The determinants of effective eHealth: high-quality applications and optimal organization: evaluating an online patient portal form a patient perspective and evaluating the quality of hybrid care from an organizational perspective

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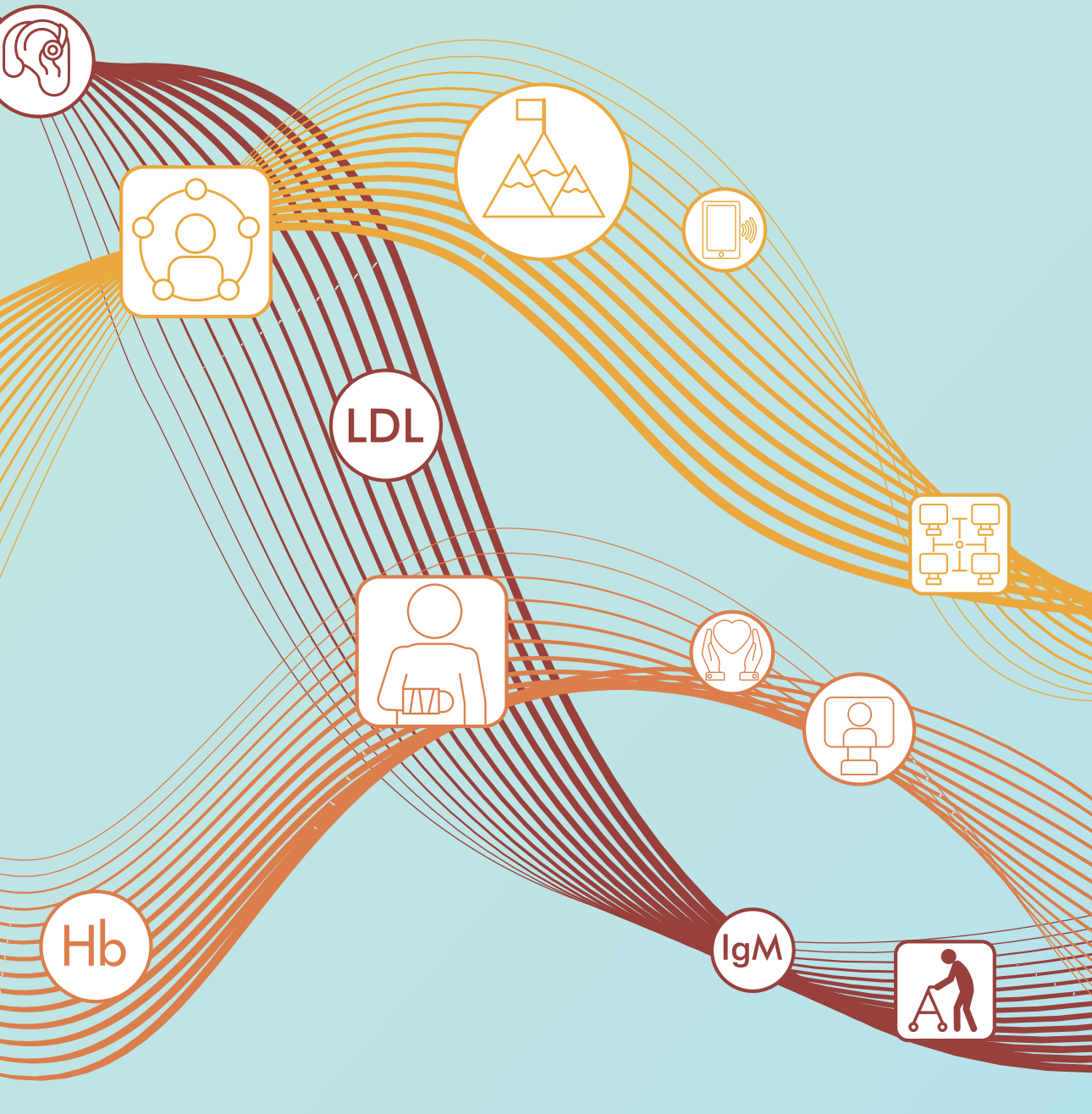
Voor mijn kinderen Nubia, Remo en Nova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Chapter 1

General introduction

eHealth

Health care is facing major challenges. Demand is rising and patient needs are increasingly complex due to an ageing population and the growing prevalence of chronic diseases. Simultaneously, the cost of health care and staff shortages are soaring, with accessibility issues as a consequence.[1,2] Pressure on the health care sector has become huge during the COVID-19 pandemic,[3] emphasizing the need for a transformation of access to care. Continuity of care needs to be secured even in times of limited access to conventional face-to-face care.[4] Innovative solutions, such as eHealth, are therefore needed to ensure access to high-quality care.[5–7]

eHealth is the application of digital information and communication to support and improve personal health and personalized health care for the patient.[8] eHealth applications include tools for communication between patients and health care professionals (HCPs), or between HCPs, such as video calls, patient portals and clinical decision support systems. eHealth applications also provide opportunities to transfer care from an institutional environment to the patient at home. Patients have more rapid access to suitable information with more options to manage their care, which can lead to higher engagement and self-management.[8] Higher patient engagement often also results in better outcomes.[9–11] eHealth is most effective when it is fully integrated into the health care system[7,12] in a "hybrid" model that combines eHealth with conventional in-person care.[13,14] Despite the increasing use of eHealth, questions remain about both the usability of these applications and the effective organization of hybrid health care.[15] The case study below illustrates some of the issues involved.

Case Study: Communicating Laboratory Results via an Online Portal

Nancy has an underactive thyroid. She takes medication for her condition, and needs to be on the right dose, since if it is not properly adjusted, it affects her hormone levels. In the past, Nancy has gained weight, been constantly tired and felt depressed. To prevent this, she goes to a diagnostic centre for blood tests every 6 to 13 weeks so her medication can be adjusted, and visits her general practitioner (GP) once a year. Nancy and her doctor can receive her laboratory test results via an online portal. Sometimes she sees that her results are slightly off. However, the portal does not explain how far from the target level they are, so she contacts her GP to share her concerns about whether she is on the right dose. Her dose almost always needs to be adjusted. Nancy wishes the online results were clearly explained and accompanied by advice about whether she should contact her GP. However, thanks to direct access to her laboratory test results and guidance from her GP, Nancy has her thyroid condition under control and is feeling well.

Paul is Nancy's GP and has a very busy practice. His workload has been increasing for several years, partly because he is seeing more and more patients with chronic conditions and complex issues, and partly due to the increased administrative burden associated with the new digital solutions. While these improve diagnostic reliability, each device has slightly different instructions. Paul feels as if he spends more time sending digital information than on diagnosis and treatment. He sometimes sees patients who have difficulties with eHealth applications, such as Nancy, and wishes the results portal provided patients with clearer explanations regarding their health information. The introduction of the online portal was expected to reduce patient visits to once a year, but instead Paul sees patients more than he did before, and the content of their consultations has changed. Before the online portal was introduced, Paul would explain Nancy's blood test results and her medication, but now he coaches Nancy on how to listen to and interpret her body's signals in conjunction with her test results.

Effective Organization of eHealth

This case study shows that the online portal does not provide adequate information to support Nancy's self-management. In combination with Paul's in-person care, however, Nancy is experiencing much better health outcomes than before. Paul is also benefiting from eHealth, but it is not yet embedded in his daily practice: he sees patients more than he did before, the content of their consultations has changed and the administrative burden has increased. Although hybrid health care is helpful for Nancy, working with eHealth is not effective for Paul.

Like Paul, many HCPs view eHealth as an extra burden rather than something that supports their work. In addition, they often experience faltering technology, have to use different communication channels, have inadequate digital skills and are concerned about data privacy.[16–22] These issues negatively affect their (perceived) workload and satisfaction levels, sometimes at the expense of quality care.[16–22] eHealth also reshapes the patient–HCP relationship, with the HCP taking on a coaching role.[23,24] The organizational structure and workflows in health care need to evolve to support HCPs in their daily practice, when working with eHealth.[12,25–28]

Hybrid health care offers many opportunities. To optimize the quality of hybrid health care, digital applications must benefit patients[6] and be easy to use, and health care organizations need to restructure the way they work to support the delivery of patient care.[12,25–28]

Thesis Objectives

The objectives of this research are twofold:

- to investigate the usability of an eHealth application and the impact on users' self-efficacy, from a patient perspective;

- and to analyze the factors that contribute to high-quality hybrid health care, from an organizational perspective.

The first part of the thesis explores perceived usability and self-efficacy with a case study, assessing patients' attitudes toward an online patient portal communicating laboratory test results. The second part of the thesis focuses on the factors that contribute to high-quality hybrid health care, and how to assess its quality. A hybrid health care quality model and an accompanying self-assessment questionnaire are also developed to help health care organizations identify possible areas for improvement in order to integrate eHealth in a robust and sustainable manner.

The Main Research Objectives of This Thesis Are as Follows:
Part 1. Evaluation of eHealth from a Patient Perspective: Assessment of an Online Patient Portal

1. To investigate the perceived usability and impact on patients' self-efficacy of using an online patient portal that communicates laboratory test results in patient-friendly language.

2. To assess the effect of patient characteristics (gender, age, education and type of chronic disease) on perceived usability and self-efficacy using an online patient portal for laboratory test results.

Part 2. Evaluation of eHealth from an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

1. To investigate which indicators in the structure, process and outcome categories affect the successful integration of eHealth into regular health care and investigate which structure and process indicators are related to outcome indicators.

2. To develop a quality assessment model for organizing hybrid health care with an accompanying self-assessment questionnaire.

Thesis Outline

Part 1. Evaluation of eHealth From a Patient Perspective: Assessment of an Online Patient Portal

The first part of this thesis describes patients' attitudes toward an online patient portal that communicates laboratory test results in patient-friendly language. The study participants were patients who visited the portal to view their results after having a blood test at a primary care diagnostic centre and laboratory in the Netherlands. Patients who viewed their test results on the portal were automatically invited to complete the eHealth Impact Questionnaire (eHIQ). The usability of the patient portal was assessed using the Information and Presentation subscale of the eHIQ, and patients' self-efficacy was assessed using the Motivation and Confidence to Act subscale, to determine whether they were motivated to act on the information they were shown.[29,30]

Chapter 2 describes a quantitative study analyzing patients' attitudes toward the portal using two subscales of the eHIQ and exploring the correlation between the usability and self-efficacy outcomes. **Chapter 3** presents a replication of this study with a larger number of participants, evaluating the effects of gender, age, education and type of chronic disease on usability and self-efficacy.

Part 2. Evaluation of eHealth From an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

The second part of the thesis focuses on the organization of hybrid health care using the Donabedian structure, process and outcomes (SPO) framework, in which structure is the health care setting and available resources; process is what is done in giving and receiving care; and outcomes are the end results of health services.[31–33] According to Donabedian, health care quality is based on aspects of these three categories and the relationships between them: improvements in structure can improve a process, which is likely to improve outcomes.

Chapter 4 describes a systematic literature review using the Donabedian SPO framework to investigate which indicators might be related to the integration of eHealth into health care.

Chapter 5 enriches and validates the evidence base derived from the literature review with practical knowledge from experts. This study uses the concept mapping method to develop a quality assessment management model designed to support health care organizations to improve the organization and quality of their hybrid health care.

Discussion

To conclude, **Chapter 6** reflects on the findings of this thesis, putting them into context, discussing the methodological choices made, and making suggestions for further research and practice.

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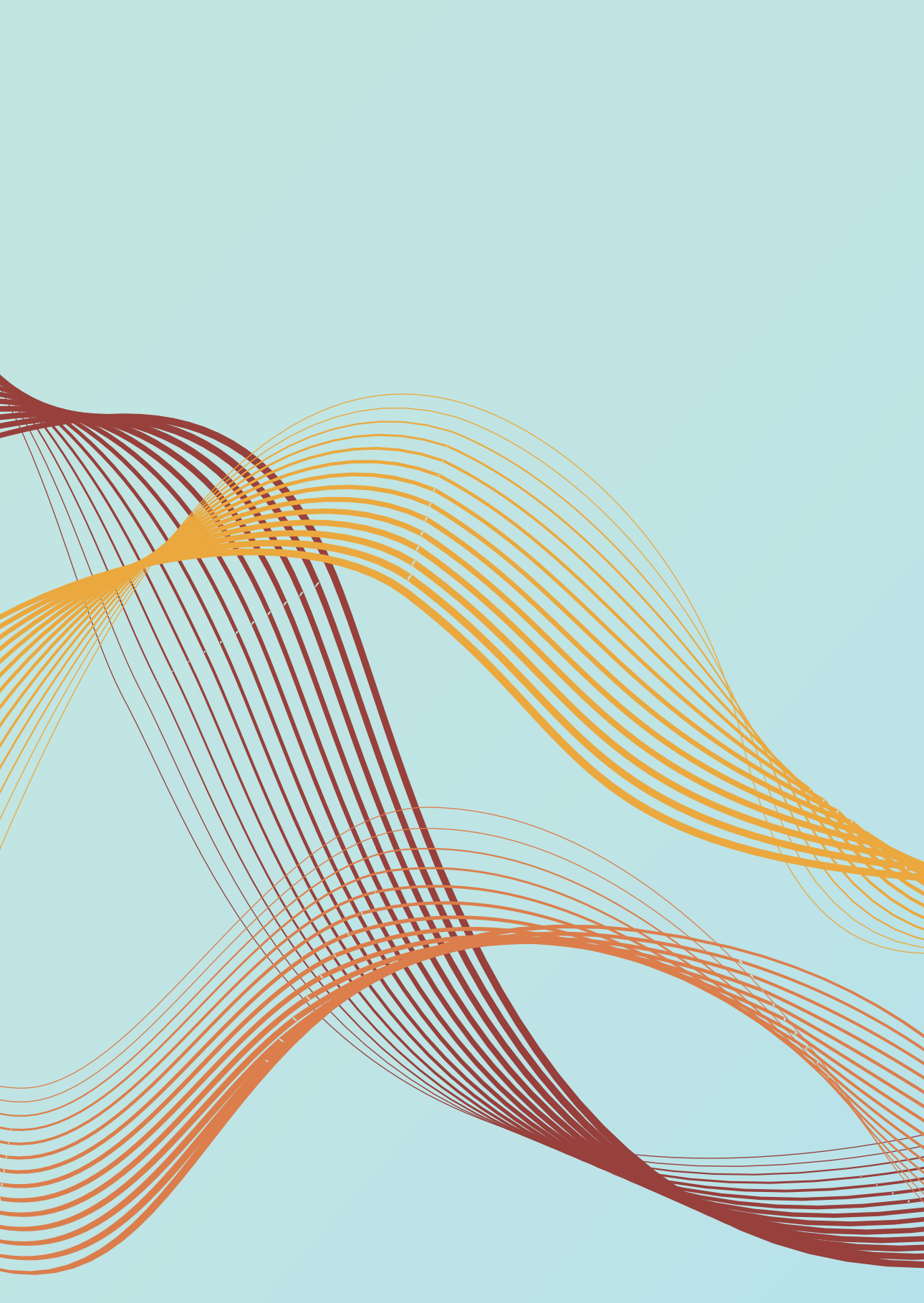
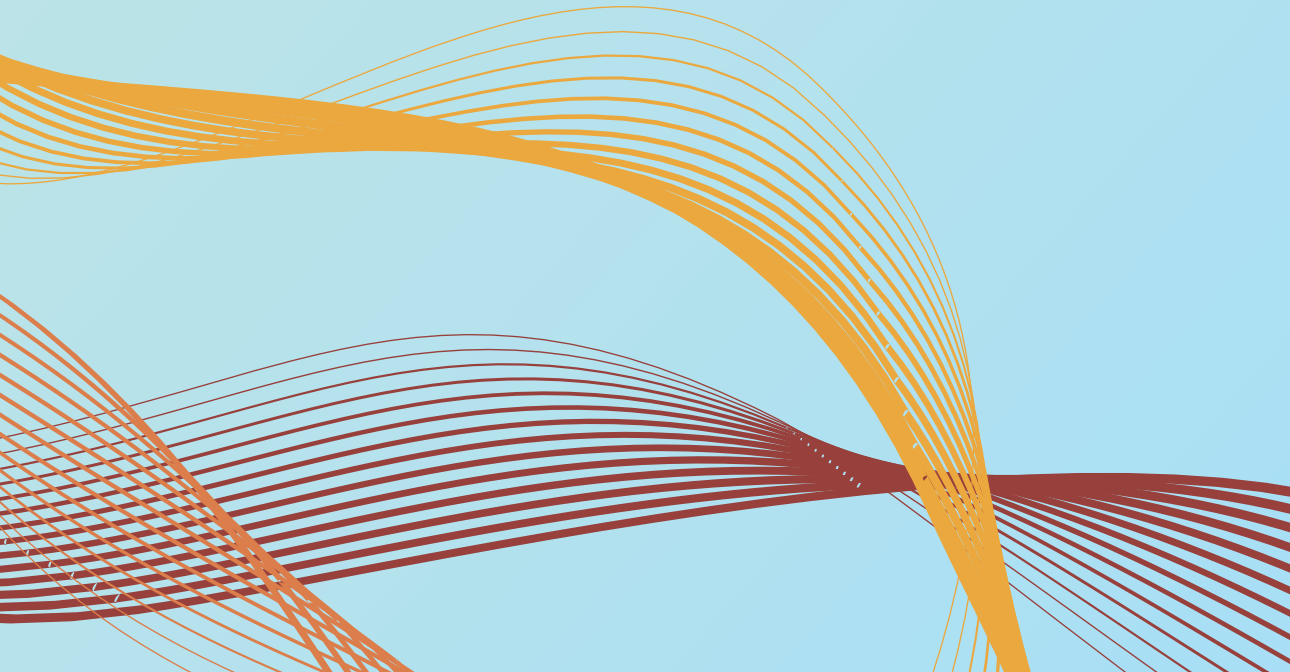
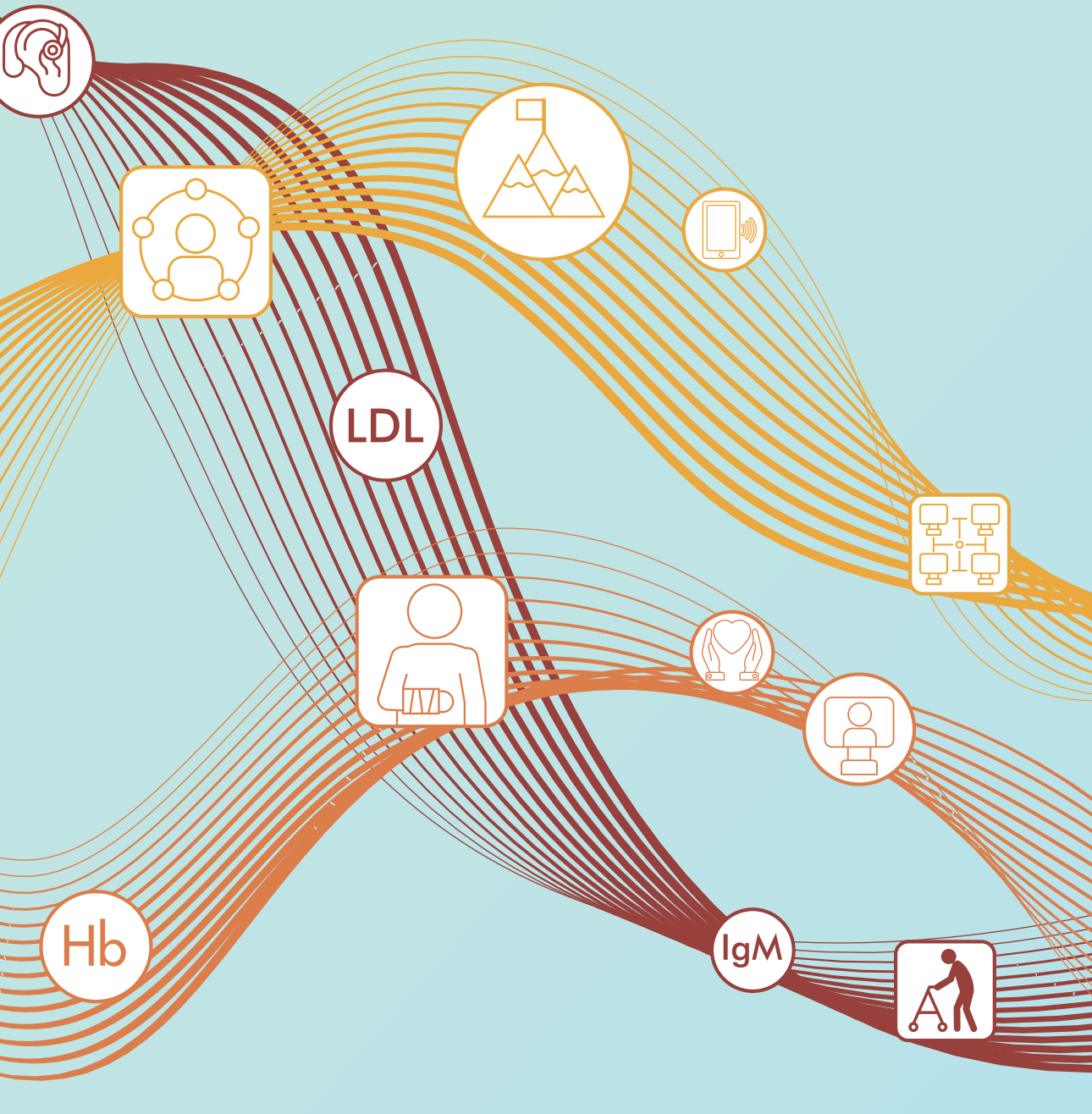


PART I

Evaluation of eHealth from a patient perspective: Assessment of an online patient portal

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Chapter 2

Patients' attitudes toward an online patient portal for communicating laboratory test results: real-world study using the eHealth Impact Questionnaire

Talboom-Kamp E., Tossaint-Schoenmakers R., Goedhart A., Versluis A., Kasteleyn M.

JMIR Formative Research. 2020 Mar 4;4(3):e17060. doi: 10.2196/17060

Abstract

Background
Communicating laboratory test results online has several advantages for patients, such as improving clinical efficiency and accessibility, thereby helping patients to take an active role in managing their health.

Objective
This study aimed to investigate the experiences and self-efficacy of patients using an online patient portal that communicates laboratory test results.

Methods
We used the online-administered eHealth Impact Questionnaire to explore patients' attitudes toward the portal. Patients visiting the portal were asked to complete the questionnaire. The subscale Information and Presentation assessed the usability of the patient portal and the subscale Motivation and Confidence to Act assessed self-efficacy to determine whether patients were motivated to act on the presented information. We used a cutoff score of 65 or greater to determine whether the portal was rated positively.

Results
The questionnaire was completed by 354 of 13,907 patients who viewed their laboratory results in the patient portal, with a response rate of 2.55%. The mean Information and Presentation score was 67.70 (SD 13.12) and the mean Motivation and Confidence to Act score was 63.59 (SD 16.22). We found a positive, significant correlation between the 2 subscales (r_{345}=.77, P<.001).

Conclusions
Patients participating in the study rated the usability of the portal positively. However, the portal only slightly helped patients to take an active role in managing their own health. The low response rate precludes generalization of the results. Future research should examine avenues to further increase patients' self-efficacy and study whether portal acceptability differs in subgroups. Patient portals conveying laboratory test results in understandable language seem usable and potentially provide a viable way to help patients take a more active role in managing their own health.

Keywords
attitude to health; eHIQ; eHealth Impact Questionnaire; laboratory test results; patient portals; self efficacy; telemedicine; usability

Introduction

Background

Patient involvement in decision making and delivery of health care is important to patients, health care providers, and policy makers. When patients are activated to be more engaged in health and disease issues, their behavior changes toward more self-management.[1] Therefore, patient involvement is stimulated as an essential element of patient-centered care and as a means to improve the quality and efficiency of care.[2,3] With modern digital possibilities, such as electronic patient portals, patients' activation and information can be organized more easily. The internet is increasingly being used by care consumers to look for answers about health concerns and has the potential to change health care behavior.[4,5] Although personal health records and patient portals are promising tools, evidence of their effects on patient centeredness of care, efficiency of care, and health outcomes is inconsistent.[6-8] Furthermore, adoption rates of electronic health (eHealth) vary greatly and are often less than 50%. [9-13]

Several health care organizations in the Netherlands, such as Saltro Diagnostic Center, have invested in the development of a high-quality patient portal that is blended into usual care. Solutions that are blended into usual care generally have higher adoption rates.[14] Saltro's portal provides access to laboratory test results, including explanatory information and visualization, for the individual patient.[15] The aim is to facilitate patients to play an active role in their diagnostic process and disease management. Patient health engagement is indispensable to improve diagnostic accuracy.[16] When patients take an active role in this process, for instance by asking questions and voicing their opinions, it improves the diagnostic process.[17] Consistent with the trend of patients being more proactive and involved in their own health care,[18] becoming a more knowledgeable consumer may reduce the risk of diagnostic error.[19]

The full potential of patient portals will only be reached if patients understand the results that are communicated, in this case, the information that becomes available from laboratory tests. How the content is presented in a portal and how the patient interprets this affects the overall usefulness of the information.[20] The information in a patient portal can, for example, cause insecurity for the patient—as patients can become emotionally destabilized by the confusion or impact of the test results—which can negatively affect patient health engagement.[21] This risk is more prominent when patients find the results difficult to interpret.[22] Problems have previously been reported with the complexity of the provided information, making it mainly useful for patients with high health literacy.[23] Research has also shown that misinterpreting the risk of blood test outcomes is common, with patients underestimating the severity.[24] These findings raise concerns for patient safety. How results are communicated through patient portals is thus important and needs to be done in a manner that minimizes the risk of misunderstanding. Therefore, testing how patients perceive online portals and test results is recommended, for example, by using the eHealth Impact Questionnaire (eHIQ).[25]

Objective

Previous research with the Saltro patient portal showed that the presented test results were valuable and important to the majority of the participants (i.e., members of a health care consumer panel).[15] To further scientific knowledge, research is needed to examine how patients perceive the online portal. Therefore, we set up a questionnaire study to explore patients' attitudes toward a patient portal that was specifically designed to communicate laboratory test results with explanatory texts and supporting visuals. The first aim of this study was to provide insight into the usability of patient portals (including ease of use, perceived trustworthiness, and appropriateness of information). Examining user experience is important, because perceived trustworthiness has been linked to use and engagement with online health information.[26,27] The second aim of this study was to provide insight into how the Saltro laboratory test results portal affects patients' motivation and confidence to manage their health. This relates to self-efficacy, defined as a person's confidence in his or her ability to perform specific behaviors that are considered beneficial.[28] Self-efficacy is considered important for motivation and intention to act on information.[29] The third aim of this study was to analyze whether there is a positive association between the perceived usability of the patient portal and self-efficacy, consistent with the literature.[30,31] Overall, this study aimed to assess the experiences and self-efficacy of patients using a patient portal and the association between the 2 constructs.

Methods

Design and Participants

We conducted a real-world study between September 2018 and February 2019 to explore patient attitudes toward a patient portal. The participants were patients who received a diagnostic request form from their general practitioner (GP) for a blood test at Saltro, a primary care diagnostic center and laboratory in the Netherlands. Each month approximately 65,000 patients receive a diagnostic request form for a blood test at Saltro. These patients have access to the patient portal, although not all patients use the patient portal. Patients who viewed their test results in the patient portal were approached online to participate in this study by completing an online questionnaire. There were no specific inclusion or exclusion criteria. This study did not require approval from an ethics committee, because no personal information was collected, and the data could therefore not be traced back to the individual.

Patient Portal

In 2015, Saltro launched a test result Web-based portal that gives patients access to their laboratory test results, including understandable explanatory information personalized to the individual patient (based on sex and age). The portal was created together with health care professionals and patients. All medical content was written by a multidisciplinary team consisting of a GP, a communication specialist, and a clinical chemist. The texts were written to be understandable for the majority of people and have been reviewed by patients and adjusted based on their advice. The level of health literacy of the result information has been estimated at communication level 1B on the scales of the Common

European Framework of Reference for Languages.[32] A previous evaluation study showed that over 85% of patients found the accompanying text with the laboratory results comprehensible.[33] Daily, approximately 300 unique individuals look up their laboratory results in the portal. Patients also have the option to share their results with others.

After having blood drawn, patients can look up the test results by logging in to the GP website with a username and password. The login procedure is in line with Dutch security legislation and guidelines (i.e., the Dutch Personal Data Protection Act) and the General Data Protection Regulation guidelines. There are no age restrictions to logging in. After logging in, the patient sees an overview of all new and old laboratory tests ordered by date (see Figure 1). This makes it possible to compare new test results with previous results.

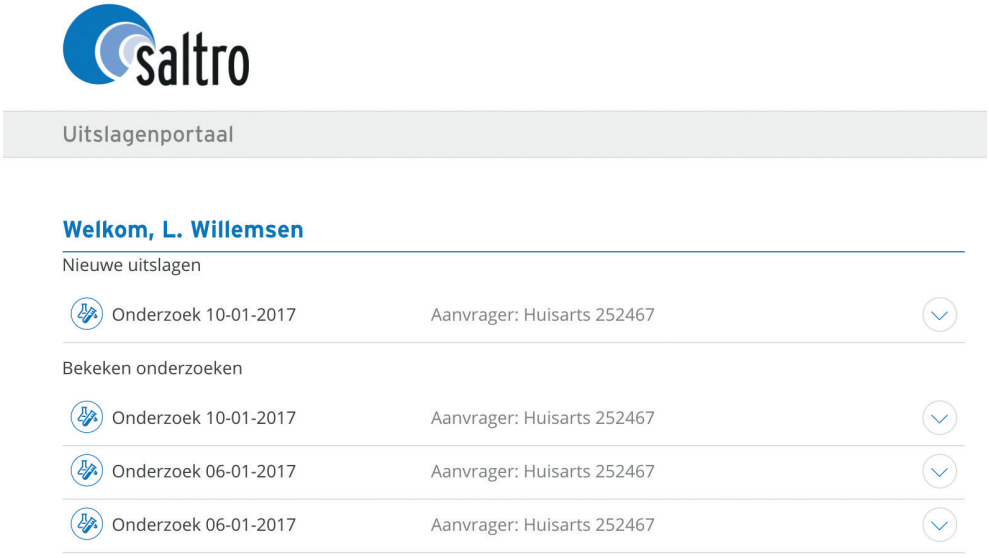

Figure 1. Patient portal overview showing the laboratory tests that were ordered, with the result of the most recent test displayed at the top.

After clicking on a specific date, the patient is shown the results of the laboratory test that was performed on that date (see Figure 2). For each laboratory test, the patient sees the individual results together with traffic light–colored bullets indicating normal or abnormal results. Clicking on an individual test result shows an explanation of the laboratory test results in a simple and understandable manner. The texts contain an explanation about the test, what was measured, and why a physician might order this test. If a test result is abnormal, then possible diagnoses are mentioned, and patients are advised to discuss the result with the GP. Next, the individual test results are discussed together, and an explanation of what the results could mean for the patient is given.

In addition to the text, a visual is presented underneath the explanatory text (see Figure 2). The visual presents the individual numeric value of the laboratory test result and how it relates to the reference value(s). Colors are added to emphasize this range. The reference values differ per laboratory test, and sometimes also by sex and age. A green dot or line means that the result is normal for the patient, and there is no deviation. An orange dot or line means the laboratory result is divergent or abnormal. As the individual numeric value of the laboratory test is presented above the line, patients can see whether their value is normal or deviates from the reference value. The majority of patients find this information valuable and important.[15] Patients are referred to their GP if they have questions. If the dot or line is red, it means the laboratory result is severely deviating (compared with the reference value). In that case, Saltro directly contacts the GP to get in contact with the patient for suitable treatment. Textbox 1 shows an example of a patient journey.

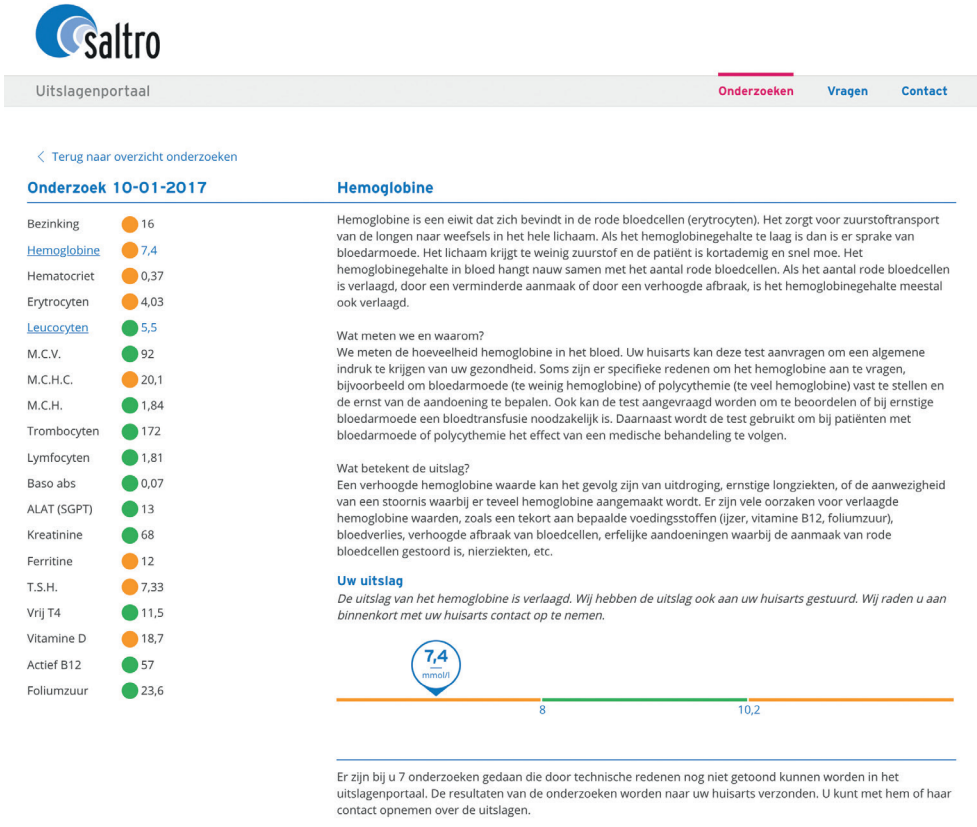

Figure 2. Display of the results of a specific laboratory test in the patient portal.

Textbox 1. Example of a patient journey.

A person develops complaints about his health and goes to the general practitioner (GP). The GP examines the person and requests blood tests. The person goes to the phlebotomist from Saltro, who collects blood, which is analyzed in the laboratory. The same evening the person can look up the results in the portal. He can see which tests are normal and not likely to be the cause of health complaints. He can see what is tested and will know what is functioning accurately in his body, which will be reassuring. He can also see and choose to read the divergent laboratory results first. He can compare the value with reference values to see how deviating the value is. He does not have to search on the internet; he reads quickly what this test means and can contact the GP to discuss worries and questions, and to make decisions together regarding further steps and treatment.

Outcome Measure

The primary outcome of this study was the second part of the validated Dutch version of the eHIQ.[25,34] The eHIQ is a self-reported questionnaire of which Part 2 measures patients' attitudes toward a *specific* health-related website, in this case, the patient portal. We chose the eHIQ for the following reasons. First, the eHIQ assesses the patient's perspective of the website. Second, the questionnaire is translated and validated in Dutch. Third, information from the eHIQ can be used to compare the effects of the websites for benchmarking; with this study we set a first standard. Fourth, the information can be used to improve a website further, in this case, the patient portal. Each of the 26 items is scored on a 5-point Likert scale ranging from "strongly disagree (1)" to "strongly agree (5)." The questionnaire has 3 subscales: (1) Information and Presentation, (2) Motivation and Confidence to Act, and (3) Identification. The Information and Presentation subscale has 13 items and measures whether people find the website easy to use; this includes items on understanding, trustworthiness, and whether images used were appropriate. This subscale relates to usability. The Motivation and Confidence to Act subscale consists of 10 items and assesses whether an individual felt reassured after reading the information on the website and was motivated to manage their health. This subscale relates to self-efficacy. The final subscale, Identification, consists of 3 items and measures whether individuals identify with others who use the website. An example item is "I feel I have a sense of solidarity with other people using the website." As users of the patient portal do not interact with other users, we considered this subscale to be irrelevant for this study and therefore did not discuss it further. We transformed the total scores for each subscale to a scale of 0 to 100, with higher scores representing a more positive attitude. No official cutoff score is available to determine whether a website or portal is rated as positive or negative. In consultation with the authors who translated and validated the eHIQ in a Dutch population of eHealth users, we determined that a score of 65 or greater is considered positive. The eHIQ has good construct validity, internal consistency, and test-retest reliability.[25,34] Cronbach alpha in this study was considered good (.88 to .90).

Procedure

Patients who received a laboratory request form for a blood test at Saltro and who used the patient portal in the period between September 2018 and February 2019 were digitally

approached to complete the eHIQ-Part 2. After patients viewed their results in the portal, a pop-up window appeared asking them whether they wanted to fill in a questionnaire. Below this question, the questionnaire was shown to patients and patients could complete it in the portal. Individuals who were unwilling to complete the questionnaire (based on the first question) had to click the pop-up away. These individuals, however, were asked to complete the questionnaire again when they logged in at a later point to view other test results. Patients could complete the questionnaire only once.

Completed questionnaires were automatically sent to us by email. The answers to the questionnaire were coupled to the last test result, indicating whether it was normal or deviant, and the number of laboratory requests for that participant. No personal information of the participant, type of blood test, and the interpretation of the laboratory results were visible to us.

Statistical Analyses

To gain insight into the patient's perceived usability of the patient portal and their self-efficacy of using a patient portal, we performed descriptive statistics. We calculated the mean scores of the 2 eHIQ subscales and used a cutoff score of 65 or greater to determine how the portal was rated. When the mean of the subscale was 65 or higher, we evaluated the subscale positively. Also, we examined the highest- and lowest-scoring items for each subscale to get a better understanding of which aspects of the patient portal were appreciated and which could be improved further. For items with the same mean score, we chose the items with the highest precision. To examine whether the perceived usability of the patient portal (first subscale, Information and Presentation) was positively associated with self-efficacy (second subscale, Motivation and Confidence to Act), we performed a Pearson correlation. Data were normally distributed and we identified no significant outliers. We performed all analyses using IBM SPSS Statistics version 24 (IBM Corporation).

Results

A total of 13,907 patients viewed their laboratory results on the patient portal and were invited to complete the eHIQ. The questionnaire was completed by 354 patients (2.55%). These participants completed all items of the eHIQ. The mean score of the subscale Information and Presentation was 67.70 (13.12) on a scale ranging from 0 to 100. This subscale of eHIQ thus scored above the set cutoff score of 65 and was evaluated positively. The mean score of the subscale Motivation and Confidence to Act was 63.59 (SD 16.22) on a scale of 0 to 100. This score was just below the set cutoff score and was therefore not considered positively evaluated. Table 1 presents the mean scores of the 2 subscales and the individual items.

We identified the 3 highest- and lowest-scoring items of the 2 subscales. The highest-scoring items on Information and Presentation were trust in the provided information (mean 4.06, SD 0.69), ease of understanding the information (mean 4.06, SD 0.81), and use of understandable language in the portal (mean 4.04, SD 0.80). The lowest-scoring items were about whether the images were distressing (mean 3.44, SD 0.79), tips were useful

(mean 3.27, SD 0.94), and website imagery was appropriate (mean 3.27, SD 0.71). The highest-scoring items on Motivation and Confidence to Act were on better understanding personal health by using the website (mean 3.86, SD 0.74), being encouraged to take health-beneficial actions (mean 3.85, SD 0.93), and confidence to take action (mean 3.56, SD 0.84). The lowest-scoring items were on whether the website would be consulted to make a decision about health (mean 3.38, 0.95), gives confidence to discuss health with other people (mean 3.37, SD 0.94), and gives confidence to explain health concerns to others (mean 3.36, SD 0.91).

To examine whether the perceived usability of the patient portal was positively associated with self-efficacy, we calculated a Pearson correlation. There was a large, positive, significant correlation between the subscale Information and Presentation and Motivation and Confidence to Act (r_{345}= .77, P<.001). This finding was in line with our expectations.

Table 1. Mean scores of the 2 subscales of the eHealth Impact Questionnaire (eHIQ)-Part 2[a] and the individual items.

Subscale and item	Score, mean (SD)
Information and Presentation	**67.70 (13.12)**
I trust the information on the website	4.06 (0.69)
I can easily understand the information on the website	4.06 (0.81)
The language on the website made it easy to understand	4.04 (0.80)
The information on the website left me feeling confused[b]	3.95 (0.98)
I value the advice given on the website	3.79 (0.78)
The website is easy to use	3.82 (0.89)
The website provides a wide range of information	3.73 (0.83)
The website has a positive outlook	3.64 (0.88)
The people who have contributed to the website understand what is important to me	3.63 (0.79)
On the whole, I find the website reassuring	3.51 (0.82)
I found the images on the website distressing[b]	3.44 (0.79)
The website includes useful tips on how to make life better	3.27 (0.94)
Photographs and other images were used appropriately on the website	3.27 (0.71)
Motivation and Confidence to Act	**63.59 (16.22)**
The website helps me to have a better understanding of my personal health	3.86 (0.74)
The website encourages me to take actions that could be beneficial to my health	3.85 (0.93)
The website gives me confidence that I am able to manage my health	3.56 (0.84)
The website encourages me to play a more active role in my health care	3.56 (0.88)
I have learned something new from the website	3.55 (0.97)
I feel more inclined to look after myself after visiting the website	3.53 (0.87)
The website prepares me for what might happen to my health	3.42 (0.91)
I would consult the website if I had to make a decision about my health	3.38 (0.95)
The website makes me more confident to discuss my health with the people around me (for example, my family, or people at work)	3.37 (0.94)
The website gives me the confidence to explain my health concerns to others	3.36 (0.91)

[a]Although the Dutch version of the eHIQ was used in this study, for the purpose of this paper the items from the standard English-language version of the eHIQ are shown.
[b]This item was reverse scored.

Discussion

Principal Findings

This study aimed to investigate patients' attitudes toward a patient portal specifically designed to communicate laboratory test results, thereby helping patients to take an active role in managing their own health. Findings showed that the usability of the patient portal, assessed by the subscale Information and Presentation of the eHIQ, was rated positively. This suggests that study participants found the patient portal easy to use, considered it trustworthy and appropriate, and found the provided information easy to understand. The self-efficacy of patients using the patient portal, indicative of patients' motivation and confidence to act on the presented information, also received a relatively high score, but this score was just below the set cutoff score that we used to determine whether patients' attitudes toward the portal were positive. In addition, as expected, we found a positive association between the portal's usability and patients' self-efficacy.[30,31] Altogether, the findings show that patients were generally positive toward the portal, but it is important to identify opportunities to further optimize patients' self-efficacy, as this affects a person's intention to act on the information.

Comparison With Prior Work

The usability of the patient portal, which includes patient understanding, was rated positively. This is important because, if all patients are to receive their test results automatically online, the portal needs to be easy to use and provide information that is understandable for all. The high score on usability is in line with previous research examining patient portals with laboratory test results.[35-37] The lowest-scoring items on usability were on provided tips and imagery, which we considered less relevant for this patient portal, as the portal does not include tips or imagery. Therefore, the actual usability of this particular patient portal might have been higher than this study found it to be. As no sociodemographic information was available, we could not determine whether the results differed by subgroup (e.g., age, sex, level of health literacy). Future studies should examine whether the patient portal with laboratory test results is usable for all.

