Dynamische mHealth mogelijkheden als drijfveer voor de dienstverlening

Een empirisch onderzoek van zorginstellingen in Nederland

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Dynamic mHealth capabilities as a driver of service performance

An empirical study of Healthcare Organizations in the Netherlands

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Abstract

In the Netherlands the rising number of new technologies and rapid demographic changes have a major effect on healthcare. Although the importance of implementing innovative technologies is known in healthcare, little research has been conducted on how to develop health information technology, such as mHealth, to improve service performances. The objective of this paper is to maintain or to improve the service performance levels in hospital departments. This study aim is to determine if patient service performance of hospital departments is affected via dynamic mHealth capabilities. This study performed exploratory research to verify the relationships between variables via partial least squares structural equation modeling. Therefore, this study investigated survey data of medical professionals in Dutch hospital departments. This study implies that hospital departments should see the potential of embedding dynamic mHealth capabilities to increase their decision rationality and strategic flexibility competences as a significant positively correlation has been found between variables. However, it is critical to say that this study cannot evaluate the effect as only a correlation assessment was performed.

Keywords: *dynamic capability, mHealth, decision rationality, strategic flexibility, hospital, healthcare*

Summary

In the Netherlands the rising number of new technologies and rapid demographic changes have a major effect on healthcare. Although the importance of implementing innovative technologies is known in healthcare, little research has been conducted on how to develop health information technology, such as mHealth, to improve service performances. The study aims to answer the following research question: *Does dynamic mHealth capabilities affect the patient service performance of hospital departments?* To answer the research question the following questions need to be addressed. First, this study investigated what the characteristics of dynamic mHealth capabilities are, and their current presence is hospitals. Secondly, this study verified whether the effect of dynamic mHealth capabilities on patient service performance is mediated via variables.

Via a systematic review, existing studies are located to set up the theoretical framework. Based on previous literature, a dynamic mHealth capability can be acknowledged as an expertise, talent, and skill of the hospital departments to manage mHealth technologies to innovate their products and services. Several papers have shown the key role of decision rationality and strategic flexibility on service performance and suggest a link with dynamic capabilities. For this reason, this study developed a theoretical model consisting of the following four hypotheses: dynamic mHealth capabilities positively impacts HCO departments' decision rationality; dynamic mHealth capabilities positively impacts HCO departments' strategic flexibility; strategic flexibility positively impacts HCO departments' patient service performance; decision rationality positively impacts HCO departments' patient service performance.

A questionnaire was expanded among medical professionals in Dutch hospitals to find out. The sampling frame consisted of doctors, managers, team leaders and department heads of different departments within Dutch hospitals. An important assumption of this population is that respondents had an intelligent insight into the use of IT and need to be actively in contact with patients. The generated survey consisted of demographic data and construct items. First, demographic data is collected to include or exclude the needed samples and to summarize the characteristics of this study. The required demographic data is based on previous literature. To research the relationships between variables in the research model, quantitative research is performed based on the variables 'dynamic mHealth capability', 'decision rationality', 'strategic flexibility', and 'service performance'. Therefore, construct items were generated based on validated scales in previous literature. All construct measurement items were classified via a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Eventually, the theoretical model was assessed by 13 completed surveys. This study presents assumable support for the established hypotheses. Research discovered a significant positive coherence between dynamic mHealth capabilities, strategic flexibility, and decision rationality. Moreover, significant positive coherences were found between strategic flexibility and patient service performance, and decision rationality and patient service performance. It is critical to say that this study can only stay with an assumption as only a correlation assessment was performed. Therefore, no positive effect has yet been shown between dynamic mHealth capabilities and patient service performance. For this reason, future research is required to elaborate further on the possible effect of dynamic mHealth capabilities on patient service performance.

In contrast to previous research, this study focused on the effect of one of the innovative HITs, namely mHealth, in hospital departments in the Netherlands. Based on these results, this study implies that hospital departments should see the potential of embedding dynamic mHealth capabilities to increase their decision rationality and strategic flexibility capabilities as these capabilities are assumed to be positively correlated to patient service performance. If medical professionals are open to the innovative HIT mHealth, and can embrace dynamic mHealth capabilities in their organization, hospitals are of greater chance to improve their processes and services.

