affordances should arise from the use of the objects, which contradicts the first school's perspective. Additionally, since affordances can be embedded in advance, designers tend to view users as imaginary characters living in their imagination during the design process, in contrast to the actual users in the first school's view (Lanamäki et al., 2016). Therefore, there is a contextual difference — the second school decontextualizes the environment, while the first school examines users in a specific context.

Table 3 illustrates the main similarities and differences between the views of these two schools of affordance theory.

Table 3. The main similarities and differences of the two schools of thought of affordance theory. Reproduced and adapted from Lanamäki et al. (2006, p. 128).

	The first school	**The second school**
Definition of affordance	Action possibilities	Actual and perceived properties
Relational ontology	Relation between IT objects and actual users	Relation between designer, IT objects, and imaginary users
Origin	Affordances arise from the interaction between the users and the IT objects	Designers design and embed the affordances into the IT objects
The existence of affordance	Exist independently of whether the users perceive them or not	Perceived properties that may exist or not
Who names	Users	Designers

Who receives	Actual users	Imagined or actual users
Expiration of affordances	Do not expire but are either actualized or not	Do not expire but are either actualized or not
Affecting it	Capabilities of the users and external factors	Capabilities of the users and external factors
Relates to	Usefulness of the IT objects	Usability of the IT objects

Potential affordances. Finally, Lanamäki et al. (2016) argue the prevailing stance in IS research, referred to as potential affordances, seeks to reconcile these two perspectives. This stance acknowledges that affordances can arise both from user interactions with IT objects and the embedment by designers. Designers can embed affordances within IT objects by considering imaginary users, but when actual users interact with the objects, unforeseen affordances may emerge. The existence of affordances is driven by a combination of technological functionalities, user goals, and needs, and they manifest in the dynamic interplay between these elements. Consequently, affordances persist independently of users' immediate perceptions, but to acquire significance, they require users to possess the intention and capability to actualize them.

Alshawmar (2021) points out that the existence of affordances cannot be determined until there is some level of human-object interaction. In a complex and intertwined environment, constant interaction occurs between objects and individuals. Even designers must interact with objects to some extent before being able to identify the affordances resulting from this interaction. For example, the affordance of 'sitting,' emerging from the interaction between a chair and users, was only discovered when the first designer interacted with a tree and realized that, if crafted correctly, people could sit on it. However, this does not contradict Lanamäki et al.'s (2016) notion that designers can embed affordances in objects. It simply underscores the need for some degree of interaction between designers and objects before any affordances can be determined. Additionally, Alshawmar (2021) also acknowledges that new and unforeseen affordances can arise from the interaction between users and objects, which is in line with notions presented by Lanamäki et al., (2016).

Otherwise, the stance of potential affordances shares the same fundamental assumptions as the preceding schools. Users' abilities and external factors, such as policies, procedures, culture, and regulations, exert an influence on the user-object interaction and, ultimately, on the emergence and realization of affordances. Importantly, affordances are not bound by expiration;

instead, they either materialize or fail to do so, contingent upon users' assessment of the congruence between the design and functionalities of the IT objects and their skills and preferences. Following actualization, users evaluate the outcome, based on which adjustments can be made to the factors that enable the emergence of affordances (Alshawmar, 2021; Lanamäki et al., 2016; Strong et al., 2014).

One noteworthy ontological question for this thesis is whether affordances are always associated with existing IT objects or if they can be perceived through imaginary interactions with the objects (Alshawmar, 2021). According to Volkoff and Strong (2017), only something that can be realized or actualized should be referred to as an affordance. Users' imaginary uses of IT objects do not give rise to affordances; instead, these represent possibilities for use. Therefore, if one is researching the types of affordances that can be identified in the future use of these objects, it might be more appropriate to use the term 'potential for use' instead of 'affordance.'

The formation of affordances by the stance of potential affordances is depicted in Figure 3. As delineated in Figure 3, affordances emerge from the dynamic interaction between goal-oriented actors and the material properties of the technology. Notably, actors' decisions to engage with technology are not driven by the features of the technology but by the latent potential it holds for achieving immediate, concrete objectives. This process is subject to external factors, encompassing policies, procedures, cultural norms, and regulatory frameworks. These external factors can either facilitate or impede the interaction, thereby shaping the formation and realization of affordances.

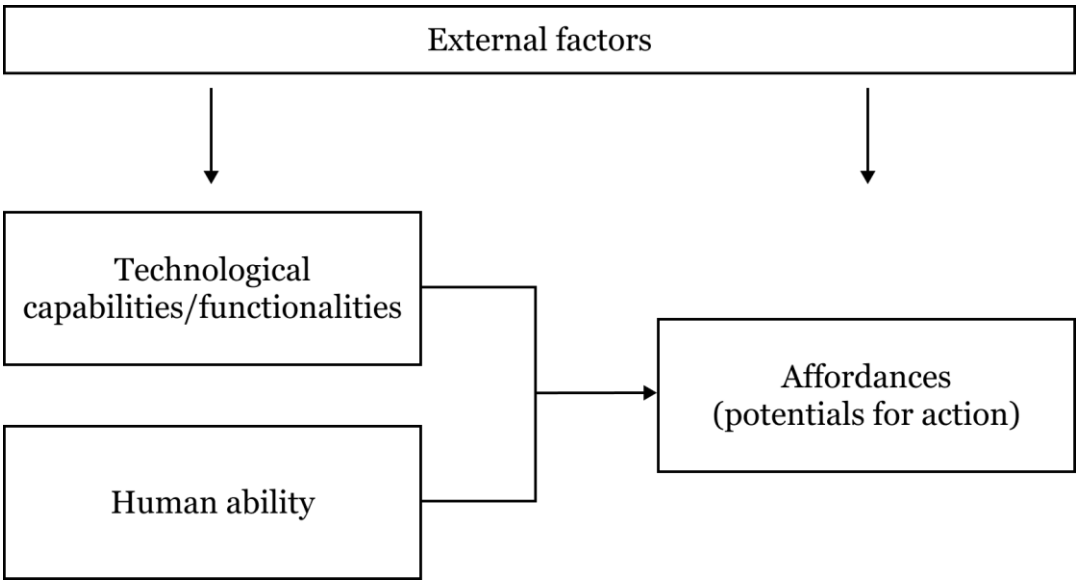

Figure 3. The formation of affordances by the stance of potential affordances. Reproduced and adapted from Lanamäki et al., 2016, p. 138).

Among the various schools of affordance theory, the potential affordances approach offers a comprehensive framework, making it beneficial for examining affordance formation in the complex landscape of physician-digital health interactions in this thesis. Volkoff and Strong (2017) illustrate that exploring potential affordances serves as a common starting point for design science researchers who aim to comprehend the desired usage possibilities of objects and how they can be improved to better align with the envisioned future needs of users. Hence, adopting the potential affordances stance appears to be a fitting strategy for exploring future potential uses of digital health and formulating a vision that reflects physicians' needs in the transition to a digitalized patient-centered integrated future of healthcare.

Nevertheless, the primary focus of this thesis centers on the identification of affordances associated with the concept of digital health. As previously highlighted, while technology indeed assumes a pivotal role within the realm of digital health, it often functions solely as a conduit for delivering health-promoting behaviors (Petrakaki et al., 2014). Consequently, rather than focusing on the intricacies of a single technology, emphasis is placed on higher-level technological properties that facilitate the formation of higher-level affordances. According to Volkoff and Strong (2017), the appropriate level of analysis is determined by the granularity of the phenomenon under examination and its associated properties. In cases where the phenomenon exhibits an abstract nature, a higher level of granularity is deemed more suitable. In line with this rationale, the selected level of granularity for this thesis surpasses what would conventionally be employed to analyze a single

digital health technology. This decision aligns with the goal of identifying higher-level affordances within the broader context of digital health.

2.3.3. Affordances in the digitalized healthcare

Despite the significant impact of affordance theory on IT research, its application to digital health has received limited attention. Current research has mainly focused on identifying affordances related to specific technologies like electronic patient records (Petrakaki et al., 2014; Strong et al., 2014) or a bundle of traditional healthcare systems consisting of lab systems, radiology systems, and medication systems (Bygstad & Bergquist, 2018). However, there has been relatively less emphasis on understanding the affordances of digital health at a conceptual level, which may be due to its lesser direct practical relevance compared to the already implemented services and technologies (Volkoff & Strong, 2017). Furthermore, researching potential future affordances, particularly in the context of patient-centered integrated care and digital health, seems to have received even less attention.

Nonetheless, research studies have demonstrated that the implementation of digital health technologies into healthcare practice can provide positive affordances and generate tangible value for multiple stakeholders in the ecosystem. Such value is often derived from improved interconnectedness and interaction among different stakeholders (Strong et al., 2014). For instance, a study by Bygstad and Bergquist (2018) shows that a bundle of digital health solutions can transform service delivery towards a more patient-centered model by reorganizing the technical environment around the provision of care to better meet the needs of patients throughout their care journeys. This approach results in improved resource optimization and care coordination, a more seamless flow of patients within healthcare services, and better care outcomes due to the more targeted care plans.

In a similar vein, Strong et al. (2014) demonstrated that digital technologies have the potential to instigate systemic changes by enhancing the operational processes within healthcare organizations and the delivery of healthcare services. The affordances that arise from the interaction between healthcare professionals and electronic patient records encompass various benefits, including the coordination of patient care across different providers, the integration of comprehensive information into clinical decision-making, and seamless access to patient data throughout healthcare organizations. These affordances have the potential to enhance the quality of patient care, expedite care delivery, and optimize resource allocation for appropriate interventions.

Moreover, the affordances that arise from digital technologies in the healthcare context can also be linked to broader cultural and institutional changes. The incorporation of technology affects many activities within healthcare organizations, necessitating a re-evaluation of how these activities are organized (Petrakaki et al., 2014). For instance, Petrakaki et al. (2014) demonstrate how the introduction of electronic health records has transformed decision-making by enabling healthcare professionals to rely less on abstract knowledge and more on the information embodied in digital systems. Such digitally produced and provided information can afford healthcare professionals legible clinical notes and requests, fast information exchange, and instant access to patient data, including diagnoses, procedures, and test results. However, the change in the work afforded by digital systems can result in operational changes and require new perspectives on the role of technology in healthcare service provision and organizational workflow.

3 Methodology and analysis

3.1 A designer's perspective on research

This research employs a speculative design perspective as its overarching epistemological lens. Speculative design is a component of critical design practice, which seeks to foster discussion and propel thinking on the potential trajectories of the future. It is important to note that speculative design is not a theoretical framework but a mindset for speculating, integrating, and communicating the societal impacts of complex phenomena. Designers who adopt a speculative design mindset engage in a process of re-thinking alternative futures and speculating on how various forces can shape existing products, services, and systems. Consequently, the speculative design also reflects the complexity of the contemporary world and facilitates a more profound understanding of the current state of affairs (Mitrović, 2015).

Although speculative design is frequently linked to the creation of utopian or dystopian visions of the future, it can also operate within the parameters of the real world. According to Mitrović (2015), design researchers can adopt a speculative design position to explore potential future trends, such as how the adoption of emerging technology may impact the prevailing status quo. By engaging in speculation, researchers seek to expand the range of possibilities for what the future world(s) could look like. Rather than predicting the future(s), the objective is to facilitate critical discussion by providing a nuanced perspective on potential societal changes (Dunne & Raby, 2013). Often, this is achieved by creating scenarios that encompass probable, plausible, possible, and preferable futures (Figure 4).

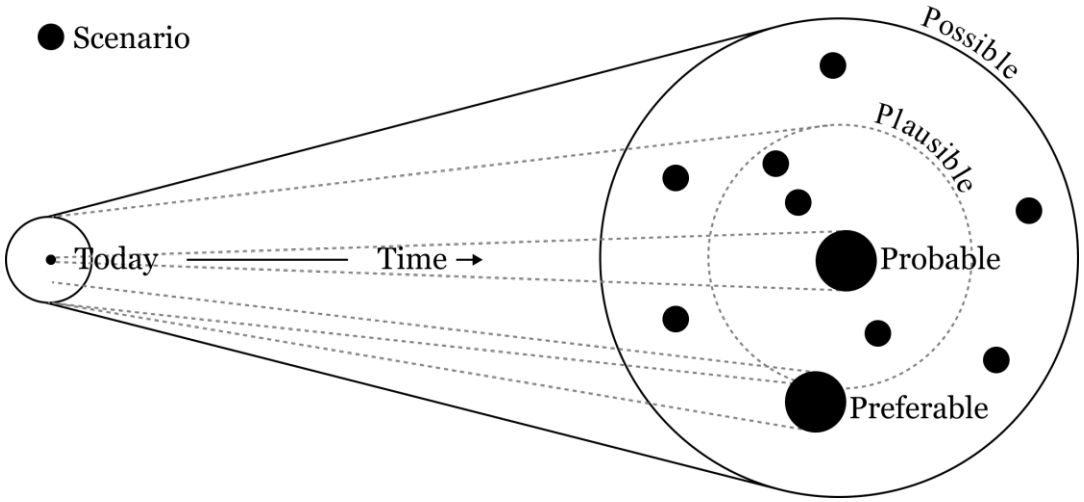

Figure 4. A diagram of potential futures (PPPP) in the future cone. Reproduced and adapted from Mitrović (2015, p. 18).

As shown in Figure 4, the time perspective of speculative design originates from the present moment and envisions the consequences of the phenomenon being examined in the future by employing four distinct Ps. *Possible futures* encompass all conceivable scenarios that may manifest in the future. Possible futures are not predictions; instead, they represent a repertoire of scientifically realistic alternatives that serve as a medium to provoke thoughts and discussion about how radically the future can unfold. *The probable future* represents what is likely to happen in light of current developments unless some extreme force, such as a technological revolution, alters the course of the future. Moving on to the next circle, *plausible futures* present a narrower scope than possible futures and establish a connection with the present world by providing feasible depictions of achievable futures. In the intersection of the probable and the plausible lies the concept of *the preferable future*, which delineates a desired future from the viewpoint of specific actors. This desired future may not necessarily align with a Pareto-optimal scenario but may prioritize, for example, certain groups, communities, or industries, contingent upon whose perspective is being considered (Dunne & Raby, 2013).

In this thesis, speculative design is used to synthesize empirical findings, providing insights into the transition of digital health from its current state to a preferable future for a specific group of physicians who were purposefully selected based on their expertise and experience in the field. By illustrating the process of transition, the thesis offers a nuanced understanding of the needs, expectations, and aspirations of these physicians, contributing to the development of a more patient-centered integrated future of digitalized healthcare. It should be noted that, owing to the length constraints of the thesis, only the preferable future as perceived by the selected physicians is examined, and not all of the future scenarios mentioned in Figure 4 are included.

As the objective of this thesis is to comprehend the underlying mechanisms of digital health in the transition of healthcare from the current state to the preferable future as envisioned by the interviewed physicians, the research encompasses two distinct temporal states: the present and the future. According to Volkoff and Strong (2017), the affordance theory provides an excellent approach to examining the relationship between technology and users in the present state and understanding how potential affordances can shape future realities. Indeed, the affordance theory is commonly employed in future studies to establish scenarios of possible future states (Ostern & Rosemann 2021; Volkoff & Strong, 2017). Therefore, the connection between affordance theory and speculative design is undeniably synergistic. By investigating the potential affordances that emerge from the transition from

the current to the future state, we can enhance our comprehension of intricate phenomena, such as the impacts of digital health, and design solutions and systems that better fulfill the desired requirements of the relevant stakeholders (Volkoff & Strong, 2017).

3.2 Grounded theory

In this study, I selected grounded theory as the methodology to collect, synthesize, and develop a theoretical comprehension of the future vision of digitally induced patient-centered integrated care. As previously mentioned, the affordance theory has mainly been used to explore potentials for action arising from the interaction between a particular technology and its users. Therefore, its applicability in studying the concept of digital health, as opposed to a specific technology, is still a subject of debate. To address this challenge, grounded theory appeared to be a suitable abductive methodology, as it permits the generation of new theories from comparatively less explored and novel subjects (Charmaz, 2006).

Both grounded theory and affordance theory are founded upon shared assumptions regarding the intricate nature of the world and emphasize understanding the complexity of the phenomena under investigation rather than pursuing straightforward, linear explanations (Corbin & Strauss, 2008; Volkoff & Strong, 2017). Thus, the grounded theory seemed to provide synergies with affordance theory in endeavoring to elucidate the underlying observations of physicians' perceptions regarding the current and future state of digitalized healthcare. Previously, Strong et al. (2014) have successfully incorporated grounded theory methodology with affordance theory in investigating the affordances emerging from the interaction between physicians and electronic health records.

At the beginning of the research, I had a clear vision that I wanted to study the phenomenon of digital health. Despite this, the actual research problem was loosely defined. The central tenet of the grounded theory is that theory emerges through an iterative and non-linear process, in which the researcher makes observations from the collected data to explain the phenomenon under investigation. During the process, the theory gradually crystallizes, and the research problem becomes more concrete. Due to its process-like nature, the grounded theory is not a single theoretical framework against which research results are mirrored. Rather than deductively testing and verifying previous theoretical assumptions, the concepts that emerge during the process of observation guide the development of a new hypothesis and/or theory related to the studied topic. Hence, the grounded theory attempts to bridge the gap between research and theory (Charmaz, 2006).

Like all theories, grounded theory has been subject to various schools of thought over time, each approaching the theory from different theoretical, philosophical, and practical perspectives (Corbin & Strauss, 2008). The current discourse surrounding grounded theory has predominantly been shaped by its two founders, Barney Glaser and Anselm Strauss, who adopted somewhat different approaches to the theory in their later works (Charmaz, 2006). Regarding this thesis, the differences between the two approaches are chiefly linked to the researcher's role throughout the research process. Advocates of the Glaserian approach emphasize that the researcher must not acquaint themselves with the literature concerning the research topic beforehand to preserve a neutral stance toward the collected findings. Conversely, the Straussian school emphasizes that the researcher has a personal attachment to the subject being researched, and therefore, it is permissible to scrutinize the literature about it throughout the distinct stages of the research (Howard-Payne, 2015). Despite these differences, both schools of thought acknowledge that the theory emerges from the researcher's conception during the research process (Charmaz, 2006).

Due to my prior involvement in digital health and my personal interest in following the topic, the methodology employed in this thesis leans more toward the Straussian approach. While grounded theory emphasizes the researcher's independence from pre-existing theories (Corbin & Strauss, 2008), the decision to incorporate affordance theory as a secondary framework in this work is based on its capacity to identify potentials for action, represented as affordances. Furthermore, as previously stated, the scope of this thesis extends beyond affordance theory's original purpose of studying a single technology, as it seeks to comprehend the broader phenomenon of digital health. Therefore, affordance theory is also utilized in a novel capacity, informed by the observations made during the application of grounded theory.

According to Charmaz (2006), the fundamental principles of grounded theory rely on sequential methods that act as a roadmap for the research process. Nonetheless, these methods do not always maintain a consistent order or a linear progression. Given the cyclical nature of the research phenomenon and the process itself, the methods employed may differ from one study to another, and the researcher may revisit previously used methods to enhance earlier observations. Therefore, these methods function more as guiding instruments for the analysis than rules that must be precisely adhered to (Charmaz, 2006). In this thesis, the following grounded theory-based methods were used to collect and analyze data and to build a conceptual theory from observed findings: 1) simultaneous data collection and analysis, 2) coding and grouping the data, 3) memo-writing, and 4) theoretical sampling, saturation, and sorting.

3.3 Simultaneous data collection and analysis

Simultaneous data collection and analysis were conducted using the selected grounded theory methods (Figure 5). These methods were divided into distinct yet complementary and iterative phases. During the interviews, the findings were coded and analyzed simultaneously, in which case, the emerging themes and categories guided the refinement of subsequent interviews. Figure 5 outlines the different stages of data collection and analysis in accordance with grounded theory.