As mentioned above, the self-efficacy of patients using the portal—measured with the Motivation and Confidence subscale—was slightly lower than the set cutoff score. Considering that this was, to our knowledge, the first study of a patient portal to use the eHIQ, no official cutoff was available, and this limits our ability to compare this study's self-efficacy score with other studies' results. Moreover, to the best of our knowledge, no studies have examined patients' self-efficacy with questionnaires other than the eHIQ after being presented with online laboratory test results. Both usability and self-efficacy affect an individual's intention to follow up the test result.[29,38] Therefore, it is important that these factors be evaluated and improved where needed. We discuss some potential avenues for improvement below.

One potential area to improve is the use of reference values when communicating laboratory test results. Currently, a visual presents how the numeric value of the laboratory test result relates to a reference value that takes sex and age into account (when relevant). This standard reference value might, however, be less relevant for individuals with a chronic

condition (e.g., diabetes). Research has now shown that using reference values that are clinically appropriate (i.e., personalized) can help to improve patients' understanding and decrease negative responses to the results.[39] Replacing standard reference values with clinically relevant values will not be relevant for all laboratory tests (e.g., not for sexually transmitted infection tests), but might be useful for other tests (e.g., glucose, kidney function), and future studies should investigate this possibility.

A second potential area to improve is the understanding and effective use of laboratory test results by providing additional information.[40] One study showed that 50% of patients using a portal accessed additional, external information related to the diagnostics test results.[36] Adding additional information, however, might also increase the complexity of the presented information and this, in turn, might decrease understanding and limit a patient's ability to extract the relevant information.[41] This highlights the need to find the right balance between providing enough information and information overload. Adding links to additional information might provide a solution, by making more in-depth information easily available to those interested, while not running the risk of overwhelming patients with large volumes of text.

A third potential area to improve relates to patient portal use being predicted by perceived usefulness and perceived ease of use.[38] This emphasizes the necessity to involve end users when designing patient portals to ensure that the portal is perceived as useful and easy to use.[42] The Saltro patient portal was developed in close collaboration with both patients and health care providers, thereby attempting to address the end users' needs and assure usability. Nevertheless, it is important to continually evaluate these aspects to ensure that they are adequately met and to identify areas for future improvements.

Limitations and Strengths

Even though communicating laboratory test results online can have some advantages, such as improving clinical efficiency and improving accessibility of results, there is a limited number of studies on the use of such systems.[41,43] This study, therefore, adds to the limited existing literature base. Some limitations, however, also need to be discussed. First, the response rate was low and, consequently, there is risk of self-selection bias. A low response rate, however, does not automatically equal low study quality, as a low response rate is only problematic when it affects the sample's representativeness.[44] Still, 97.45% (13,553/13,907) of the patients did not complete the study questionnaire. This high rate of noncompletion precludes generalizing whether the patient portal display and explanation of results are acceptable and informative for all patients.

Second, as mentioned above, no sociodemographic information was available from participants. This restricted us from doing subgroup analyses to see whether attitudes regarding the portal were dependent on these characteristics. Limited research is available on whether portal use and acceptance differ between groups. One study did find that portal use was influenced by age, presence of a chronic illness, and eHealth literacy level.[39] Further research into potential group differences is necessary, and such information can be used to fine-tune the portal to make it acceptable for every user.

Third, in some cases, it is important that patients act on the test results presented in the portal. Even though self-efficacy can be a valuable predictor of action,[45] it is still a proxy of action and it would be interesting to study the effect on actual behavioral activation.

A strength of this study is that patients completed the questionnaire immediately after they accessed the portal and viewed their results, thereby limiting recall bias and giving an accurate picture of patients' attitudes toward the portal.

Conclusions

Study participants evaluated the usability of Saltro's online patient portal communicating laboratory test results positively. Nevertheless, it should be noted that the low response rate precludes generalization of the results. Patients' motivation and confidence to act on the presented information also scored relatively high, but future research should examine ways to further optimize patients' self-efficacy to increase an individual's intention to act on the information. In addition, it is important to determine potential group differences in portal use and acceptance. Overall, study participants had a positive attitude toward the patient portal and the portal potentially can help patients take a more active role in managing their own health.

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Conflicts of Interest
ET-K, RT-S, AG, and AV are employees of Saltro, where the portal has been developed and implemented.

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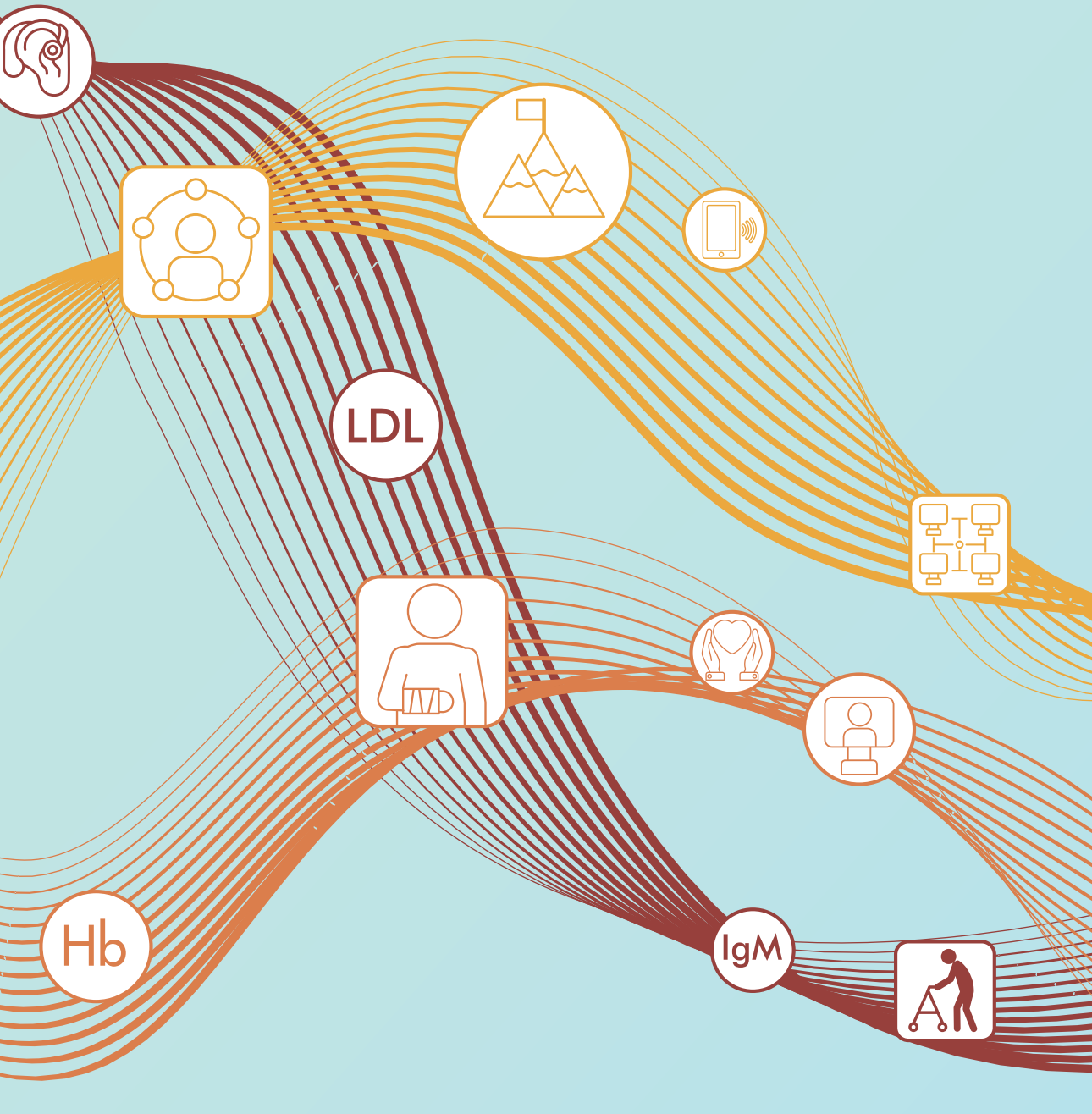
Abbreviations

eHealth: electronics health
eHIQ: eHealth Impact Questionnaire
GP: general practitioner


LDL
Hb
IgM

Chapter 3

The impact of patient characteristics on their attitudes toward an online patient portal for communicating laboratory test results: real-world study

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Abstract

Background
Patient portals are promising tools to increase patient involvement and allow them to manage their health. To optimally facilitate patients, laboratory test results should be explained in easy language. Patient characteristics affect the usage of portals and the user satisfaction. However, limited research is available, specified for online communicating laboratory test results, on whether portal use and acceptance differ between groups.

Objective
The aim of this study was to assess the effect of patient characteristics (gender, age, education, and chronic disease) on the self-efficacy and perceived usability of an online patient portal that communicates diagnostic test results.

Methods
We used the online-administered eHealth impact questionnaire (eHIQ) to explore patients' attitudes toward the portal. Patients visiting the portal were asked to complete the questionnaire and to answer questions regarding gender, age, education, and chronic disease. The subscale Information and Presentation of the eHIQ assessed the usability of the patient portal and the subscale Motivation and Confidence to Act assessed self-efficacy to determine whether patients were motivated to act on the presented information. Age, gender, education, and chronic disease were the determinants to analyze the effect on usability and self-efficacy. Descriptive analyses were performed to explore patient characteristics, usability, and self-efficacy. Univariable and multivariable regression analyses were performed with age, gender, education, and chronic disease as determinants, and usability and self-efficacy as outcomes.

Results
The questionnaire was completed by 748 respondents, of which 428 (57.2%) were female, 423 (56.6%) were highly educated, and 509 (68%) had no chronic disease. The mean age was 52.8 years (SD 16.4). Higher age, high education, and asthma or chronic obstructive pulmonary disease were significant determinants for decreased usability; respectively, b=-.094, 95% CI -1.147 to -0.042 (P<.001); b=-2.512, 95% CI -4.791 to -0.232 (P=.03); and b=-3.630, 95% CI -6.545 to -0.715 (P=.02). High education was also a significant determinant for a lower self-efficacy (b=-3.521, 95% CI -6.469 to -0.572; P=.02). Other determinants were not significant.

Conclusions
This study showed that the higher-educated users of a patient portal scored lower on usability and self-efficacy. Usability was also lower for older people and for patients with asthma or chronic obstructive pulmonary disease. The results portal is not tailored for different groups. Further research should investigate which factors from a patient's perspective are essential to tailor the portal for different groups and how a result portal can be optimally integrated within the daily practice of a doctor.

Keywords
patient portal; eHealth impact questionnaire; laboratory test results; self-efficacy; usability; age; gender; chronic disease; education; patient characteristics

Introduction

The involvement of patients is important to allow them to manage their own health. When patients are more engaged, they tend to make better decisions on health behavior.[1] Patient involvement has increasingly been stimulated with digital possibilities,[2] such as in patient portals.[3,4] A Dutch patient portal developed by Saltro Diagnostic Center provides patients access to laboratory test results, including explanatory information and visualization.[3] The aim of this portal is to increase patients' knowledge and to facilitate them to take an active role in their diagnostic process (e.g., to ask questions and share opinions to improve the diagnostic process and reduce the risk of diagnostic errors).[5] Patient portals conveying laboratory test results in understandable language can help patients to take a more active role in managing their own health.[6] Therefore, it is recommended to test how patients perceive online portals and test results, for example by using the eHealth impact questionnaire (eHIQ).[7]

In 2019, we investigated patients' attitudes toward the same portal designed to communicate laboratory test results using the eHIQ.[6] The usability of this portal was rated positively, suggesting that the study participants found the patient portal easy to use, considered it trustworthy and appropriate, and that the provided information was easy to understand. The self-efficacy of the patients received a satisfying score, referring to whether patients were motivated to act on the presented information. It was concluded that the patients were generally positive toward the portal with opportunities to optimize self-efficacy; however, the impact of patient characteristics was not accounted for. Patient characteristics such as gender, age, education, and chronic disease can affect the usage of portals and the user satisfaction.[8-10] Limited research is available, specified for online communicating laboratory test results, on whether portal use and acceptance differ between groups. Further research on potential group differences is necessary to fine-tune the portal, making it acceptable for every user. We aim to replicate the previous study with larger numbers to examine how different groups of patients perceived the portal.

The main aim of this study is to evaluate the effect of gender, age, education, and chronic disease on the usability and self-efficacy of patients using a patient portal designed to communicate laboratory tests.

Methods

Design and Participants

A cross-sectional real-world study was conducted between December 2019 and July 2020 to explore the influence of patient characteristics on the usability of a patient portal and on self-efficacy. Patients who viewed their test results in the portal were automatically approached to complete the eHIQ. Age, gender, education level, and chronic disease were measured as well. There were no further inclusion or exclusion criteria.

No personal information was collected, and the data could not be traced back to the individual. Therefore, this study does not fall under the Medical Research Involving Human Subject Act (Wet medisch-wetenschappelijk onderzoek met mensen) and did not require approval from an ethics committee.

Patient Portal

In 2015, Saltro launched a web-based portal that gives patients access to their own laboratory test results, including understandable explanatory information.[3] The content was created by a team of patients, general practitioners (GPs), communication specialists, and clinical chemists. Researchers estimated the level of health literacy of the information at communication level 1B based on the scales of the Common European Framework of Reference for Languages.[11] Daily, approximately 300 unique individuals look up their laboratory test results with the option to share their results with others.

After blood withdrawal, the patients can look up their results by logging into the portal, with a username and password, through the website of the GP. The log-in procedure adheres to Dutch security legislation and guidelines (i.e., the Dutch Personal Data Protection Act) and the General Data Protection Regulation guidelines. The patients can see an overview of all laboratory tests ordered by date (Figure 1). Each result has traffic-light–colored bullets and a visual.

This portal can be approached directly for laboratory test results but can also be approached within other portals as a plug-in; for example, a GP portal that functions as medication description.

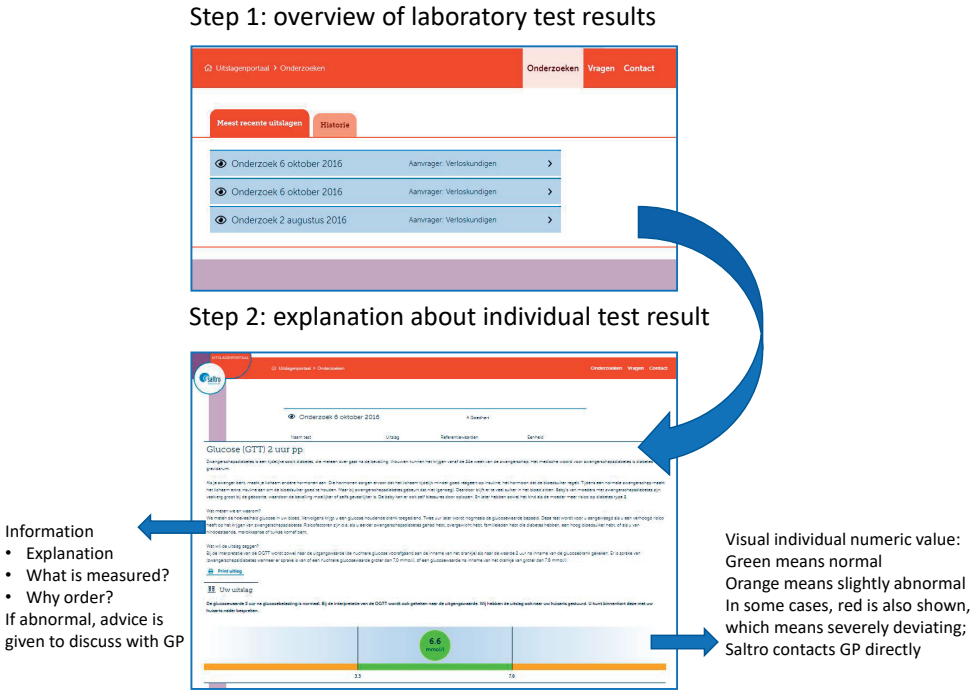

Figure 1. Example of a test result with explanation. GP: general practitioner.

Outcome Measures

Primary outcomes were Information and Presentation and Motivation and Confidence to Act in the Dutch version of the eHIQ, part 2 (eHIQ2).[12,13] The eHIQ2 is a self-reporting questionnaire measuring patients' attitudes toward a specific health-related website. Each of the 26 items is scored on a 5-point Likert scale ranging from "strongly disagree (1)" to "strongly agree (5)." The questionnaire has three subscales: Information and Presentation; Confidence to Act; and Identification. The Information and Presentation subscale has 13 items and measures whether people find the website easy to use, which includes items on understanding, trustworthiness, and whether images used were appropriate. This subscale relates to usability. The Motivation and Confidence to Act subscale consists of 10 items and assesses whether an individual felt reassured after reading the information on the website and was motivated to manage their health. This subscale relates to self-efficacy. The final subscale, Identification, consists of 3 items and measures whether individuals identify with others who use the website. An example item is the following: "I feel I have a sense of solidarity with other people using the website." As users of the patient portal do not interact with other users, this subscale was considered irrelevant for the current study and is therefore not discussed further. The total scores per subscale were transformed to a 0-100 scale (higher scores representing a more positive attitude).

The determinants were age, gender, education, and chronic disease (Table 1), based on studies demonstrating that portal use was influenced inter alia by age, gender, presence of a chronic illness, education, and health literacy level.[8,9,14] Gender, instead of sex, was chosen because the patients' attitude and experience were analyzed. There was no biological measurement involved. Education level was chosen, but not health literacy, in order to minimalize the participants' number of questions. Relationships are proven between health literacy and education level, although poor health literacy is also common among the highly educated.[15] The choice for types of chronic diseases is based on the 5 most prevalent chronic diseases in the Netherlands: diabetes mellitus, asthma, chronic obstructive pulmonary disease (COPD), cardiovascular disease, and cancer.[16,17] Except for cancer, Saltro performs the blood test for these types of chronic diseases. People with asthma and COPD receive the same pulmonary function test and are therefore considered as 1 patient group in this research. Diabetes mellitus, Asthma or COPD, and cardiovascular diseases are the most prevalent chronic diseases in the population of Dutch GPs; these chronically ill patients are regularly monitored by GPs in a chronic care program with regular laboratory checks.

Table 1. Patient characteristics.

Determinant	Variables
Age	Age at completing the questionnaire
Gender	
	Male
	Female
Education[18]	
	Low (no education, high school)
	Intermediate (intermediate vocational education)
	High (bachelor's degree, master's degree, doctorate)
Chronic disease	
	Diabetes mellitus
	Asthma or chronic obstructive pulmonary disease
	Cardiovascular disease
	None

Statistical Analyses

Descriptive analyses were performed to explore patient characteristics, usability, and self-efficacy. Univariable regression analyses were performed with age, gender, education, and chronic disease as determinants and usability and self-efficacy as outcomes. Significant ($P<.10$) determinants were included in multivariable models to examine which characteristics were independently related to the outcomes. To be rather inclusive than exclusive regarding the selection of variables for our multivariable model, $P=.10$ was chosen. A common level of $P=.05$ might fail to include relevant variables in those models.[19] For all other analyses and conclusion, $P<.05$ was considered statistically significant. The analyses were performed using the SPSS version 24 (IBM Corp).[20]

Results

Participant Characteristics, Usability, and Self-efficacy

The questionnaire was completed by 748 respondents. Response rate was 1.9% (39,430 unique visitors during the study period). The participants had a mean age of 52.8 years (SD 16.4), and they were mostly female (428/748, 57.2%) and highly educated (423/748, 56.6%) (Table 2). Moreover, 509/748 (68%) had no chronic disease. The mean scores of usability and self-efficacy were 68.9 (SD 10.6) and 62.5 (SD 13.1), respectively (Table 3). The mean (SD) scores on all items of the Information and Presentation and Motivation and Confidence to Act domains can be found in in Appendix 1.

Table 2. Patient characteristics (N=748).

Characteristics	Values
Age (years), mean (SD)	52.8 (16.4)
Gender, n (%)	
Male	314 (42.0)
Female	428 (57.2)
Missing value	6 (0.8)
Education, n (%)	
Low (no education, high school)	96 (12.8)
Intermediate (intermediate vocational education)	220 (29.4)
High (bachelor's degree, master's degree, doctorate)	423 (56.6)
Missing value	9 (1.2)
Chronic disease, n (%)	
Diabetes mellitus	93 (12.4)
Asthma or COPD[a]	54 (7.2)
Cardiovascular disease	87 (11.6)
No chronic disease	509 (68.0)
Missing value	5 (0.7)

[a]COPD: chronic obstructive pulmonary disease.

Table 3. Mean scores on the eHealth impact questionnaire (eHIQ); N=747.

Subscale	Value
Usability[a], mean (SD) (1 missing[b])	68.9 (10.6)
Self-efficacy[c], mean (SD) (1 missing)	62.5 (13.6)

[a]Usability is measured with the eHIQ subscale Information and Presentation.
[b]Missing value: one respondent gave the same answer to every question, including reversed questions, which indicates false responding.
[c]Self-efficacy is measured with the eHIQ2 subscale Motivation and Confidence to Act.

Determinants for Perceived Usability

Age, education level, and chronic disease were relevant determinants with *P*<.10 for usability in the univariable analysis and where subsequently added in the multivariable model (Table 4). Multivariable analysis showed that higher age and high education were associated with a decreased usability: respectively, *b*=-.094, 95% CI -1.147 to -0.042 (*P*<.001); and *b*=-2.512, 95% CI -4.791 to -0.232 (*P*=.03). Chronic disease affected usability, with patients with asthma or COPD scoring significantly lower compared with those without a chronic disease (*b*=-3.630, 95% CI -6.545 to -0.715; *P*=.02).

Table 4. Determinants for perceived usability.

Determinant		Univariable analysis		Multivariable analysis	
Reference group	**Determinant**	***b*[a] (95% CI)**	***P* value**	***b* (95% CI)**	***P* value**
Age per year	Age	-.067 (-0.114 to -0.021)	.004	-.094 (-1.147 to -0.042)	<.001
Male	Gender	1.322 (-0.234 to 2.878)	.10	-.153 (-1.806 to 1.500)	.86
Low education	Intermediate education	1.275 (-1.224 to 3.774)	.32	1.262 (-1.189 to 3.712)	.31
	High education	-1.992 (-4.302 to 0.318)	.09	-2.512 (-4.791 to -0.232)	.03
No chronic disease	Diabetes	-.377 (-2.692 to 1.939)	.80	.347 (-2.053 to 2.747)	.78
	Asthma or COPD[b]	-3.399 (-6.337 to -.416)	.02	-3.630 (-6.545 to -0.715)	.02
	Cardiovascular disease	-.286 (-2.668 to 2.096)	.81	.890 (-1.576 to 3.357)	.48

[a]*b*: unstandardized beta value.
[b]CODP: chronic obstructive pulmonary disease.

Determinants for Perceived Self-efficacy

Education level was a relevant determinant for self-efficacy in the univariable analysis with *P*<.10 (*b*=-3.521, 95% CI -6.469 to -.572; *P*=.02) (Table 5). Other determinants were not relevant; therefore, there was no need for a multivariable analysis.

Table 5. Determinants to perceived self-efficacy.

Determinant		Univariable analysis	
Reference group	**Determinant**	***b*[a] (95% CI)**	***P* value**
Age per year	Age	-.035 (-.095 to 0.024)	.24
Male	Gender	-1.490 (-3.478 to 0.498)	.14
Low education	Intermediate education	.159 (-3.031 to 3.348)	.92
	High education	-3.521 (-6.469 to -0.572)	.02
No chronic disease	Diabetes	-1.279 (-4.254 to 1.697)	.40
	Asthma or COPD[b]	-2.438 (-6.214 to 1.338)	.21
	Cardiovascular disease	2.205 (-.856 to 5.265)	.16

[a]*b*: unstandardized beta value.
[b]CODP: chronic obstructive pulmonary disease.

Discussion

Principal Findings

This study aimed to evaluate the impact of patient characteristics on the perceived usability and self-efficacy of a patient portal. Higher education was associated with decreased usability and self-efficacy. Furthermore, usability was lower for older patients and for patients with asthma or COPD. The eHIQ is a validated questionnaire, and the results of this study with the eHIQ are in line with our previous study.[6]

The finding that highly educated people have a significantly lower perceived usability and self-efficacy after using the portal is not in line with other research projects.[21] Mostly, people with high education tend to be more eHealth literate, showing more positive outcomes (motivation, self-efficacy, and better interaction with the doctor) after reading health information on the internet.[21] The use of qualitative interviews with the participants to explore the usability findings would be worthwhile. Nonetheless, other research projects on digital health information showed that tailoring—enabling users to self-tailor the preferred mode of information delivery via text and (audio)visuals—enhanced satisfaction with attractiveness and comprehensibility as compared with various versions of the nontailored digital information.[22,23] The patients were directly involved in the design phase of the studied results portal. However, the portal is not tailored for a specific group and might not be suitable for highly educated people. The continued development of the portal is an opportunity to take into account, especially by involving different education groups to give tailored advice through the portal.

This study also revealed that older participants scored lower on the usability of the portal. In other studies, the differences between age groups could be explained via the groups' digital skills. Van Deursen et al[24] and Broekhuizen et al[25] found that a higher age lowered operational and formal internet skills, such as operating an internet browser and maintaining a sense of orientation. However, in a study about the association of the usage of a public evidence-based health website and health care consultations, the use of digital information led to a decrease in regular doctors' consultations for older people in the same way as for other age groups.[26] Nevertheless, the presentation and design of test results should be tailored for every age group[27] to obtain excellent usability and self-efficacy.

Furthermore, our research demonstrated that patients with asthma or COPD were more negative about usability. Other research projects reported that these patients are often insufficiently capable of understanding health information,[28] which could be explained by anxiety, specific illness perception, age, and disease severity.[29] Other studies showed that the use of COPD self-management platforms is higher when the platform is an integrated part of health care.[4] Finally, some studies emphasized the importance of integrating skill-building activities into comprehensive education programs that enable patients with severe cases of asthma or COPD to identify high-quality sources of web-based health information.[30] Our study revealed that asthma or COPD patients are more negative about the results portal. Even more important for this group is tailoring the portal and integrating

it into usual care.[4] Therefore, considerations for redesigning the online portal are at issue, together with COPD patients.

Strength and Limitations

A strength of our study was the high sample size and that the patients completed the questionnaire immediately after they viewed their results, thereby limiting recall bias and giving an accurate picture of the patients' attitudes toward the portal. Nevertheless, those who completed the study questionnaire were a small portion of the total group that used the patient portal. The low response rate precludes generalizing whether the patient portal display and explanation of the results are acceptable and informative for all of the patients. In future research, it is interesting to compare patients that use the portal to those who do not. Moreover, we were not exhaustive with the possible patient characteristics as determinants. We cannot determine other factors that contribute to the patients' perceived usability and self-efficacy after seeing their lab results online. Possible other determinants that may impact usability and self-efficacy are the quality of the portal, the motivation to use the internet for health improvement,[31] and the way patients use their knowledge in relation to the doctor.[32,33] Regarding the patient portal itself, lab results need to be easily understandable,[34] and technology needs to be easy to use.[8,35] Previous research shows that the related lab results are easily understandable and that the patient portal is easy to use.[3] Therefore, it is interesting to explore which other factors influence a patient's attitude toward the patient portal.

Conclusions

Highly educated users of a test results portal scored lower on usability and self-efficacy. The usability was also lower for older people and for patients with asthma or COPD. Result portals must adapt the language and communication used, according to the different target groups of age, education, and chronic illness. Only then can users take full advantage of the online information provision. Further research is necessary to determine promoting factors that users themselves consider important in a results portal, in order to tailor it for different groups. Further research is also needed on ways in which a portal can be optimally implemented and integrated within the daily practice of a doctor.

Acknowledgments

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Conflicts of Interest

RT-S and AG are employees of Saltro, where the portal has been developed and implemented. ET-K is a former employee of Saltro.

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Abbreviations

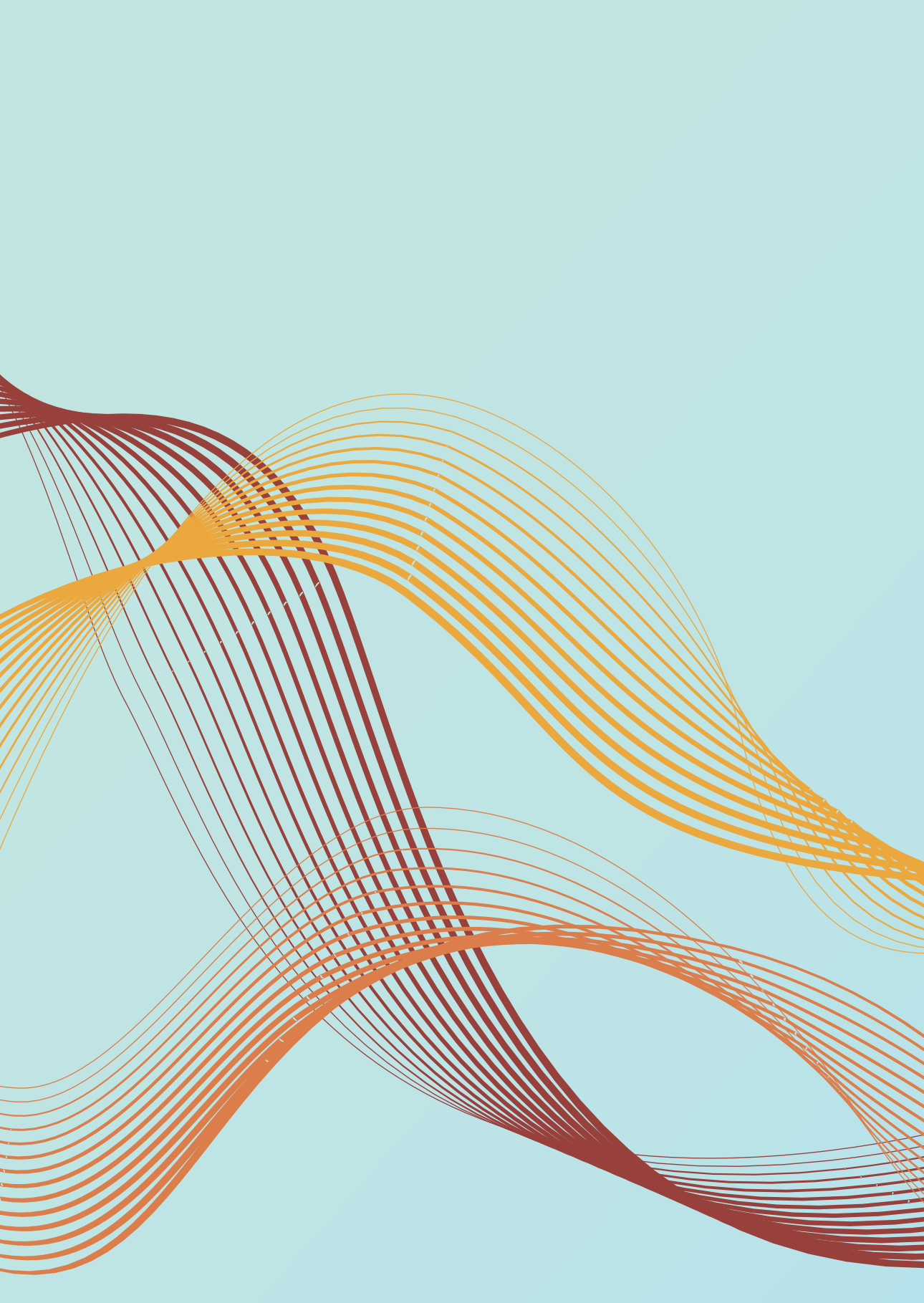
COPD: chronic obstructive pulmonary disease
eHIQ: eHealth impact questionnaire
GP: general practitioner

Appendix 1. Mean (SD) score subscales "information and presentation" and "motivation and confidence to act" from the eHealth impact questionnaire (eHIQ)

Table 1. Means and standard deviations (SDs) of the two subscales of the eHIQ-part 2 and the individual items.

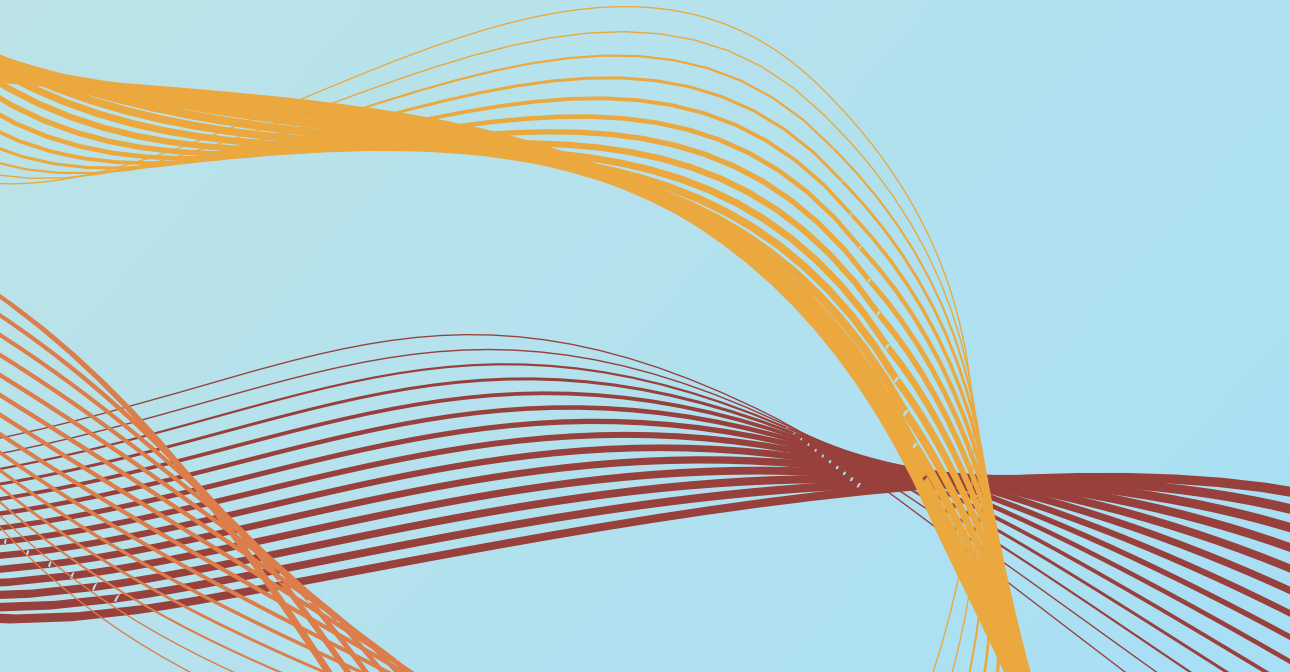
Subscale	Item	Mean (SD)
Information and presentation		
	I trust the information on the website	4.1 (0.6)
	I can easily understand the information on the website	4.2 (0.7)
	The language on the website made it easy to understand	4.1 (0.7)
	The information on the website left me feeling confused[a]	4.1 (0.8)
	I value the advice given on the website	3.8 (0.7)
	The website is easy to use	3.9 (0.7)
	The website provides a wide range of information	3.7 (0.7)
	The website has a positive outlook	3.7 (0.8)
	The people who have contributed to the website understand what is important to me	3.6 (0.7)
	On the whole, I find the website reassuring	3.6 (0.7)
	I found the images on the website distressing[a]	3.5 (0.7)
	The website includes useful tips on how to make life better	3.4 (0.7)
	Photographs and other images were used appropriately on the website	3.3 (0.6)
Motivation and confidence to act		
	The website helps me to have a better understanding of my personal health	3.8 (0.7)
	The website encourages me to take actions that could be beneficial to my health	3.8 (0.9)
	The website gives me confidence that I am able to manage my health	3.6 (0.8)
	The website encourages me to play a more active role in my health care	3.5 (0.8)
	I have learnt something new from the website	3.4 (0.9)
	I feel more inclined to look after myself after visiting the website	3.4 (0.8)
	The website prepares me for what might happen to my health	3.5 (0.8)
	I would consult the website if I had to make a decision about my health	3.4 (0.8)
	The website makes me more confident to discuss my health with the people around me (for example, my family, or people at work)	3.3 (0.9)
	The website gives me the confidence to explain my health concerns to others	3.3 (0.8)

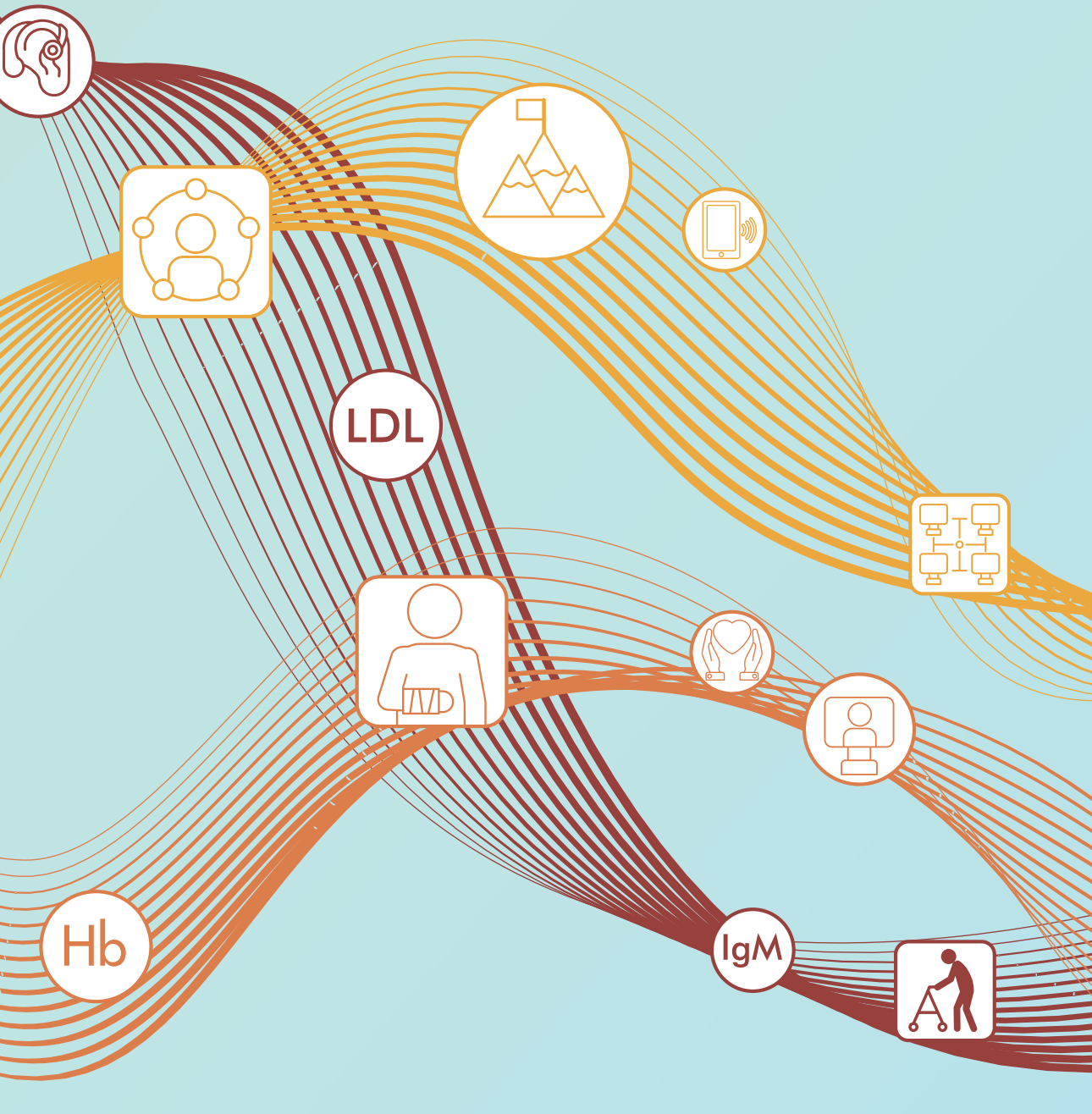
Note. eHIQ = eHealth Impact Questionnaire.
[a]This item was reversed scored.



PART II

Evaluation of eHealth from an organizational perspective: What factors affect the quality of hybrid health care?

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Chapter 4

The challenge of integrating eHealth into health care: systematic literature review of the Donabedian model of Structure, Process, and Outcome

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Abstract

Background
Health care organizations are increasingly working with eHealth. However, the integration of eHealth into regular health care is challenging. It requires organizations to change the way they work and their structure and care processes to be adapted to ensure that eHealth supports the attainment of the desired outcomes.

Objective
The aims of this study are to investigate whether there are identifiable indicators in the structure, process, and outcome categories that are related to the successful integration of eHealth in regular health care, as well as to investigate which indicators of structure and process are related to outcome indicators.

Methods
A systematic literature review was conducted using the Donabedian Structure-Process-Outcome (SPO) framework to identify indicators that are related to the integration of eHealth into health care organizations. Data extraction sheets were designed to provide an overview of the study characteristics, eHealth characteristics, and indicators. The extracted indicators were organized into themes and subthemes of the structure, process, and outcome categories.

Results
Eleven studies were included, covering a variety of study designs, diseases, and eHealth tools. All studies identified structure, process, and outcome indicators that were potentially related to the integration of eHealth. The number of indicators found in the structure, process, and outcome categories was 175, 84, and 88, respectively. The themes with the most-noted indicators and their mutual interaction were inner setting (51 indicators, 16 interactions), care receiver (40 indicators, 11 interactions), and technology (38 indicators, 12 interactions)—all within the structure category; health care actions (38 indicators, 15 interactions) within the process category; and efficiency (30 indicators, 15 interactions) within the outcome category. In-depth examination identified four most-reported indicators, namely "deployment of human resources" (n=11), in the inner setting theme within the structure category; "ease of use" (n=16) and "technical issue" (n=10), both in the technology theme within the structure category; and "health logistics" (n=26), in the efficiency theme within the outcome category.

Conclusions
Three principles are important for the successful integration of eHealth into health care. First, the role of the care receiver needs to be incorporated into the organizational structure and daily care process. Second, the technology must be well attuned to the organizational structure and daily care process. Third, the deployment of human resources to the daily care processes needs to be aligned with the desired end results. Not adhering to these points could negatively affect the organization, daily process, or the end results.

