Towards the integration of telemedicine in medical practice

A decision framework design supporting the implementation of an RPM application in the practice of chronic care

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Award date:
2023

Department of Industrial Engineering and Innovation Sciences

Innovation, Technology Entrepreneurship & Marketing Research Group

Master Thesis

Towards the integration of telemedicine in medical practice:

A decision framework design supporting the implementation of an RPM application in the practice of chronic care

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Date: 01-08-2023

Version: 01

Keywords: Telemedicine, digitalization, remote patient monitoring, chronic care, Inflammatory Bowel Disease (IBD), technology acceptance, organizational readiness, implementation challenges.

Executive summary

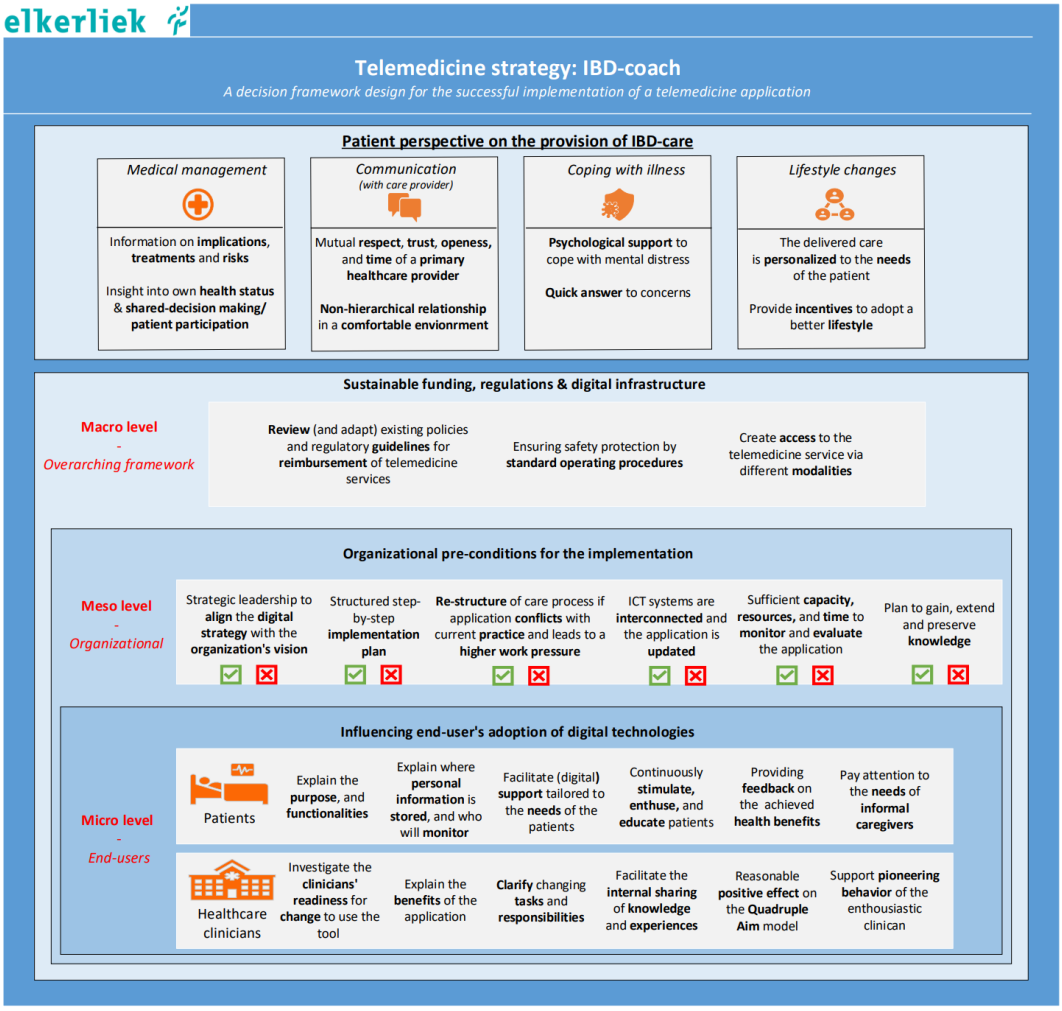
INTRODUCTION

Globally, there is a growing recognition of the crucial role telemedicine plays in addressing the public challenges of our healthcare systems. These challenges include the rising demand for healthcare services, the aging population, and the greater emphasis on self-management of health. Hence, applications of telemedicine to provide care outside the traditional clinical setting are increasingly recognized as helpful in a variety of medical specialties. When speaking of telemedicine, this study refers to "a subset of telehealth that refers solely to the provision of health care services and education over a distance where no in-person visit is required" (Rahman Mullick et al., 2020). Due to the increasing prevalence of chronic diseases and the escalating costs associated with chronic care, the integration of telemedicine into medical practice has in particular become a critical area of research in the practice of chronic care. Evidence reveals that telemedicine services are increasingly being integrated in the delivery process of chronic care to not only expand a patient's access to health services and information but also to enable periodic or continuous remote monitoring of a patient's health condition. This initiative-taking approach facilitates timely interventions, promotes better disease management, and empowers patients to take a more active role in their own health journey. Yet, while the additive value of telemedicine in the practice of chronic care is highlighted in theory, many telemedicine initiatives do not survive the research phase or become a failure in daily practice due to a variety of implementation barriers. Because of that, in the realm of telemedicine research, often the focus lies on identifying factors that influence the successful implementation of telemedicine applications. While existing literature tends to highlight barriers to implementation or focuses on evaluating the outcomes of telemedicine interventions, there is a gap when it comes to providing practical guidance or tools to aid in the operationalization of telemedicine applications prior to its actual implementation. As a result, the primary research objective of this study is to design a decision framework that supports the successful implementation of remote monitoring applications in the practice of chronic care. Furthermore, incorporating the insights gained from the decision framework, an effort is made to utilize the decision framework to ensure an effective integration of telemedicine in a practical case. The study seeks to (re)design the process of IBD care at the Elkerliek hospital since the previous integration of a telemedicine application (MijnIBDcoach) did not meet the intended performance expectations. Subsequently, in this study, the following research question is answered*: "How can the challenges that impede the successful implementation of remote patient monitoring (RPM) applications in the self-management of chronic diseases be mitigated?"*

METHOD

To achieve the main study objective, the research design of this master thesis follows the regulative cycle of the Business Problem Solving project, as outlined by van Aken & Berends (2018). In accordance with the five steps of the project cycle, i.e., (i) problem definition, (ii) diagnosis, (iii) design,

(iv) intervention, and (v) evaluation, the research strategy that is applied to design the decision framework is two-fold. First, in order to answer the research question, the criteria that impede the implementation of telemedicine applications in medical practice are examined in literature to design an initial (theoretical) decision framework. For the design of the initial decision framework, the aim was to first get and understanding of the available scientific knowledge on the patients' subjective perception on chronic care. Furthermore, in support of the adoption of a telemedicine application, this study investigated the factors that influence the behavioral intention of key stakeholders, including patients (customers) and healthcare providers, to adopt such an application. Additionally, the contextual barriers (organizational preconditions and environmental influences) impeding the implementation of telemedicine were researched. Second, based on the findings of the empirical data from semi-structured interviews, the initial design of the framework was tested and validated in practice by means of an Alpha- and Beta test. In the Alpha test, the initial design is expanded with findings from practice based on the insights of 4 experts that are highly involved in the process of IBD care and 5 patients with the chronic condition IBD. As for the Beta test, insights into a successful implementation of an RPM application in the process of IBD care at a different healthcare institution is given. Below, the main findings from the theoretical analysis and semi-structured interviews are presented that constitute the final decision framework.



RESULTS

From the decision framework, it becomes clear that telemedicine applications need to be usable and trusted by patients (customers) and health workers alike, are equitable and accessible across populations, and supported with legal guidelines for their institutionalization in medical practice. Next, it shows the importance to carefully assess the patients' (customer) needs. Additionally, it indicates that six organizational preconditions should be addressed: 1) a clear digital strategy which is aligned with the organization's vision, 2) implementation according to a structured implementation plan, 3) a well-established connection between the different ICT systems, 4) sufficient capacity, resources, and time available, 5) a critical view on the care process, and 6) a plan to retain the knowledge that is accumulated, including the continuous evaluation of the effect of the implementation of telemedicine for optimization purposes.

Following, for (re)designing the care pathway for the provision of IBD care in the Elkerliek hospital, it was investigated what changes were required in the IBD care pathway in order to have a successful implementation of an RPM telemedicine application. First, to determine what barriers occurred in the current process of IBD care at the Elkerliek, the process's limitations when using MijnIBDcoach were investigated through an explorative data analysis. The analysis confirmed that the Elkerliek was unable to stimulate a relatively large patient group to activate their profile in MijnIBDcoach, but also encourage the activated patients to continue to use the application. Second, factoring the criteria from the final decision framework, the former care pathway for IBD was discussed with experts in the process of IBD care from the Elkerliek. Through this discussion, it was revealed that the implementation of MijnIBDcoach lacked a clear strategic vision on telemedicine, and there was no structured implementation plan in place. Also, no review of the current care pathway was performed in which the task division and responsibilities within the team were further examined. Nor was a connection established between the various information systems, leading to a higher workload for the clinicians. Based on these findings, the Elkerliek made the decision to operationalize a new format of telemedicine, which required a structured redesign of the pathway for IBD care. Considering the identified limitations and barriers that hindered the implementation of MijnIBDcoach, necessary amendments were made to the care pathway to efficiently integrate the new format of telemedicine.

However, the research findings should be interpreted bearing some limitations in mind. Affecting the generalizability to use the decision framework in other health institutions, this study was single site and conducted with a small sample size. Besides, since each hospital operates in its own unique context and faces specific challenges, the (re)design of a care pathway must be customized and tailored to the needs of the specific organization and its target patient group. Therefore, in future research, one should attempt to adopt more test cases, including other health institutions or departments, to increase support of the results.

Acknowledgement

This report, executed on behalf of the MDL department from the Elkerliek Hospital in Helmond, is the result of my Master thesis project to finish my degree in Innovation Management at the Eindhoven University of Technology in the Netherlands. Within the healthcare industry, the topic of digital care is on everyone's agenda. Therefore, I am proud to contribute to this highly relevant and promising topic by conducting research on what challenges interfere with the implementation of telemedicine within medical practice.

Fortunately, I did not need to conduct this research without the support of others. During this period, a lot of people have contributed to this study, to whom I am greatly indebted. Therefore, I would like this opportunity to express my gratitude to all who have supported me in this period of graduating.

First and foremost, I would like to thank my academic supervisors Néomie Raassens and Nico Dellaert. Thank you for your feedback, clear communication and supervision in these last months. Your critical view and experience made me challenge myself to further strengthen this research study. I am thankful that both of you were eager to participate in this study.

Second, I would also like to thank all my colleagues at the department of Zorgvernieuwing and people that I met at the Elkerliek who made the past few months more bearable. From the beginning on you made me feel welcome and appreciated. In particular, my gratitude here goes out to Suzanne de Vries and Esther van den Bogaart. Suzanne and Esther, thank you for the challenges, support, and given responsibilities. Your trust, advice, and guidance allowed me to develop myself on a personal and academic level.

Finally, I want to express a few kind words to the people close to me. I would like to thank my family and friends for giving me moral support whenever needed. Special thanks to my dad and mom for the challenging questions and showing understanding at difficult moments. I am incredibly grateful for that.

I hope you enjoy reading this research study!

Jenneau (J.T.J.M) Debats

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List of Abbreviations

IBD	*Inflammatory Bowel Disease*
MDL	*Maag, Darm, Lever*
RPM	*Remote Patient Monitoring*
TPB	*Theory of Planned Behavior*
UTAUT	*Unified Theory of Acceptance and Use of Technology*
EHR	*Electronic Health Record*
PGC	*Periodic Health Check / Periodieke Gezondheids Check*
HL7	*Health industry level 7*
KCC	*Customer Service Center / Klant Contact Center*
i.e.	*That is*
e.g.	*For example*

1 INTRODUCTION

1.1 THEORETICAL BACKGROUND

Inflammatory bowel disease (IBD) has increased awareness over the last decades with latest reports showing epidemiological estimates of prevalence in IBD affecting more than five million people worldwide, and three million in Europe (Arora & Malik, 2016). In the Netherlands, on average 1 out of 200 inhabitants is diagnosed with IBD, significantly affecting the daily life of more than 90,000 patients (Ng et al., 2017). IBD, which comprises primarily 2 types of disorders: ulcerative colitis (UC) and Crohn's disease (CD), is characterized as a progressive and unpredictable disease arising from interactions among genetic, immunological, and environmental factors, which influence the immune responses. Both disorders are classified as chronic conditions that can cause inflammation and ulceration in the gastrointestinal tract (Patel et al., 2018).

The chronic progression of IBD is characterized by periods of symptomatic relapses and symptom-free phases, which commonly requires a lifetime of care (Shanahan & Bernstein, 2009). Hence, chronic diseases are disruptive for patients and place considerable demands on health service costs and labor because of their relapsing nature (Buchanan et al., 2011). Moreover, patients with IBD often require continuous follow-up to achieve long term remission, with relapses often leading to outpatient visits, hospitalizations, invasive procedures, and surgery (Kemp et al., 2013). To suppress the number of outpatient visits, cost of care, and to meet the demand for health services, health institutions are increasingly focusing on ways to enhance individuals' abilities to self-manage chronic diseases. However, the decision to prioritize self-management in healthcare entails a trade-off. On the one hand, it contributes to the fact that patients are increasingly demanding shared decision making. On the other hand, health professionals are anxious about losing control over their patient care (Kennedy et al., 2004). This poses challenges in the management of care activities for chronic diseases.

As a response, extensive research on the incorporation of information and communication technologies (ICTs) has influenced medical practice, primarily in the management of chronic diseases (George et al., 2020). Evidence reveals that patients with chronic conditions are increasingly being monitored at a distance using technological applications (Zulman et al., 2015). In addition, a study by Peris (2015) shows that the possibility to have real-time interactive communication between patients and practitioners at a distant site is increasingly used in chronic care to enhance the patients' health-related knowledge and ability to self-manage. When speaking of the integration of telecommunications and information technologies to provide remote clinical services to patients, the World Health Organization (WHO) (2020) refers to the notion of telemedicine. However, not only has telemedicine gained in attention over the years, the influence of telemedicine on the organizational performance of healthcare institutions is increasingly recognized as a result of the COVID-19 pandemic. Prior to the pandemic,

many barriers to the widespread implementation and use of telemedicine existed (Howie et al., 2022). Yet, since the onset of the pandemic, the number of telemedicine beneficiaries has exponentially increased. As a result, the advantages in clinical practice offered by telemedicine are currently increasingly recognized, leading to its wider implementation across healthcare institutions (Eprs, n.d.). Consequently, telemedicine has now emerged as a global concept that can be implemented in various clinical settings.

1.2 MOTIVATION AND RESEARCH QUESTIONS

With regard to chronic disease care, telemedicine applications of remote patient monitoring are more frequently used. Remote patient monitoring (RPM) is seen as a healthcare delivery method that uses technology to periodically or continuously monitor a patient's health outside of a traditional clinical setting (Atreja et al., 2018). This approach is particularly beneficial in managing chronic diseases as it enables early identification of potential complications and enhances self-awareness among vulnerable patients (Omboni et al., 2022). Yet, whilst the benefits of implementing RPM in the practice of chronic care are known, the implementation of such telemedicine applications remains a complex task. Despite the intensive amount of research that has been invested on the implementation barriers of telemedicine applications regarding chronic diseases, many telemedicine initiatives do not survive the research phase or fail to succeed in daily practice (Broens et al., n.d.; Hjelm, 2005; Marshall, 2013). As a contributing factor beyond the barriers encountered during the implementation of telemedicine, the stakeholders' adoption of telemedicine can present challenges and lead to implementation failures. The question remains: how can we predict the adoption behavior of the patient population for which the telemedicine practice is intended? Ajee & Sanford (2009) discovered a significant positive correlation between the stakeholder's intention regarding new IT usage and their usage behavior, also called the intention-behavior gap. To stimulate the stakeholders' intention to adopt an RPM application, one must understand which motivational factors contribute to bridging the intention-behavior gap.

Against this background, research by Jafarzadeh et al. (2022) states that a suitable platform and structure for the integration of telemedicine services is necessary for a successful implementation. Their paper mentions that no adequate decision-making framework exists that provides an overview of the determinants which influence the success of various telemedicine applications. This urgent need for the development for an 'implementation model' is also described by Barlow (2006).

To inform these efforts, this study aims to develop a consolidated decision framework which recognizes the values of all stakeholders involved in the delivery of care. By identifying and considering the criteria that impact the implementation of RPM applications, the decision framework aims to create a structured and comprehensive approach to allow a better implementation in the practice of chronic care. This results in the following research question:

"How can the challenges that impede the successful implementation of remote patient monitoring (RPM) applications in the self-management of chronic diseases be mitigated?"

The research strategy for answering the above-mentioned research question is two-fold. Firstly, it aims to gain an understanding of the reasons behind the deployment of telemedicine services. This involves exploring the specific needs of patients in the context of their healthcare management and how a telemedicine service can meet these identified needs. In addition, to determine which criteria exert influence on the implementation success rate of an RPM application, the stakeholders' intention supporting the implementation of RPM applications is investigated based on the principles of Ajzen's Theory of Planned Behavior (TPB) (Ajzen, 1991). The TPB creates a better understanding on the intention of key stakeholders to adopt RPM applications. However, besides the behavioral intention of stakeholders, other factors, e.g., organizational commitment and resources, and environmental influences affect the implementation of telemedicine services too (Tsiknakis & Kouroubali, 2009). By answering the following sub-question, barriers related to the implementation, and factors influencing the adoption of RPM applications are identified that provide a theoretical basis for the design of a initial decision framework.

1. Which determinants are found in literature to affect the implementation of RPM applications in the process delivery of chronic care?

Secondly, since the implementation of telemedicine services remains complex, it is reconned relevant to built on the available theoretical knowledge through the collection of practical perspectives from clinicians that are highly knowledgeable on the topic of telemedicine. Moreover, enhancing the chances of successful adoption, it is crucial to gain practical insights on the specific needs of patients regarding chronic care. By incorporating both the perspectives of knowledgeable clinicians and the preferences of patients, the decision framework can be better tailored to meet the unique demands and opportunities of telemedicine in the context of chronic care. With the answer to the following sub-question, a final decision framework can be designed.

2. Which criteria are recognized by end-users to be influential in the implementation of an RPM application in the process delivery of chronic care?

At last, an effort is made to operationalize the final decision framework in a use case. The final decision framework will be used to (re)design the pathway of IBD care at the Elkerliek hospital which contains the integration of a telemedicine application. Furthermore, to ensure the validity and applicability of the decision framework and the (re)design of the care pathway, it is necessary to gain insight into a successful implementation of a telemedicine application for the delivery of IBD care. As a result, the following sub-questions are formulated:

3. What changes are required in the pathway of IBD care at the Elkerliek hospital in order to successfully integrate an RPM telemedicine application?

4. How are telemedicine applications implemented in the process of IBD care in other healthcare institutions?

1.3 EMPIRICAL CONTEXT

On behalf of the Elkerliek hospital located in Helmond, research will be conducted on the operationalization of an RPM telemedicine application in the process of IBD care. The Elkerliek is a modern hospital that includes around 500 beds, with more than 120 medical specialist and over 2,000 employees which are focused on continuously improving, adjusting, and adapting work processes to increase the value of care for their patients. For the delivery of IBD care, the Elkerliek counts 5 IBD physicians, 2 physician assistants (PA), 1 nurse specialist (VPS), and 2 nurses (VP) (Elkerliek hospital, sd). Concerned by the vulnerability of IBD-patients, which was observed even more during the corona crisis, Elkerliek wants to deliver remote care to 867 IBD-patients (Zorgpad – MDL Elkerliek ziekenhuis, 2023). In pursuit of enhancing patient care and streamlining healthcare delivery, the hospital embarked on an innovative approach by adopting MijnIBDcoach, a digital solution for remotely monitoring patients with Inflammatory Bowel Disease (IBD). The primary objectives were to reduce the burden on healthcare professionals, elevate the quality of care provided to patients, and improve the accessibility of healthcare services, all without increasing healthcare costs.

With the integration of telemedicine in the care process through MijnIBDcoach, a notable change has occurred in the way patients' disease progression is monitored. Unlike the traditional approach, which relied solely on (physical) consultations, MijnIBDcoach offers the convenience of periodically monitoring a patient's health status through questionnaires in between their two outpatient visits. Furthermore, MijnIBDcoach includes a chat function that allows patients to (digitally) communicate with their healthcare provider. For clarification, a schematic representation of the care process before and after implementation of MijnIBDcoach is given in Figure 1.

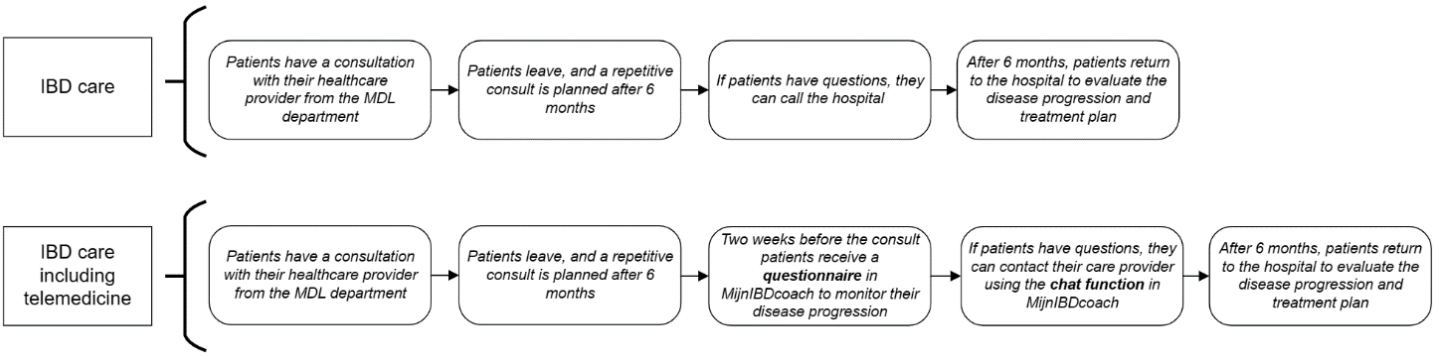

Figure 1 – A schematic representation of IBD care (Elkerliek hospital)

As for the intended impact of MijnIBDcoach, the Elkerliek expected a reduction on the number of repetitive consultations. In addition, an improvement was expected in the patients' perceived quality of care due to the possibility of being periodically monitored and the ability to easily contact a clinician. Similar, the clinicians' job satisfaction was considered to be enhanced as the questionnaires would allow them to provide more personalized care during the outpatient visits. However, after the clinicians evaluated the effect of MijnIBDcoach, the application proved to be complementary to the existing care pathway. The patients' number of visits to the outpatient clinic remained the same and, additionally, the patients' data needed to be monitored and manually stored in the electronic patient record causing a higher administrative burden, more expensive care, and a decrease in the clinicians' job satisfaction. Because of this, the Elkerliek reached the conclusion that the implementation of MijnIBDcoach did not meet their performance expectations. In light of this realization, the hospital has expressed a willingness to undertake a redesign of the care process for Inflammatory Bowel Disease (IBD). The objective of this redesign is to integrate a more effective telemedicine application that enables the delivery of personalized care remotely.

2 METHODOLOGY

To answer the research question, the research design of this master thesis follows the structure of the regulative cycle of the Business Problem Solving project described by van Aken & Berends (2018). This research methodology, originally developed by Van Strien (1997), is a well-known design methodology commonly used in practice. It involves identifying a proper problem definition and creating and implementing a solution design based on an extensive problem analysis and diagnosis. Hence, the regulative cycle is considered to be an appropriate model to design a solution for the business problem of the Elkerliek. The regulative cycle is presented in Figure 2. As shown, the regulative framework represents five different steps that involve a combination of design and research activities: (i) problem definition, (ii) analysis and diagnosis, (iii) solution design, (iv) intervention, and (v) learning and evaluation. The problem mess serves as the starting point for this research project, referring to the challenge of integrating telemedicine in medical practice.