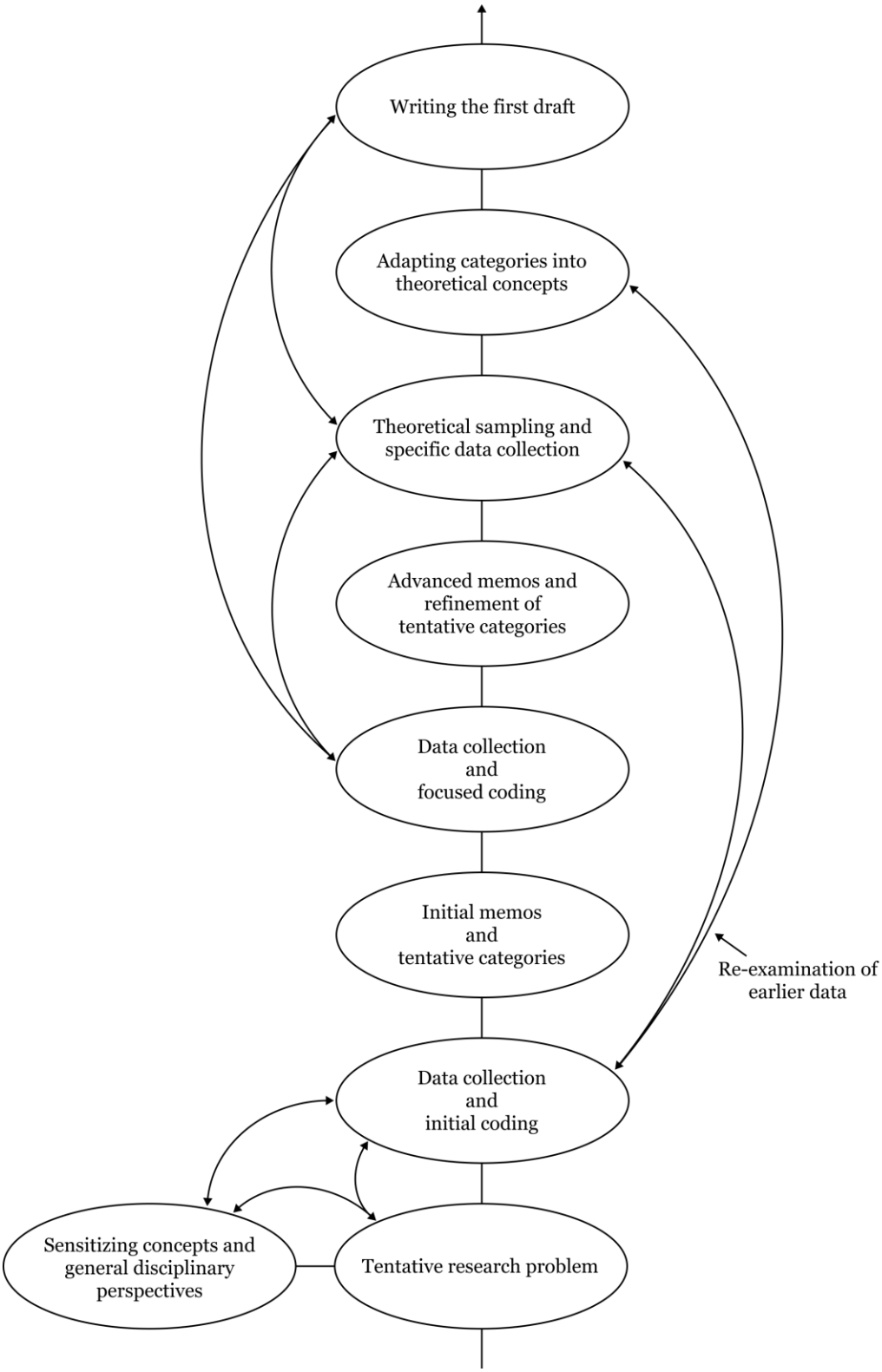

Figure 5. The process of grounded theory. Reproduced and adapted from Charmaz (2006, p. 11).

At the outset, the research was focused purely on technological factors, leading to the development of the preliminary research question and interview structure. However, as the research progressed, it became evident that a purely technological perspective was insufficient, and the approach shifted towards a more socio-technical viewpoint. Additionally, when the study encompassed the entire concept of digital health rather than a single technology or digital service, the original technological focus expanded to the broader theme of creating shared value through mutual participation. The initial streams identified through the literature: the closer integration of digital and physical healthcare, ecosystem thinking, integrated healthcare, networking effects, patient-driven and -oriented care, and data-based decision-making, guided the development of interview questions and provided the lens of starting the analytical review of the gathered data.

3.3.1. Timetable and starting position

The research process started in August 2022 with the development of a preliminary research topic, a research plan, and a review of the literature related to digital health. As mentioned earlier, it was apparent from the beginning of the research process that an iterative approach would be required to clarify and refine the research structure and question. Seven to twelve months were reserved for the research process, which included simultaneous data collection and analysis, in-depth coding of findings, literature review, writing, and finalization of the thesis. As the research was conducted alongside full-time work commitments, the schedule was adjusted at any given time to accommodate the current workload. See Figure 6 below for a further description of the timetable.

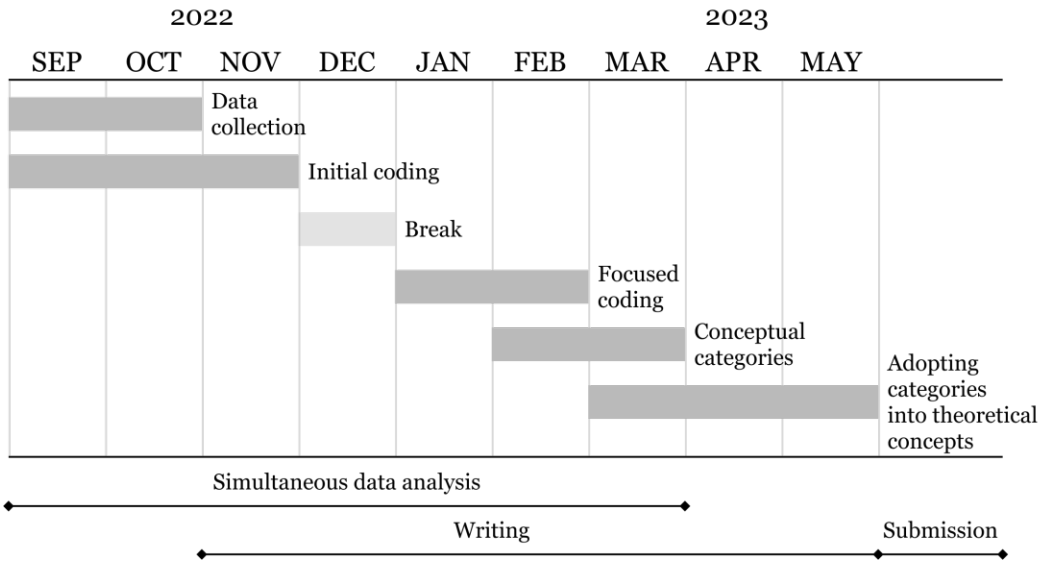

Figure 6. The timetable of the master's thesis.

3.3.2. Setting and participants

The study was centered on addressing the phenomenon of digital health in the context of Finland. As such, licensed physicians in Finland were chosen as the study's target group. The research aimed to gather practical perspectives and experiences related to the current and future states of digital health. To achieve this objective, the participating physicians were required to possess some degree of knowledge and user experience in digital health and its associated tools gained through clinical or other practical work. Therefore, the individuals referred to as e-physicians were deemed appropriate participants. Such individuals currently use or have previously used digital health and associated technologies in their daily work, thereby possessing a practical understanding of the phenomenon and factors influencing it (Győrffy et al., 2020).

The potential participants in the study were identified using predetermined criteria related to the research topic. This identification process involved scrutinizing online publications, activities, and presence, from various Internet sources, forums, and communities. Participants were then contacted by email and asked to indicate their willingness to participate in the study. The videophone software Microsoft Teams was selected as the platform for conducting the interviews, as such software has proven to be a useful and reliable tool for collecting data in qualitative interviews (Archibald et al., 2019). Each interview was recorded with the consent of the interviewees for later analysis.

3.3.3. Data collection through semi-structured interviews

Given that the research topic, digitalized patient-centered integrated healthcare, is a relatively novel and developing phenomenon, semi-structured interviews were deemed as the suitable method for data collection. Semi-structured interviews typically consist of a flexible interview protocol that can be supplemented with follow-up questions, comments, and probes that arise during the interview. Semi-structured interviews possess flexibility, facilitating a reciprocal exchange between the researcher and the participant, thus providing favorable circumstances for a thorough and multi-dimensional investigation of the subject matter. Consequently, the method permits the collection of open-ended data that reflects the participant's personal perspectives, emotions, and convictions regarding the researched topic, enabling the researcher to comprehend the world as it is perceived and constructed by people's experiences and beliefs (DeJonckheere & Vaughn, 2019).

Grounded theory constitutes a process in which data are molded, analyzed, and redefined to provide a comprehensive understanding of the interviewees' experiences and opinions. This approach allows for the revision and improvement of interview questions to accurately reflect the emerging themes and insights from previous interviews, facilitating a dynamic interpretation of the collected data. This technique emphasizes the simultaneous nature of data collection and analysis, forming the foundation of grounded theory (Charmaz, 2006).

Since the research problem was loosely defined at the outset of the research process, the final number of interviewees was not predetermined but primarily depended on the saturation of the research material. This flexibility in data collection and analysis aligns well with the techniques of grounded theory and semi-structured interviews (Charmaz, 2006; DeJonckheere & Vaughn, 2019). Ultimately, data for the study were gathered from ten physicians who were interviewed between September and October 2022. Refer to Table 4 for further details.

Table 4. Table of research participants.

Physician	Domain	Length of occupation	Length of the interview
A	General practitioner	Short	49:06
B	General practitioner	Middle	1:00:08
C	Specialist	Long	54:32
D	Specialist	Long	59:17
E	Specialist	Middle	32:32
F	Specialist	Long	55:51
G	General practitioner	Long	52:29
H	Specialist	Middle	35:03
I	Specialist	Middle	46:42
J	Specialist	Long	54:23

As previously stated, the interviews were not conducted according to a standardized framework. Instead, the structure of the interviews was adjusted based on the outcomes of prior interviews. Participants were prompted to provide a comprehensive description of the current state and future perspectives of digital health by reflecting on its impact on healthcare operations, patient and physician roles, decision-making, and technological prerequisites, among other things. The objective of the interviews was for physicians to contemplate their individual experiences while I, as the interviewer, assumed the role of a listener and observer, encouraging candid and thorough discussion.

The initial interviews were utilized as a preliminary method to become familiar with the topic of digital health. The aim of these interviews was twofold: to verify pre-existing assumptions regarding the subject and to identify overarching themes interwoven with the phenomenon. The early interviews promptly revealed that an exclusively technological approach was inadequate and irrelevant in addressing the subject matter. This realization facilitated a shift in perspective towards a more socio-technical standpoint. The discovery was pivotal as it emphasized themes, such as changes in the healthcare ecosystem, information exchange, and the provision and delivery of healthcare services, which were repeatedly expressed by physicians in subsequent interviews.

After collecting and analyzing data from the initial interviews, I modified the interview questions for the mid-stage interviews. The revision included reducing question details and emphasizing open-ended questions, aligning with the grounded theory methodology (Charmaz, 2006). Furthermore, when contacting the physicians for the mid-stage interviews, I provided them with advanced information regarding the questions and the themes that emerged from the first interviews. This approach was selected because digital health is a vast concept, and the first interviews demonstrated that each interviewee had slightly different perspectives on the topic. The mid-stage interviews uncovered that while the interviewees were physicians, the theme of digital health was frequently intertwined with the patients' perspectives. As such, emerging themes included changes in patients' roles, activities, and involvement.

The final interviews were primarily geared toward clarifying the observations made during the preceding interviews. At this stage, I made slight modifications to the interview questions, encouraging more extensive discussions on the pre-emerged themes. This approach facilitated a more in-depth exploration of various perspectives concerning the present and future states of digital health. Additionally, during the final interviews, I noted that

the topics discussed were reaching a point of saturation, and thus the collected data was deemed sufficient. Although the last interviews primarily verified previous findings, they provided fresh insights, such as the closer integration of digital and physical healthcare and the seamless movement of patients between digital and physical care.

The standard structure of the interviews can be found in the appendix at the end of this paper (Attachment 1).

3.3.4. Coding and categorizing the data

The ten interviews were transcribed, resulting in approximately 80 pages of raw data, after which the analysis continued with the coding and categorization of the interview data. Data coding and categorization represent the analytical phase in grounded theory, involving the examination of collected material from multiple perspectives to derive an analytical theory grounded in the data (Charmaz, 2006). It is important to note that coding and data collection occurred concurrently and were not separate phases during the interview process. As per Charmaz (2006), coding is an experiential learning process in which the researcher gains insights into the interviewees' perspectives and situations by scrutinizing the data.

The data coding and categorization process consists of two main steps:

1. **Initial coding:** This step involves examining lines, segments, and incidences of data to identify their analytical significance.
2. **Focused coding:** In this step, the most important codes are synthesized into broader themes, forming the basis for the analytical theory (Charmaz, 2006).

Initial coding. During the initial coding phase, the theoretical possibilities embedded in the data remain open. Nevertheless, the objective is to identify fundamental categories that elucidate the meaning and expressions of the data from each respondent's perspective. These categories are subsequently organized into coherent and integrated groupings. In the initial coding phase, the text is promptly examined, and codes are compared against each other to uncover cohesive elements while considering their significance regarding the phenomenon under investigation (Charmaz, 2006).

A line-by-line coding approach was employed in this study to analyze interviews transcribed into text format. Each line was assessed separately, with a focus on extracting their relevance to the study. It is pertinent to note that not every line contributes to the subject of interest (Charmaz, 2006), and therefore, the text was refined and condensed to extract the essential content.

This open coding process aimed to facilitate a comprehensive understanding of the digital health phenomenon, leading to the discovery of new research perspectives and directions. Ultimately, individual codes were grouped into broader themes, from which focused codes were derived.

Furthermore, during the initial coding phase, the data collected from interviews was analyzed using constant comparative methods. These methods involve comparing the collected information to each other and the researcher's perceptions of the topic in order to identify recurring patterns and themes (Charmaz, 2006). In this thesis, constant comparison served as a means of connecting my prior observations and knowledge about digital health to the gathered data. Confirming and validating my preconceptions related to the topic through the interview data allowed me to better understand the perspectives and experiences of the physicians, leading to new insights into the multifaceted effects of digital health.

Focused coding. After the initial coding process, the next phase involved focused coding. This approach entails a deeper and more conceptual analysis of the codes compared to line-by-line scrutiny. During this phase, any indications of broader themes that emerged during the initial coding were organized into segments, allowing for an assessment of their adequacy and size in drawing analytical conclusions. Nevertheless, the identified codes were kept open and closely tied to the data, enabling the discovery of new thematic directions and subsegments (Charmaz, 2006).

The research employed the axial coding method for focused coding, which involves identifying similarities and differences between various categories or segments (Charmaz, 2006). The purpose of axial coding is to define the characteristics and dimensions of each category by synthesizing and organizing individual codes formed during open coding into larger entities (Charmaz, 2006).

This study's axial coding method was based on the data structuring model introduced by Gioia et al. (2012), where codes are initially divided into first-order concepts, then second-order themes, and ultimately aggregated dimensions. In this study, each dimension comprised approximately two to four themes, further subdivided into 10–15 individual codes. The final aggregated dimensions served as the study's framework, establishing the primary categories upon which the analysis was based.

The themes of the formed dimensions were: 1) from a single system to a modular ecosystem, 2) from data silos to consolidated insights, and 3) from isolated to integrated care paths, which are discussed in detail in Chapter 4.2. Consequently, the focused coding was consistent with grounded theory

methodology (Charmaz, 2006). Figure 7 displays the coding structure based on Gioia et al.'s (2012) approach. Note that Figure 7 portrays a cross-sectional view of the coded data, consequently excluding part of the material encompassed within the study.

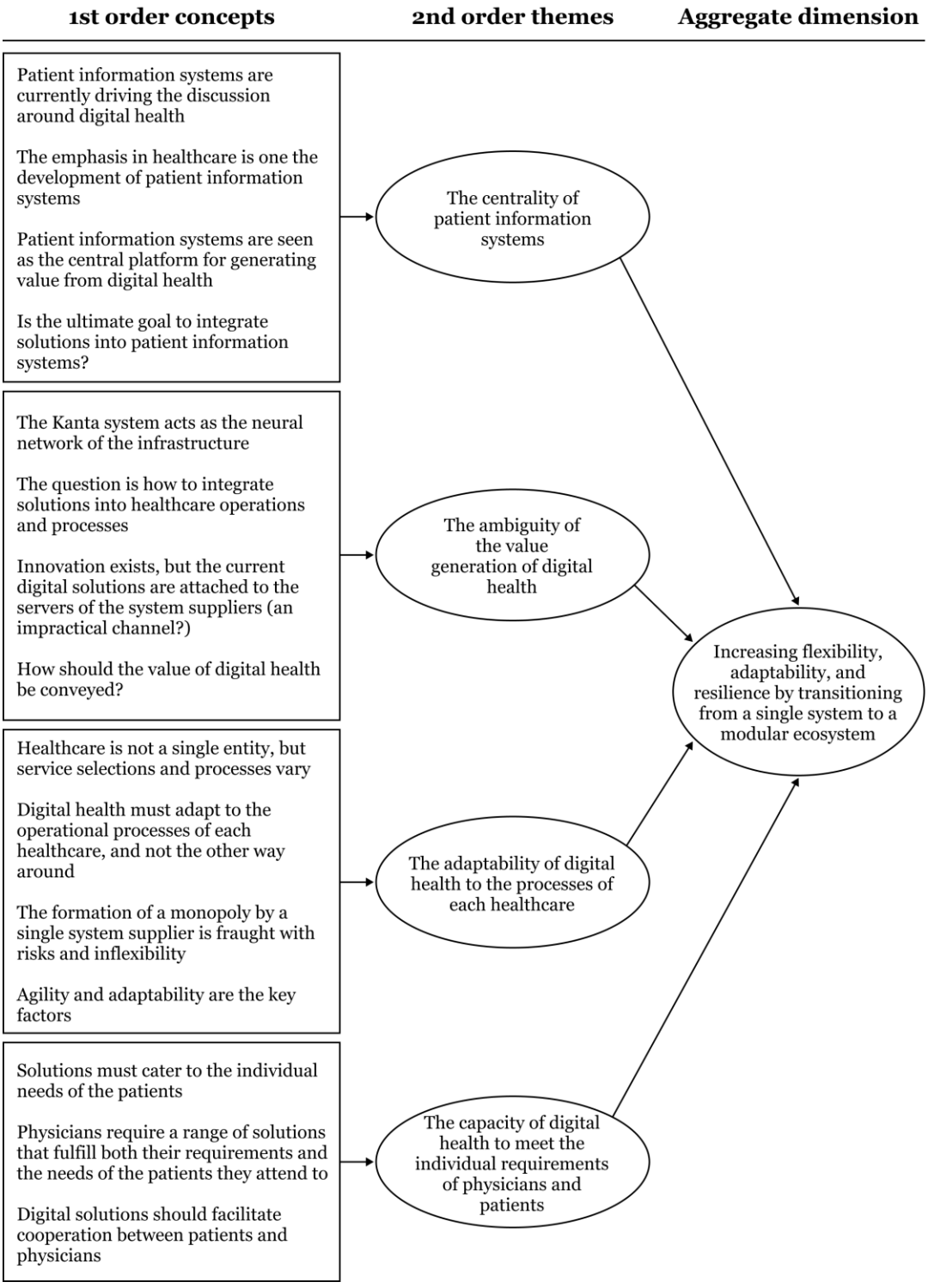

Figure 7. Coding of collected data. Based on the method by Gioia et al. (2012).

3.3.5. Memo-writing

Memo-writing is a pivotal step in grounded theory, serving as a tool to facilitate the analysis of empirical data by recording ideas and thoughts and forming connections between different chunks of data. Similar to other phases in grounded theory, memo-writing is a continuous process that spans the entire research process. The notes are valuable when comparing the formed observations, from the initial data to the final categories, facilitating the conversion of abstract material into more concrete concepts (Charmaz, 2006).

Memo-writing played a crucial role in this study as it enabled the recording of ideas and thoughts that arose during the different stages of the research. The notes were primarily made in electronic form, using a phone or a computer, for ease of access and the ability to supplement them from anywhere. In addition to capturing thoughts and ideas, the notes also included questions and gaps that needed to be addressed through the collected data from the interviews. Consequently, the notes served as a guide throughout the entire research process, from ideation to completion.