Keywords
eHealth; digital health; blended care; quality; integration; health care organization; structure; process; outcome

Introduction

Health care is changing, whereby patient empowerment, democratization of the internet, and an increasing burden on health care professionals play influential roles.[1-3] In line with these trends, innovations such as eHealth are required to maintain high quality of care.[4-6] eHealth includes a wide range of web-based interventions, for example e-consults, telemonitoring, and web-based viewing of medical records.[1,7,8] However, eHealth is more than a technology; it is another way of working and thinking and requires a change in attitude, which goes beyond the boundaries of a local health care organization.[9,10]

The most comprehensive definition of eHealth with reference to the organizational context is that provided by Eysenbach:[11]

e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

In other words, the integration of eHealth into traditional health care requires organizational and behavioral changes for both health care professionals and patients.[9,10]

Organizations are increasingly working with eHealth; however, implementing eHealth into the regular health care system requires organizations to change the way they work.[9-11] eHealth enables patients to have a more active role in managing their health,[7,12,13] which affects interactions between the patient and health care professional.[14-17] Furthermore, working with eHealth technology requires workflow adjustments for health care professionals.[18,19] The organization's structure and care processes need to be adapted to ensure that eHealth supports the attainment of desired outcomes.[20,21]

The challenge of optimally integrating eHealth into health care is thus a complex organizational issue. Several studies have identified elements to promote eHealth adoption, such as the degree of complexity, adaptability of the technology, costs, and stakeholder value,[20,22] but uncertainty remains on how digital and traditional health care can blend successfully in the long term. With different definitions of eHealth available in the literature,[10,11,23] and unclear barriers or facilitators in the application of eHealth,[19] there is a need for further research on how eHealth can successfully be integrated into health care.

The aim of this study is to analyze how the integration of eHealth can be organized optimally by reviewing studies evaluating real-world eHealth interventions. The Donabedian framework of Structure-Process-Outcome (SPO)[24] was used, allowing the identification of relevant indicators that demonstrate how effective the integration of eHealth is in the organization.

According to the Donabedian model, the quality of health care can be assessed by three components that are relevant for organizations: structure (i.e., requirements of the organization), process (i.e., actions to be taken), and outcome (i.e., end results), as shown in Figure 1.[24,25] *Structure* is defined as the setting in which health care is provided (e.g., facilities, equipment, numbers, and qualification of personnel); *process*, as what is actually done in giving and receiving care (e.g., patient and doctor activities, doctor-patient communication and information); and *outcome,* as the consequence of the provided health care (e.g., health status, satisfaction, and costs).[24-26] Quality of health care is based on different aspects of these three categories and their relationships. As Donabedian eloquently puts it: "A good structure increases the likelihood of good process, and good process increases the likelihood of good outcomes".[24] The interaction between the categories can be bidirectional, and it is not a simple separation between cause and effect.[25] The movement is an "unbroken chain of antecedents, followed by intermediate ends, which are themselves the means to still further ends".[25]

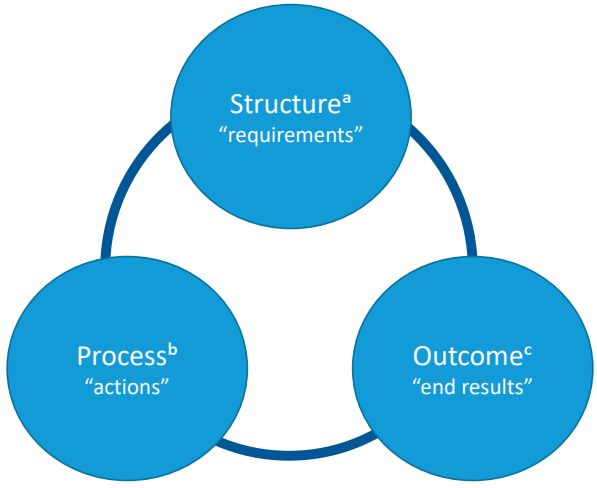

Figure 1. Donabedian Structure-Process-Outcome framework.
a. What an organisation needs to have to provide health care
b. The actions in giving and receiving health care
c. End results as a consequence of providing care

The aim of this systematic review is twofold: (1) to investigate whether there are identifiable indicators in the structure, process, and outcome categories related to the successful integration of eHealth in regular health care and (2) to investigate which indicators of structure and process are related to outcome indicators.

Methods

Theoretical Framework

The Donabedian SPO framework was used to identify the indicators of structure, process, and outcome that potentially affect the integration of eHealth into health care organizations. The Donabedian framework covers all relevant aspects of an organization's structure, process, and outcome and their interrelations, and it combines these aspects with health and social factors. Therefore, it is a suitable model to evaluate the organization of eHealth within health care organizations. The SPO categories are thematically explained in Figure 2.[24,25]

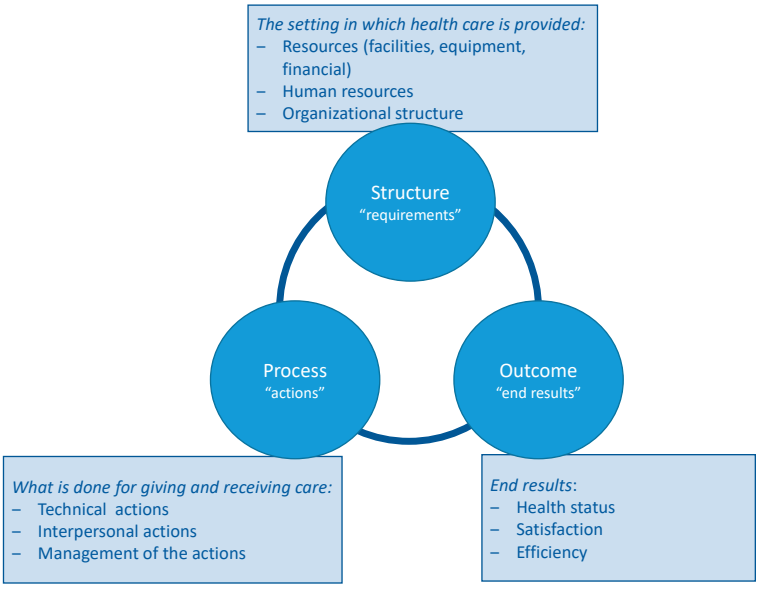

Figure 2. Explanation of the Structure-Process-Outcome categories of the Donabedian model.

The Donabedian SPO framework was designed in the 20th century before the introduction of eHealth. For this review, the SPO framework was adjusted to be compatible with the current time and incorporated the application of eHealth. The adjustments are described in the themes presented in Textbox 1. The adjustments to the SPO framework are shown in Figure 3.

Textbox 1. Adjustment of the Structure-Process-Outcome framework into themes, to integrate the application of eHealth into the health care system.

Structure: The setting of provided care can be internal and/or external. Therefore, a distinction was made between inner and outer settings. With regard to resources, technology was added as a separate theme to cover eHealth. This was done because the focus of this research was eHealth. The remaining parts of the resources are covered under inner setting. Human resources, besides health care professionals, included care receivers. Their mutual involvement is required and is therefore also considered a conditional human resource.[1] Organizational structure was split into inner setting and outer setting, in line with the reasons given above, and to take the external stakeholders into account.[27]

Process: Instead of technical actions, the term health care actions was used, to avoid confusion with the term technology in the structure. Interpersonal actions remained unchanged. Management of the actions was shortened to process management.

Outcome: Health status was retained as health status. Satisfaction was broadened to include experience of the health care receiver and experience of the health care provider, as both are pivotal outcome parameters in the health care process.[28,29] Efficiency remained unchanged.

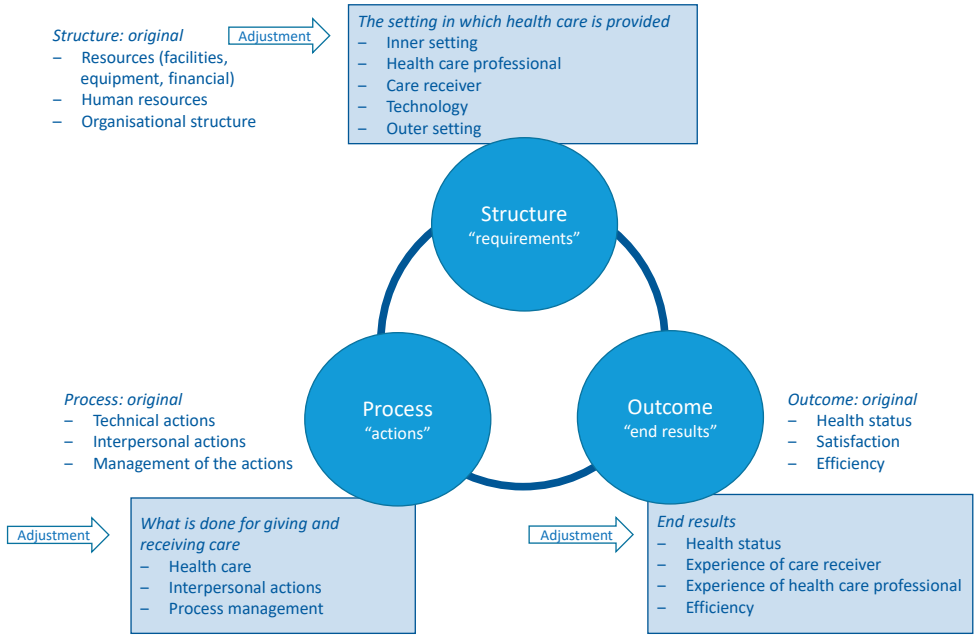

Figure 3. Adjustment to the themes of the Structure-Process-Outcome framework, considering eHealth integration.

Search Strategy
This systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines. The research question was as follows: "How are structure indicators and/or process indicators related to eHealth or blended health care outcome indicators?"

Two authors (RT-S and MK) searched PubMed, EMBASE, Web of Science, Cochrane, and Emcare databases for relevant studies published up to December 12, 2019. They searched for the following terms in the titles, abstracts, and keywords of the published papers: structure* indicators* or process* indicators* or outcomes* indicators* and [blended care or eHealth* or telehealth*].

Appendix 1 contains the full search details. After the search, two authors (RT-S and AV) screened the titles and abstracts of the relevant articles. Studies were included if they mentioned (1) the use of eHealth or blended care for diagnostics or treatment and (2) structure, process, or outcome indicators. Quantitative, qualitative, and mixed method study designs were included. A study was excluded if (1) it was a protocol, review, meta-analysis, grey literature, book chapter, oral presentation, or poster presentation; (2) it was published in a language other than English or Dutch; (3) full-text of the article was not available; (4) the intervention was not implemented (e.g., conducted research regarding the users' expectations towards a prototype); or (5) the intervention used an analog application via plain-old-telephone lines. Of the remaining articles, RT-S reviewed the full texts. To ensure reliability, AV randomly selected about 10% of the fully reviewed articles for a blind review. Discrepancies were resolved by discussion. In case of uncertainty, a third author (MK) was consulted.

Data Extraction
Data extraction sheets were designed to provide an overview of the (1) study characteristics (e.g., title, author, study aim, setting, disease, and quality appraisal); (2) characteristics of the eHealth intervention (e.g., technology and function) and description of the intervention; (3) distribution of indicators into themes and categories related to the integration of eHealth into health care; and (4) interaction among the indicators, presented as themes.

RT-S designed the first concepts of the data extraction sheets. Authors RT-S, MK, NC, and ET-K discussed the design of the data extraction sheets to ensure their usability. Improved sheets were developed accordingly. The blind reviewer (AV) did not discuss the data extraction sheets. The included articles were reread by RT-S to check whether data clustering was complete and logical and for purposes of data pooling itself. AV selected a sample of 10% of the included articles for data extraction. Discrepancies were resolved by discussion.

Quality Appraisal
The Mixed Methods Appraisal Tool (MMAT) was used to appraise the quality of eligible studies in mixed methods systematic reviews—that is, reviews that included qualitative research, randomized controlled trials, nonrandomized studies, quantitative descriptive studies, and mixed methods studies.[30] The MMAT allows determination of the quality of

different empirical study designs by using the same measure of five criteria in the chosen category. MMAT scores range on a scale of 1 to 5, with 1 indicating the lowest quality and 5 indicating the highest quality.

Classification of eHealth Interventions

eHealth interventions were ordered by type of technology and functionality. For technology, the classification proposed by Nictiz was used, distinguishing websites, apps, video communication, sensors, and wearables, domotics, robotics, and big data (i.e., artificial intelligence).[31] This classification is based on international studies.[10,32] For the present study, eHealth only concerns digital interventions and not analog ones such as analog applications via plain-old-telephone lines; this is in line with the classification proposed by Nictiz. For labelling the functionality, the second and third tiers of the National Institute for Health and Care Excellence (NICE)[33] were used, because these functionalities measure patient outcomes (Tier one consists of system services with no measurable patient outcomes). The functions were classified as communication, self-management, clinical calculation, active monitoring, diagnosis, and treatment.[33]

Organization of Indicators and (Sub)themes of the SPO Framework

Indicators that had a potential impact on the integration of eHealth in health care were extracted and organized by the relevant theme according to the adjusted SPO framework (Textbox 1). In addition, the reported interactions between the indicators were extracted and organized by the relevant categories and themes. For a clear overview, the indicators within each theme were further divided into two subthemes by RT-S and ET-K (Table 1). The creation of subthemes was an iterative process. When reading the full texts, we found some definitions that sharpened some of the subthemes. The full definitions of the themes and subthemes are provided in Appendix 2.

For each of the extracted indicators, the relevant impact on the integration of eHealth was noted. As there is no general standard for when eHealth is successful or effective,[3,19] nor did the included studies specify such standards, these indicators were labeled as *advantage*, *disadvantage*, or *neutral*. An advantage in the structure and process categories indicates a positive effect on the integration and/or a positive effect on the outcome. A disadvantage in the structure and process categories indicates a negative effect on the integration and/or a negative effect on the outcome. An indicator that did not turn out to be an advantage nor a disadvantage was labeled neutral. The extracted indicators were noted as *advantage*, *disadvantage*, or *neutral*, in line with the evaluation performed in the corresponding study.

The following results are presented in this paper: (1) distribution of the indicators into (sub) themes and categories, and the impact on the integration of eHealth into health care; (2) most frequently reported indicators (i.e., reported 10 times or more); and (3) interaction among indicators organized into themes and categories.

Table 1. Themes and subthemes in the structure, process, and outcome categories.

Category and theme	Subtheme
Structure	
Inner setting	• Support of primary process • Culture and leadership
Health care professional	• Skills • Attitude
Care receiver	• Daily life • Baseline characteristics
Technology	• Usability and functionality • Interaction with electronic health record
Outer setting	• Finance and legislation • Involvement of stakeholders
Process	
Health care actions	• Workflow • Patient-centered
Interpersonal actions	• Personal • Shifting roles
Process management	• Quality improvement • Mistake-proofing
Outcome	
Health status	• Clinical or functional • Intrapersonal
Experience of care recipient	• Satisfaction • Convenience
Experience of health care professional	• "What's in it for me" • "What's in it for them"
Efficiency	• Operations • Revenues

Results

Study Selection

The systematic search led to the identification of 11 eligible articles, selected from a total of 739 articles shortlisted initially (Figure 4).

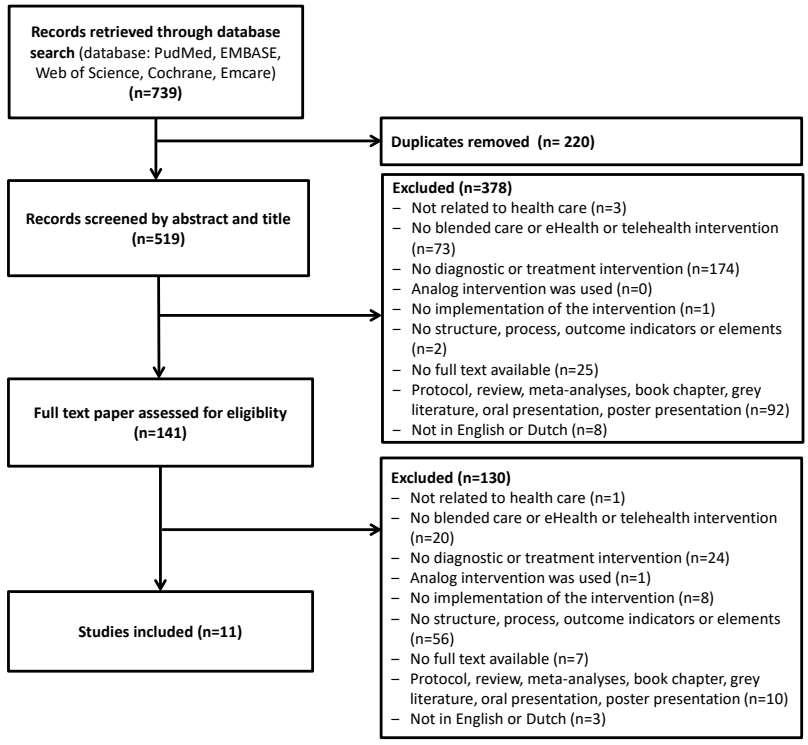

Figure 4. Flowchart of the systematic review.

Data Results: Study and eHealth Characteristics

Study Characteristics

The included studies cover various study designs, diseases, and health care settings. Most studies were published after 2017[27,34-41] and were of high quality.[27,34,36,37,39,40,42] Table 2 shows a detailed description of the characteristics of the included studies.

Table 2. Study characteristics.

Title, author (year)	Aim of the study	Study design	Setting and country	Disease	Sample size (N) and participant type	Quality of study[a]
Implementation of the blended care self-management program for caregivers of people with early-stage dementia, Boots et al (2017)[34]	To assess the internal and external validity of the trial and its implementation to inform effect analysis.	Mixed methods, nested in an RCT[b]	Elderly care, home setting, the Netherlands	Early-stage dementia	N=62; Informal caregivers, psychologists, nurses	4.5
Lack of adoption of a mobile app to support patient self-management of diabetes and hypertension in a Federally Qualified Health Centre, Thies et al (2017)[35]	To understand why the trial was unsuccessful.	Qualitative (interview) analysis	Primary care, USA	Uncontrolled diabetes and hypertension	N=13; Patients, primary care provider, nurses, research assistants	3.0
"Sounds a bit crazy, but it was almost more personal:" A qualitative study of patient and clinician experiences of physical therapist-prescribed exercise for knee osteoarthritis via skype, Hinman et al (2017)[36]	To explore the experience of therapists and patients using Skype for exercise management of knee osteoarthritis.	Qualitative study, nested in an RCT	Rehabilitation at home, Australia	Knee osteoarthritis	N=20; Patients, physical therapists	5.0
The challenge of real-world implementation of web-based share care software, Lycett et al (2014)[43]	To highlight the challenges of implementing software and reporting on the extent to which the software met its implementations and user aims.	Mixed methods study, nested within an RCT	Children's Hospital, General Practices, Australia	Obesity	N=27; General Practitioners	2.5
Implementation of a multicomponent telemonitoring intervention to improve nutritional status of community-dwelling older adults, Van Doorn-van Atten et al (2018)[37]	To study how PhysioDom Home Dietary Intake Monitoring was delivered and received by participants and nurses, and to study the intervention's mechanism of impact.	Mixed methods study	Home care and/ or lived in a service flat in sheltered accommodation, the Netherlands	At risk of undernutrition	N=105; Patients, nurses	4.5
Implementation of internet-delivered cognitive behaviour therapy within community mental health clinics, Hadjistavropoulos et al (2017)[27]	To understand facilitators and barriers impacting the uptake and implementation of internet cognitive behavior therapy.	Mixed methods study	Community Mental Health Clinic, Canada	Depression and anxiety	N=33; Therapists, managers	4.5

Title, author (year)	Aim of the study	Study design	Setting and country	Disease	Sample size (N) and participant type	Quality of study[a]
Implementation and evaluation of the safety net specialty care program in the Denver Metropolitan Area, Fort et al (2017)[38]	To describe the program, identify aspects that work well, areas for improvement, and offer lessons learned.	Mixed methods study	Safety-net: a non-profit integrated health care system, USA	Uninsured patients	N=43; Patients, primary care clinicians, specialists	3.5
Perceived improvement in integrated management of childhood illness implementation through use of mobile technology, Mitchell et al (2012)[42]	To examine health care provider and carer perceptions of electronic Integrated Management of Childhood Illness (eIMCI) in diagnosing and treating childhood illnesses.	Qualitative study (semi-structured interviews)	Health centers, Tanzania	Childhood illness in children 5 years or younger	N=31; Carers, health care providers	4.5
High level of integration in integrated disease management leads to higher usage in the e-Vita Study, Talboom-Kamp et al (2017)[39]	To analyze the factors that successfully promote the use of a self-management platform for chronic obstructive pulmonary disease patients.	Quantitative, nonrandomized, parallel cohort design	Primary care, the Netherlands	Chronic obstructive pulmonary disease	N=215; Patients	4.0
What drives adoption of a computerised, multifaceted quality improvement intervention for cardiovascular disease management in primary healthcare settings? Patel et al (2018)[40]	To identify and explain the underlying mechanisms by which the intervention did and did not have an impact.	Mixed methods study	Primary care, Australia	Cardiovascular disease	N=19; Patients, general practitioners, nurses, aboriginal health workers	4.5
Exploring the challenges of implementing a web-based telemonitoring strategy for teenagers with inflammatory bowel disease, Dijkstra et al (2019)[41]	To evaluate whether the telemonitoring strategy could move from a demonstration project to one that is sustained within existing sites.	Mixed methods study, nested within an RCT	Pediatric gastroenterology centers, the Netherlands	Inflammatory bowel disease	N=27; Researchers, clinicians, hospital decision makers, web designer	2.5

[a]Methodological quality of studies assessed with MMAT, ranging from 0 (lowest) to 5 (highest).

[b]RCT: randomized controlled trial.

eHealth Intervention Characteristics, Descriptions, and Results

The most frequently used digital technology was a website (n=7),[27,34,37-41] and the most frequently reported functions[33] of the technology were self-management (n=6)[34-37,39,41] and communication (n=6).[35,37,39-41,43] Table 3 shows an overview of the eHealth intervention characteristics, descriptions, and the study results. A detailed description of indicators, sorted according to the structure, process, outcome categories and their respective (sub) themes, is highlighted in the next paragraph.

Table 3. eHealth intervention characteristics, descriptions of the intervention, and study results.

First author	Technology; intervention name	eHealth function	Intervention	Study results (findings)[a]
Boots[34]	Website; Partner in Balance	Self-management	Face-to-face coaching with tailored web-based modules.	The participation rate of eligible caregivers was 51.9% (80/154). Recruitment barriers included lack of computer and need for support. Young age and employment were considered recruitment facilitators. All coaches attended training and supervision in blended care self-management. Deviations from the structured protocol were reported on intervention time, structure, and feedback. Coaches described an intensified relationship with the caregiver post-intervention. Caregivers appreciated the tailored content and positive feedback. The blended structure increased their openness. Overall, personal goals were attained after the program (t>50). Implementation barriers included lack of financing, time, and deviating target population.
Thies[35]	App; Undisclosed	Self-management, communication	Platform for active collaboration between patients and their primary care teams.	There was a poor fit between the app, end-users, and recruitment and treatment approaches in the setting. Usability testing might have revealed this prior to launch, but this was not an option. There was not sufficient time during routine care for clinical staff to familiarize patients with the app or to check clinical data and messages, which are unreimbursed activities. Some patients did not use the app appropriately. The lack of integration with the electronic health record was cited as a problem for both patients and staff who also said the app was just one more thing to attend to.
Hinman[36]	Video communication; Telerehabilitation via Skype	Self-management, treatment	Individualized home-based training strengthening program via Skype delivered physiotherapy.	Six themes arose from both patients and therapists. The themes were Structure: technology (ease of use, variable quality, set-up assistance helpful) and patient convenience (time-efficient, flexible, increased access); Process: empowerment to self-manage (facilitated by home environment and therapists focusing on effective treatment) and positive therapeutic relationships (personal undivided attention from therapists, supportive friendly interactions); and Outcomes: satisfaction with care (satisfying, enjoyable, patients would recommend, therapists felt Skype more useful as adjunct to usual practice) and patient benefits (reduced pain, improved function, improved confidence and self-efficacy). A seventh theme arose from therapists regarding process: adjusting routine treatment (need to modify habits, discomfort without hands-on, supported by research environment).

First author	Technology; intervention name	eHealth function	Intervention	Study results (findings)[a]
Lycett[43]	Website, HIE[b]; Shared-Care Obesity Trial in Children (HOPSCOTCH)	Communicate	Children attended a tertiary appointment with a pediatrician and dietician specializing in childhood obesity, followed-up by general practitioner consultations over the following year, supported by shared-care web-based software.	Software implementation posed difficult and at times disabling technological barriers. The software's speed and inability to seamlessly link with day-to-day software was a source of considerable frustration. Overall, general practitioners rated software usability as poor, although most (68%) felt that the structure and functionality of the software was useful.
Van Doorn-van Atten[37]	Website; PhysioDom HDIM[c]	Self-management, communication	Nutritional telemonitoring, education, a follow-up of telemonitoring measurement by a nurse.	About 80% of participants completed the intervention. Drop-outs were significantly older, had worse cognitive and physical functioning, and were more care-dependent. The intervention was largely implemented as intended and was received well by participants, but less well by nurses. Participants adhered better to weight telemonitoring than to telemonitoring by means of questionnaires, for which half the participants needed help. Intention to use the intervention was predicted by performance expectancy and social influence. No association was found between process indicators and intervention outcomes.
Hadjistavropoulos[27]	Website; ICBT[d]	Treatment	Web-based lessons that provide psychoeducation and instructions and therapist support via email or telephone.	ICBT implementation was perceived to be most prominently facilitated by intervention characteristics (namely, the relative advantages of ICBT compared to face-to-face therapy, the quality of the ICBT program that was delivered, and evidence supporting ICBT) and implementation processes (namely the use of an external facilitation unit that aided with engaging patients, therapists, and managers and ICBT implementation). The inner setting was identified as the most significant barrier to implementation as a result of limited resources for ICBT combined with greater priority given to face-to-face care.
Fort[38]	Website; Safety Net Specialty Care Program	Diagnosis, treatment	E-consults between primary care clinicians and specialist, face-to-face visits to the patients from a specialist, and continuing medical education for the primary care clinicians.	In the first 20 months of the program, safety-net clinicians at 23 clinics made 602 e-consults to specialists, and 81 patients received face-to-face specialist visits. Of 204 primary care clinicians, 103 made e-consults; 65 specialists participated in the program. Aspects facilitating program use were referral case managers' involvement and the use of clear, concise questions in e-consults. Key recommendations for process improvement were to promote an understanding of the different health care contexts, support provider-to-provider communication, facilitate hand-offs between settings, and clarify program scope.

First author	Technology; intervention name	eHealth function	Intervention	Study results (findings)[a]
Mitchell[42]	App; Electronic Integrated Management of Childhood Illness (eIMCI)	Diagnosis, treatment	An electronic handheld device or personal digital assistant, to guide the health care provider through IMCI protocols.	Providers expressed positive opinions on eIMCI, noting that the personal digital assistants were faster and easier to use than were the paper forms and encouraged adherence to IMCI procedures. Carers also held a positive view of eIMCI, noting improved service from providers, a more thorough examination of their child, and a perception that providers who used the personal digital assistants were more knowledgeable.
Talboom-Kamp[39]	Website; e-Vita COPD[e]	Self-management, communication	Insight into personal health data, self-monitoring of health values, education, and a coach for attaining personal goals.	Use of a self-management platform was higher when participants received adequate personal assistance about how to use the platform. Blended care, where digital health and usual care are integrated, will likely lead to increased use of the web-based program.
Patel[40]	HIE, website; HealthTracker	Communication, monitoring	Real-time decision support integrated with electronic medical records; CVD[f] risk communication tool between provider and patient; clinical audit tool; web portal providing peer-ranked performance trends.	A complex interaction was found between implementation processes and several contextual factors affecting uptake of the intervention. There was no clear association between team climate, job satisfaction, and intervention outcomes. There were four spheres of influence that appeared to enhance or detract from normalization of the intervention: organizational mission and history, leadership, team environment, and technical integrity of the intervention.
Dijkstra[41]	Website, IBD-live	Monitoring, self-management, communication	Flarometer, platform for direct communication with the IBD[g] team, module with study questionnaires (Quality of life, absenteeism, health care utilization).	The technology and the linked program allowed selection and targeting of teenagers who were most likely to benefit from a face-to-face encounter with their specialist. The value proposition of the technology was clear, with a distinct benefit for patients and an affordable service model, but health providers had plausible personal reasons to resist (double data entry). The organization was not yet ready for the innovation, as it required a shift to new ways of working. Dutch health insurers agreed that screen-to-screen consultations will be reimbursed at a rate equivalent to face-to-face consultations. The technology was considered easy to adapt and evolve over time to meet the needs of its users.

[a]Results[27,34-38,40-43] or conclusion[39] as described in the abstracts of the included studies.
[b]HIE: Health information exchange.
[c]HDIM: Home Dietary Intake Monitoring.
[d]ICBT: internet cognitive behavior therapy.
[e]COPD: chronic obstructive pulmonary disease.
[f]CVD: cardiovascular disease.
[g]IBD: inflammatory bowel disease.

Indicators Organized by (Sub)themes of the SPO Framework

Overview

In total, an indicator was reported 347 times: 175 times in the structure category, 84 times in the process category, and 88 times in the outcome category. Of the 347 indicators, 111 were unique indicators (see Appendix 3). In the structure category, most indicators were labeled as neutral (65/175, 37.1%) or as a disadvantage (70/175, 40%). In the process category, most indicators were labeled as an advantage (30/84, 36%) or neutral (33/84, 39%). In the outcome category, the indicators were mostly classified as a realized advantage (49/88, 56%), as shown in Figure 5.

Table 4 shows the total distribution of the indicators organized by themes and subthemes of the structure, process, and outcome categories and the extent to which it was reported as an advantage, disadvantage, or neutral to the integration of eHealth and its outcome in regular health care. The themes and subthemes containing the most reported indicators are described next.

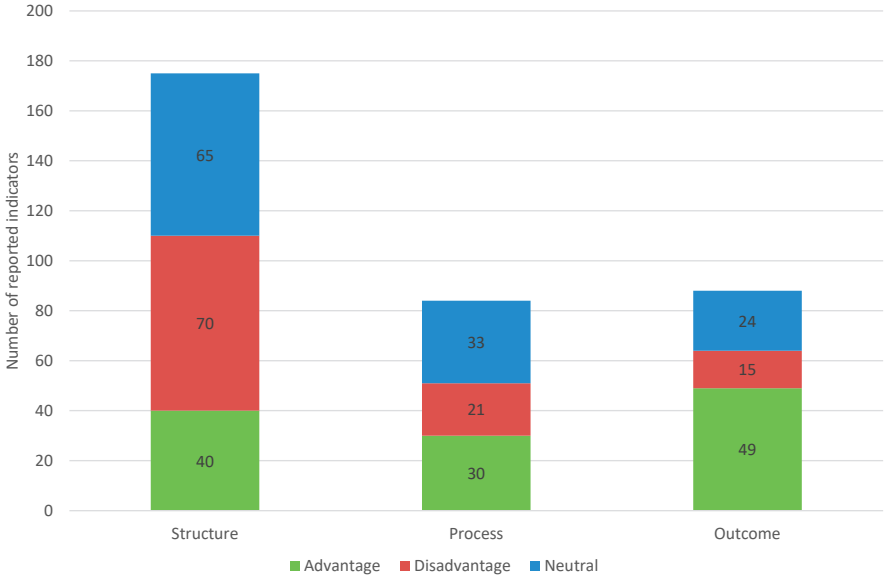

Figure 5. Number of indicators reported in the structure, process, and outcome categories. Advantage: in the structure and process categories, advantage indicates a positive effect on the integration. In the outcome category, it indicates a positive effect on the outcome. Disadvantage: in the structure and process categories, disadvantage indicates a negative effect on the integration. In the outcome category, it indicates a negative effect on the outcome. Neutral: indicator was neither an advantage nor a disadvantage.

Table 4. Distribution of the indicators according to the themes and subthemes of the structure, process, and outcome categories.

Category, theme, and subtheme	Advantage (n)	Disadvantage (n)	Neutral (n)	Source
Structure (n=175)				
Inner setting (n=51)				
Support of primary process (n=34)	7	13	14	27,34,37-43
Culture and leadership (n=17)	7	9	1	27,34,37,40
Health care professional (n=28)				
Skills (n=8)	4	0	4	27,36,38,40,41,43
Attitude (n=20)	8	8	4	27,34-41,43
Care receiver (n=40)				
Daily life (n=18)	3	8	7	27,34-39
Baseline characteristics (n=22)	1	5	16	34-39
Technology (n=38)				
Usability and functionality (n=33)	8	17	8	27,34-43
Interaction with EHR[a] (n=5)	0	5	0	35,37,38,41,43
Outer setting (n=18)				
Finance and legislation (n=10)	0	2	8	27,34,36,38-41
Involvement of stakeholders (n=8)	2	3	3	27,38,43
Total structure	40	70	65	
Process (n=84)				
Health care actions (n=38)				
Workflow (n=18)	5	11	2	27,34-39,41-43
Patient-centered (n=20)	7	0	13	27,34-39,41,42
Interpersonal actions (n=24)				
Personal (n=19)	11	3	5	27,34-42
Shifting roles (n=5)	2	1	2	34,36,42
Process management (n=22)				
Quality improvement (n=11)	4	3	4	27,34,38,40
Mistake-proofing (n=11)	1	3	7	27,37-39,41-43
Total process	30	21	33	
Outcome (n=88)				
Health status (n=10)				
Clinical/functional (n=3)	1	0	2	36,41,43
Intrapersonal (n=7)	6	0	1	34,36,37,41,42
Experience of care receiver (n=23)				
Satisfaction (n=16)	11	3	2	34-38,42
Convenience (n=7)	7	0	0	36,38,42
Experience of health care professional (n=25)				
"What's in it for me" (n=15)	9	2	4	27,34,36-38,40,42
"What's in it for them" (n=10)	10	0	0	27,34,36-38,41-43
Efficiency(n=30)				
Operations (n=27)	4	9	14	34-43
Revenues (n=3)	1	1	1	27,41,43
Total outcome	49	15	24	

[a]EHR: electronic health record.

Distribution of Indicators Within the Themes and Subthemes of the Structure Category

In the structure category, most indicators were reported in the inner setting (51/175, 29.1%), care receiver (40/175, 22.9%), and technology (38/175, 21.7%) themes. The indicators in the inner setting (n=22) and technology (n=23) themes were mainly classified as a disadvantage to the integration, whereas those in the care receiver theme (n=23) were mainly classified as neutral. Regarding the subthemes, most indicators were reported in the support of the primary process subtheme within the inner setting theme (34/175, 19.4%), the baseline characteristics subtheme within the care receiver theme (22/175, 12.6%), and the usability and functionality subtheme within the technology theme (33/175, 18.9%), as shown in Table 4.

Distribution of Indicators Within the Themes and Subthemes of the Process Category

Almost half of the indicators were organized within the health care actions theme (38/84, 45%), which were diversely reported as an advantage (n=13), disadvantage (n=11), and neutral (n=15). The subthemes with the most reported indicators were workflow (18/84, 21%), patient-centered (20/84, 24%), both within the health care actions theme, and the personal subtheme (19/84, 23%) within the interpersonal actions theme (Table 4).

Distribution of Indicators Within the Themes and Subthemes of the Outcome Category

In the outcome category, the most frequently reported indicators were from the efficiency theme (30/88, 34%), with advantages (n=5) reported for very few indicators. The "experiences" themes of care receivers and health care professionals together accounted for 55% (48/88), both predominated by advantages (n=37). The highest number of indicators were reported in the operations subtheme (n=27/88, 31%; Table 4).

Most Reported Indicators

An in-depth examination of the distribution of the indicators showed that the following four indicators were the most reported (i.e., reported 10 times or more) among the included studies: "deployment of human resources" (n=11) of the inner setting theme in the structure category; "ease of use" (n=16) and "technical issue" (n=10), both belonging to the technology theme in the structure category; and "health logistics" (n=26) of the efficiency theme in the outcome category. An overview of all indicators is presented in Appendix 3.

Interactions Among Indicators Organized into Themes and Categories

Overview

Of the 11 included studies, 10 (91%) reported interactions among indicators organized by themes within the structure, process, and outcome categories. The most frequently reported interaction among indicators at the category level was between the structure and outcome categories (14 times). The most frequently reported interaction among indicators at the theme level was between the care receiver theme within the structure category and the efficiency theme within the outcome category (8 times), as shown in Figure 6.

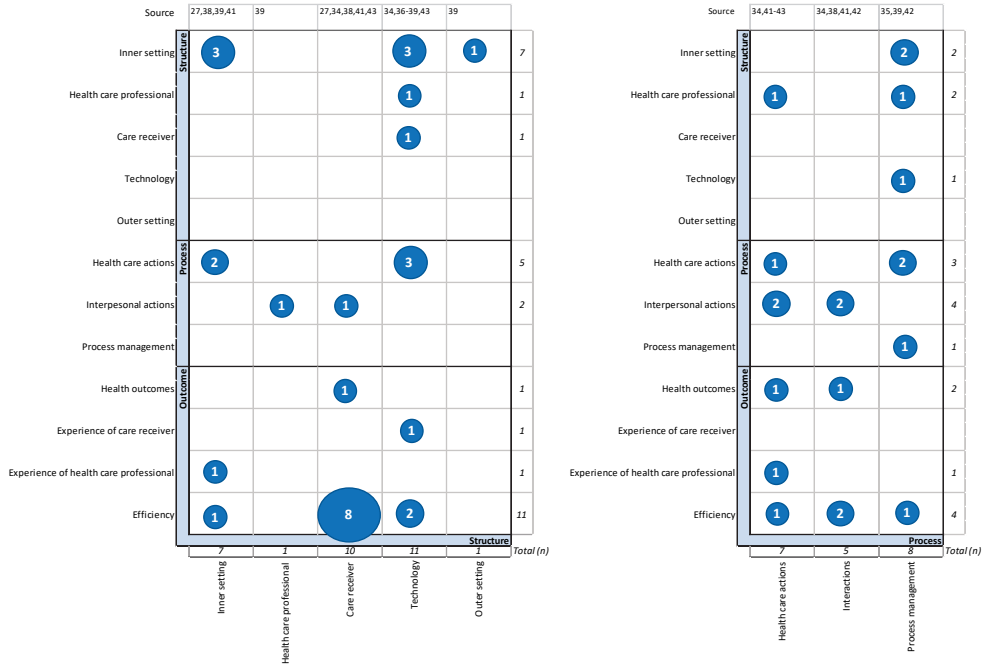

Figure 6. Interactions among indicators within themes and categories. The numbers within the blue circles represent the number of noted interactions among indicators within the themes. The x-axis represents the antecedent, and the y-axis represents the (intermediate) result.

Interactions With Themes in the Structure Category

All themes in the structure category contained indicators as an antecedent to, or as an intermediate result of other indicators. The inner setting (n=16), technology (n=12), and care receiver (n=11) themes represented the highest number of interactions with other themes. Inner setting was noted 7 times as an antecedent and 9 times as an intermediate result. Technology was noted 11 times as an antecedent and once as an intermediate result. Care receiver was noted 10 times as an antecedent and once as an intermediate result. The health care professional (n=3) and outer setting (n=1) themes were noted less frequently (Figure 6).

Interactions With Themes in the Process Category

In all themes in the process category, the indicators displayed interactions with indicators of other themes; specifically, health care theme (n=15), noted 7 times as an antecedent and 8 times as an intermediate result; interpersonal actions theme (n=11), 5 times as an antecedent and 6 times as an intermediate result; process management theme (n=9), 8 times as antecedent and once as an intermediate result (Figure 6).

Interactions With Themes in the Outcome Category

In the outcome category, the efficiency theme (n=15) contained most of the interacting indicators, all as an intermediate result. The other themes, including health status (n=3),

experience of health care receiver (n=1), and experience of health care provider (n=2), were noted less frequently as (intermediate) results (Figure 6).

Examples of interactions among the indicators and the associated themes are illustrated in Textbox 2.

Textbox 2. Illustrations of reported interactions among indicators and their themes. Indicator names are written in italics as reported in the published studies (followed by the corresponding themes and categories in parentheses).

- *Technical and usability issues* (technology theme, structure category) experienced by the health care professional negatively impacted the *engagement* and the *internal collaboration* (inner setting theme, structure category)[40] and the health care workflow by causing *extra steps* and *workarounds* (health care actions theme, process category).[37,41,43]
- *Technical and usability issues* (technology theme, structure category) experienced by the care receiver challenged the care receiver to *fit the application of eHealth into their daily lives* (care receiver theme, structure category) and caused increased *dropouts* (efficiency theme, outcome category).[34,39] Conversely, one study[36] showed that technology that is *easy to use* (technology theme, structure category), can contribute positively to its application, and *fit into the patient's daily life* (care receiver theme, structure category).
- Insufficient attention to the *patient's burden* (care receiver theme, structure category), *health literacy* (care receiver theme, structure category), and whether the plan *fits into their daily life* (care receiver theme, structure category) caused *dropouts* (efficiency theme, outcome category),[36,37,39] and *nonadherence to care plans* (efficiency theme, outcome category).[34]
- *High workload* (inner setting theme, structure category) hindered the *incorporation of the application into daily practice* (inner setting theme, structure category).[40]
- *Lack of time* (inner setting theme, structure category) discouraged health care professionals from their *intention to (re)*use (experience health care professional theme, outcome category)[37] and health care professionals did not *experience an added value for themselves* (experience health care professional theme, outcome category).[37]
- *Communicated added value* (inner setting theme, structure category) on a corporate level positively influenced the *collective engagement* (inner setting theme, structure category).[40]

- *Guidelines on the work process* (process management, process category) made the *work process easier and faster for health care professionals* (health care actions theme, process category) but *limited the adaptability of the technology for certain recipients* (technology theme, structure category).[42]
- Limited *feedback about the quality of care* (process management theme, process category) made specialists feel *uncertain about the suitability of the technology* (health care professional theme, structure category),[38] whereas *sharing information* (process management theme, process category) to improve program efficiency allowed the program *to be a part of the workflow* (health care actions theme, process category).[38]
- *Face-to-face contact* (health care actions theme, process category) benefitted the *personal connection between care receiver and professional* (interpersonal actions theme, process category) and the *engagement of the care receiver with the treatment* (interpersonal actions theme, process category).[34]
- *Personal assistance* (health care actions theme, process category) and *personalized therapy* (health care actions theme, process category) increased the *usage of the intervention by the care receiver* (efficiency theme, outcome category).[39]
- *Personalized therapy* (health care actions theme) also increased the *satisfaction of the care receiver* (experience of care receiver theme, outcome category).[36]
- *Exceptions to the operational process* (health care actions theme, process category) were made too often, such as *providing extra support to patients* (health care actions theme, process category), or *providing less care* (health care actions theme, process category), *creating new administrative workarounds* (health care actions theme, process category) caused by *technical issues* (technology theme, structure category) [35,37,38,41,43] or *high workloads* (inner setting theme, structure category).[27]
- An increase in *questioning* by professionals (interpersonal actions theme, process category) made carers feel more *engaged and knowledgeable* (health status theme, outcome category).[42]
- Recipients' *detailed input* (interpersonal actions theme, process category) on the assignments enabled professionals to *empathize with their situation and focus on their feedback* (interpersonal actions theme, process category).[34]

Discussion

Principal Findings

This literature review analyzed how eHealth can be organized optimally by using the Donabedian SPO framework. General organizational developments were identified, regardless of the type of illness, setting, or the eHealth application used. A review of the literature of selected cases highlighted three important findings. First, the role of the care recipient needs to be incorporated into the organizational structure and daily care process. Second, the technology must be well attuned to the structure of the organization and daily care process. Third, the deployment of the human resources to the daily processes needs to be aligned with the desired end results. Not adhering to these points could negatively affect the organization, daily process, or the end results. Findings from this research using the Donabedian framework corresponds to the conclusions of other studies using different research methodologies, which is explained below.