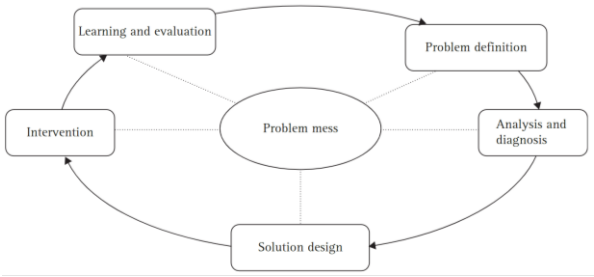

Figure 2 – The Regulative cycle according to van Aken & Berends (2018)

2.1 RESEARCH APPROACH

In accordance with the regulative cycle introduced by van Aken & Berends (2018), the following methodological choices are made underlying this research study. In Appendix 1, the research methodology is outlined to present all the methods and tools used in the five steps of the regulative cycle.

First, an initial literature review will be conducted. Moreover, oriented dialogues with doctors, nurses, and other employees of the Elkerliek hospital are held in order to get acquainted with the topic and to search for current evidence and solution-oriented interventions (van Aken & Berends, 2018). Secondly, in the analysis and diagnosis phase, academic knowledge and practical experiences are collected to meet the research objective of designing a comprehensive decision framework supporting the implementation of a telemedicine service in the practice of chronic care. For the initial design of the decision framework, relevant criteria that affect the implementation of RPM applications in the process of chronic care are derived from literature through a literature review (SQ1). Next, an empirical analysis is performed to enrich and validate the theoretical findings. Through the engagement of knowledgeable experts in the research field of chronic care, empirical validation of the identified factors in theory is enabled, while exploring new barriers that expand the current knowledge base on the challenges that impede the

implementation of telemedicine services (Lavin et al., 2007). Semi-structured interviews are held with relevant stakeholders, i.e., health professionals and (customers) patients who engage in the process of IBD care, to capture practical insights on which criteria affect the implementation of telemedicine (SQ2). Semi-structured interviews are most often used in exploratory research as it allows the researcher to cover a specific list of topic areas (Barriball, 1994). Moreover, the open structure of semi-structured interviews ensures that unexpected facts can be easily explored (Jarratt, 1996). However, according to Chung et al. (2010), socio-demographic differences, such as an individual's age, can cause variability in the technology acceptance and user behavior of the end-users. Therefore, it is analyzed to what extent socio-demographic disparities have an impact on the behavioral intention of key stakeholders to use a telemedicine service. In the third step, the solution design phase, the scientific findings and the practical insights from the semi-structured interviews are synthesized to design a (final) comprehensive decision framework.

Next, in the intervention phase, the decision framework is used to (re)design the current process of IBD care at the Elkerliek to facilitate a better integration of a telemedicine application (SQ3). To (re)design the process of care, the 7-phase model of patient journey mapping (IPJM) of Vanhaecht et al. (2012) is followed. However, because there is overlap in the steps to be taken in the regulative cycle and the 7-phase model, e.g., problem definition, implementation, and evaluation, these steps are discarded. As a result, only two steps of the 7-phase model are performed in the (re)design of the care pathway, i.e., the diagnosis and objectification of the current situation, and the development of the actual care pathway. In the last step, the learning and evaluation phase, the (re)design of the care pathway and the final decision framework are evaluated (SQ4).

The research structure that will be supportive in answering the research questions is presented in Figure 3.

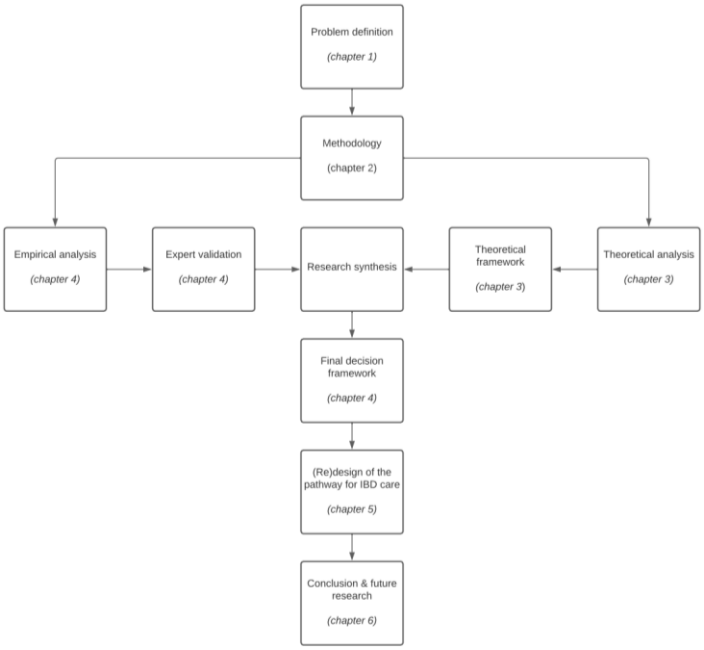

Figure 3 - Research outline

2.2 DATA COLLECTION AND ANALYSIS

In an effort to design a decision framework supporting the implementation of an RPM application in the practice of chronic care, two research approaches are employed, i.e., a theoretical and empirical analysis. Subsequently, a process analysis is conducted to (re)design the pathway for IBD care at the Elkerliek hospital. Hence, the research procedure distinguishes three phases as depicted in Figure 4. Phase 1 is considered the exploratory phase, during which the initial design of the decision framework is developed based on the findings from theory. In phases 2 and 3, the initial framework is assessed and validated. In further sub-sections, the three research approaches are explained.

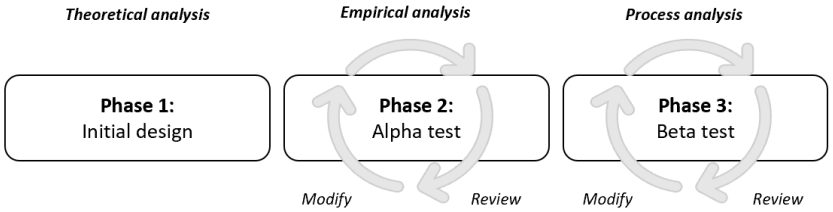

Figure 4 – Research procedure for the collection and analysis of data

THEORETICAL ANALYSIS

The theoretical analysis is concerned with extracting relevant scientific knowledge from the immense amount of literature available on the implementation of telemedicine applications within medical practice. To conduct the literature study, search strings are used in the databases Google scholar, Scopus, and ProQuest. These bibliographic databases are selected as they allow a comprehensive content coverage of relevant literature. Next, reflecting on the defined research questions, core constructs are defined that are aligned with the objective of the theoretical analysis: "*Which determinants are found in literature to affect the implementation of RPM applications in the process delivery of chronic care?"*. To increase the probability of finding high-quality academic research studies, the reach of the search strings is widened by specifying terms that refer to the same construct. An overview of the core constructs and search strings that are used in the bibliographic databases can be found in Appendix 2. As for selecting relevant literature from the attained search procedure, the results of the search commands are observed on relevance and only those articles that are published in peer-reviewed scholarly journals are selected. If applicable, the article is coded and stored on subject in the database of Mendeley. Simultaneously, a citation search strategy of backward and forward citation, often referred to as snowballing, is used to find relevant articles that are referenced in papers of interest (Wohlin, 2014). Hereafter, the selected articles are read with caution to extract all pertinent information to support the study objective.

EMPIRICAL ANALYSIS

The research design of the empirical analysis involves an explorative data analysis to examine whether the behavioral intention of key stakeholders is influenced by socio-demographic disparities. However, the main focus of the empirical analysis is on testing the initial decision framework. An iterative

approach is taken to evaluate and validate the framework via Alpha- and Beta-testing (Gold & Wolfe, 2012). The Alpha test involves analyzing the practical insights that are derived from semi-structured interviews with the customers and health professionals involved in the process of IBD care. The first step of this analysis was focused on gaining a thorough understanding of the available empirical data. This entailed getting a first impression of the available data by carefully reading the interview transcripts. Once the researcher had a good impression of the available data, the interview transcripts were coded to retrieve practical insights. To analyze the collected qualitative data of the Alpha test, a hybrid form of deductive coding followed by inductive coding of qualitative research is used. This hybrid approach is suitable for analyzing open-ended interviews (Skjott Linneberg & Korsgaard, 2019). First, to ensure structure and theoretical relevance from the start, a pre-defined list of codes is created based on preconceived themes that are found in the theory. This form of deductive coding, also known in literature as the template approach, imposes to analyze the qualitative data based on the insights retrieved from the literature review (Fereday et al., 2006). Following, inductive coding is used to seek for criteria that were not accounted for in the initial framework. Inductive coding is often used for this purpose as it allows to analyze a set of interview transcripts without being predicated on any theory or concept (Chandra & Shang, 2019).

PROCESS ANALYSIS

In phase 3, a process analysis is performed in which the current process of IBD care in the Elkerliek is reviewed. In regard to the (re)design of the pathway of IBD care, the current patient's flow is assessed and discussed with clinicians and experts of the Elkerliek to identify process inefficiencies and opportunities for improvements (Halvorsrud et al., 2018). According to the National Council for the Professional Development of Nursing and Midwifery (NCPDNW) (2006), this kind of process mining is an excellent diagnostic tool to assist in determining where barriers and blockages occur in the patient's flow through the care delivery system. First, the most important utterances from the discussions with the clinicians are grouped using affinity diagramming from which the current limitations were drawn (Remy et al., 2021). Affinity diagramming helps the researcher to organize the information that is retrieved from the discussion. Second, based on the final decision framework and initialized recommendations by the clinicians on how to improve the current provision of care, the pathway for IBD care is iteratively redesigned. The TO-BE care pathway, reflecting the desires of all stakeholders involved, consists of the patient flow and clinical activities in the process from the initial point of care to the ultimate endpoint (Halvorsrud et al., 2018). To visually illustrate the desired patient journey from the start to the endpoint, Microsoft Visio is utilized. Here, the process of the Patient Journey Mapping (IPJM) design tool is followed (George & Brown, 2023). Last, the final decision framework and design of the care pathway are validated in the Beta test by means of an expert interview that exemplifies a successful implementation of an RPM application.

2.3 PARTICIPANTS

Since the findings of the interviews are dependent on the selected respondents, only those respondents were selected that ought to be well experienced or had first-hand experiences with the digitalization of care activities in the medical sector, preferably in the practice of IBD care. To that end, respondents were purposefully drawn from a sample of employees and patients from the Elkerliek hospital who met this criteria. In total, six experts with a keen view on telemedicine and five customers in the field of IBD care of the Elkerliek hospital were asked to participate in the phases 2 and 3. Besides, in compliance with the fourth study objective, i.e., *"How are telemedicine applications implemented in the process of IBD care in other healthcare institutions?"*, other hospitals that have prior experience in implementing telemedicine in the practice of Inflammatory Bowel Disease (IBD) care were invited to evaluate the design of the decision framework. In the third phase of this study, one representative of the Zuyderland hospital was interviewed. In Table 1, the final interviewee sample is presented. For each interviewee, their years of experience, function, and the type of data collection form are noted.

Table 1 – An overview of all the participants in this research

Participants	Years of experience	Employment function	Phase of data collection
Phase 1			
Participant A	<10 year experience in the medical sector	*Project manager innovation of care*	Orientation dialogues
Participant B	>15 year experience in the medical sector	*Program manager healthcare technology*	Orientation dialogues
Participant C	>10 year experience in the medical sector	*Project manager ICMT*	Orientation dialogues
Phase 2			
Participant E	>15 year experience in the medical sector	*Nurse specialist (VS)*	Semi-structured interview – Alpha test
Participant F	>10 year experience in the medical sector	*Nurse*	Semi-structured interview – Alpha test
Participant G	>20 year experience in the medical sector	*Department manager of multiple outpatient clinics*	Semi-structured interview – Alpha test
Participant C	>10 year experience in the medical sector	*Project manager ICMT*	Semi-structured interview – Alpha test
Patient A	-	-	Semi-structured interview – Alpha test
Patient B	-	-	Semi-structured interview – Alpha test
Patient C	-	-	Semi-structured interview – Alpha test
Patient D	-	-	Semi-structured interview – Alpha test
Patient E	-	-	Semi-structured interview – Alpha test
Phase 3			
Participant D	>15 year experience in the medical sector	*MDL arts*	Process analysis
Participant E	>15 year experience in the medical sector	*Nurse specialist (VS)*	Process analysis
Participant B	>15 year experience in the medical sector	*Program manager healthcare technology*	Process analysis
Participant H	>15 year experience in the medical sector	*Nurse specialist (VS)*	Expert interview – Beta test

2.4 QUALITY OF RESEARCH

To ensure the quality of the research findings, reliability and validity methods are employed. The importance of testing the reliability and validity in research is highlighted in a research paper of Golafshani (2003), as they state that both concepts are the structure for doing and documenting high-quality qualitative research. Subsequently, the methods that enhance the reliability and validity of the research findings are described.

Reliability refers to the degree of consistency in the measurement procedure, i.e., repetition in the collection procedure will lead to the same results (Bannigan & Watson, 2009). In order to account for the personal bias which could influence the reliability of the research findings, the collection of data needs to be transparent and reproducible (Shelton et al., 2014). Therefore, in order to obtain the same results, an independent company expert of the Elkerliek attended all the discussions that were conducted throughout the process analysis. In all cases, the company expert and the researcher reached consensus over the insights that were achieved from the discussions. Moreover, an interview protocol was conducted for the replicability of research. This interviewing format has been validated internally at the Elkerliek. In addition, the interviews were processed anonymously and individually, to reduce socially desirable answers. Next, to reduce the tendency of response bias, the researcher communicated a general definition of telemedicine to all the interviewed patients. In doing so, all participants had an equal understanding of what is considered telemedicine.

Secondly, validity refers to the extent to which the research measures what it purports to measure (Collingridge & Gantt, 2008). Using multiple instruments to find emerging patterns in the Alpha and Beta test, i.e., semi-structured interviews, exploratory data analysis, and testing in practice, the validity of this research is enhanced through multiple triangulation. Multiple triangulation, i.e., theoretical and data triangulation, ensures the legitimation and completeness of the research findings (Thurmond, 2001).

3 THEORETICAL ANALYSIS

In this chapter, the findings from the literature review are presented and discussed, serving as the basis to address the first sub-question: *Which determinants are found in literature to affect the implementation of RPM applications in the process delivery of chronic care?*

To answer this sub-question, the study investigates the perceptions of patients regarding the delivery of chronic care and the impact of telemedicine on their healthcare experience. This exploration aims to understand how a telemedicine application can effectively cater to the needs of patients with chronic diseases. Additionally, the researcher delves into the existing scientific literature on the stakeholders' behavioral intentions concerning the adoption and utilization of telemedicine applications. Furthermore, the contextual implementation barriers that may arise during the integration of Remote Patient Monitoring (RPM) applications in the delivery of chronic care are explored. These barriers encompass challenges within both the direct and indirect organizational environment. Accordingly, the research funnel of the theoretical analysis consists out of three sections, which are depicted in Figure 5.

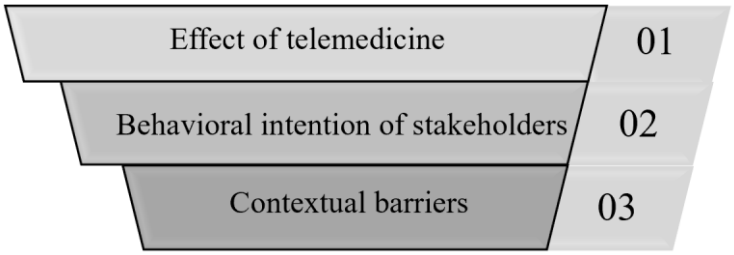

Figure 5 - Research funnel

3.1 THE EFFECT OF TELEMEDICINE

3.1.1 The evolution of telemedicine

Telemedicine has revolutionized the way healthcare is accessed and delivered, bridging the divide between providers and their patients throughout the years. Traditionally, both the clinician and the patient needed to be present in the same place and at the same time to achieve equitable access to healthcare (Argy & Caputo, 2006). Rahman Mullick et al. (2020) mention that the history of telemedicine, the area where these latest information and communication technologies are committed to the exchange of high-quality healthcare over a distance, began with the development of technological innovations. The telephone is considered the kick start of the modern telemedicine as we know it now (Kumar et al., 2021). According to research by Mermelstein et al. (2017), the telephone was the first viable medium of telemedicine to enable the exchange of healthcare information, when medical care was limited to the radius in which physicians were available. Besides these new methods of communication, telemedicine has developed because of the frontier efforts by organizations and individuals. For example, individuals like the Dutch physician, Willem Einthoven, who notified the

promise of telemedicine by demonstrating the feasibility of telephonic transmission of heart sounds over a distance of nearly 1 mile (Bashshur et al., 2013).

The availability of these consecutive technologies enabling communication between distant parties has had its impact on the evolution of telemedicine (Duplaga & Zieliski, 2007). The first objective of telemedicine was to assist in the delivery of healthcare to patients who were geographically distant from the physicians or a medical center (Zundel, 1996). Today, telemedicine is recognized on a world level, resulting in different implementations depending on various health services (Ramos, 2010). As a result, due to the wide scope and various health areas in which telemedicine is used, no uniform definition of telemedicine exists in literature (Bashshur, 1995). A wide spectrum of terms with similar meaning, e.g., telemedicine, telehealth, and telecare, refers interchangeably to the use of technologies to deliver health services. Even though the core of these definitions is the same, significant differences remain between these terminologies (Tulu et al., 2005). To clarify the boundaries and enhance the readers' understanding and meaning on telemedicine, an overview of the definitions found in literature is presented in Table 2. To enhance the reliability of the research findings, the most overarching telemedicine definition of Rahman Mullick et al. (2020) is communicated to the respondents of the semi-structured interviews who are not familiar with the term "telemedicine".

Table 2 - Definition of telemedicine found in literature

Telemedicine Definitions		
No.	**Statements**	**References**
1	*"The practice of medicine without the usual physician-patient confrontation via interactive audio-video communication systems".*	(Bird, 1972)
2	*"Telemedicine simply delivers healthcare and the exchange of healthcare information across distances using telecommunication technologies"*	(Subba Rao, 2001)
3	*"The use of telecommunication technology to assist in the delivery of health care".*	(Aas, 2007)
4	*"Telemedicine is defined as the use of advanced communication technologies, within the context of clinical health that deliver care across considerable physical distance".*	(Breen & Matusitz, 2010)
5	*"Telemedicine signifies the use of ICT to improve patient outcomes by increasing access to care and medical information. The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities."*	(World Health Organization (WHO), 2010)
6	*"Telemedicine is a subset of telehealth that refers solely to the provision of health care services and education over a distance, through the use of telecommunications technology. Telemedicine involves the use of electronic communications and software to provide clinical services to patients without an in-person visit".*	(Rahman Mullick et al., 2020)

3.1.2 Patients' perception on the provision of chronic care

According to the Common-Sense Model of Leventhal et al. (1992), subjective perceptions of a chronic disease, rather than its objective characteristics, encourage health-related behavior of patients. More specifically, the model proposes that beliefs play a leading role in motivating individuals' decisions to engage in actions that are concerned with the care they receive (Hagger & Orbell, 2022). Facilitating an understanding to satisfy the patient's personal values, needs, and wishes regarding the delivery process of chronic care is therefore fundamental for a successful implementation of a telemedicine application. This is supported in research of Asua et al. (2012) and Lindenberg et al. (2022), who showed that telemedicine applications of remote monitoring must be adaptable to the demands of chronic patients in order to be successful. They mention that if the remote monitoring applications can be integrated into the patient's lifestyle and personalized to satisfy the patient's personal values on chronic care, the motivation among patients to adopt the application is improved. Therefore, the patient perspective on the provision of chronic care is researched beforehand.

When looking at the rising prevalence of chronic diseases, it becomes clear that, persisting over time, chronic diseases have significant impact on the patients' quality of life (Lawn & Schoo, 2010). Patients are struggling with their disease not only because it affects their physical health and functions, but also their autonomy, freedom, and identity (Gullacksen & Lidbeck, 2004). Because of this, health organizations are looking for possibilities to enhance patients' responsibility in the day-to-day care of their chronic illness. Self-management is such a possibility that is becoming a core component in the management of long-term conditions (Wagner, 1998). To assess the patients' perceived self-management tasks and support needs with a chronic disease, Bayliss et al. (2003) distinguished four dimensions of self-management tasks: (i) medical management, (ii) communication with healthcare providers, (iii) coping with consequences of the illness, and (iv) making lifestyle changes. The different supporting needs, which can be classified in these four categories, are further explained.

First, the need for medical management is related to the empowered healthcare consumer to be increasingly involved in its own healthcare decision making. Factors such as a higher accessibility and continuity of care is demanded among patients which involves access to information concerning their diagnosis and implications, available treatments and their consequences, and the potential impact on the patient's future (Huygens et al., 2016). Furthermore, Huygens et al. (2016) mention that drug management support, i.e., explaining and reminding the patient of the necessity to take the medicine, and symptom management support, i.e., acquiring information about the health condition, are important needs which are identified in the medical management of chronic diseases. Second, for the patient-physician relationship, patients are valuing mutual respect, trust, transparency, and time for communication (Zizzo et al., 2017). As these patients are struggling with a long-term life threat, they value a non-hierarchical relationship with their healthcare provider in which they are able to address their concerns about the chronic disease. As such, patients value a transparent, informed, and sensitive

communication with the clinician to enhance their reassurance. Third, since patients are confronted with the daily challenges and future uncertainty of living with chronic illness, many experience mental health related problems, including fatigue, pain, and depression (Keles et al., 2007). As a result, these patients need psychological support in order to cope with distress about their symptoms or complications. Finally, besides this strategy to manage stress, support in lifestyle and behavior helps in preventing the progression of the chronic disease. Patients that suffer from a chronic disease have difficulties following recommended exercise and dietary plans (Kerr et al., 2007). Therefore, these patients desire support or incentives that help to adopt a healthy eating diet and become more physically active.

3.1.3 Promise of telemedicine

An innovation in healthcare fails or succeeds by its purpose and expected result. Research by Damschroder et al. (2009) supports this statement by mentioning that the extent to which there is a match in the stakeholders' needs and intended result of the telemedicine service determines whether an application is considered to be effective. It is therefore important for the decision makers of health organizations, who are willing to implement a telemedicine application, to question and evaluate its impact at the start of the implementation: What are the benefits of the application for the patient compared to the regular care process, and can the application enhance the effectiveness and efficiency of care provided by the healthcare professionals? Therefore, besides investigating the patients' needs as described in Chapter 3.1.2, the intended result of telemedicine services is investigated.

In literature, evidence shows that telemedicine contributes to the perceived feeling of control of patients, as they become an active member of their own care team (L'Esperance & Perry, 2016). Furthermore, telemedicine provides the ability for patients to address complaints or ask for advice on their health problems, as it allows patients to virtually interact with the clinician (Monaghesh & Hajizadeh, 2020). These virtual visits enhance the convenience and lower the travel costs for patients (Rossano et al., 2022). But what is the operational impact of telemedicine applications on health organizations? According to Williams et al. (2018), telemedicine should have a positive impact, permitting among other opportunities, to have better diagnostic and therapeutic services, faster and easier access to medical knowledge, and enhanced communication between healthcare providers. However, these expected results of telemedicine services are not completely straightforward. Varying evidence is found in literature on the accessibility, quality, and cost of care through the use of a telemedicine program. For example, a report of a telemedicine experience for the home care of chronic patients suffering from chronic obstructive pulmonary disease (COPD) showed a significant improvement in the patient's health as a result of close contact with a care team without requiring frequent visits (de Toledo et al., 2006). Contrary, the report of Auener et al. (2021) showed different effects on this number and duration of (re)admissions, and health care costs for patients with a chronic heart failure.

It appears that the use of telemedicine can have a positive effect on various aspects of care for the patient, but the specific added value for health organizations and indirectly for the healthcare providers has not

yet been clearly demonstrated. This often causes the inclusion of healthcare providers to stagnate, as healthcare professionals are not convinced or motivated by the added value or they do not recognize the effect of telemedicine after the implementation (Hjelm, 2005). Because of this, healthcare institutions cannot implement a telemedicine application without a true understanding of the system-level problem they seek to address (Liddy & Keely, 2018). Instead, at the start of the implementation, the operational impact of the telemedicine application needs to be evaluated. For example, does the health organization intend to reduce the number of (re)admissions? Or is it intending to increase the quality of care for their patients when implementing a telemedicine application? A model which hospitals frequently use to analyze the operational impact of a telemedicine program implementation is the Quadruple Aim (Kalwani et al., 2021). The Quadruple Aim is a widely adopted framework which encompasses four achievement goals: improving population health, reducing costs, and enhancing the patient and clinician experience. With the Quadruple Aim framework, hospitals have a standardized approach to analyze the effect of the telemedicine application on all four achievement goals to prevent excessive costs, poor adoption, and ultimately failure. In doing so, hospitals are able to predict and communicate the intended result of the telemedicine application, which increases the probability that the implementation of the application is successful.