3.3.6. Theoretical sampling, saturation, and sorting

The scientific process of grounded theory consists of three sequential activities: *theoretical sampling, saturation, and sorting* (Charmaz, 2006). The first step, *theoretical sampling*, involves an examination of the observations collected from the original data. This process allows for the determination of the representativeness and sufficiency of the observations in forming higher hierarchical categories. The sampling techniques enable the researcher to refine categories by gathering more information about any gaps, establishing an analytical basis for the research and a direction for the research process. During the second phase, *theoretical saturation*, the categories become fully developed. At this stage, no additional data contributes to the further refinement of the categories and thus brings new insights into the research problem. In the last step, *theoretical sorting*, the researcher organizes the maturated categories into interrelated connections, allowing for analytical and logical chains to form between them.

These three activities were closely integrated throughout the research process. Data analysis and categorization began with the initial interviews, aiming to identify connections between observations. As categories emerged, any potential theoretical gaps were refined during subsequent interviews, as discussed in Section 3.3.3. The most significant discovery occurred when the research focus shifted from individual factors of digital health to encompass

the meta-level changes in healthcare service production and provision. This holistic perspective facilitated the identification of logical connections between distinct categories and the development of a narrative framework for the research's theoretical foundation. This holistic meta-level perspective guided the analytical process in the subsequent stages and informed the construction of the theoretical model/vision of the future.

4 Findings

4.1 The multi-threaded concept of digital health

All of the interviewed physicians had formed personal views and experiences regarding the concept of digital health through their current or previous medical work. Several interviewees had also engaged in training, research, and development within the field of digital health, either at a practical level in public or private healthcare facilities or at a broader societal level in various educational organizations and healthcare associations. Consequently, the personal experiences of physicians significantly influenced their perspectives on the concept of digital health, often manifesting concretely through the integration and utilization of diverse digital tools and services in their daily professional activities.

The ambiguity and continuity. Although all interviewees were familiar with the concept of digital health, several physicians found it challenging to provide an unambiguous definition of the term. The lack of a unified definition was often considered to result in varied interpretations of the concept, contingent on contextual factors such as the situation and the interpreter's motives in examining it.

> *"Digital health is a very broad concept, and these definitions vary a lot depending on the context in which they are considered. When reading different articles, it is always worth filtering a little and considering how each person sees the concept and what they mean by digital health. […] In such a new and developing field, there are as many definitions for the term as there are people who profile themselves as experts."*
>
> – Physician D, specialist

Several interviewees noted that terminology related to digital health often confuses due to the absence of a single authority providing a precise definition of its meaning and content. In general discussion, different terms are frequently used interchangeably, and even larger entities such as the WHO and the EU define digital health in slightly different ways. Nonetheless, it was generally perceived that digital health is a unifying concept that encompasses several related sub-concepts. For instance, many interviewees viewed eHealth as the most concrete term to describe the current state of healthcare digitization.

> *"I personally see that digital health is an umbrella term under which there are, for example, eHealth, which is a slightly narrower concept, and then its parallel term mHealth. I feel that digital health is perhaps even a bit broader*

than eHealth, which I am used to using. That is, in practice, these electronic healthcare services. Then there are other closely related concepts as well."

– Physician B, general practitioner

"We are probably talking more about eHealth than digital health in healthcare at the moment."

– Physician I, specialist

On the other hand, various sub-concepts, such as eHealth, can be seen as precursors to the emergence of the concept of digital health. The terminological framework of digital health has evolved over the years with the digitization of healthcare, but it has also been influenced by the increasing use of electronic services in other industries. As a result, the rise of digital technology in healthcare is not an isolated phenomenon; with the growing prevalence of digital services in other sectors, healthcare has had to adapt to meet the demands of the digital age.

"I have seen many terms used for this phenomenon during my career. In the 1990s, when digital telecommunication opened up completely new possibilities for data transmission, there was talk of telemedicine and telecare. […] In early 2000, e-services, e-commerce, and e-logistics were used in other industries. So, the idea arose that digitally provided services also concern healthcare, which formed the conceptual world in which we have been building this current environment. […] At the beginning of the 2000s, different concepts were put under eHealth, and in mid-2010, this concept of digital health where intelligent information and data processing was added to it. So, I see such a clear continuum here."

– Physician F, specialist

More about health-related actions than technology. While the terminology surrounding digital health is still evolving and interpretations of the concept vary depending on the source, physicians generally perceived that digital health refers more to health-related actions than to technology itself. Within this framework, the focus is on expanding and transforming the delivery of healthcare services. This is reflected, for example, in patients' ability to access and navigate healthcare services through various digital channels.

"I see that digital health covers all these health-related offerings through digital solutions, such as chats, video receptions, and others. I would also see it more broadly related to all patient guidance. For example, if you type HUS positive coronavirus test into Google, there is a lot of information on how to act and where to go. I feel that this is also that digitalization that supports health."

– Physician A, general practitioner

Furthermore, the aspects of accessibility and navigability can be interpreted as a convergence of digital and physical healthcare, wherein certain physical services and functions may be partially substituted or augmented with their digital counterparts. Patients may engage in various activities digitally or be transitioned between digital and physical healthcare for different stages of their care. Thereby highlighting the importance of patient engagement and the integration of the digital and physical domains.

> *"I see there is no such thing as digital healthcare or physical healthcare. It is more of a pathway where the patient can be guided in the right direction through different channel. For example, from chat to video reception or video reception to physical reception. The patient can participate in different stages by, for example, filling out electronic forms in advance, which again direct the patient in a certain direction."*
>
> – Physician C, specialist

Although digital solutions and applications play a vital role in facilitating and executing various digital activities in healthcare, some physicians noted that the discussion surrounding digital health tends to disproportionately concentrate on technology. The emphasis on technological intricacies may not invariably cater to the fundamental aspects of digital health, particularly its health-focused aspects. Consequently, physicians regarded digital health more as an ensemble of tools that empower them to accomplish a range of health-promoting activities rather than purely a consideration of technologies.

> *"I think artificial intelligence, for example, is a bit wrongly mixed with this digital health, which is about the use of these different digital tools in various health-related activities. Artificial intelligence is just one technology within this world of digital health and other related concepts."*
>
> – Physician J, specialist

> *"If you think about how physicians see digital health, they do not think of utilizing a specific technology but see it as a way to perform patient care and other health-related activities, such as some treatment or diagnostic procedure."*
>
> – Physician D, specialist

Data, the fuel of digital health. Physicians considered digital health to also be strongly intertwined with the effective collection and utilization of diverse data sources. Digital information was frequently referred to as the most concrete manifestation of how the various functions and activities of healthcare have moved from the physical world to digital space. Whether communicating with patients and healthcare professionals, utilizing various diagnostic tools, or monitoring patients' health status, the ability to store,

analyze, and share information via digital means emerged as a fundamental factor in physicians' reflections on the concept of digital health.

> *"At the end of the day, digital health is information that can be collected, numerically processed, and enables treatment to be monitored. […] What really seems to matter in the long run is this digital information and how it is processed and utilized."*
>
> – Physician G, general practitioner

Data was frequently deemed as the adhesive that binds together various healthcare stakeholders. With the advancement of digital technologies, information has evolved from an isolated resource into a shared resource. Improved availability and shareability of information have facilitated the emergence of digital health as a new opportunity to connect patients and healthcare service providers, resulting in a more uniform and cohesive digital healthcare field.

> *"The flow and manageability of information are central to this digital health. […] Nowadays, we can send things electronically between organizations, and with a few clicks, data can be transferred to different parties. The information can also be accessed from anywhere in Finland through the Kanta system. That is part of this digital health as well."*
>
> – Physician B, general practitioner

When data has brought about a more cohesive healthcare system, it has also affected the organization of health services. Emerging digital tools have provided novel avenues for collecting and utilizing information to directly address patients' health and opened new location-independent channels for the provision and consumption of care. Consequently, the processing and transmission of digital information have established the foundation for the broader dissemination of digital health and enabled the closer integration of digital and physical healthcare.

> *"Everything related to the transfer and processing of digital information is digital health. It can be directly related to client therapies that aim to influence the patient's health, but also indirectly to service processes in order to make them more efficient or bring about the desired change. […] Today, both patients and physicians increasingly use a variety of digital tools and digital channels to deliver and receive care."*
>
> – Physician E, specialist

4.2 From the status quo to the future vision

Physicians' perceptions of the current state of digital health were strongly connected to how they experienced the concept of digital health. Some

physicians saw the status quo on a social level, while for some, digital health was connected more as a change in the nature and structure of work. These differing views were also reflected in how they visualized the preferred future state of digitalized healthcare. However, three aggregated themes emerged during the interviews: 1) from a single system to a modular ecosystem, 2) from data silos to consolidated insights, and 3) from isolated to integrated care paths. All these themes described different aspects of digital health, which together formed a comprehensive picture of the transition from the current situation to the preferred future state of digitalized healthcare.

4.2.1. From a single system to a modular ecosystem

The status quo. The current digital healthcare ecosystem in Finland was seen in the eyes of interviewed physicians as the result of many rigorous efforts, where the evolution of digital health has taken place over the decades. Several physicians described the historical development of digital health as separate waves that have gradually created the readiness for the adoption of digital services in healthcare operations. During these different waves, new tools, communication methods, and ways of managing information have been added to healthcare processes, influencing how healthcare has gradually evolved into a digitalized environment.

One physician illustrated this change as a two-part process. During the first wave, the digitization of healthcare processes was mainly focused on general electrification activities, during which paper-based healthcare was slowly transformed into a digitalized one. These initial digitization efforts created new activities, the most visible of which was the transfer of patient data to information systems.

> *"The first wave of healthcare digitization was carried out from the early 90s until the 2010s, during which all new key patient data in public healthcare began to be embedded in information systems. No such information has been stored on paper since then. On the private side, the big chains have moved at the same pace. […] So, such a wave of digitalization has already happened in Finland quite early."*
>
> – Physician F, specialist

The digital development of the first wave was strongly reflected in how several physicians saw the degree of digitization of healthcare even today. Moving to electronically processed information was often used as an example of how digitization has changed the organization and execution of work from manual to digital. The change in the nature of work was closely related to the growing importance of patient information systems at the system level. Many physicians associated healthcare digitization with the development of patient

information systems, considering these systems as the most significant sources of value generation in today's digitally driven healthcare.

> *"I am still of the generation that started working as a physician when there were paper folders with patient information. There was no electronic patient information system, and the telephone was the only means of communication apart from the reception. There has been quite a dramatic change here in 20 years. […] The electronic patient information system is probably the most important [tool of digital health]. It is absolutely revolutionary."*
>
> – Physician J, specialist

While the first wave of digitization centered on converting paper-based healthcare information to electronic format, the second wave aimed to interconnect various healthcare touchpoints, align operational procedures, and establish a standardized framework for digitalized healthcare. This emphasis was reflected in the development of the National Archive of Health Information, also known as the Kanta system.

> *"If the first wave of digitization was done from the early 90s to the 2010s, then the following decade was spent building national standardization. So, the Kanta system that. The Kanta system standardized these different areas, since each area, even at the municipal level, had acquired its own systems back then. […] For those who are part of this Kanta system, it has created such a uniform basis, which has made it possible in this next step for the supplier to deploy, sell, and install solutions for several operators because the field has now been the same everywhere."*
>
> – Physician F, specialist

The advent of the second wave of digitization enabled healthcare stakeholders to access electronic health records, prescriptions, and other healthcare data from all over Finland. The development of the Kanta system served as a mutual infrastructure, facilitating the integration of various internal and external actors into an interconnected ecosystem. Consequently, digital health providers entered a new era, where applications would not be limited to a specific system structure but could be integrated for multiple operators through the Kanta system. At present, digitalization has progressed to a stage where applications can be incorporated as part of healthcare service selection, leading to novel prospects for more patient-centric digital care. This development has opened new avenues for digital healthcare services to be included as an integral component of the healthcare service selection.

> *"These technologies have now made it possible to take the back office to a digital format around which various services can be built. I often take an apple tree analogy from the garden, where we have first grown those apple*

tree trunks and then started planting different varieties on them. This means these digital services. […] Now we are in a situation where the kind of dreams we had about a virtual hospital in the 90s are possible."

– Physician F, specialist

"It [digital health] can already be seen quite a lot in healthcare. If you think about the patient record system, e-prescriptions, and electronic laboratory and imaging systems, then the base system there is already pretty much digitalized."

– Physician I, specialist

While a significant portion of the base system and infrastructure is presently digitalized, many physicians considered the integration of digital health applications into the infrastructure as the most pressing topic in the current discourse. In the digital health field, innovation is abundant, and companies of many sizes are increasingly focused on developing comprehensive digital applications that enhance the patient experience and healthcare service processes, as opposed to mere hardware. Nevertheless, investments in the healthcare sector continue to be primarily guided by the general perspective of information technology, where patient information systems are deemed to be the most critical user interfaces for creating value. As a result, there is a growing need for a more comprehensive view of digital healthcare that goes beyond the current focus on patient information systems to include a broader range of digitally driven services.

"There is a lot of [innovation] going on in every area. […] There are both service companies and public sector organizations that develop their own tools and systems or customize existing systems to suit themselves. Then there are large information system suppliers who do a lot of development work and move things forward. Traditional equipment manufacturers are also moving in a more digital direction, meaning you can no longer get added value from just hardware, so it must be supported with digital solutions. And then there are these smaller growth companies that produce solutions/applications for some areas, are agile, and have to innovate so that solutions can be implemented quickly. It is an interesting area where I see an opportunity to make an impact and where a lot is happening."

– Physician E, specialist

"What is required by all public operators at the moment is that they [digital solutions] are integrated into the patient information system. […] Now the discussion [in healthcare] revolves around how the patient information system works. We are talking about all those patient information system projects that are actually just enterprise resource planning systems. To a very small extent, they are about any digital therapy or patient care or digital care paths or anything such. But it is really about the basic patient

information system or operational management, so the appointment booking, and everything related to it."

– Physician D, specialist

Consequently, digitalization has made significant strides in the healthcare sector, enabling the emergence of new and innovative solutions that have the potential to transform patient care. However, the potential for creating value in digital healthcare is constrained by the differing views on the design of the ecosystem. Some stakeholders view patient systems as a central hub for all digital needs, while others advocate for a more decentralized ecosystem. As a result, two divergent approaches have emerged for integrating solutions into the current healthcare service selection. The former approach involves enhancing the functionalities of existing patient information systems to accommodate additional digital health applications. In contrast, the latter approach focuses on an ecosystem that enables developers to create and offer digital health applications through developers' portals.

"There are already public systems where a diagnostic digital system is integrated into the patient information system. For example, on the pulmonary side, a PEF monitoring application for asthma diagnostics or its follow-up can have been integrated into that patient information system. So, it can be part of everyday life if the service provider or the organization has implemented it. There are only a few of them, but they are increasing all the time depending on the region."

– Physician D, specialist

"So far, those [digital solutions] have not worked through it [Kanta]. If such solutions have enabled remote monitoring, they have been integrated into suppliers' own servers. The physician has been able to see the data from there if the patient has given the password. So, it is good to note that there has been a channel even now [for integrating digital applications], but it has been manufacturer- or device-specific. Very difficult channel in a way."

– Physician F, specialist

The preferable future. The physicians were broadly unanimous that focusing solely on patient information systems could not meet all future needs of digitalized healthcare. While patient information systems were considered crucial for the operational activity of healthcare, relying exclusively on a single system for value creation in digital health was viewed unfavourably in many respects. Some physicians discussed that one prevailing approach aims to create interfaces that allow different digital health applications to be integrated into patient information systems. However, the challenge here is that also patient information systems vary, and developing interfaces could become excessively expensive and labour-intensive. This would not address the underlying issues but could potentially

further increase rigidity and reduce user-centeredness within the entire digital health ecosystem. Many physicians cited the recent development efforts of the Apotti patient information system as a concrete example of these challenges.

> *"If we are talking about having such a single system where all these [digital solutions] would be, then this is exactly what is now being tested in the HUS area under the name Apotti. This ideology is okay that the information would be versatilely available in all units. And in each unit, it [information collected by digital solutions] could be used within the limits allowed by the customer's consent and usage needs. A bit the same as with the Kanta now. […] However, I am afraid that if there is only one system, the system will become so complex and large that usability will suffer."*
>
> – Physician G, general practitioner

> *"If you think about it, there are a zillion systems that they [digital solutions] should be integrated into. Even though those interfaces and others make it easier, unfortunately, those purchasers have the attitude that the supplier should do the work and tailor it [digital solution] to their system. And when patient information systems are not identical, even if they are exactly the same patient information system. […] Of course, we need the basic infrastructure, but now, with all the Apotti, Asteri, and other problems, the share of the basic infrastructure has become so large that it has taken the attention from the fact that it [patient information system] should only be the core, and around that are those [digital solutions] that actually produce that care."*
>
> – Physician D, specialist

Relying solely on patient information systems may also lead to dependence on a limited number of large system providers, increasing vulnerability within the ecosystem. Physicians mentioned that providers may lack the interest or resources to develop systems that address the evolving needs of healthcare professionals, making it challenging to obtain new features or solutions for patient information systems. As digital health continues to develop and new opportunities emerge through the changing needs, it is essential to have solutions that can swiftly adapt and respond to the changing landscape, enabling prompt implementation and modification. In light of this, the agility, user orientation, and innovation of smaller operators were regarded as a more effective and faster way to bring added value from digital health applications to healthcare operations, ultimately striving to improve patient outcomes and more efficient healthcare delivery.

> *"Well, for example, the oncology application I mentioned was implemented as a separate block and then integrated into the processes. If Epic had been expected to build something like it, it would have been a very long wait. Or that Epic would even be interested enough to take it through regulation. Still,*

in my opinion, the previously discussed chain of innovation works better here where we start with a start-up and focus on something that really brings added value and impact quickly and agilely."

– Physician E, specialist

The viewpoints of physicians regarding the centrality of patient information systems resulted in the conclusion that healthcare is frequently perceived as overly unified, with identical needs and functions across all settings. Nonetheless, several physicians noted that healthcare is a multi-network system composed of multiple units with varying service offerings and operational procedures. Focusing on a single system was deemed to reduce flexibility by establishing a monopolistic and centralized approach that dictates how functions and processes should be structured across all aspects of healthcare. This approach could further inhibit adaptation to the unique requirements of each healthcare facility, unit, or even an individual specialty area by enforcing uniformity across all settings. Instead, modularity was often perceived as inevitable for the future value creation of digital health.

"I very strongly disagree with the view that there should be one system [in Finland]. There are many perspectives on it. […] We do not have one healthcare, but we have different types of healthcare in terms of size and range of services and what kind of services they have to respond to. And the entirety of information systems must be customizable or adaptable to those operational processes. It cannot be like buying one system and forcing everyone to do things the same way."

– Physician F, specialist

"I think we should give up this ideal of mammoth information systems but understand that healthcare is such an enormous and complex system that we have to accept the fact that there can be different systems. […] Separate systems are necessary because it is unrealistic to think that there is one big system supplier that houses all the wisdom and ability to apply, for example, artificial intelligence in healthcare from cancer treatments to psychiatry and orthopedics."

– Physician E, specialist

Consequently, there was a frequent desire for the digital healthcare ecosystem of the future to be more decentralized, with modular applications tailored to the unique needs of patients and healthcare professionals. The adaptability of the system to the service processes and workflows of each healthcare unit was deemed a priority. Ideally, healthcare professionals could even be able to individually select applications, curating a customized collection of solutions that enhance their work's value and promote greater patient involvement in care planning and delivery. As a result, a decentralized and modular digital health ecosystem could offer patients and

healthcare professionals a more adaptable and personalized healthcare experience, leading to better health outcomes and greater patient-centricity.