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1. Introduction

1.1 Theoretical background

In the Netherlands, as worldwide, the rising number of new technologies and rapid demographic changes have a major effect on healthcare (Bradley et al., 2012; Tarenskeen et al., 2020). A shift towards patient centered care is one of the effects (Tarenskeen et al., 2020). Following the study of Bradley et al. (2012), patient centered care is the ability to supply appropriate services and care that are aligned with patient needs. However, there is limited understanding about the functioning role of IT in sensing and responding capabilities (Wetering & Versendaal, 2021). Therefore, it remains hard to correspond to the needs and wishes of patients sufficiently. To maintain or enhance patient service performance, it is important to modify current systems in hospital departments. Besides, to react to rapid demographic changes, hospitals must leverage their future Health Information Technology (HIT) investments. By doing so, healthcare organizations are prepared for rapid changes in the environment and can meet the essentials of administrative and clinical processes (Tarenskeen et al., 2020).

Due to digital transformation and new technologies, HIT has developed substantially over the last two decades (Karaca et al., 2019) and takes an important role in daily medical practices (Wetering, 2021b). Usage of technology and the awareness of innovative electronic health (eHealth) is of major importance in healthcare organizations (HCOs) as they rely on HIT in their patient services (Wu et al., 2022). Therefore, HCOs are investigating innovative HIT and digital possibilities to enhance their procedures and thereby healthcare services, doctor-patient relationships, partnerships with stakeholders, and value for patients (Wu et al., 2022; Wetering et al., 2021a). In other words, health care systems, hospitals, are embracing the digital transformation (Wetering, 2021c).

Examples of innovative technologies that could be mentioned are applications, internet of things (IoT), electronic medical records (EMR) and decision-support systems (Wetering, 2021c). Another well-known feature in health care delivery is mobility (Prgomet et al., 2009). The mobility of information systems is required to give physicians access to data resources during their work in any time and any place. The anytime-any place operability and application functions of smartphones produces several chances for health promotion (Cao et al., 2021). Health promotion that is aided by mobile devices can be described as mobile health (mHealth) (Cao et al., 2021; Rowland et al., 2020). Greenspun et al. (2014) reported that mHealth can be divided in four different dimensions namely, single use mHealth, social mHealth, integrated mHealth and complex mHealth. This study will focus predominantly on the third dimension: integrated mHealth. Integrated mHealth enables data exchange between a healthcare provider - e.g. electronic health records (EHR) - and multiple end users, such as administrators, consumers and clinicians (Greenspun et al., 2014). It is assumable that mHealth will be fully integrated in future clinical treatments to enhance clinical processes, outcomes, and to elevate the efficiency of specialized therapies (Rowland et al., 2020).

1.2 Problem statement

Therefore, perception of the utilization of the innovative technology mHealth is of major importance for present HCOs to enhance their patient service performance. With the help of possible new technologies, HCOs can improve their healthcare and business services. Consequently, enhancing the relationships between doctors and long-term value for patients (Wu et al., 2022).

Although the importance of implementing innovative technologies is known in healthcare, little research has been conducted on how to develop HIT to improve service performances (Wetering, 2021c). Rowland et al. (2014) shows that there is hardly any clinical guidance about how the utilization of mHealth could contribute towards increased value of patient care. To proactively react to changes and opportunities in the environment, dynamic capabilities are required. According to Teece et al. (1997) the dynamic capability is '*the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment's (p. 516)* '. Based on the limited research, it is important to understand how dynamic mHealth capabilities can lead to the enhancement of service performances.

1.3 Research objective

This study aim is to determine if patient service performance of hospital departments is affected via mHealth. As literature shows the importance of hospital department's dynamic mHealth capability, the following research question will be conducted during this study:

Does dynamic mHealth capabilities affect the patient service performance of hospital departments?

To understand how dynamic capabilities can enhance service performances it is important to understand what dynamic mHealth capability is in general. Moreover, as this study is performed in hospitals, it is important to know what already is known about dynamic mHealth capability in hospital departments. Therefore, the following sub questions will be answered during this study:

1. What are dynamic mHealth capabilities?
2. Wat is already known about dynamic mHealth capabilities in hospital departments?