3.2 STAKEHOLDERS' INTENTION TOWARDS TELEMEDICINE APPLICATIONS

3.2.1 The influence of acceptation among stakeholders

Besides the degree to which telemedicine applications align with the patients' needs in the provision of chronic care, and the operational impact telemedicine can have, the behavioral intention and actual use of the individual stakeholder is considered a pivotal factor in determining the success or failure in any implementation of a new technology (Dillon, 1996; Greenhalgh et al., 2017; van Dyk, 2014). The Stakeholder's resistance to change is often the reason telemedicine initiatives fail. Hence, a lot of research has been performed related to the topic of bridging this intention-behavior gap of stakeholders, including the enhancement of stakeholder's readiness and acceptance of information technologies (Davis, 1989; Luszczynska & Schwarzer, 2015; Rogers, 2010). The structure-process-outcome framework of Hebert & Korabek (2004) is an example of a framework that presents the individual and organizational factors affecting the diffusion of innovations. At the individual level, readiness for changes involves initiating and perseverance in implementing change and cooperation (Jennett et al., 2005; Shea et al., 2014). This is also mentioned by Weiner (2009),who states that readiness for change is the extent to which an individual or group is cognitively inclined to accept, resolve, and implement a particular plan to purposefully alter the status quo.

But which appropriate measures can organizations take to encourage the user's readiness for change? The Unified Theory of Acceptance and Use of Technology (UTAUT), presented in Figure 6, is an accumulation of various research efforts in which the goal is to identify the factors that have an impact on the predictability of user acceptance in the context of a technology usage environment (Ahmad,

2014). The UTAUT indicates that there are four theoretical constructs that significantly influence the stakeholder's readiness for change (Venkatesh et al., 2003). As shown in Figure 6, the direct determinants of the Behavioral Intention to Use and the Actual Use are: (i) performance expectancy, (ii) effort expectancy, (iii) social influence, and (iv) facilitating conditions. The definitions of the four constructs are adopted from the research paper of Venkatesh et al., (2003). First of all, performance expectancy is described as the extent to which an individual believes that the system helps him or her to improve its job performance. Second, effort expectancy is defined as the degree to which an individual experiences convenience in using the system. Thirdly, social influence is considered the social pressure of important others to use a system which is recognized by the individuals. At last, the facilitating conditions are the organizational, and technical support that an individual receives in order to reduce any obstacles.

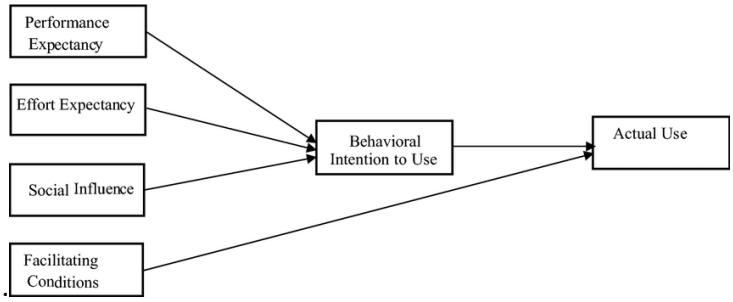

Figure 6 - Unified theory of Acceptance and Use of Technology (UTAUT), (Venkatesh et al., 2003)

In Table 3, an overview is given of all the factors that were found in the extensive literature research to have an impact on one of the four theoretical constructs of the UTAUT. These factors are described to indirectly affect the intention of patients and clinicians to use a telemedicine application and are thus important for organizations to discuss. In the following subsections, the factors are further explained.

Table 3 - Factors influencing the stakeholder's intention towards telemedicine applications

Construct	Dimensions	Factors
Patient's acceptance	*Performance expectancy*	• Time investment of the patient • Data security and therapy trust • Fear of losing face-to-face interaction
	Effort expectancy	• Digital literacy and access • Evaluation of health-benefits
	Social influence	• Integrating informal caregiver needs
	Facilitating conditions	• Matched organizational & technical support
Clinician's acceptance	*Performance expectancy*	• Trust • Feeling of control over the patient
	Effort expectancy	• Professional confidence / self-efficacy • Workload
	Social influence	• Pressure of coworkers
	Facilitating conditions	• Training & resources • Alignment with professional roles

THE TECHNOLOGICAL ACCEPTANCE OF PATIENTS

As the patient is viewed as the end-user of the digital application, their usage and adaptation play a crucial role in determining the success of the implementation. First, in order to improve the patients' performance expectancy, i.e., encouraging his believe in the telemedicine application, it helps to clearly address the purpose of the innovation and facilitate digital support tailored to the needs of the patient (Harst et al., 2019; Venkatesh & Bala, 2008). If the patient is not being convinced of the application's value, the likelihood that s/he is willing to invest time to effectively utilize the technology is low. Convincing the patient about the purpose of the telemedicine application is also important as patients are often concerned about a loss in face-to-face interaction with the clinicians, and they express unease about the safety and security of sharing confidential information through a digital platform (Lennon et al., 2017).

Second, the effort expectancy, or perceived ease of use is increased by continuously stimulating, educating, and enthusing the patients. The convenience of patients to utilize the telemedicine program is in the first place increased by providing timely feedback and communicating the health benefits that are achieved with the telemedicine application (Nolte et al., 2018). In addition, particularly at the start of the implementation, there are patients who are willing to use the application, but they simply do not have the digital skills or access to interact with the application. For example, the gradual decline in the perceptual and cognitive faculties with advanced age could reduce older patients' adaptation to constantly changing technologies in telemedicine (Alsabeeha et al., 2023). Not only people with low digital capabilities, but also illiterate or visually impaired patients are frequently experiencing problems using telemedicine services. These people need technical and organizational support that matches their preferences to improve their usability with the digital technology (O'Connor et al., 2016). Therefore, hospitals must seek to organize and structure facilitating conditions that help these patients to be more comfortable with the application.

Social influence appears to be important for patients but less important for health care providers (Harst et al., 2019). In fact, informal caregivers such as the patient's family are becoming more involved in the process of delivering care. For example, family members play a significant role in the assistance of self-care. As a result, for the effective management of their illness, patients are increasingly requiring appropriate medical options that will suit themselves and their families. Therefore, informal caregivers are considered indirect-end-users that need to be increasingly recognized as relevant stakeholders in the provision of chronic care (Kim & Park, 2012).

THE TECHNOLOGICAL ACCEPTANCE OF THE HEALTHCARE PROVIDER

Besides encouraging the digital perception of the patient, it is important to improve the satisfaction of the healthcare provider. Without the clinicians' support, a telemedicine service is not utilized within the organization and can therefore not be successful. As a result, clinicians must be motivated to put the

telemedicine service into practice and enjoy its usefulness. To improve the clinicians' satisfaction and perceived usefulness, Jonasdottir et al. (2022) state that it is necessary that healthcare professionals understand, get to know, and utilize a system to improve their work, instead of them treating the technology as an additional tool to their current practice. The factors influencing the performance expectancy and effort expectancy are further explained.

Perceived usefulness, also known as performance expectancy, is positively related to the behavioral intention of clinicians if they have a clear understanding of the innovation's immense benefits (Adenuga et al., 2017). A human factor that plays a crucial role in the clinicians' perceived usefulness of telemedicine services is the feeling of control. Clinicians need to have the feeling that they are not losing control over their patients and schedule while working with the application. Bulik (2008) reported that health care providers feel less in control of their time and the way that they perform history-taking when utilizing a telemedicine application. As a result, during the implementation of a telemedicine technology, healthcare organizations need to determine how far the clinicians are professionally prepared to embrace and adopt the telemedicine service in their current practice.

Next to that, clinicians perceive the technology to be effortless if their behavioral intention to use the service is intensified. Telemedicine services need to be compatible with the existing clinical workflow and not create additional tasks to the already burdensome services (Kissi et al., 2020). The Normalization Process Theory (NPT) of May et al. (2009) addresses this challenge of telemedicine systems to not interfere with the daily practice of clinicians, but to become routinely incorporated in a clinical setting. This is also mentioned in research by Dash et al. (2019), who state that, in order for the implementation to be successful, the technology should not interfere with the active role functioning or the clinicians' traditional practice routines. As a result, when telemedicine services conflict with the current practice of care, new agreements on the function differentiation and tasks responsibilities need to be made internally. This means that the responsibilities in the mix of providers, i.e., physician assistants, nurses, and specialists, need to be questioned in order for the telemedicine to work. Besides the fear for an increase in their workload, clinicians often do not want to spend time learning how to use an innovative technology. Self-efficacy, or the belief that the physician has in its own ability to use the telemedicine device(s), is related to the perceived ease of use (Rho et al., 2014). Clinicians are more motivated to use a telemedicine service if they are confident they have the appropriate skills to use the application efficiently.

The role of social influence in technology acceptance was already mentioned to be less important for the physicians. This is also supported in research of Han et al. (2004), as their findings showed that the effect of social influence on the behavioral intention of clinicians is insignificant. However, some studies report a significant role of social pressure among coworkers (Ketikidis et al., 2012). This means that in some cases clinicians can motivate each other in using the application. Therefore, if a clinician presents

a significant motivation and drive to use a new technology, the organization needs to react and stimulate this behavior in order for other clinicians to react as well.

Lastly, organizational and technical facilitation conditions are necessary for explaining, adapting, and securing new technologies (May & Finch, 2009). Clinicians require the right resources and knowledge to use the telemedicine service. With the implementation of a new digital innovation, sufficient training should be facilitated and clarification on changing responsibilities can be given to the clinicians in order to prevent inefficient use of the telemedicine service and confusion.

3.3 THE IMPLEMENTATION OF RPM TELEMEDICINE APPLICATIONS

3.3.1 Contextual implementation barriers of telemedicine initiatives

Although beliefs, attitudes, and intentions are the filters through which individuals normally decide whether an organization is capable of implementing a telemedicine initiative, the concept of 'individual readiness', i.e., the technological acceptance of end-users is, on its turn, influenced by the social, infrastructural, or legal environment they are embedded in (Otto et al., 2023). Therefore, the barriers within the broader health network are researched, which can be grouped according to a macro-, meso-, and micro level of analysis (Schlieter et al., 2022). In Figure 7, an illustration of the relationships between the levels is given.

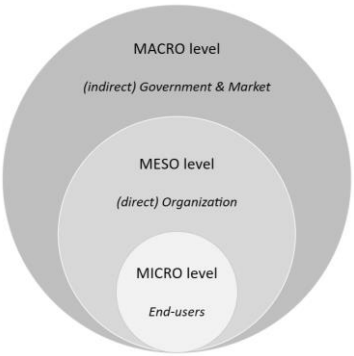

Figure 7 – Multi-level readiness for the implementation of telemedicine initiatives

The factors influencing the stakeholders' intention towards digital technologies that are described in Chapter 3.2 are key themes that only determine the individual readiness for digital health at the micro level. The macro level is concerned with the wider context of readiness which involves barriers related to the market, or governmental policies and financing, and the meso level relates to the organization in which the technology will be implemented (Lennon et al., 2017). In Table 4, the barriers of the macro- and meso level which are found during the extensive literature research are grouped by categories for an effective implementation. The category column of Table 4 is adopted from the article of Otto & Lorenz Harst (2019) in which various categories for the implementation of telemedicine initiatives into regular care are described. The article of Otto & Lorenz Harst (2019) is an extension of the D&M IS success model of DeLone & McLean (2003), which includes both barriers and success factors for an effective implementation.

Table 4 - Contextual barriers in the implementation of telemedicine initiatives

Level	Categories[b]	Barriers	References
Macro	Sustainable funding	• Unclear payment processes and reimbursement mechanisms for telemedicine services	(Leon et al., 2012), (Kowatsch et al., 2019), (Schlieter et al., 2022), (World Health Organization (WHO), 2022), (Jang-Jaccard et al., 2014)
	Cost-effectiveness	• Missing cost-effectiveness evaluation • Risk factors are not considered	(Leon et al., 2012), (Kowatsch et al., 2019)
	Regulatory	• Lack of national guidelines on data security and access • Liability issues	(Schlieter et al., 2022), (Otto et al., 2023), (World Health Organization (WHO), 2022), (Jang-Jaccard et al., 2014)
	ICT infrastructure	• Lack of internet access • Lack of institutional support	(Lopez et al., 2021, (Tromp et al., 2022), (Lennon et al., 2017)
Meso	Strategic leadership	• No alignment with strategic health goals and end-user needs • Missing digital strategy	(Greenhalgh et al., 2017), (Leon et al., 2012), (Schlieter et al., 2022), (World Health Organization (WHO), 2022), (Jang-Jaccard et al., 2014), (Lennon et al., 2017)
	Interoperability	• No integration with existing work practices • Missing link with electronic patient record (EPR) software	(Greenhalgh et al., 2017), (Kowatsch et al., 2019), (Schlieter et al., 2022), (Chang, 2015)
	Privacy and security	• Insufficient ICT infrastructure	(Jang-Jaccard et al., 2014), (Alanazi & Daim, 2021), (M. P. Gagnon et al., 2006)
	Capacity for implementation	• Insufficient resources for monitoring and evaluation • Lacking business support	(Lennon et al., 2017), (M. P. Gagnon et al., 2006), (Chang, 2015), (Jang-Jaccard et al., 2014)

[b]*: categories are adopted from the research paper of (Otto & Lorenz Harst, 2019)*

As shown in Table 4, the implementation of a telemedicine initiative in healthcare has many different facets. These eight categories indicate the importance for health organization to not solely focus on the individual acceptance of telemedicine solutions by its prospective users, but that a telemedicine implementation must also hold unique requirements to the direct (meso) and indirect (macro) organizational environment.

On the macro level, researchers have identified various barriers which are related to the financial mechanisms, regulatory assessment, and digital environment surrounding the telemedicine initiative. These barriers form the overarching framework which on its turn influences the organizational and individual layer. The national regulations and legal requirements of telemedicine are critical for ensuring quality of care, clarifying accountability, and protecting health workers and patients during the provision of remote care (World Health Organization (WHO), 2022). When care is provided via telemedicine, patients and providers often have privacy concerns about the disclosure of personal medical information which causes liability issues. Therefore, in the integration of telemedicine within service delivery models, the trust of the patients and clinicians is enhanced by the presence of safety protection in

transparent guidelines for data security and privacy (Jang-Jaccard et al., 2014). The financial concerns of patients and healthcare providers are another roadblock in the long-term financial sustainability of telemedicine initiatives (Tromp et al., 2022). The implementation of a remote patient monitoring initiative has the goal to reduce the number of physical consultations. However, in most cases a face-to-face consultation is required for a medical act to be legally valid or recognized as an official health service (Schlieter et al., 2022). As a result, with the implementation of a telemedicine service, the current payment processes and reimbursement mechanisms need to be reviewed, and if needed changed. Besides the regulation and financial concerns, the lack of internet access and institutional support is a barrier which impacts the patients' access to the telemedicine program. For a telemedicine initiative to be adopted, a sufficient digital infrastructure is required to enable a wide adoption of the digital health service (Lennon et al., 2017).

At the meso level, strategic leadership helps to align the organization's digital strategy with the health service organizational vision, and it assesses the added value of the telemedicine service for the different end-users (Greenhalgh et al., 2017). So, without aligning the digital strategy, the digital innovation will not be able to optimally address the needs of its end-users. According to Lennon et al. (2017), it is therefore important to have a digital strategy in which one must clearly define the responsibilities, requirements, and goal of the telemedicine care delivery by means of a step-by-step implementation plan. Secondly, interoperability relates to an efficient integration of the telemedicine service into the organization's existing processes and work practices (Kowatsch et al., 2019). According to Smith (2007), even the most advanced equipment will lie idle if it cannot be integrated into the routine workflow of clinicians. It is safe to say that the interoperability of a telemedicine application is therefore related to the clinicians' acceptance of a telemedicine application which is described at the micro level. So, when a telemedicine service is assessed to be incompatible with the existing work processes and practices, a re-structure of the organization's care process is necessary. Furthermore, a high interoperability of the telemedicine service means that the clinicians have the ability to use the healthcare data optimally and efficiently. This is supported by Leon et al. (2012), who mention that the telemedicine service needs to connect and be able to directly share medical information between the internal information systems. The lack of integration between the various ICT systems hinders data exchange (Greenhalgh et al., 2017). When a telemedicine application is not interconnected with the other ICT systems, clinicians are often obligated to manually convert the patient data of the application into the electronic health records resulting in an increase in workload. Because of this, clinicians will experience unease in using the technology. In addition, without the integration of the ICT systems, errors occur in this data exchange of patient data into the electronic health records, affecting the patients' privacy and security (Jang-Jaccard et al., 2014). As a result, with a better interconnected ICT infrastructure, the ease of use is improved, and safety requirements are better satisfied. Last, workload pressure and lack of capacity are recurring barriers in the introduction of a telemedicine service into everyday working

practices (Gagnon et al., 2006). Without the required resources in terms of staff, equipment, technical support, and training, the telemedicine initiative is most likely to fail. This means that organizations need to evaluate whether or not sufficient capacity is available to monitor the patients' health status and information which is collected through the RPM application.

3.4 THEORETICAL RESULTS

Based on the results, it becomes clear that all layers of the multi-level analysis are interrelated and have an impact on the success of the telemedicine's implementation, as depicted in Figure 7. For example, the use behavior of the stakeholders is influenced by factors on the micro level, which on their turn are affected by barriers on the meso and macro level. This is underlined by Dantu & Mahapatra (2013), who state that the organizational environment and governmental regulations have a significant impact on the behavior of stakeholders in the health care industry. Since the different readiness levels for change are interrelated, the initial framework is built up out of the micro, meso, and macro criteria of Chapter 3. At the micro level, interventions are defined that stimulate the behavioral intention of patients and clinicians to adopt and use a telemedicine application. Following, at the meso level, organizational preconditions are established that must be satisfied before an organization starts with the implementation of a telemedicine application. Last, the macro level represents the contextual concerns that demand the organization's attention. In addition to the three different readiness levels for adopting a telemedicine application, a fourth layer is made in which interventions are defined to meet the patients' subjective perception regarding chronic care. This layer is specifically added for the case of the Elkerliek to determine how a telemedicine application can respond to the needs that patients with a chronic disease have. By satisfying these needs, the telemedicine application has a higher chance to be adopted. This is supported by Bardus et al. (2014), who mention that technology is better accepted if it is tailored to the needs of the patients and can be fitted easily in their personal life. Based on the theoretical findings of this chapter, these four levels represent a comprehensive decision framework that adds to a structured implementation of a telemedicine application for the management of chronic care.

The initial decision framework is presented in Figure 8.

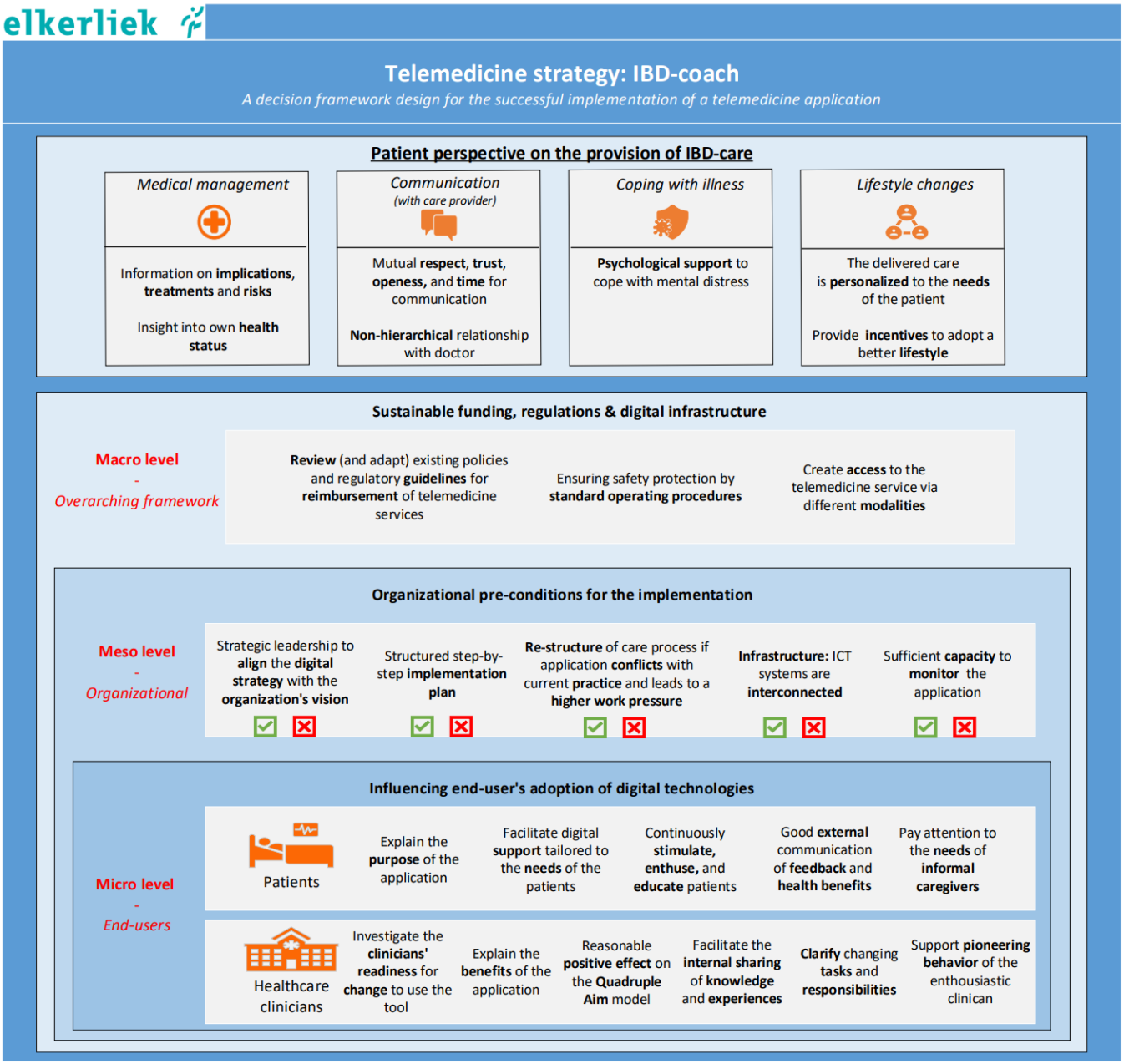

Figure 8 – Initial decision framework for the successful implementation of an RPM telemedicine application

4 EMPIRICAL ANALYSIS

The design of this chapter is two-fold. Firstly, an exploratory data analysis is performed on an activity data set of MijnIBDcoach. As a reminder, MijnIBDcoach is a digital application which allows to remotely monitor the health status of IBD-patients through questionnaires. Furthermore, MijnIBDcoach includes a chat function in which patients can easily contact their clinicians. The goal of this exploratory analysis is to get a brief illustration of the users' behavior in MijnIBDcoach, and whether this behavior is influenced by socio-demographic differences. The decision to only analyze the effect of age is made, as only information about a patient's age and gender is known, and experts specifically address the expectation that the behavior of patients is primarily influenced by a patient's age. Secondly, the main empirical analysis is conducted to answer the following sub-question: *Which criteria are recognized by end-users to be influential in the implementation of an RPM application in the process delivery of chronic care?*

The empirical analysis includes the development of an interview guide. Following, the interviews are analyzed to Alpha test the initial decision framework of Figure 8. The practical insights of the empirical analysis are used to evaluate and adapt the initial design.

4.1 EXPLORATORY DATA ANALYSIS

To assess the performance of the telemedicine application, MijnIBDcoach, the Elkerliek provided a data set in which data is stored of 155 patient profiles over a three-year period (from 2021 until 2023). Each profile represents a single IBD-patient of the Elkerliek that currently uses or made use of MijnIBDcoach. The current status on the number of IBD-patients included is presented in Table 5. For each patient profile, data is collected on the date of activation and de-registration. Additionally, the file contains information on the number of messages that are send by and to the patients.

Table 5 - Current status on the number of IBD-patients included

Number of patients activated	155
Number of patients active	121
Number of patients that de-registered	34

Using these enrolment numbers, and the collected data on the number of messages that are sent between the clinicians and patients, the patients' adoption- and usage behavior is analyzed to review the utilization of MijnIBDcoach. As the file only contains data of patients who activated the application, the findings are not completely representative to the behavior of all IBD-patients. However, the data file is analyzed to get an illustration of the users' behavior. Furthermore, the data file also consists of data about an individual's age, and gender. For both behaviors, i.e., activation and de-registration, and the use of the chat function, the relation to the patients' age is analyzed to assess whether the elderly patients are less willing to use the application. It could be, for example, possible that the telemedicine application

is only effectively used by certain subgroups of the patient population (Chung et al. (2010). This would mean that the application is successfully implemented for a specific subgroup, as it would work for a certain number of patients, but for another patient cluster, the application would not work. First, the patients' adoption behavior is analyzed by looking at the number of activations and de-registrations among all IBD-patients, and by determining the distribution of the number of deactivations per period of days. By looking at the number of activations and de-registrations, it is possible to review whether the Elkerliek was able to stimulate the patients in adopting the telemedicine application, and when they succeeded in doing so, it is determined how long the patients used the telemedicine application before deactivating. Second, the patients' usage behavior is analyzed by identifying how many messages patients, on average, send via the application.