First, the SPO analysis showed that the care recipient plays a crucial role in the successful integration of eHealth. Patient-centered interaction and communication are important, to activate patients in managing their health care and to improve health outcomes in the application of eHealth.[5,31,44-46] Kuipers et al[44] and Rathert[45] demonstrated with systematic literature reviews that patient-centered care and co-creation are positively associated with the physical and social well-being of patients and with satisfaction of patients and health care professionals. These findings are in line with the review of Wildevuur and colleagues,[46] demonstrating that organizations that are more patient centered with eHealth interventions achieve better outcomes with regard to patient health and quality of life. Although most health care professionals embrace more patient involvement and engagement, delegating power and responsibilities could be a challenge for health care professionals' authority.[47,48] Another important issue is knowing who the customers are, what they want, and how the customer's demand is answered.[49] A previous study reported that eHealth is not suitable for all care receivers.[18,50] Therefore, identifying who benefits most from which kind of therapy is an essential addition to the screening process, and it could lead to more effective targeting and resourcing.[51] Furthermore, insufficiently incorporating the patients' family, work, and life goals into care plans will likely result in dropouts or nonadherence to care plans.[50]

The second noteworthy finding is the essential role of excellent technology in the integration of eHealth. The way technology is set up has an influence on the working environment of health care professionals.[52] Inflexibility and complexity of the technology comes at the expense of effective daily processes and their quality.[53,54] Several studies demonstrated that the adaptability of eHealth technologies to fit to the local context, its ease of use, and its integration into clinical workflow benefit the users' acceptance and meaningful use.[22,55,56] This was also reflected in the early phase of the COVID-19 pandemic, where rapid scalable technologies were the easiest to use and quickly implementable.[53] However, the health care system continued to face challenges in adopting digital technology after the first emergency phase of the COVID-19 pandemic, due to inadequate information and communication technology infrastructure and a bad fit of the technology into the clinical workflow that is primarily designed for face-to-face care.[53] Granja et al[54]

demonstrated that the application of eHealth is often not fitted to the existing workflow due to time and space constraints and breaking of traditions. Although eHealth is seen as an innovative solution for alleviating the increasing burden for health care professionals,[2] it could have a counterproductive effect on the working conditions for employees if the technology is not properly adapted to the structure and processes.[57,58]

Third, integrating eHealth into a health care organization requires adjustments of the care processes and utilization of the human resources, with appropriate process monitoring. Working with eHealth also poses logistical challenges; for example, a clear understanding is needed of the expected achievements, processes, and staffing requirements in order to bring about changes and create new capabilities.[59] Vissers and De Vries[49] pointed out that it is necessary to know how the logistical capacities should be assigned to the process, how the processes are measured, and who is responsible for the management of the process. Changes in the workflow are inevitable and necessary for eHealth interventions to be successful.[54] However, integrating eHealth technology into daily care processes is complex, and it needs coordination and process communication.[19] For example, a living laboratory experiment conducted over 3 years with patients, health care professionals, enterprises, and researchers to accelerate the integration of eHealth in daily practice showed that workflow, responsibilities, and roles needed to change, but health care professionals did not know how to approach this and had difficulties in integrating eHealth into their daily care processes.[18]

Strength and Limitations

The strengths of this research are that international studies were included and represented a wide range of patient groups and settings. The findings were representative for the included studies, and they were not dependent of the study design, disease, target population, setting, or type or function of the eHealth application used. The wide range of settings of the included studies is supportive of a broader application of the present study's findings. In the *Methods*, we stated that there is no clear consensus on what constitutes as *good eHealth* and how it is best organized.[3,19] Nevertheless, we believe that our findings make a significant contribution to improving the integration of eHealth in regular health care by identifying the most common indicators in the organization's structure, processes, and outcomes. Thus, this research contributes to a new model for integrating organizational, health, and social factors.

A limitation of this study is that the health outcomes were rarely mentioned in this review. We hypothesized that this is because the main method used in the included studies was process evaluation. Therefore, although the health outcomes played a major role in earlier RCTs, this was not the case in process evaluation studies. The included studies did not define clear standards for the indicators to determine their quality. However, an indicator only becomes meaningful if a standard is specified.[60,61] There are also limitations in the selection procedure. The interrater reliability was not calculated. Due to this complex, broad topic, the predefined inclusion and exclusion criteria were sharpened at the time of selection. It was an iterative process, with a lot of consultation and coordination. In the process, full consensus was reached for all inclusion and exclusion criteria for selection at each step of the research. Another limitation is the classification of indicators into

subthemes and themes at the discretion of the authors. It is conceivable that different classifications would reach different conclusions. Yet, the conclusions of each included study fit with the overall conclusion; therefore, the chance of this bias seems to be small. However, the findings of this literature review are dependent on the results of the included studies and may be subject to publication bias. Even though the included publications contain either positive or negative results (e.g., a failed randomized trial[35] or interventions with no or less impact[40,43]), a chance of publication bias cannot be precluded automatically.[62,63]

It is also noted that the Donabedian framework itself was designed before the introduction of eHealth and may not include the latest prevailing ideas on the organization of health care. For this reason, the model has been adapted in order to represent eHealth. By doing so, an attempt has been made to reduce the limitation as far as possible. Nevertheless, this literature review confirmed that it is still useful to analyze what contributes to the successful integration of eHealth into traditional health care. Additionally, there are other reputable models for evaluating eHealth interventions, such as the nonadoption, abandonment, scale-up, spread, sustainability (NASSS) framework,[20] Consolidated Framework for Implementation Research (CFIR),[64] and the holistic framework to improve the uptake and impact of eHealth technologies.[19] These models describe the different phases from the design of the intervention to its adoption and implementation. This literature review focused on quality improvement of the way eHealth is organized, that has already passed the initial phase (of design and adoption). The Donabedian framework covers all relevant aspects for sustaining the integration of eHealth into health care and the interrelations of organization's structure, processes, and outcomes, as well as integrating these aspects with human and social factors, after the adoption and uptake phase of eHealth.

Conclusions

For optimal integration of eHealth into health care, the following main principles should be considered and approached simultaneously. First, the role of the care recipient needs to be incorporated in the organizational structure and daily care process. Second, the technology must be well attuned to the structure of the organization and daily care process. Third, the deployment of human resources to the care process needs to be aligned with the desired end results.

Thus far, no study has presented a complete overview of the successful and effective organization of eHealth. Therefore, it is desirable to supplement this research with knowledge from other sources, such as in-depth research into the experiences from different perspectives, as this can help us to obtain a complete overview of how eHealth can be successfully integrated into health care organizations.

Conflicts of Interest
No conflict specified.

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Abbreviations

CFIR: Consolidated Framework for Implementation Research
MMAT: Mixed Method Appraisal Tool
NASSS: nonadoption, abandonment, scale-up, spread, sustainability
NICE: National Institute for Health and Care Excellence
RCT: randomized controlled trial
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses
SPO: Structure-Process-Outcome

Appendix 1. Search strategy

How are structure indicators, process indicators related to ehealth and blended care outcomes indicators?

In the title and abstract we search for structure* indicators* or process* indicators* or outcomes* indicators and [blended care or ehealth* or telehealth*]:

structure* indicators* or process* indicators* or outcomes* indicators* and [blended care or ehealth* or telehealth*]:

("structure indicators" OR "process indicators" OR "outcomes indicators" OR "value proposition" OR "structure indicator" OR "process indicator" OR "outcomes indicator" OR "value propositions") AND ("blended care" OR ehealth* OR telehealth*)

Databases PubMed, EMBASE, Web of Science, Cochrane, Emcare:
((((("structure"[ti] OR "structures"[ti]) AND ("process"[tiab] OR "processes"[tiab])) OR (("structure"[tiab] OR "structures"[tiab]) AND ("process"[ti] OR "processes"[ti]))) AND ("Outcome Assessment (Health Care)"[Mesh] OR "outcome"[tw] OR "outcomes"[tw]) AND (app[tw] OR apps[tw] OR Cell Phone[tw] OR Cell Phones[tw] OR cellular phone[tw] OR cellular phones[tw] OR computer application*[tw] OR computer assisted therapy[tw] OR computer assisted intervention[tw] OR computer assisted interventions[tw] OR Computer Mediated Communication[tw] OR Computer Mediated Communications[tw] OR computer-assisted instruction[tw] OR computer-assisted therapy[tw] OR computer-assisted[tw] OR digital health[tw] OR econsult*[tw] OR e-consult*[tw] OR ehealth[tw] OR e-health[tw] OR electronic communication*[tw] OR Electronic Learning[tw] OR Electronic Mail[mesh] OR Electronic Mail[tw] OR email*[tw] OR e-mail*[tw] OR information technology[tw] OR Internet[mesh] OR internet[tw] OR ipad*[tw] OR ipad[tw] OR iphon*[tw] OR mhealth[tw] OR m-health[tw] OR mobile health[tw] OR mobile*[tw] OR mobile[tw] OR multimedia[tw] OR online therapy[tw] OR personal digital assistant[tw] OR phone[tw] OR phones[tw] OR Reminder Device[tw] OR Reminder Devices[tw] OR reminder message[tw] OR reminder messages[tw] OR Reminder System[tw] OR Reminder Systems[mesh] OR Reminder Systems[tw] OR remote care[tw] OR remote communication[tw] OR remote computer[tw] OR remote computers[tw] OR "Remote Consultation"[mesh] OR remote consultation[tw] OR remote health care[tw] OR remote healthcare[tw] OR remote monitoring[tw] OR remote system[tw] OR remote systems[tw] OR remote technologies[tw] OR remote technology[tw] OR remote[tw] OR short message service[tw] OR smart phone[tw] OR smart technol*[tw] OR smart technology[tw] OR Smartphone[tw] OR Smartphones[tw] OR SMS[tw] OR social network*[tw] OR social network[tw] OR tablet*[tw] OR tele health[tw] OR telecare[tw] OR tele-care[tw] OR telecommunication*[tw] OR Telecommunications[mesh:noexp] OR teleconsult*[tw] OR teleconsultation[tw] OR telehealth[tw] OR tele-health[tw] OR telemed*[tw] OR Telemedicine[mesh:noexp] OR telemedicine[tw] OR telemonitoring[tw] OR tele-monitoring[tw] OR telenurs*[tw] OR telenursing[tw] OR telephon*[tw] OR Telephone[mesh] OR Telerehabilitation[mesh] OR telerehabilitation[tw] OR text messag*[tw] OR Text Messaging[tw] OR texting[tw] OR Therapy, computer-assisted[mesh:noexp] OR virtual community[tw] OR Virtual

Reality[mesh] OR Virtual Reality[tw] OR wearable technologies[tw] OR wearable technology[tw] OR web access[tw] OR web application[tw] OR web applications[tw] OR web portal*[tw] OR web[ti] OR webapp*[tw] OR webbased[tw] OR web-based[tw] OR webcast*[tw] OR Webcasts as Topic[mesh] OR webpage[tw] OR webpages[tw] OR website[tw] OR websites[tw] OR blended care[tw] OR blended intervention[tw] OR blended interventions[tw] OR blended e health[tw] OR blended[tw])) **OR** ((((”structure”[tw] OR ”structures”[tw]) AND (”process”[tw] OR ”processes”[tw])))) AND (”Outcome Assessment (Health Care)”[Mesh] OR ”outcome”[tw] OR ”outcomes”[tw]) AND (app[ti] OR apps[ti] OR Cell Phone[ti] OR Cell Phones[ti] OR cellular phone[ti] OR cellular phones[ti] OR computer application*[ti] OR computer assisted therapy[ti] OR computer assisted intervention[ti] OR computer assisted interventions[ti] OR Computer Mediated Communication[ti] OR Computer Mediated Communications[ti] OR computer-assisted instruction[ti] OR computer-assisted therapy[ti] OR computer-assisted[ti] OR digital*[ti] OR digital[ti] OR digital health[ti] OR econsult*[ti] OR e-consult*[ti] OR ehealth[ti] OR e-health[ti] OR electronic communication*[ti] OR Electronic Learning[ti] OR Electronic Mail[majr] OR Electronic Mail[ti] OR email*[ti] OR e-mail*[ti] OR information technology[ti] OR Internet[majr] OR internet[ti] OR ipad*[ti] OR ipad[ti] OR iphon*[ti] OR mhealth[ti] OR m-health[ti] OR mobile health[ti] OR mobile*[ti] OR mobile[ti] OR multimedia[ti] OR on line[ti] OR online therapy[ti] OR online[ti] OR on-line[ti] OR personal digital assistant[ti] OR phone[ti] OR phones[ti] OR Reminder Device[ti] OR Reminder Devices[ti] OR reminder message[ti] OR reminder messages[ti] OR Reminder System[ti] OR Reminder Systems[majr] OR Reminder Systems[ti] OR remote care[ti] OR remote communication[ti] OR remote computer[ti] OR remote computers[ti] OR “Remote Consultation”[majr] OR remote consultation[ti] OR remote health care[ti] OR remote healthcare[ti] OR remote monitoring[ti] OR remote system[ti] OR remote systems[ti] OR remote technologies[ti] OR remote technology[ti] OR remote[ti] OR short message service[ti] OR smart phone[ti] OR smart technol*[ti] OR smart technology[ti] OR Smartphone[ti] OR Smartphones[ti] OR SMS[ti] OR social network*[ti] OR social network[ti] OR tablet*[ti] OR tele health[ti] OR telecare[ti] OR tele-care[ti] OR telecommunication*[ti] OR Telecommunications[majr:noexp] OR teleconsult*[ti] OR teleconsultation[ti] OR telehealth[ti] OR tele-health[ti] OR telemed*[ti] OR Telemedicine[majr:noexp] OR telemedicine[ti] OR telemonitoring[ti] OR tele-monitoring[ti] OR telenurs*[ti] OR telenursing[ti] OR telephon*[ti] OR Telephone[majr] OR Telerehabilitation[majr] OR telerehabilitation[ti] OR text messag*[ti] OR Text Messaging[ti] OR texting[ti] OR Therapy, computer-assisted[majr:noexp] OR virtual community[ti] OR Virtual Reality[majr] OR Virtual Reality[ti] OR wearable technologies[ti] OR wearable technology[ti] OR web access[ti] OR web application[ti] OR web applications[ti] OR web portal*[ti] OR web[ti] OR webapp*[ti] OR webbased[ti] OR web-based[ti] OR webcast*[ti] OR Webcasts as Topic[majr] OR webpage[ti] OR webpages[ti] OR website[ti] OR websites[ti] OR blended care[ti] OR blended intervention[ti] OR blended interventions[ti] OR blended e health[ti] OR blended[ti])) **OR** ((”structure indicators”[tw] OR ”process indicators”[tw] OR ”structure indicator”[tw] OR ”process indicator”[tw]) AND (”Outcome Assessment (Health Care)”[Mesh] OR ”outcome”[tw] OR ”outcomes”[tw]) AND (app[tw] OR apps[tw] OR Cell Phone[tw] OR Cell Phones[tw] OR cellular phone[tw] OR cellular phones[tw] OR computer application*[tw] OR computer assisted therapy[tw] OR computer assisted intervention[tw] OR computer assisted interventions[tw] OR Computer Mediated Communication[tw] OR Computer Mediated Communications[tw] OR

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Appendix 2. Explanatory notes on structure, process, and outcomes, and the (sub)themes

Textbox 2. Structure.

Inner setting: The administrative structure and operations in the institute.
- *Support of primary process*: The created/facilitated conditions to provide care, e.g., training skills, available resources, workload balance, supply of information.
- *Culture & leadership*: The specific collection of values and norms that are shared by people within an organisation and the internal collaboration and collective engagement. Leadership relates to a leadership that inspires the organisation with the values, the way they communicate these values, but also the traditional leadership, e.g., setting priorities, strategic goals, etc.

Health care professionals: Characteristics of the health care providers.
- *Skills*: Competence with treatment aspects, technology, computer.
- *Attitude*: Confidence and/or comfort with the intervention and, or in the patient's competence to use; willingness to use/learn; belief in program's value.

Care receiver: Characteristics of the care receiver.
- *Daily life*: Household and lifestyle; access to technology, insurance cover, fit with daily life, (lack) of time.
- *Baseline characteristics*: Age, gender, SES, skills, attitude (e.g., believes in program's value), quality of life, cognitive/physical functioning, therapy compliance.

Technology: The adequacy of the facility and technological equipment to provide eHealth.
- *Usability and functionality:* Its ease of use, technical performance, quality of the audiovisual aspects.
- *Interaction with EHR*: It interacts with the Electronic Health Record in use.

Outer Setting: The administrative structure and operations in the environment outside the institute (government/policies/regulations/network).
- *Finance & Legislation*: Policy context, regulatory, reimbursement.
- *Involvement of stakeholders*: Collaboration of external stakeholders; fit with the community needs; external communication.

Textbox 3. Process.

Health care actions: The actual health care which is given and received.
- *Workflow*: The steps and time the actual health care requires and the extent of integrating it into conventional health care; reduction of work, integration with workflow, (lack) of consultation time.
- *Patient-centred*: Creation of conditions in the workflow for patient-centred care. Personal assistance, personalised medicine/therapy, screening of patient's eligibility.

Interpersonal actions: Interactions between care receiver and health professionals.
- *Personal*: Development of a therapeutic relationship and/or openness/compliance with the intervention.
- *Shifting roles*: Shift in the power balance in the relationship; changing role of practice; refocus treatment elements.

Process management: The action to improve the quality of the health care process in question.
- *Quality improvement:* Monitoring and improvement activities (re-active) e.g., best practices, clinical feedback, continued development of guidelines.
- *Mistake-proofing*: error prevention activities (pro-active), e.g., notifications, (systematic) guidance in the work process, using guidelines.

Textbox 4. Outcome.

Health status: The clinical, functional and intrapersonal health outcomes.
- *Clinical/functional*: Clinical, functional outcomes e.g., vital values, pain reduction, performance of organs or joints.
- *Intrapersonal:* Quality of live, self-efficacy, personal confidence.

Experience of care recipients: Satisfaction and convenience.
- *Satisfaction:* Attitude towards care received (trust, confidence, satisfaction).
- *Convenience*: Reduced travel, increased access.

Experience of health care professionals: Gains for job performance and gains for clients, according to the health care professional.
- *"What's in it for me":* e.g., satisfied, intends to re-use, burdensome/demanding.
- *"What's in it for them":* Believes that is helpful for the care receiver, that the care receiver is satisfied, etc.

Efficiency: Business consequences of the health care is provided.
- *Operations*: Operational performance; e.g., response time, number of contacts, performance according to protocol, drop-outs, reschedules, processing time, waiting time.
- *Revenues*: Costs, turnover.

Appendix 3. Unique reported indicators

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Inner setting (Structure)	Support of primary process	Incorporation into daily practice	"Intervention is adequate and feasible in daily practice", "incorporate usage into every day work", "flexibility to design work".	1	1	1	**3**
		Deployment of human resources	The required capacity, time needed to adapt a new route, "high staff workload as a barrier for recruitment care receivers".	1	9	1	**11**
		Training	Content-specific training and/or technical training.	3		5	**8**
		Supervision meetings	Supportive to the organization of the primary process.			1	**1**
		Financial incentives	Financial cutbacks or rewards for working with the intervention.		1	1	**2**
		Helpdesk for health care professionals	Technical assistance (e.g., telephonic, digital).			5	**5**
		Policies		1	1		**2**
		Access to program information		1	1		**2**
		Other		-	-	-	
	Culture and leadership	Added value	"Compatibility with clinic needs", "understanding the objective", which often is communicated/influenced by the top of the organization.	2	1		**3**
		Engagement	Engagement with the program by the individual and/or colleagues or managers.	2	2	1	**5**
		Ambassadors		1			**1**
		Leadership		1	1		**2**
		No priority			3		**3**
		Collaboration of internal stakeholders	Collective action.	1	2		**3**
		Other		-	-	-	

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Health care professional (Structure)	Skills	Competence with the technology/computer skills		2		1	**3**
		Competence with treatment elements		2			**2**
		Knowledge of the program				1	**1**
		Influence of age, gender, years of clinical experience with technology use				2	**2**
		Other		-	-	-	
	Attitude	Feeling (un)comfortable with the technology	The professional experiences hurdles or pitfalls associated with the use of the technology (regardless of whether he/she is right in this or not).		2	3	**5**
		(Un)certainty about patients' competence of use/eligibility	"Patients are suitable/eligible" according to the clinician (regardless of whether the health care professional is right in this or not).		4	1	**5**
		Belief in program's value	The professional believes that the program/intervention is valuable for them and/or for the patient and/or for the organization.	7	2		**9**
		Willingness to learn		1			**1**
		Other		-	-	-	

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Health care receiver (Structure)	Daily life	Access to technology	"Does not have a computer", "no access to internet".		3		**3**
		Insurance cover				1	**1**
		Program is valuable			1	1	**2**
		Fit with the need	E.g., fit with the need, lack of need, patients, needs beyond the scope of the program.	1		3	**4**
		(Lack of) time			2		**2**
		Fit with daily life		1	1		**2**
		Social influence				1	**1**
		Burden	Health burden care receivers or burden for carers.		1	1	**2**
		Home environment		1			**1**
		Other		-	-	-	
	Baseline characteristics	Age			1	4	**5**
		Gender				4	**4**
		SES				1	**1**
		Education				3	**3**
		Self-efficacy				1	**1**
		Quality of life				1	**1**
		Cognitive/physical functioning			1	2	3
		Competence with the technology/ computer skills		1	3		**4**
		Other		-	-	-	
Technology (Structure)	Usability and functionality	Easy to use for care receiver and/or professional		5	6	5	**16**
		Technical issues	E.g., speed, quality of audiovisual components.	1	6	3	**10**
		Evidence-based		1			**1**
		Extent of adaptability			5		**5**
		Suitable for diagnosis/ therapy		1			**1**
		Other		-	-	-	
	Interaction with EHR	Interaction with EHR			5		5
		Other					

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Outer setting (Structure)	Finance, legislation, guidelines	Funded				2	**2**
		Registration possibilities for regular care			1		**1**
		Guidelines/policies				5	**5**
		Reimbursement			1	1	**2**
		Other		-	-	-	
	Involvement of stakeholders	Affiliation with target group			1		**1**
		Promotion and recruitment	Promoting/communicating the program in the community, recruitment of patients.		1		**1**
		Alignment with the community needs	For the region/community in general, e.g., health care resources are lower than the demand.	2			**2**
		Sharing of information	E.g., about each other's expectations and limitations.		1		**1**
		Collaboration of external stakeholders	E.g., difficulties engaging referring providers			3	**3**
		Other		-	-	-	
Health care actions (Process)	Workflow	Integration with workflow	Ease of integration into work-related activities.	2	3		**5**
		(Lack of) time			2		**2**
		FtF contact	FtF intake/ FtF contact.	1			**1**
		Usage according to protocol		1	1		**2**
		Adjusting routine treatment				1	**1**
		Simplification/reduction of work	The intervention activities are fewer or simplified.	1		1	**2**
		Creating an additional step or extra workaround			5		**5**
		Other		-	-	-	
	Patient-centred	Personal assistance for care recipients	Training care recipients how to use the intervention and/or helpdesk for the recipients.	2		4	**6**
		Personalised medicine/ therapy	Possibilities for a tailor-made intervention, which can be online, by telephone and/or FtF.	4		3	**7**
		Self-management				1	**1**
		Screening patients for eligibility		1		5	**6**
		Other		-	-	-	

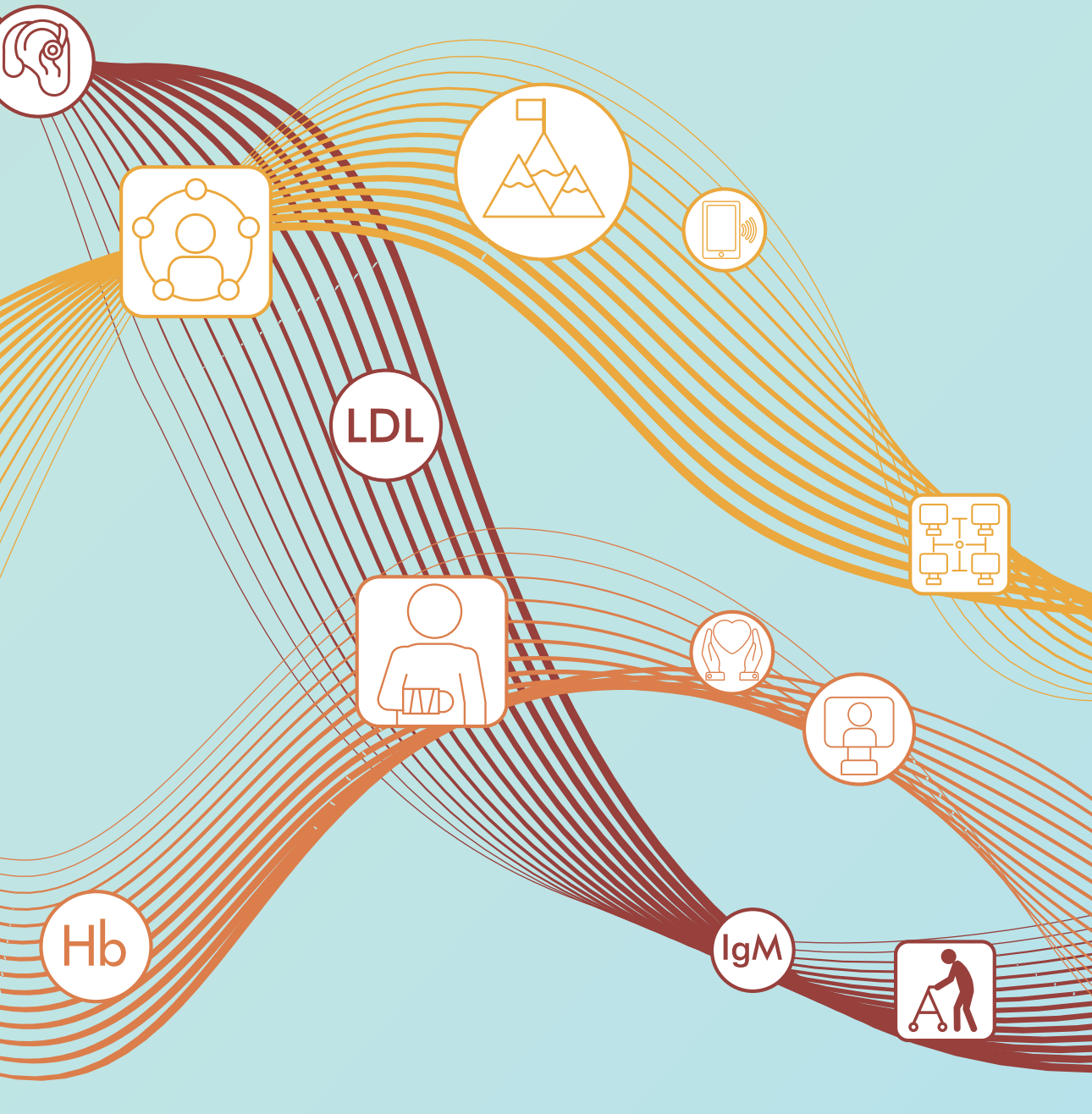
THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Interpersonal actions (Process)	Personal	Therapeutic relationship	Development of a professional relationship/change to the professional distance between care receiver and professional.	2	1	1	**4**
		Compliance	E.g., tailored information to improve compliance/information in need of compliance	1		3	**4**
		Personal connection		1			**1**
		Exchange of personal information	Information necessary for making a diagnosis, as well as for selecting the most appropriate method of care. In this way, the physician provides information about the nature of the illness and its management and motivates the patient to actively collaboration in care[24]/detailed input/knowing the recipient's circumstances. Recipient's background information, which allows the professional to empathize with the recipient.	4	2	1	**7**
		Openness/engagement of the recipient	Change to the recipient's openness/ engagement during the appointment/ treatment.	3			**3**
		Other			-	-	
	Shifting role	Shift in the power balance in the relationship to the patient			1		**1**
		Changing role of practice health care provider		1		1	**2**
		(Re)focus treatment elements	For example, they were accustomed to a proactive role, or able to focus more on self management.	1		1	**2**
		Other		-	-	-	

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Process management	Quality improvement	Feedback to therapist (clinical, performance)		1	1	1	**3**
	Actions after the error, including the used input	Monitoring and evaluation service and treatment outcomes	Evaluation of and improvement in the use of the intervention/supervision meetings.	2		1	**3**
		Supervision	Care-related cases.			1	**1**
		(Un)reliable data			1		**1**
		Development of guidelines			1	1	**2**
		Best practices		1			**1**
		Other		-	-	-	
	Mistake-proofing ('error" prevention)	Notifications for patients			1	1	**2**
		Notifications for health care professional			1	1	2
		Guidelines				2	**2**
		Guidance (other than notifications) built into the work process for health care professionals to prevent error	Shaping the work process in such a way that it becomes almost impossible to make mistakes. An operation is carried out in a way that forces the correct operation, e.g., decision trees.	1	1	3	**5**
		Other				-	
Health status (Outcome)	Clinical/ functional outcomes	Clinical/functional outcomes		1		2	**3**
		Other					
	Intrapersonal	Self-efficacy	Self-management, self-efficacy.	4		1	**5**
		Quality of life		1			**1**
		Confidence	Recipient has gained confidence in themselves.	1			1
		Other		-	-	-	

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Experience of care recipient (Outcome)	Satisfaction	Satisfied in general		4			**4**
		Responds to the needs		4	2		**6**
		Privacy trust			1		**1**
		Intention (desire) to re-use				1	1
		Favour the eHealth intervention over the conventional		1			**1**
		Favour an initial in-person consultation				1	**1**
		Satisfied knowledge/ skills of health care professional	Satisfied with the knowledge, confidence in the abilities of the professional.	1			**1**
		Confidence in the application		1			**1**
		Other		-	-	-	
	Convenience (Relative advantage)	Increased access to the health care		2			**2**
		Time-saving		2			**2**
		No travel when in pain		1			**1**
		Flexibility to participate anywhere		1			**1**
		Logistical convenience		1			**1**
		Other		-	-	-	
Experience of health care professional (Outcome)	"What's in it for me"	Gains for job performance	Program is useful for job performance.	3		2	**5**
		Intention to re-use			1		1
		Uncomfortable			1		**1**
		Satisfied in general		3		2	**5**
		Less demanding		1			**1**
		Useful as addition to regular care		2			**2**
		Other					
	"What's in it for them"	Gains for care recipients		8			**8**
		Useful as an addition to regular care		2			**2**
		Other					

THEMES	SUBTHEMES	INDICATOR	Explanatory notes	A[a] (n)	D[b] (n)	N[c] (n)	Total (n)
Efficiency (Outcome)	Operations	Healht logistics	Response time, reschedule, number of FtF/e-contacts, mean time spent (by patient and or professional), drop-outs, no-shows.	3	9	14	**26**
		Referral	Internal and external referrals/ prescriptions.	1			**1**
		Other		-	-	-	
	Revenues	Costs		1	1	1	**3**
		Other					
Unique indicators		111	**Total reported indicators**	119	106	122	**347**

[a] A=Advantage
[b] D=Disadvantage
[c] N=Neutral


LDL
Hb
IgM

Chapter 5

Development of a quality management model and self-assessment questionnaire for hybrid health care: a concept mapping study

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Abstract

Background
Working with eHealth requires health care organizations to make structural changes in the way they work. Organizational structure and process must be adjusted to provide high-quality care. This study is a follow-up study of a systematic literature review on optimally organizing hybrid health care (eHealth and face to face) using the Donabedian Structure-Process-Outcome (SPO) framework to translate the findings into a modus operandi for health care organizations.

Objective
This study aimed to develop an SPO-based quality assessment model for organizing hybrid health care using an accompanying self-assessment questionnaire. Health care organizations can use this model and questionnaire to manage and improve their hybrid health care.

Methods
Concept mapping was used to enrich and validate evidence-based knowledge from a literature review using practice-based knowledge from experts. First, brainstorming was conducted. The participants listed all the factors that contributed to the effective organization of hybrid health care and the associated outcomes. Data from the brainstorming phase were combined with data from the literature study, and duplicates were removed. Next, the participants rated the factors on importance and measurability and grouped them into clusters. Finally, using multivariate statistical analysis (multidimensional scaling and hierarchical cluster analysis) and group interpretation, an SPO-based quality management model and an accompanying questionnaire were constructed.

Results
All participants (n=39) were familiar with eHealth and were health care professionals, managers, researchers, patients, or eHealth suppliers. The brainstorming and literature review resulted in a list of 314 factors. After removing the duplicates, 78 factors remained. Using multivariate statistical analyses and group interpretations, a quality management model and questionnaire incorporating 8 clusters and 33 factors were developed. The 8 clusters included the following: Vision, strategy, and organization; Quality information technology infrastructure and systems; Quality eHealth application; Providing support to health care professionals; Skills, knowledge, and attitude of health care professionals; Attentiveness to the patient; Patient outcomes; and Learning system. The SPO categories were positioned as overarching themes to emphasize the interrelations between the clusters. Finally, a proposal was made to use the self-assessment questionnaire in practice, allowing measurement of the quality of each factor.

Conclusions
The quality of hybrid care is determined by organizational, technological, process, and personal factors. The 33 most important factors were clustered in a quality management model and self-assessment questionnaire called the Hybrid Health Care Quality Assessment.

The model visualizes the interrelations between the factors. Using a questionnaire, each factor can be assessed to determine how effectively it is organized and developed over time. Health care organizations can use the Hybrid Health Care Quality Assessment to identify improvement opportunities for solid and sustainable hybrid health care.

Keywords
quality assessment; hybrid health care; blended health care; eHealth; digital health; structure; process; outcome; concept mapping

Introduction

Background

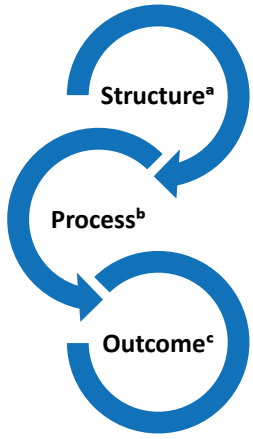
In recent years, the use of eHealth has expanded, encouraged by the increasing pressure on health care[1,2] and growing interest in patient empowerment.[3,4] On the one hand, an aging population and an increase in chronic diseases are causing a higher and more complex demand for health care. In addition, the COVID-19 pandemic has accelerated pressure on health care.[5-8] Therefore, innovations such as eHealth are required to maintain accessibility and high quality of health care.[9-12.] On the other hand, digital health technologies have significantly accelerated patients' involvement.[13-16] In line with these developments, health care organizations have intensively integrated eHealth into traditional face-to-face consultations.[17] The combination of eHealth and face-to-face consultations can be defined as hybrid health care.[18,19] A few examples of hybrid health care are telemonitoring systems for patients with chronic diseases,[20,21] web-based video coaching,[22,23] and direct web-based access to medical records of patients,[24,25] all of which are integrated into traditional health care.

Although health care organizations are increasingly providing hybrid health care, integrating eHealth into the daily care process is challenging. Working with hybrid health care requires organizations to change the way they work. The roles of health care providers and patients are changing, and the available resources are used differently.[4,22,26,27] Organizational structure and work processes must be adapted to ensure high-quality hybrid care.[28-31] Several studies have examined ways to promote eHealth adoption, such as increasing the adaptability of the technology or stakeholders' value.[32,33] However, it remains challenging to organize hybrid health care effectively and sustainably.[17] There is a need for further research on how hybrid health care can be improved to add value to patients and health care providers when they work with eHealth. Therefore, we recently performed a systematic literature review to optimally organize hybrid health care.[17]

In the systematic literature review, the Donabedian Structure-Process-Outcome (SPO) framework was used to identify indicators related to the integration of eHealth into health care organizations.[17,34-36] (Figure 1). According to Donabedian, health care quality is based on the aspects of these 3 categories and their relationships. The SPO framework and its categories are described in detail in the literature review.[17]

In the literature review, we identified 111 potential indicators under the SPO categories that impact eHealth integration. The study demonstrated that 3 principles are important for

successful integration. First, the patient's role must be centrally placed in the organization of hybrid care. Second, technology must be well attuned to the organizational structure and daily care process. Third, the deployment of human resources must be aligned with the desired results.[17]



a. The setting in which health care is provided
b. What is actually done in giving and receiving care
c. The consequence of the provided health care

Figure 1. Donabedian Structure-Process-Outcome framework.

Objectives

To translate the findings from the literature study into a modus operandi for health care organizations, we aimed to develop a model that can help health care organizations organize hybrid health care and identify improvement opportunities for a solid and sustainable integration of eHealth. To achieve this aim, the objectives of the concept mapping study included the following: (1) enrich and validate evidence-based knowledge from the literature review with practice-based knowledge from experts and (2) develop an SPO-based model for organizing hybrid health care with an accompanying self-assessment questionnaire.

Methods

Concept Mapping

Concept mapping is a highly structured methodology for organizing ideas from different stakeholders and other data sources to produce a common framework for complex topics that can be used for evaluation or planning.[37-40] The method integrates qualitative data collection with quantitative analysis to construct an interpretable pictorial view of different ideas and concepts and how these are interrelated.[41,42] Concept mapping has been used worldwide, for a diverse range of health care projects and studies to develop conceptual frameworks, as well as health and eHealth evaluations.[43-49]

In this study, the 6-step concept mapping approach of Trochim and McLinden[42] was followed[49] to develop a usable, tailored, SPO-based quality management model for hybrid

health care and an accompanying questionnaire. The six steps of concept mapping are as follows: (1) preparation, (2) idea generation, (3) sorting and rating, (4) concept mapping analysis, (5) map interpretation, and (6) utilization. Each step involves different activities leading to an output, which serves as an input for the next step. The steps and activities are explained in Figure 2 and in the paragraphs below. All the steps were supported by the GroupWisdom webtool.[41,42]

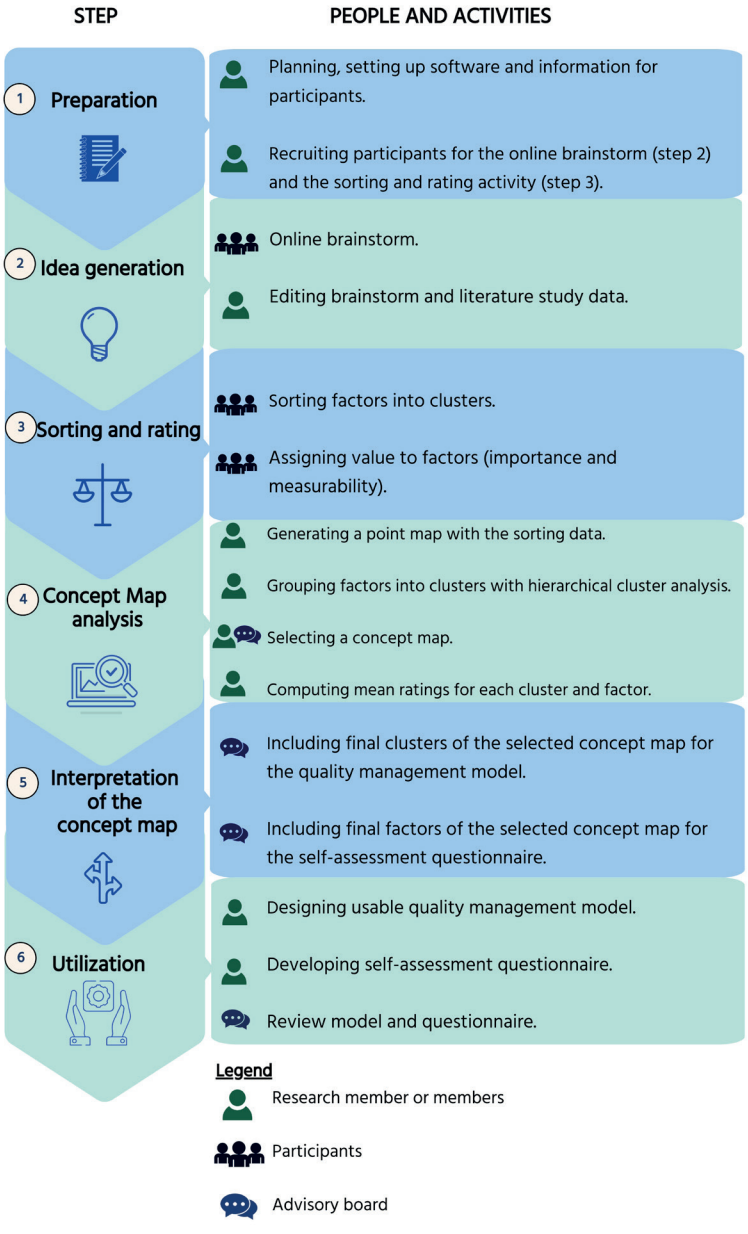


Figure 2. Concept mapping steps and study activities.

Step 1: Preparation

Concept mapping is most effective when multiple stakeholders participate in all the steps of the concept mapping process.[50] There is no strict limitation to the number of participants, ranging from small groups of 8 to 15 people or groups of hundreds of participants.[50] For this study, participants with eHealth experience, those employed by health care organizations, and patients with eHealth experience were recruited. The amount or kind of eHealth experience, health care setting, or disease was not relevant for inclusion. The goal was to create a diverse group in which different experiences, perceptions, and viewpoints complemented each other. We aimed to include a mix of health care professionals, patient experts (patients and caregivers), managers, directors, project leaders, researchers, and eHealth suppliers.

Potential participants were approached to attend both brainstorming in step 2 and sorting and rating in step 3. Participants were invited via the research team's network, social media, and snowballing. Before agreeing to participate, participants received an information letter about the concept mapping method, the study's purpose, and the SPO framework. None of the potential participants were familiar with our previous literature study results. A selected group was asked to participate in step 4 (concept mapping), step 5 (interpretation), and step 6 (utilization), which will be explained in the subsequent sections.

Step 2: Idea Generation

Web-Based Brainstorming

In step 2, data from the participants were collected and combined with data from the literature study. Idea generation with participants was organized by brainstorming. Brainstorming is the most common method used in concept mapping, and can be either group brainstorming or individual brainstorming.[42] In this study, web-based brainstorming was conducted by the participants. Participants received a link via email with instructions, giving them access to the web-based brainstorm program of the GroupWisdom webtool. Before starting the brainstorming session, informed consent was provided, and participant characteristics (age, eHealth experience, professional background, and work setting) were collected to generate general background information about the participants. When the brainstorming started session, the following instruction was presented: "Name all factors, which you believe contribute to effective organization of patient care with eHealth, and what the outcomes of this care should be. Keep the 'Structure-Process-Outcome' framework in mind."

For 23 days, the participants could list as many factors they considered essential contributors to effective hybrid health care. Participants could see each other's inputs and save their brainstorming results in the meantime. They received reminders after 10 and 15 days.

Editing Brainstorming and Literature Study Data

After closing the web-based brainstorming session, the brainstorming and literature study data were combined for sorting and rating. A manageable amount of data for sorting and rating is ideally ≤100 to prevent redundancy and a loss of participants' motivation.[51,52]

To generate a final set of up to 100 factors, duplicates and factors that did not match the brainstorming instructions were removed. For this purpose, each factor was assessed independently by the authors, RT-S and ET-K. The assessments were compared, and disagreements were resolved by discussion between RT-S and ET-K. Next, RT-S edited the remaining factors for grammar and spelling.