Concerning the service performance, it is critical to get a better understanding of what service performance is, and why it is important in hospital departments. Finally, to answer the research question, it is crucial to discover by what mechanisms dynamic mHealth capability drives service performance levels. Therefore, the following sub questions will be answered during this study:

3. What is service performance?
4. Via which variables could dynamic mHealth capability increase service performance?

The objective of this paper is to maintain or to improve the service performance levels in hospital departments. However, little research is available about the required dynamic mHealth capabilities. To maintain or improve service performance in hospital departments it is important to determine what the effect is of dynamic mHealth capabilities, and via which variables these capabilities could increase service performance levels. This study will elaborate further on the effect of dynamic capabilities on service performance via the utilization of mHealth in HCO's. Results could help hospital departments in the future by implement, maintain, and improve the required dynamic mHealth capabilities.

1.4 Main lines of approach

The following section of the report will describe the theoretical framework. The theoretical framework explains more about the research approach, the implementation of literature reviews, the developed theoretical framework and finally the objective of the follow-up research. Section 3 validates the empirical research of section 2 as the methodology will be subscribed. Next, section 4 provides a brief description of the conducted research and the results. Based on the results, the discussion, conclusion, and recommendations are provided in section 5.

2. Theoretical framework

2.1 Research approach

The objective of this study is to determine if service performance of hospital departments is affected by dynamic mHealth capabilities. To answer the research question the following questions need to be addressed:

- What are the characteristics of dynamic mHealth capabilities?
- Via which variables does dynamic mHealth capability increase service performance levels.

For setting up the theoretical framework, literature research has been performed via the OU library. To find this literature, the queries '(Dynamic capability) AND (Healthcare)', '(Dynamic capability) AND (Strategic)' and '(Dynamic capability) AND (Service performance)' have been used.

2.2 Selection of studies

Via a systematic review (appendix A, figure A1) existing studies are located per query and included for identification via inclusion and exclusion criteria (appendix A, table A1). Continuously, studies were eligible to include in this paper if they fulfilled the inclusion criteria as presented in appendix A (table A2).

Within the first search strategy the query '(Dynamic capability) AND (Healthcare)' was performed and resulted in 779 hits. Inclusion and exclusion criteria for identification were performed for the parameters publication period, language, literature type and correspondence between the title and query (appendix A, table A1). Subsequently, duplicates were identified and excluded. Thereafter, inclusion criteria were performed for eligibility screening (appendix A, table A2). Irrelevant studies were removed, and the remaining articles were fully screened and included, resulting in 5 articles. Based on the full screening, a snowball technique was performed, adding up to 6 articles in total.
The second query '(Dynamic capability) AND (Strategic)' resulted in 3555 hits. Following the systematic review method, all articles were screened for the identification criteria, duplicates were removed, and eligibility screening was performed. 4 articles remained and 6 articles are added by performing a snowball technique (appendix A, table A2).
The last query '(Dynamic capability) AND (Service performance)' resulted in 2934 hits and 3 articles remained (appendix A, table A1). Between the queries, duplicates were shown. Therefore, again duplicates were removed for the total count of articles. The total literature search resulted in 17 articles (appendix A, table A3).

2.3 Theoretical background

2.3.1 Dynamic capabilities

Dynamic capabilities are well known as the 'Holy Grail' of strategic management (Zhou et al., 2019). According to van de Wetering (2022) dynamic capabilities can be viewed as primary capabilities offering an organization the capability to establish, continue and change their basis, and are driven by digital innovations. In addition, these capabilities enable firms to act on rapidly changing environments via the integration, development and reconfiguration of external and internal recourses and assets (Teece et al., 1997). Dynamic capabilities can be divided into multiple groups, namely: sensing capability, seizing opportunities, and the reconfiguring capability (Teece, 2007). Thereby, a firm can meet changing customer needs and increases their fitness. Dividing the seizing capability into two categories results into value capture and orchestrating (Teece et al., 2020). According to Teece et al. (2020), value capture relates to business model innovation and gaining accompanying benefits. Orchestrating capabilities are associated with the integration and reconfiguration of important assets to maintain or improve the innovation process (Teece et al., 2020). The study of Teece et al. (2016) indicates that strong dynamic capabilities can be both enhanced or diminished by the strength or weakness of firm strategies. This possibly indicate a correlation between dynamic mHealth capabilities and service performance in hospitals.