4.2 FINDINGS FROM THE EXPLORATORY ANALYSIS

First, a complete overview on the number of IBD-patients included in MijnIBDcoach relative to the total population is given to identify whether the Elkerliek struggled in motivating patients to use the telemedicine application. The current status of MijnIBDcoach is presented in Table 6.

Table 6 - Number of patients included per age cluster

Number of patients included in MijnIBD-coach (2023)				
Age categories	*# of patients included*	*# of patients not included*	*Total # of patients*	*% included*
10 – 19 years	2	17	19	11%
20 – 29 years	**12**	**88**	**100**	**12%**
30 – 39 years	27	124	151	18%
40 – 49 years	20	120	140	14%
50 – 59 years	**30**	**129**	**159**	**19%**
60 – 69 years	26	138	164	16%
70 – 79 years	4	107	111	4%
80 – 89 years	0	22	22	0%
90 – 99 years	0	1	1	0%
TOTAL	**121**	**746**	**867**	**14%**

From Table 6, it becomes clear that only 155 out of the 867 IBD-patients activated their profile. In addition, 121 out of 867 are currently active. This means that overall, 14 percent of all IBD-patients are currently stimulated to use the telemedicine application. So, with the assumption that the Elkerliek invited all 867 patients to activate their profile, it is observed that the Elkerliek struggled to motivate a relatively large proportion of IBD-patients. But why? In exploratory conversations, clinicians state that the behavioral intention to activate the profile is mainly influenced by a patients' age. The clinicians indicate that telemedicine applications in particular receive resistance from older IBD-patients, as they would not want to use a digital application or would not have the digital capabilities to use a telemedicine application. Therefore, the expectation that age would influence the adoption and use of the application is tested. To determine whether a patient's age has an influence on the adoption behavior, the patients are grouped into different age clusters in Table 6. Indeed, the results show that adoption of patients at the age of 70 and older is significantly lower. However, contra to the expectation, patients in their 20s

were not extra encouraged to activate the telemedicine application compared to, for example, patients in their 50s. Only 12 percent of patients between the age of 20 and 29 are included relative to 19 percent of patients that are between the age of 50 and 59. These results only show that there possibly is a threshold to the adoption of the telemedicine application when patients are at the age of 70 and older.

As for the patients' adoption behavior, Figure 9 shows that relatively most of the patients were stimulated to activate their profile in the first three quartiles after the implementation of the telemedicine application. Directly after the first quartile, a drastic decrease is already visible in the number of users who registered by activating their profile. In the first quartile, 49 people activated their profile compared to 32 in the second quartile.

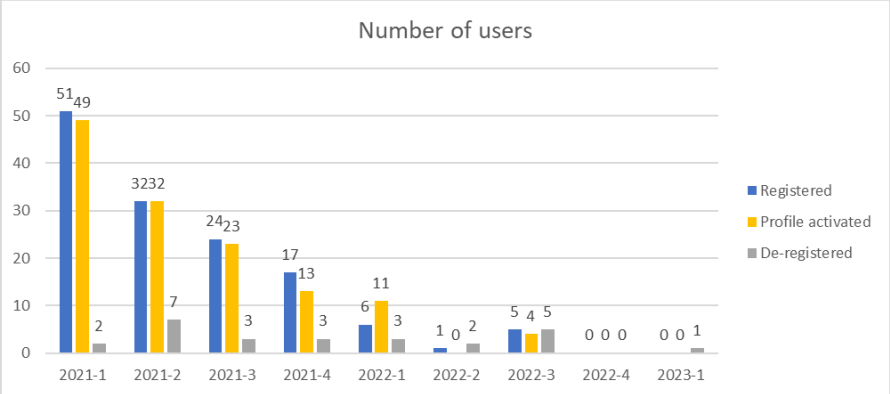

Figure 9 - Number of MijnIBDcoach users (2021-2023)

Next, the distribution of the number of deactivations per period of days (as shown in Figure 10) has a somewhat similar shape as an exponential distribution, which means that it occurs more frequently that patients deactivate relatively quickly. For example, there are 6 patients who already deregistered within the first 50 days after activation.

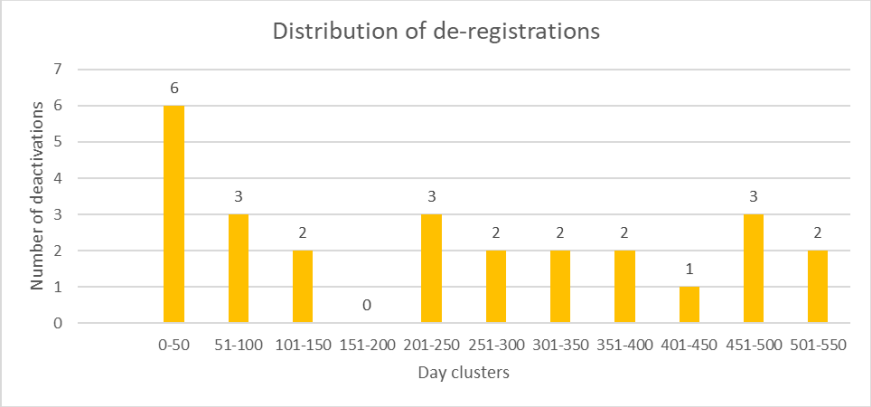

Figure 10 - Number of de-registrations per period of days in MijnIBDcoach

From the results on the patients' adoption behavior, it becomes clear that the Elkerliek's current practice was ineffective in motivating patients to activate their profile over a longer period of time. This could be caused by the fact that clinicians were not experiencing the advantages of the application and were therefore not encouraged to stimulate the patients either. Also, when patients were eventually motivated to use the application, 34 out of 155 patients de-registered which means that 22 percent of the activated patients did not experience enough benefit from the application.

As for the patients' usage behavior, Figure 11 clearly shows that the included IBD-patients consistently used the application's chat function to contact their clinician over the period of 2021 until 2023. It can be observed that after the second quartile, a drastic increase occurs in the number of messages that are send to the patients. It is possible that after the second quartile the clinicians tried to increase the effective use of MijnIBDcoach by sending out more messages. In addition, it can be noted that in the last quartiles progressively fewer messages are sent. Therefore, it seems that clinicians are also less motivated to use the application. When analyzing whether a patient's age had an influence on the number of messages that they sent, only a small effect was found (see Appendix 3). Figure 12 shows that, on average, only patients at the age of 70 and older were using the chat function less compared to the other patient categories.

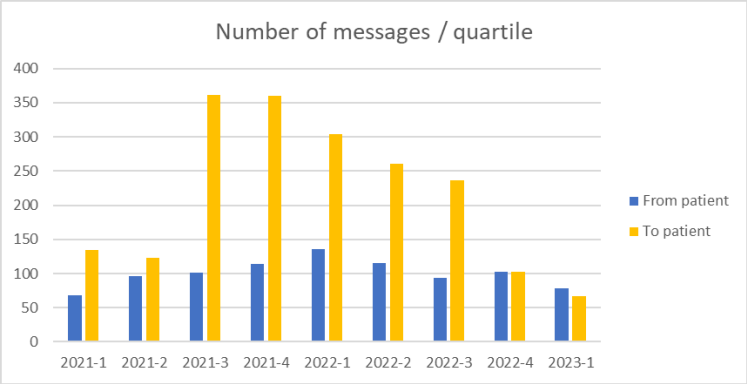

Figure 11 – Depiction of the number of messages send in MijnIBDcoach

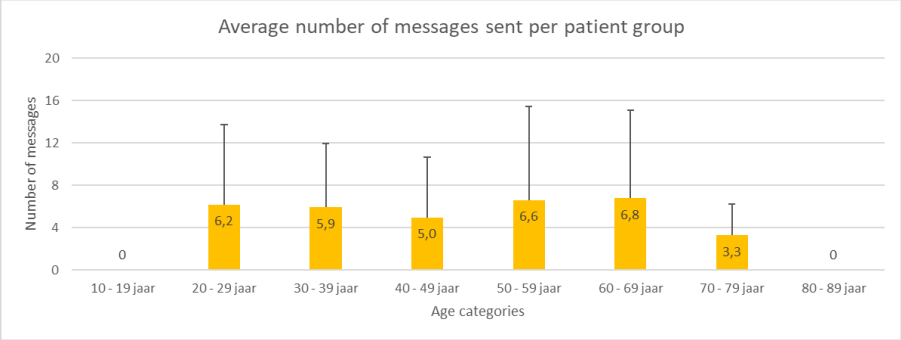

Figure 12 - Average messages send per patient cluster in MijnIBDcoach

With these results, it is confirmed that it was difficult for the Elkerliek hospital to stimulate all patients to activate their profile, but also encourage the activated patients to continue to use the application. Over the whole period, the results reflect a decreasing tendency on the number of activations. This can be the cause of demotivated clinicians who stopped inviting patients to activate their account. Influencing the behavioral intention of the patients is, therefore, a primary area of concern for the Elkerliek to make the implementation work. A different strategy for the inclusion of patients is necessary. Furthermore, it was shown that the application was on average somehow equally used by almost all the different subgroups of age. Only patients over the age of 70 have a somewhat deviant behavior. However, outside this boundary, results do not show a significant effect of a users' age on the adoption-, and usage behavior. Therefore, the expectation that the elderly IBD-patients of the Elkerliek are unwilling or unable to use a telemedicine application is not supported, except for patients older than 70.

4.3 INTERVIEW PROCEDURE

For a systematic collection and analysis of interview data, an interview guide is developed. The guide consists of open-ended questions to identify the behavioral factors and other criteria that are considered to affect the implementation of RPM telemedicine applications in medical practice according to IBD-patients and healthcare professionals of the Elkerliek. Evidence in literature is found that an appropriate interview protocol contributes to the quality of the gathered data as it would facilitate in the researcher's ease of analysis (Taherdoost, 2022). An interview protocol is an instrument of inquiry, i.e., a guide consisting of themes and guiding questions, to retrieve specific information related to the aims of the study (Jacob & Furgerson, 2012). Hence, the protocol is used by the researcher as an interview guide to address all the predetermined topics of interests. The interview guide covers the main topics of this study: (1) the subjective perception of patients' regarding chronic care, (2) behavioral intention of patients and clinicians to use the telemedicine application, and (3) contextual implementation barriers. Additionally, the initial framework of Figure 8 will be discussed with the interviewees to elicit additional insights as showing the initial design will potentially provoke new modes of thought amongst the respondents. The final interview guide and preliminary coding scheme, which is approved by a representative of the Elkerliek, can be found in Appendix 4.

Overall, 4 interviews with experts from the Elkerliek and 5 interviews with IBD-patients were held. As for the procedure, the interviews were, respectively, held in an office room, and via the mobile phone. If possible, the patients were asked to participate via Microsoft Teams to make the conversation more personal, which enhances the patients to give less biased answers (Seitz, 2016). The interviews were conducted separately to avoid the chance of interviewees affecting each other's opinion. Also, at the start of the interview, all the participants were notified about the purpose of the interview, the duration (on average 30 to 45 minutes), and the patients were told that this research would not affect their treatment. In addition, all participants were asked for permission to record their answers and were informed that the transcripts are anonymized. In any case, the participants gave permission to record the interview. Next, the interview transcripts are sent to the interviewees to debrief the provided answers and to reaffirm that the respondents' answers are dealt with in the strictest confidence (Cairns & Cox, 2008). After the final interviews, the researcher noticed that saturation was reached, as (almost) no new insights were emerged, and no additional themes about the subject were gained (Weller et al., 2018).

Furthermore, for the sequence of questions, a funnel technique is used to avoid influencing user behavior or perceptions as much as possible (Ikart, 2019). With this technique, detailed information on the primary topic of interest could be progressively retrieved while making the respondents feel at ease. Hence, to stimulate the interviewees to share their individual experiences and unbiased opinion, broad-open questions about the respondents' company function, professional background, and perception towards digital care are asked at the beginning of the interview (Seitz, 2016). Following, the respondents are confronted with critical questions to retrieve their thoughts on, for example, the use of telemedicine

in medical practice. Yet, as the goal of the semi-structured interviews with IBD-patients is mainly to identify the customers' needs in coping with a chronic disease and their attitude about using a telemedicine application that will be used to monitor their health status, no questions are included in the patient interview protocol that relate to the contextual implementation barriers of the initial framework.

4.4 ALPHA TEST: EXPERT DATA ANALYSIS

In this section, the findings from the qualitative data that were collected in the semi-structured interviews are discussed. The qualitative data analysis software QDA Miner is used to analyze the interviews, where each interviewee is seen as a single entity. QDA Miner is a relevant tool which is used to code and transcribe empirical findings (Lewis & Maas, 2007). Following the hybrid thematic approach as described in section 2.2, the quotes of interviewees are first categorized using the preliminary coding scheme to support the findings of the literature review (Skjott Linneberg & Korsgaard, 2019). Next, the sections of the qualitative data that do not correspond to the earlier identified (theoretical) insights are inductively coded. Hence, additional codes were derived from quotes that did not relate to the pre-defined list of themes to identify practical insights that were not yet included in the initial decision framework of Figure 8 (Chandra & Shang, 2019). These additional codes are presented in Table 7, which helps to identify the practical insights that were not accounted for in the preliminary coding scheme. The final coding scheme can be found in Appendix 4. Furthermore, after all the interviews were coded, a cross-case analysis is conducted to enhance the empirical generalizability by showing commonalities and differences across the interviewees (Miles et al., 2009). By reviewing the communalities and differences, the main themes are better identified and distinguished from other categories. In Appendix 5, the results from the cross-case analysis are presented.

Table 7 – Coding scheme presenting the practical insights from the semi-structured interviews

Categories	**Codes**	**Sub-codes**
(1) Subjective perception of the patient's needs regarding chronic care		
Medical management	Shared decision making	Patient participation
Communication	Patient-physician relationship	Primary healthcare provider, environment
Coping with illness		Direct answer to questions, medication, recovery
(2) Behavioral intention of patients and clinicians to use the telemedicine application		
Performance expectancy	(Dis)Trust	Fear of unobserved symptoms, native language, digital interference, explanation of functionalities, information storage
	Time investment	Unnecessary burden
Facilitating conditions	Learning from others	
(3) Contextual implementation barriers		
Interoperability	Use of healthcare data	Up to date information, updated application
Capacity for implementation	Resources	Time
	Sufficient expertise and knowledge	Team composition
Knowledge accumulation	Knowledge retention	Partnerships, benchmarking
	Testing	Impact / effect analyses

Overall, the interviews revealed that the initial decision framework was quite comprehensive already. Nevertheless, based on the findings of the qualitative data analysis, some minor adjustments are made to the four layers of the decision framework. In this section, interviewee quotes will be used to support the most important adaptations that are made to the initial decision framework. First the interpretations of the researcher are presented, which are subsequently underlined with statements of the interviewees.

PATIENTS' NEEDS REGARDING CHRONIC CARE

From the interviews, it becomes clear that patients with a chronic disease value to have control over their own disease in terms of being able to participate in their own care trajectory, but also by deciding which topics to discuss with the clinician. *"I would like to participate and decide even more on my own treatment plan" (Patient B).* And, as corroborated by another patient: *"I like having the authority to change the doses of my medication" (Patient D).* Therefore, shared-decision making is an additive supportive need for the medical management task. Furthermore, one patient mentioned that: *"I really like that I have one contact person who answers my questions almost always at the same day" (Patient E).* Besides having a quick response from a clinician, another patient indicates that: *"I am more comfortable to ask questions to my doctor in a more or like physical encounter" (Patient B)* Therefore, the supportive need of being able to communicate with a primary healthcare provider in a comfortable environment is a new need in the self-management task 'communication' of the decision framework. Last, a patient indicated: "*Having a direct answer is a trait of care which reassures me" (Patient D).* So, a quick response is included as a trait of care that helps to cope with a chronic disease.

MICRO LEVEL

When looking at the factors that were defined in Table 3 to influence the stakeholders' behavioral intention, the interview analysis showed that the patients' intention to use a telemedicine application is mainly influenced by the fear to lose face-to-face interaction with their clinician. Patients are concerned about the fact that their symptoms are unobserved or ignored: *"I have the fear that because of telemedicine my clinician easily loses track of my complaints, as he gets less overview when compared to a physical meeting" (Patient B).* The cross-case analysis shows that all the interviewed patients like the opportunity to be remotely monitored, but none would want to completely lose all physical encounters with their clinician. Furthermore, all patients indicate that a telemedicine application should not create unnecessary burden. *"If I don't have any complaints, I do not send messages, but then I also do not like to get messages" (Patient A).* This is supported by an expert who mentions that: *"I think we must be aware of the danger to not overload our patients with information or messages" (Department manager outpatient clinics).* Therefore, besides the time investment to use a telemedicine application, hospitals should be aware to not overwhelm the patients with unnecessary messages or requests. In addition, experts mention that next to the digital literacy of patients, the native language is a principal factor influencing the acceptance of telemedicine applications. "*We have a lot of patients who are not*

proficient in the Dutch language" (Nurse). As for the clinicians' acceptance, digital interference is a prominent factor in practice which leads to resistance from clinicians. Digital interference refers to a technical failure in the telemedicine application. All experts agree that the digital interference in a telemedicine application should be minimal. *"With previous telemedicine applications, 8 out of 10 times a technical problem occurred, like the camera or microphone did not work" (Nurse).*

In terms of modifications that are performed on the interventions at the micro level of the initial framework, one of the experts highlighted that: *"Patients must be aware of what possibilities a telemedicine application offers" (Nurse).* Therefore, it is included in the final framework to not only explain the purpose of the telemedicine application, but also its functionalities to be effective. Furthermore, one expert indicated that: *"I see that patients are more willing to participate in telemedicine when I explain them that information is safely stored in their personal patient file, and that I am the one who will monitor the results" (Nurse).* One of the patients support this by mentioning: *"Currently, I am not informed where the information is stored" (Patient E).* As a result, it is important to explain where the retrieved personal medical information by the application is stored, and who will be responsible for monitoring. The last modification done is concerned with a broader facilitation of support. Besides digital support, patients mention the need for opportunities to learn from each other: *"I advise the hospital to facilitate meetings in which patients can share experiences, so we can see how someone else makes use of the telemedicine application" (Patient A).*

MESO LEVEL

With regard to the organizational barriers on the meso level of the initial framework, the preconditions of interoperability and capacity for monitoring from the initial framework are extended with the interventions to realize an adequate team of specialists with sufficient time and resources, and the condition to regularly update the application. Furthermore, a precondition is added to the meso level of the final framework: 'Plan to gain, extend, and preserve knowledge'.

All experts mentioned the importance of having a multidisciplinary team composition of specialists with sufficient resources and time to monitor the application: *"I think it is important to involve the right people, but also give them space to realize the implementation" (Project manager ICMT).* Furthermore, as for the interoperability of a telemedicine application, experts agree that the application must be regularly updated. Updating the application means: *"We need to collect patients' feedback to adjust the application according to their needs, but also update the medical information conform national guidelines" (Department manager outpatient clinics).* As for the precondition about knowledge, experts indicate: *"We need to make sure that the right knowledge is retained and preserved within the organization" (Department manager outpatient clinics).* This need to acquire the right knowledge is supported by a nurse who states that: "*There is still a lack of use cases that describe a successful implementation of an application for telemedicine" (Nurse).* Experts augment this interest by

mentioning to create partnerships with other health institutions or companies. *"It is necessary to establish collaborations with other hospitals to learn from each other, but also to have the required patient volume to perform good qualitative or quantitative analysis to see what the effects of telemedicine are" (Project manager ICMT).*

MACRO LEVEL

At the macro level, no environmental barriers were mentioned in the interviews that were not already included in the initial framework. Therefore, no changes to the macro level of the initial framework are made.

Following the above-mentioned practical insights, adjustments are made to the initial decision framework (see Figure 13). The final decision framework is presented in Figure 14.

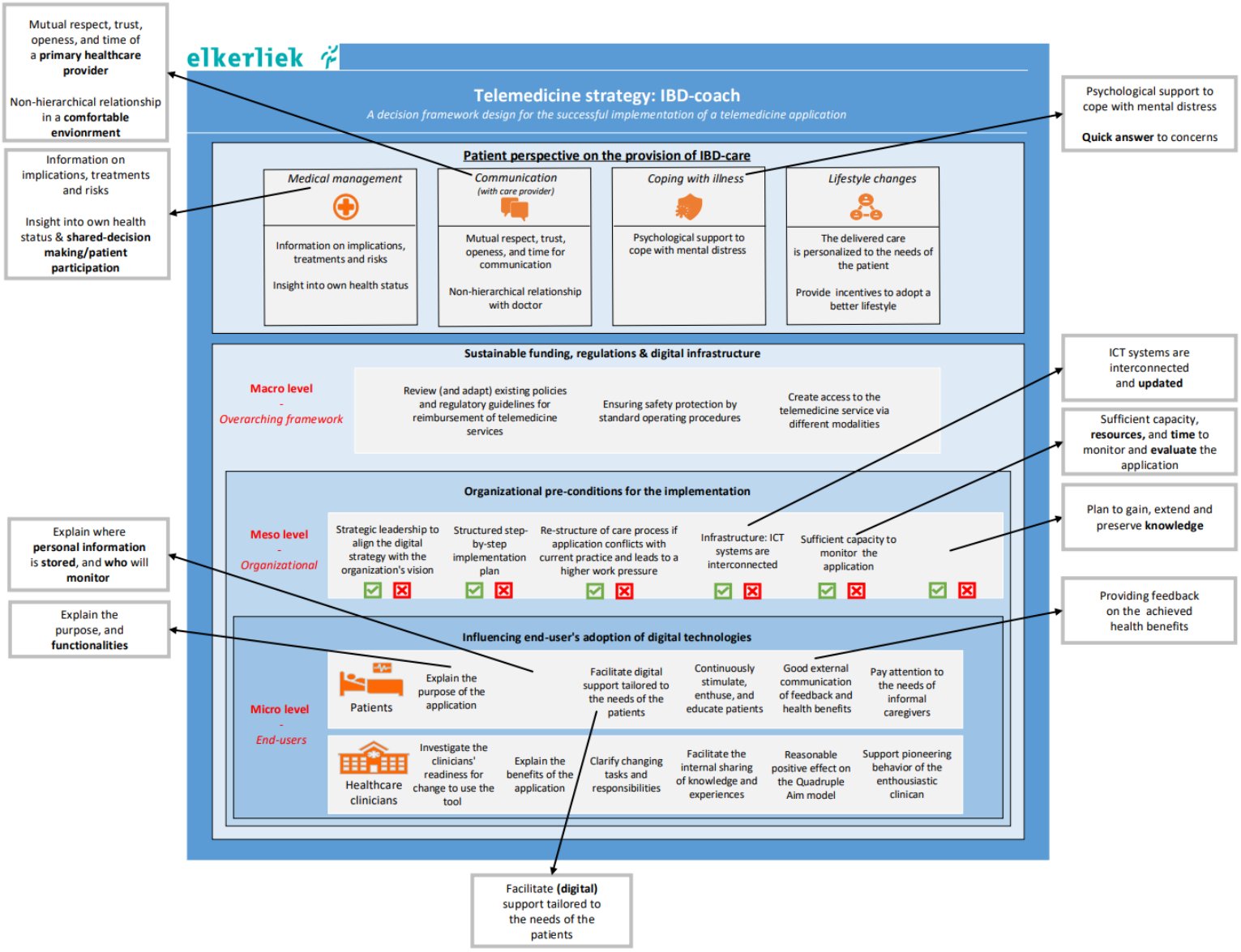

Figure 13 - Changes relative to the initial decision framework that constitute the final decision framework