> *"My goal is to be able to choose the kind of digital applications that I need in treating my patients […] Our treatment is so specialized, so I will probably have five or six digital applications in active use. And I am an active user; most physicians will have one or two, depending on their specialty. […] So, the fact that in terms of the overall system, if there are these 100 different applications that should be adapted to this patient information system when each user uses one or two or five of them at their maximum, it makes no sense to force all of them into one."*
>
> – Physician D, specialist

> *"I see that it [digital health] works as a framework within which subsystems could be integrated into a part of it. […] From the patient's point of view, there would be a collection of applications that talk to each other in critical areas exactly according to the needs. There would be one caring entity that coordinates the care and gets the necessary information about the patient's situation at any given time. It would be intuitive, easy to use, and adapt to the progression or worsening of the disease or recovery from it."*
>
> – Physician E, specialist

Although such a modular system was the desirable future vision of interviewed physicians, it was unclear how the ecosystem should be structured in practice. Some degree of integration between the digital health applications was felt to be a prerequisite for the ecosystem to support treatment processes, patient flow, and information exchange between different healthcare units. As in the case of one centralized system, it was also seen as more advantageous here that the integration would not take place by creating a central platform from patient information systems, but the applications would be connected using, for example, common information exchange standards. Each digital health application could operate within its own user interface, ensuring that the usability of each application remains intuitive. Simultaneously, data could be consolidated within a shared data repository, enabling its use across multiple healthcare touchpoints.

> *"If I had all the power in the world, I would direct the use of common data transfer standards between these different applications. In this case, even small companies could attach innovative solutions as part of the system entirety. […] Throughout history, convenient stand-alone systems have been used in health care, but it has been found that they do not work because the information must be compiled from somewhere. We must be able to see, for example, who has care responsibility for the patient and what is the patient's situation at any given time."*
>
> – Physician F, specialist

"I think it would be best if the ecosystem had separate user interfaces for the patient information system and digital health solutions and data pool where that information is collected and from which it can be used for different purposes. As I said before, our care is so specialized, and everyone only needs certain solutions, so it would be more intuitive to have the applications operate in their own interfaces with their own logic than as part of patient information systems."

– Physician D, specialist

Figure 8 depicts the identified potential affordances in the transition from a single system to a modular digital health ecosystem.

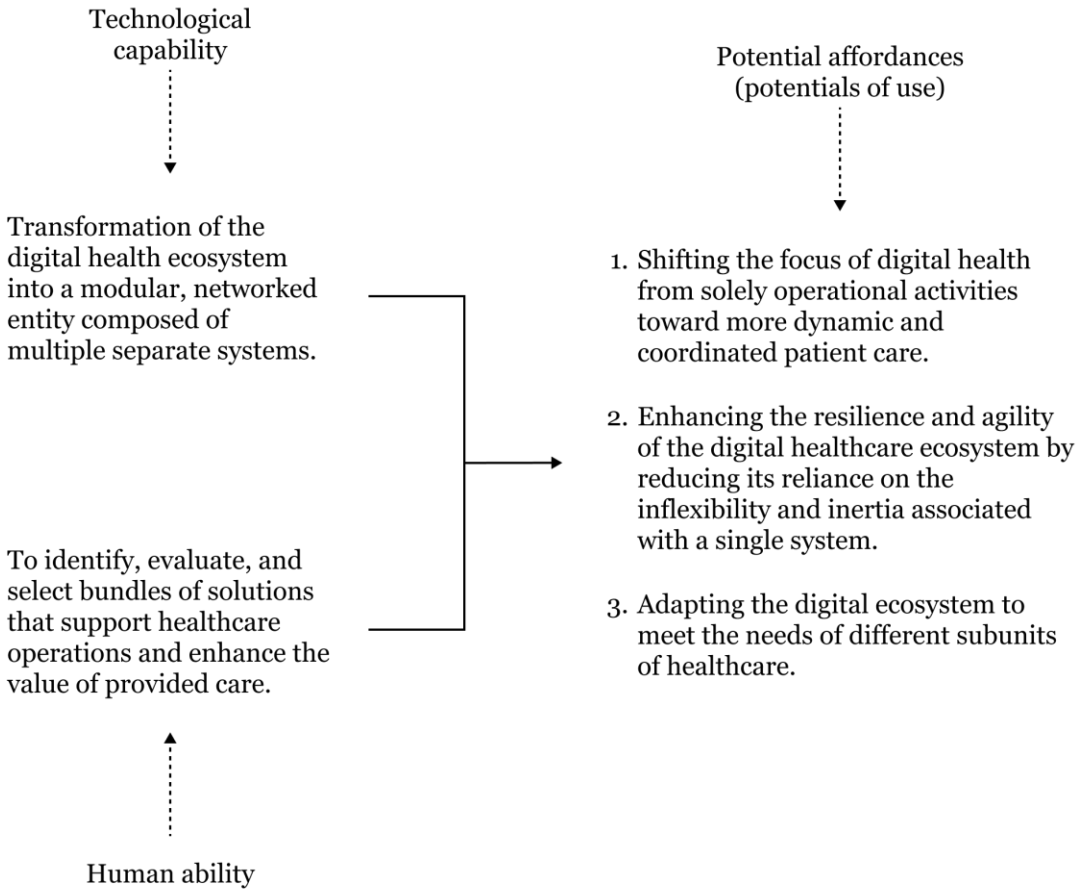

Figure 8. Identified potential affordances in the transition from a single system to a modular digital health ecosystem.

4.2.2. From data silos to consolidated insights

The status quo. The effects of the digitalization of healthcare were exemplified in the interviews as a change in the nature and role of the information. On the one hand, this change was felt to have been influenced by the transfer of information from paper to digital storage at one stage of

the development curve, which enabled the collection and compilation of data into more meaningful entities. On the other hand, the change in the role of information was seen to be due to accelerated development in various areas of healthcare, whereby knowledge of the factors and methods affecting the maintenance and care of health has improved. As a combined result, the amount of digital information circulating in healthcare has increased, and the use of data has become one of the cornerstones of modern patient care. For physicians, this has meant improved access to information about patients and factors influencing the management of their health.

> *"The electronification of old papers was one big thing, and nowadays the amount of information we process in healthcare could no longer even be processed on paper. The number of medicines is also increasing all the time and the indications for the medicines are increasing all the time. […] So, what we know about patients and what we are able to treat is growing all the time. And when that information grows all the time, it must be able to be stored. If you think about the care and then the cure side, the need for information has grown in both. And I see that it also improves the quality when we know what the drains have been and get those blood pressure curves and other information about patients and everything is documented and available in digital form."*
>
> – Physician B, general practitioner

The physicians emphasized that while there has been an exponential increase in the amount of available information, its usability has also been subject to new prerequisites. It was considered paramount that the data is processed, analyzed, and accessible so that it can be promptly adapted to actionable insights that support patient care. The significant role of the existing digital solutions was seen as enabling the conversion of information into knowledge that allows interventions to be targeted efficiently and precisely at the proper measures. Specifically, decision-support systems and medical databases were frequently mentioned as examples of how data is currently translated into knowledge to support decision-making and patient care.

> *"If we used to look for information in books, now we have electronic databases from where we can relatively easily search and filter information to get the latest evidence to support decision-making. These have greatly facilitated the patient work. […] And then there are also these decision-making support systems, for example, if we say that among health center physicians, 50% have an integrated electronic decision-making system that issues alerts of harmful interactions that professionals should pay attention to."*
>
> – Physician J, specialist

One physician highlighted that access to information and data-driven decision-making are now mandatory in healthcare, rendering digital

information systems strategic tools for processing and transmitting this information. While physicians rely on digital solutions to transform data into knowledge, patients also anticipate physicians to possess ample information about their health upon seeking consultation. Thus, the proliferation of data has not only impacted the practice of physicians but also redefined patients' expectations regarding the use of their health history and needs in the planning and delivery of care.

> *"Information systems have turned into such strategic tools you cannot work without them anymore. […] Today, patients expect the physician to have all the relevant information about their medical history and other factors available when they go to the physician's office. This is the basic assumption that patients have today."*
>
> – Physician F, specialist

The development of the Kanta system was often cited as a pivotal factor in the conversion of information to strategic knowledge within the healthcare sector. Physicians reported that the Kanta system has improved data accessibility across organizational barriers, thereby expanding the utilization of information to a broader audience. With this enhanced access to information, healthcare professionals are now better equipped to understand the needs of patients, beyond just relying on local data availability or patient communication during consultations.

> *"Now that the Kanta service has become available and information can be transferred between different healthcare organizations and sectors, this is a significant change. The availability and utilization of information about patients is essential and has improved considerably compared to the past."*
>
> – Physician J, specialist

> *"Access to and exchange of information has improved drastically. Different actors can better understand the patient's situation when, for example, a health center and a hospital can each other's texts about the patient's treatment history."*
>
> – Physician H, specialist

Conversely, the availability of information has also contributed to improving patients' knowledge and influence. Currently, patients can access their health information via the MyKanta portal (OmaKanta) from any location, facilitating the monitoring of their health and enabling them to participate more actively in planning their treatment. As the accessibility of information has increased, there has been greater recognition of the importance of ensuring its quality and accuracy. Various stakeholders have requirements for examining and utilizing information for different purposes, whereby they

have together assumed the role of quality controllers. This has been reflected in the requirements for improved information quality.

> *"Citizens can now monitor and stay up to date on the progress of the care. At the same time, it has raised the requirements for high-quality patient records. Different parties must be able to use and review information in different situations for various purposes, so it must be precise and to the point. It is the community of stakeholders that takes care of quality control."*
>
> – Physician F, specialist

Although the development of the Kanta system was seen to have improved the transfer of information between organizations via a shared infrastructure, the data obtained through it may be insufficient to form a comprehensive understanding of the patients' histories and care needs to support decision-making. Physicians reported that they may need to manually search relevant patient insights across different records and sources, resulting in a time-consuming process that diverts resources away from value-adding tasks. Few physicians described the current situation as sometimes being more straightforward to acquire information directly from patients than through the Kanta service.

> *"Of course, you can see something through the Kanta service, but the information in there is often fragmented. If you are lucky enough to find one good summary text, such as a final assessment from a hospital, it is valuable. Kanta is quite slow to use after all, and you must often search for information from different records and sources manually."*
>
> – Physician H, specialist

> *"At the moment, I get better information from patients verbally or manually written than from the Kanta service on average. I use Kanta mainly to validate the information given by the patient."*
>
> – Physician G, general practitioner

Consequently, the fragmentation of data within various healthcare systems was often reported as the most significant impediment in the current situation. Data is collected from different healthcare operations and activities into a range of systems and repositories, resulting in silos of information that are detached from one another. Due to this scattered nature of data, physicians perceive inconvenience in consolidating information into more insightful hierarchical entities, which hinders the potential of increasing value to decision-making and patient care.

> *"We have a massive amount of data, but it is not hierarchical data in any way. There are many different databases, such as the local patient record system, the Kanta archive, and even another archive for imaging or something else. These databases do not talk to each other, they do not*

aggregate, and they do not do risk assessments. So, I see this usability in the data is the most problematic of all."

– Physician I, specialist

The preferable future. Although data-mediated knowledge in healthcare has increased as a result of improved availability, accessibility, and shareability of information, the majority of physicians perceived that the underlying potential of data is still largely untapped. The current efforts were seen to be more focused on gathering data rather than effectively leveraging it to develop patient care and aid healthcare professionals in making informed decisions. In order to bring the data to the heart of the action, it was considered to be imperative to establish a clear and purposeful vision of how data could be translated into actionable insights for improving patient care.

"Data is undeniably valuable, but I also want to emphasize why we gather it and what we intend to do with it. If we do not use data for any prediction, diagnostics, or decision-making activities but gather it under the illusion that it can be used for something later, it is of no use. […] I see that the focus has now shifted away from what we need to develop, scale, and improve patient care to gathering data just for the sake of data."

– Physician D, specialist

Ensuring that healthcare professionals can monitor and understand the complete patient picture across the healthcare touchpoints was considered a critical aspect of future desires. Presently, the inability to consolidate information was seen as an obstacle to upholding patient-centric care, since isolated data may prevent healthcare professionals from obtaining a comprehensive understanding of the patient's medical history and care needs, potentially leading to unnecessary and redundant work, such as repetitive laboratory tests. Therefore, improving the compilation and seamless exchange of information was seen as paramount, especially as the size of healthcare organizations expands due to the healthcare, social welfare, and rescue services reform (SOTE). In such circumstances, maintaining patients at the center of care may become even more challenging.

"In the future, it would be crucial to remember how we get that information to flow better and how we get each patient to be kept in the center so we can seamlessly see their overall picture in healthcare. […] And the fact that we do not duplicate work. If a measurement, such as a blood test, has already been taken, we would not do such a test again. This kind of activity exists right now, which is such a waste. […] The potential of digital health is to reduce this waste by making our healthcare more seamlessly integrated."

– Physician B, general practitioner

"The problem with the Kanta service is that it is terribly difficult to extract summaries and get such an understanding of it [the patient's care needs]. You can see individual texts and records, but it is difficult to form an overall picture of the patient with them."

– Physician J, specialist

In addition to the clinical data gathered through internal healthcare activities, many physicians expressed the view that patient-generated information is not currently being fully utilized in healthcare processes. It was perceived that patients' current demand for digital health solutions designed to collect and convey health data is generally low, and the quality of data produced by consumer devices may be insufficient to be used in decision-making. However, physicians acknowledged the potential benefits of such solutions in supporting their diagnostic reasoning and providing a more comprehensive understanding of their patients' health.

"To a large extent, patients still bring some slips of paper with notes on blood pressure measurements or something similar. And this data is not archived anywhere. […] In general, the fact that the patient would produce information for healthcare, and the professionals could also use the accumulated data has been a pivotal need and lack in healthcare."

– Physician J, specialist

"Occasionally, patients have displayed on their mobile phones that devices such as the Oura or Apple Watch have taken some measurements, but this has not yet sparked a broader trend. […] I think wearable devices could be utilized to a greater extent given that they are reliable. For example, if an Apple Watch shows beats that look like ventricular fibrillation, that could be such an indicator that, hey let's use a Holter monitor to see how much there really are [ventricular fibrillation]. So, I see such devices supporting our diagnostic reasoning."

– Physician A, general practitioner

The physicians recognized the development of the Kanta Personal Health Record (Omatietovaranto) as a pioneering opportunity for digitalized healthcare, facilitating the seamless integration of patient-generated data into healthcare processes via the Kanta system's unified infrastructure. However, despite this integration, similar challenges to those encountered in the current utilization of data in healthcare may persist. An increase in the volume of data does not necessarily translate into a more comprehensive understanding of patients' needs if the information cannot be effectively compiled into insightful entities highlighting essential health-related factors. Thus, healthcare professionals may be left with unfiltered and potentially irrelevant data that does not improve decision-making and patient care.

"There is a turning point [in patient-generated data] where we can see signals that something is about to happen but not yet know what. […] From 2024 onwards, the legislation will make it possible for that data to be collected and put in one place [Omatietovaranto], and the citizen can then authorize it to be seen by healthcare professionals."

– Physician F, general practitioner

"The applications and devices that patients currently use offer little to no benefit to healthcare professionals. You can extract a 100-page PDF file worth of data, and I do not know what kind of crystal ball you would need to draw any conclusions about the patient's health or well-being from it. […] When considering, for instance, the monitoring of chronic diseases, my goal is to get factually useful documentation that can be used in the actual care. In other words, not any nice-to-know information such as how many times the patient exercises or how well he or she sleeps on an average night, but information about actual factors affecting quality and prognosis of life."

– Physician D, general practitioner

Consequently, the physicians identified similar needs in utilizing patient-generated data as in the prevailing healthcare information environment. Physicians expect digital health solutions to collect and combine both clinical and patient-generated data into value-enhancing and actionable insights that support their decision-making process by providing them with timely and accurate information they could use to improve patient outcomes. Automated dashboards, alarms, and summaries that monitor and visualize patients' health were often highlighted in the physicians' reflections on how unstructured data could be turned into actions in the data-driven healthcare of the future. Such features could facilitate healthcare professionals in promptly detecting alterations in patients' health statuses and responding as necessary.

"It would be immensely valuable if the collected data could be transformed into a more usable and user-friendly format. For instance, a digital patient card with real-time access to information on medications, diseases, services, and new symptoms that would be available for all actors would be valuable. […] It can sometimes be challenging to get objective information on whether a patient's memory symptoms, forgetfulness, confusion, or something like that have decreased or increased over period of time. So, a solution that collects that information itself and monitors it in the background or gives a good summary would be really good."

– Physician H, specialist

"In the future, I expect that digital applications will facilitate closer collaboration between patients and healthcare professionals. And I do not mean more people coming to the reception, but a more seamless flow of measurable health data. That is, even to the extent that there are some automatic algorithms that monitor how the patient is doing and will

automatically trigger appropriate alarms that will flash if something is wrong."

– Physician G, general practitioner

The future outlooks of physicians also underscored the significance of digital health solutions capable of seamlessly integrating patient-generated data and clinical medical records. This integration could empower healthcare professionals with real-time insights into patients' health, enabling informed clinical decision-making even during consultations. By synthesizing multiple and rich data sources, clinicians could attain a more nuanced understanding of patients' health status, enabling targeted interventions for high-risk groups and personalized treatments based on empirical evidence derived from real-world data.

"Digital health solutions could also support decision-making by consolidating information during a consultation. For instance, if a patient has kidney failure and is not producing urine, the situation is far more concerning than if a patient does not have kidney failure. So, it would be possible to use the data obtained from the patient's previous medical reports together with the real-time information provided by the patient during the consultation so that we physicians could make more informed decisions about the patient's condition and needs."

– Physician I, specialist

"In the future, we require the entirety of the signal - the rich data - that comprehensively describes a patient's health status over an extended period. Then we can target our efforts and offer personalized treatment to each patient based on the data derived from their health outcomes."

– Physician D, specialist

While the more versatile utilization of data was often associated with healthcare professionals' improved understanding of patients' health, physicians also emphasized the importance of enhancing patients' knowledge and engagement in their visions of the future. The data produced by digital solutions could provide added value for patients by enabling them to monitor their health, take measures to improve their health status, and actively participate in treatment planning and implementation. Moreover, by aggregating information from heterogeneous sources and integrating medical and social factors into higher-level entities, patients and healthcare professionals could develop an even more comprehensive understanding of diverse and individual aspects of health.

"Similarly, the digitally collected information could be compiled for patients to enhance their understanding of health and promote engagement in its maintenance. […] In addition to medical indicators, we know that social factors such as employment situation, social life, and related aspects

significantly impact health as well. So, it would be valuable to obtain a unified overview of these factors to enable healthcare professionals and patients to monitor changes in health status over time."

– Physician G, general practitioner

"I think it would be useful to have objective and trackable information about the maintenance of functional capacity and memory, especially for elderly patients. Digital solutions could help here by collecting information from everyday life observations. […] Patients could also perform various digital memory tests providing us with follow-up information and motivating them to maintain their treatment and condition."

– Physician H, specialist

Figure 9 depicts the identified potential affordances in the transition from data silos to consolidated insights.