2.3.2 Dynamic mHealth capabilities

If hospitals want to improve their patient service performance via mHealth, they must be willing to develop a dynamic mHealth capability. A dynamic mHealth capability can be acknowledged as an expertise, talent, and skill of the hospital departments to manage mHealth technologies to innovate their products and services. An example of the application of dynamic capabilities in HCO's is the study of Wu et al. (2022). Following this study, the establishment of eHealth innovations depends on alertness and assimilation to alert and adapt external knowledge to support strategic and operational activities (Wu et al., 2022). According to Wu et al. (2022), being alert to external environments enables HCO to spot chances to stimulate eHealth innovations in services and processes. Therefore, the ability to exploit innovations are established by three different factors. First, exploiting eHealth innovations are determined by understanding developments in the healthcare market. Secondly, exploiting eHealth innovations could be dependent on the ability to foresee shortcomings in services and processes. Finally, possessing the ability to adjust the shortcomings in question through HIT innovations. For this reason, Wu et al. (2022) define eHealth entrepreneurial alertness as *'an HDO's capability to sense or identify threats from competitors as well as changes regarding the environment, technology, and policy in the eHealth context'*. The importance of assimilation can be outlined by the fact that it enables HCOs by improving services and processes via the deployment of eHealth innovations. For the adaption, current knowledge, services, and processes are combined to assimilate eHealth innovations. Combining the capabilities alertness and assimilation enables HCOs to create new capabilities, consequently leading to development of new healthcare services (Wu et al., 2022).

Rapid demographic changes in environments of HCO's demands strategic choices to establish healthcare services. The study of Wu et al. (2022) already implies the importance of dynamic eHealth capabilities. However, little information is available about the possible advantages of mHealth on service performances in hospitals and subsequently how to implement these insights. Hence, to develop dynamic mHealth capabilities, hospital departments must possess certain competencies. Haarhuis & Liening (2020) addresses the gap between the required assets and the strategic foresight. Haarhuis & Liening (2020) defines strategic foresight as the potential to create, and maintain a forward view, and to implement these insights in organizationally manners. Therefore, Haarhuis & Liening (2020) focuses on the impact of strategical foresight on the dynamic capability's decision rationality and strategic flexibility. Following Haarhuis & Liening (2020), foresight promotes these dynamic capabilities as it enables to generate and prolong a quality view. Based on these papers, this study assumes a prominent role for dynamic mHealth capabilities to impact patient service performance via the stimulation of the competences decision rationality, and strategic flexibility.

<u>Decision rationality</u>

Decision rationality represents activities that form the sensing capacity of organization by researching costumer requirements, competitor behavior and collecting new information (Haarhuis & Liening, 2020; Naldi et al., 2014). The study of Teece (2014) supports the fact that decision rationality can be treated as a dynamic capability because gathering information in a rapidly changing environment is of major importance.

The establishment of eHealth innovations depends on eHealth entrepreneurial alertness and eHealth assimilation to alert and adapt external knowledge to support operational activities (Wu et al., 2022). Gained knowledge by environmental scanning possibly provides decision makers with important information and could possibly thereby increase decision rationality (Haarhuis & Liening, 2020). Therefore, m

Health entrepreneurial alertness and mHealth assimilation are possibly of major importance to implement decision rationality in HCO's. As the establishment of eHealth innovations depends on the eHealth entrepreneurial alertness and eHealth assimilation (Wu et al., 2022), and both are possibly required to conduct decision rationality, it appears assumable that decision rationality is affected by Dynamic mHealth capabilities. Concretizing the assumptions above, it appears logical that decision rationality is impacted by Dynamic mHealth capabilities. Hence, this study defines the following:

> **H1: Dynamic mHealth capabilities positively impacts HCO departments' decision rationality.**