Authors, MK and AR reviewed the editing process to check whether they would conclude the same selection and wording and made recommendations where appropriate. Finally, the set was entered into the GroupWisdom webtool, serving as an input for the sorting and rating activities.

Step 3: Sorting and Rating

At the beginning of step 3, the participants received instructions for the sorting and rating tasks. For the sorting task, the participants were asked to cluster the factors into self-created clusters and assign names to the clusters. The participants were instructed to keep the Donabedian SPO categories in mind while sorting each factor into self-created clusters. For the rating task, each participant was asked to rate each factor by relevancy on a 5-point Likert scale, ranging from 1 (*not important at all* or *not feasible to measure*) to 5 (*very important* or *very feasible to measure*) by answering the questions, "How important is this factor for effective patient care with eHealth?" and "How feasible to measure is this factor?"

The participants had the opportunity to sort and rate over 3 weeks. They could save their activities and return later and received reminders after 10 and 15 days. The sorting data were approved for concept mapping analysis for participants who completed 75% of the sorting activity and created at least three clusters.[41] The rating data were included when the participant rated at least one factor.

Step 4: Concept Mapping Analysis

Concept mapping analysis consisted of four main activities: (1) generating a point map with the sorting data, (2) grouping factors into clusters using hierarchical cluster analysis, (3) selecting a concept map from the hierarchical cluster analysis, and (4) computing average ratings for each factor and cluster of the selected concept map.[50] All computations were based on the concept mapping approach of Kane et al[53,5] and conducted using the GroupWisdom webtool.

Generating a Point Map With the Sorting Data

Data from the rating step were analyzed to create a point map.[45,53,55,56] A point map is a 2-dimensional point map, in which each point represents a factor.[53] The point map visually displayed the locations of all factors. Factors closer to each other on the point map were sorted together more frequently by the participants, whereas more distant factors on the map were sorted together less frequently.[42,50,53] The point map was constructed using a similarity matrix and multidimensional scaling algorithm. First, the similarity matrix indicated the number of times various factors were grouped together. Next, a multidimensional scaling algorithm plotted factors as points on a point map.[42,54,55] Subsequently, a stress value (0-1) was calculated, indicating the degree to which the

distances on the point map fit the original similarity matrix.[38,54] The better the fit, the lower is the stress value.

Grouping Factors Into Clusters With Hierarchical Cluster Analysis

The point map provided the input for the hierarchical cluster analysis. The hierarchical cluster analysis grouped factors into clusters[44] using Ward algorithm.[57] The algorithm proposed several concept map solutions, where 2 clusters were merged at each following the proposed solution.

Selecting a Concept Map

From the proposed concept map solutions, a concept map that made sense for conceptualization was selected. There is no single correct number of clusters or mathematical decision criterion for selecting a concept map solution.[38,56] This study selected the number of clusters for the concept map by determining the range of the highest and lowest number of clusters. The range was the average number of clusters made by the participant and its SD.

Subsequently, the cluster solutions in this range were reviewed to select the cluster level by following the cluster tree in the Methods section of the studies by Trochim[53] and Kane et al.[54] Finally, in a meeting, 2 authors (RT-S and ET-K) and 2 participants reviewed the merging of clusters, beginning with the highest number of clusters and moving to the lowest. The 2 study participants were asked to join this meeting because of their extensive experience with eHealth, daily care processes, research, operational management, and concept mapping.

After establishing the number of clusters in the concept map, each factor was reviewed for compatibility with the cluster and to determine whether it was appropriate to move the factor to a different cluster. A cluster and its content were appropriate for inclusion when they were considered essential and usable for the quality management model.[53]

In addition, each cluster received a name and description based on the cluster names that emerged from the sorting activity.

Computing Mean Ratings for Each Cluster and Factor of the Selected Concept Map

After the cluster map was selected, the relationships between ratings were computed using pattern-match and Go-zones.[42]

Pattern-match and its Pearson product-moment (*r* value) were calculated to compare how the clusters of the selected concept map were rated on importance and measurability. The pattern-match visualized the mean ratings of each cluster in a ladder graph, connecting lines between the mean ratings on importance and measurable of each cluster.[50,57] The *r* value represented the correlation strength between the 2 mean ratings of all clusters.[50,57]

Finally, multiple Go-zones were computed: a Go-zone of the total point map and Go-zones per cluster of the selected concept map. Go-zone is a 4-quadrant graph with an

x-y graph,[50] visualizing the mean ranking results of each factor on the questions "How important is this factor" and "How feasible to measure is this factor." The minimum and maximum values for each axis were the minimum and maximum average Likert scores, respectively. The upper-right quadrant is called the *Go-zone* because it shows factors rated above the mean for both importance and measurability.[42,58] The pattern-match and Go-zone showed how important and measurable each cluster and its factors were rated for quality assessment by the individual participants during the step, sorting and rating.

The selected concept map, with its calculation of importance and measurability for each cluster and factor, formed the basis of interpretation in the next step.[53]

Step 5: Interpretation of the Concept Map

The selected concept map, with its pattern-match and Go-zones, was discussed with an advisory board. On the basis of the pattern-match and Go-zones, the advisory board decided which clusters and factors should be included in the quality management model and the accompanying questionnaire. The advisory board consisted of 4 study participants from the brainstorming and sorting step, of whom, 2 also participated in step 4, concept mapping analysis. The advisors were chosen because they could be future model users. In addition, all had extensive experience with eHealth, health care business, and as health care professionals (general practitioners, nurses, anesthetists, and clinical psychologists) in different health care settings.

The advisors voted individually on which clusters and factors of the selected concept map should be included in the quality management model and questionnaire to ensure usability. Using a web-based survey, the following questions were asked: "Which cluster should be included in the quality management model based on the mean cluster rating scores of the pattern matches? Please, specify your choice." and "On which factors should the questionnaire give focus? Guide your choice by the Go-zones of each cluster and the Go-zone of the total point map. Please specify your choice." The advisors could not see each other's votes. By 75% (3/4) agreement or more, the concerned clusters and factors were operationalized in the quality assessment model and questionnaire. Where there was less agreement, the advisors viewed all responses, including the comments, and were asked to vote again. This process was repeated until a 75% consensus was reached. The web-based survey results were used as inputs to develop the quality management model and its questionnaire.

Step 6: Utilization

Quality Management Model

The remaining clusters and their positions in the selected concept map provided the blueprint for the quality management model. First, the excluded clusters and factors were removed from the concept map. Second, the concept map with the remaining clusters was used to produce a logic model. A logic model is a framework that visualizes the interrelations between the clusters in graphic form and is therefore valuable for quality evaluation.[59] The SPO framework[34,35] was used to identify logical interrelationships between the clusters. Accordingly, noticeable SPO connections between the clusters were drawn on the map by RT-S. A simplified version of the logic model was designed

for clarity and readability. Authors SW, ET-K, and RT-S discussed the design of the quality management model to ensure the usability and clarity of the model.

Self-assessment Questionnaire
The questionnaire was drafted by RT-S with the remaining factors, taking the advisors' comments into account. The questionnaire should give care organizations insight into the quality of hybrid care and how quality develops over time. On the one hand, the questionnaire must be easy to use and uniformly independent of the type of health care organization, type of eHealth, and disease. On the other hand, the questionnaire results must provide specific guidance to improve the quality of specific clusters and factors.

The concept model and questionnaire were submitted to the advisors for peer review of usability and clarity. Their comments were processed by RT-S, resulting in an improved draft. Finally, ET-K and SW peer reviewed the last draft to ensure that the representatives' comments were implemented entirely in the quality management model and the related questionnaire.

Ethics Approval
Approval by an ethics committee was not needed because no intervention or trial has occurred in the sense that the research participants were subjected to actions or had modes of behavior imposed on them.[60]

Results

Participant Characteristics (Step 1)
A total of 39 people participated in this study. The participants had a mean age of 45.2 (SD 11.1) years and were mainly working at the family medicine clinic (12/39, 31%) or hospital (10/39, 26%) within a management function (16/39, 41%) or as a health care professional (14/39, 36%). A total of 59% (23/39) of the participants estimated their eHealth experience to be extensive. The 3 most commonly used eHealth tools were apps (37/147, 25.2% participants), web portals (35/147, 23.8% participants), and video communication (34/147, 23.1% participants). An overview of the participants' characteristics is shown in Table 1.

Of the 39 participants, 38 (97%) completed the brainstorming sessions. In all, 18% (7/38) of the participants dropped out after the brainstorming session, and a new participant joined the sorting and rating phase. In total, 79% (31/39) of the participants completed the sorting and rating phase (Figure 3).

Table 1. Participant characteristics (N=39).

Variables	Values
Age (years), mean (SD)	45.2 (11.1)
Main work setting, n (%)	
Family medicine	12 (31)
Hospital	10 (26)
Mental health clinic	5 (13)
Nursing and residential care	5 (13)
eHealth supplier	4 (10)
Research institute	2 (5)
Patient experts (self-employed)	1 (3)
Main profession, n (%)[a]	
Manager, director, or project leader	16 (41)
Health care professional (e.g., physician, nurse, therapist, or psychologist)	14 (36)
Patient expert (e.g., patient or caregiver)	5 (13)
Researcher	3 (8)
Unknown	1 (3)
eHealth technology experience, n (%)[b]	
Apps	37 (25.2)
Web portals (e.g., electronic health records or personal care records)	35 (23.8)
Video communication	34 (23.1)
Sensors and wearables	23 (15.6)
Artificial intelligence	13 (8.8)
Domotica and robotica	10 (6.8)
Estimated level of experience with eHealth, n (%)	
Extensive experience	23 (59)
Moderated experience	15 (38)
Limited experience	1 (3)

[a]Many participants had dual roles, from which they were asked to choose one role.
[b]Participants could select multiple answers.

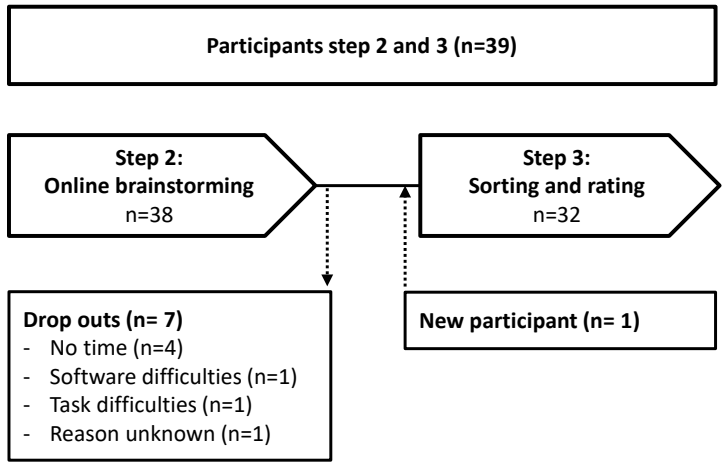


Figure 3. Number of participants at steps 2 and 3.

Idea Generation (Step 2)

Brainstorming during idea generation resulted in a list of 203 factors. A total of 111 potential indicators were extracted from the literature study.[17] Both lists were aggregated, resulting in a list of 314 factors. Editing of the data led to a final list of 78 factors. These 78 factors served as inputs for the sorting and rating activity. The list of 78 factors is provided in Appendix 1.

Sorting and Rating (Step 3)

The rating data of the 32 participants were included in this study. All factors received mean rating scores of >3.1, for both importance and measurability. The mean ratings on the questions, "How important is this factor for successful integration of eHealth?" and "How feasible to measure is this factor" are described in Appendix 1.

The sorting data of 8 people were excluded, with the reason "less than 75% sorted" (n=4, 50%) or "sorted in two clusters" (n=4, 50%). The mean number of clusters of the approved data was 7 (SD 3.5) with a range of 3 to 15 clusters.

Concept Mapping Analysis (Step 4)

Visual Representation

The point map in Figure 4 shows how the 78 factors are related according to the sorting data. The point map had a stress value of 0.26, indicating that it had a good fit with the original similarity matrix.[38,54]

The point map displays the locations of all factors that were frequently sorted closer together by the participants, whereas unrelated factors were plotted farther from each other. The number of points corresponds to the number of factors presented in Appendix 1.

Figure 4. Point map.

Selecting the Concept Map

Concept map solutions ranging from 11-cluster to 3-cluster options were reviewed (mean 7, SD 3.5). The 9-cluster concept map was selected to make the most sense of conceptualization. A few factors (n=14) were unanimously replaced, leading to the concept map shown in Figure 5. Replaced factors and their reasons are presented in Appendix 2. The 9 clusters were labelled and received a short description, as described in Table 2. The number of points corresponds to the number of factors presented in Appendix 1. The clusters represent how the participants sorted the factors into self-created clusters using the proposed cluster labels.

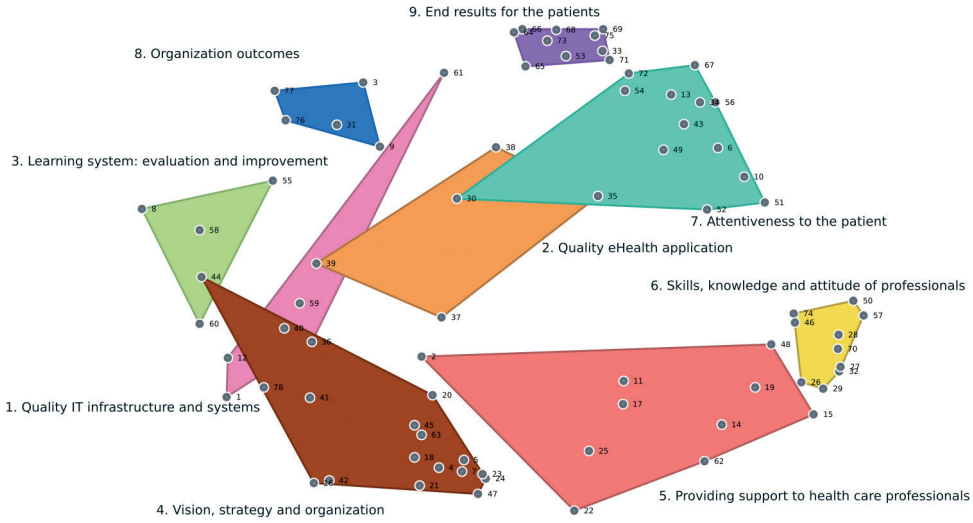


Figure 5. Nine-cluster concept map. IT: information technology.

Table 2. Clusters labels and descriptions.

Cluster number[a]	Cluster label	Description	Included factors, n
1	Quality information technology infrastructure and systems	Conditions concerning technology, information technology systems, and data.	6
2	Quality eHealth application	Conditions concerning the eHealth application.	4
3	Learning system: evaluation and improvement	Evaluation and realignment with stakeholders and the patient care objectives for a continuous development.	4
4	Vision, strategy, and organization	Responsibilities of the health care organization concerning vision, strategy, policy, leadership, funding, and work process designs.	16
5	Providing support to health care professionals	Conditions arranged by the health care organization to encourage the use of eHealth among its health care professionals.	10
6	Skills, knowledge, and attitude of health care professionals	Health care professionals' ability to provide hybrid care.	10
7	Attentiveness to the patient	Organize the daily care process in line with the patient's needs, demand for care, and its capacity.	13
8	Organization outcomes	Outcomes for the health care organization; for example, quality health care provision and health care logistics.	5
9	End results for the patient	Outcomes for the patients; for example, health, added value, satisfaction, ownership, and convenience.	10

[a]Number corresponds with the number of the concerning cluster in Figure 5.

Mean Ratings for Each Cluster and Factor of the Selected Concept Map

The pattern-match showed that all clusters had a mean score between 3.75 and 4.27 on the importance and a mean score between 3.79 and 4.10 on measurability (Figure 6). The cluster with the highest mean score on importance was Attentiveness to the patient (mean 4.27, SD 0.27), and the cluster with the highest mean score on measurability was End results for the patients (mean 4.10, SD 0.17). On the contrary, the cluster with the lowest mean score on importance was Organization outcomes (mean 3.75, SD 0.36), whereas the cluster Quality eHealth application (mean 3.79, SD 0.45) had the lowest mean score on measurability. The r value was 0.63, indicating a predictable alignment between the rating of importance and the rating of measurability. The mean ratings of the factors and Go-zones per cluster are included in Appendix 3.

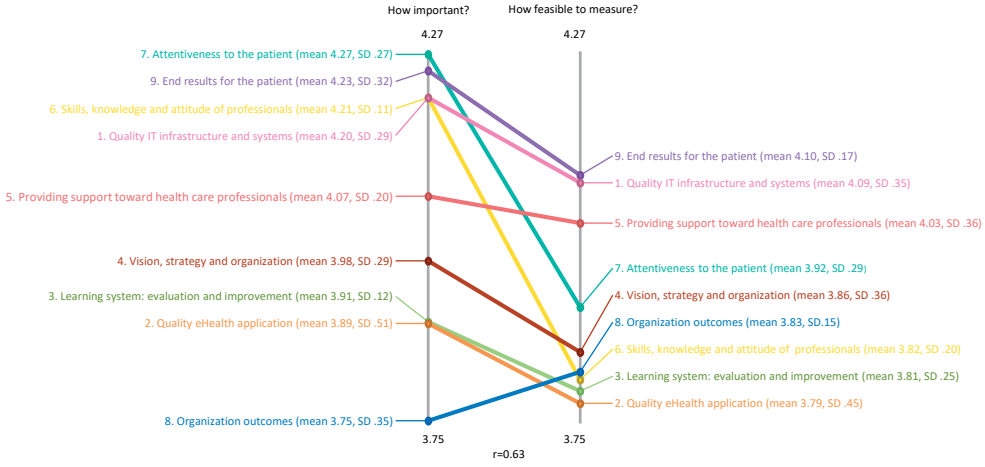


Figure 6. Pattern-match between the cluster-mean scoring on importance and measurability, with Pearson product-moment. IT: information technology.

Interpretation of the Concept Map (Step 5)

The pattern-match and Go-zones were input to determine which clusters and factors of the selected concept map should be included in the quality management model and questionnaire. Decisions were made in 2 voting rounds. Of the 9 clusters, the cluster *Organization outcomes* was not included in the quality management model, based on the voting (3/4, 75% of the advisors had doubts about including the cluster in the model) and after discussion with the research team. The factors included in the questionnaire concerned those placed in the Go-zone of the total point map or the Go-zone of the clusters. As a result, 8 clusters remained in the model and 33 factors in the questionnaire remained as a manageable utility for quality assessment (Textbox 1). Appendix 3 presents the responses and comments of the advisory board during the voting rounds.

Textbox 1. The included clusters and factors.

Quality Information technology infrastructure and systems (1)
- Information technology architecture available within the health care organization (1).
- Back-up scenario during technical problems (12).

Quality eHealth application (2)
- The eHealth application is user-friendly (35).

Learning system: evaluation and improvement (3)
- Cocreation: eHealth is developed, implemented and redeveloped with different stakeholders (8).
- Monitoring and evaluation of service and treatment results (58).

Vision, strategy, and organization (4)
- Support the implementation and development of eHealth in the organization with good project management (4).
- Mobilizing funding for working with eHealth (16).
- Clear internal policies regarding the use of eHealth (18).
- Vision supported by the line, "Why are we doing this?" (21).
- Care delivery with eHealth complies with laws and regulations (41).
- Financial reimbursements for eHealth deployment (42).
- Redesign the current work process and review what contributes to the desired care outcomes (47).

Providing support toward health care professionals (5)
- Health care professionals have easy access to information technology resources; for example, device, internet, screen, or headset (2).
- Embedding eHealth in the daily practice of health care professionals (11).
- Training and supervision for health care professionals (15).
- Help desk for health care professionals (17).
- Information on the treatment with eHealth is clear and accessible to the health care professional (19).

Skills, knowledge, and attitude of health care professionals (6)
- Good balance between face to face and eHealth for the health care professional (46).
- The health care professional has confidence in the eHealth application (70).
- The health care professional is satisfied with working with eHealth (74).

Attentiveness to the patient (7)
- Clear communication to the patient about how care is offered (10).
- Personalized care, considering patient needs with regard to (deployment of) eHealth (13).
- The patient has easy access to the necessary information technology resources; for example, device, Internet, and so on (30).

- Patients receive practical support in using the eHealth application; for example, a help desk (49).
- The patient has confidence in the eHealth application (67).
- The patient has the flexibility to use eHealth wherever and whenever it is convenient (72).

End results for the patient (9)
- The patient can integrate the use of eHealth in their daily life (33).
- Treatment with eHealth has a positive influence on the patient's health (64).
- Treatment with eHealth contributes to the patient's self-reliance (65).
- The patient is satisfied (68).
- The patient has easy access to care (71).
- eHealth provides logistical convenience for the patient (73).
- eHealth has added value for the patient (75).

Utilization (Step 6)

Utilization Model

The clusters and factors excluded from the voting rounds were removed from the selected concept map. The remaining clusters (n=8) and their factors (n=33) led to nonoverlaying clusters on the concept map. Above the clusters, the SPO categories were positioned as overarching themes to emphasize the interrelations between the clusters. In addition, a complex cluster map can be simplified into a logic model. Figures 7A-C show the simplification of the model.

The overarching categories *structure*, *process* and *outcomes* and the clusters' interconnections refer to the Donabedian SPO framework.[34,35] The cluster *Learning system* is visualized in the arrows with the dashed line. The numbers inside the clusters represent the number of factors included.

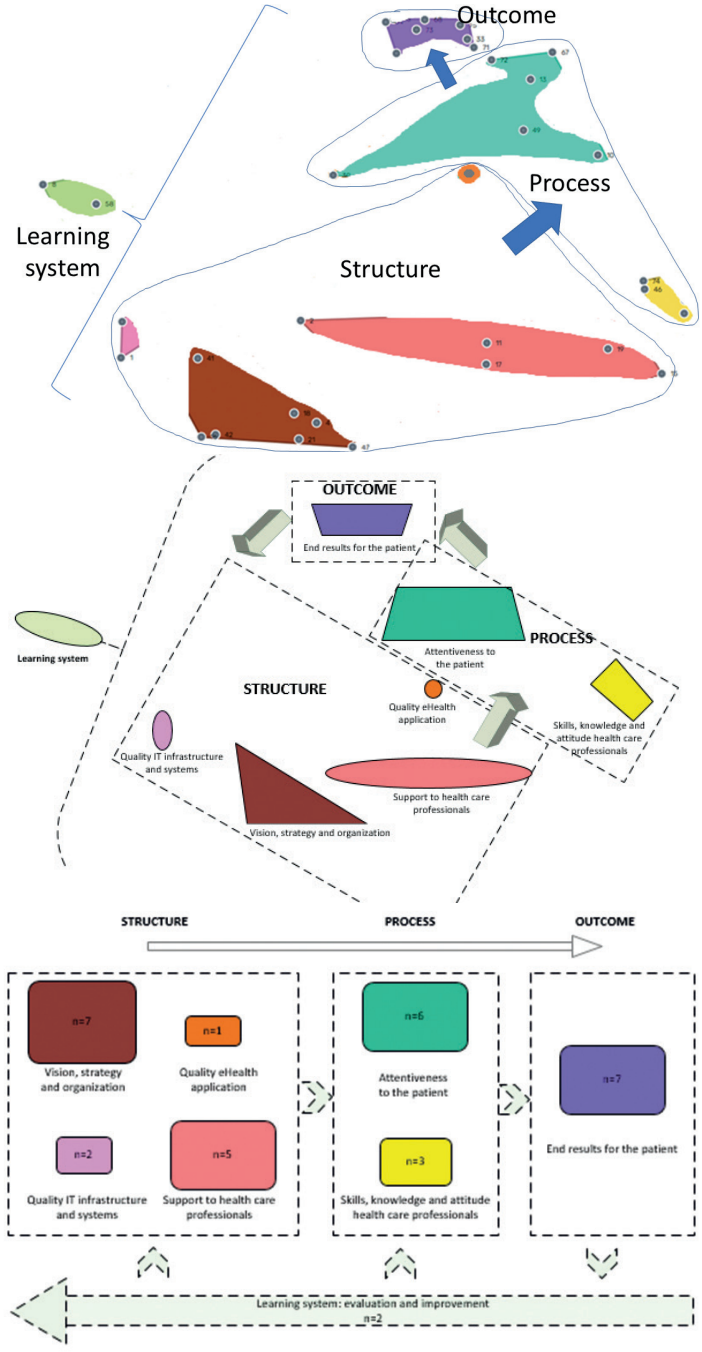


Figure 7. Simplification of the model. (A) Removing the excluded cluster and factors from the selected concept map and adding the overarching categories structure, process, and outcome. (B) Drawing a logic interrelationship with structure, process, and outcome categories. (C) Simplification into a quality management model. IT: information technology.

Utilization Questionnaire

The remaining 33 factors were included in the questionnaire, where each factor can be measured on how effectively it is organized and developed over time. The advisory board noted that measuring the quality progress of hybrid health care is very important, in addition to learning and continuous improvement with stakeholders. Subsequently, the idea was to enrich the questionnaire with a quality progress tracker based on the plan-do-check-act (PDCA) cycle of Deming.[61] Incorporating the PDCA cycle makes it possible to assess the quality easily and uniformly with tailored feedback for health care organizations. PDCA is a well-known cycle method for continuous improvement and quality measurement.[61] The PDCA cycle assess each factor's quality by measuring the extent to which *The objective is tangible?* (plan), *The plan is implemented?* (do), *To what extent is the plan realized?* (check), and *Providing feedback on the quality of the execution to make improvements* (act).[61] Each factor can be monitored on the quality level of the PDCA cycle using a Likert score (0-10). A score of 0 means there is *no plan to improve the concerning factor*, and a score of 10 means *continue improvement with stakeholders*. The Likert scoring is based on the PDCA cycle and the 2 factors of the cluster Learning system, which include the following: (1) *Cocreation: eHealth is being developed and implemented with various stakeholders* and (2) *Monitoring and evaluation of service- and treatment outcomes*. Using the PDCA cycle in combination with a Likert score provides a health care organization insight into improvement possibilities for each factor or cluster.

Finally, the model and questionnaire obtained a more convenient workname Hybrid Health Care Quality Assessment (HHQA). The HHQA model and questionnaire with suggestions on how to use it are explained in Appendix 4.

Discussion

Principal Findings

In this concept mapping study, we aimed to develop an SPO-based model and an accompanying self-assessment questionnaire for hybrid health care. By combining practice-based knowledge from eHealth users with an evidence-based literature review, we found that organizational, technological, and process and personal factors affect the quality of hybrid health care. Health care organizations must understand that these factors play a role in organizing hybrid health care and should be familiar with ways to improve them. The authors developed the HHQA, which can be used to systematically assess and improve the quality of hybrid health care.

The HHQA model includes 8 clusters. Cluster 1 (*Vision, strategy, and organization*) includes the responsibilities of the management to set the vision, strategy, policy, leadership, finance, and project management. Cluster 2 (*Quality information technology infrastructure and systems*) focuses on information technology infrastructure and back-up scenarios by information technology issues. Cluster 3 (*Quality eHealth application*) concerns the user-friendliness of the digital health application itself. Cluster 4 (*Providing support toward care professional*) and cluster 5 (*Skills, knowledge, and attitude of health care professionals*) include factors concerning health care providers. Cluster 4 focuses on factors that should

be arranged for the individual health care professional by the care organization, and cluster 5 includes the responsibilities of the professional. The patient is central in cluster 6 (*Attentiveness to the patient*). This cluster contains the measurement of factors that allow patients to increase their self-management and consider the individual patient's needs. Patient centeredness is also reflected in cluster 7 (*Patient outcomes*), including factors such as patient's health outcomes, added value, satisfaction, ownership, and convenience. Finally, cluster 8 (*Learning system*), forms the relationship between the continued development of hybrid health care with stakeholders and health care provision objectives. The factors in cluster 8 provide insight into where alignment can be improved with other organizational criteria and actions, such as cost-benefit or capacity management.

The interdependencies of the clusters are logically expressed in the HHQA model because of the overarching categories of the Donabedian SPO framework. Moreover, according to eHealth users, clusters consist of the most important factors for the quality of hybrid health care. Using the questionnaire, each factor (33 in total) can be measured to determine how effectively it is organized and develops over time. Subsequently, the main results of the questionnaire will be shown at the cluster level. It is possible to zoom in on the relevant factors for each cluster.

Comparison With Literature

In our previous literature review,[17] we concluded that the capabilities of patients, health care professionals, and technology play a crucial role in the quality of hybrid health care. We also concluded that offering hybrid health care requires adjusting the daily care process and appropriate process monitoring. The conclusions from the literature review are reflected in the HHQA clusters, namely, the patient's role is visible in the clusters *Attentiveness to the patient* and *Patient outcomes*; the health care professional's role is central in the clusters *Providing support toward health care professionals* and *Skills, knowledge, and attitude of professionals*; and technology is covered in the clusters *Quality information technology infrastructure and systems* and *Quality eHealth application*. The adjustment of the daily care processes is elaborated in the cluster *Vision, strategy, and organization*. Finally, monitoring is embedded in the cluster *Learning system* and the PDCA-progress tracker.

The 8 clusters of the HHQA model fit the 3 overarching categories of the Donabedian SPO framework. According to Donabedian,[34] health care quality is based on aspects of these 3 categories and their relationships. The interaction between the categories can be bidirectional and is an "unbroken chain of antecedents, followed by intermediate ends, which are themselves the means to still further ends".[35] Our research translated the complex interaction between the categories, structure, process, and outcome into user language.

The HHQA connects essential contributions to the quality of hybrid health care using a progress tracker. The relationship between quality contributors and continuous improvement also appears in the European Foundation for Quality Management Model (EFQM);[62,63] nonadoption, abandonment, scale-up, spread, sustainability (NASSS);[32] and the Consolidated Framework for Implementation Research (CFIR).[64,65] All models approach

the organizational structure, process, and outcomes with continuous improvement in a structured manner, but with different focus areas. For example, the EFQM is not specified for health care, in contrast to the NASSS and CFIR. The NASSS focuses on the adoption of technology and reduces implementation complexity, whereas the CFIR emphasizes on implementation in general. However, none of them have been specified for quality assessment and improvement of hybrid health care.

Nevertheless, it is interesting to conduct a detailed examination of the assessment questionnaires of the EFQM and NASSS. The EFQM deployed the Results-Approach-Deployed-Assessment-Refinement (RADAR) method,[66,67] a questionnaire to assess the quality improvement at each EFQM criteria, which incorporates the continued improvement circle. The assessment using the RADAR method is similar to the PDCA cycle in our questionnaire, as both monitor continuous quality improvement by completing the cycle plan-executing-monitoring and refining. However, the RADAR, similar to the EFQM model, is not specified for hybrid health care. In addition, the NASSS comes with a questionnaire to monitor the complexity of technology implementation in health care,[68] but the focus is on project management instead of the hybrid health care process itself. Furthermore, there are other questionnaires measuring the quality of eHealth[69-72] or the quality of health care.[73,74] However, these questionnaires are concerned with the quality assessment of eHealth nationwide,[68,70] the quality of a specific digital health application,[70,72] or measuring the quality of a specific disease pathway.[73,74] To the best of our knowledge, HHQA is the first questionnaire measuring the quality of hybrid health care at an organizational level, taking the role of the patient, health care professionals, and technology into account, accompanied by an improvement progress tracker. Therefore, the authors recommend using the HHQA to measure and improve the quality of hybrid health care.

Strengths and Limitations

This study has several strengths. First, the HHQA was developed in cocreation with stakeholders who are direct users of eHealth. Therefore, the HHQA content was drawn from inside the health care system itself and not conceived or imposed outside the health care organizations. Second, stakeholders choose the included clusters and factors. The researcher only played a facilitating role. Consequently, the clusters and factors accurately reflect stakeholders' views and values, expressed in their own words and visual representations. Third, the stakeholder group was diverse and consisted of representatives of health care professionals, patients, managers, researchers, and eHealth designers. Nevertheless, the stress value of the point map shows that the stakeholders' outcomes are highly compatible. Therefore, the study results are likely to be generalizable to everyday practices. Fourth, the model and questionnaire were developed by combining scientific and practice-based knowledge. Together, these strengths result in important factors for effective hybrid health care covering different users' needs and organization requirements.

Our study had some limitations. First, the questionnaire had not yet been tested in health care organizations. This will be conducted in a follow-up study. Although eHealth users from different health care organizations have reviewed the model and questionnaire, the model and questionnaire may still be too abstract for daily practice,

as is often the case in scientific research.[75-77] A follow-up study could provide concrete recommendations on how to use the HHQA. Second, it is conceivable that other factors and clusters could be included in other participants and health care environments. We attempted to overcome this problem by creating diverse groups of participants with different backgrounds, various eHealth experiences, and different kinds of health care settings. In addition, combining idea generation through brainstorming with results from a systematic literature review reduces the risk of bias. Third, based on the analysis of the concept mapping phase, 14 factors were moved to other clusters. However, some of these factors were moved far across the map, which was not entirely in line with the spirit of group concept mapping. Nevertheless, we deemed it necessary to move these factors for substantive reasons. Fourth, the advisory group consisted of 4 participants. We wanted to avoid overquestioning the participants and, therefore, deliberately selected a group of delegates who reflected on the diversity among the participants and who also had experience with quality management and concept mapping. Combined with in-depth preparation and discussion among the research groups, this appeared to be the most feasible solution.

Finally, it is worth pointing out that the HHQA gives a first general impression of improvement, as there is much to be gained in taking the role of the patient, health care professionals, and used technology into account.[17] Furthermore, the authors will continue with follow-up research and warm-heartedly welcome repetition of the study to improve the HHQA, taking into account the different users and health care environments.

Conclusions

This study developed a quality management model and an accompanying self-assessment questionnaire tailored for hybrid health care, the HHQA. A quality model for hybrid care is indispensable for effectively integrating eHealth into regular care and delivering high-quality health care. The HHQA covers all relevant aspects for the assessment and sustainable improvement of hybrid health care and the interrelations of eHealth with organizational, technical, and human factors. The next step is to validate and apply the HHQA model and questionnaire in practice.

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Conflicts of Interest
None declared.

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Abbreviations

CFIR: Consolidated Framework for Implementation Research
EFQM: European Foundation for Quality Management Model
HHQA: Hybrid Health Care Quality Assessment
NASSS: nonadoption, abandonment, scale-up, spread, sustainability
PDCA: plan-do-check-act
RADAR: Results-Approach-Deployed-Assessment-Refinement
SPO: Structure-Process-Outcome

Appendix 1: Mean (SD) rating of each cluster and factor

Table 1. Mean (SD)[a] rating of the clusters and factors

Cluster	Nr	Factor	How important?[b] Mean (SD)	How feasible to measure?[c] Mean (SD)
1. Quality information technology infrastructure and systems			4.20(0.29)	4.09 (0.35)
	12	Back -up scenario during technical problems.	4.21 (0.59)	4.17 (0.99)
	1	IT architecture available within the health care organization.	4.13 (0.73)	4.36 (0.93)
	36	Technology is up-to date and works flawlessly.	4.56 (0.57)	3.88 (0.97)
	59	Use of reliable data.	4.42 (0.64)	3.74 (0.99)
	40	Exchange of data possible between different systems; for example, EPD, HIS, HIC.	4.25 (0.88)	3.73 (1.14)
	61	Built-in patient notifications.	3.64 (0.64)	4.67 (0.75)
2. Quality eHealth application			3.89 (0.51)	3.79 (0.2)
	35	The eHealth application is user-friendly.	4.75 (0.43)	4.38 (0.70)
	39	The eHealth application is suitable as a medical intervention.	3.39 (1.15)	3.96 (0.89)
	37	The provision of care with eHealth is evidence-based.	3.73 (0.86)	3.71 (1.10)
	38	The eHealth application is also usable when the care needs are different than expected.	3.68 (0.87)	3.13 (1.05)
3. Learning system: evaluation and continue improvement of hybrid care			3.91 (0.12)	3.81 (0.25)
	8	Co-creation: eHealth is developed, implemented and redeveloped with different stakeholders.	4.09 (0.72)	3.91 (1.00)
	58	Monitoring and evaluation of service and treatment results.	3.91 (0.67)	4.17 (0.75)
	60	Learn from each other through 'best and worst practices' or other forms of exchanging experiences.	3.75 (0.80)	3.58 (1.22)
	55	Use data to tailor the treatment to the patient's situation.	3.88 (0.84)	3.58 (1.04)
4. Vision, strategy, and organization			3.98 (0.29)	3.86 (0.36)
	41	Care delivery with eHealth complies with laws and regulations.	4.33 (0.69)	4.67 (0.47)
	16	Mobilizing funding for working with eHealth.	4.33 (0.90)	3.96 (1.16)
	21	Vision supported by the line, "Why are we doing this?"	4.33 (0.62)	3.86 (0.87)
	4	Support the implementation and development of eHealth in the organization with good project management.	4.29 (0.84)	4.00 (1.00)
	47	Redesign the current work process and review what contributes to the desired care outcomes.	4.23 (0.52)	4.00 (0.80)
	18	Clear internal policies regarding the use of eHealth.	4.17 (0.80)	3.96 (1.00)
	42	Financial reimbursements for eHealth deployment.	4.09 (0.85)	3.95 (1.07)
	23	Leadership: share the vision, mission and strategy to create support.	4.08 (0.93)	3.79 (1.00)
	7	Set eHealth goals in your organization.	3.96 (0.72)	4.42 (0.70)
	5	Achievement of organizational goals concerning eHealth is invested in the organization.	3.95 (0.93)	3.96 (0.86)
	78	The costs of treatment with eHealth are transparent.	3.46 (0.87)	4.00 (0.88)
	24	Create urgency and direction within the organization: make eHealth part of every innovation and health care project.	3.96 (0.86)	3.57 (1.10)
	20	eHealth has added value for the strategy of the organization.	3.78 (0.93)	3.71 (1.14)

Cluster	Nr	Factor	How important?[b] Mean (SD)	How feasible to measure?[c] Mean (SD)
	63	Organize the work process in such a way that it becomes almost impossible to make mistakes.	3.73 (0.91)	3.22 (1.06)
	45	There is good collaboration with external partners.	3.54 (0.76)	3.26 (0.94)
	44	Treatment with eHealth is in line with community and regional needs and developments.	3.52 (0.76)	3.46 (1.15)
5. Providing support to health care professionals			4.07 (0.19)	4.03 (0.36)
	15	Training and supervision for health care professionals.	4.25 (0.60)	4.46 (0.82)
	2	Health care professionals have easy access to IT resources; for example, device, internet, screen, headset.	4.25 (0.59)	4.17 (0.85)
	17	Helpdesk for health care professionals.	4.24 (0.64)	4.71 (0.54)
	19	Information on the treatment with eHealth is clear and accessible to the health care professional.	4.13 (0.60)	4.09 (0.65)
	11	Embedding eHealth in the daily practice of health care professionals.	4.29 (0.73)	4.00 (0.87)
	14	Staff are given time to (learn to) work with eHealth.	4.17 (0.69)	3.91 (0.79)
	62	Clear guidelines and protocols for health care professionals.	3.88 (0.59)	4.20 (0.80)
	48	Make the work easier for the health care professional.	3.92 (0.86)	3.74 (0.94)
	25	Strong collaboration concerning eHealth with your colleagues of different departments within your health care organization.	3.91 (0.72)	3.50 (0.78)
	22	Encourage and support the use of eHealth by 'ambassadors' in the teams.	3.70 (0.86)	3.54 (1.29)
6. Skills, knowledge, and attitude of professionals			4.21 (0.11)	3.82 (0.20)
	70	The health care professional has confidence in the eHealth application.	4.40 (0.63)	4.13 (0.80)
	46	Good balance between face-to-face and eHealth for the health care professional.	4.29 (0.68)	4.13 (1.01)
	74	The health care professional is satisfied with working with eHealth.	4.12 (0.65)	4.04 (0.81)
	29	The health care professional is willing to learn to work with eHealth.	4.32 (0.67)	3.72 (1.04)
	28	The health care professional recognizes the added value of eHealth.	4.33 (0.62)	3.68 (0.93)
	27	The health care professional feels comfortable working with eHealth.	4.17 (0.83)	3.83 (0.85)
	50	Health care professionals focus on supporting patients' self-management in their treatment.	4.20 (0.75)	3.73 (1.09)
	26	Health care professionals are digitally literate.	4.13 (0.53)	3.78 (1.02)
	57	The health care professional can adapt to the changing relationship and needs of the patient.	4.09 (0.78)	3.55 (1.23)
	32	The health care professional knows at which moments in the care process, the patient can be supported with eHealth.	4.04 (0.54)	3.64 (0.98)
7. Attentiveness to the patient			4.27 (0.27)	3.92 (0.29)
	13	Personalized care: taking into account patient needs regard to (deployment of) eHealth.	4.58 (0.49)	3.96 (0.91)
	10	Clear communication to the patient about how care is offered.	4.50 (0.50)	4.33 (0.69)
	67	The patient has confidence in the eHealth application.	4.48 (0.64)	4.12 (0.71)
	43	Care with eHealth meets the needs of the target population.	4.36 (0.56)	3.74 (0.67)

Cluster	Nr	Factor	How important?[b] Mean (SD)	How feasible to measure?[c] Mean (SD)
	49	Patients receive practical support in using the eHealth application; for example, a help desk.	4.21 (0.41)	4.54 (0.64)
	72	The patient has flexibility to use eHealth where and when it is convenient.	4.16 (0.83)	4.09 (1.02)
	30	The patient has easy access to the necessary IT resources; for example, device, internet.	4.16 (0.77)	3.95 (1.02)
	6	Attention to patient eHealth literacy.	4.17 (0.70)	3.55 (1.08)
	56	The patient is open to treatment with eHealth.	4.43 (0.71)	3.83 (0.82)
	52	Clear expectations between patient and practitioner.	4.40 (0.63)	3.68 (1.09)
	54	There is personal attention for the patient.	4.38 (0.70)	3.91 (0.88)
	51	Prior to treatment, an assessment is made of whether eHealth can work for this patient.	4.22 (0.66)	3.55 (1.12)
	34	The patient is supported by his or her environment in the use of eHealth.	3.48 (0.85)	3.67 (0.99)
8. Organization outcomes			3.75 (0.35)	3.83 (0.15)
	3	eHealth leads to increased quality of health care services.	4.17 (0.55)	3.96 (0.89)
	76	Improvement of health care logistics; for example, waiting time, turnaround time, drop out, no-show, time per treatment.	3.88 (0.88)	4.04 (0.95)
	31	eHealth contributes to more meaningful care.	4.00 (0.75)	3.73 (1.09)
	9	eHealth provides opportunities to offer care in a more enjoyable way.	3.50 (0.65)	3.65 (1.09)
	77	eHealth affects the referrals rate.	3.20 (0.75)	3.78 (0.98)
9. End results for the patient			4.23 (0.32)	4.10 (0.17)
	75	eHealth has added value for the patient.	4.76 (0.43)	4.18 (0.83)
	68	The patient is satisfied.	4.42 (0.64)	4.40(0.63)
	65	Treatment with eHealth contributes to the patient's self-reliance.	4.28 (0.70)	4.17 (0.85)
	66	Improved patient quality of life.	4.39 (0.64)	3.92 (0.91)
	33	The patient can integrate the use of eHealth in his or her daily life.	4.32 (0.68)	4.09 (0.79)
	64	Treatment with eHealth has a positive influence on the patient's health.	4.32 (0.68)	4.04 (0.81)
	73	eHealth provides logistical convenience for the patient.	4.22 (0.66)	4.25 (0.78)
	71	The patient has easy access to care.	4.18 (0.57)	4.17 (0.75)
	69	The patient is satisfied with the knowledge and skills of the health care professional.	3.95 (0.64)	4.00 (0.72)
	53	Patient is therapy compliant.	3.48 (0.96)	3.75 (0.94)

[a] The numbers are rounded to two decimal places.