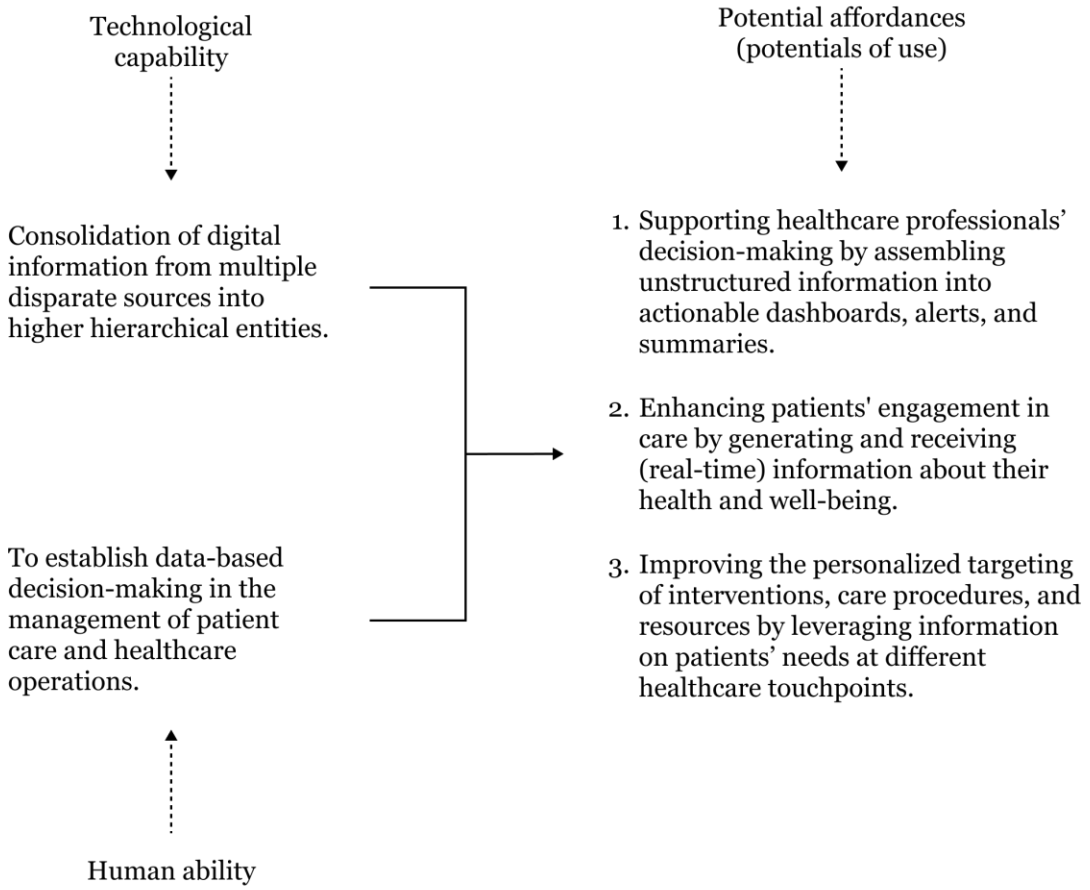

Figure 9. Identified potential affordances in the transition from data silos to consolidated insights.

4.2.3. From isolated to integrated care paths

The status quo. The physicians recognized that digitalization has introduced innovative ways of delivering healthcare services, thereby transforming how patients are encountered, treated, and communicated with. The proliferation of digitally provided healthcare services has brought care closer to patients, empowering them to self-perform procedures that previously required in-person attendance and reinforcing their role as active partners in care. By leveraging digital tools, patients can nowadays access health-related services in real-time regardless of location, resulting in more timely, equitable, and flexible care. This shift towards digital services has introduced a novel medium for delivering and receiving healthcare services, reflecting the change of care processes in a more patient-oriented direction.

> *"I believe that remote channels have enhanced the flexibility, speed, and equality of access to treatment. For instance, we are now able to provide medical services to areas that have a shortage of physicians. Moreover, I think that when patients can simply chat with their physicians about any health concerns, they are more likely to seek care and take better care of themselves."*
>
> – Physician A, general practitioner

> *"Virtual reception has expanded and transformed the service process into a more patient-oriented direction. Patients can now communicate with physicians regardless of location, which highlights the patient's initiative to seek care and improves access to the care process."*
>
> – Physician I, specialist

Previously, the traditional physical reception served as the primary touchpoint for patients throughout their care journey. However, the integration of digital channels has facilitated the partial transfer of some of these contact points and their associated functions into digital formats. Partly catalyzed by the COVID-19 pandemic, video consultations, chat features, and electronic communication channels were often cited in the interviews as examples of how digital health has become an integral part of healthcare service selection. Frequently, such services were seen to be suitable for simple tasks and procedures, such as prescription renewals and the diagnosis of easily identifiable diseases and ailments, thereby replacing the need for physical presence in relatively routine cases.

> *"At first, I was a bit skeptical that it [remote consultation] is only suitable for renewing prescriptions and for some easy eye and skin infections and so on. But it [remote consultation] can take care of such low-hanging fruit patients. […] If, for example, there is no physician in a town, the patient can still show*

a rash and receive antibiotic treatment for, say, borreliosis or a nail bed or eye infection. So, I think it is quite a remarkable phenomenon in a sense."

– Physician H, specialist

Beyond curative factors, remote channels play an essential role as a gateway to healthcare services. Physicians noted that while simple issues can be managed directly via video or chat consultation, these channels are also frequently used to evaluate patients' needs and facilitate their transition into the care processes. In this context, remote channels do not function as a disease-treating component but rather as a digital platform for conducting preparatory measures before the implementation of actual treatment procedures.

"For example, one important function of the chat service today, and what it often leads to, is that preparatory measures are taken there prior to the actual contact. Whether the actual contact will be a physical or video consultation. In other words, in there [chat] the problem is brought up, a preliminary plan is made, and the first steps are taken to solve the problem. […] For example, some of the people I have treated have already been in contact with the digital clinic, and from there, they have been referred to me, where we have continued the care process."

– Physician G, general practitioner

Such preparatory measures are not solely reliant on a real-time connection between patients and healthcare professionals. An increasing number of healthcare service providers are utilizing digital solutions meant for the assessment of patients' treatment requirements. Such solutions enable patients to evaluate the gravity of their condition and the urgency of their treatment needs while giving healthcare professionals a preliminary understanding of patients' medical history and needed actions for the implementation of care. Thus, bringing value to care processes by allocating more time and resources from pre-activities to actual patient care. For instance, the Omaolo service and various interactive forms that guide patients towards the care continuum were often mentioned in the interviews as examples of such preparatory digital services.

"Various targeted forms are a large part of our service selection, and they are increasing more and more all the time. For example, for women's urinary tract infections. When the customer fills out the form, it leads to a certain continuation from there. The physician can take the form directly and see that this is the situation, make a prescription, and send a message to the customer."

– Physician C, specialist

"The useful aspect of these pre-information forms or treatment evaluations is that when the patient answers certain questions, then healthcare

professional can already see the anamnesis and can very comprehensively go through all the essential questions and especially such alarming questions. In this way, we can speed up the processing and do this kind of preliminary work, which can then be refined at the reception or to think about where the patient should be directed next."

– Physician J, specialist

One physician emphasized that the maturation of technology, combined with the increased need to support treatment with digital means, has led to the development of new digital service processes. While remote consultations and digital pre-assessment tools are designed for periodic contact, digital treatment paths in specialized medical care integrate digital elements into long-term care processes. Such treatment paths enable patients to navigate both physical and digital worlds during different stages of their care. This results in a partial transfer of certain functions, such as sharing essential information, communicating with patients, and monitoring care implementation, from physical channels to digital ones. While actual treatment procedures are still delivered through physical contact, digital treatment paths enhance patient orientation by bringing treatment monitoring and guidance closer to patients. This enables them to better participate in and commit to care processes.

"Through the Health Village (Terveyskylä), we have such a digital treatment path for certain groups of patients who are a bit more complicated and require a lot of visits. […] It [the digital treatment path] contains the kind of information that is usually written by a nurse or midwife, so now such more verbose and longer information has been transferred there [to the digital care path]. From there, the patient can see the information, follow the treatment, and also communicate with healthcare professionals."

– Physician B, general practitioner

Beyond healthcare-driven care, digitalization has empowered patients to improve their health maintenance by utilizing various targeted digital self-care materials. These resources promote active patient participation in treatment implementation and shift the responsibility of health maintenance to patients, emphasizing their role outside of formal care delivery.

"And more about digital services, we have a lot of digital training videos that are targeted to customers. There are, for example, coaching related to nutrition, smoking, alcohol, and sleep disorders. They are quite a big part of our service selection, and I think the customers have also appreciated and want more of these."

– Physician C, specialist

While digitalization has led to the emergence of new patient-oriented care processes, improved the availability of health services, and increased

resource efficiency by transferring some functions from physical to digital channels, physicians noted in interviews that digital care does not fully complement traditional care delivery today. On the one hand, patients may face challenges in determining when digital channels are appropriate, reducing their effectiveness and sometimes burdening physicians when patients seek care through digital means for situations unsuitable for them. On the other hand, the convenience of digital channels in bringing healthcare services closer to patients and enhancing their availability can also lead to an overwhelming influx of patients seeking care. Due to both factors, the capacity to meet patients' needs may be exceeded, creating challenges for healthcare providers.

> *"When we offer a chat or some form that guides the patient in a certain direction or possibly artificial intelligence or preliminary questions, then everything we have offered so far has increased the demand and not reduced it at all. To put it somewhat caricaturally. That is, the pent-up demand is so great that it is difficult to meet these needs."*
>
> – Physician C, specialist

As a result, physicians identified the dichotomy between digital and physical service channels as one of the critical impediments in the current healthcare system. In a multi-channel service system, directing patients to the appropriate channels based on their service needs can be suboptimal, leading to intermittent or incomplete transitions between different channels at various stages of care processes. This division between channels may not only result in duplicated efforts but also undermine the efficient utilization of resources, hinder the seamless transition of patients between digital and physical services, and diminish the value provided by the multi-channel service system.

> *"In practice, the problem with it [directing the patient to the right channel] has been that there have not necessarily been enough of these so-called virtual treatments that come through the Omaolo service. The service promise is that they would be processed in a certain time, and this has not necessarily been fulfilled. And in different municipalities, there has been a lot of variation in how the direction of patients to the right channel based on the virtual treatments works."*
>
> – Physician J, specialist

> *"In a way, there will always be physical services and there will always be a need for physical services. It is perhaps a problem now that the remote channels and physical channels somehow function in such a dichotomy. We have a multi-channel service system, but despite that, we operate separately and do an awful lot of overlapping work in different channels. So, these channels kind of do not work together in a way."*
>
> – Physician I, specialist

The preferable future. Physicians' envisioning of the future highlighted the importance of integrating digital health into healthcare operations to better support patients throughout their care processes and establish a more balanced harmony between physical and digital care. While the current multi-channel service system incorporates both digital and physical channels, the role of digitally provided health services in this ecosystem is still in its infancy. Given that digital methods are frequently seen as suitable for addressing easily diagnosable conditions, both patients and healthcare professionals may have reservations about their potential to replace or even complement physical services. As a result, demonstrating the equality of therapeutic effectiveness between digitally provided health services and physical care was considered a crucial step in the future.

> *"When the COVID-19 pandemic started, there was a lot of this kind of attitude in a society where people took remote reception only because they could not get to the physical reception. A remote reception is, however, a replacement service. I mean that people should understand that it is just as good as the physical one. We take care of exactly the same things as at a physical reception. This same attitude is also there on the professional side. For some, it is a lower quality reception, and they think that let's do it this way now because there is no other option."*
>
> – Physician D, specialist

Most physicians stressed the importance of not taking digitally provided health services for granted. Instead, the focus should be on how these services can introduce new and improved ways to organize health services and respond to patients' care needs. While modern digital services have effectively expanded the provision of health services, they have yet to match the level of proximity provided by physical channels. Due to this disparity, the potential of digital services to generate value may remain incomplete for both patients and physicians.

> *"One such thing that we currently lack or that is yet to be developed in this whole is a closer collaboration or interaction with patients on a large scale through these digital tools. When these surveys have been conducted for physicians, it often emerges that these digital systems do not yet enable communication with the patient on the same level as, for example, between physicians and nurses within the same hospital."*
>
> – Physician F, specialist

To some extent, the dearth of proximity between physicians and patients was attributed to technological limitations. For instance, the insufficient integration of patients' asynchronous digital messages into their medical records has the potential to hinder their care processes and result in

fragmented comprehension of their conditions. On a broader scale, this lack of proximity was considered detrimental to physicians' capacity to discern patients' needs during consultations. In these instances, the interaction is not limited to direct communication but also encompasses the ability to observe factors associated with patients and their health.

> *"The key question is what can be treated digitally or using remote channels. […] Observing the patient, how he/she moves, how he/she comes to the reception, all of that can be ignored when we only open that [remote channel] link. When you examine and touch the patient, that too has its own meaning and importance. […] Seeing the patient there at the reception is diagnostically very important, especially if it is the first contact with the patient."*
>
> – Physician J, specialist

The physicians indicated several methods exist to enhance diagnostic certainty in remote consultations. For instance, remote consultations can be conducted in an assisted manner, where a nurse facilitates synchronous communication between the patient and the physician via video connection. Despite these advances, diagnosing patients remotely is still often challenging regarding verifying the severity of their condition, determining the necessary treatment, and ensuring patient safety, particularly in cases of non-specific symptoms. In serious situations, physical care is always required, but in some cases, patients may be referred to physical channels due to inadequate technological support for physicians' diagnostic reasoning rather than because of an actual need for physical care.

> *"In a remote reception, it is necessary to consider whether patient safety is compromised and how reliably we can confirm the disease without examining the patient. The more non-specific the symptom, for example, if there is some dizziness, fatigue, or malaise, where there are tens if not hundreds of diagnosis options, the more difficult it is to arrive at a final diagnosis based on the interview alone. […] That is, just when I was talking about [difficulties in making a diagnosis] that in a way the diagnostic reasoning is what that doctor does at the remote reception, that if it were possible to make such technical applications that would help in that decision-making."*
>
> – Physician I, specialist

Beyond remote consultations, patients may experience misdirection between digital and physical channels, either unintentionally or intentionally. For instance, they may habitually seek physical appointments for minor issues or struggle to differentiate whether their symptoms require physical or digital contact. This absence of interaction stems from the digital tools' inability to accurately identify and direct patients to the appropriate channel based on

their care needs, resulting in a diminishing value delivered through digital health.

> *"Of course, there are times when the patient has said one thing to the nurse, and there are two or three other problems that require that physical contact, so then you need to refer them to a physical reception. It is also much the other way around; patients call the nurse to say that they want to go to a physical clinic, and then the nurse calls me to ask if it is really necessary to go to a physical clinic. The notion that if my blood pressure medication is adjusted, I will go to the physical reception is still deeply rooted. Even though it does not necessarily bring much added value. If there is good home monitoring and so on, it is possible to promote the patient's condition even remotely in most cases. Some patients are stuck in the old way, and some think they are really modern and want to handle everything remotely. And then everything in between."*
>
> – Physician A, general practitioner

Physicians' perspectives on the future often highlighted the need for a more seamless integration of digital and physical channels across various stages of patients' care processes. The primary goal of adopting digital solutions is to enhance the value proposition of health services delivery. However, digital services should not create a parallel channel operating independently from the physical processes, as this could impede the operational efficiency of healthcare services and hinder value generation. Notably, one physician emphasized that digital services should aim to both facilitate healthcare professionals' work and provide better conditions for patients to manage their illnesses, thereby generating tangible value for all stakeholders.

> *"We are under tremendous pressure in terms of costs in our health care, and our resources cannot keep up with that. But it [digital health] has to be done sensibly because it can also be done so that we waste those resources on something that does not bring value. At the end of the day, our health care should be about producing a survival surplus for people so that they can cope with their illnesses and live a better life. I think that we can hopefully produce this survival surplus with these digital services."*
>
> – Physician B, general practitioner

The potential of digital solutions to enhance resource utilization was often associated with increased patient participation in treatment planning and implementation. Several physicians emphasized that the limited time of healthcare professionals is currently being utilized for activities that do not necessarily improve value delivery. For instance, the identification of patients' care needs is often more healthcare-oriented than patient-derived. In situations with high demand for healthcare services and scarce resources, care needs may remain partially unrecognized, potentially resulting in inadequate allocation of patients to appropriate healthcare services.

Consequently, digital solutions were considered as a way to improve patient-professional interaction by gathering patient information about their care needs, directing patients to suitable healthcare services based on this information, and offering evidence-based recommendations to physicians about appropriate interventions.

> *"I would see it as very important in the future, whether it is a mobile application or augmented reality in glasses or something else, that the customer chooses that I have this problem, and then the process starts running. So, it [the digital solution] asks questions that patients can answer and directs them to the right or even probably the right place. This way we would be able to offer more targeted services and not waste professionals' limited time on something that the patients can do by themselves."*
>
> – Physician C, specialist

> *"Then this really wild vision that there are practically three antibiotics for a urinary tract infection, we could have an automatic symptom questionnaire that asks the patient about all the risk factors, allergies, and others. If there is nothing alarming, then that questionnaire could even automatically prepare a prescription and deliver it to the doctor for approval. Or if there is something strange in the answers, it would directly book a remote consultation or a physical visit. This could greatly improve both our work and the patient's access to care."*
>
> – Physician A, general practitioner

Alongside the initial assessment of patient needs, the effective utilization of healthcare resources can be hindered by inadequate direction of patients during various stages of their care processes. For instance, patients may transition between healthcare units without a clear understanding of when, by whom, and how their healthcare should be managed next. In such cases, the alignment between patients' needs and healthcare operations may become disjointed, potentially impeding their progress of care. Physicians saw that by integrating digital solutions throughout the entire care pathway, healthcare professionals could attain better visibility into patients' requirements, ensure the continuity of care, and facilitate the seamless transfer of patients between digital and physical channels at each stage of their care processes.

> *"I see that it [the digital solution] should make it clearer to those who walk the treatment path and those who maintain it, where the matter will be dealt with next. We know that there is some bouncing of patients in healthcare, that this is not our business, or that the patient should go here or there. I think making this more efficient would be extremely important and would also improve the use of resources. If we think of asthma or asthma symptoms as an example, the patient first fills out a questionnaire about needs, and then the digital solution would offer the patient the option of either a chat, a video*

reception, or a physical consultation. From there, the patient can then be directed directly to a laboratory or something similar, which provides an analysis of the alarm values and a new recommendation on where the matter should be treated next. And then this process can be supported by offering various digital training courses or programs."

– Physician C, specialist

In addition to defining care needs, the physicians observed that digital solutions have the potential to promote patient-oriented care even during remote consultations. Currently, patients often have a relatively passive role in healthcare service production, despite independently monitoring and managing their health using various digital solutions, such as blood pressure monitors. Digital solutions could be more closely integrated into patients' self-care routines, allowing video-mediated consultations to be supplemented with health-related insights generated by such solutions. This integration could enhance diagnostic certainty for physicians during remote consultations, alleviate resource pressure at local clinics, and provide a more equitable and consistent care experience across both digital and physical channels.

"Even though patients' role is becoming more active, we quite often still passivize them. People measure their blood pressure without any problem, and we make treatment decisions based on that. In the same way, with these diagnostic services that are taken to the patient's home, we can support the patient's ability to function quite a lot and bring those patient-oriented services to remote consultation. […] For example, a patient can be taught to use a digital otoscope to obtain an image of the eardrum, based on which an ear infection diagnosis can be made without having to leave the house anywhere with the child with an earache. We do not have to turn people into doctors, but quite a lot of things can be evaluated based on the image and sound in a remote consultation situation."

– Physician I, specialist

Figure 10 illustrates the identified potential affordances in the transition from isolated to integrated care paths.

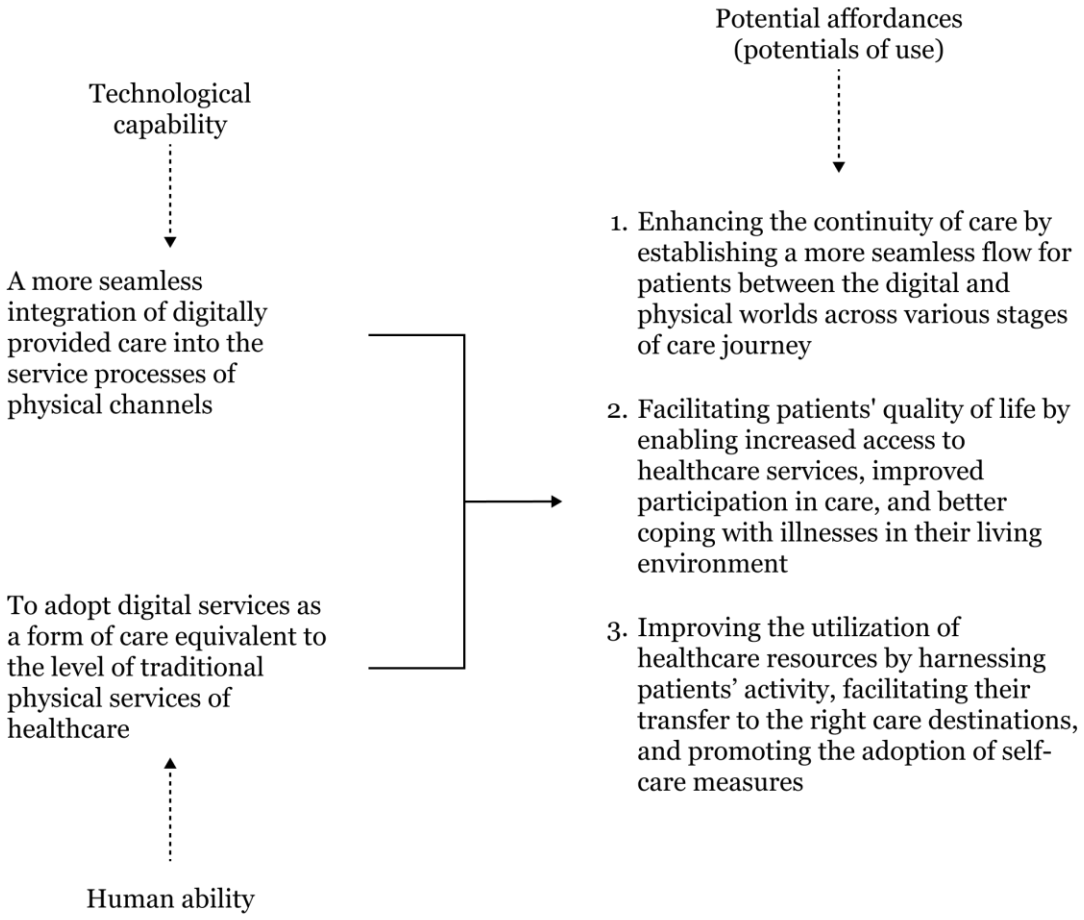

Figure 10. Identified potential affordances in the transition from isolated to integrated care paths.