Strategic flexibility

Besides the well-known dynamic capabilities frameworks (Teece, 2007; Teece et al., 2020), several classifications of dynamic capabilities have been developed in the last few years (Sermontyte-baniule et al., 2022). Based on the last framework of Teece et al. (2020), Pundziene et al. (2021) suggests a framework of five dynamic capabilities. The capability 'sensing' of Teece et al. (2020) has been divided into two classifications, namely environment scanning and opportunity selection capability. Environment scanning is associated with data detection and acquisition capabilities, which enables firms to monitor its internal and external environment (Pundziene et al., 2021). The opportunity selection capability is associated with data processing and sense-making capabilities, which enables firms to identify, develop and calibrate opportunities of internal and external needs and challenges (Pundziene et al., 2021). Scanning internal and external needs and challenges connects to the earlier view of multiple studies (Teece et al, 1997, Shimizu and Hitt, 2004; Nadkarni & Narayanan 2007) and Haarhuis & Liening (2020), where strategic flexibility is viewed as a pivotal dynamic capability by navigating the environment, recognizing, and responding to problems via sensing and seizing opportunities, and moreover via dealing with a changing environment. Haarhuis & Liening (2020) holds on to the conceptualization of Grewal and Tansuhaj (2001), which defines strategic flexibility as an investment over different business departments, flexible resources to react to uncertainties, and flexibility towards new chances due to a variable environment.

Nowadays, strategic flexibility is acknowledged by information systems and management literature as a noticeable dynamic capability that is aided by using innovative technologies (van der Wetering, 2022). Capabilities characterize the needed activities - such as systems, business processes, data, and people - to conduct the strategy successfully. Organizations are triggered via strategic flexibility to conduct their strategy on the most effective way via business resources, IT resources and its people. Moreover, the importance of strategic flexibility is well known in rapid changing environments to make sure that responding and sensing behavior are conducted adequately. Nevertheless, at the same time, hospitals are still struggling in their transition to innovative HIT (Wetering et al., 2021a). According to Wu et al. (2022) the establishment of eHealth innovations depends on eHealth entrepreneurial alertness and eHealth assimilation to alert and adapt external knowledge to support strategic activities. Therefore, MHealth entrepreneurial alertness and mHealth assimilation are possibly of major importance to implement strategic flexibility in HCO's. As the establishment of eHealth innovations depends on the eHealth entrepreneurial alertness and eHealth assimilation (Wu et al., 2022), and both are possibly required to implement strategic flexibility, it appears assumable that strategic flexibility is impacted by Dynamic mHealth capabilities. Concretizing the assumptions above, it appears logical that strategic flexibility is impacted by Dynamic mHealth capabilities. Hence, this study defines the following:

> **H2: Dynamic mHealth capabilities positively impacts HCO departments' strategic flexibility.**

2.3.3 Service performance

Leung (2012) states that dynamic capabilities are essential for implementing services and digital transformations of healthcare systems. Dynamic capabilities enable firms to reach their long-term business performance (Teece, 2007). However, the discussion continues if and how dynamic capabilities can lead to firm performance (Zhou et al., 2019). The ambiguity of dynamic capability mechanisms results in contrary indications in several studies. The study of Teece et al. (1997) mentioned that dynamic capabilities have a direct impact on firm performance. This can be clarified by the effect of dynamic capabilities on the facilitation of resource development and access, creation of market change, and the ability to match changing environments with the resource base (Teece et al. 1997). Moreover, Teece (2007; 2014) elaborates this statement as these studies indicate that the framework of dynamic capabilities helps organizations to recognize the base of firm-level competitive advantage. Nevertheless, other papers specify that service performance does not depend on dynamic capabilities, but rather are influenced by recourse configurations (Zhou et al., 2019). Following Zhou et al. (2019), firms need to evolve and expand their products to secure advantage in a dynamic environment, thereby improving the performance of the organization. Strikingly, some papers even mention that dynamic capabilities possibly have a contrary effect on firm performance at the moment that no dynamic capabilities are required (Zhou et al., 2019).