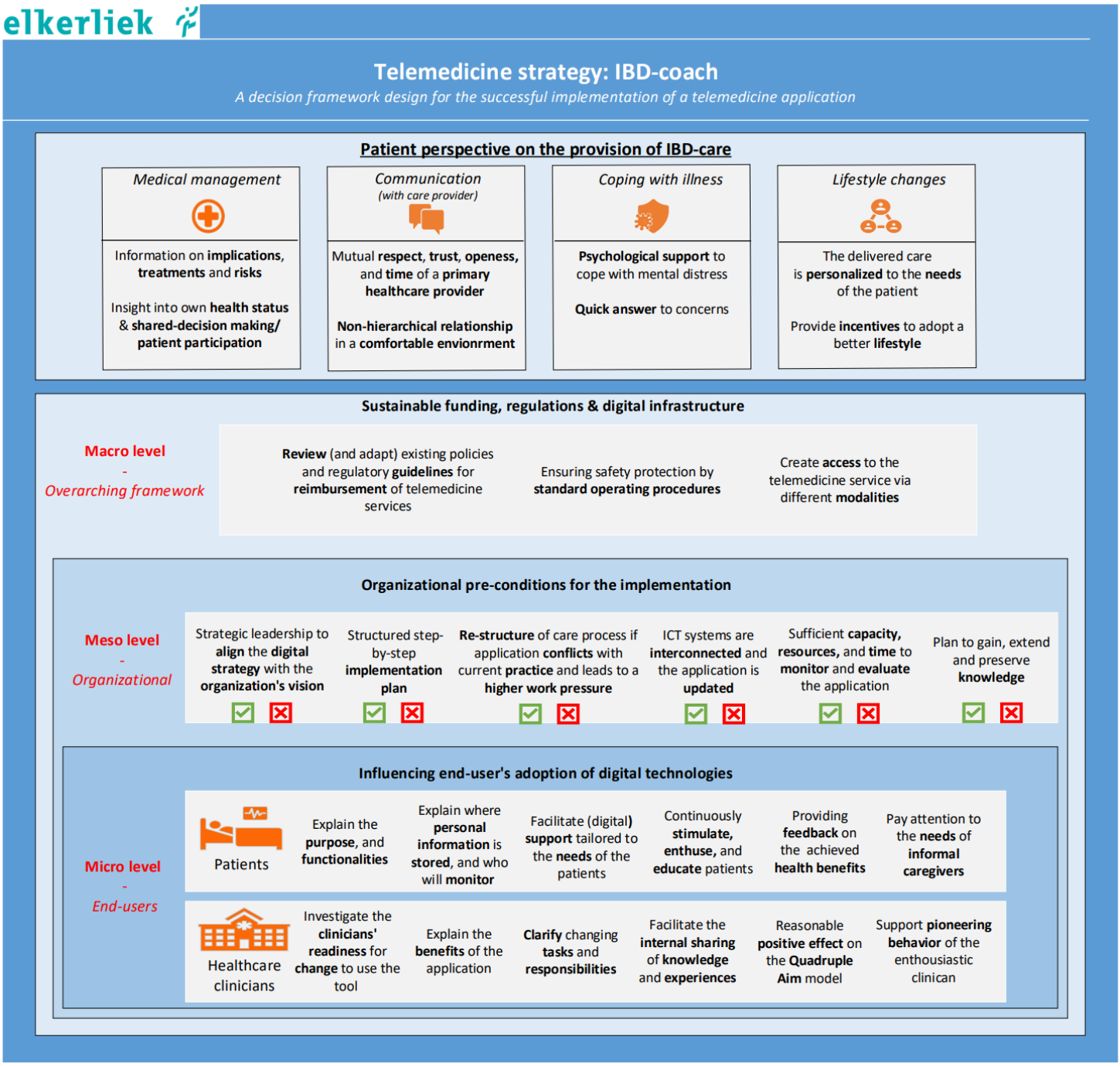

Figure 14 - Final decision framework for the successful implementation of an RPM telemedicine application

5 PROCESS ANALYSIS

In this chapter, the findings from the process analysis are described which provide an answer to the following sub-question: *What changes are required in the pathway of IBD care at the Elkerliek hospital in order to successfully integrate an RPM telemedicine application?*

To answer this sub-question, the current (AS-IS) situation of MijnIBDcoach is reviewed. The review involves discussing the current process of IBD care in the Elkerliek with different experts that were involved during the implementation or made use of MijnIBDcoach. In this discussion, clinicians and other employees of the Elkerliek described what they thought to be the main limitations and bottlenecks of the current process of care. Following, based on the preconditions and criteria of the final decision framework, the company experts recommended different process adaptations. In this chapter, statements from the discussion are documented to highlight the process inefficiencies of the current process of care, but also to explain the adaptations that are performed. With regard to these adaptations, a visualization and description of the desired (TO-BE) care pathway for the provision of IBD care in the Elkerliek hospital is made.

Subsequently, insight into a successful implementation of a telemedicine practice for the provision of IBD care is given to validate the final decision framework and redesign of the IBD care pathway. Experiences and lessons learned from an implementation of the telemedicine service MijnIBDcoach at the Zuyderland hospital are reported. These insights serve to answer the last sub-question: *How are telemedicine applications implemented in the process of IBD care in other healthcare institutions?*

5.1 AS-IS SITUATION

When discussing the current process of care, the clinicians were unanimously about the relevance and potential of telemedicine within the process of IBD care. *"Certainly, in the future a shift towards digital care will occur because of an increase in the number of patients" (Nurse specialist). "There is scientific proof that patients can better manage their chronic diseases if they have a feeling of control, by means of adjustments to their lifestyle, but also by creating an opportunity to directly ask questions. These are all services that we can offer through a telemedicine service" (MDL doctor).* So, the clinicians do recognize the potential and future of telemedicine, yet MijnIBDcoach did not have the intended effect.

The activity model, which is presented in Appendix 6, is a visualization of the IBD care process in the Elkerliek hospital from beginning to the end, showing the sequence of all process activities and information flows between different stakeholders. The activity model, provided by the Elkerliek hospital, is a representation of the current (AS-IS) care pathway for the provision of IBD care. Based on this activity model, a simplified process model was designed, as presented in Appendix 6. The model includes the process activities that the clinicians are responsible for, such as monitoring the patients' health status through the questionnaires and responding to questions in the chat function.

During the discussion with the company experts, the simplified activity model was utilized as a reference to investigate the reasons behind the application's lack of the desired effect. As the experts analyzed the factors that could have contributed to the non-successful implementation of MijnIBDcoach, several preconditions from the meso level of the final decision framework were identified as crucial points of concern. In this section, the main limitations of the current care pathway for IBD care, which encompasses MijnIBDcoach, are further elucidated.

For the situation of MijnIBDcoach, the clinicians mentioned that the hospital's digital strategy was one of the reasons that made it difficult to stimulate patients to adopt the telemedicine application. The MDL doctor indicated: *"When I look back at the implementation of MijnIBDcoach and think about where it went wrong, I feel that we already went wrong in the phase of including our patients. The hospital wanted to first test the effects of the application with a small group of IBD-patients, but this group was too small for the application to be efficient" (MDL doctor).* The nurse specialist agreed that the organizational vision on the inclusion of patients was not aligned to their needs. *"During the implementation of MijnIBDcoach, patients had complete freedom to choose whether to participate or not. I think that a telemedicine application can only work if all our patients make use of it" (Nurse specialist).*

Furthermore, it was highlighted that MijnIBDcoach was implemented without structured, predetermined implementation steps. *"The implementation of MijnIBDcoach was frankly disorganized" (Program manager 'Care Technologies').* This is recognized by one of the clinicians who mentioned that: *"It was difficult to make the implementation work as no standard implementation procedure was followed, or process analyses were performed by the organization prior to the implementation" (MDL doctor).*

Moreover, the clinicians indicated that the application resulted in a higher work pressure. In the first place, the telemedicine application resulted in higher work pressure because the application was not connected to the EPD software (HiX) of the Elkerliek. *"I need to manually convert the information from the questionnaires into a PDF format, which can then be copied into HiX. The application is unnecessary complicated and time-consuming" (Nurse specialist).* On top of that, the clinicians experienced an increase in work pressure as patients were now able to contact their healthcare provider through the chat function in MijnIBDcoach. The telemedicine application should have resulted in more time for the specialists to provide personalized care, instead they felt that they spent a lot of time monitoring and answering questions that did not belong to their specialty. "*I'm a doctor of the intestines. MijnIBDcoach led to more work for the specialists, as I now receive questions I would normally not get" (MDL doctor).* According to the nurse specialist, the current process of care was not reviewed, which was the cause of this higher work pressure. When MijnIBDcoach was implemented, no re-structure of the care process was performed, and no internal agreements about the division of tasks

within the team were made. *"I receive a lot of questions that are forwarded to me by the outpatient assistants, which do not belong to me. In some cases, they can provide the answer themselves. The outpatient assistants are not informed about which questions are their responsibility to answer. For example, questions about the scheduling of a new appointment" (Nurse specialist).*

To conclude, MijnIBDcoach was implemented without a clear strategic vision on telemedicine, and no structured implementation plan was followed. Also, no review of the current care pathway was performed in which the task division and responsibilities within the team were further examined, and a connection between the various information systems was not realized, which resulted in a higher workload for the clinicians.

5.2 TO-BE SITUATION

5.2.1 Redesign of the IBD care pathway

From the qualitative analysis, it becomes clear that the clinicians value the argument that with the implementation of a telemedicine application, they would have more time available to provide personalized care. On the contrary, the clinicians felt that after the implementation of MijnIBDcoach they had less time to provide personalized care to their patients and were even confronted with an increase in workload. Confirmed by the analysis on the current adaptation and utilization of MijnIBDcoach among the patients, and the bottlenecks that were identified in section 5.1 to inhibit the effect of the application, the Elkerliek made the decision to terminate the use of MijnIBDcoach. The decision was mainly made to discontinue operationalizing MijnIBDcoach, as the telemedicine application could not be connected to the electronic patient record system (EHR) obstructing the clinicians' ease. As an alternative to MijnIBDcoach, Elkerliek has the possibility to periodically assign questionnaires (PGC) to patients in MijnElkerliek. MijnElkerliek is the personal digital environment in which patients can view their medical record, make and reschedule appointments, and change personal information. The questionnaires, which can be assigned to the patients, are stored in the electronic patient record software HiX. Fortunately, in contrast to the situation with MijnIBDcoach, MijnElkerliek has a direct connection to the electronic patient record. However, MijnElkerliek does not have the functionality for patients to contact their healthcare provider. Still, the hospital wants to provide the opportunity to patients to be in contact with their clinicians through a digital platform. For this reason, the Elkerliek realized a partnership with BeterDichtbij. BeterDichtbij is a digital application including a chat function that allows patients to contact their care provider about, for example, their outpatient visit, treatment, and medical prescriptions.

Altogether, Elkerliek made the decision to operationalize an alternative care trajectory in which patients will periodically receive questionnaires through MijnElkerliek to monitor their health status. Additionally, a hospital-wide communication platform, BeterDichtbij, will be used to facilitate direct contact between patients and their doctors. To operationalize this alternative practice, the integrated care

pathway for IBD is re-designed together with the Elkerliek's MDL doctor, nurse specialist, and program manager of care technology, factoring the final decision framework of Figure 14, and the learnings from the assessment of MijnIBDcoach in section 5.1. The TO-BE care pathway which consists out of three phases: (i) the inclusion of IBD-patients, (ii) a digital care trajectory, and (iii) a regular trajectory is shown in Figure 15, 16, and 17. As one can see, the care trajectory includes multiple activities and decision points. Within the workflow, several activities are highlighted by a combination of a letter and a number, such as P1 or B1. The messages that are sent to or received from patients in BeterDichtbij are labeled with the letter B(x), and the process activities with a P(x). These specific markings serve to identify and reference the key steps and decision points within the care pathway, facilitating clear communication and understanding among the stakeholders involved in the care process.

When explaining the care pathway, the researcher will refer to these markers to guide the reader along the changes that are made in the process of care.

1. INCLUSION OF IBD-PATIENTS

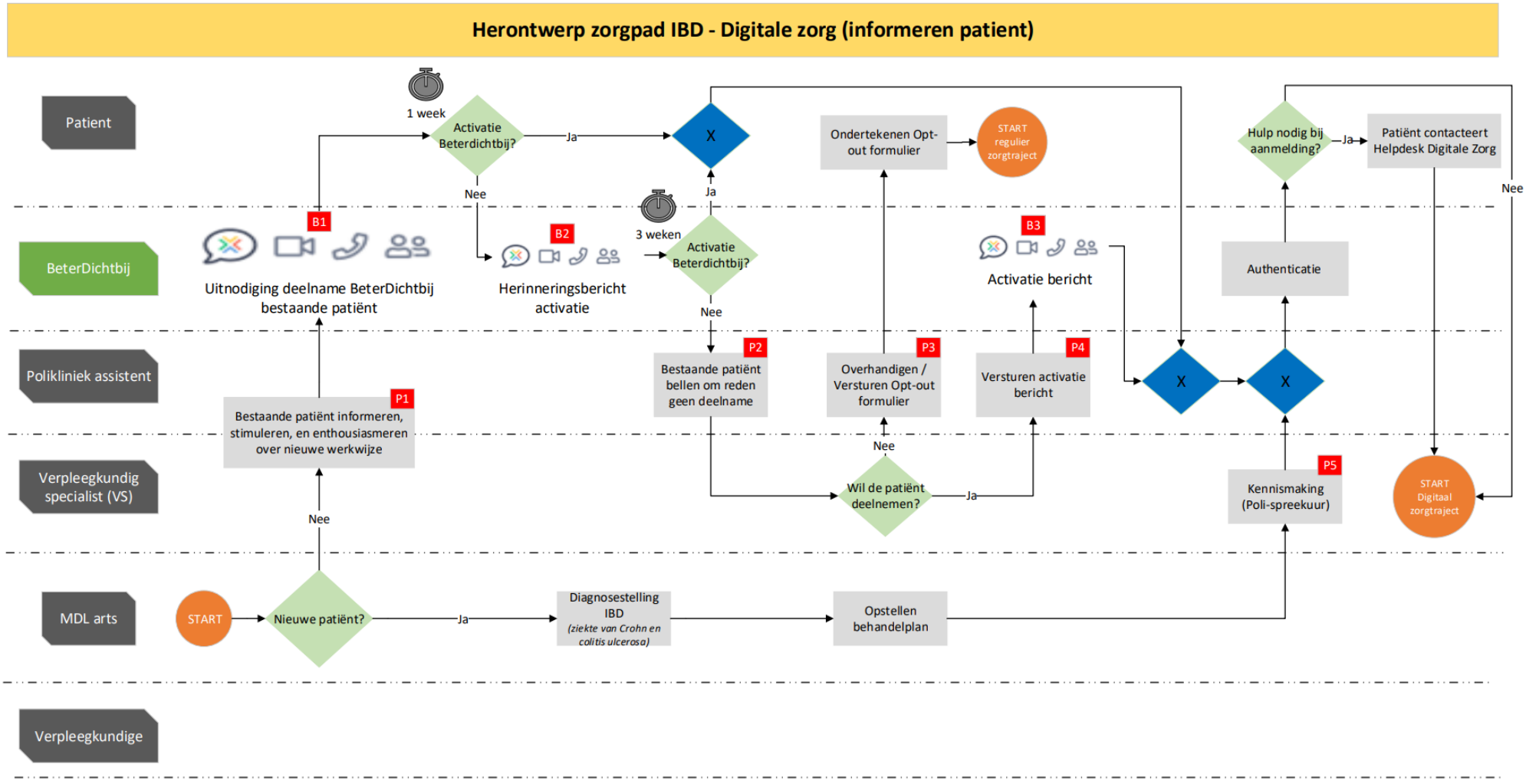

Figure 15 - Re-designed care pathway (inclusion)

2. CARE PATHWAY – DIGITAL CARE TRAJECTORY

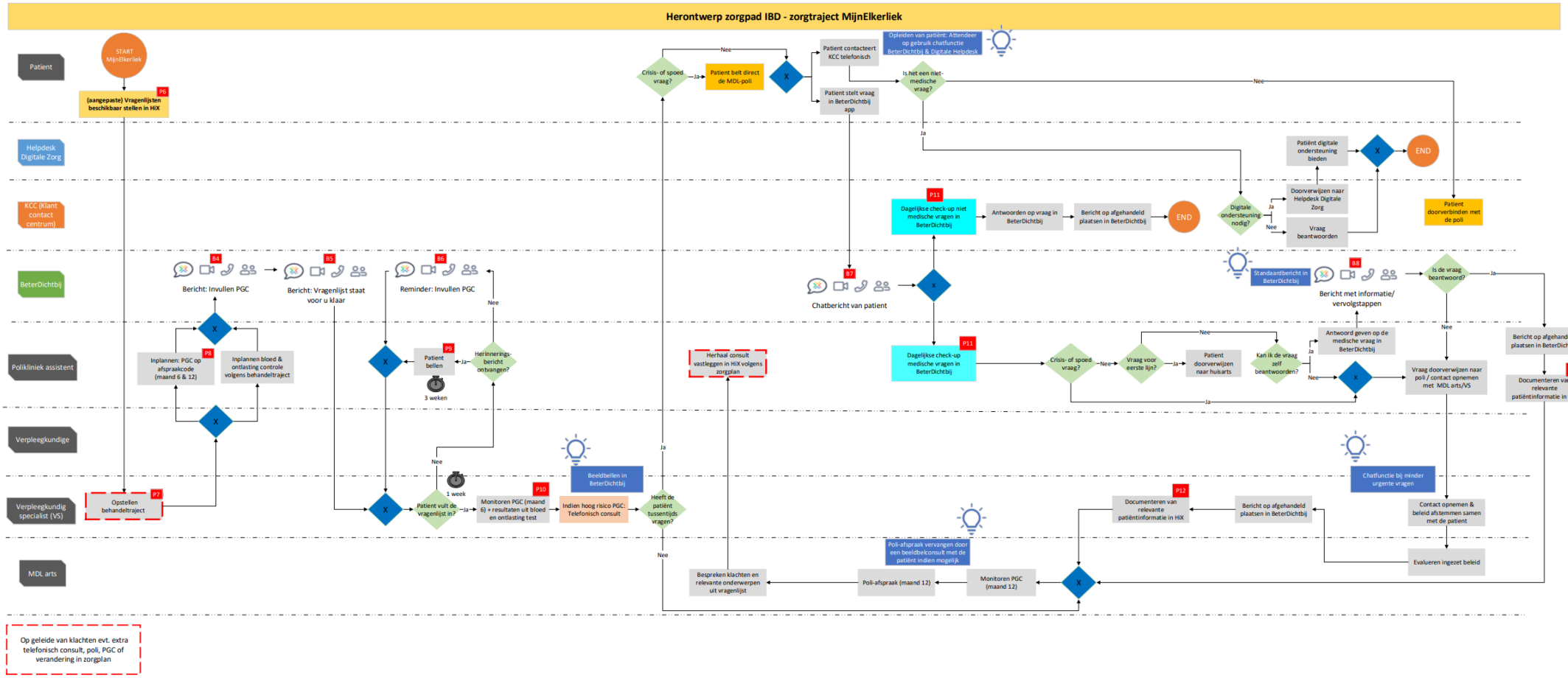

Figure 16 - Re-designed care pathway (digital)

3. CARE PATHWAY – REGULAR CARE TRAJECTORY

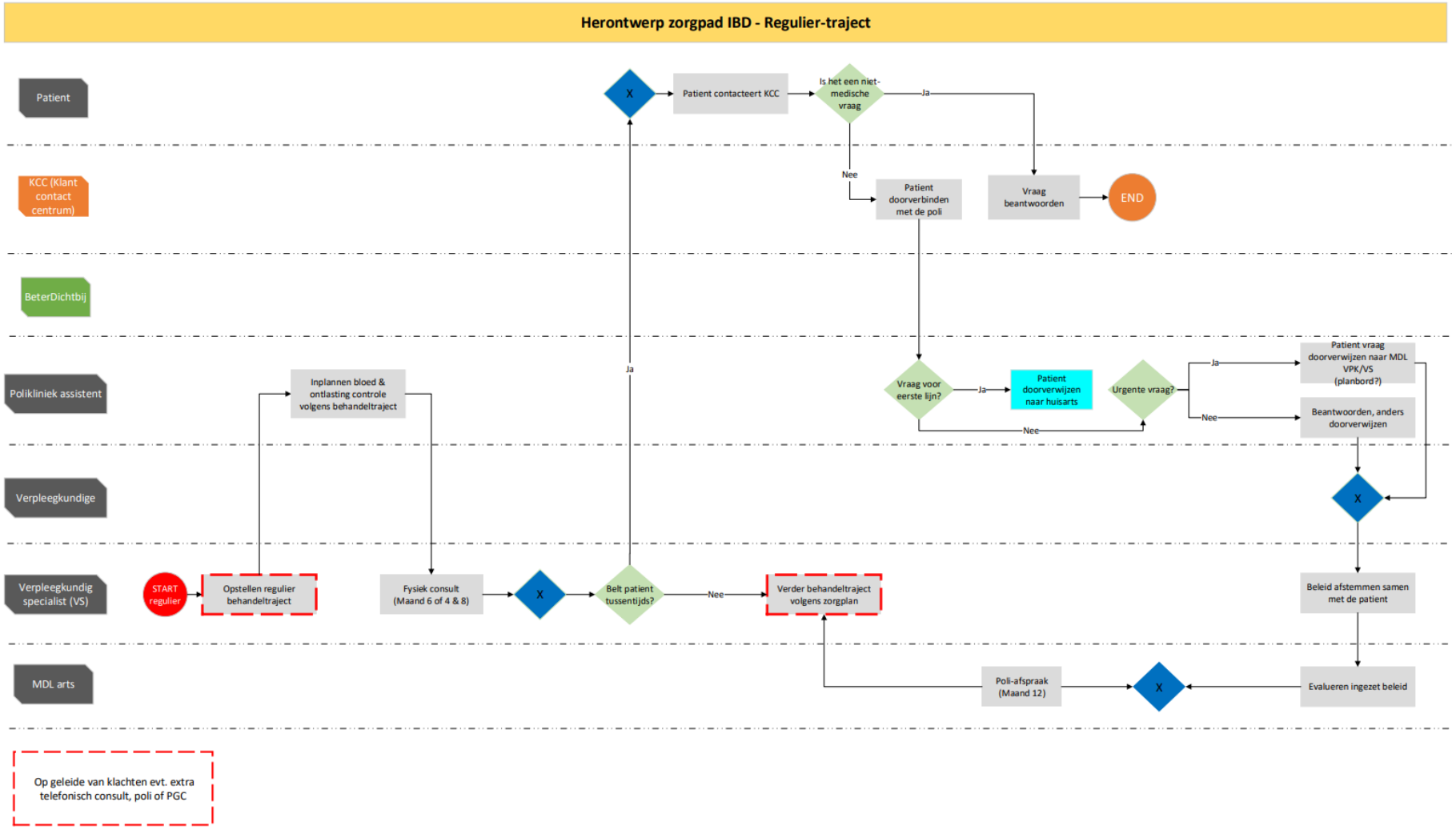

Figure 17 - Re-designed care pathway (regular)

When developing the care pathway together with the MDL doctor, nurse specialist, and program manager of care technology, the factors which were addressed in the final decision framework to have an impact on the success of the implementation are accounted for. First, the organizational preconditions of the meso level that are enumerated in section 5.1 to influence the implementation are acknowledged, i.e., aligning the digital strategy and the organizational vision, organization of an interconnected ICT-system, conducting a re-structure of the current care process, and following a structured implementation plan. These organizational preconditions are satisfied to enhance the effectiveness and efficiency before integrating a telemedicine application in the care pathway. Second, based on the micro level, various interventions are organized with the goal to stimulate the adoption- and usage behavior of patients and clinicians. Last, the factors of the macro level are not attainable on the pathway level of care. As a result, no adjustments are made to the care pathway based on the criteria at the macro level.

With respect to the above-mentioned description, the modeling choices that are made in the TO-BE care pathway are further explained in the following subsections.

MESO LEVEL: ALIGNING A DIGITAL STRATEGY WITH THE VISION OF THE ELKERLIEK

The digital care and regular care trajectory, which are approved by the MDL doctor of the Elkerliek, are presented in Table 8. The following digital strategy is adopted as clinicians highlight that a telemedicine application can only be additive to the physical consultations. *"I at least need one physical consultation in order to perform certain medical tests" (MDL doctor).* Therefore, in both care trajectories, at least one physical consultation with the MDL doctor is included. This also meets the needs of the patients, as it became clear in the interviews that patients highly value the physical contact with their healthcare provider. As stated: *"If for some reason physical check-ups are not possible, or are replaced by digital options, I think I would be more negative towards the digitalization of care activities" (Patient).*

Table 8 - Apprehended organizational strategy of the new care pathway

	Digital trajectory	**Regular trajectory**
All IBD-patients	- One planned physical consultation with MDL doctor/VS per year (30min). - Intermediate PGC control in month 6 and 12. - If PGC shows elevated risk, possibility to plan a telephonic consult with VS/nurse (10min). - Based on the telephonic consult, an additional consultation with the MDL doctor can be scheduled.	- 2/3 physical consultation with MDL doctor/VS per year (depending on symptoms) (30min).