[b] "How important is this factor for effective patient care with eHealth?"

[c] "How feasible to measure is this factor?"

Appendix 2. Relocation factors and its reasons

Table 1. Relocation factors and descriptions of the reasons

Factor		Original cluster		Transfer to cluster		Reason transfer
26.	Health care professionals are digitally literate.	5.	Providing support to health care professionals	6.	Skills, knowledge, and attitude of professionals	Digital literacy is a skill.
29.	The health care professional is willing to learn to work with eHealth.	5.	Providing support to health care professionals	6.	Skills, knowledge, and attitude of professionals	Willing to learn is an attitude.
30.	The patient has easy access to the necessary IT resources; for example, device, internet.	2.	Quality eHealth application	7.	Attentiveness to the patient	Easy access to IT-resources concerns not the eHealth application itself but is a condition for access to eHealth.
39.	The eHealth application is suitable as a medical intervention.	1.	Quality IT infrastructure and systems	2.	Quality eHealth application	It concerns the eHealth application itself.
41.	Care delivery with eHealth complies with laws and regulations.	1.	Quality IT infrastructure and systems	4.	Vision, strategy, and organization	It concerns the vision, strategy, and how to organize hybrid health care.
44.	Treatment with eHealth is in line with community and regional needs and developments.	3.	Learning system: evaluation and continue improvement of hybrid care	4.	Vision, strategy, and organization	It concerns the vision, strategy, and how to organize hybrid health care.
48.	Make the work easier for the health care professional.	6.	Skills, knowledge, and attitude of professionals	5.	Providing support to health care professionals	It concerns a condition that a health care organization has to arrange.
54.	There is personal attention for the patient.	9.	End results for the patient	7.	Attentiveness to the patient	Personal attention is needed during the treatment.
55.	Use data to tailor the treatment to the patient's situation.	8.	Organization outcomes	3.	Learning system: evaluation and continue improvement of hybrid care	Tailoring the treatment to the patients' situation is needed during the treatment.
60.	Learn from each other through 'best and worst practices' or other forms of exchanging experiences	1.	Quality IT infrastructure and systems	3.	Learning system: evaluation and continue improvement of hybrid care	It concerns learning and improving.
61.	Built-in patient notifications.	8.	Organization outcomes	1.	Quality IT infrastructure and systems	Notifications has to be built in the IT-systems.

Factor	Original cluster	Transfer to cluster	Reason transfer
72. The patient has flexibility to use eHealth where and when it is convenient.	9. End results for the patient	7. Attentiveness to the patient	Using eHealth is needed during the treatment.
78. The costs of treatment with eHealth are transparent.	1. Quality IT infrastructure and systems	4. Vision, strategy, and organization	Providing transparent costs of hybrid health care is a part of the vision, strategy, and organization.

Appendix 3. Results of the votings 'Which clusters and factors to include in the model and questionnaire' and given comments by the advisory board

This appendix consists of two parts. The first part concerns the inclusion of the clusters in the quality management model. The second part concerns the inclusion of the factors in the accompanying questionnaire.

1. Results voting on which clusters the selected concept map should be included in the quality management model

Table 1. Results 'Which clusters should be included in the model?'

Which Clusters		First round[a]			Second Round[a]
		Yes (%)	No (%)	I don't know (%)	Yes[c] (%)
1	Quality IT infrastructure and systems	75	25	0	
2	Quality eHealth application	75	25	0	
3[b]	Learning system: evaluation and improvement	50	0	50	75
4	Vision, strategy, and organization	100	0	0	
5	Providing support to health care professionals	100	0	0	
6	Skills, knowledge and attitude health care professionals	75	25	0	
7	Attentiveness to the patient	100	0	0	
8	Organization outcomes	0	25	75	
9	End results for the patient	75	25	0	

[a] By more than 75% agreement, the cluster is operationalized in the quality management model resp. questionnaire.
[b] Cluster nr. 3 'learning system' was asked again in the second round.
[c] Percentage based on four people, including one no response.

Comments advisory group (the comments were placed unanimously) per cluster
Cluster 1. Quality IT infrastructure and systems

"You cannot deliver eHealth without a good quality system."
"It is challenging to integrate hybrid care into care processes without thinking carefully about your infrastructure."
"This can also become a prerequisite that needs to be established once. There is so much investment in IT that this is probably already high and not prohibitive."

Cluster 2. Quality eHealth application

"Because it determines the outcome for the patient."
"Quality and eHealth applications are transient. Therefore, it should be considered per model, but not in a guideline."
"An obvious limiting factor for implementation is that it is quickly done if it does not work (well)."

Cluster 3. Learning system: evaluation and improvement

Ronde 1:
"Evaluation is of importance but possible as a second step."
"Because we are in transition, it is precisely learning and a learning attitude essential for getting better. It is never right the first time."

Ronde 2:
"I believe measurability is important because it can help organizations demonstrate the effects of digitization within the health care."

Cluster 4. Vision, strategy, and organization

"Embedding within the organization is necessary."
"A vision and strategy to support the workflow are essential for proper embedding in an organization."
"With a vision, strategy and organization, the Board of Directors focuses on hybrid care and thus directs the organization. It is then no longer a toy."

Cluster 5. Providing support to care professionals

"To develop a positive attitude among health care professionals, support in applications is necessary."
"Without proper guidance, health care professionals will drop out at the slightest setback."

Cluster 6. Skills, knowledge, and attitude care professionals

"It can be merged with cluster 5."
"Not only are the buttons of the application needed but also learning to work with a patient remotely and support them in the use of eHealth."

Cluster 7. Attentiveness to the patient

"Hybrid care should take into account the patient's wishes and abilities."
"Personalize care also in eHealth because every patient differs in economic circumstances -equipment- education and ability to do things. Eye for the difference."

Cluster 8. Organization outcomes

"Relevant, but possibly just less relevant than the other parameters."
"For me, cluster 9 is less important."
"There is a much less straight line between e-health application and organization outcomes, at most some proxies like fewer repeat consultations."

Cluster 9. End results for the patient

"Departure and added value to the patient, both measurable and important."
"Bit analogous to cluster 7."
"The patient must always be taken into account. Both in the ability and inability."
"This is the most important outcome of all: if there is no result here, it can go in the garbage can."

2. Results voting on which factors of the selected concept map should be included in the questionnaire

Table 2. Results 'Which factors should be included in the model?'

Which factors		First round[a]	Second Round[a]
		Yes (%)	Yes[c] (%)
1	All factors	0	
2[b]	All factors in the Go-zone of each *cluster* or the Go-zone of the *total point* map with 78 factors.	50	50[c]
3	All factors in the zone '*importance*' of *each cluster* and in the *zone 'importance' of* the *total point map* with 78 factors, regardless the measurability.	0	
4	All factors in the Go-zone' of the *total point map* with 78 factors.	0	
5	All factors in the zone '*importance*' of the *total point map* with the 78 factors, whatever its measurability	0	
6[b]	All factors in the Go-zone of *each cluster*	25	0[c]
7[b]	All factors in the zone '*importance*' of *each cluster*, whatever its measurability	25	0[c]
8[b]	Other, namely .... Could be option 2, 6 or 7. It depends on the way it is incorporated into the questionnaire.	0	25[c]

[a] By more than 75% agreement, the factors are operationalized in the quality management model resp. questionnaire.

[b] Factors at questions nr. 2, 6-8 were asked again in the second round.

[c] Percentage based on four people, including one no response.

Explanation visualization Go-zones at the tables of each cluster (next pages)

Below each cluster tables stands the concerning Go-zone. The x-axis of the graph represents the mean ratings of the factors on the question "How important is this factor to successful patient care with eHealth" (in Dutch). The y-axis represents the mean rating of the factors on the question "How feasible to measure is this factor"? The upper-right quadrant (color green) is called the 'Go-zone' because it showed factors that were rated above the mean in both importance and measurability of the concerning cluster. In the lower-left quartile are the factors that have been scored as less important and measurable (color blue). The corresponding color of the zone is reflected in the tables. On the left side of each table, the color of the factor corresponds to the Go-zone of the belonging clusters.

In addition to the Go-zone per cluster, all factors are placed in a Go-zone with all 78 factors together. In this Go-zone, some factors just fall into a different quartile. The Go-zone with 78 factors is too large and cluttered to show it. Instead, the color of the corresponding quartile is shown on the right side of the table with the title "Quadrant 78 factors'.

The included factors are situated in the Go-zone of the concerning clusters (green in the left column of the table) or the Go-zone of the total point map (green in the right column of the table).

Cluster 1. Quality information technology infrastructure and systems

Description		Rating scores		Quadrant 78 factors
Conditions concerning technology, IT systems and data.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
12	Back -up scenario during technical problems.	4.21 (0.6)	4.17 (1.0)	
36	Technology is up-to date and works flawlessly	4.56 (0.6)	3.88 (1.0)	
59	Use of reliable data.	4.42 (0.6)	3.74 (1.0)	
40	Exchange of data possible between different system; for example, EPD, HIS, HIC.	4.25 (0.9)	3.73 (1.1)	
1	IT architecture available within the health care organization	4.13 (0.7)	4.36 (0.9)	
61	Built-in patient notifications.	3.64 (0.6)	4.67 (0.8)	

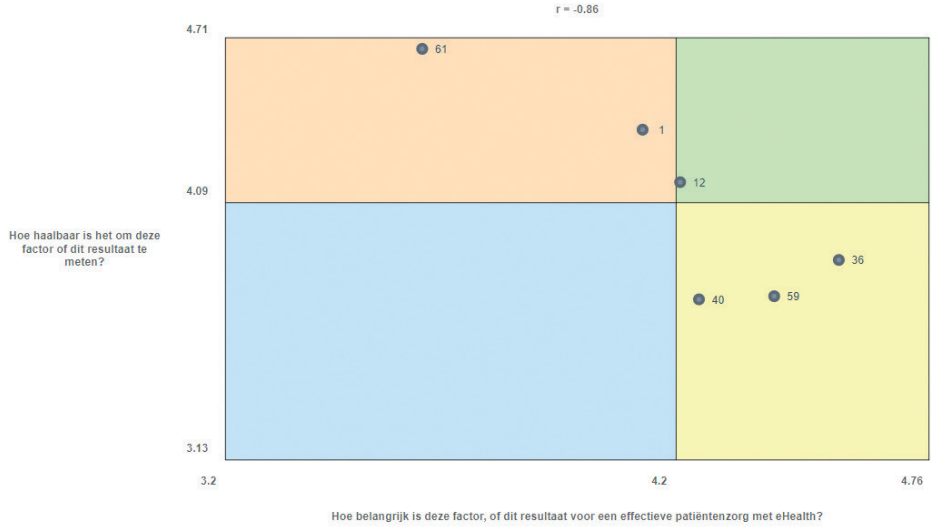


Figure 1. Go-zone cluster 1. Quality IT infrastructure and systems.

Cluster 2. Quality eHealth application

Description		Rating scores		Quadrant 78 factors
Conditions concerning the eHealth application.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
35	The eHealth application is user-friendly.	4.75 (0.4)	4.38 (0.7)	
39	The eHealth application is suitable as a medical intervention.	3.39 (1.2)	3.96 (0.9)	
37	The provision of care with eHealth is evidence-based.	3.73 (0.9)	3.71 (1.1)	
38	The eHealth application is also usable when the care needs are different than expected.	3.68 (0.9)	3.13 (1.1)	

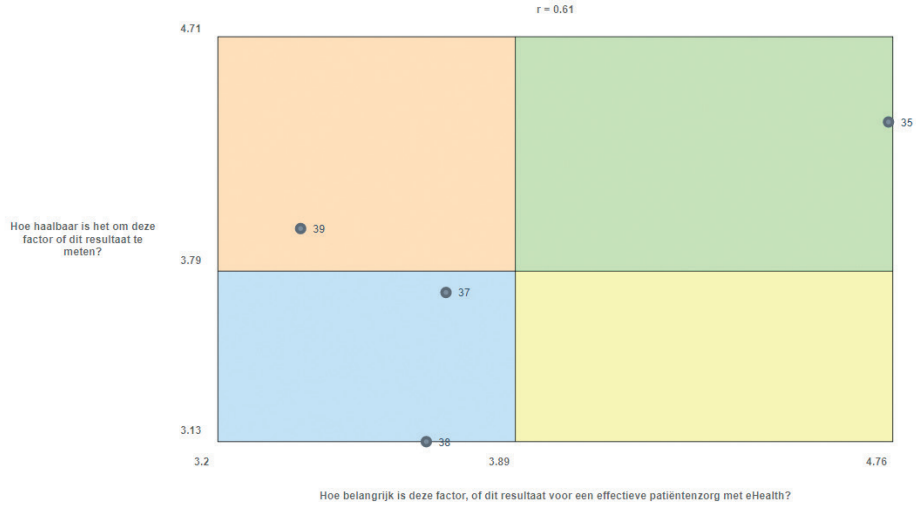


Figure 2. Go-zone cluster 2. Quality eHealth application.

Cluster 3. Learning system: evaluation and improvement

Description		Rating scores		Quadrant 78 factors
Evaluate and re-align with stakeholders and the patient care objectives for an continue development.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
8	Co-creation: eHealth is developed implemented and redeveloped with different stakeholders.	4.09 (0.7)	3.91 (1)	
58	Monitoring and evaluation of service and treatment results.	3.91 (0.7)	4.17 (0.8)	
60	Learn from each other through 'best and worst practices' or other forms of exchanging experiences.	3.75 (0.8)	3.58 (1.2)	
55	Use data to tailor the treatment to the patient's situation.	3.88 (0.8)	3.58 (1.0)	

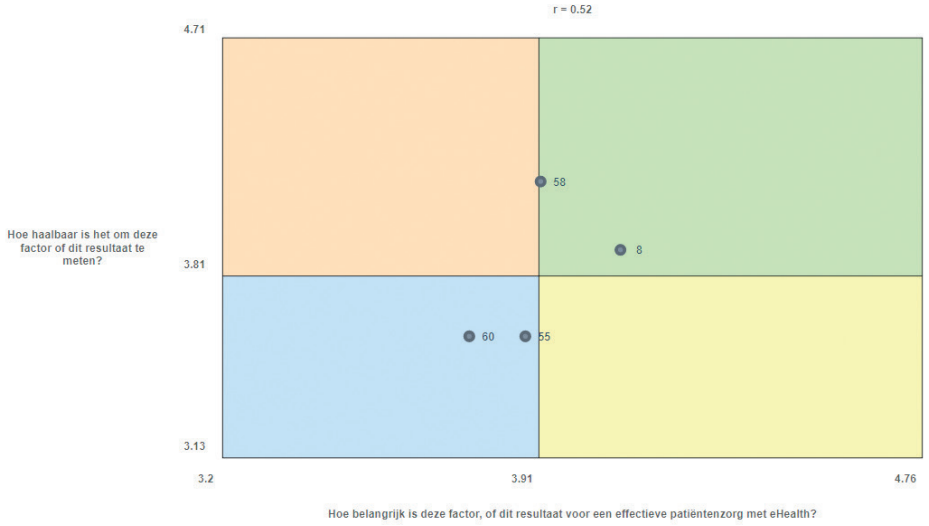


Figure 3. Go-zone cluster 3. Learning system: evaluation and improvement.

Cluster 4. Vision, strategy, and organization

Description		Rating scores		Quadrant 78 factors
Responsibilities of the health care organization concerning vision, strategy, policy, leadership, funding, and work process designs.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
41	Care delivery with eHealth complies with laws and regulations.	4.33 (0.7)	4.67 (0.5)	
16	Mobilizing funding for working with eHealth.	4.33 (0.9)	3.96 (1.2)	
21	Vision supported by the line, "Why are we doing this?"	4.33 (0.6)	3.86 (0.9)	
4	Support the implementation and development of eHealth in the organization with good project management.	4.29 (0.8)	4.00 (1.0)	
47	Redesign the current work process and review what contributes to the desired care outcomes.	4.23 (0.5)	4.00 (0.8)	
18	Clear internal policies regarding the use of eHealth.	4.17 (0.8)	3.96 (1)	
42	Financial reimbursements for eHealth deployment.	4.09 (0.9)	3.95 (1.1)	
23	Leadership: share the vision, mission, and strategy to create support.	4.08 (0.9)	3.79 (1.0)	
7	Set eHealth goals in your organization.	3.96 (0.7)	4.42 (0.7)	
5	Achievement of organizational goals concerning eHealth is invested in the organization.	3.95 (0.9)	3.96 (0.9)	
78	The costs of treatment with eHealth are transparent.	3.46 (0.9)	4.00 (0.9)	
24	Create urgency and direction within the organization: make eHealth part of every innovation and health care project.	3.96 (0.9)	3.57 (1.1)	
20	eHealth has added value for the strategy of the organization.	3.78 (0.9)	3.71 (1.1)	
63	Organize the work process in such a way that it becomes almost impossible to make mistakes.	3.73 (0.9)	3.22 (1.1)	
45	There is good collaboration with external partners.	3.54 (0.8)	3.26 (0.9)	
44	Treatment with eHealth is in line with community and regional needs and developments.	3.52 (0.8)	3.46 (1.2)	

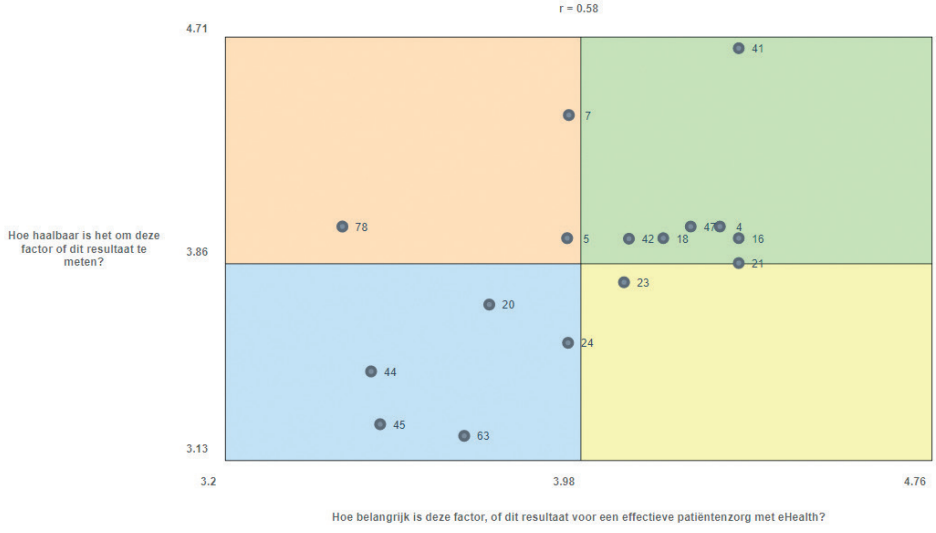


Figure 4. Go-zone cluster 4. Vision, strategy, and organization.

Cluster 5. Providing support to health care professionals

Description		Rating scores		Quadrant 78 factors
Conditions arranged by the health care organization to encourage the use of eHealth among its health care professionals.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
15	Training and supervision for health care professionals.	4.25 (0.6)	4.46 (0.8)	
2	Health care professionals have easy access to IT resources; for example, device, internet, screen, headset	4.25 (0.6)	4.17 (0.9)	
17	Helpdesk for health care professionals.	4.24 (0.6)	4.71 (0.5)	
19	Information on the treatment with eHealth is clear and accessible to the health care professional.	4.13 (0.6)	4.09 (0.7)	
11	Embedding eHealth in the daily practice of health care professionals.	4.29 (0.7)	4.00 (0.9)	
14	Staff are given time to (learn to) work with eHealth.	4.17 (0.7)	3.91 (0.8)	
62	Clear guidelines and protocols for health care professionals.	3.88 (0.6)	4.20 (0.8)	
48	Make the work easier for the health care professional.	3.92 (0.9)	3.74 (0.9)	
25	Strong collaboration concerning eHealth with your colleagues of different departments within your health care organization.	3.91 (0.7)	3.50 (0.8)	
22	Encourage and support the use of eHealth by 'ambassadors' in the teams.	3.70 (0.9)	3.54 (1.3)	

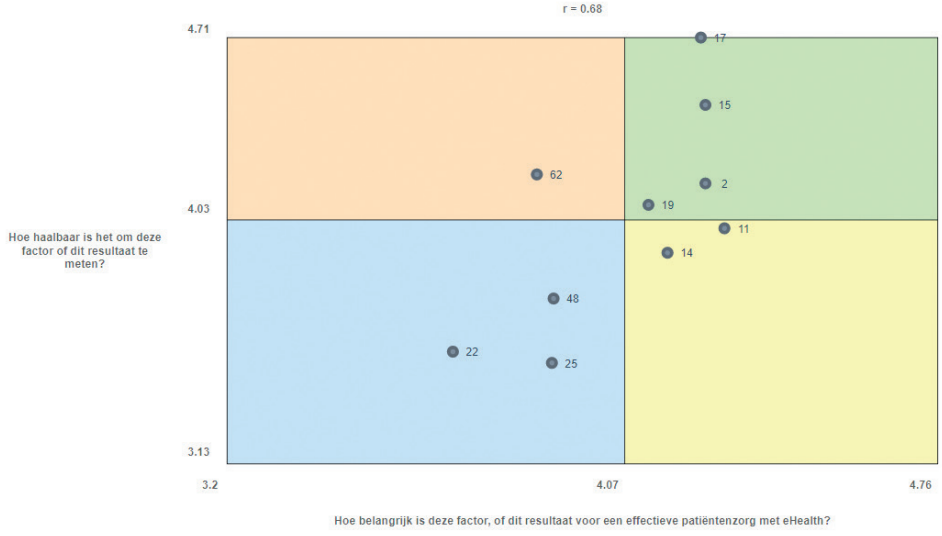


Figure 5. Go-zone cluster 5. Providing support toward health care professionals.

Cluster 6. Skills, knowledge, and attitude of professionals

Description		Rating scores		Quadrant 78 factors
Health care professional's ability to provide hybrid care.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
70	The health care professional has confidence in the eHealth application.	4.40 (0.6)	4.13 (0.8)	
46	Good balance between face-to-face and eHealth for the health care professional.	4.29 (0.7)	4.13 (1.0)	
29	The health care professional is willing to learn to work with eHealth.	4.32 (0.7)	3.72 (1.0)	
28	The health care professional recognizes the added value of eHealth.	4.33 (0.6)	3.68 (0.9)	
27	The health care professional feels comfortable working with eHealth.	4.17 (0.8)	3.83 (0.9)	
74	The health care professional is satisfied with working with eHealth.	4.12 (0.7)	4.04 (0.8)	
50	Health care professionals focus on supporting patients' self-management in their treatment.	4.20 (0.8)	3.73 (1.1)	
26	Health care professionals are digitally literate.	4.13 (0.5)	3.78 (1.0)	
57	The health care professional can adapt to the changing relationship and needs of the patient.	4.09 (0.8)	3.55 (1.2)	
32	The health care professional knows at which moments in the care process, the patient can be supported with eHealth.	4.04 (0.5)	3.64 (1.0)	

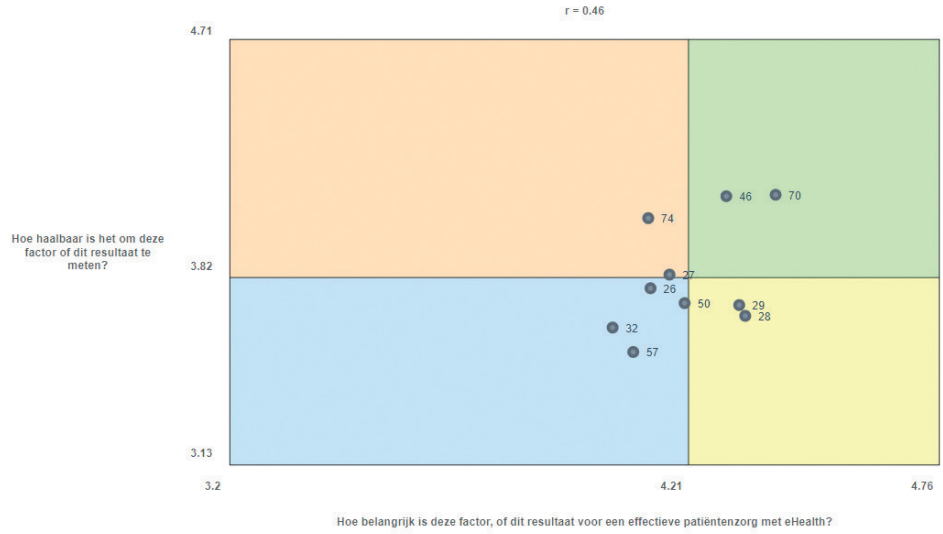


Figure 6. Go-zone cluster 6. Skills, knowledge, and attitude of professionals.

Cluster 7. Attentiveness to the patient

Description		Rating scores		Quadrant 78 factors
Organize the daily care process in line with the patient's needs, demand for care, and its capacity.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
6	Attention to patient eHealth literacy.	4.17 (0.7)	3.55 (1.1)	
13	Personalized care, considering patient needs with regard to (deployment of) eHealth	4.58 (0.5)	3.96 (0.9)	
10	Clear communication to the patient about how care is offered.	4.50 (0.5)	4.33 (0.7)	
67	The patient has confidence in the eHealth application.	4.48 (0.6)	4.12 (0.7)	
56	The patient is open to treatment with eHealth.	4.43 (0.7)	3.83 (0.8)	
52	Clear expectations between patient and practitioner.	4.40 (0.63)	3.68 (1.1)	
54	There is personal attention for the patient.	4.38 (0.7)	3.91 (0.9)	
43	Care with eHealth meets the needs of the target population.	4.36 (0.6)	3.74 (0.7)	
49	Patients receive practical support in using the eHealth application; for example, a help desk.	4.21 (0.4)	4.54 (0.6)	
72	The patient has flexibility to use eHealth where and when it is convenient.	4.16 (0.83)	4.09 (1.02)	
30	The patient has easy access to the necessary IT resources; for example, device, internet.	4.16 (0.8)	3.95 (1.0)	
51	Prior to treatment, an assessment is made of whether eHealth can work for this patient.	4.22 (0.7)	3.55 (1.12)	
34	The patient is supported by his or her environment in the use of eHealth.	3.48 (0.9)	3.67 (1.0)	

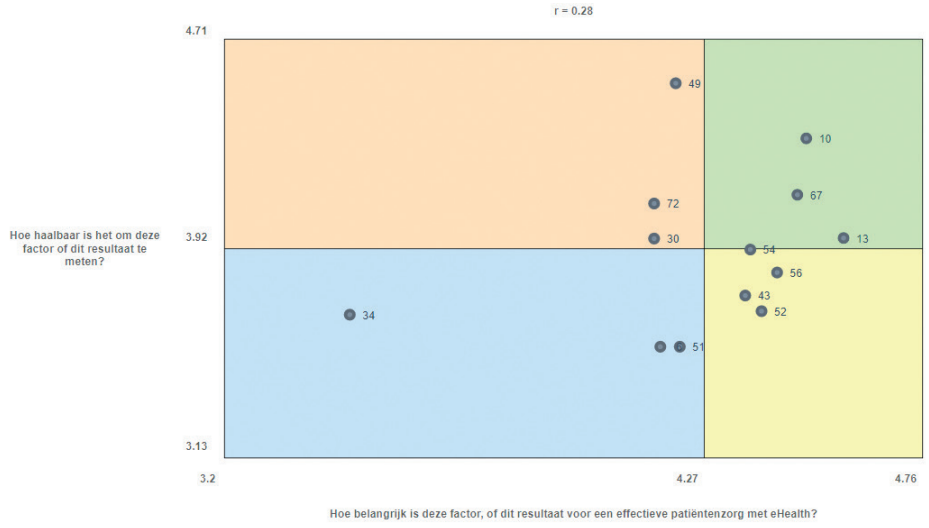


Figure 7. Go-zone cluster 7. Attentiveness to the patient.

Cluster 8. Organization outcomes

Description		Rating scores		Quadrant 78 factors
Outcomes for the health care organization.		Importance	Measurability	
Nr.	**Factors**	**Mean (SD)**	**Mean (SD)**	
3	eHealth leads to increased quality of health care services.	4.17 (0.6)	3.96 (0.9)	
76	Improvement of health care logistics; for example, waiting time, turnaround time, drop out, no-show, time per treatment.	3.88 (0.9)	4.04 (1.0)	
31	eHealth contributes to more meaningful care.	4.00 (0.8)	3.73 (1.1)	
9	eHealth provides opportunities to offer care in a more enjoyable way.	3.50 (0.7)	3.65 (1.1)	
77	eHealth affects the referrals rate.	3.20 (0.8)	3.78 (1.0)	

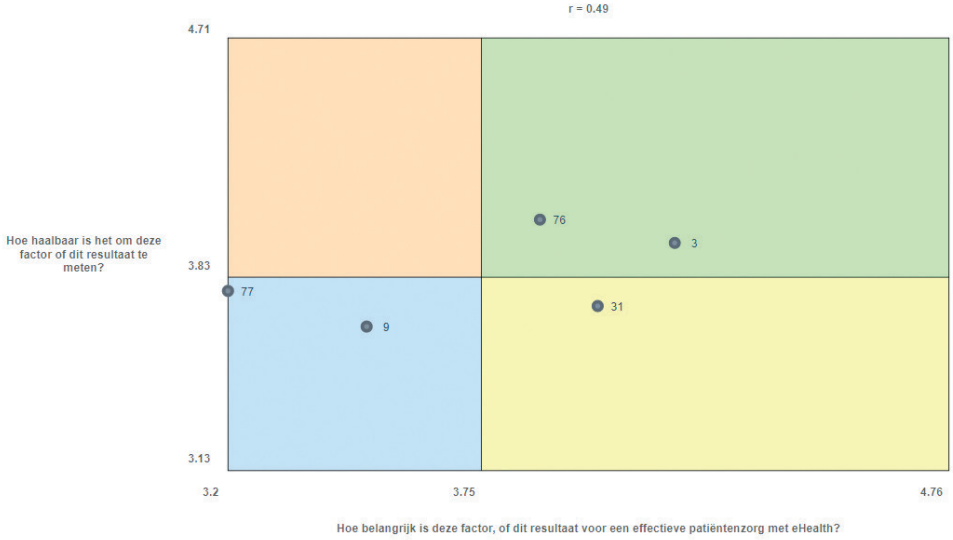


Figure 8. Go-zone cluster 8. Organization outcomes.

Cluster 9. End results for the patient

Description		Rating scores		Quadrant 78 factors
Outcomes for the patients; health, added value, satisfaction, ownership, convenience.		Importance	Measurability	
Nr.	**Factor**	**Mean (SD)**	**Mean (SD)**	
75	eHealth has added value for the patient.	4.76 (0.4)	4.18 (0.8)	
68	The patient is satisfied.	4.42 (0.6)	4.40(0.6)	
65	Treatment with eHealth contributes to the patient's self-reliance.	4.28 (0.7)	4.17 (0.9)	
66	Improved patient quality of life.	4.39 (0.6)	3.92 (0.9)	
33	The patient can integrate the use of eHealth in his or her daily life.	4.32 (0.7)	4.09 (0.8)	
64	Treatment with eHealth has a positive influence on the patient's health.	4.32 (0.7)	4.04 (0.8)	
73	eHealth provides logistical convenience for the patient.	4.22 (0.7)	4.25 (0.8)	
71	The patient has easy access to care.	4.18 (0.6)	4.17 (0.8)	
69	The patient is satisfied with the knowledge and skills of the health care professional.	3.95 (0.6)	4.00 (0.7)	
53	Patient is therapy compliant.	3.48 (1.0)	3.75 (0.9)	

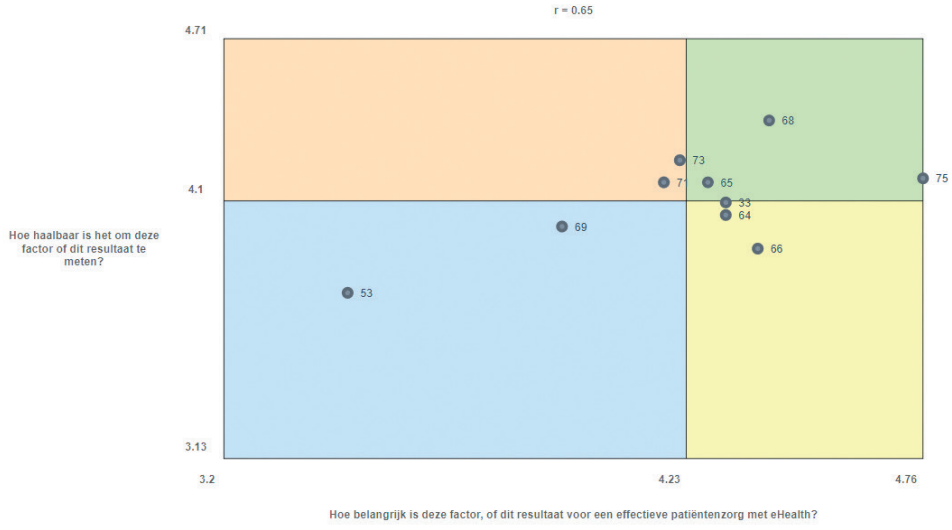


Figure 9. Go-zone cluster 9. End results for the patient.

Appendix 4. Suggestion utilization Hybrid Health Care Quality Assessment questionnaire

XLSX File (Microsoft Excel File), 84 KB

Excel File, tab 1

Background and objective Hybrid Health Care Quality Assessment

Health care organisations increasingly work with eHealth. However, the integration of eHealth into regular health care (called hybrid health care) is challenging. It requires organizations to change the way they work. Various factors at organizational, technological, process and personal-level impact the quality of hybrid health care (eHealth and face-to-face). For example, the roles of the health care provider and patient are changing, and the available resources are utilized differently. To ensure high quality of hybrid health care, the organizational structure and work processes need to be adapted.

To give health care organizations understanding which factors affect the quality of hybrid care, a quality management model with an accompanying self-assessment questionnaire has been developed. Together called the Hybrid Health Care Quality Assessment (HHQA). Health care organizations can use this model and questionnaire to organize hybrid health care and to identify improvement opportunities for a solid and sustainable integration of eHealth. The model and questionnaire can be used for any type of health care organization, type of eHealth tool or health care need.

The HHQA-model

The HHQA includes eight clusters. See Table 1 and Figure 1. Each cluster consist of the most important factors for the quality of hybrid health care.

Table 1. HHQA clusters and descriptions.

Cluster label	Description
Vision, strategy, and organization	Responsibilities of the health care organization concerning vision, strategy, policy, leadership, funding and work process designs.
Quality information technology infrastructure and systems	Conditions concerning technology, IT systems and data.
Quality eHealth application	Conditions concerning the eHealth application.
Providing support to health care professionals	Conditions arranged by the health care organization to encourage the use of eHealth among its health care professionals.
Attentiveness to the patient	Organize the daily care process in line with the patient's needs, demand for care, and its capacity.
Skills, knowledge, and attitude of professionals	Health care professional's ability to provide hybrid care.
End results for the patient	Outcomes for the patients; health, added value, satisfaction, ownership, convenience.
Learning system: evaluation and improvement	Evaluate and re-align with stakeholders and the patient care objectives for an continue development.

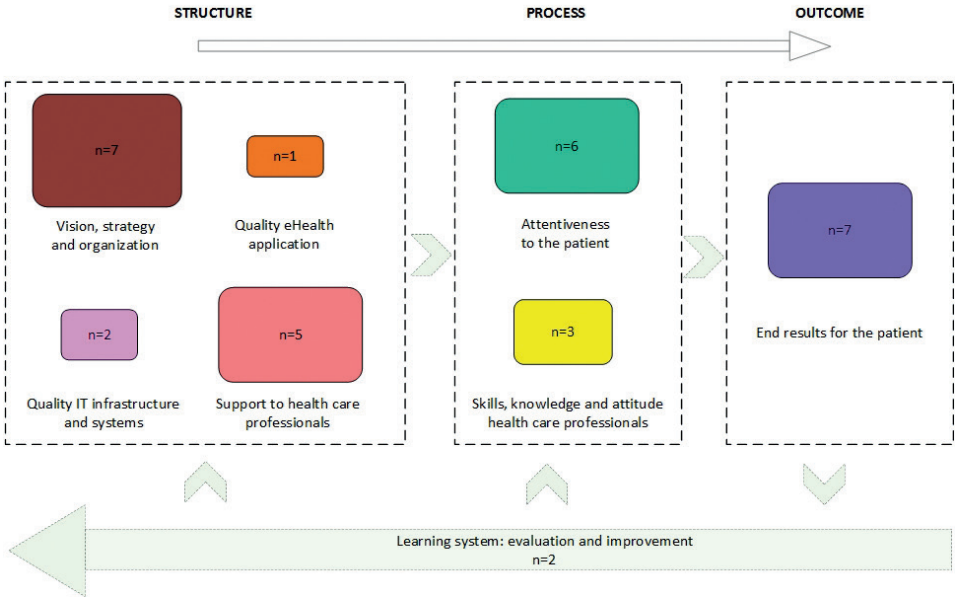


Figure 1. Hybrid Health Care Quality Assessment (HHQA).

Above the clusters, the Structure-Process-Outcome categories of Donabedian[1,2] are positioned as overarching themes to emphasize the interrelations between the clusters. Structure is the setting in which health care is provided, process is what is actually done in giving and receiving care and outcome is the consequence of the provided health care. The number inside the clusters represents the number of included factors, in total 33 factors.

The HHQA-questionnaire

In the questionnaire, each factor (33 in total) can be measured on how effective it is organized and how it develops over time. Per factor can be scored whether there is a plan, the quality of implementation, and to what extent the quality is evaluated and (re)developed with stakeholders. This score is done with the Plan-Do-Check-Act quality cycle of Deming[3] and converted into a ranking of 0 to 10 (0 = no plan, 10 = continuous improvement of this factor in co-creation with stakeholders). Subsequently, the main results of the questionnaire will be shown at cluster level in a spider diagram (see example below). Per cluster, it is possible to zoom into the corresponding factors. The scoring and how to fill in the questionnaire will be explained on the next tabblad.

Quality is something you do together. What quality is, is aligned with the expectations of the stakeholders. Therefore, the questionnaire includes how implementers of the plan experience something and how stakeholders receive the result (for example, by the management team beneath them or the patients). Use this questionnaire as a Quick Scan to gain insight into which factors are important for the quality of hybrid care.

Questionnaire results

The mean of each cluster will be displayed in a spider diagram. See the example below (Figure 2). This will provide an organization with insight into its strengths and opportunities for improvement at the cluster level. For each cluster, it is possible to zoom in to the corresponding factors by looking at the questionnaire scores. In this way, the organization can see for each factor what they have done well and where there are opportunities for improvement[a]. The questionnaire results can also be used to visualize the progress of the own improvements on a cluster level by using the questionnaire as a zero and intermediate measurement. Subsequently, use the questionnaire annually, depending on the speed at which your organization can implement improvement. The spider diagram will then show where improvements have been achieved at the cluster level.

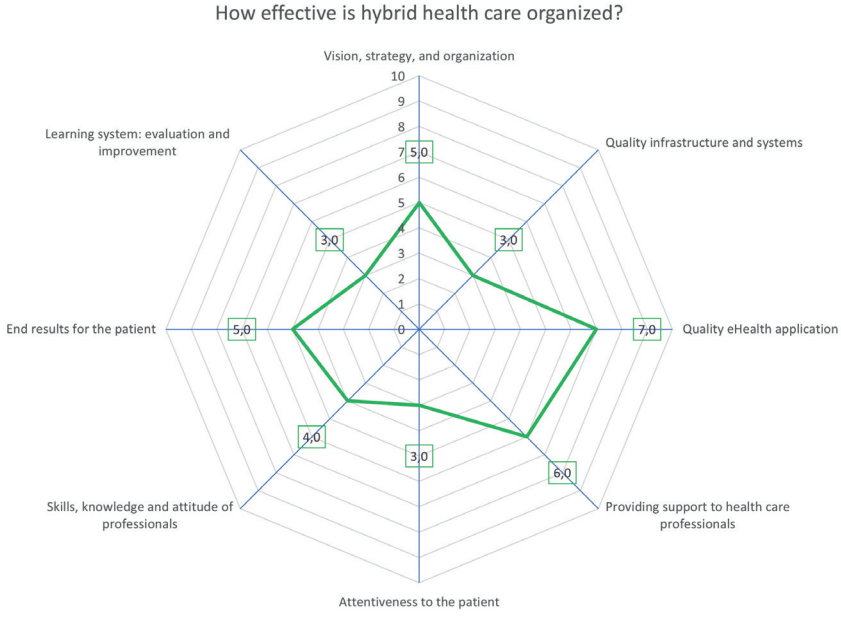


Figure 2. Example results HHQA questionnaire.

1. Donabedian A. The Quality of Care: How Can It Be Assessed? JAMA: The Journal of the American Medical Association. Published online 1988. doi:10.1001/jama.1988.03410120089033.
2. Donabedian A. Evaluating the quality of medical care. Milbank Quarterly. Published online 2005. doi:10.1111/j.1468-0009.2005.00397.x.
3. P.P.M. Harteloh and A.F. Casparie. Instituut Beleid and Management Gezondheidszorg. Kwaliteit van zorg. Van een zorginhoudelijke benadering naar een bedrijfskundige aanpak. Elsevier/ De Tijdstroom, 1998.

[a] The questionnaire results do not provide the health care organization with recommendations or concrete tips. The questionnaire will be further developed and expanded to include best practices and concrete tips in follow-up studies.

Excel file, tab 2

Instructions questionnaire
This questionnaire is completed with the stakeholders in your organization, i.e., the relevant target groups. Target groups include the Board of Directors, managers, staff, care providers and patients. These are the people who make the relevant plans, implement the plans and experience the effect of these plans. Use this questionnaire and the results primarily for dialogue and to inspire each other on possibilities for improvement.

The questionnaire shows how the factors of the clusters are rated. The clusters are: 1) Vision, strategy, and organization; 2) Quality infrastructure and systems; 3) Quality eHealth application; 4) Providing support toward health care professionals; 5) Attentiveness to the patient; 6) Skills, knowledge, and attitude health care professionals; 7) End results for the patient and 8) Learning system.