Service performance in healthcare

The primary objective of HCOs is to leverage high-quality patientcare. Patient performance acknowledges three indicators in a strategic map of the BSC, namely hospital image, patient relationships and service attributes. Diverse critical process capabilities are concerned to regulate the success of a hospital, like medical services and innovation, logical services, and patient services (Wu and Hu, 2012). In addition, the structural model of Wu & Hu (2012) showed that patient performance capabilities are significantly mediated by hospital process capabilities.

Recent studies in HCO's assume the positive effect of dynamic capabilities on performances. Wetering et al. (2021a) show that the patient sensing capability and responding capability are positively impacted by the hospital department's digital dynamic capability. Follow up studies of Wetering et al. (2021b, 2021c) show the major role of IT ambidexterity on both capabilities. Ambidexterity enables firms to perform IT exploration and IT exploitation (Wetering et al., 2021b). Moreover, Wetering et al. (2021b, 2021c) show that patient agility positively influences patient service performance via the positive enhancement of IT ambidexterity. Patient agility can be defined as the capability to sense and respond to the needs and demands of patients (Wetering et al., 2021b). Furthermore, the study of Wetering et al. (2022) shows that patient service performance is positively enhanced by patient agility. Moreover, dynamic capabilities are critical to the strategic change of healthcare providers to pursue value-based performances and establish digital healthcare services (Sermontyte-baniule et al., 2022).

Based on found literature, it can be assumed that patient service performance is positively enhanced by dynamic capabilities. To verify whether the reported effect is influenced by mHealth in the same manner, it is crucial to explore via which mediating roles patient service performance can be influenced.

2.3.4 Mediating roles to increase patient service performance

Even though literature shows the relation between dynamic capabilities and performances, and studies indicate strategic flexibility is important to respond to changes in the environment, little literature is found that elaborates on the relation between patient service performance and dynamic mHealth capabilities via strategic flexibility. However, diverse institutes clarify that organizations investing in strategic flexibility are achieving efficiencies, innovativeness, IT and business alignment and quality enhancement on the operational capability Level. Besides, strategic flexibility enables organizations the distribution of digital innovations (van der Wetering, 2022)

Furthermore, several papers present a positive impact on performance. Results of the study of Nadkarni & Narayanan (2007), presents a positive relationship between strategic flexibility and firm performance. The paper of Wetering et al. (2021c) shows that patient service performance is positively impacted by patient agility, and strategic flexibility can be considered as a dynamic capability - that acts in the same way via sensing, seizing, and responding to changes and opportunities. Besides, a recent study of van de Wetering (2022) shows the significant and crucial role of strategic flexibility to gain operational benefits. Based on these findings, the following hypothesis is lined up.

H3: Strategic flexibility positively impacts HCO departments' patient service perfomance.

Besides strategic flexibility, Haarhuis & Liening (2020) states that firms also require decision rationality in an unpredictable environment. This paper describes decision rationality as "*the extent to which the decision process involves the collection of information relevant to the decision, and the reliance upon the analysis of this information in making the choice"* (Haarhaus & Liening, 2020, p6). Moreover, an empirical study shows a positive effect of the sensing and seizing capability on the innovative performance of firms (Naldi et al., 2014). As the paper of Wetering et al. (2021c) shows that patient service performance is positively impacted by patient agility and decision rationality can be considered as a dynamic capability - that acts in the same way via sensing capabilities – the following hypothesis is lined up.

H4: Decision rationality positively impacts HCO departments' patient service performance.

Figure 1 summarizes shows the associated hypothesis within the theoretical model.