In addition, the final decision framework states that the digital strategy must be aligned with the vision of the organization. The vision of the Elkerliek sounds: *"Digitally unless. So, the care process does always need to have a plan B for patients who have an eligible reason to not participate" (Program manager healthcare technology).* Clinicians support this organizational vision by indicating that: *"It would be better if hospital-wide the decision is made to include all IBD-patients, unless they have a*

valid reason not to" (Nurse specialist). Based on these insights, the activity model 'inclusion of IBD-patients' adopts the principle of endeavoring to include all IBD-patients, beyond those who explicitly mention that they do not want to participate in digital care. As for the inclusion of patients: "*We need to differentiate between two groups of patients. On the one hand, there are patients who are newly diagnosed with IBD, but, on the other hand, we have patients which are already in-house" (MDL doctor).* Therefore, at the start of the activity model 'inclusion of IBD-patients' in Figure 15, a **decision node** is modelled that distinguishes new and existing patients. Newly diagnosed patients are directly included in their introductory consultation with the nurse specialist **(P5)**. Existing patients will first receive an invitation message **(B1),** and an automatic reminder after one week in BeterDichtbij **(B2)**. In accordance with the organizational vision, the existing patients are granted with the option to still receive only regular care. **The activity node P2** shows that patients are called by an outpatient assistant with the option to not receive digital care when they did not activate their account within four weeks after receiving the invitation message. When the patient decides to participate in the digital trajectory, s/he will receive a new activation message in BeterDichtbij **(B3).** If the patient does not want to participate, s/he will receive an 'Opt-out form' **(P3)** in which the patient's decision is saved.

MESO LEVEL: INTEGRATION OF CONNECTED INFORMATION SYSTEMS

To advance the integration of work processes and communication between patient and caregiver, a HL7 (Health industry level 7) connection is available between the electronic patient software HiX, MijnElkerliek, and BeterDichtbij. HL7 interfaces connect different health IT systems which allows to exchange health data such as clinical documents, or lab results between other systems (Dolin et al., 2001). This connection ensures that information can be exchanged unambiguously between the different information systems, i.e., BeterDichtbij, HiX, and MijnElkerliek. With regard to the appointment code that can be scheduled by the outpatient assistant in advance **(P8)**, HiX automatically sends out the questionnaires to the patients in MijnElkerliek, and the answers are automatically stored in a patient's personal medical record. In addition, the HL7 connection between HiX and BeterDichtbij allows to send automated messages in BeterDichtbij **(B4, B5, B6).** Moreover, BeterDichtbij has a function that allows the healthcare provider to easily document relevant patient information in HiX **(P12)**. Furthermore, clinicians are able to open patient messages from the BeterDichtbij app within HiX. So, compared to the situation of MijnIBDcoach, different manual procedures such as the transmission of information into the EPD are automated in the new process of care. As a result, the process is made as unambiguous as possible which reduces the work pressure for the clinicians.

MESO LEVEL: RE-STRUCTURE OF THE CARE PROCESS (ROLE DIVISION)

In section 5.1, the clinicians mention to experience an increase in work pressure because of MijnIBDcoach, as they feel to answer a lot of questions that do not belong to their specialty. Because of this, a re-structure of the care process is performed to efficiently allocate the steps from the activity model of Appendix 6. A re-structure of the care process was also recognized to be necessary: "*In the ideal situation, there will occur a displacement of care activities from the specialists to the physician assistant" (MDL doctor)*. In the discussion with the clinicians, one mentioned that: *"As for the division of tasks, we could definitely gain efficiency by a better triaging of questions" (Nurse specialist).* Therefore, in the re-structure, the main focus was to reach consensus on who is responsible for replying to incoming patient questions. To improve the triage of patient questions, a new strategy is developed: "*All the non-medical questions are processed by the KCC" (Program manager of care technology)*. Furthermore, it is mentioned by one that: *"I believe that the outpatient assistants have enough knowledge and experience to answer the more standard medical questions" (MDL doctor).* In accordance with above statements, the strategy for answering questions follows the principle of the one who has the answer gives the answer, with a distinction between medical and non-medical questions. As for incoming questions of patients, the digital care process of Figure 16 shows two contact moments between the patient and the hospital. Besides the chat function in BeterDichtbij, patients' calls are received through the telephone at the customer contact service (KCC) of the hospital. The KCC is given the responsibility to monitor the non-medical questions in BeterDichtbij **(P11)**, but also answer non-medical questions which are received through the telephone. Similarly, the outpatient assistants are the first contact point who will triage the incoming medical questions in BeterDichtbij **(P11)**, but also the phone calls that are referred by the KCC to the outpatient clinic. Being the first point of contact, the outpatient assistant and KCC must ensure that the question ends-up at the right person if they cannot answer the question themselves, i.e., the general practitioner, nurse, or doctor. When triaged properly, it is expected that both facilities will contribute to minimize the number of unnecessary questions that reach the specialist.

MICRO LEVEL: ORGANIZED INTERVENTIONS TO INFLUENCE THE ADOPTION AND USE OF END-USERS

To influence the patients' behavioral intention to participate in the digital care trajectory, a communication strategy is developed to continuously stimulate and enthuse the existing and new patients with IBD. When informing the patients, one should explain the purpose and functionalities of the telemedicine service. As already said, new patients are easily informed during their introductory consultation by the nurse specialist. However, communicating the change in practice to the existing patients will be more challenging. *"We need to inform the existing patients from MijnIBDcoach about the new mode of practice" (Nurse specialist). "In my opinion we can inform the existing patients best during their hospital visit, else by information leaflets" (MDL doctor).* As a result, existing patients are informed at a hospital visit and through (digital) flyers, brochures, and during a hospital visit **(P1)**. In

addition, next to the development of multiple opportunities to include the IBD-patients in the digital strategy, several contact moments in BeterDichtbij have been included in the digital care pathway (see Figure 16) to continuously stimulate the patients to share information about their health status, even during the periods in which their condition is stable. Three automated messages **(B4, B5, B6)** will be send to the patients. These three moments of contact are carefully selected to not overwhelm the patients with messages causing unnecessary burden. Message B4 is sent to notify the patients one week before the questionnaire is available for them in MijnElkerliek. B6 is a reminder which will be send one week after the questionnaire is available. If the patient does not respond to the questionnaire (PGC) within 4 weeks, an outpatient assistant will call to remind them **(P9)**. Furthermore, the decision framework highlights the importance of educating patients when using a telemedicine application to improve its effect. As a result, to minimize the number of calls in the future, patients are attended to ask their questions in BeterDichtbij when they contact the KCC by phone. Last, in the interviews, caregivers have expressed their concerns about the fact that not all patients would have sufficient digital skills to participate in a form of telemedicine. The framework shows the importance to facilitate support that is tailored to the needs of the patients. Therefore, to increase the self-efficacy and trust of patients to participate in the digital trajectory, the Elkerliek decided to partner with Helpdesk Digitale Zorg. The partnership with Helpdesk Digitale Zorg is described as: *"An opportunity for patients to get support outside the hospital when having difficulties regarding digital care" (Program manager healthcare technology).* It is expected that Helpdesk Digitale Zorg increases the self-efficacy and trust of patients by facilitating digital support in, for example, the activation of BeterDichtbij or the completion of questionnaires in MijnElkerliek.

To improve the clinicians' adoption of a telemedicine service, the decision framework states to give a clarification on the changing tasks and responsibilities and explanation of the application's benefits. As a result, to properly inform the clinicians, a presentation is held in the MDL outpatient clinic on the 6th of July. In this presentation, the newly designed care pathway will be presented to an audience of doctors, nurses, and outpatient assistants of the Elkerliek's MDL department. By allowing the audience to ask questions after the presentation while also being open to feedback, the clinicians' readiness for change is expected to increase. Besides, an instruction of the work process is provided in Appendix 7 that secures a step-by-step guide of the most important process activities in the new care pathway.

MESO LEVEL: DESCRIPTION OF A STRUCTURED IMPLEMENTATION

In addition, an implementation trajectory is constructed before operationalizing the new format of telemedicine. First, it is mentioned that: *"It is necessary that the patient data which is currently stored in MijnIBDcoach must be transferred into the patient record" (MDL doctor).* Therefore, Elkerliek needs to decide how the privacy-sensitive patient information which is currently stored in MijnIBDcoach can be saved in the EPD system HiX. Secondly, it would contribute to a better triage of incoming patient questions if the outpatient assistants would be instructed which questions they should be able to answer

and which to refer to a nurse or doctor. The development of an instruction format that includes examples of standard medical questions that the outpatient assistants are expected to answer will increase their self-awareness. In addition, the decision framework indicates to facilitate the internal sharing of knowledge and experiences. By organizing a training program for the outpatient assistants, the Elkerliek can create a positive practice environment by increasing the interdisciplinary teamwork and collaboration (Bunnell et al., 2013). Third, the decision framework states the importance of regularly updating the application, providing feedback on the achieved health benefits, but also showing a positive effect on the Quadruple Aim model. In order to do so, the Elkerliek can integrate intermediate process evaluations in which they evaluate the effects of the digital care trajectory to optimize the process of IBD care accordingly. For example, one expert states that the process of care can be updated by mentioning that: *"The Digitale Help Desk can support in receiving feedback from the patients regarding the provision of care" (Program manager healthcare technology).* By performing quantitative and qualitative impact analyses, insights can be collected on the health benefits, and effect of the new telemedicine format.

To conclude, the Elkerliek is recommended to make the following implementation decisions:

1. Decision-making on how to store the recorded patient information from MijnIBDcoach into the electronic patient record system HiX.
2. Organization of a training program/instruction format for the outpatient assistants with regard to answering (standard) questions.
3. Integration of impact analyses to evaluate the effect of the telemedicine application and updating the application through feedback moments.

5.2.2 Beta test: Expert interview

To support the redesign of the care pathway for the Elkerliek and validate the final decision framework, an expert interview was held with one nursing specialist from the Zuyderland hospital. During the interview, the clinician explained how the Zuyderland hospital successfully implemented MijnIBDcoach in their process of care. The nurse described the implementation of the telemedicine practice as: *"A trial and error process which involved engaging the right individuals and carefully reviewing the current care process".* This demonstrates that the implementation of MijnIBDcoach was also a challenge for the Zuyderland hospital. However, the nurse acknowledged that they organized multiple interventions to address process inefficiencies, which were also identified in the case of the Elkerliek.

As for the inclusion of IBD-patients, the nurse indicated that: *"In a period of 4 years, we were able to scale-up the use of MijnIBDcoach from 50 to over 1,600 patients through a team effort".* But how did the Zuyderland stimulate these patients to activate their profile? The nurse mentioned that: *"We closely monitored the number of activations, and repeatedly urged patients to activate at physical contact*

moments". Besides the inclusion of patients, the nurse designates the importance of continuously motivating patients to use the application. In order to do so, the Zuyderland did the following: *"We hired a medical student to remind our patients to activate their account, but also to fill in the questionnaires".*

The clinician also highlighted that the application led to an increase in the perceived workload. *"We were confronted with a lot of extra work as a lot of questions from patients did not belong to our specialty".* As a countermeasure, the nurse mentioned that: *"We conducted a format consisting of in-house regulations in which examples of standard-questions and referrals are given to let our patients know where to go with a certain question".* Next, to decrease the perceived workload among its employees, the Zuyderland conducted a review on its current work structure: *"We have adapted and redistributed our work within the department in order to make this care process run better and as efficiently as possible".* Additionally, to answer the incoming patient questions, the Zuyderland opts for the following strategy: *"We would like to have our assistants in the outpatient clinic to triage the questions in MijnIBDcoach first, but unfortunately we are not that far yet".*

To summarize, the Beta test shows some practical implications worth considering for the Elkerliek such as the hiring of a medical student or conducting in-house rules for the use of the telemedicine application. However, the interview presented broadly similar interventions that were already integrated in the new designed care pathway. As a result, based on the findings of the Beta test, it is decided that the re-designed care pathway is ready to operationalize.

6 CONCLUSION AND DISCUSSION

In this closing chapter, the main research question will be answered. Additionally, the theoretical and practical implications of this research are discussed. Last, the possible limitations to the designed decision framework are discussed, as well as some direction for future research projects to strengthen the framework as well as the redesign of the care pathway.

6.1 CONCLUSION

Delivering care at a distance using modern technology is becoming an essential function of healthcare organizations as digital care has the possibility to make the provision of healthcare more affordable, accessible, and effective (Haleem et al., 2021). Caused by the growing prevalence of chronic diseases and the rising costs of chronic care, the management of chronic patients has become a key area of research as a response to this required change in the current healthcare system (Elkhuizen et al., 2020). In particular, empirical evidence shows that telemedicine applications are frequently used in chronic care to enhance the patients' self-management (Guo & Albright, 2018; Hanlon et al., 2017). Nonetheless, the transition to a more digital healthcare process is not something that will happen automatically as the adoption and management for any type of digital care remains a challenge (Taylor et al., 2015).

Therefore, the objective of this research was to design a consolidated framework that allows for a structured implementation of remote patient monitoring applications, recognizing the values of all stakeholders involved. This resulted in the following research question:

"How can the challenges that impede the successful implementation of remote patient monitoring (RPM) applications in the self-management of chronic diseases be mitigated?"

In order to provide an answer to this research question, at first a literature review was conducted in which the subjective perception on the provision of chronic care is examined. Next, supporting the adoption of a telemedicine application, the factors impacting the behavioral intention of key stakeholders, i.e., patients (customers) and healthcare providers to adopt a telemedicine application are investigated. Additionally, contextual barriers, i.e., the organizational preconditions and environmental influences, in the implementation of telemedicine are researched. Second, by means of semi-structured interviews with stakeholders of the IBD care process, the criteria that are found in theory are broadened with findings from practice. In this research, support is found for interventions that influence the behavioral intention of the end users, organizational preconditions, and environmental influences that address the importance of the community's readiness to apply telemedicine applications within medical practice. The result is a comprehensive decision framework which provides guidance for implementing an RPM application, offering points of interest to consider: "What is the purpose of telemedicine in the organization?", "How do you structurally organize monitoring?", and "What do we offer in terms of organizational and digital support?".

Prior to the implementation of a RPM application in medical practice, the research findings show that there are six organizational preconditions that should be addressed: a clear digital strategy which is aligned with the organization's vision, implementation according to a structured implementation plan, a well-established connection between the different ICT systems, sufficient capacity, resources, and time available, and a critical view on the care process. Also, to ensure the sustainability of telemedicine in medical practice, it is necessary to carefully evaluate its effects. By retrieving valuable insights from these evaluation, one can suggest process changes that contribute to the efficiency of using telemedicine. Furthermore, the decision framework can be used on an operational- and strategical level to organize interventions to increase the inclusion of patients and keep clinicians motivated. As for the end-users' adoption of the telemedicine application, interventions such as the facilitation of sharing experiences among end users, increasing the patients' confidence in the security of personal data when using a telemedicine application, as well as improving the self-efficacy of end-users' and enhancing their digital literacy, are expected to have a positive impact on the adoption.

Next, in this research, an example is presented on how to operationalize the decision framework by assessing the as-is state and target state of care. Hence, the framework is used to develop an integrated

care pathway for IBD care at the Elkerliek involving a telemedicine application to improve the delivery and management of high-quality care at a distance.

6.2 THEORETICAL IMPLICATIONS

As debriefed in the previous section, it is widely accepted that changes in the way care is provided are needed to ensure quality and cost containment. Yet, although it is known that integrated telemedicine services support in caring for patients with a chronic disease (Anthony Jnr, 2021; De Jong et al., 2017), telemedicine applications frequently fail to achieve uptake (Verma et al., 2023). As a result, emphasis in research is placed on the need of developing an implementation framework for the development and evaluation of telemedicine interventions (AlDossary et al., 2017; van Dyk, 2014). However, where existing telemedicine frameworks mainly focus on how one can evaluate or assess the effects of telemedicine interventions to determine their level of success (Greenhalgh et al., 2017; Kidholm et al., 2012), little provide guidance or are designed to aid in the operationalization of a telemedicine application prior to the implementation. This research fills this gap by showing how the designed decision framework can reveal implementation issues of telemedicine, and how it can be used as an instrument to operationalize an RPM application in medical practice.

Furthermore, existing literature focuses mainly on creating a list of problem areas that are classified on three distinct levels of analysis: (i) micro: individual adoption, (ii) meso: organizational, and (iii) macro: environmental (Harst et al., 2020; Schreiweis et al., 2019). However, it is also known that matching demand and services for patients when integrating telemedicine can be challenging as the needs of patient groups can differ causing a lot of implementations to fail. As stated by Dinesen et al. (2016), the user needs must be satisfied if an implementation of a telemedicine application wants to be successful as there is no ‘one-size-fits-all’ approach. This is supported in research by Leplege et al. (2007) who state that a patient’s perception is person oriented. This insinuates that each individual patient has different interests and needs regarding the process of care. Therefore, in addition to the three levels of readiness which are frequently researched in literature to explain the adoption of telemedicine, a fourth layer is added in the decision framework in which the subjective perception of patients regarding IBD care is disclosed. Hence, since it is known that the users’ needs can vary from one individual to another, the patients’ subjective perceptions according to literature are expanded with the needs that are recognized in the semi-structured interviews.

Similarly, this research adds to the identified criteria in literature by integrating a practical perspective on the three adopted levels of analysis (i.e., micro, meso, macro) through a multi-methodological approach consisting of a collection of qualitative data in semi-structured interviews, and a validation with an expert interview. So, through conducting a literature review that is complemented with findings from the various expert discussions, a comprehensive framework of criteria affecting the implementation of a telemedicine application could be compiled. For instance, additional to the meso

and macro categories adopted from the research paper by Otto & Lorenz Harst (2019), the findings of the empirical analysis denoted that it is also important for hospitals to focus on knowledge acquisition and retention, as well as to periodically evaluate the effects of the telemedicine application during implementation. Moreover, research to understand the problem areas on the micro level concerning the individual adoption is often limited to the behavioral perspective of patients, neglecting the behavioral intention of clinicians to accept and adopt a telemedicine application or conversely (Chau & Jen-Hwa Hu, 2001; Jen-Hwa Hu et al., 2000; Woo & Dowding, 2018). This research therefore contributes to the existing scientific literature by addressing the technology acceptance from different perspectives, i.e., patients and clinicians. This is in line with the research paper by Menachemi et al. (2004) where the need to address the uncertainty using telemedicine for different adopter groups is also denoted.

6.3 MANAGERIAL IMPLICATIONS

In this section, the most interesting insights for other hospitals regarding the implementation of a telemedicine application are described, and managerial implications for the Elkerliek are discussed. As the scope of this study is focused on improving the implementation of a telemedicine application within medical practice specifically for the field of IBD care, the generalizability of the implications to other hospital departments may be limited. However, the insights provided in this research and the findings gained during the redesign of the care pathway for the Elkerliek Hospital are expected to be of interest to other institutions in the medical sector as well.

This research emphasizes that the implementation of a telemedicine application within medical practice requires a thoughtful process of preparation. Prior to the implementation, management must carefully examine whether the organization is set to integrate a telemedicine application. Management needs to have discussions with all stakeholders of the care process to evaluate the relevance and importance of telemedicine. It is important to question what the needs are of the end users, but also to determine what is necessary to stimulate the adoption of telemedicine, as it could be possible that the target group for whom the use of telemedicine is intended is not receptive (Valikodath et al., 2017). Furthermore, management must remain critical when they consider adopting telemedicine. Here, the rationale should be to seek for an appropriate form of telemedicine that fits the organization's vision on changing the process of care rather than the opposite. This is recognized by the project manager ICMT of the Elkerliek *"We need to look at what we would like to change in the care process, and then we look for a technology that supports these changes"*.

Further, to operationalize the designed care pathway for IBD care in the Elkerliek, an implementation plan was constructed in section 5.2.1. Although this plan already highlights some important implications for practice, e.g., organizing department trainings to educate the outpatient employees on how to work efficiently with for instance the newly integrated communication platform BeterDichtbij, other practical recommendations are given aimed at addressing the problems faced by the MDL department of the

Elkerliek. First, the Elkerliek is recommended to pay extra attention to the inclusion of patients. The Elkerliek should closely monitor the number of IBD-patients who have activated their profile in BeterDichtbij. By showing clinicians the progress in the number of active users, the Elkerliek may enhance the internal motivation of clinicians to include more patients, but it also is a reminder for the clinicians to continually approach patients. Besides, to evaluate the intermediate effect of the implementation, the Elkerliek can extract the experiences of the end users regarding the use of telemedicine in focus groups to adjust the care pathway accordingly. Next, to further improve the triage of patients' questions, the Elkerliek could explore the possibility of enabling patients to attach a topic to their questions in BeterDichtbij. In this way, the clinicians have a direct overview on the content of the questions that are asked but it also gives them the control to filter out and respond directly to the more urgent questions. Last, as an implication for the future, the interviews declared that the Elkerliek should be actively engaged in ongoing developments concerning telemedicine for further expansion. Hence, the Elkerliek could collect valuable information concerning telemedicine developments elsewhere through the sharing of knowledge with other hospitals or by creating partnerships with knowledge institutions in the region. Finally, the Elkerliek can also consider using the decision framework and the redesigned care pathway as an example for a uniform and organization-wide integration of telemedicine initiatives in other departments of care.

6.4 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

LIMITATIONS

As with most studies, this research is not without limitations. First, as stated by the Dutch Minister of Health, Welfare and Sports, Hugo de Jonge (2021): "the implementation and upscaling of digital technologies in healthcare is not possible according to a standard formula". Since healthcare institutions differ in, for example, size, resources, and expertise, the problems that they face when implementing telemedicine can be different. There may be variation in which criteria apply, but also the degree of influence the criteria from the decision framework have on the implementation of telemedicine in different healthcare settings may vary. This is supported in research by Gagnon et al. (2004) who state that the specific context of organizations influences the success of integrating telemedicine. Hence, the design of a decision framework for the implementation of a telemedicine application in medical practice requires customization tailored to the respective department or hospital where telemedicine will be integrated.

In this study, the initial decision framework was complemented and tested in practice with representatives from one hospital only. Furthermore, due to the poor accessibility of patients and clinicians, the obtainability of a large simple size was difficult. In addition, although the researcher searched for a variety of expertise among the experts, it was only possible to interview clinicians from two different departments. Since the test sample is relatively small and single site, the external validity

of the research findings is affected (Ferguson, 2004). To overcome this limitation, in future research one should attempt to adopt more test cases, including other health institutions, for the further development and operationalization of the decision framework.

Second, the frame of reference is limited by the boundary of interviewed patients who have a firsthand experience with only one telemedicine application. Additionally, a weakness of this study is that the patients' subjective perception regarding chronic care is questioned exclusively for patients diagnosed with IBD. On top of that, Elkhuizen et al. (2020) mention that there is a variety of needs in dissimilar stages of chronic illness. Therefore, it would be of interest in future research to investigate how patients' supportive needs in care differ for other chronic conditions, considering the variations between different stages of illness.

FUTURE RESEARCH DIRECTIONS

Complementary to this research, future studies could explore the decision framework's applicability to additional domains. Furthermore, it would contribute to ensuring the sustainability of telemedicine initiatives by creating an understanding of how clinicians can successfully integrate telemedicine as part of their routine healthcare service. Hence, future research should focus on how hospital management can effectively shift the prevailing culture within the functional hospital departments (silos) to promote greater inclusivity among clinicians.

Secondly, it would be of interest for future research to analyze how the queuing of incoming patients' questions can be optimally managed and pooled. Determining the number of Full-Time Equivalents (FTEs) required per day to effectively integrate a form of telemedicine within the practice of IBD care would be beneficial. Furthermore, while this research demonstrates how a care process can be transformed based on the identified criteria that affect the success of implementing a telemedicine application, additional investigation is needed to demonstrate the long-term quantifiable benefits on the health outcomes, costs, and the impact the redesign has on the burden placed on the healthcare professionals. The Elkerliek could, for example, evaluate the promise of reducing the healthcare spending following the redesigned care pathway through a cost prediction model comparing the number of inpatient and digital consultations in the regulatory and digital care trajectory. Therefore, in succession to this study, research could focus on the following: How does telemedicine compare to the process of traditional IBD care in terms of quality and care?