4.3 Factors influencing the achievement of the future vision

During the interviews, physicians also highlighted various factors that impact the proliferation of digital health. These identified factors represent external forces that influence the realization of the identified potential affordances. Consequently, they are not exclusively inhibiting or promoting but rather aspects that must be considered to attain future visions. The identified factors were broadly classified into three main categories: 1) enhancing multidisciplinary collaboration, 2) developing a shared vision, and 3) establishing ecosystems for testing and integrating solutions.

Enhancing multidisciplinary collaboration. Most physicians emphasized that the development of digital tools should not be seen as an ultimate goal but rather as an endeavour to expand healthcare service availability, improve patient access to care, and enhance care processes. However, the rapid adoption of digital services without considering the

unique needs and characteristics of different healthcare user groups may result in disparities in healthcare access. For instance, physicians frequently pointed out that a substantial portion of healthcare service users includes seniors and multi-morbidity individuals. These groups may exhibit unique needs, differing levels of familiarity with digital devices and applications, and variations in their willingness to interact with digital platforms, in contrast to relatively healthy individuals primarily utilizing occupational health services, for instance. In light of this, digital services should be designed and configured to align with the specific needs and preferences of diverse user groups, ensuring that healthcare remains accessible and equitable for all.

In addition to patients, healthcare professionals' willingness and ability to embrace digital services may vary. These variations can be partially attributed to resistance to change stemming from the ever-increasing role of technology in the daily routines of healthcare practitioners. During interviews, physicians emphasized that digital health not only introduces new practices in patient care but also places new demands on healthcare professionals' roles and responsibilities. For instance, if technology fails to enhance physicians' professional identity by enabling more efficient, personalized, and high-quality patient care but, instead, increases their workload by introducing new channels and complexity into routine tasks, it can lead to a negative perception of technology adoption. This perspective was frequently cited when discussing the technology-related challenges physicians encounter in the current healthcare environment, particularly concerning structural recording, remote consultations, and patient information systems.

Furthermore, resistance to change may also stem from concerns about how technology may potentially compromise the fundamental values and principles of patient care. For instance, digital health services and tools might weaken the development of the patient-physician relationship if they do not offer a user experience comparable to that of physical channels. Several physicians emphasized that delivering healthcare services through digital platforms often requires increased autonomy and the ability to establish an interactive relationship of trust with patients. Therefore, if digital healthcare services fail to facilitate a trustful relationship between patients and healthcare providers, resulting in a distant experience during interactions and care processes, it may hinder the patient encounter and the continuity of care. Such an outcome could lead to negative perceptions of digital services among both patients and healthcare professionals.

The factors mentioned above led physicians to the conclusion that the advancement of digital health necessitates increasingly robust multidisciplinary collaboration. Similarly, as healthcare is not a monolithic

entity with identical needs and service processes, digital health must also consider the expectations of various user groups. One physician emphasized that the complexity of the healthcare landscape means that not all pertinent digital health stakeholders are necessarily identified or involved in development processes. While healthcare professionals represent one facet of the therapeutic need and patients another, even these stakeholders have different characteristics and digital needs. Additionally, entities such as pharmacies, the Social Insurance Institution of Finland (KELA), social services, and other third-party institutions may also have distinct requirements. As the digital health ecosystem encompasses an expanding number of actors, it becomes essential to enhance collaboration among these parties to determine how digital health can meet their unique expectations.

Developing a shared vision. As digital health signifies a holistic overhaul of healthcare services production and provision, its development cannot rely exclusively on healthcare professionals. Physicians frequently emphasized that new digital services and tools should not be pursued merely because of their digital nature but that healthcare organizations must establish a clear and systematic vision for what they are trying to accomplish through digitalization. As indicated in Chapter 4.2.3., the goal of digital health is not to create a separate channel isolated from physical care but to complement and improve patients' access to care and flow within the care processes. Hence, the advancement of digital health cannot occur in isolation; instead, healthcare organizations must consider how these services can be integrated into their existing healthcare service selection and how they can enhance shared value between patients and healthcare professionals.

The physicians underscored the importance of allocating adequate time and resources to learning new technologies to promote the development and implementation of digital health. Neglecting or underestimating the implementation and training process of digital services can lead to isolated and poorly integrated outcomes, undermining the value creation of digital health. Similarly, organizations must ensure that the technologies and tools support the use of digital services. The physicians noted that the reliability of the technology surrounding digital services constitutes the most significant limitation in the current environment, which often leads to interruptions in work and shifts the focus from patient care to solving technical issues. In the current situation, such factors were often associated with technical problems, including unreliable VPN connections and update issues, along with the incompatibility of various digital systems.

As critical end-users of digital health, physicians stressed the importance of consistent, two-way communication within organizations regarding the shared vision. Organizations should ensure that their personnel share a

common commitment and a positive attitude toward adopting digital services in healthcare service selection while actively guiding patients in using digital channels. Additionally, organizations should consider healthcare professionals' input and ideas. Neglecting to communicate the goals of digital health or failing to address healthcare professionals' feedback on perceived shortcomings and improvements was frequently cited as a demotivating factor in achieving the shared vision.

Establishing ecosystems for testing and integrating solutions. Evidence of clinical efficacy is crucial for the acceptance of healthcare interventions, including digital health solutions, in medical practice. Physicians expressed that the absence of clear evidence showcasing how digital health solutions can improve patient health and healthcare service processes is a significant impediment to their integration and adoption within the contemporary healthcare system. This constraint was deemed equally relevant to solutions aimed at patients, where the emphasis may be more on promoting overall well-being than health, and to solutions intended for healthcare professionals, where the ability to support professionals' workflows and processes may be inadequate. The lack of robust evidence for the efficacy of digital health solutions may lead to scepticism about their benefits, reducing willingness to invest in and recommend such solutions.

The physicians stressed that the current regulatory ecosystems are inadequate to provide effective pathways for evaluating the effectiveness of digital solutions. Legislation acts as a gatekeeper, imposing restrictions on how solutions can be tested, who can access and use healthcare-generated data, how data security is interpreted, and the evidence required for marketing the solutions. While the significance of legislation cannot be underestimated for many critical reasons, the physicians noted that the institutions responsible for interpreting and implementing the legislation sometimes result in protracted, rigid, and economically burdensome evaluation processes. This issue was cited, for instance, concerning certification processes and healthcare registry data processing times.

Even if solutions meet the legislative requirements and demonstrate clinical efficacy, the existing ecosystems may not offer a sufficient framework for testing and comparing different solutions. As previously noted, the healthcare sector is a multifaceted entity comprised of distinct units with varying service offerings and processes. Therefore, the requirements for digital solutions differ across settings, with each unit expecting seamless integration of the solutions within their specific systems and processes. The physicians identified a lack of opportunities within the current ecosystems to compare and evaluate solutions from different vendors, potentially resulting in solutions that do not comprehensively blend into the specific healthcare

context and limit the ability to incorporate new technologies into the system as development progresses. This observation was particularly relevant to patient information systems and their extensions.

Consequently, to realize the future vision of digital health, it was considered crucial to establish comprehensive ecosystems for testing and integrating solutions. These ecosystems play an indispensable role in accelerating and streamlining the assessment of the clinical efficacy of solutions during their initial development stages. They also serve as a means to identify optimal alternatives from existing solutions, tailoring them to meet the specific needs of each healthcare unit. In both scenarios, physicians emphasized the necessity of a robust testing framework where the effects can be efficiently evaluated first in smaller units before being implemented across the broader architecture of healthcare facilities.

Figure 11 illustrates the above-mentioned themes and their respective sub-factors derived from the reflections of interviewed physicians.

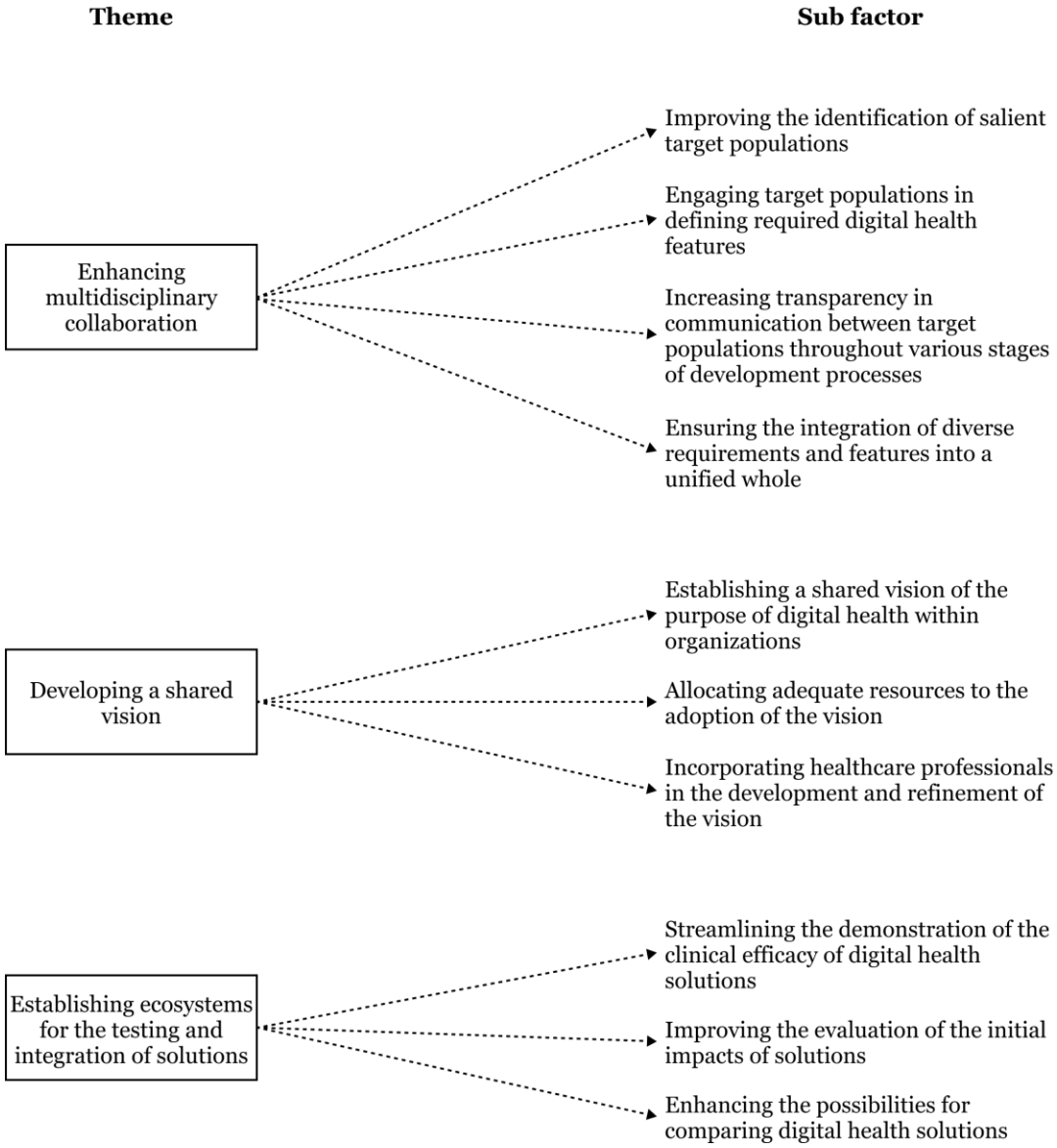

Figure 11. Identified external factors influencing the transition from current states to the preferable future of interviewed physicians.

5 Discussion

5.1 Discussion over the findings

The objective of this study was to explore the potential of digital health in transforming the provision of healthcare services in Finland toward a more patient-centered integrated care model. To achieve this, the study employed the theory of affordance in conjunction with the grounded theory methodology to identify potential affordances emerging from the digitally oriented physicians' perceptions of the future of digitalized healthcare. The study began by elucidating the concept of digital health as perceived by the physicians, then proceeded to depict the transition of digital healthcare from its present state to the patient-centered integrated future. Lastly, the factors influencing this transition were reviewed.

To fulfill the study's objective, the following research question was formulated:

RQ1: *How can digital health promote the provision of patient-centered integrated healthcare in Finland?*

The following sub-research questions were established to complement the main research question:

RQ2: *What can the speculative future of digitalized patient-oriented integrated healthcare look like in Finland?*

RQ3: *What are the key factors influencing the achievement of the future vision?*

The findings presented in Chapter 4 demonstrate that digital health has the potential to transform healthcare into a more patient-centered integrated entity, with shared value co-created in collaboration between different healthcare stakeholders. The findings imply that the generation of this value is bound to a transition from 1) a single system to a modular ecosystem, 2) siloed data to consolidated insights, and 3) isolated to integrated care paths. The affordances emerging from the transitions illustrate the future of digitalized healthcare as a networked modular ecosystem, where digitally generated information about patients' care needs enables a seamless and personalized flow between digital and physical healthcare settings at different stages of their care journeys.

The study's findings suggest that to realize the future vision of digitalized patient-centered integrated healthcare, it is paramount to 1) enhance multidisciplinary collaboration, 2) develop a shared vision, and 3) establish ecosystems for testing and integrating solutions. These factors underscore that the successful transition to digital healthcare does not occur in isolation but necessitates collaborative efforts among key healthcare stakeholders at individual, organizational, and institutional levels. Prioritizing stakeholder engagement, defining clear digital health objectives within organizations, and adopting an agile approach to test and implement solutions are crucial components for achieving the future of patient-oriented integrated healthcare.

5.2 Digital health and patient-centered integrated care

In order to comprehend the impact of digital health on promoting patient-centered integrated healthcare, it was critical to investigate physicians' perceptions of the concept of digital health in this study. The findings indicate that digital health is a dynamic and ambiguous concept that has yet to establish its position in the healthcare industry. Over the years, digital health has been associated with multiple definitions, and its scope and content have progressed in response to the technologization within and outside the healthcare sector. Terms like telemedicine and eHealth can be perceived as antecedents of digital health, which are still extensively employed today to describe the digitization of healthcare and electronically provided health services. Conversely, digital health can be regarded as an overarching framework encompassing the aforementioned terms and associated concepts, representing a more comprehensive digital transformation in the healthcare sector. These findings are primarily consistent with the WHO's (2021) description of digital health as an umbrella term that includes a variety of technologies striving to foster health and associated functions in the healthcare sector.

However, the results of the study indicate that the weight of technology in the concept of digital health is not unambiguous. Although technology has a significant intermediary role in enabling digital activities in healthcare, focusing solely on the technical aspects may lead to an oversimplified approach that cannot fully capture the complex nature of the healthcare sector and overemphasizes technological factors at the expense of its health-promoting effects. Fatehi et al. (2020) show in their concept analysis that the multifaceted concept of digital health focuses generally more on health-promoting aspects than the technologies themselves. This study confirms this view and adds that the health-promoting value of digital health is derived through multi-stakeholder networks formed by the interaction of technological components and the data they produce, resulting in more

integrated healthcare activities and services. Iyawa et al. (2016) describe digital health as a networked ecosystem composed of various interconnected components, which is broadly in line with the findings of this study.

Meskó et al. (2017) have previously characterized digital health as a technological-cultural transformation towards more unified, accessible, shared, and thus more patient-centered integrated healthcare. This study implies that digital health is an inherently patient-centered integrated concept. Socio-technical networks that integrate healthcare stakeholders vertically and horizontally through technologies and data 1) facilitate novel, more agile, and more personalized ways of delivering and receiving healthcare services, 2) enable closer patient-provider collaboration and interaction, and 3) establish a more seamless and cohesive patient flow between digital and physical touchpoints of healthcare. Similar attributes have widely been acknowledged as fundamental aspects of patient-centered integrated care (Berntsen et al., 2018; Burdett & Inman, 2021). Thus, the study supports Meskó et al.'s (2017) view of technological-cultural transformation and emphasizes the connection of digital health to the notion of patient-centered integrated healthcare.

Figure 12 illustrates the concept of digital health and its connection to patient-centered integrated care based on the findings of this study.

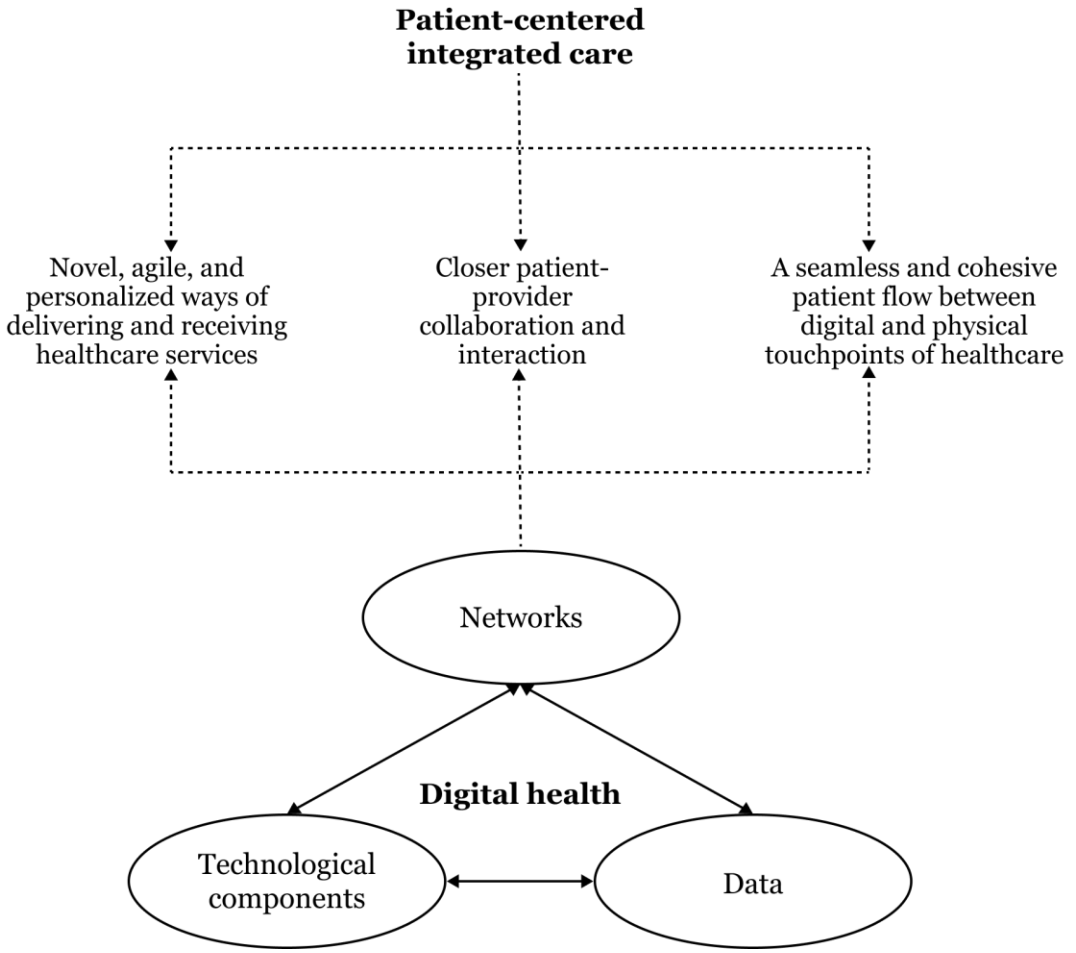

Figure 12. The concept of digital health and its connection to patient-centered integrated care.