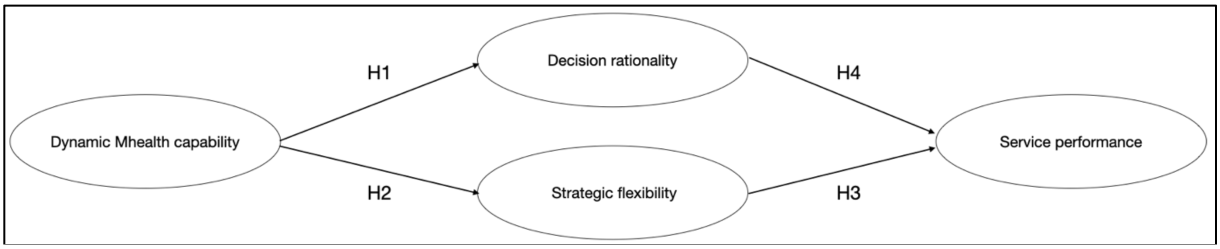

Figure 1: Theoretical model

2.4 Objective of the follow-up research

Enhancing service performance in hospital departments enables the quality of patient service care. Previous literature (Nadkarni & Narayanan, 2007; Wu and Hu, 2012; Naldi et al., 2014; Haarhuis & Liening, 2020; Wetering et al., 2021c; Wetering et al, 2022; van de Wetering, 2022; Wu et al., 2022) suggests that there is a relationship between dynamic mHealth capabilities, strategic flexibility, decision rationality and service performances. For this reason, it is important to investigate the impact of decision rationality and strategic flexibility on service performance. By conducting this study, we hope to find more about the possible effect of dynamic mHealth capabilities on strategic flexibility and decision rationality. Moreover, by investigating both aims, this study can answer the question what the effect of dynamic mHealth capabilities on hospital departments' service performances is. By finding an answer to this research question, this study could support hospital departments by further research to investigate the underlying mechanisms of dynamic mHealth capabilities to enhance service performances.

3. Methodology

3.1 Conceptual design

The purpose of this research design is exploratory research to explain relationships between variables. A quantitative method enabled us to examine the relationship as numerical and standardized data can be analyzed by using statistical techniques (Saunders et al., 2019). For this reason, a qualitative method is excluded - such as ethnography, action research, grounded theory, and narrative inquiry - as no relationship can be found based on unstructured data. Moreover, research methods that could be used for both quantitative or qualitative research - such as archival and documentary research, and a case study - are excluded from the possibilities. A case study cannot meet the requirements of the data collection as multiple data has to be gathered instead of a single case. Besides, no archival and documentary research is available about the chosen research model (Saunders et al., 2019). Principally two quantitative research methods are possible to deliver the needed information, namely an experiment and a survey. A survey is performed as this study determines whether a relationship is present. This study did not perform an experiment as it is not the purpose to predict the relationship.

3.2 Technical design

Due to the available time and number of researchers, a self-completed-survey is conducted as this enlarges the sample size in contrast to a researcher-completed survey. Moreover, the likelihood of contamination or distortion of the answers of respondents is low. The self-completed survey is based on an internet questionnaire as this enables a feasible length of the required questionnaire, a likely response rate, a possibility for a large sample size and a low likelihood of contamination of given answers (Saunders et al., 2019). Replications and consistency apply for this design as it covers threats to reliability as participants' error and bias are covered as surveys are self-completed. Thereby, the participant can fill in the survey when it suits the participant. Above allows an internal validity as different threats - such as past or recent events, testing, instrumentation, mortality, and maturation - are covered since the survey is about the current capabilities, is send only once and covers cross-sectional research. Nevertheless, external validity only applies to departments which have interactions with patients. Researchers' error and bias are covered as surveys are structured and based on literature research (Saunders et al., 2019). Therefore, the interpretation cannot change during this research.

The sampling frame consisted of doctors, managers, team leaders and department heads of different departments within Dutch hospitals. An important assumption of this population is that respondents have an intelligent insight into the use of IT and need to be actively in contact with patients. A list of hospitals in the Netherlands is drawn from approximately 250 locations (Informatie over Volksgezondheid en Zorg, 2022). For collecting data of 100 departments, a sample size of 200 responses is required as the internet questionnaire has a response rate of approximately 30-50% (Saunders et al., 2019). This study did only invite departments with sufficient contact and operational activities in leveraging care to patients. To embrace a response rate that is large enough, the design of individual questions, lucid exchange of the purpose and a clear visual presentation must be tested via a pilot by all master students, and if possible, by a medical participant. Conducting a pilot makes sure that questions are understood or acted by the respondent in the same manner as was considered by researchers. In addition, this guarantees that the given answers are understood in the same way by both researchers as respondents. For this reason, it is required that both researchers and medical professionals are part of the pilot. In addition, participants of the pilot will be selected based on affinity with healthcare and knowledge of business terms in healthcare. This will ensure that the correct terms are used for comprehensibility of the questionnaire. Based on the given facts, conducting a pilot ensures the robustness of the questionnaire.