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8 APPENDICES

APPENDIX 1: RESEARCH METHODOLOGY AND TOOLS

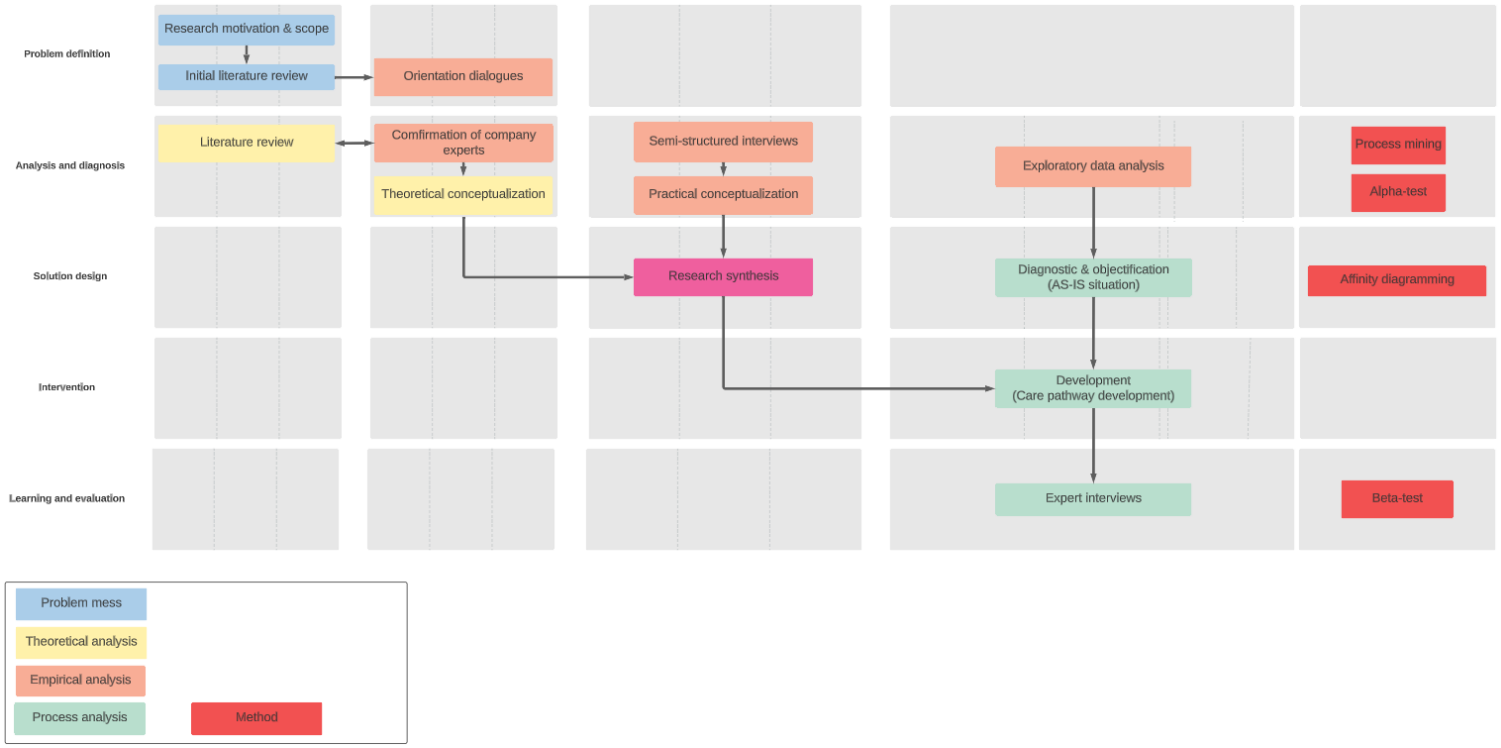

Figure 18 - Visualization of the research methodology and methods used

APPENDIX 2: LITERATURE REVIEW – SEARCH PROCESS

Table 9 - Overview of documented search strings

Search strings	Keywords list		
	Construct 1	Construct 2	Construct 3
("History" OR "Evolution" OR "Fundamentals") AND ("Contribution" OR "Value") AND ("Telemedicine" OR "Information technologies" OR "Communication technologies")	History	Contribution	Telemedicine
("Definition" OR "Purpose" OR "Statement") AND ("Telemedicine" OR "E-health" OR "Telehealth")	Definition	Telemedicine	
("Perception" OR "Perspective" OR "Need") AND ("Patients" OR "Stakeholder" OR "Healthcare customer") AND ("Chronic care" OR "Long-term healthcare" OR "Continuous")	Perspective	Patients	Chronic care
("Patients" OR "Stakeholder" OR "Healthcare customer") AND ("Perception" OR "Perspective" OR "Need") AND ("Chronic care" OR "Long-term healthcare" OR "Continuous") AND ("Self-management" OR "Self-regulation" OR "Self-control")	Patients	Need	Self-management
("Telemedicine" OR "Information technologies" OR "Communication technologies") AND ("Promise" OR "Influence") AND ("Chronic care" OR "Long-term healthcare" OR "Continuous") AND ("Patients" OR "Stakeholder" OR "Healthcare customer")	Telemedicine	Influence	Chronic care
("Telemedicine" OR "Information technologies" OR "Communication technologies") AND ("Effect" OR "Impact") AND ("Quality of care" OR "Standard of care" OR "Care goals")	Telemedicine	Effect	Quality of care
("Behavioural intention" OR "Acceptance" OR "Readiness for change" OR "Factors") AND ("Stakeholders" OR "Patients" OR "Healthcare provider") AND ("Telemedicine" OR "Information technologies" OR "Communication technologies")	Behavioural intention	Stakeholders	Telemedicine
("Telemedicine" OR "Telehealth" OR "Telecare" OR "E-health" OR "M-health") AND ("Pilot" OR "Adopt" OR "Implement") AND ("Change management" OR "Organizational change" OR "Readiness")	Telemedicine	Implementation	Change management
("Telemedicine" OR "Telehealth" OR "Telecare" OR "E-health" OR "M-health") AND ("Barriers" OR "Enablers" OR "Preconditions") AND ("Implementation" OR "Scale-up" OR "Adoption")	Telemedicine	Barriers	Implementation
("Telemedicine" OR "Telehealth" OR "Telecare" OR "E-health" OR "M-health") AND ("Readiness" OR "Adoption") AND ("Multi-level" OR "Macro" OR "Meso" OR "Micro")	Telemedicine	Readiness	Multi-level

APPENDIX 3: EXPLORATORY ANALYSIS – PATIENTS' USAGE BEHAVIOR

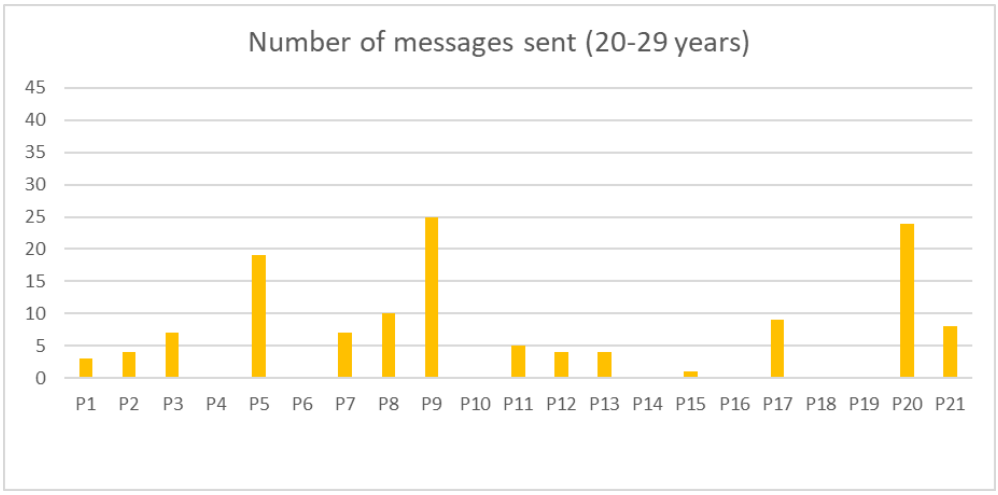

Figure 19 - Number of messages sent per patient (20 - 29 y) in MijnIBDcoach

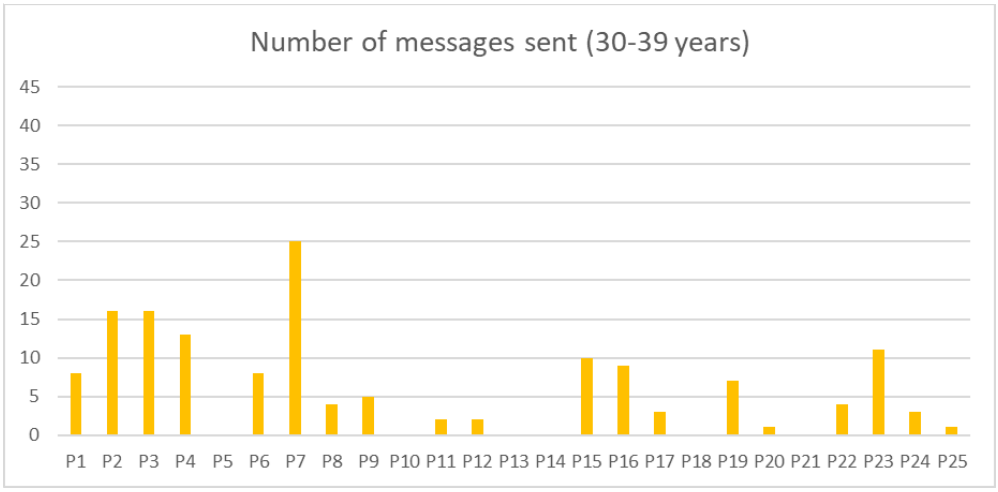

Figure 20 - Number of messages sent per patient (30 - 39 y) in MijnIBDcoach

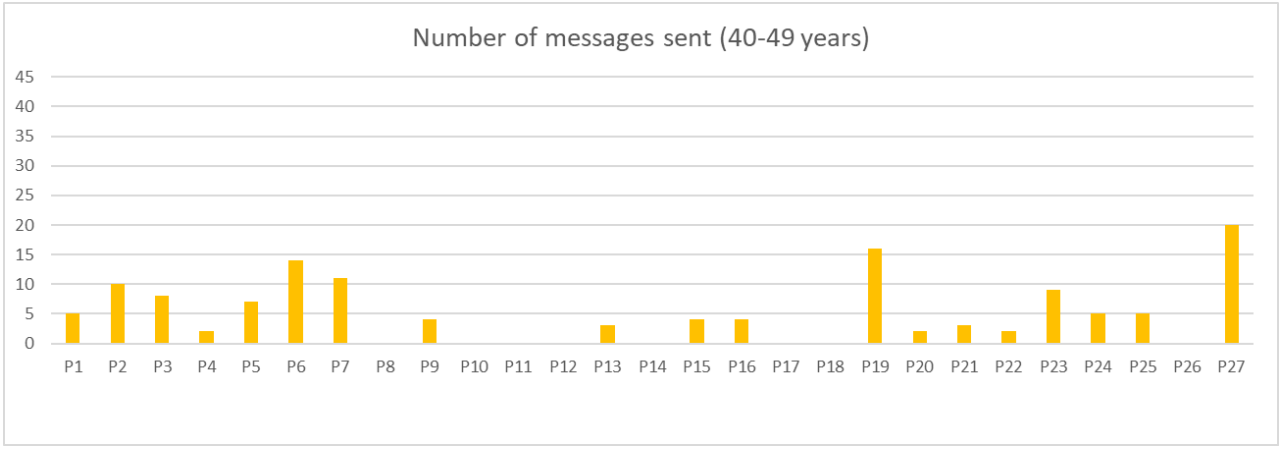

Figure 21 - Number of messages sent per patient (40 - 49 y) in MijnIBDcoach

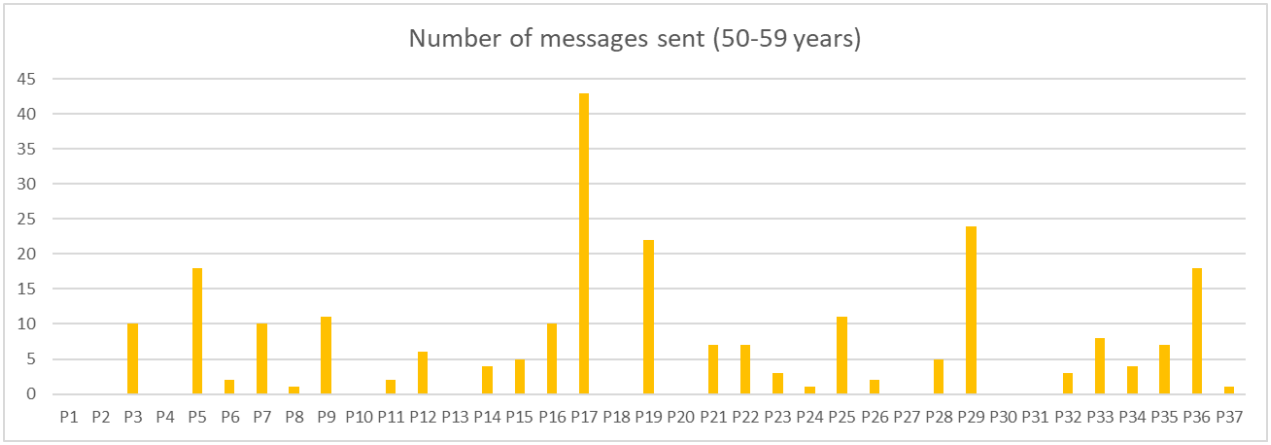

Figure 22 - Number of messages sent per patient (50 - 59 y) in MijnIBDcoach

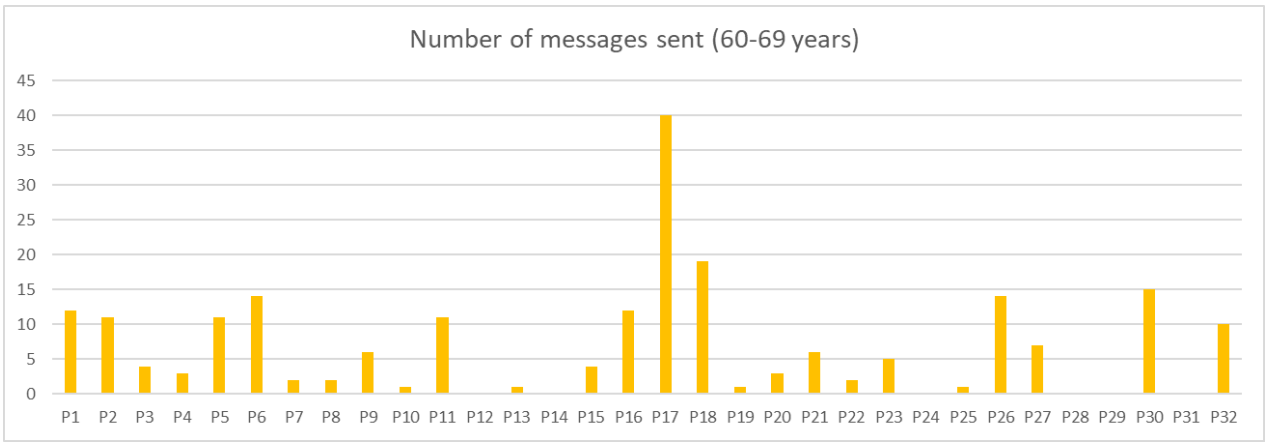

Figure 23 - Number of messages sent per patient (60 - 69 y) in MijnIBDcoach

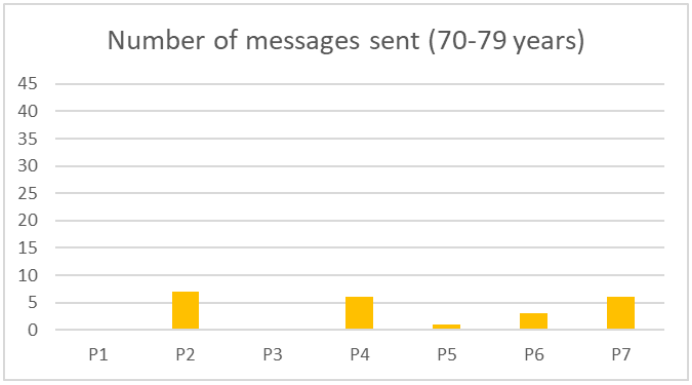

Figure 24 - Number of messages sent per patient (70 - 79 y) in MijnIBDcoach

APPENDIX 4: INTERVIEW GUIDE

1. INTERVIEW FORMAT – HEALTHCARE PROVIDER

Interview scheme

Name of the interviewer: Jenneau (J.T.J.M.) Debats

Interview date:

Number respondent:

Department of respondent:

Function of respondent:

Introduction for the informant

In order to make healthcare future-proof, smart solutions of digital care are constantly being sought to overcome the challenge of keeping care accessible and affordable for everyone. When such a smart solution involves a technology to deliver the clinical care at a distance, we speak of telemedicine. To give an example, telemedicine can be as simple as text messaging medical care between the patient and clinician.

In this research, we focus on finding criteria that affect the implementation of digital applications that have the purpose to remotely monitor a patient's health status. The goal of this interview is to receive your opinion about using such a telemedicine application in the delivery and receiving of medical care.

- **Time:** The interview will take approximately 45 minutes. The interview is based on open ended questions.
- **Recording:** Asking permission to record the interview. Recording the interview will enable a better understanding and transcribing of the results. When the research is finalized, the audio recording will be deleted.
- **Usage of respondent's information:** Interviewee results are processed anonymously in the report.

Questions:

Introduction questions:

1. Could you give a short introduction of yourself and your professional background?
   (Kunt u een korte introductie van uzelf en uw werkachtergrond geven?)

……

2. What is your current company function?
   (Wat is op dit moment uw functie?)

……

Questions regarding the usage of a telemedicine application:

1. Are you familiar with digitalization? If so, how would you describe digitalization?
   (Bent u bekend met digitalisering? Zo ja, wat verstaat u onder digitalisering?)

……

2. Did you already experience a healthcare transformation in healthcare? Could you give some examples of digital care?
   (Heeft u al ervaring omtrent de digitalisering van zorg? Kunt u hier enkele voorbeelden in noemen?)

……

3. How do you feel about the digitalization of care activities?
   (Wat is uw mening over digitalisering binnen de zorg?)

……

4. In particular, how do you feel about using a digital application to remotely monitor the patients within your current practice? What do you mean by telemedicine?
   (Meer specifiek, wat is uw mening over het gebruik van digitale applicaties binnen uw zorg voor telebegeleiding? Wat verstaat u onder telebegeleiding?)

……

5. What do you think are the main reasons to (not) use a telemedicine application within your healthcare profession?
   (Wat zijn volgens u de belangrijkste redenen om een digitale applicatie voor telebegeleiding (niet) te gebruiken binnen uw vakgebied?)

……

6. Can you mention any (dis-)advantages of using a telemedicine application? Do you feel that a telemedicine application can have (dis-)advantages for the patient? Can you think of factors that would stimulate/hinder the usage behavior of the healthcare professional, and the patient?
   (Zijn er voor- of nadelen in het gebruik van een digitale applicatie voor telebegeleiding? Welke voor- of nadelen van een zijn hieraan verbonden voor de patiënt? Wat zijn voorbeelden van factoren die het gebruik van een digitale applicatie voor telebegeleiding stimuleren of belemmeren?)

……

7. Which factors that you mentioned in the previous questions do you consider to be more relevant than others? Why?
   (Welke van de zojuist genoemde redenen zijn voor u meer relevant/belangrijk, en waarom?)

……

8. **(Show the framework)** Several factors were mentioned in literature to influence the adoption of a telemedicine application among clinicians and patients. Do you agree with these factors? Why (not)? Which factors do you think should be mentioned as well?
   (Enkele factoren worden benoemd in de literatuur om de adoptie van zorgverleners ten aanzien van een digitale applicatie voor telebegeleiding te beïnvloeden. Kunt u zichzelf herkennen in deze factoren, waarom wel (niet)?)

……

Questions regarding the organizational and external implementation barriers:

1. Do you feel that there are organizational factors that could influence the implementation of a telemedicine application? What are organizational factors that could stimulate/hinder the implementation?
   (Denkt u dat er op organisatieniveau factoren zijn die de implementatie van een digitale applicatie voor telebegeleiding kunnen beïnvloeden? Welke organisatorische factoren kunnen stimulerend/beperkend zijn voor de implementatie?)

……

2. Which external (regulations, financing, etc.) influences do you think are important to take into consideration when implementing a telemedicine application in daily practice? Why?
   (Aan welke externe factoren moet naar uw mening aandacht worden besteed bij de implementatie van een digitale applicatie voor telebegeleiding in de zorg, en waarom?)

……

3. **(Show the framework)** Do you agree with the contextual barriers that are mentioned in the framework to be affecting the implementation of telemedicine services? Why (not)?
   (Bent u het eens met de organisatorische en externe factoren die beschreven staan in het framework om hun impact op de implementatie van een telebegeleiding service? Waarom wel (niet)?)

……

Closing of the interview

Word of thank

Do you have remarks/feedback on the interview?

2. INTERVIEW FORMAT – IBD PATIENT

Interview scheme

Name of the interviewer: Jenneau (J.T.J.M.) Debats

Interview date:

Respondent:

Introduction for the informant

In order to make healthcare future-proof, smart solutions of digital care are constantly being sought to overcome the challenge of keeping care accessible and affordable for everyone. When such a smart solution involves a technology to deliver the clinical care at a distance, we speak of telemedicine. To give an example, telemedicine can be as simple as text messaging medical care between the patient and clinician.

In this research, we focus on finding criteria that affect the implementation of digital applications that have the purpose to remotely monitor a patient's health status. The goal of this interview is to receive your opinion about using such a telemedicine application in the delivery and receiving of medical care.

- **Time:** The interview will take approximately 45 minutes. The interview is based on open ended questions.
- **Recording:** Asking permission to record the interview. Recording the interview will enable a better understanding and transcribing of the results. When the research is finalized, the audio recording will be deleted.
- **Usage of respondent's information:** Interviewee results are processed anonymously in the report.

Questions:

Introduction questions:

1. Could you give a short introduction of yourself? What is your name, age, place of residence?
   (Kunt u zichzelf kort introduceren? Wat is uw naam, leeftijd, woonplaats?

……

2. Could you give an indication of when you were diagnosed with IBD?
   (Hoe lang is het geleden dat u de diagnose IBD hebt gekregen?)

……

Questions regarding the patient's needs in chronic care:

1. Could you describe what it is like to live with a chronic disease such as IBD?
   (Kunt u omschrijven hoe het voelt om te leven met een chronische ziekte zoals IBD?

……

2. Do you feel restricted by the chronic disease in your daily life? If so, do you experience any discomfort from the disease, and why? Could you give some examples?
   (Voelt u zich beperkt of juist niet beperkt door de chronische ziekte? Wanneer u zich beperkt voelt, waarom ondervindt u in uw dagelijks leven hinder van de ziekte? Wilt u enkele voorbeelden geven?)

……

3. What are the main aspects of care, that you possess yourself or that are provided by the clinicians, which give you the ability to live with your chronic disease? Why?
   (Welke aspecten van uw huidige zorg, die u zelf bezit of die de zorgverlener kan aanbieden, helpen om het beste om te gaan met de chronische ziekte, en waarom?)

……

4. Can you think of any needs regarding your current care that are not yet satisfied?
   (Kunt u enkele behoeften/wensen noemen die u heeft omtrent de zorg die u ontvangt?)

……

Questions regarding the usage of a telemedicine application:

1. Are you familiar with the term telemedicine? If so, do you already have an experience with telemedicine? If not, did you had an opportunity to participate?
   (Bent u bekend met de term telebegeleiding? Zo ja, op welke manier heeft u gebruik gemaakt van telebegeleiding? Zo niet, heeft u wel eens de mogelijkheid gekregen?)

……

2. How do you feel about the digitalization of care? In particular, how do you feel about the fact that more often care is being delivered at a distance using digital applications for the purpose of telemedicine?
   (Wat is uw mening omtrent de digitalisering van de zorg? Meer specifiek, wat vindt u ervan dat steeds meer zorg op afstand geleverd wordt middels digitale applicaties voor telebegeleiding?)

……

3. Would you feel comfortable to use a telemedicine application, why (not)? Could you think of some (dis)advantages for yourself when using digital application?
   (Zou u zich comfortabel voelen bij het gebruik van een digitale applicatie voor telebegeleiding? Wat zijn volgens u hierin de voornaamste voor- en nadelen? Zou u deze kunnen rangschikken van meest naar minst belangrijk?)

……

4. Which advise would you give hospitals on how they could stimulate patients to participate in using a digital application for telemedicine?
   (Welk advies zou u geven aan ziekenhuizen om patiënten te stimuleren gebruik te maken van digitale applicaties voor telebegeleiding?)

……

Closing of the interview

Word of thank

Do you have remarks/feedback on the interview?