Each factor of the clusters is scored on how well it is in place (0=no plan, 10=continuous improvement of the factor in co-creation with stakeholders), using the plan-do-check-act (PDCA) quality cycle. The PDCA is a well-known cycle method for continuous improvement and quality measurement.[3] The plan-do-check-act cycle allows to assess the quality of each factor by measuring the extend to which; 'The objective is tangible?' (plan); 'The plan is implemented?' (do); 'To what extent is the plan realized?' (check) and 'Providing feedback on the quality of the execution to make improvements' (act). With a Likert-score from zero to ten, each factor can be monitored on the quality level of the PDCA-cycle. Zero means there is 'no plan to improve the concerning factor', and ten means 'continues improvement with stakeholders'.

Per factor, one score can be filled in from 0 to 10. Always look carefully at what each score means. The scores are explained below and in the next tab, above the questionnaire.

Is there no plan for a particular factor? Then fill in 0 (=no plan). Is the plan being implemented? Subsequently, ask those involved in implementing the plan (score 5) and those confronted with it to their experience (score 6). If the factor in question has gone through the entire PDCA cycle, is further developed in co-creation with various stakeholders and is evaluated with the other service and treatment results, fill in a 10 (Act).

For each factor, fill in what comes to your mind first.

Completing the questionnaire takes approximately 20 minutes.

Scoring based on the plan-do-check-act cycle

PLAN There is a plan to realize this factor with the desired results.
It contains the (SMART) objectives, available resources and intended activities.
The plan's method of reporting and assessing the implementation is laid down.
The relationship with other factors is also described in the plan.

Score	*Meaning*
0	Plan is not (yet) present.
1	Plan is present.
2	The plan clearly describes the connection with the other factors in the model (can be of the same or different cluster).

DO Actual implementation (specified in work instructions, vision plans)[1]

Score	*Meaning*
3	Execution is specified, but not yet/ or partly started.
4	The plan is implemented.

CHECK Check whether the implementation corresponds to the plan's intentions ("are the right things being done and experienced").[1] Checking occurs with the implementers of the plan or with the target groups who experience the effects of this.[1] Those who experience the plan's effects and implementation may be a different group than those who have drawn up or implemented the plan. For example, the managers and care professionals have drawn up the plans, but the patients are confronted with the effects.

Score	*Meaning*
5	Execution corresponds to the plans ("the right things are being done"), according to those who drew up the plans.
6	The intended results are experienced by the target group ("the right things are being experienced"), according to those confronted with implementation.
7	The effect of the factor is monitored together with other service and treatment results (these can also be results outside this model, such as clinical, financial or health care logistic results).

ACT The effect of implementation is considered in light of the plan's intentions. An explanation is sought for any discrepancies between the observed and intended effect. From this explanation, opportunities for improvement[1] are formulated.

Score	*Meaning*
8	Evaluation of discrepancies.
9	Suggestions for improvement (adjust plans or implementation).
10	Further development with various stakeholders.

The questionnaire results and an explanation are listed on the tab 'Results of the questionnaire'.

1. P.P.M. Harteloh and A.F. Casparie. Instituut Beleid and Management Gezondheidszorg. Kwaliteit van zorg. Van een zorginhoudelijke benadering naar een bedrijfskundige aanpak. Elsevier/ De Tijdstroom, 1998.

Excel file, tab 3

The questionnaire

Explanation PDCA-score

PLAN	
0	Plan is not (yet) present.
1	Plan is present.
2	The plan clearly describes the connection with the other factors in the model (can be of the same or different cluster).
DO	
3	Execution is specified, but not yet/ or partly started.
4	The plan is implemented.
CHECK	
5	Execution corresponds to the plans ("the right things are being done"), according to those who drew up the plans.
6	The intended results are experienced by the target group ("the right things are being experienced"), according to those confronted with implementation.
7	The effect of the factor is monitored together with other service and treatment results (these can also be results outside this model, such as clinical, financial or health care logistic results).
ACT	
8	Evaluation of discrepancies.
9	Suggestions for improvement (adjust plans or implementation).
10	Further development with various stakeholders.

				For each factor, specify the target group for whom it is being assessed, AND indicate the score of where it is in the PDCA phase*	
NR	NAME CLUSTER AND DESCRIPTION	NR	QUESTION	TARGET GROUP	PDCA-score (0-10)*
1	**Vision, strategy, and organization**	a	Care delivery with eHealth complies with laws and regulations.		
	Responsibilities of the health care organization concerning vision, strategy, policy, leadership, funding and work process designs.	b	Vision supported by the line: why are we doing this?		
		c	Clear internal policies regarding the use of eHealth.		
		d	Support the implementation and development of eHealth in the organization with good project management.		
		e	Financial reimbursements for eHealth deployment.		
		f	Mobilizing funding for working with eHealth.		
		g	Redesign the current work process and review what contributes to the desired care outcomes.		
				Mean PDCA score	#NAAM?
2	**Quality information technology infrastructure and systems**	a	IT architecture available within the health care organization.		
	Conditions concerning technology, IT systems and data.	b	Back -up scenario during technical problems.		
				Mean PDCA score	#NAAM?
3	**Quality eHealth application:** Conditions concerning the eHealth application.	a	The eHealth application is user-friendly.		
				Mean PDCA score	0,0
4	**Providing support to health care professionals**	a	Health care professionals have easy access to IT resources; for example, device, internet, screen, headset.		
	Conditions arranged by the health care organization to encourage the use of eHealth among its health care professionals.	b	Helpdesk for health care professionals.		
		c	Information on the treatment with eHealth is clear and accessible to the health care professional.		
		d	Training and supervision for health care professionals.		
		e	Embedding eHealth in the daily practice of health care professionals.		
				Mean PDCA score	#NAAM?
5	**Attentiveness to the patient**	a	Personalized care: taking into account patient needs regard to (deployment of) eHealth.		
	Organize the daily care process in line with the patient's needs, demand for care, and its capacity.	b	Clear communication to the patient about how care is offered.		
		c	The patient has confidence in the eHealth application.		
		d	Patients receive practical support in using the eHealth application; for example, a help desk.		
		e	The patient has flexibility to use eHealth where and when it is convenient.		
		f	The patient has easy access to the necessary IT resources; for example, device, internet.		
				Mean PDCA score	#NAAM?
6	**Skills, knowledge, and attitude of professionals**	a	Good balance between face-to-face and eHealth for the health care professional.		
	Health care professional's ability to provide hybrid care.	b	The health care professional has confidence in the eHealth application.		
		c	The health care professional is satisfied with working with eHealth.		
				Mean PDCA score	#NAAM?
7	**End results for the patient**	a	eHealth has added value for the patient.		
	Outcomes for the patients; health, added value, satisfaction, ownership, convenience	b	The patient is satisfied.		
		c	Treatment with eHealth contributes to the patient's self-reliance.		
		d	Treatment with eHealth has a positive influence on the patient's health.		
		e	The patient has easy access to care.		
		f	The patient can integrate the use of eHealth in his or her daily life.		
		g	eHealth provides logistical convenience for the patient.		
				Mean PDCA score	#NAAM?
8	**Learning system: evaluation and improvement**	a	Co-creation: eHealth is developed, implemented and redeveloped with different stakeholders.		
	Evaluate and re-align with stakeholders and the patient care objectives for an continue development	b	Monitoring and evaluation of service and treatment results.		
				Mean PDCA score	#NAAM?

Excel file, tab 4

Results questionnaire: How well is hybrid care organized in your organization?
The table and diagram below show the average PDCA score for each cluster. Below the diagram is an explanation of how to interpret the score. The scoring provides a general impression of the performance of the quality of hybrid health care and where there is room for improvement.

The scores from the table and diagram are the mean scores of the factors from the relevant cluster. The scores will give a general impression on which cluster the hybrid is effectively organized and where there is room for improvement. The mean score provides a direction. Next, look at improvement potential for each factor from the cluster in question. The score per factor is explained in the 'questionnaire instructions' tab.

Table 2. Results questionnaire (results visible after completing the questionnaire in Excel file, tab 3)

Theme	Mean score
Vision, strategy, and organization	
Quality information technology infrastructure and systems	
Quality eHealth application	
Providing support to health care professionals	
Attentiveness to the patient	
Skills, knowledge, and attitude of professionals	
End results for the patient	
Learning system: evaluation and improvement	

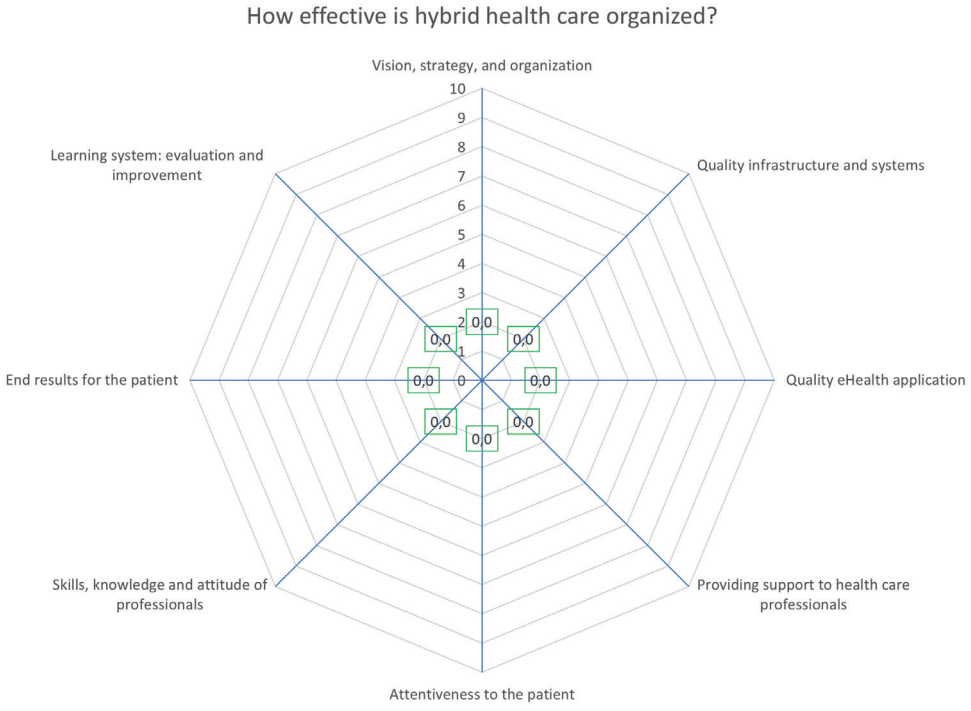


Figure 3. Results questionnaire (results visible after completing the questionnaire in Excel file, tab 3)

Score 0-2

If a cluster scores between 0 and 2, it means that many components (the so-called factors) are still in a 'plan phase', or perhaps there is no plan for some factors. Check per factor at this cluster whether there is a plan and whether connections are made with other factors in this plan. The connection can be at the same cluster but also from another cluster. Scientific research shows that the factors are not separate but reinforce each other. Make use of this when making your plans.

Tip: There is much information and tips about the PDCA and each phase on the internet. For example, in the Plan phase, make the objectives SMART (Specific, Measurable, Achievable, Realistic and anchored within a Time Frame), create owners of the plans who will monitor the plan's realization, set up control and monitoring data, and ensure that the intention is clear to the implementers.

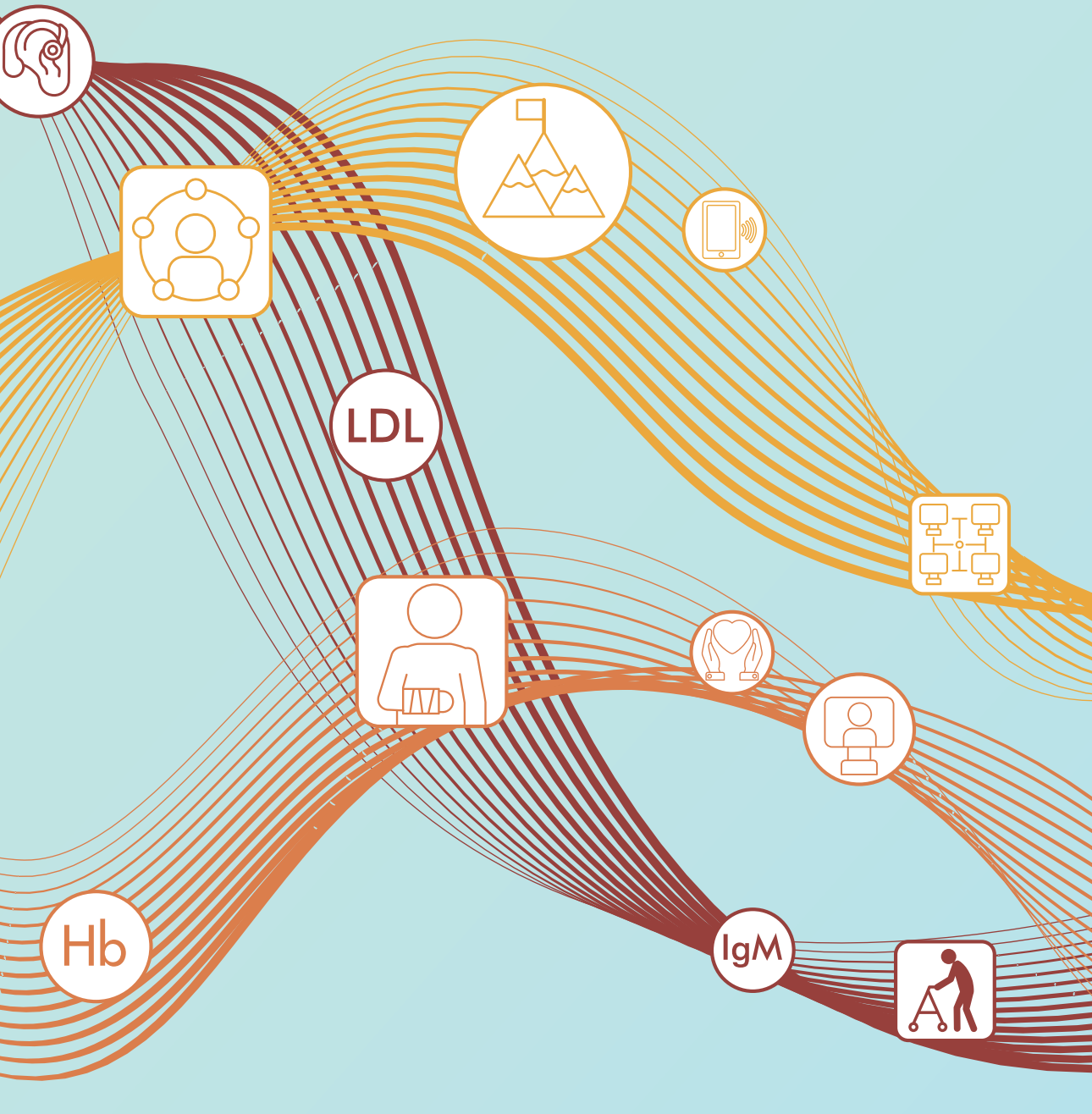
Score 3-6

Your organization is implementing the improvement plans, and perhaps some of the plans are already being evaluated and improved. For the relevant factor, look at how the activities are performing concerning the plans made. Then also include the objectives around this factor. Next, analyze the implementation, supported by the available data. If there is no data, arrange for this data as soon as possible. Otherwise, it is impossible

to evaluate the quality of the implementation. This will provide insight into where improvements can be made.

Tip: Look for best and worst practices in what lessons have been learned.

Score 7-10
On average, the factors in this cluster run through the entire PDCA cycle. However, for some factors, your organization redevelops the implementation or adjusts the plans with various stakeholders. Your organization has adopted a working method with a continuous improvement cycle for these factors. Perhaps it is possible to use this as best practice in organizing the factors where the PDCA score is lower? Based on the score per individual factor, you will gain insight into where there is still potential for improvement on the part in question.


LDL
Hb
IgM

Chapter 6

Discussion

eHealth is most effective when integrated into conventional health care in a "hybrid" health care model. In order to achieve high-quality hybrid health care, eHealth must benefit patients and must be effectively integrated and organized within regular health care.[1–3] This thesis describes the evaluation of eHealth from both a patient perspective and an organizational perspective. **Chapters 2 and 3** present patients' views of an online patient portal. **Chapters 4 and 5** describe the factors that affect the organization of high-quality hybrid health care and use these as inputs to develop a tailored quality management model and accompanying self-assessment questionnaire: the Hybrid Health Care Quality Assessment (HHQA) (**Chapter 5).** Health care organizations can use the model and questionnaire to gain insight into ways of improving the quality of their hybrid care.

In this chapter, the main findings of the research are briefly summarized and placed in a broader context, the methodological choices are discussed, and recommendations for practice and possible follow-up studies are presented. Finally, we return to the case study involving Nancy and Paul from Chapter 1 and provide examples of how the usability of the online patient portal and the quality of hybrid care might be improved.

Summary of Main Findings

Part 1. Evaluation of eHealth From a Patient Perspective: Assessment of an Online Patient Portal

Two quantitative studies investigated patients' attitudes toward a patient portal designed to communicate diagnostic test results in patient-friendly language and help patients take an active role in managing their health. Both studies found that the usability of the patient portal was rated positively, meaning that it was easy to use, considered to be trustworthy and appropriate, and provided information that was easy to understand. However, the portal only slightly contributed to self-efficacy. The items on the self-efficacy scale explored whether the patients were motivated and had the confidence to manage their health after seeing the information. A strong positive correlation was also found between the portal's usability and patients' self-efficacy, meaning that if patients found the portal easy to use, it had a positive effect on their self-efficacy. Older people, higher-educated users and patients with asthma or chronic obstructive pulmonary disease (COPD) scored the portal lower for usability, while higher-educated users also reported lower scores for self-efficacy.

It was concluded that patient portals communicating diagnostic test results in patient-friendly language appear to be usable and can help to increase the confidence of patients in managing their health. However, differentiation and personalization of the subgroups are recommended to maximize the effects of usability and self-efficacy.

Part2. Evaluation of eHealth From an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

In the second part, a systematic literature review and a concept mapping study were used to explore the factors involved in the effective delivery of hybrid health care. Both studies used the Donabedian SPO framework, in which structure is the health care setting and

available resources; process is what is done in giving and receiving care; and outcomes are the end results of the health services.[4,5] According to Donabedian, the quality of care is based on these three categories and the relationships between them.

The two studies found that the quality of hybrid care is determined by organizational, technical, process-related and human factors. To translate the findings from the literature review and concept mapping study into a guide for health care organizations, a model was developed to help organizations manage hybrid health care and identify areas for improvement in order to integrate eHealth in a robust and sustainable manner. The 33 most important factors were divided into clusters, which formed the basis of a quality management model and self-assessment questionnaire named the HHQA. The model is presented visually and explained in **Chapter 6**, Figure 1 and Table 1-8. The model also visually presents the interrelationships between the factors. Using a questionnaire, the quality of each factor and cluster can be assessed to determine how effectively hybrid health care is organized. By using the questionnaire regularly, changes can also be tracked over time. A description of how the questionnaire can be used is set out in the appendix to Chapter 5.

Comparison With the Literature

Based on the results of this research, it was concluded that the quality of digital health and hybrid health care depends on the usability of eHealth itself, human factors, and how eHealth and conventional care are organized as a whole. These findings are consistent with the available evidence. The following sections discuss the main findings and compare them with the existing literature, explain the methodological choices made, and identify the strengths and weaknesses of this research.

Part1. Evaluation of eHealth From a Patient Perspective: Assessment of an Online Patient Portal

The first part of the research focused on perceived usability and self-efficacy with relation to an online patient portal communicating laboratory test results (**Chapters 2 and 3**). Other studies have found that how a portal's content is presented and how the patient interprets it affects the overall usefulness of the information, and patient satisfaction.[6–9] It is important for the information to be understandable because the online portal gives patients direct access to their medical information. The results must therefore be communicated in a way that minimizes the risk of misunderstanding. Risks may include the information causing anxiety for the patient, which can negatively affect patient health engagement.[7] Alternatively, blood test results may be misinterpreted by patients in a way that leads them to underestimate their severity.[10]

Patient characteristics such as gender, education and chronic disease status can affect portal use and perceived self-efficacy in managing their own health. [8,9,11]In this research, higher-educated users reported lower scores for usability and self-efficacy while older people and people with asthma or COPD reported lower scores for information usability (**Chapter 3**). Other studies have found that higher-educated users were more eHealth-

literate and had improved self-management after consulting health information online.[12] It is possible that the test results in the online portal were communicated too simply for higher-educated users and thus provided less of a relative advantage. [9,13–15] For older people, the lower usability could be explained by the group's digital skills.[16,17] For people with asthma or COPD, the lower usability may be explained by higher levels of anxiety, specific illness perception, age and disease severity and insufficient ability to understand health information.[18,19]

Previous research has shown that usability and perceived self-efficacy are partly influenced by the extent to which the different skills and preferences of patients are taken into account.[20] For example, eHealth applications need to be adapted for people with disabilities (e.g., those who are illiterate or have a visual or motor impairment), because otherwise digitization might increase health inequalities.[21,22] Personal preferences also need to be considered, since different people have different interests and needs.[20]

The research findings in **Chapters 3 and 4** demonstrate that patients value viewing laboratory test results online. Patients' attitudes toward an eHealth application and the extent to which it meets their needs are influenced by how the information is communicated and by personal factors such as age, disease and education. In addition, comparison with the literature reveals the need for a particular focus on personal preferences and people with disabilities. Different patient characteristics and needs must therefore be considered when developing a digital application.

Findings from various studies demonstrate that the ability to use a portal is also strongly influenced by the role of the health care professional (HCP).[9] Portals can support patient engagement and improve their health if the HCP involved has a positive belief in the portal and gives additional feedback.[9,23,24] For example, the HCP might ask whether a patient has seen the results and has any further questions.[20] The usability of the patient portal is also influenced by organizational factors, such as the use of shared decision-making, customized patient-centred care and free and adequate information flow. The implementation of a portal also interferes with workflows and culture.[20,25] Care organizations therefore need to reconsider their structure, process and outcomes in order to effectively implement eHealth. This brings us to Part Two of this thesis, which discusses the factors affecting the quality of hybrid health care.

Part 2. Evaluation of eHealth From an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

The systematic literature review and concept mapping study found that the successful integration of eHealth into health care is conditioned by the interplay of organizational, technical, process-related and human factors. Working with eHealth places demands on the application itself and requires consideration of patients' individual needs, a careful adjustment of human resources and the care process, and the realignment of care goals (**Chapter 4**). The challenges involved in establishing high-quality hybrid health care go beyond the type of eHealth application used, setting and treatment (**Chapters 4 and 5**).

A nationwide survey of Dutch care providers concluded that digital transformation is both a technical and social issue.[26] The Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) Framework and Consolidated Framework for Implementation Research (CFIR) show that the implementation of eHealth only succeeds when the various interacting domains (such as support from the organization, the characteristics of the technology and individual persons) are recognized and managed.[27–29] Previous studies have also shown that social aspects play a role in the integration of eHealth.[3] eHealth shifts power toward the patient and partially replaces in-person care,[30] resulting in the emergence of a patient-HCP-eHealth relationship.[31] Due to increased self-management, different approaches to patients are needed, requiring HCPs to develop new coaching communication styles and digital skills.[32] These developments require support from the management of health care organizations[3].

Several frameworks and models have been developed to support different stages of eHealth and other technical innovations.[33–35] Some commonly used examples are the CeHRes Roadmap,[36,37] the NASSS,[34] CFIR,[1,38] and Normalization Process Theory,[39,40] which complement each other well in relation to the different phases of developing a prototype, implementation, embedding and uptake. These models do not, however, include translation to redesigning care processes and preparing the organization. To improve the added value for patients and HCPs, any health care organization that introduces eHealth must be adequately prepared at the strategic, tactical and operational management levels.[41–43] The HHQA assesses all the necessary areas of focus at these three levels that determine the quality of hybrid health care.

The study of patients' attitudes toward the online portal (**Chapters 2 and 3**) is consistent with the findings of the literature review and concept mapping study (**Chapters 5 and 6)**, with the usability of the technology and information provision reflected in the clusters "Quality eHealth application" and "Attentiveness to the patient". Self-efficacy corresponds to the factor "Treatment with eHealth contributes to patient self-reliance" in the "End results for the patient" cluster. Co-creation and continuous development are reflected in the "Learning system: evaluation and improvement" cluster. The factors involved in integrating eHealth effectively into health care are expressed in the "Vision, strategy, and organization", "Providing support to HCPs", and "Skills, knowledge and attitude of HCPs" clusters.

Critical Discussion of the Methodology: Strengths and Limitations

Part 1. Evaluation of eHealth From a Patient Perspective: Assessment of an Online Patient Portal

Many eHealth applications could have been evaluated, but analyzing patients' attitudes toward this particular online patient portal was interesting for several reasons. First, the study participants were patients who received a referral for a diagnostic test from their GP and viewed the online results via the patient portal on their GP's website. As most people in the Netherlands are registered with a general practice, the participants were therefore a good reflection of the Dutch population. Second, a growing number of GPs

offer patients online access to their medical records, and the laboratory results section is the most frequently consulted.[44,45] Third, in the development phase of the online patient portal, a great deal of attention was paid to how the data were communicated, with input from patients, physicians, and communications experts. Earlier scientific research was done on the communication style, following which the portal was further improved and developed.[14] As eHealth is designed to communicate personal health information and provide patients with access to their medical information,[2] it was useful to explore these aspects in relation to a high-quality patient portal. Fourth, the portal is designed to increase patients' knowledge in order to help them play an active role in the diagnostic process.[46] As eHealth is seen as a way to increase patient empowerment, there was scientific merit in exploring whether this was happening in practice.

The eHealth Impact Questionnaire (eHIQ) was selected as the most suitable instrument for evaluating the portal.[47] The eHIQ is a validated, self-reported questionnaire that measures patients' attitudes toward a specific health-related website or application. The eHIQ Information and Presentation and Motivation and Confidence to Act subscales made it possible to analyze the patients' perceptions of usability and self-efficacy as closely as possible.

The main strength of these studies is their real-world setting, with actual patients reflecting on their attitudes toward the portal. Both studies produced comparable findings regarding usability and self-efficacy, increasing the reliability of the study. Another strength is the size of the patient group and the inclusion of GP patients: since almost everyone in the Netherlands is registered with a GP practice,[48] this provided a considerable likelihood of obtaining a representative sample of Dutch society. One limitation is the fact that only a small portion of the total group that used the patient portal completed the study questionnaire. The low response rate makes it impossible to draw general conclusions about whether the way in which results are displayed and explained on the patient portal are acceptable and informative for all patients. At the time of the survey, just prior to the COVID-19 pandemic, only 2% of GP practices offered patients online access to their medical records.[44] As of 2022, however, 93% of Dutch GP practices offer online access, and eHealth has gained more attention.[44] This timing might have impacted the response rate. Using qualitative interviews with users and non-users to further explore the findings for usability and self-efficacy would be worthwhile.[49,50]

These studies were cross-sectional. They assessed whether the different variables were related to one another but were unable to investigate causality. Other personal variables may have affected the results. Other studies have shown that many determinants can play a role in how a web-based intervention is experienced, such as "fit with their daily life", technology anxiety, eHealth literacy, socioeconomic status and portal-specific factors: expectations, perceived ease of use and enjoyment.[51] Other health conditions may also have an influence, such as the severity of the disease, comorbidity or mental illness.[52] As around 90% of the patient portal users of the laboratory in our research, receive confirmation that their blood values are normal, it is plausible that these patients feel there is no need to act after seeing their results. Organizational factors might also have an impact on usability and self-efficacy. Research has shown that online portals improve

usability and self-management more when they are integrated into health care.[1,53,54] The extent to which the online portal is effectively integrated into the everyday care of the GP practice is unknown.

Finally, this research analyzed one specific digital application, using one questionnaire, across two studies. More research is needed to evaluate usability and self-efficacy from a patient perspective. This research analyzed the goal of the concerning laboratory in questions, namely, patients having easy access to reliable data and facilitating them to play an active role in the diagnostic process. For future studies analyzing an eHealth application from a patient perspective, it would be advisable to assess patients' needs, and then select an appropriate research methodology.

Part 2. Evaluation of eHealth From an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

The literature review and concept mapping study used the Donabedian SPO framework in their analyses. The Donabedian framework includes all relevant aspects of an organization's structure, process and outcomes and the relationships between them and combines these aspects with health and social factors. This makes it a suitable model for evaluating the organization of hybrid health care. The Donabedian SPO framework was designed in the twentieth century, before the introduction of eHealth. For the systematic literature review, the SPO framework was adapted to the present day and to incorporate working with eHealth applications. In the concept mapping study, the SPO framework was explained to the participants during the brainstorming and sorting activities. Donabedian suggests that each category can be evaluated separately or in conjunction, and that the results will be better if the structure and process are efficient. These arguments are also reflected in the HHQA.

The literature review explored the evidence base, and the concept mapping study was used to enrich this with practical knowledge and to validate the findings. The concept mapping method made it possible to combine qualitative and quantitative data in the analyses and to present the results visually, making it ideal to develop a quality model. An accompanying self-assessment questionnaire was added to make the findings more practical and useful for health care organizations. Validating the HHQA questionnaire in follow-up studies is recommended.

The literature review included relevant studies published up to December 12, 2019, less than two weeks after the first known infection with COVID-19 (December 1, 2019).[55] As a result of the pandemic, eHealth has been scaled up rapidly, with growing experience and knowledge. Repeating the literature review two years into the pandemic might identify new factors. During the concept mapping study (March-December 2021), the new knowledge from stakeholders working in the pandemic was included. The stakeholders were direct users of eHealth and consisted of patients, HCPs and managers who determined the factors included in the model.

The strengths of these two studies are the combination and translation of knowledge from science and clinical practice into a practical model and questionnaire. Both studies

also used different research techniques. The literature review and brainstorming exercise resulted in a list of 78 unique factors, with the most important and measurable of these included in the final model. As a result, the number of factors included in the model was reduced to 33. This makes it manageable for a health care organization to use, but simplifying complexity can also become a limitation: it may mean that the model is not comprehensive, or suggest that hybrid health care quality can be improved with "quick fixes". Another limitation is that most of the data came from high-resource settings in high-income countries. In low-resource settings, care and internet facilities are different and other factors may be more important.[1,56] It would therefore be worthwhile to repeat the mapping exercise in low-resource settings.

Finally, further research is still needed to understand exactly how hybrid care can be organized optimally. The following issues require thorough evaluation. First, in the concept mapping study, it was observed that stakeholders clustered the factors differently. Second, there is still no consensus about how the quality of hybrid care should be defined.[33,37] Third, the literature review revealed that the role of the patient, health care provider, the technology used, and the health care organization need more attention in future research. Finally, the organization of hybrid health care is an emerging area of research. The HHQA provides an initial guideline for health care organizations based on systematic and scientific analysis, but further research is required.

The overarching commonality of all four studies is that the data came from real patients, HCPs and managers in real-world settings. This means that the findings are up-to-date and representative. There was also alignment across the findings, such as the impact of portal usability, individual characteristics, communication tactics and care processes on the outcome. All of these general findings are reflected in the model and questionnaire. The HHQA model and questionnaire are presented at the end of this thesis using the case study involving Nancy and Paul from Chapter 1.

Implications and Recommendations for Practice

Based on the Findings and Discussion Section of This Thesis, the Following Recommendations for Clinical Practice Are Proposed:

Invest in the Quality of eHealth Applications and Hybrid Health Care

Both the quality of eHealth applications, and their integration with conventional care, are crucial. One cannot exist without the other. Health care managers should therefore ensure that eHealth applications are high-quality and well integrated and organized within conventional health care. Improvements should also be prioritized in consultation with end-users (patients and HCPs) and other stakeholders, such as IT employees, managers and eHealth developers. In future, it will be important to consult patients that do not use eHealth or abandon its use in order to prevent inequality in the use of eHealth.

Ensure Continuous Development at all Levels of Management

The efficient and effective deployment of digital health care requires changes at the strategic, tactical, and operational levels. At the strategic level, a clear vision and policy are

required; at the tactical level, care processes need to be redesigned; and at the operational level, HCPs require new communication, coaching and digital skills. Coordination between and within the various management levels is therefore necessary. This requires monitoring data to enable continuous feedback and adjustments between the different levels.

Clearly, this is a sizeable task. Directors, managers and HCPs all have an essential role to play. However, to manage it in an integrated way, it might be wise to establish a specific job role responsible for hybrid health care. Depending on the size of the organization, this might be at the director or manager level.

Support Patients and Health Care Professionals

Patients and HCPs need to be supported to work with digital health care. This involves the following: 1) providing hands-on support for the use of devices, training, instructions, time to learn and a 24/7 help desk; 2) redesigning the care process to contribute to patients' self-reliance and desired health outcomes, in co-creation with patients and HCPs; 3) adopting a new way of working and guiding patients with shared decision-making; and 4) supporting HCPs to change their attitudes, arranging supervision, providing training and setting aside time for these activities.

Arranging this support and the roll-out to the relevant departments could be centrally organized, and coordinated by the director or manager of hybrid health care in collaboration with the human resources department, quality managers, local managers, medical staff and patient board. For smaller organizations, a lighter governance model might be developed.

Pay Attention to Coaching Communication Styles and Digital Skills

Working with eHealth requires HCPs to develop coaching communication and digital skills. It would therefore be advisable to introduce these skills at an early stage in professional training and for professionals to work on them continuously throughout their careers via in-service training.[57,58] In a Dutch survey of the quality of GP training, 50% of students reported that there was an insufficient focus on the opportunities and targeted use of online patient access and digital consultation.[59] These skills need to be recognized and supported by health care organizations.

Use the Hybrid Health Care Quality Assessment (HHQA) as a Tool for Assessment and Improvement

The HHQA can be used as a tool to assess one disease pathway in particular, or as a guide to improve hybrid health care in general. The HHQA acts as a mirror: it reflects what needs to be done, but not how. For example, it might be used to reveal where improvements need to be made, before an organization then develops and implements an action plan. After a couple of months, the organization could check on the progress of the improvements and revise the plan where needed. The HHQA does not, however, provide an answer as to why an institution should improve its hybrid health care. The answer to that question is to be found in the strategic goals a health care organization has set for itself.[60]

Recommendations for Further Research

Based on These Findings and Considerations, the Following Recommendations for Future Research Are Proposed.
In order to develop a comprehensive understanding of the needs of HCPs in terms of engagement, daily practice and communication and coaching skills in relation to eHealth, we recommend analyzing the attitudes and needs of care providers, for example using questionnaires and semi-structured interviews.

We also recommend analyzing patients' needs, expectations and other outcomes they perceive to be of value, differentiating them further into different user groups ("users", "non-users", "rejecters" and "excluded users")[61] using interviews and focus groups.

The above suggestions might also be applied to other eHealth applications beyond the online patient portal studied to obtain an even more comprehensive picture of using eHealth from a patient and HCPs perspective.

The online patient portal was developed as part of a hybrid health care system. However, the extent of integration is unknown. It would therefore also be useful to investigate how the patient portal can be organized as part of hybrid health care with GPs, for example using the HHQA as an assessment tool. The HHQA questionnaire provides a tool for assessing whether the strategy is clear, the work processes have been well adapted, and there is good communication with the patient.

The HHQA provides a general indication of the areas for improvement in relation to the quality of hybrid health care. Using this model, a clear overview of the roles of patients, HCPs, the health care organization and the technology used can provide a basis for improvements. As the usability of the model is essential, the authors will continue with follow-up research, such as validating the HHQA in clinical practice. Questionnaires and focus groups will support an analysis of whether the HHQA can be used to assess the quality of hybrid health care, and to identify improvements to make using the HHQA as easy as possible, logical and helpful.

Other follow-up research ideas are:

- Interventional research involving the model and questionnaire: a before-after study with one-year follow-up comparing the HHQA results before and after improvement. This might be done for or by a single care institution. A comparison of the before-after measurements across several care institutions would also be interesting. The HHQA can also be used as a benchmarking tool. If necessary, it can be supplemented with qualitative group discussions to explain the differences.

- Weighting the factors based on the extent of their impact on the quality of hybrid health care in order to help organizations prioritize. This might be done using longitudinal intervention studies after the HHQA is validated.

- Repeating the concept mapping studies in other health care environments, such as low-resource settings.[1] In low-resource settings, health care systems are set up differently at the macro, meso and organizational levels and may have different health care needs, and therefore other factors may be important for effective hybrid health care. It would therefore be valuable to repeat the concept mapping study with stakeholders in different health care environments.

- Analyzing opportunities to expand the HHQA with a toolkit, templates or manuals that enable organizations to conduct in-depth research that provides them with insight into practical improvements. We might build on several valuable toolkits that have been developed to redesign the work process from other management philosophies such as LEAN,[62] Six Sigma,[63] and Clinical Pathway.[64]

- Carrying out a process study of best and worst practices using the HHQA as an assessment tool. The lessons learned concerning each cluster and related factors can be used for health care organizations and added into the toolkit.

Conclusion

The effective and optimal organization of health care with eHealth is determined by a complex interplay of organizational, technical, process-related and human factors. Achieving high-quality hybrid health care requires consideration of patients' needs, the new patient-HCP-eHealth relationship, and a robust organizational design. Using the new quality model, HHQA, any health care organization can systematically assess the quality of its hybrid health care. Health care organizations can also use the HHQA to evaluate and identify areas for improvement in their hybrid health care to add value for patients and HCPs.

CASE STUDY

Below we provide an example of how the HHQA might be used, based on the case study of Nancy and Paul from Chapter 1. Nancy and Paul are personas based on real people. This case study illustrates the everyday experience of eHealth from the perspective of a patient and a GP. Some factors from the HHQA model have been translated into possible clinical practice situations, although not all are reflected in this case study. The model is presented visually and explained below in Figure and Table 1. For a description of how the questionnaire can be used, please see the appendix to Chapter 5.

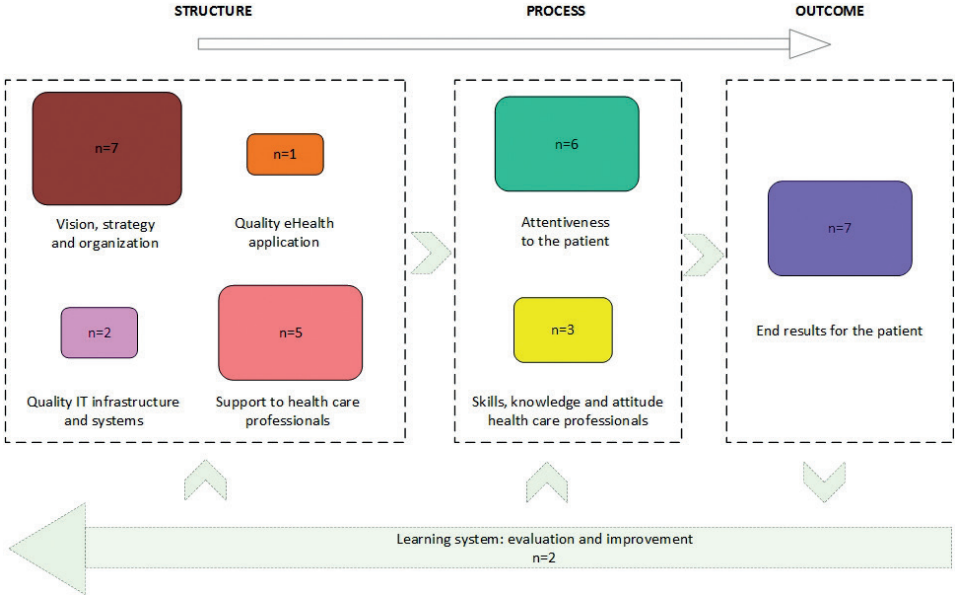


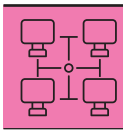
Figure 1. The Hybrid Health Care Quality Assessment (HHQA) model

Table 1-8. Description of clusters and factors, illustrated by translation to the case study

Cluster 1. Vision, strategy, and organization

Description: Responsibilities of the health care organization concerning vision, strategy, policy, leadership, funding, and work process designs.

Factor	Possible recommendations for the case study
a. Support the implementation and development of eHealth within the organization with good project management. b. Mobilise funding for working with eHealth. c. Clear internal policies regarding the use of eHealth. d. Vision supported by the line, "Why are we doing this?" e. Care delivery with eHealth complies with laws and regulations. f. Financial reimbursement for eHealth deployment. g. Redesign the current work process and review what contributes to the desired care outcomes.	Nancy and Paul both experience the advantages of eHealth, but also see many disadvantages in the way the eHealth application is set up and organized in everyday clinical practice. As an organization, it makes sense to investigate the needs of patients, HCPs and other colleagues to form a vision of the goals of hybrid care (factor d) and determine, in co-creation with patient and HCP representatives, which process activities will ensure that the end results are met (factor g). Additionally, representatives might be involved in more depth to ensure practical implementation of the necessary activities (factors a and g).



Cluster 2. Quality IT infrastructure and systems

Description: Conditions concerning technology, information technology systems, and data.

Factors	Possible recommendations for the case study
a. IT architecture available within the health care organization. b. Back-up in case of technical problems.	Nancy and Paul's case study does not provide any information about this factor. From other research we know that the IT architecture is often set up from a technical perspective and could be more supportive of care processes with good coordination between the HCPs and the IT department.[3] A back-up also needs to be in place in case the internet fails, or logins do not work.

Cluster 3. Quality eHealth application

Description: Conditions concerning the eHealth application.

Factors	Possible recommendations for the case study
a. The eHealth application is user-friendly.	Nancy and Paul both report that the eHealth application is not completely user-friendly. It would be useful to identify the requirements of patients and GPs and to check whether the eHealth application meets these requirements and what may be needed for it to do so. This could be done in various ways, using open questions but also quantitative validated questionnaires, such as the eHIQ.

Cluster 4. Providing support to HCPs

Description: Conditions arranged by the health care organization to encourage the use of eHealth among its health care professionals.

Factors	Possible recommendations for the case study
a. HCPs have easy access to IT resources, for example, devices, internet, screens and headsets. b. Embedding eHealth in the daily practice of HCPs. c. Training and supervision for HCPs. d. Help desk for HCPs. e. Information on treatment with eHealth is clear and accessible to the HCPs.	Clearly, eHealth is not yet embedded in Paul's everyday work (factor b): he sees patients more than before but the content of their consultations has changed, and his administrative burden has increased. There is a need to sit down with Paul and take a critical look at how his everyday work is organized and how he might work smarter (factor b). Perhaps the current provision of care is not appropriate to present circumstances, and the structure of the organization and health care process need to be reconsidered. Training and supervision may also be helpful (factor c), for example; user instructions on the online portal and improving digital skills, but also communication and coaching skills.

Cluster 5. Attentiveness to the patient

Description: Organize the daily care process in line with the patient's needs, demand for care, and its capacity.

Factors	Possible recommendations for the case study
a. Clear communication to the patient about how care is provided. b. Personalized care, considering patient needs with regard to (deployment of) eHealth. c. The patient has easy access to the necessary IT resources, for example, device, internet, and so on. d. Patients receive practical support in using the eHealth application; for example, a help desk. e. The patient has confidence in the eHealth application. f. The patient has the flexibility to use eHealth wherever and whenever it is convenient.	The information on the portal does not provide Nancy with clear explanations, and she does not know when to contact her GP. The information for Nancy about how care is offered could be improved (factor a), but more insight into Nancy's personal needs (and those of other patients) regarding eHealth (factor b) is also necessary in order to redesign the care process to meet her personal needs. The design of the care process and eHealth application is reflected in the "Vision, strategy, and organization" cluster, and in the "Quality of eHealth application" cluster.