5.3 Affordances emerging from the transition to digitalized patient-centered integrated healthcare

In this study, the influences of digital health on the transition of healthcare from its current state towards a patient-centered integrated model were examined by utilizing the affordance theory framework. Affordance theory seeks to elucidate the possibilities for action (i.e., affordances) that emerge from the interaction between technology and users (Strong et al., 2014). In the context of this research, it was essential to identify what is known as 'potential affordances,' which describe the expected action possibilities offered by technology in the future (Alshawmar, 2021). As noted by Ostern and Rosemann (2021) and Volkoff and Strong (2017), potential affordances serve as a means to articulate the future requirements of various user groups, aiding in the identification of innovative opportunities and the redesign of services to address contemporary challenges.

In the study, the digital health-induced transition from the current state towards the future was identified through three distinct yet interconnected themes: 1) from a single system to a modular ecosystem, 2) from data silos to consolidated insights, and 3) from isolated to integrated care paths (Table 5). The potential affordances identified within these themes, as presented in Table 5, depict desired future possibilities for action. These affordances emerge from the interaction between technological capabilities and human ability (Strong et al., 2014), collectively forming a theoretical perspective on digitalized patient-centered integrated healthcare.

Table 5. Identified potential affordances emerging from the interaction of technological capability and human ability by theme.

Theme	Technological capability	Human ability	Potential affordances (potentials of use)
From a single system to a modular ecosystem.	Transformation of the digital health ecosystem into a modular, networked entity composed of multiple separate systems.	To identify, evaluate, and select bundles of solutions that support healthcare operations and enhance the value of provided care.	1. Shifting the focus of digital health from solely operational activities toward more dynamic and coordinated patient care. 2. Enhancing the resilience and agility of the digital healthcare ecosystem by reducing its reliance on the inflexibility and inertia associated with a single system. 3. Adapting the digital ecosystem to meet the needs of different subunits of healthcare.
From data silos to consolidated insights.	Consolidation of digital information from multiple disparate sources into higher hierarchical entities.	To establish data-based decision-making in the management of patient care and healthcare operations.	4. Supporting healthcare professionals' decision-making by assembling unstructured information into actionable dashboards, alerts, and summaries. 5. Enhancing patients' engagement in care by generating and receiving (real-time) information about their health and well-being. 6. Improving the personalized targeting of interventions, care procedures, and resources by leveraging information on patients' needs at different healthcare touchpoints.
From isolated to integrated care paths.	A more seamless integration of digitally provided care into the service processes of physical channels.	To adopt digital services as a form of care equivalent to the level of traditional physical services of healthcare.	7. Enhancing the continuity of care by establishing a more seamless flow for patients between the digital and physical worlds across various stages of the care journey. 8. Facilitating patients' quality of life by enabling increased access to healthcare services, improved participation in care, and better coping with illnesses in their living environment. 9. Improving the utilization of healthcare resources by harnessing patients' activity, facilitating their transfer to the right care destinations, and promoting the adoption of self-care measures.

5.3.1. Potential affordances emerging from the ecosystem transformation

The potential affordances identified within the first theme presented in Table 5 (from a single system to a modular ecosystem) depict the future transition toward a modular ecosystem structure. In this structure, the value of digital health is derived from multiple decentralized technological solutions instead of a single system. Ruokolainen et al. (2023) have previously described the formation of digital health ecosystems around multiple separate systems rather than a focal company or system. The modular, decentralized ecosystem provides a flexible opportunity to remove, add, and customize solutions according to the prevailing and changing needs of salient healthcare stakeholders (Blaschke et al., 2019; Ruokolainen et al., 2023).

Digital development in healthcare has been strongly tied to the establishment of the general ICT environment where patient information systems serve as fundamental building blocks (Larsio, 2017). The study demonstrates that while patient information systems are fundamental to the operational management of healthcare, the considerable focus on them can blur the distinction between the development of general healthcare ICT capabilities and the advancement of digital health. The findings indicate that a patient information system-centric approach may hinder the broader dissemination of patient-centered digital solutions by highlighting operational processes at the forefront of digitalization. If the value of digitalization is tied to the functionalities enabled by patient information systems, technological advancements may end up reinforcing the prominence of these systems in the healthcare environment. Consequently, intentionally or unintentionally, patient information systems can transform into all-encompassing platforms for digital health, with investments primarily focused on promoting operational processes rather than patient-centered innovations. These findings align closely with the observations made by Ahlqvist and Kalliola (2022) regarding the concentration of digital development in healthcare on ICT systems rather than services targeted toward patients. The results underscore the need to prioritize patient-centered digital health solutions as a central objective of digitalization, which is one of the core themes outlined in the healthcare digitalization guidelines published by the Finnish Ministry of Social Affairs and Health (STM, 2016).

→ The identified potential affordance of *"shifting the focus of digital health from solely operational activities toward more dynamic and coordinated patient care"* indicates the need to prioritize patient-oriented solutions at the core of digital health advancements.

The results of the study imply that a single-system approach contributes to the rigidity of the healthcare technological environment and hampers the broader adoption of patient-centered digital health solutions. Interviews revealed that the value creation of digital solutions currently heavily relies on their ability to integrate with patient information systems. Although the interoperability of digital systems has been recognized as vital for the efficient functioning of the digital healthcare ecosystem (Dinh-Le et al., 2019), the findings suggest that technical integration is laborious, costly, and diverts resources from the development of patient-centered solutions to addressing integration-related questions. The formed single-system structures can become massive constructs, further emphasizing the role of patient information systems at the core of digital activities and submerging patient-centered digital solutions within this complex patchwork structure. Consequently, this can diminish the flexibility, agility, and usability of the overall system as well as its separate components. Thus, the results affirm the importance of system interoperability in the value creation of digital health (Dinh-Le et al., 2019) while providing a complementary perspective on the challenges related to the technical integration between patient information systems and digital solutions (Orenstein, 2018).

→ The identified potential affordance of "*enhancing the resilience and agility of the healthcare digital ecosystem by reducing its reliance on the inflexibility and inertia associated with a single system*" underscores the need for agile and flexible interoperability of digital solutions.

Healthcare is a complex network consisting of interconnected subunits that provide and maintain various service entities. The findings of the study indicate that digital health cannot manifest uniformly across healthcare, but digital solutions need to be adaptable and customizable to meet the needs of various subunits and their respective patients. Ideally, this would allow the selection of solutions into value-adding collections even at the level of an individual physician specialty. Robinson et al. (2021) argue that the market power of large system vendors hinders the spread of digital innovations and locks healthcare into the functionalities enabled by existing systems. The results of the study support this view by suggesting that a centralized approach formed by a single system architecture may enforce uniformity in healthcare by reducing the possibility to customize digital health solutions to meet the needs of different subunits. If digital solutions are tied to patient information systems, healthcare can become dependent on the capabilities, interests, and expertise of system vendors to develop and improve solutions. Consequently, the implementation of innovative patient-centered solutions can be challenging and limited, and digital health may appear more as a standardized selection rather than customizable individual collections. These

findings align with the observations presented by Robinson et al. (2021) and emphasize the individual characteristics of digital needs in healthcare.

→ The identified potential affordance of "*adapting the digital health system to meet the digital needs of different subunits of healthcare"* suggests that digital solutions should be flexibly customizable to address the unique needs of various healthcare subunits and their respective patients.

5.3.2. Potential affordances emerging from transformation of siloed data to insights

The potential affordances identified within the second theme presented in Table 5 (from data silos to consolidated insights*)* depict a future transition where fragmented data is gathered into actionable insights to support healthcare operations and healthcare professionals' decision-making. Kohtamäki et al. (2021) propose that ecosystems enable the interaction, collaboration, and sharing of resources between various network actors, leading to the creation of mutual value. In the context of digital patient-centered integrated care, this reflects a more intensive and transparent approach to generating, sharing, and utilizing data among various healthcare stakeholders (Burdett & Inman, 2021; Shah et al., 2022).

The research shows that the transition of information from paper-based archives to digitally shareable resources has provided improved opportunities for healthcare stakeholders to gain a better understanding of patients' health and the factors influencing it. Specifically, the Kanta system was found to play a significant role in promoting the availability, accessibility, and sharing of information, as supported by the results of the 2022 satisfaction survey (Kanta, 2023a). However, despite these advancements, the study implies the conversion of data into actionable knowledge to support decision-making is still insufficient. The findings suggest that the healthcare sector has been primarily focused on accumulating data rather than effectively harnessing it to enhance decision-making and patient care. Currently, the vast amount of data is gathered into multiple disjointed databases that lack communication between them, resulting in a fragmented and siloed overall architecture. This impedes the efficient transformation of data into value-adding use. In a prior study, Shah et al. (2022) have identified siloed data within the healthcare sector as a critical constraint impeding the realization of patient-centered integrated care. Consequently, the ability of information to track changes in patients' health status, proactively respond to health deviations, and provide essential insights for healthcare professionals' decision-making remains limited. According to the findings, integrating information into larger hierarchical structures to support decision-making through various dashboards, alerts,

and summaries is among the fundamental factors in converting data into value. This notion is further reinforced by the findings of the MASSE project at Aalto University (2022).

→ The identified potential affordance of *"supporting healthcare professionals' decision-making by assembling unstructured information into actionable dashboards, alerts, and summaries"* highlights the need for digital solutions to transform data into actionable decision-supporting knowledge.

Digital health emphasizes a symbiotic interaction where shared value is created through collaborative efforts among healthcare stakeholders that produce and share information for improving therapeutic outcomes (Győrffy et al., 2020). The findings indicate that digital advancements have improved patients' access to information, providing them with better opportunities to monitor and stay updated on the progress of their care. However, the transfer of information from patients to healthcare professionals still heavily relies on handwritten notes, and the utilization of digitally generated data remains limited. The results suggest that the data generated by present patient-specific digital solutions primarily concentrate on delivering general well-being-related information that does not provide significant therapeutic value, which is in line with previous studies (Mathews et al., 2019). Furthermore, although various digital questionnaires, self-assessments, and other medical devices have brought patient-generated information closer to healthcare, this information can be considered as more structured and fragmented rather than continuous and qualitatively rich information about patients' health. Shapiro et al. (2012) have previously proposed that a two-way flow of structured and unstructured information can enhance patient engagement in treatment while improving healthcare professionals' knowledge of patients' health conditions and care needs. The findings of this research support this view by suggesting that integrating patient-generated information with healthcare data can help healthcare professionals gain a more comprehensive understanding of patients' health and increase patients' involvement in care planning and implementation.

→ The identified potential affordance of *"enhancing patients' engagement in care by generating and receiving (real-time) information about their health and well-being"* suggests that patient-generated information can increase patients' knowledge, commitment, and activity in healthcare processes.

The overlap of procedures and treatment processes across various healthcare units is a widely recognized issue that undermines patient-centricity and the value delivery in healthcare services (Tolmala et al., 2019). The study's

findings indicate that the inability of digital information to track patients' care journeys reduces its value-generating effect. Challenges in accessibility, flexibility, and shareability of information within and between healthcare organizations contribute to unintegrated and inconsistent service paths where patients are not kept at the core of care. Consequently, the targeting of interventions may rely more on symptom-based assessments rather than addressing patients' actual care needs. These findings are consistent with prior research (Tolmala et al., 2019) and were exemplified by unnecessary patient visits, service gaps, and redundant procedures occurring at different healthcare contact points. Thus, the existence of information silos hinders the attainment of patient-centered integrated care by creating an uncoordinated and disease-centered service continuum where patients struggle to navigate the complexities of the healthcare network. Previously, Leijten et al. (2018) proposed that the connection between digital health and patient-centered integrated care stems from improved care coordination, more effective intervention targeting, and the establishment of personalized care experiences. In this study, the future potential of digital health was identified in its capacity to serve as a bridge between various healthcare contact points, enabling a better understanding of patients' care needs and facilitating a more efficient allocation of resources, interventions, and treatments. Therefore, these observations align with the perspectives put forth by Leijten et al. (2018).

→ The identified potential affordance of *"improving the personalized targeting of interventions, care procedures, and resources by leveraging information on patients' needs at different healthcare touchpoints"* emphasizes the transformation of data into a more personalized, continuous, and efficient delivery of care.

5.3.3. Potential affordances emerging from transformation to integrated care paths

The potential affordances identified within the third theme presented in Table 5 (from isolated to integrated care paths*)* depict a future transition where physical and digital channels seamlessly merge into cohesive care pathways. These seamless care pathways reflect the blended care model, in which patients navigate between the digital and physical realms at different stages of the treatment process. The closer integration of offline and online channels can enable harnessing the strengths of both modalities, thereby promoting more unified and flexible care pathways (Valentine et al., 2020).

The results of the study indicate that digital advancements in healthcare have opened up novel mediums for delivering and receiving healthcare services. Digital services no longer manifest as individual touchpoints, but an

increasing number of physical services have been complemented with digital counterparts in the contemporary multichannel service system. However, despite the development, digital services have not fully achieved the breadth of services, user experience, proximity, and clinical efficiency offered by physical care. As a result, they are still perceived as disconnected from physical ones, and their current role is more complementary to, rather than substitutive or parallel with, physical channels. Previous studies have reported similar observations, further highlighting the gap between digital and physical channels (Haleem et al., 2021). The study illustrates that the dichotomy between channels creates two separate service pathways that are not fully integrated, potentially resulting in fragmented and discontinuous care journeys. Iorfino et al. (2021) note that deficiencies in channel integration convey episodic rather than continuous care, which can lead to disjointed patient transitions between healthcare services. The findings of this study complement the view by implying that the dichotomy may contribute to incomplete patient navigation between healthcare services, hinder the seamless movement of patients across different stages of care processes, and undermine the value provided by the multichannel service system. Consequently, physicians recognize the importance of digital health in creating a more seamless interaction between digital and physical channels to improve the continuity of patient care.

→ The identified potential affordance of *"enhancing the continuity of care by establishing a more seamless flow for patients between the digital and physical worlds across various stages of the care journey"* underscores the need for effectively integrating digital and physical service pathways to facilitate the seamless flow of patients within the multichannel service system.

The ability of digitally delivered healthcare services to bring care closer to patients and enhance accessibility has been a critical objective of digital health in recent decades (Barbosa et al., 2021). The findings of the study indicate that the increasing prevalence of video and chat consultations has enabled the provision of medical services to a broader patient population, reduced barriers to seeking care, and emphasized patient initiative in accessing healthcare services. Despite this progress, the value provided by such digital channels appears to be limited to relatively routine care matters. The study implies that real-time communication facilitated by digital technologies primarily revolves around visual and text-based interactions, which yet cannot fully convey the diagnostic scope and certainty offered by physical care. Thus, while digital channels partly alleviate the resource burden on physical healthcare facilities, their potential to integrate healthcare services into patients' living environments on a larger scale remains largely untapped. The study shows that with advancements in digital

technology, various diagnostic devices could be more widely deployed in patients' living environments, which could expand the range of healthcare services offered through digital channels, bring the level of physical healthcare services closer to digital channels, and enhance patients' ability to manage their healthcare outside inpatient care settings. Consequently, the study's findings both reinforce and provide new insights into the development of digital health to improve access to care and bring healthcare services closer to patients (Barbosa et al., 2021).

→ The identified potential affordance of *"facilitating patients' quality of life by enabling increased access to healthcare services, improved participation in care, and better coping with illnesses in their living environment"* suggests that digital health can enhance access to care by bringing healthcare services closer to patients' living environments.

While the primary objective of digital health is to improve the delivery of healthcare services by integrating healthcare contact points and actively involving patients in care planning and implementation (Győrffy et al., 2020; Leijten et al., 2018), the evidence regarding its ability to enhance the efficiency of healthcare service delivery remains controversial (Ibrahim et al., 2022). The study revealed that the adoption of new digital channels has increased the demand for healthcare services, which has partially been reflected in the increased workload for healthcare professionals. While more and more tasks have been shifted to patients' self-performance, digital solutions are not yet able to target services effectively based on the patients' care needs. Consequently, the increased demand has tied up healthcare professionals' resources in handling service requests and directing patients within the healthcare system toward appropriate services. The results of the study suggest that digital advancements should increasingly enable automated processes in which digital solutions independently target services based on patients' identified needs. This could allow healthcare professionals to direct their resources towards adding therapeutic value, as patients individually define their service needs and solutions automatically facilitate their navigation between digital and physical services to the appropriate destinations. Thus, the findings both support and provide new insights into the challenge of balancing digital health and healthcare cost-effectiveness (Ibrahim et al., 2022).

→ The identified potential affordance of *"improving the utilization of healthcare resources by harnessing patients' activity, facilitating their transfer to the right care destinations, and promoting the adoption of self-care measures"* emphasizes the ability of digital health to leverage patients' activity in targeting services and directing patients within healthcare services.

5.4 Towards the future of digitalized patient-centered integrated care

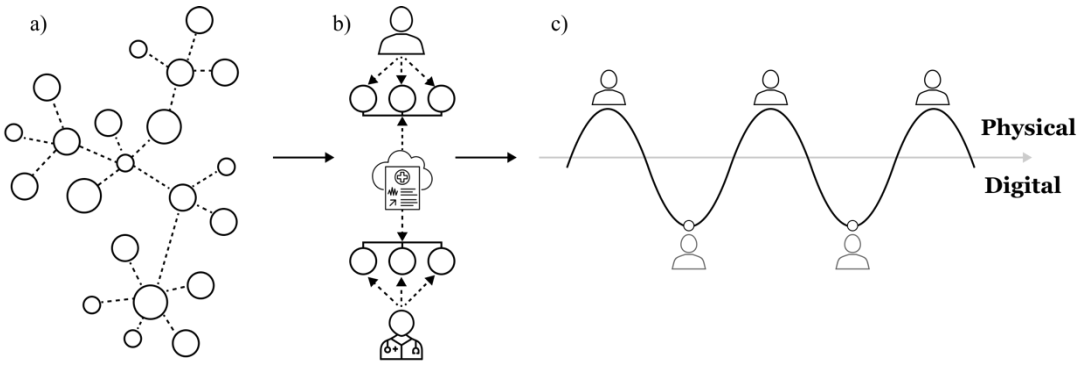

Figure 13. A speculative vision of the preferable future of digitalized patient-centered integrate care based on the three identified themes in the research: a) from a single system to a modular ecosystem, b) from data silos to consolidated insights, and c) from isolated to integrated care paths.

The thesis adopted a speculative design perspective as its overarching lens to conceptualize a theoretical vision of digitalized patient-centered integrated care (Figure 13). Speculative design is a component of critical design practice, seeking to depict potential trajectories of the future by examining how various forces may influence and reshape the existing status quo (Mitrović, 2015). Through the speculative design process, designers attempt to identify unmet needs and expectations from the current state of affairs and form a vision of the preferable future, representing a desired future from the viewpoint of specific actors (Dunne & Raby, 2013). As shown in Figure 13, the preferable future in this thesis was derived from the potential affordances arising from the three identified interconnected themes, thus reflecting the viewpoints of the interviewed e-physicians. However, it should be noted that the formed future is not intended to be an all-encompassing but rather a speculative vision to foster discussion and propel thinking of how digital health may contribute to a more patient-centered integrated delivery of healthcare services.

Point a) in Figure 13 represents the transition from a single system to a modular, decentralized ecosystem. The core of the ecosystem is not one focal system (Ruokolainen et al., 2023), but the value is generated through the synergistic interplay of several subsystems (Blaschke et al., 2019). In the envisioned preferable future, the digital requirements of healthcare would not be considered pre-defined nor limited to standardized and non-configurable possibilities of large system providers. Instead, the decentralized structure of the ecosystem would enable various healthcare facilities, units, and specialties to assemble a collection of value-adding

digital health solutions tailored to support their unique operational processes and enhance the personalized delivery of care to their patients. The integration of solutions would not be based on rigid and laborious technical implementation but emphasize flexible and agile interoperability to facilitate the synchronization of patient flow, treatment processes, and information exchange. Furthermore, the adaptive nature of the decentralized ecosystem would allow healthcare subunits to swiftly modify solutions bundles to effectively address emerging opportunities and evolving digital needs. Consequently, the speculative preferable future offers a nuanced perspective in achieving a more personalized, adaptable, and coordinated multichannel healthcare system, which reflects the characteristics of patient-oriented integrated care (Berntsen et al., 2018; WHO, 2015) and is in line with the broad objectives of the digitalization of Finnish healthcare (Reponen et al., 2021; STM, 2016).