3. PRELIMINARY CODING SCHEME INTERVIEWS

Table 10 - Initial coding scheme to analyze the semi-structured interviews

(1) Subjective perception of the patient's needs regarding chronic care		
Categories[a]	**Codes**	**Sub-codes**
Medical management	Accessibility and continuity of care	Insight in own health status
	Information on treatment options and implications	
	Drug management	
Communication	Patient-physician relationship	Type of interaction, information exchange, trust, respect
Coping with illness	Quality of life	Mental health distress, emotional support, confrontation with the disease
Lifestyle changes	Personalized care	
	Lifestyle incentives	Diet, stress management, physical activity
(2) Behavioral intention of patients and clinicians to use the telemedicine application		
Categories[b]	**Codes**	**Sub-codes**
Performance expectancy	Privacy and information security	Leaking of patient data
	(Dis)Trust	Communication of benefits, feedback
	Fear of losing face-to-face interaction	Fear of losing control
	Time investment	
Effort expectancy	User-friendliness	Ease of use, work pressure, self-efficacy, education/training, digital literacy
Social influence	Pressure of co-workers	Motivation/attitude
	Informal caregiver involvement	
Facilitating conditions	Digital training and help	Support in performing digital activities
(3) Contextual implementation barriers		
Categories[c]	**Codes**	**Sub-codes**
Sustainable funding	Reimbursement process	Payment mechanism, financial
Cost-effectiveness	Risk assessment	Health benefits, costs
Regulations	Standard procedures	Guidelines, rules
ICT-infrastructure	Internet availability	
Strategic leadership	Digital strategy	Implementation plan, organizational vision, communication strategy
	Business support	
Interoperability	Use of healthcare data	Interconnected ICT system, data exchange
	Workload of clinical practice	Task responsibility, function differentiation
Privacy and security	Safety requirements	
Capacity for implementation	Resources	# of FTE available, monitoring & evaluation of test results, work schedule

a: adopted from the research paper of (Bayliss et al., 2003)
b: adopted from the research paper of (Venkatesh et al., 2003)
c: adopted from the research paper of (Otto & Lorenz Harst, 2019)

4. FINAL CODING SCHEME INTERVIEWS

Table 11 - Final coding scheme after analyzing the semi-structured interviews

(1) Subjective perception of the patient's needs regarding chronic care		
Categories[a]	**Codes**	**Sub-codes**
Medical management	Accessibility and continuity of care	Insight in own health status
	Information on treatment options and implications	
	Drug management	
	Shared decision making	Patient participation
Communication	Patient-physician relationship	Type of interaction, information exchange, trust, respect, primary healthcare provider, environment
	Sense of being understood	
Coping with illness	Quality of life	Mental health distress, emotional support, confrontation with the disease, medication, recovery, direct answer to questions
Lifestyle changes	Personalized care	
	Social life	
	Lifestyle incentives	Diet, stress management, physical activity, structure
(2) Behavioral intention of patients and clinicians to use the telemedicine application		
Categories[b]	**Codes**	**Sub-codes**
Performance expectancy	Privacy and information security	Leaking of patient data
	(Dis)Trust	Communication of benefits, feedback, fear of unobserved symptoms, native language, digital interference, explanation of functionalities, information storage
	Fear of losing face-to-face interaction	Fear of losing control
	Time investment	Unnecessary burden
	Stakeholder involvement	Autonomy, self-awareness
Effort expectancy	User-friendliness	Ease of use, work pressure, self-efficacy, education/training, digital literacy, language
Social influence	Pressure of co-workers	Motivation/attitude
	Informal caregiver involvement	
Facilitating conditions	Digital training and help	Support in performing digital activities
	Learning from others	
(3) Contextual implementation barriers		
Categories[c]	**Codes**	**Sub-codes**
Sustainable funding	Reimbursement process	Payment mechanism, financial
Cost-effectiveness	Risk assessment	Health benefits, costs
Regulations	Standard procedures	Guidelines, rules
ICT-infrastructure	Internet availability	
Strategic leadership	Digital strategy	Implementation plan, organizational vision, uniform communication strategy
	Business support	
	Network of care	
Interoperability	Use of healthcare data	Interconnected ICT system, data exchange, up to date information, updated application
	Workload of clinical practice	Task responsibility, function differentiation
Privacy and security	Safety requirements	
Capacity for implementation	Resources	# of FTE available, monitoring & evaluation of test results, work schedule, time
	Sufficient expertise and knowledge	Team composition
Knowledge accumulation	Knowledge retention	Benchmarking, partnerships
	Testing	Impact / effect analysis

a: adopted from the research paper of (Bayliss et al., 2003)
b: adopted from the research paper of (Venkatesh et al., 2003)
c: adopted from the research paper of (Otto & Lorenz Harst, 2019)

APPENDIX 5: CROSS-CASE ANALYSIS

Patients' needs regarding chronic care

Medical management	Patient A: Patient A mentions the need of being actively involved in the decision making, but also being able to decide which topics to discuss with the clinician Patient B: Patient B agrees with patient A Patient C: Patients C agrees with patient A Patient D: Patients D agrees with patient A, but also mentions that the autonomy to change the dose of the medication in period of having more complaints is helpful. Patient E: Patient E agrees with patient A, but also highlights the importance of available information. Patient E advises the hospital to refer more often to platforms where information about implications, or risks of the disease is stored.
Communication	Patients A: Patient A mentions that it is preferred to have a low-threshold relationship with the doctor Patients B: Patient B agrees with patient A but indicates that a feeling of being heard is even more valuable. Patient B also mentions that a comfortable environment reassures to ask more questions to the doctor. Patients C: Patient C agrees with patient B Patients D: Patient D agrees with patient B Patients E: Patient E agrees with Patient D and adds that one clinician being the main contact point increases the feeling of being heard.
Coping with Illness	Patients A: Patient A indicates that being diagnosed at a young age with a chronic disease resulted in a lot of insecurity. Medication and being able to talk about complaints helps. Patients B: Patient B agrees with patient A, by saying that the disease is hard physically but also mentally as you are confronted with the disease very often. Patients C: Patient C agrees with patient B, and states that psychological support would help. Patients D: Patient D agrees with patient A, and states that it helps to directly get an answer from the clinician Patients E: Patient E agrees with patient C
Lifestyle changes	Patients A: Patient A states that the chronic disease results in lower energy levels which influences the social life Patients B: Patient B agrees with patient A, but adds that structure, and a healthy lifestyle are important Patients C: Patient C agrees with patient B, and would like to receive care that is more adapted to the personal life Patients D: Patient D agrees with Patient B Patients E: Patient E agrees with Patient B

Micro level

Performance expectancy	Patients A: Patient A mentions that a telemedicine application must not demand a lot of time, or unnecessary burden in the periods where the disease is stable. Patients B: Patient B agrees with patient A, but also indicates the fear to lose physical contact with the doctor because of telemedicine Patients C: Patient C disagrees with patient B by recognizing the benefits of being remotely monitored, but still being able to regularly get physical check-ups at the hospital Patients D: Patient D agrees with patient C, but also indicates that feedback is important to experience the effect of being monitored remotely Patients E: Patient E agrees with C, and mentions that it would help to explain which clinician is responsible for the remote monitoring Expert A: Expert A indicates that the application should function properly and must not demand extra time and effort of the specialists. Expert B: Expert B agrees with expert A but mentions that patients can be motivated by explaining that the remotely collected information is safely stored in their personal file. Expert C: Expert C agrees with expert A but adds that a telemedicine application is often a cultural change for clinicians which requires levitation of their expectations. Expert D: Expert D agrees with expert A, but indicates that the effectiveness of remotely monitoring for clinicians is increased when patients properly use all its functionalities
Effort expectancy	Patient A: Patient A was concerned about understanding the medical terms, and expects that elderly are less capable of using a telemedicine application Patient B: Patient B agrees with patient A Patient C: Patient C agrees with patient A Patient D: Patient D agrees with patient A Patient E: Patient E agrees with patient A, but also indicates that telemedicine applications are less useful for patients who are not proficient in the Dutch language Expert A: Expert A indicates patient often have too few digital experiences or have difficulties understanding the information from the telemedicine application. For clinicians, Expert A indicates that doctors refuse to work through a computer screen as they are afraid to lose control over their patients. Expert A states that doctors want to know what is possible with the application, and what it means for their current practice Expert B: Expert B agrees with expert A, but indicates that telemedicine applications must account for differences in native language Expert C: Expert C agrees with expert A, but also mentions that not every patient likes to be remotely monitored Expert D: Expert D agrees with expert A, and mentions the fear for clinicians to have an increased workload

Social influence	Patient A: - Patient B: - Patient C: - Patient D: - Patient E: - Expert A: Expert A indicates that telemedicine applications must be available for family and friends of patients, as they supported in daily care. Expert B: - Expert C: - Expert D: -
Facilitating conditions	Patient A: Patient A mentions that with the right digital support everyone can use a digital application but would also like to learn from experiences that other patients have with telemedicine. How do other patients use it? Patient B: Patient B agrees with patient A Patient C: - Patient D: - Patient E: Patient E agrees with patient A Expert A: Expert A indicates that clinicians can learn from each other on how to use a digital application, and digital support needs to be organized for the patients. Expert B: Expert B agrees with expert A Expert C: Expert C agrees with expert A Expert D: Expert D agrees with expert A

Meso level

Strategic leadership	Expert A: Expert A mentions that a new telemedicine application must be implemented within an interconnected network where all actors are involved, and aware of the direction and organizational vision. Also, a structured implementation plan and communication strategy is required to inform newly hired employees, and patients on forehand Expert B: Expert B agrees with expert A to have a uniform communication strategy Expert C: Expert C agrees with expert A, but adds that due to the tight labor market and limited availability of time implementations are carried out to quickly without performing good qualitative and quantitative analysis Expert D: Expert D agrees with expert A, and would like to have a digital strategy that is aligned to the needs of all stakeholders
Interoperability	Expert A: Expert A indicates that it is important to agree on the division of responsibilities and tasks. In addition, expert A indicates that a telemedicine application must be updated regularly, and be connected to the EPD system Expert B: Expert B agrees with expert A, and mentions that a review of the care process is desired to increase the process's efficiency by looking which activities can be replaced or supported by the telemedicine application Expert C: Expert C agrees with expert B, and adds when reviewing the care process, one must look to the whole network of care Expert D: Expert D agrees with expert A
Privacy and security	Expert A: Expert A states that standard operating procedures guarantee the safety and privacy of personal patient information Expert B: - Expert C: Expert C agrees with expert A Expert D: -
Capacity for implementation	Expert A: Expert A indicates that the implementation of a telemedicine application requires sufficient resources and time Expert B: Expert B agrees with expert A Expert C: Expert C agrees with expert A, but adds that due to the tight labor market and limited availability of time implementations are carried out to quickly Expert D: Expert D agrees with expert A, but also mentions that the right people at in the right positions helps, so a good composition of the work group is necessary
Knowledge accumulation	Expert A: Expert A indicates to extend and preserve knowledge within the organization Expert B: Expert B agrees with expert A, by indicating that there is a lack of use cases, but also every hospital setting is different. Expert B mentions to create partnerships with institutions such as libraries to acquire the right knowledge in-house Expert C: Expert C agrees with expert B, but also mentions that literature is a valuable source of information that is often not used Expert D: Expert D agrees with expert B

Macro level

Sustainable funding	Interview 1: - Interview 2: - Interview 3: Expert C indicates that every implementation of a telemedicine application needs financial support Interview 4: -
Cost-effectiveness	Interview 1: - Interview 2: - Interview 3: - Interview 4: -
Regulatory	Interview 1: Expert A mentions that all the information which is provided through the use of a telemedicine service needs to be comfort the national guidelines Interview 2: - Interview 3: - Interview 4: Expert D agrees with expert A
ICT infrastructure	Interview 1: Expert A indicates that not all patients have the financial resources or technology available to utilize a telemedicine application. Interview 2: Expert B agrees with expert A by mentioning that everyone should be facilitated to participate in a telemedicine practice Interview 3: Expert C agrees with expert A Interview 4: -

APPENDIX 6: ACTIVITY MODEL

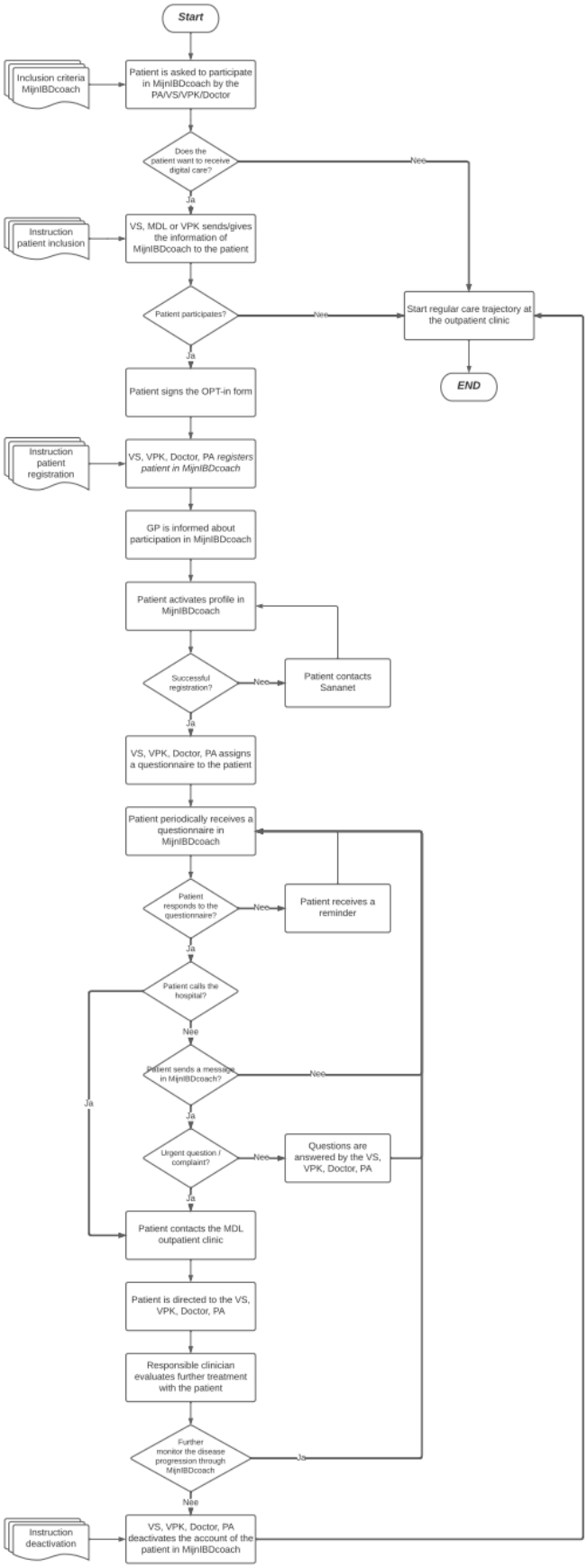

Figure 25 - Activity model of the IBD care process in the Elkerliek hospital (MijnIBDcoach)

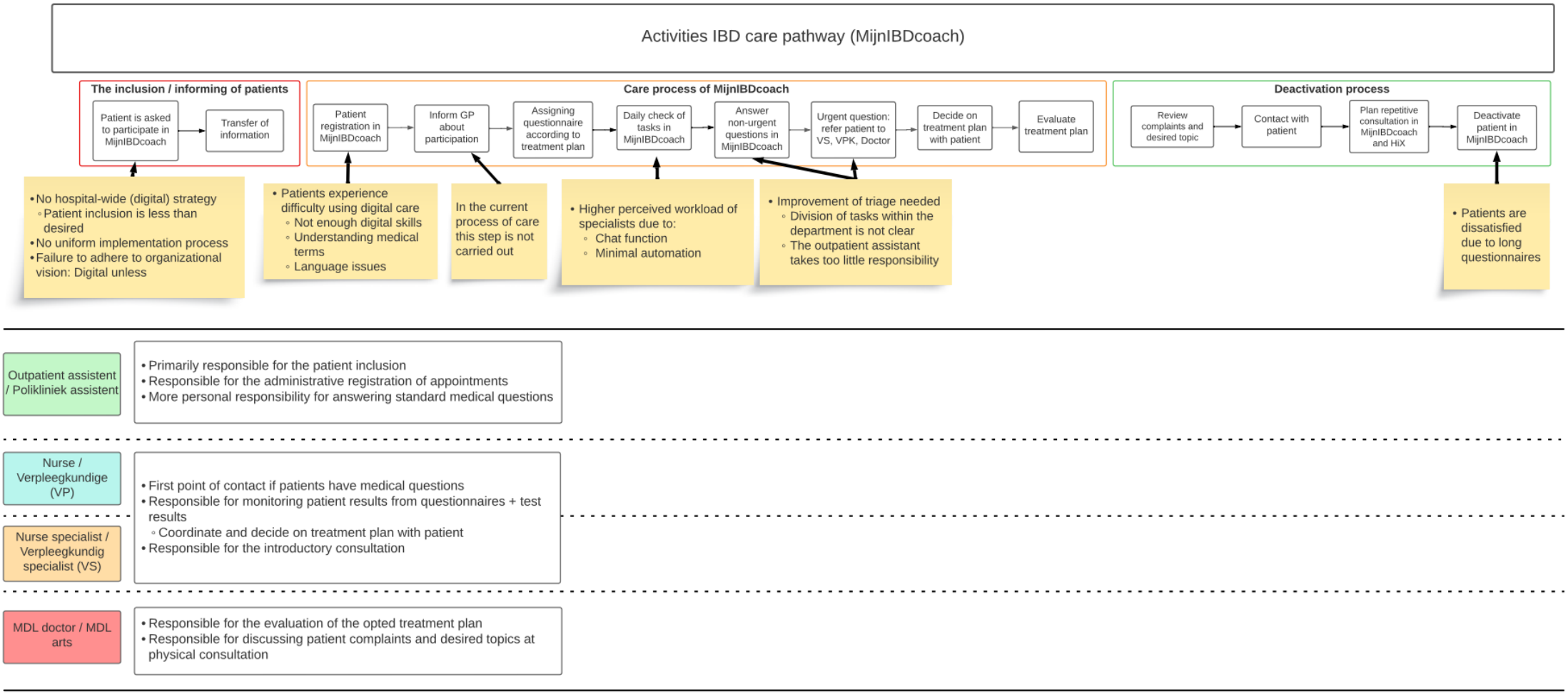

Figure 26 - Simplified activity model of IBD care process in the Elkerliek hospital (MijnIBDcoach)

APPENDIX 7: TO-BE SITUATION

Work instruction IBD care pathway: Digital care – Inclusion of patients

Werkprocess stap	Toelichting/Instructie	HiX documentatie van toepassing?
P1: Bestaande patiënten informeren, stimuleren en enthousiasmeren over nieuwe werkwijze	Besluitvorming over **communicatie** richting patiënt voorafgaand aan uitnodiging in BeterDichtbij (B1). Communicatie richting patiënt kan op de volgende momenten: 1. **Polikliniek assistent** informeert de patiënt bij aankomst op de poli 2. **Verpleegkundige/VS/MDL arts** informeert de patiënt tijdens spreekuur 3. Informeren van patiënt d.m.v. **folders/brochures/posters**	-
B1: Uitnodiging deelname BeterDichtbij bestaande patiënt	**Automatische groepsuitnodiging** deelname BeterDichtbij door **BeterDichtbij** • **Uitnodiging bevat folder Digitale zorg (BeterDichtbij en Helpdesk Digitale zorg)**	(HL7 – koppeling: automatisch bericht)
B2: Herinneringsbericht activatie	Wanneer de patiënt de BeterDichtbij app niet heeft geactiveerd binnen **1 week** na het versturen van B1 wordt een **automatisch herinneringsbericht** verzonden	(HL7 – koppeling: automatisch bericht)
P2: Bestaande patiënt bellen om reden geen deelname *(Visie van het Elkerliek- Digitaal tenzij)*	De **polikliniek assistent** heeft **telefonisch contact** met bestaande patiënten die de BeterDichtij app niet hebben geactiveerd binnen **3 weken** na het versturen van B2 Hierin is het zaak om de patiënt te informeren en overtuigen van nieuwe werkwijze: • Voordelen van digitale zorg bespreekbaar maken • Wanneer patiënt twijfelt aan digitale vaardigheden, verwijzing naar Helpdesk Digitale Zorg	
P3: Versturen Opt-out formulier	Bij het uitblijven van deelname krijgt de patiënt **digitaal of fysiek een Opt-out formulier** overhandigt door de **polikliniek assistent**	Polikliniek assistent registreert het ondertekende Opt-out formulier in HiX
P4: Versturen activatie bericht	Bij deelname volg B3: Activatie bericht	-
B3: Activatie bericht	**Polikliniek assistent** stuurt een **standaardbericht met informatie over de activatie** in BeterDichtbij naar de patiënt	-
P5: Poli-spreekuur	Tijdens het eerste poliklinisch bezoek van een nieuwe IBD-patiënt wordt een **informatiepakket** overhandigd: • **Folder Digitale zorg (BeterDichtbij en Helpdesk Digitale zorg)**	-

Digital care – MijnElkerliek (care pathway)

Werkprocess stap	Toelichting/Instructie	HiX documentatie van toepassing?
P6: Aangepaste vragenlijsten beschikbaar stellen in HiX	Door een **functioneel beheerder** zullen de geselecteerde vragenlijsten beschikbaar worden gesteld in **HiX**	-
P7: Opstellen behandeltraject	De **verpleegkundig specialist** bepaalt het **behandeltraject** van de patiënt • Communiceren van afspraken naar de poli-assistent	Order in HiX naar de poli-assistent voor het inplannen van een afspraak
P8: Inplannen: PGC op afspraakcode (maand 6 & 12)	**Inplannen van PGC**-afspraak in HiX door de **polikliniek assistent** volgens behandeltraject • HiX stuurt automatisch deze vragenlijsten naar de patiënt in MijnElkerliek	-
B4: Bericht – Invullen PGC	**Automatisch bericht - 1 week voor** de gezondheidscheck/vragenlijst wordt uitgezonden naar de patiënt (B5) krijgt hij een herinneringsbericht	(HL7 – koppeling: automatisch bericht)
B5: Bericht – Vragenlijst staat voor u klaar	**Automatisch bericht** naar de patiënt waarin vermeld staat dat de vragenlijst klaarstaat in MijnElkerliek wanneer beschikbaar	(HL7 – koppeling: automatisch bericht)
B6: Reminder – Invullen PGC	**Automatisch herinneringsbericht** voor het invullen van de periodieke gezondheidscheck 1 **week na** ontvangst B5	(HL7 – koppeling: automatisch bericht)
P9: Patiënt bellen	Op het moment dat de patiënt **4 weken** na het ontvangen van de vragenlijst (B2) deze nog niet heeft ingevuld belt de **polikliniek assistent** de patiënt	-
P10: Monitoren PGC (maand 6) + resultaten bloed en ontlasting	De **verpleegkundig specialist/verpleegkundige** is verantwoordelijk voor het monitoren van de **resultaten** uit de **periodieke gezondheidscheck** en de testen op **bloed en ontlasting.**	Verpleegkundig specialist/ verpleegkundige documenteert patiëntinformatie in HiX indien noodzakelijk
B7: Chatbericht van patiënt	De patiënt stuurt een bericht in BeterDichtbij	-
P11: Dagelijkse check-up vragen in BeterDichtbij	**Ziekenhuisbrede afspraken voor beantwoorden vragen in BeterDichtbij:** - **Niet medische vragen** worden beantwoord binnen **1 werkdag** door het **KCC** - **Medische vragen** bij de **polikliniek** worden binnen **3 werkdagen** beantwoord - Na het beantwoorden van een vraag wordt het bericht in BeterDichtbij op **afgehandeld** geplaatst	Vragen worden doorverwezen d.m.v. orders in HiX

B8: Bericht met informatie / vervolgstappen	De zorgmedewerker geeft antwoord op de vraag van de patiënt in BeterDichtbij waarbij geldt: • Wie het antwoord heeft is degene die het antwoord geeft • Berichten worden geschreven volgens **de afspraken voor communicatie**	-
P12: Documenteren van relevante patiëntinformatie in HiX	Vanuit BeterDichtbij kan de betrokken **zorgverlener** (Polikliniek assistent/ Verpleegkundige/ Verpleegkundig specialist) relevante informatie kopiëren • Button “kopiëren”	De betrokken zorgverlener kan de patiënten informatie handmatig kopiëren in BeterDichtbij en verplaatsen naar HiX

APPENDIX 8: INTERVIEW TRANSCRIPTIONS (ALPHA TEST)

For confidentiality reasons not available here, but upon request.