Cluster 6. Skills, knowledge, and attitude of HCPs

Description: Health care professionals' ability to provide hybrid care.

Factors	Possible recommendations for the case study
a. Good balance between face-to-face and eHealth for the HCP. b. The HCP has confidence in the eHealth application. c. The HCP is satisfied with working with eHealth.	Paul has more patient consultations than before, and they discuss different things in these sessions. Even his administrative burden has increased due to digital applications. It is important to analyze potential areas for improvement, in conjunction with Paul. It may be necessary to redesign the workflows and application or to set new expectations or provide training.

Cluster 7. End results for the patient

Description: Outcomes for the patients; for example, health, added value, satisfaction, ownership, and convenience.

Factors	Possible recommendations for the case study
a. The patient can integrate the use of eHealth in their daily live. b. Treatment with eHealth has a positive influence on the patient's health. c. Treatment with eHealth contributes to the patient's self-reliance. d. The patient is satisfied. e. The patient has easy access to care. f. eHealth provides logistical convenience for the patient. g. eHealth has added value for the patient.	Nancy likes the fact that she can always consult the online patient portal and that, in combination with Paul's guidance, she has better control over her health. The ambitions of an organization in this area depend on its organizational goals. It is crucial for these factors to be checked with patients and in relation to clinical outcomes.

Cluster 8. Learning system: evaluation and improvement

Description: Evaluation and realignment with stakeholders and the patient care objectives for a continuous development.

Factors	Possible recommendations for the case study
a. Co-creation: eHealth is (re)developed and implemented with different stakeholders. b. Monitoring and evaluation of service and treatment results.	Nancy has better health outcomes. However, both Nancy and Paul wish that the results of the portal were more clearly explained. Paul also finds that his administrative burden and the number of patient consultations have increased. These are inputs for improvement (factor a). After a certain period, it would be interesting to monitor the impact of the improvement on health outcomes and desired end results, such as patient and HCP satisfaction, or on other organizational criteria such as cost (factor b).

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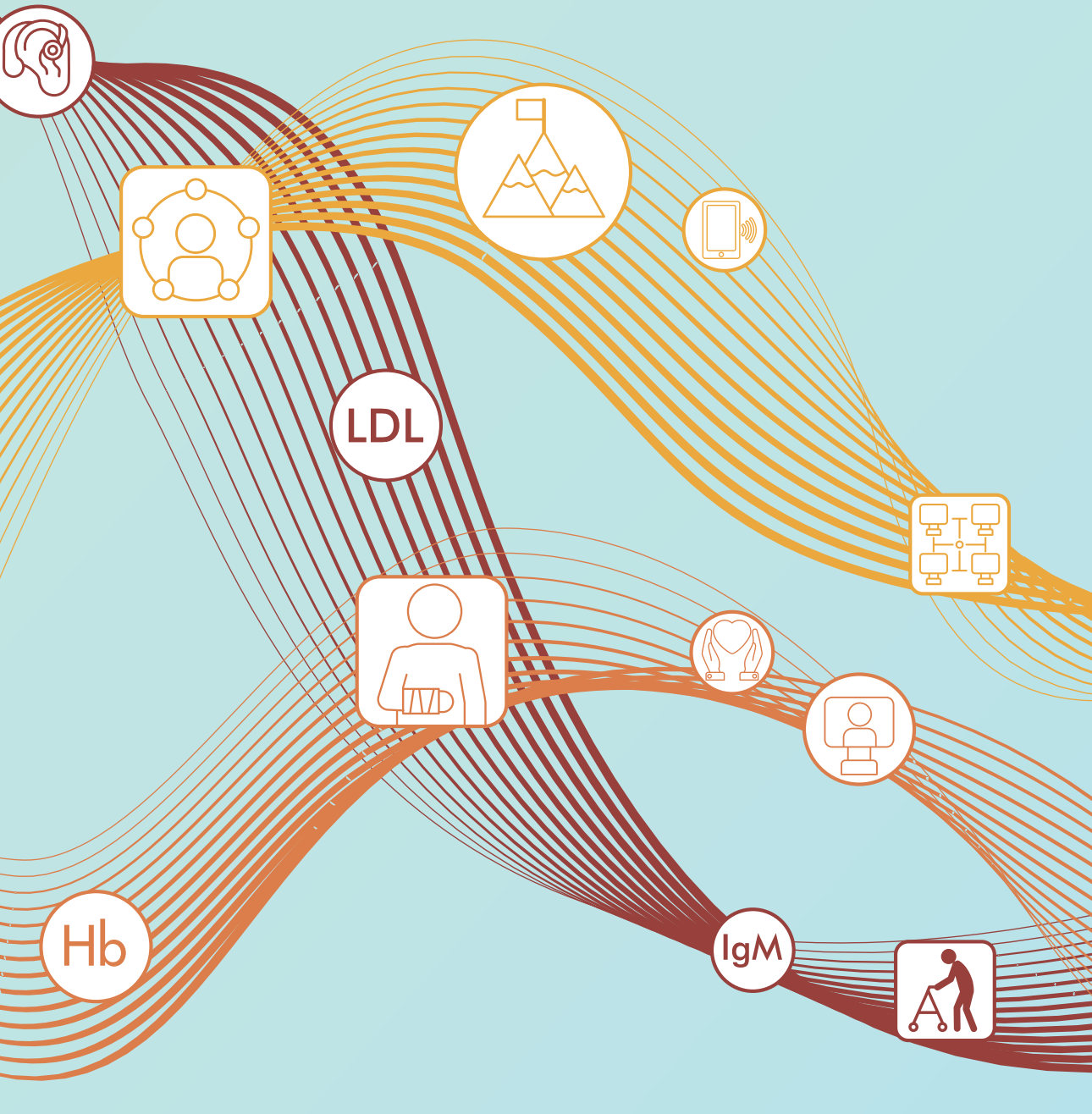
LDL
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Summary

In recent years, the use of eHealth has been increasing. eHealth is seen as an innovative solution and a necessity to keep health care accessible and affordable. It provides convenient opportunities to transfer care from an institutional environment to the patient at home. Putting patients more in charge of managing their health affects patient and HCP interactions. Working with eHealth technology therefore requires patients and HCPs to develop new skills, and workflows need to adjust.

Integrating eHealth into health care is a complex organizational challenge. The usability of eHealth applications – the extent to which they benefit patients and are easy to use – must be carefully considered in order to fully support patients. At the same time, working with eHealth requires health care organizations to restructure the way they work. The usability of eHealth and the way it is integrated into health care are often not optimal. There is considerable knowledge to be gained in both areas. This thesis therefore had two aims: first, to investigate eHealth from a patient perspective and thereby test the usability of an eHealth application and its impact on users' self-efficacy; and second, to evaluate eHealth from an organizational perspective in order to explore the factors that contribute to high-quality hybrid health care (the combination of eHealth with in-person care). **Chapter 1**, the introduction, describes the background to this thesis and the research aims. The main body of this thesis is divided into two parts: first, the patient perspective; and second, the organizational perspective.

Part 1. Evaluation of eHealth From a Patient Perspective: Assessment of an Online Patient Portal

In the first part, patients who visited an online patient portal communicating laboratory results in patient-friendly language were asked to evaluate this portal for its usability and the impact on their self-efficacy. Portal usability is essential to ensure that patients receive their test results online, that it is easy to use and provides understandable information. Perceived self-efficacy is a person's confidence in his or her ability to execute necessary behaviours. Both usability and self-efficacy affect an individual's intention to follow up on their test results.

Two cross-sectional studies (**Chapters 2 and 3**) examined patients' attitudes toward an online patient portal. The studies were conducted using the eHIQ questionnaire. The eHIQ Information and Presentation subscale was used to assess the usability of the patient portal, while the eHIQ Motivation and Confidence to Act subscale was used to assess self-efficacy to determine whether patients were motivated to act on the information they were shown.

In the first study **(Chapter 2),** the questionnaire was completed by 354 patients. This study found that the usability of the portal was evaluated positively, and the participants had high confidence in the portal. A positive correlation was found between usability and self-efficacy, meaning that if patients found the portal easy to use, it had a positive effect on their self-efficacy. However, the portal only slightly supported patients to take an active role in managing their health. The second study **(Chapter 3)** repeated the first study with

a larger group in order to examine how different groups of patients perceived the portal. The characteristics explored were age, gender, education and type of chronic disease. The eHIQ was completed by 748 patients. This study found that the higher-educated users of the patient portal reported lower scores for usability and self-efficacy. Lower usability scores were also reported by the elderly and by patients with a diagnosis of asthma or COPD. This study showed that the way in which a patient portal communicates information must be tailored to different target groups. Further research is necessary to determine the supportive factors that users in these different groups consider important in a results portal to tailor it to their needs. Further research is also needed on how portals can be optimally implemented and integrated into daily general practice.

Part 2. Evaluation of eHealth From an Organizational Perspective: What Factors Affect the Quality of Hybrid Health Care?

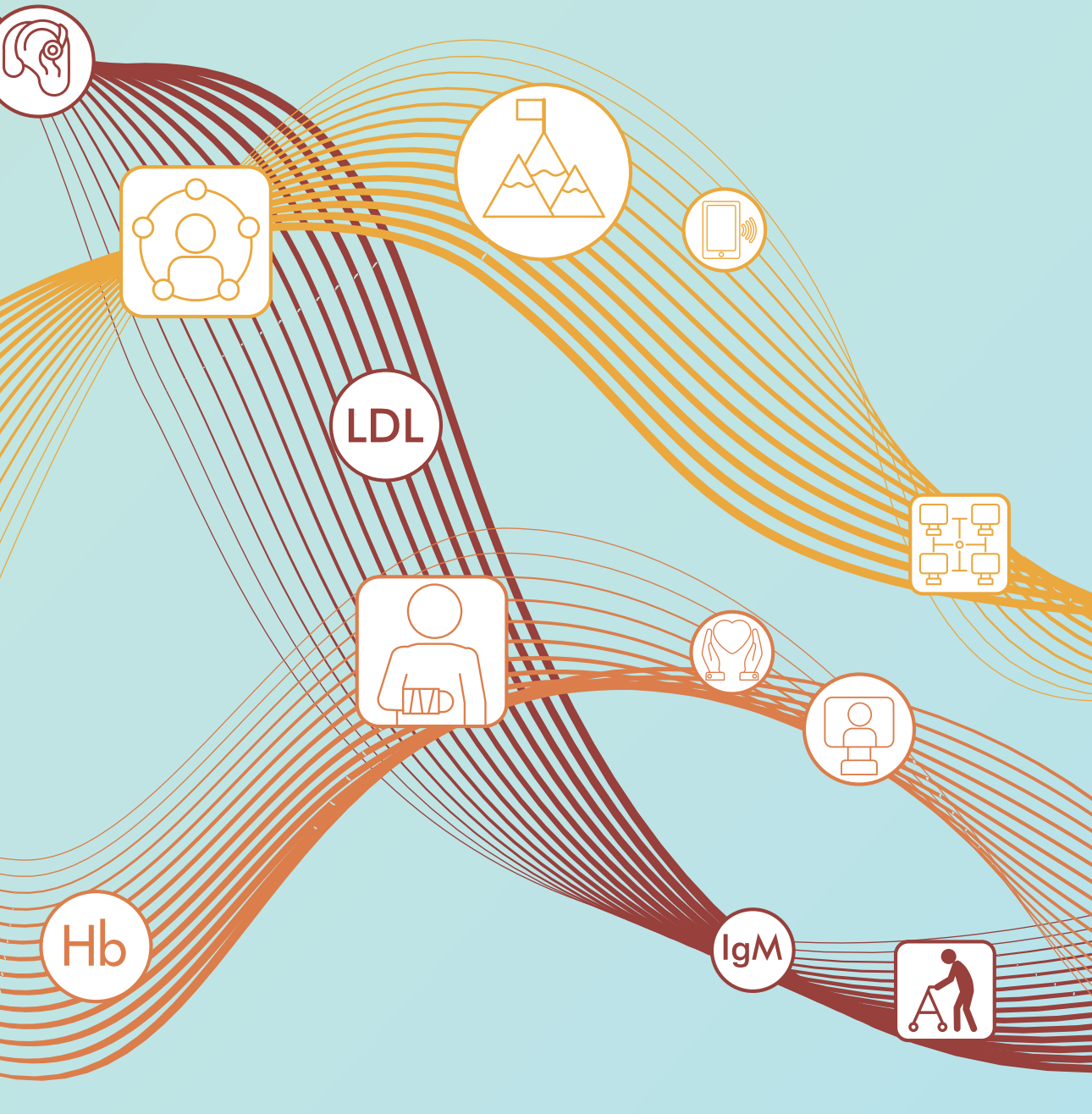
eHealth is most effective when it is optimally blended with in-person care in a "hybrid" health care model. However, organizing hybrid health care is challenging, and preparation and management are often ineffective. There is a need for knowledge on how hybrid health care can be improved to provide added value for patients and HCPs working with eHealth.

In the second part of this thesis, a systematic literature review **(Chapter 4)** and a concept mapping study **(Chapter 5)** were used to explore the factors relating to the effective organization of hybrid health care. Based on the findings, a quality management model for hybrid care was developed. Both studies used the Donabedian Stucture-Process-Outcome (SPO) framework, in which structure is the care setting itself and the available resources; process is the delivery of care; and outcomes are the end result of care. According to Donabedian, the quality of care is dependent on these three categories and the relationships between them.

As part of the systematic literature review, 739 studies were screened, focusing on the implementation and evaluation of eHealth and describing potential structure, process or outcome indicators **(Chapter 4).** Eleven of those studies were included in the review. Data extraction sheets were designed to provide an overview of the study characteristics, eHealth characteristics and indicators. Indicators with a potential impact on the integration of eHealth in health care were extracted and organized into themes and subthemes of structure, process and outcome categories. We also analyzed whether the indicators influenced each other. Altogether, a total of 111 unique indicators were extracted. Looking at these indicators overall, three main principles can be distinguished. First, the role of the patient must be embedded in the organizational structure and the care process; second, the technology must be aligned with the organizational structure and the care process; and third, the staffing of the care process needs to be aligned with the desired outcomes. Inadequate attention to these principles can have a negative impact on the organization, the care process and/or the outcomes.

To translate the findings from the literature study into a guide for health care organizations, a model was developed to help health care organizations manage hybrid health care and identify areas for improvement in order to integrate eHealth in a robust and sustainable manner. A concept mapping study **(Chapter 5)** was used to enrich and validate the evidence base from the literature review with practice-based knowledge from experts. The participants (n = 39) consisted of HCPs, managers, researchers, patients and eHealth suppliers who were all familiar with eHealth. First, a brainstorming exercise was conducted in which participants listed all the factors contributing to the effective organization of hybrid health care and the associated outcomes. These factors were combined with the factors identified from the literature study to produce a list of 314 factors. After removing duplicates, 78 factors remained. Participants then rated the factors on their importance and measurability. Participants were asked to group factors that were related to each other into clusters. Information from the various participants was combined and, using a multivariate statistical and qualitative analysis, the 33 most important factors were grouped into eight clusters: 1. Vision, strategy and organization; 2. Quality of IT infrastructure and systems; 3. Quality of eHealth application; 4. Providing support to HCPs; 5. Skills, knowledge and attitude of HCPs; 6. Attentiveness to the patient; 7. End results for the patient; and 8. Learning system. The SPO categories were positioned as overarching themes to emphasize the relationships between the clusters. A proposed model was then developed for using the self-assessment questionnaire in practice, making it possible to measure the quality of each factor and its development over time. The model and questionnaire were jointly renamed the Hybrid Health Care Quality Assessment (HHQA).

Chapter 6 reflects on the findings and the methodology of the studies, including suggestions for follow-up research and practice. It was concluded that the effective organization of eHealth is determined by a complex interplay of organizational, technical, process-related and human factors. Achieving high-quality hybrid health care requires consideration of the changing personal needs of patients, the patient-HCP-eHealth relationship and the organizational design. Health care organizations can use the HHQA to evaluate the quality of hybrid health care and identify areas for improvement. The model and questionnaire act as a mirror, reflecting what needs to be done. At the end of the chapter, suggestions are made for practice and further research, such as validating the HHQA, interventional research, repeating concept mapping studies in other health care environments such as low-resource settings, and weighting the factors based on the extent of their impact on the quality of hybrid health care. Finally, the HHQA is illustrated using a case study.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Samenvatting

In de zorg wordt steeds meer met eHealth gewerkt. eHealth wordt gezien als een innovatief middel om de gezondheidszorg toegankelijk en betaalbaar te houden. Het schept mogelijkheden om de zorg te verplaatsen van een zorginstituut naar de patiënt thuis. Maar het biedt patiënten ook mogelijkheden voor meer de eigen regie te voeren over hun gezondheid en ziekte, hetgeen van invloed is op de interacties tussen patiënt en zorgverlener. Werken met eHealth vergt van patiënten en zorgverleners nieuwe vaardigheden, en van zorgorganisaties een andere inrichting van hun dienstverlening.

De integratie van eHealth in de gezondheidszorg is een complexe organisatorische uitdaging. De eHealth-toepassing dient de individuele behoeften en behandeldoelen van de patiënt te ondersteunen, en gebruiksvriendelijk te zijn. Tegelijkertijd vereist het werken met eHealth dat zorgorganisaties hun manier van werken aanpassen. De bruikbaarheid van eHealth en de manier waarop eHealth in de zorg wordt geïntegreerd zijn nog vaak niet optimaal. Op beide gebieden is nog veel winst te behalen door nieuwe kennis in te winnen. Het doel van dit proefschrift is dan ook tweeledig. Het eerste doel is het onderzoeken van de bruikbaarheid vanuit patiëntenperspectief van een eHealth-applicatie en de impact daarvan op de 'self-efficacy' (zelfredzaamheid) van gebruikers. Het tweede doel is het onderzoeken welke factoren vanuit organisatorisch perspectief bijdragen aan een hybride gezondheidszorg van hoge kwaliteit. Hybride gezondheidszorg is de combinatie van eHealth, en reguliere en traditionele zorg. **Hoofdstuk 1**, de inleiding, beschrijft de achtergrond van dit proefschrift en de gestelde onderzoeksdoelen.

Deel 1. Evaluatie van eHealth Vanuit Patiëntenperspectief: een Evaluatie van een Online Patiëntenportaal.

In het eerste deel hebben we patiënten die het online patiëntenportaal bezoeken, waarin laboratoriumuitslagen in lekentaal worden verstrekt, gevraagd de ervaren bruikbaarheid en de self-efficacy te evalueren. De bruikbaarheid is noodzakelijk om ervoor te zorgen dat patiënten op een eenvoudige manier hun testresultaten online ontvangen en dat deze in begrijpelijke taal worden verstrekt. De waargenomen self-efficacy is de voorspelling van latere gedragshandelingen. Zowel bruikbaarheid als self-efficacy beïnvloeden de intentie van een individu om met de online testresultaten aan de slag te gaan.

In twee cross-sectionele studies (**hoofdstukken 2 en 3**) werden de attitudes van patiënten onderzocht ten aanzien van het online patiëntenportaal. De studies werden uitgevoerd met behulp van de eHIQ-vragenlijst. De eHIQ-subschaal Informatie en Presentatie werd gebruikt om de bruikbaarheid van het patiëntenportaal te beoordelen, en de eHIQ-subschaal Motivatie en Vertrouwen om te Handelen werd gebruikt om de self-efficacy te beoordelen en zo te bepalen of patiënten gemotiveerd waren om te handelen naar aanleiding van de getoonde informatie.

In de eerste studie (**hoofdstuk 2**) werd de vragenlijst ingevuld door 354 patiënten. In deze studie werd vastgesteld dat de deelnemers de verstrekte informatie gemakkelijk te begrijpen vonden, dat de bruikbaarheid van het portaal positief werd beoordeeld, en dat de deelnemers veel vertrouwen hadden in het portaal. Er werd een positief verband

gevonden tussen de bruikbaarheid en de motivatie om te handelen naar aanleiding van de gepresenteerde informatie. Dit betekent dat als patiënten het portaal gemakkelijk in gebruik vinden, dit een positief effect heeft op hun motivatie om te handelen. Echter, het portaal helpt patiënten slechts in geringe mate om een actieve rol te spelen in het managen van hun gezondheid. In de tweede studie (**hoofdstuk 3**) is onderzocht of de kenmerken van de patiënt een rol spelen in de mate waarin het online patiëntenportaal als bruikbaarheid wordt ervaren en of het aanzet tot zelfmanagement. Deze patiëntkenmerken zijn gender, leeftijd, opleiding en chronische ziekte. De eHIQ is door 748 patiënten ingevuld. Deze studie toont aan dat de hoger opgeleide gebruikers van een patiëntenportaal lager scoorden op bruikbaarheid en hen in mindere mate aanzet tot zelfmanagement. De bruikbaarheid was ook lager voor ouderen, en voor patiënten met astma of COPD. Dit onderzoek toont aan dat de communicatie op patiëntenportalen specifiek moet worden afgestemd op de verschillende doelgroepen.

Verder onderzoek moet uitwijzen welke factoren vanuit patiëntenperspectief belangrijk zijn bij het op maat maken van een online portaal voor de verschillende groepen, en hoe een online patiëntenportaal optimaal geïntegreerd kan worden binnen de dagelijkse praktijk van een arts.

Deel 2. Evaluatie van eHealth Vanuit een Organisatorisch Perspectief: Welke Factoren Houden Verband met de Kwaliteit van Hybride Gezondheidszorg?

eHealth is het meest effectief wanneer het wordt gecombineerd met reguliere en traditionele zorg, ook wel hybride gezondheidszorg genoemd. Het organiseren van hybride gezondheidszorg is lastig, vooral om deze vorm effectief te laten werken in de praktijk. Er is behoefte aan kennis over hoe hybride zorg kan worden verbeterd en van toegevoegde waarde kan zijn voor patiënten en zorgverleners.

In het tweede deel van dit proefschrift hebben we met een systematisch literatuuronderzoek (**hoofdstuk 4**) en een concept mapping studie (**hoofdstuk 5**) onderzocht welke factoren samenhangen met de effectieve organisatie van hybride zorg. Op basis van de bevindingen hebben we een kwaliteitsmanagementmodel voor hybride zorg ontwikkeld. In beide studies is gebruikgemaakt van het raamwerk Structuur-Proces-Uitkomst (Structure-Process-Outcome; SPO) van Donabedian. Structuur is de setting van de zorg zelf en de beschikbare middelen. Proces is de zorgverlening zelf en uitkomst is het eindresultaat van de zorgverlening. Volgens Donabedian is de kwaliteit van zorg gebaseerd op deze drie categorieën en hun onderlinge verbanden.

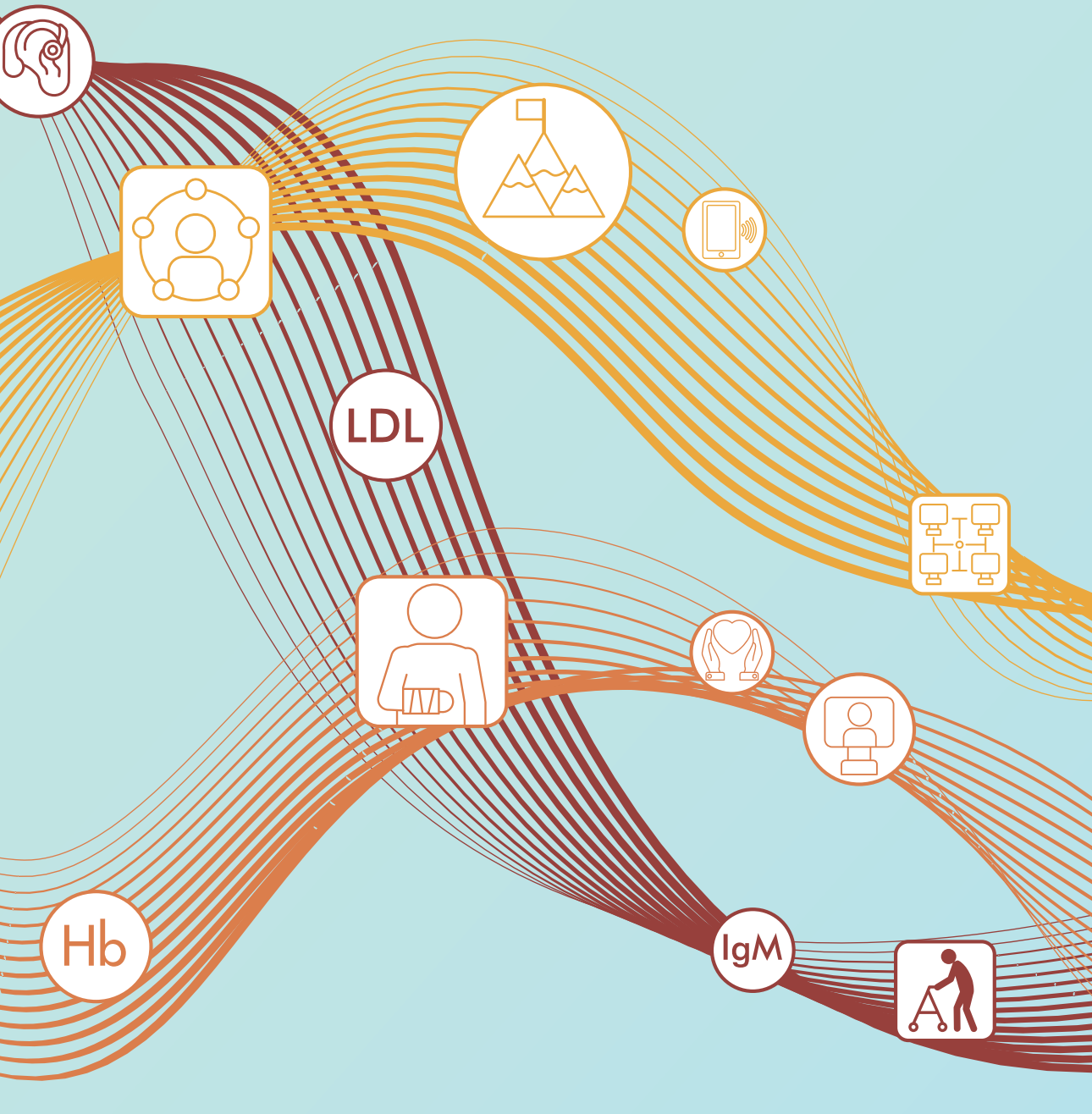
In de systematische literatuurstudie werden 739 studies gescreend, gericht op de implementatie en evaluatie van eHealth en waarbij potentiële structuur-, proces- of uitkomstindicatoren werden beschreven **(hoofdstuk 4).** 11 van deze studies zijn in de review opgenomen. Er werden data-extractiebladen ontworpen om een overzicht te maken van de studiekarakteristieken, eHealth-karakteristieken, en indicatoren. Indicatoren die een potentiële impact hadden op de integratie van eHealth in de gezondheidszorg werden geselecteerd. De verzamelde indicatoren werden geordend op thema's en

subthema's van de categorieën Structuur, Proces en Uitkomst. Tevens werd geanalyseerd of de indicatoren elkaar beïnvloedden. In totaal werden 111 unieke indicatoren gevonden. Over het geheel genomen bleek uit de studie dat er drie basisbeginselen kunnen worden vastgesteld die belangrijk zijn voor een succesvolle integratie van eHealth. Ten eerste moet de rol van de patiënt ingebed zijn in de organisatiestructuur en het zorgproces. Ten tweede moet de technologie worden afgestemd op de organisatiestructuur en het zorgproces. Ten derde moet de personele bezetting in het zorgproces worden afgestemd op de gewenste uitkomsten. Onvoldoende aandacht voor deze drie beginselen kan een negatieve invloed hebben op de organisatie, het zorgproces of de uitkomsten.

In de concept mapping studie zijn de bevindingen uit de literatuurstudie aangevuld en gevalideerd met praktijkkennis van eHealth-gebruikers. Een doel van dit onderzoek was het ontwikkelen van een kwaliteitsmanagementmodel voor hybride zorg met een bijbehorende quickscan. Zorgorganisaties kunnen dit model en deze quickscan gebruiken om hun eigen hybride zorg goed te organiseren en te verbeteren. Het model en de vragenlijst zijn gebaseerd op het SPO-raamwerk van Donabedian. Er hebben 39 personen deelgenomen aan de studie en zij hebben hun visie gegeven over welke factoren bijdragen aan het zo effectief mogelijk organiseren van hybride zorg en tot welke uitkomsten dat moet leiden. De groep bestaat uit een mix van zorgprofessionals, managers, bestuurders, projectleiders, onderzoekers, patiënten, eHealth-ontwikkelaars, werkzaam in verschillende zorginstellingen en -settings. Uit dit onderzoek blijkt dat de kwaliteit van hybride zorg bepaald wordt door een combinatie van organisatorische, technologische, procesmatige, en persoonsgebonden factoren. De 33 belangrijkste factoren zijn gegroepeerd in 8 clusters: 1. Visie, strategie en organisatie; 2. Kwaliteit IT-infrastructuur en -systemen; 3. Kwaliteit eHealth-toepassing; 4. Ondersteuning van zorgprofessionals; 5. Vaardigheden, kennis en attitude van zorgprofessionals; 6. Aandacht voor de patiënt; 7. Patiëntresultaten, en 8. Lerend systeem. De categorieën Structuur-Proces-Uitkomst zijn als overkoepelende thema's neergezet om de onderlinge verbanden tussen de clusters te benadrukken. Het model visualiseert de onderlinge verbanden tussen de factoren. Met de vragenlijst kan een zorginstelling van elke factor beoordelen hoe effectief deze is georganiseerd binnen de eigen organisatie, dan wel is verbeterd. Het model en de vragenlijst hebben de werknaam Hybrid Health Care Quality Assessment (HHQA) gekregen.

Hoofdstuk 6 beschrijft de reflecties op de resultaten en de gebruikte methodologie van de studies, met suggesties voor vervolgonderzoek en de dagelijkse praktijk. We concludeerden dat een effectieve organisatie van eHealth wordt bepaald door een complexe interactie van organisatorische, technische, procesmatige en persoonlijke factoren. Voor hybride gezondheidszorg van hoge kwaliteit moet rekening worden gehouden met de veranderende persoonlijke behoeften van de patiënt, de nieuwe patiënt-zorgprofessional-eHealth-relatie, en het organisatorische ontwerp van hybride zorgverlening. Zorgorganisaties kunnen de HHQA gebruiken om de kwaliteit van hybride gezondheidszorg te evalueren en kansen op verbetering te signaleren. Het model en de vragenlijst hebben een spiegelfunctie en maken duidelijk wat er gedaan moet worden. Vervolgens worden in het hoofdstuk suggesties gedaan voor toepassing in de praktijk en verder onderzoek zoals HHQA validatiestudie, interventieonderzoeken, herhaling van

de concept mapping studie in andere gezondheidszorgomgevingen, bijvoorbeeld in "low resource settings" (omgevingen met weinig middelen); en weging toepassen op de mate van invloed van de factoren op de kwaliteit van de hybride gezondheidszorg. Ten slotte wordt de HHQA geïllustreerd aan de hand van een casestudy.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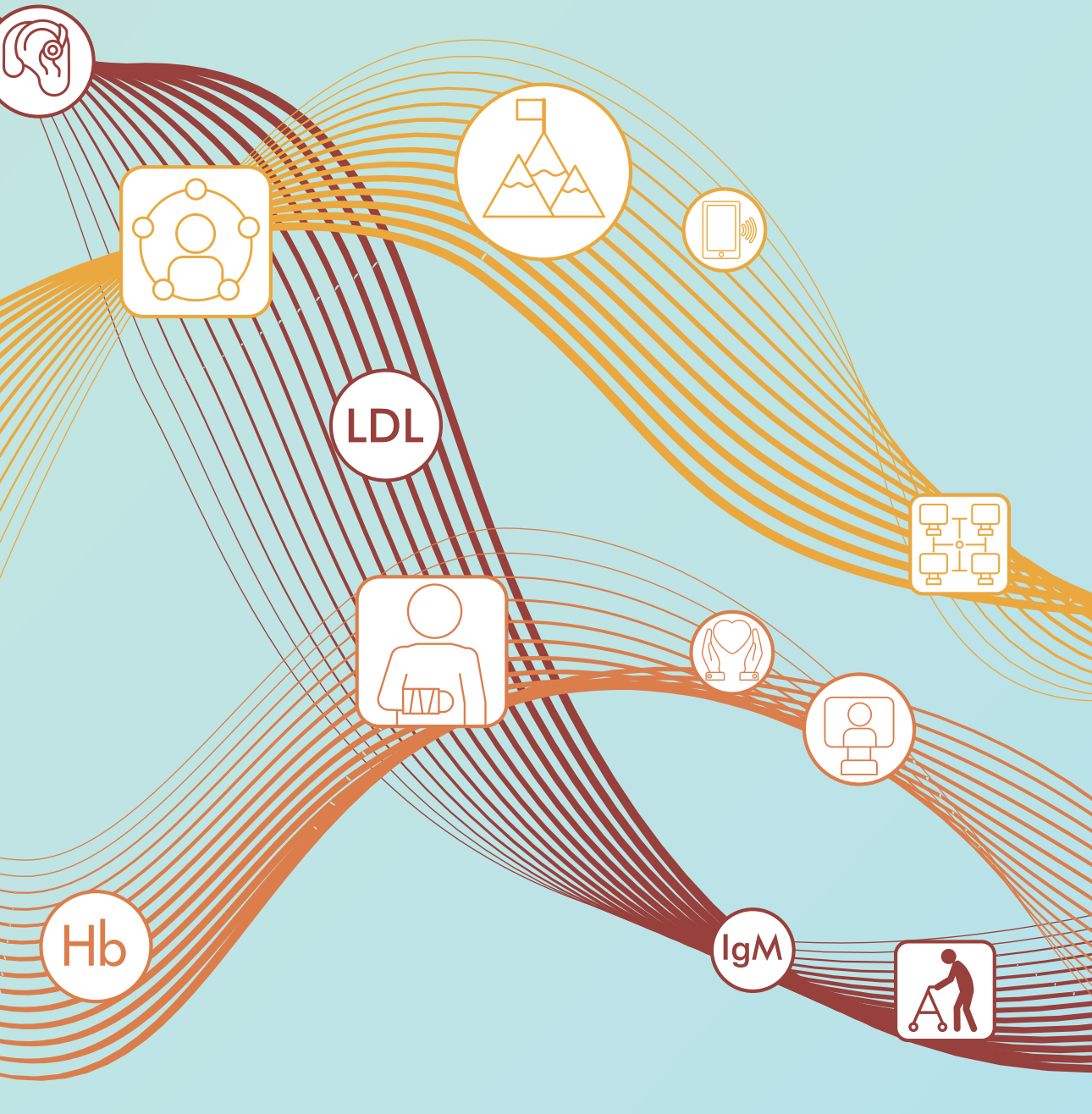
Curriculum Vitae

Rosian Tossaint-Schoenmakers was born in 1976 in Beek en Donk in the province of North Brabant in the Netherlands. She graduated from Macropedius College High School in Gemert in 1994 and went on to study physiotherapy in Eindhoven. During her clinical placement she observed numerous organizational inefficiencies in the health care system, and developed her interest in improving it. After taking some time out backpacking around Asia, Australia and New Zealand, Rosian returned to the Netherlands, where she enrolled in a Health Policy and Business Administration course at the Faculty of Health Sciences at Maastricht University, combining her studies with working as a physiotherapist. She graduated in Health Logistics, conducting her research in the surgical center at the Wilhelmina Children's Hospital in Utrecht, and subsequently travelled to India to pursue research on improving the distribution of tuberculosis medicines.

In 2002, back in the Netherlands, Rosian began working as a physiotherapist in a primary health care center, and became manager for two centers. Curious to learn more about improving health care and missing learning about the latest developments from her university studies, she began working as a Health Operations Management consultant at Prismant in 2006, and continued to work for its successor companies. For nine years she worked closely with people in both clinical practice and academia, helping health care institutions improve their capacity management and clinical pathways, and developing and delivering training in lean management and health care logistics. She was also an advisor on national breakthrough projects in the rehabilitation sector. In 2015 she took on the roles of Interim Program Manager for Clinical Pathways, Routine Outcome Monitoring, and eHealth and Interim Manager for Forensic Care at the mental health institution GGZ Oost Brabant. There she was exposed to the complex, fascinating dynamics involved in eHealth and its impact on the organization, health care professionals and patients. After that, she began working as a manager at Saltro, where she also saw many parallels with the impact of eHealth in the same areas. In 2019, she moved to the Innovation team to focus on improving health care using digital solutions, among others. She began the scientific research presented in this thesis under the guidance of Professor Niels Chavannes, Dr Esther Talboom-Kamp and Dr Marise Kasteleyn. After completing her thesis, her goal is to continue improving health care through scientific research and by translating knowledge into practice and vice versa.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List of publications and presentations

Peer Reviewed Publications

Development of a Quality Management Model and Self-assessment Questionnaire for Hybrid Health Care: Concept Mapping Study. Tossaint-Schoenmakers R., Kasteleyn M., Rauwerdink A., Chavannes N., Willems S., Talboom-Kamp E. JMIR Form Res 2022 Jul 7;6(7):e38683. doi: 10.2196/38683.

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The impact of patient characteristics on their attitudes toward an online patient portal for communicating laboratory test results: real-world study. Tossaint-Schoenmakers R., Kasteleyn M., Goedhart A., Versluis A., Talboom-Kamp E. JMIR Formative Research. 2021 Dec 17;5(12):e25498. doi: 10.2196/25498.

Patients' attitudes toward an online patient portal for communicating laboratory test results: real-world study using the eHealth Impact Questionnaire. Talboom-Kamp E., Tossaint-Schoenmakers R., Goedhart A., Versluis A., Kasteleyn M. JMIR Formative Research. 2020 Mar 4;4(3):e17060. doi: 10.2196/17060.

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List of Presentations (Selection)

The Impact of Patient Characteristics on their Attitudes Toward an Online Patient Portal for Communicating Laboratory Test Results. Poster presentation, WONCA Europe GP Conference. Londen United Kingdom. 2022 June 28 – July 1.

The challenge of integrating eHealth into health care. Poster presentation, European Congress of Internal Medicine (ECIM). Malaga, Spain. 2022 June 9 – 11.

Hoe organiseer je eHealth succesvol binnen de bestaande zorg? Presentation, Nederlands Huisartsen Genootschap (NHG) -Wetenschapsdag. The Hague, The Netherlands. 2022 June 8.

The impact of patient characteristics on their attitudes toward an online patient portal for communicating laboratory test results. Presentation, NHG-Wetenschapsdag. The Hague, The Netherlands. 2022 June 8.

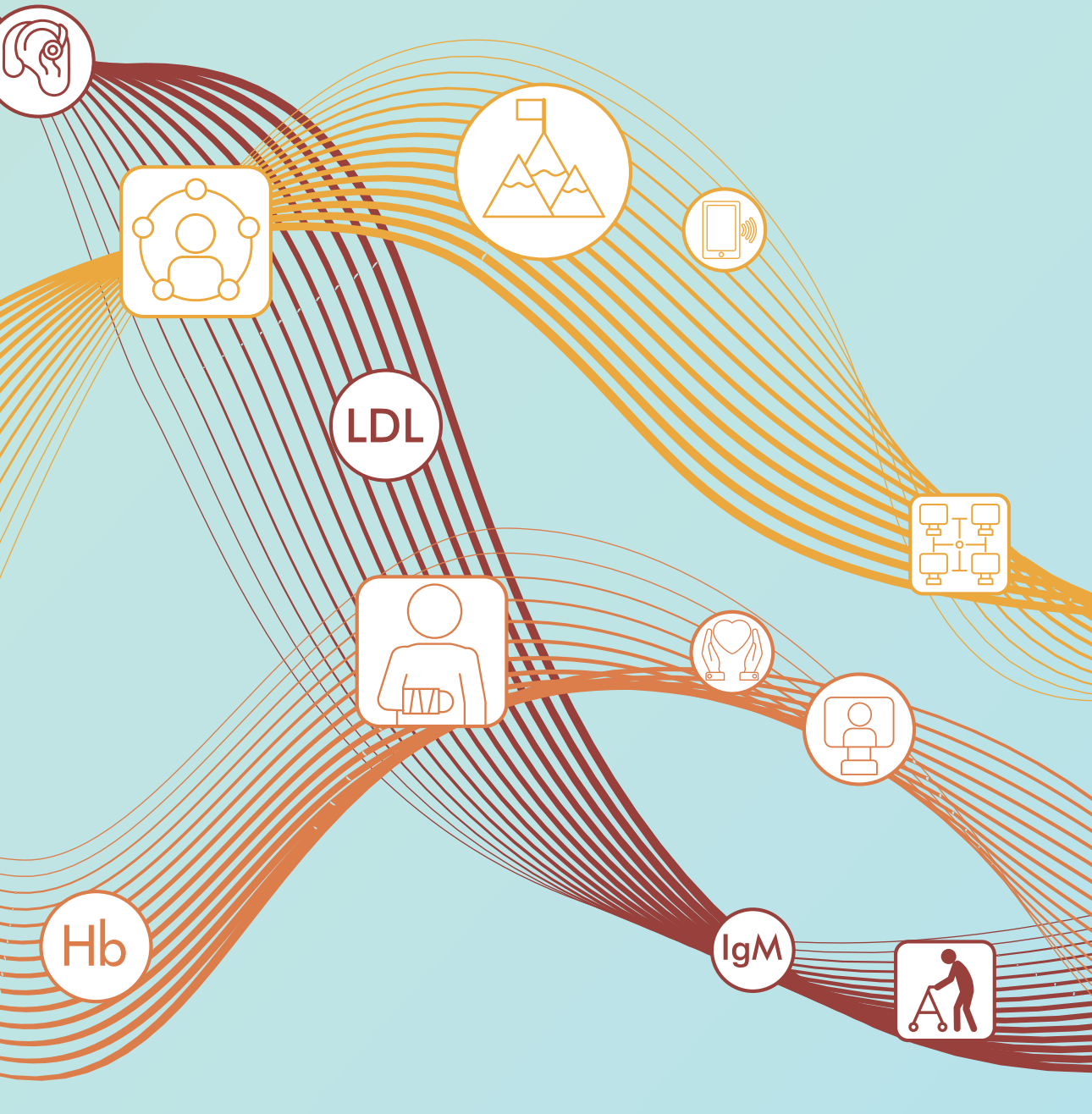
Patient centered e-diagnostics. How to organize hybrid health care? Presentation, LUMC Department of Parasitology. Leiden, The Netherlands. 2022 May 19.

The challenge of integrating eHealth into healthcare. Masterclass eHealth, WONCA Virtual Europe GP Conference. 2021 July 7.

The impact of patient characteristics on their attitudes toward an online patient portal for communicating laboratory test results. Poster presentation, Health by Technology Virtual conference. 2021 June 10.

Patients' attitudes toward an online patient portal for communicating laboratory test results. Poster presentation, Health by Technology Virtual conference. 2021 June 10.

The challenge of integrating eHealth into healthcare. Presentation, LUMC Public Health and Primary Healthcare. Leiden, The Netherlands. 2020 December 15.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Dankwoord

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"Logic will get you from A to B. Imagination will take you everywhere."

- Albert Einstein