Point b) in Figure 13 illustrates the transition from data silos to consolidated insights, where the improved flow of data through digital health solutions acts as a shared resource in facilitating closer collaboration between healthcare professionals and patients. Both stakeholders would simultaneously be resource providers and resource users in the decentralized digital health ecosystem, thus establishing a socio-technical phenomenon based on a reciprocal value co-creation process (Blaschke et al., 2019; Kohtamäki et al., 2021). On the one hand, patients would be active partners in care by utilizing digital health solutions to produce health-related information for improving healthcare professionals' decision-making, enhancing the targeting of interventions and resources, and providing more personalized care based on real-world evidence. On the other hand, digital health solutions operating on the healthcare professionals' end would aggregate information from internal sources of healthcare and consolidate it with insights derived from patient-generated data. In addition to further increasing physicians' understanding of patients' health, conveying this information back to patients would generate added value for patients by allowing them to better monitor their health and progress of care, take measures to improve their health status, and participate in the planning and implementation of care. Accordingly, the preferable future envisions collaborative healthcare where patients and healthcare professionals align around a mutual value proposition of delivering more personalized, targeted, and participatory care. Hence, the future vision complements the prior research on the synergistic connection between digital health and patient-centered care (Győrffy et al., 2020; Leijten et al., 2018).

Finally, point c) in Figure 13 depicts the transition from isolated to integrated care pathways, where the improved interaction through digital solutions merges physical and digital healthcare into a seamless care continuum. In

the envisioned preferable future, the multichannel healthcare system would consist of tightly integrated and mutually reinforcing physical and digital touchpoints. Patients' self-directed participation through digital means would produce information about care needs and automatically guide patients to appropriate services between the modalities at different stages of their care journeys. Healthcare professionals would receive timely and accurate information on patients' situations at any given time, which would reduce the overlapping work, improve the allocation of resources to value-adding therapeutic activities, and enhance the coordination of care. Access to high-quality healthcare services would not be limited to physical presence, but digital solutions would increasingly bring the same level of service to remote channels. Digital diagnostics, digital sensors and biomarkers, and self-tracking devices would allow more and more diseases to be diagnosed and treated remotely, aiding patients' coping in their living environments and reserving resources from physical facilities for patient groups unsuitable for digital care. Consequently, the preferable future represents a vision of an optimal blended care model, where the integration of offline and online worlds establishes a coordinated mix of physical and digital care (Toonders et al., 2021; Valentine et al., 2020). Therefore, the formed speculative vision aligns with the prior research of patient-centered integrated care by demonstrating a transition from fragmented and uncoordinated towards more seamless and continuous care pathways that respond to real-world illness trajectories and dynamics (Iorfino et al., 2021; Luis-Martínez et al., 2020).

5.5 Factors influencing the achievement of the future vision

The findings of the research show the realization of the identified potential affordances, and thus, the achievement of the preferable future vision, is influenced by several factors. As presented in Chapter 4.3., these factors can be broadly classified into three meta-level categories: 1) enhancing multidisciplinary collaboration, 2) developing a shared vision, and 3) establishing ecosystems for testing and integrating solutions.

The first identified category emphasizes the identification and assessment of the impacts of digital development for salient healthcare stakeholders. As frequently discussed, healthcare is formed around a multi-stakeholder network where each actor has distinct capabilities, processes, and requirements for benefitting from digitalization. Although the introduction of digital tools and services strives to enhance some aspects of the healthcare value chain, the potential effects for all relevant stakeholders may not always be considered. For instance, the findings show that too fast and comprehensive transition to digital care may reduce the accessibility of healthcare services for their most critical user groups (e.g., older generations

and multi-morbidity people), which has also been suggested in previous research (Pirhonen et al., 2020). Similarly, studies have shown that increasing the use of digital tools may jeopardize the core values of delivering equal, trustful, and safe patient care (Johansson, 2016) and cause challenges in encountering patients and nurturing meaningful patient-physician relationships (Åhs et al., 2023). Both of these factors were also referred to during the interviews. Naturally, while the introduction of digital services does not aim to hamper the accessibility of healthcare services or cause challenges in providing quality patient care, the findings demonstrate that the development of digital health may lead to unfavorable results that diminish the intended value.

As presented in Chapter 4.3., since the ever-increasing digitalization will, directly and indirectly, impact more and more actors within the healthcare value chain, it is essential to go over a static and siloed view and enhance multidisciplinary perspective in the development of digitalized healthcare. Identifying all salient stakeholders and their digital needs, engaging stakeholders in the development processes, increasing transparent communication during the development processes, and ensuring that the formed digital entity collectively adds value to the actors in the multi-stakeholder network were identified as essential factors for achieving the preferable future vision. Hence, the findings supplement the prior discussion about the essential role of multidisciplinary collaboration in achieving more integrated and user-centered digital healthcare (Kostkova, 2015).

In close connection with the previous category, the second identified category emphasizes the need to establish a systematic and shared vision for the development of digital health within and between organizations. The findings of the study suggest that digital efforts are sometimes driven by idealism rather than a clearly defined vision of what healthcare organizations should achieve through digital health. Taking these efforts for granted and pursuing new initiatives with the illusion that digitalization alone brings value can lead to a short-sighted perspective that oversimplifies the nature of digital health and neglects its potential to enhance the delivery of healthcare services. While a significant body of research often adopts a broader perspective by focusing on national and international levels, these studies frequently highlight the lack of a clearly defined vision as a central obstacle to the widespread adoption of digital health (Liede, 2022; Preston, 2021). The findings of this study support these observations by suggesting that the absence of a vision can exacerbate the disconnect between physical and digital care, hinder the usability of digital services and tools, place an additional burden on healthcare professionals, and weaken the commitment to and acceptance of digital initiatives within organizations.

The factors identified to promote the realization of the preferable future of digitalized patient-centered integrated care emphasize the necessity of establishing a well-defined vision for digital health within organizations. Digital initiatives should not be treated as passive endeavors, expected to generate value effortlessly and integrate seamlessly into practice. Instead, organizations must ensure that the vision is both consistent and embraced by healthcare professionals, allocate sufficient resources for its implementation, and remain open to revising and adapting the vision based on the feedback, user experiences, and development ideas of healthcare professionals.

Finally, the factors of the third theme go beyond the individual and organizational levels and focus on establishing appropriate institutional ecosystems for developing and evaluating digital health solutions. It is generally acknowledged that entering the highly regulated healthcare sector is arduous and requires solid clinical evidence of efficacy for any health technology solution. Maier et al. (2021) argue that many digital health solutions still fail to demonstrate their quality and effectiveness in promoting improved health outcomes, enhancing healthcare processes, and improving access to care. The findings of this study support this view and suggest that the limited adoption of digital health solutions is due, in part, to the absence of robust development ecosystems rather than insufficient innovation and development efforts. On the one hand, the current regulatory environment, characterized by its inflexible, ambiguous, and protracted evaluation processes imposes impediments for digital technology companies to validate, pilot, and scale their solutions. Specifically, the rigorous interpretation of secondary use of healthcare data was identified as a fundamental obstacle in fostering innovation in the medical (technology) field, a concern also widely recognized in previous studies (Reito et al., 2022). On the other hand, even though digital companies would have succeeded in demonstrating the required preconditions, the lack of evaluation frameworks poses challenges in determining effective and useful solutions addressing the specific needs of each healthcare subunit. Therefore, healthcare providers may face the risk of being constrained by ineffective and non-scalable technologies incompatible with the real-life needs and operational processes of each subunit.

The findings illustrate that realizing the preferable future vision necessitates the emergence of streamlined and collaborative ecosystems encompassing the entire life cycle of digital health technologies. These ecosystems should promote the interconnection of relevant healthcare stakeholders and solution developers, enabling agile and cost-efficient validation of clinical efficacy and safety for digital solutions. Once appropriate solutions are licensed, these ecosystems should extend to allow healthcare providers to effectively compare and test solutions, facilitating the identification of

optimal bundles that address their specific technical, clinical, usability, and cost requirements. These findings align with prior research emphasizing the establishment of a more objective, transparent, and standard-based evaluation of digital health solutions (Mathews et al., 2019).

5.6 The value of affordance theory for the research

While this thesis applied the affordance theory differently from its original emphasis on the relationship between specific technology and goal-oriented users (Strong et al., 2014), it provided a solid framework for examining the desired potentials for action resulting from the interaction between digital health and digitally oriented physicians.

According to Volkoff and Strong (2017) and Ostern and Rosemann (2021), potential affordances convey the future needs of various user groups regarding technology, assisting in identifying unexplored innovation opportunities and reshaping services to address existing challenges. The findings of this study support this perspective by demonstrating that discovering potential affordances and their interdependencies can cultivate a holistic understanding of the future and aid in comprehending the required directions of development between the current state and the desired future.

Previous research on the relationship between digital health and affordance theory has primarily focused on identifying affordances that arise from the interaction between specific technological components of digital health, such as electronic health records (Petrakaki et al., 2014; Strong et al., 2014), and their relevant stakeholders. However, less attention has been given to exploring future potential affordances, particularly in the conceptual context of digital health. This neglect may partially be attributed to the greater pragmatic relevance associated with the precise granularity of specific technologies or technology-mediated services (Volkoff & Strong, 2017). Nevertheless, the findings of this study suggest that identifying more abstract potential affordances at a conceptual level can offer functional benefits in understanding socio-technological phenomena and the future potentials they represent.

In the past, the affordance theory has garnered criticism for its ambiguous terminology and inclination to generalize users and technological objects within research. By concentrating on disembodied users and loosely defined technologies, there is a risk of generating a multitude of hypothetical affordances that plunge the theory into speculative territory and undermine its analytical value (Oliver, 2005). Arguably, using affordance theory inevitably led to some degree of generalization about technology and users in this study. For instance, the decision to examine digital health at a conceptual

level may not offer much for someone interested in understanding the action possibilities and impacts emerging from a specific technological component of digital health. Similarly, only a limited number of digitally oriented physicians were interviewed for the study, whereby the identified affordances do not cover all the potential action possibilities arising from the interaction of digital health and its users. On the other hand, the purpose of the study was not to arrive at all-encompassing conclusions. Instead of trying to express how things should be, the findings of the thesis provide a nuanced picture of how a limited but pertinent group of actors would envision the situation to be. The analytical value of the formed preferable future (see Chapter 5.4.) can be considered to arise from its ability to act as a discursive tool to provoke reflection and discussion rather than giving normative recommendations. Hence, the research demonstrates that identifying potential affordances offers an intriguing perspective - albeit speculative as every attempt to explain the future - for contemplating the relationship between artifacts and users.

5.7 Practical implications

Although the identified potential affordances and the envisioned future vision remain speculative in nature, the study provides a practical lens for perceiving and contemplating the ever-increasing digital transformation in the healthcare sector. The study's outcomes serve as a valuable discursive tool to ignite discussions among pertinent stakeholders on the potential trajectory of digital health in the Finnish healthcare sector. Specifically, each of the three identified meta-level themes (from a single system to a modular ecosystem, from data silos to consolidated insights, and from isolated to integrated care paths) offers concrete starting points to propel thinking and provoke critical evaluation of the required changes in the current state. By fostering a deeper understanding of these themes, stakeholders can collectively work towards achieving the envisioned future of patient-centered integrated healthcare, leveraging the opportunities presented by digital transformation.

5.8 Limitations of the study

Although the study contributes to understanding the potential implications of digitalized patient-centered integrated healthcare, it is essential to acknowledge its inherent limitations, which may warrant further consideration.

Firstly, the potential affordances and future vision were derived from interviews with only ten digitally oriented e-physicians conducted for the thesis. While these physicians can be considered to possess relevant

knowledge about the researched topic and, thus, be an appropriate target population for this study, they only constitute a portion of the diverse healthcare stakeholders impacted by digitalization. Due to the complexity of the healthcare sector, the future aspirations and expectations of 'non-digitally oriented' physicians, patients, pharmacies, social services, and other public and private healthcare organizations regarding the future of digital health may differ from those identified in this research. As a consequence, attempting to generalize the findings of this study to encompass a broader audience is not inherently feasible. Instead, the findings should be regarded as a springboard, serving to initiate discussions, provoke thoughts, generate ideas, and provide a starting point for further refinement rather than being the basis for deriving all-encompassing normative recommendations.

Secondly, it is worth noting that digital health comprises a diverse array of technologies and technology-induced components considered as given within this research framework. Since the manifestation, impacts, and future potentials of digital health were studied at a conceptual level in this thesis, attempting to link the study's findings to specific technologies or discern which technologies enable the rise of potential affordances and the envisioned future may become unfeasible. These limitations stem not only from the standpoint of the principal tenets of affordance theory but also from a practical perspective. When technology is detached from its contextual setting, it can obscure what is practically achievable and what is not, making it challenging to identify the crucial technologies and understand their interactions within the realm of digitalized healthcare.

Thirdly, the formed future vision exhibits simplifications and abductive inferences that may not align entirely with the principal tenets of affordance theory. Within the current consensus of affordance theory, a distinction is made among an affordance (representing the potentials of use for goal-oriented actors), the actualization of the affordance (referring to the actions taken), and the immediate concrete outcomes (resulting from those actions) (Volkoff & Strong, 2017). Given the temporal difference between these stages, determining the post-actualization outcome of affordance(s) is possible only after such affordance(s) have been actualized (Strong et al., 2014). Nonetheless, in this thesis, the formed future vision is derived from speculations on how the identified potential affordances may constitute the model of digitalized patient-centered integrated healthcare. Acknowledging this limitation is essential to maintain a clear distinction between empirically observed potential affordances and the abductively formed outcome of what the realization of affordances may lead to.

5.9 Suggestions for future research

Given the present condition of relatively limited scientific knowledge of both digital health and patient-centered integrated care, as separate concepts and in terms of their interrelation, any additional research would be valuable in advancing knowledge within this domain.

Each of the three identified meta-level themes in this thesis—from a single system to a modular ecosystem, from data silos to consolidated insights, and from isolated to integrated care paths—offers compelling prospects for advancing the contributions of this thesis. For instance, one could explore the intricacies of digital health ecosystem formation and the tensions arising while striving to interlink various subsystems within a complex multistakeholder environment. Furthermore, comprehending health data-sharing frameworks for facilitating value co-creation among diverse healthcare actors presents intriguing avenues for further enriching the scientific discourse in this field. Lastly, by developing an understanding of how seamless physical-digital care pathways can enhance proximity, patient-orientedness, and the flow of care, a more substantial foundation could be laid for demonstrating the positive synergies between digital health and patient-centered integrated care.

6 Conclusion

Over the past decade, the concept of patient-centered integrated care has emerged as a central topic of discussion, aiming to overcome the limitations of the traditional medical approach (Greenfield et al., 2014). Despite its multifaceted nature, patient-centered integrated healthcare strives to facilitate the development of personalized, seamless, and coordinated pathways that foster shared value between healthcare professionals and patients (Greenfield et al., 2014; Burdett & Inman, 2021). Concurrently, the evolution of digital health has ushered in new technology-driven possibilities to comprehend, manage, and promote health and well-being. Emerged novel digital tools and techniques have expanded the provision of healthcare services, promoted collaboration among healthcare stakeholders, and provided avenues for targeted interventions (Győrffy et al., 2020), thereby paving the way for the realization of patient-centered integrated healthcare (Leijten et al., 2018).

This thesis focused on developing an understanding of how digitally oriented physicians perceive the future of digital health and its potential contributions to fostering patient-centered integrated healthcare in Finland. By combining the stance of potential affordances of affordance theory with the methodological approach of grounded theory, this study identified future potentials of use (referred to as potential affordances) that emerge in relationship with digital health and digitally oriented physicians. Additionally, the speculative design mindset was employed to project identified potential affordances into an overarching future vision of digitalized patient-centered integrated healthcare.

The study's findings unveiled that digital health is an evolving multidisciplinary concept that transcends a mere technological evolution and signifies a profound paradigm shift in the provision of healthcare services. Digital health has the potential to establish a more integrated, continuous, and personalized healthcare system, with shared value co-created in collaboration between different healthcare stakeholders. The generation of this value was identified to be bound to a transition in three distinct yet interconnected meta-level themes: 1) from a single system to a modular ecosystem, 2) from data silos to consolidated insights, and 3) from isolated to integrated care paths. The identified potential affordances within each theme provide insights into the needs of digitally oriented physicians concerning the future applications of digital health. Together, they paint a picture of the transition from the current state towards the preferable future vision of digitalized patient-centered integrated healthcare.

The envisioned future portrays an adaptable, participatory, and coordinated healthcare system, seamlessly blending the digital and physical worlds to deliver cohesive and mutually supportive multichannel healthcare services. The value of the vision stems from a networked and decentralized digital ecosystem, empowering different healthcare subunits to flexibly configure digital health solutions to cater to their and their patients' unique service needs and operating processes. Within this ecosystem, digitally generated information harnessed through digital technologies serves as a shared resource, fostering a collaborative healthcare model founded on reciprocal information sharing and active involvement of patients and healthcare professionals in health-related decision-making processes. The synergy of improved interaction and collaboration integrates both physical and digital domains, creating a seamless care continuum where real-time knowledge of patients' care needs directs them to appropriate services across modalities at different stages of their care journeys. As a result, this preferable future aligns harmoniously with the principles of patient-centered integrated care, illustrating a personalized, patient-centered, and coordinated digitally induced healthcare system.

Furthermore, the research results imply that the achievement of the envisioned future of digitalized patient-centered integrated care necessitates substantial progress in three crucial meta-level categories. These categories are 1) enhancing multidisciplinary collaboration, 2) developing a shared vision, and 3) establishing ecosystems for testing and integrating solutions. The significance of these categories lies in demonstrating that the transition to a patient-centered approach is not an isolated effort but rather demands a concerted focus on engaging relevant stakeholders in the developmental processes, setting clear objectives for digital health across healthcare organizations, and adopting an agile approach to testing and implementing solutions. By effectively addressing these imperatives, the healthcare sector can pave the way for a transformative and patient-centric future, where seamless digital integration harmonizes with a patient-centric care continuum, ultimately elevating the quality of healthcare services and improving patient outcomes.

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Appendix

Attachment 1. Standard structure of the semi-structured interviews.

1. Introduction and background

- Please provide a brief introduction of yourself and your profession.
- Could you describe your work in the domain of digital health?

2. The status quo

- How would you define the term "digital health"? / What does "digital health" mean to you?
- How does digital health currently manifest in your role as a physician when treating patients?
- Which digital health technologies are you currently utilizing in your work?
- What is your perspective on the current availability of these technologies?
- For what purposes do you employ the digital health technologies mentioned above?

3. Aspirations, impacts, and goals

- What are your goals in using digital health?
- What steps do you believe are necessary to achieve your goals?
- How has digital health impacted your work as a physician?
- In what ways has digital health affected your role as a physician and your interactions with patients?

4. Inhibiting and promoting factors

- What factors do you think currently facilitate the broader adoption of digital health in your work and the realization of your goals?
- What factors do you think currently constrain the broader adoption of digital health in your work and the realization of your goals?
- Do the technologies you previously mentioned share common characteristics that either encourage or hinder their adoption and goal attainment?
    - Technological factors? (e.g., usability, features, integrability…?)

    - Internal factors (e.g., knowledge, skills, willingness of healthcare professionals and patients)?
    - External factors (e.g., organizational support and recommendations, legislation, culture, rules…?)

5. The preferable future

- In an ideal scenario where the limitations you mentioned are resolved, in which areas of your work or which specific tasks do you see digital health having the most potential?
- What expectations do you have for the role of digital health in your medical profession and patient care in the future?
- How would you envision the ideal landscape of digitalized healthcare?