3.3 Construct and items

Furthermore, the validity of the survey is tested for the content and the construct. To provide adequate coverage of the investigative questions this study used careful definitions of literature research. In addition, all researchers decide whether each item in the survey is necessary.

The generated survey consisted of demographic data and construct items. First, demographic data is collected to include or exclude the needed samples and to summarize the characteristics of this study. The required demographic data is based on previous literature (Wetering et al.,2022) (Appendix B). To research the relationships between variables in the research model, quantitative research is performed based on the variables 'dynamic mHealth capability', 'decision rationality', 'strategic flexibility', and 'service performance'. Therefore, construct items were generated based on validated scales in previous literature (Wu & Hu, 2012; Haarhaus & Liening, 2020; Wetering et al., 2022; van de Wetering, 2022; Wu et al., 2022) (Appendix C). All construct measurement items were classified via a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). By using for all event items, a Likert scale, which is coded on beforehand, results cannot be recorded or interpreted in a different way.

Concerning antecedent constructs, this study has elected measurement items originating from the recent paper of Wu et al. (2022). Accordingly, to this study, alertness and assimilation are of major importance to deploy eHealth innovation exploitation in HCOs. The model suggests a positive correlation between the potential alertness and assimilation and the innovation of innovative HIT.

Concerning mediating constructs, this study has chosen for using measurement items originating from the previous papers of Haarhuis & Liening (2020) and van de Wetering (2022). Haarhuis & Liening (2020) investigated the impact of strategic foresight on decision rationality and strategic flexibility. This paper describes decision rationality and strategic flexibility as two distinct types of dynamic capabilities (Haarhuis & Liening, 2020). For this reason, the measurement items of decision rationality are based on the study of Haarhuis & Liening (2020). The study of van de Wetering (2022) elaborates on the significant and crucial role of strategic flexibility to gain operational benefits. Therefore, the measurement items of strategic flexibility are based on the study of van de Wetering (2022).

To verify the outcome of the theoretical model, this study has chosen for using measurement items originating from the previous papers of Wu & Hu (2012) and Wetering et al. (2022). Recently, Wetering et al. (2022) showed the positive influence of IT ambidexterity on patient agility and thereby the hospital department's patient service performance. Therefore, measurement items of 'patient service performance' of the paper of Wetering et al. (2022) are followed. In addition, the measurement items of Wu & Hu are added to the construct patient service performance to increase the scope of the construct. Thereby, the construct does not only focus on patient satisfaction, quality of care delivery and accessibility, but availability and reputation as well.

3.4 Data analysis

Once collected, descriptive statistics were applied to summarize the characteristics of the data. Thereafter, this study verified whether the study sample was affected by method biases via the guidelines by Podsakoff et al. (2003). First, via Harman's single-factor analysis by using exploratory factor analysis. Besides, possible non-response bias was analyzed by a t-test. Thereby, possible significant differences in the responses could be discovered between early and late respondents. In addition, Cronbach's Alpha will be performed to assess the internal consistency reliability. Cronbach's Alpha assessment indicates whether the response values across the questionnaire are consistent for each response ID.

Continuously, data is analyzed by partial least squares (PLS) structural equation modeling (SEM) via SmartPLS. PLS-SEM is conducted as we mainly focus on an exploratory method by researching the relationship between multiple variables. In contrast to first-generation techniques, PLS-SEM is known for its causal-predictive model and primarily explains the variance in the dependent variables in research models (Hair et al., 2017). Thereby, PLS-SEM overcomes several limitations of first-generation techniques. First, PLS-SEM enables a model consisting of more than one layer of dependent and independent variables. Moreover, PLS-SEM is not restricted to observable variables. Finally, first generation techniques can only be applied when no random or systematic error occurs. PLS-SEM is applicable when systematic or random errors occur (Hair et al., 2017). This is crucial as this study encounters theoretical concepts and intentions, attitudes, and perceptions possibly occur.

Two theories are assessed in front to develop the path model: the measurement theory and the structural theory. To evaluate which indicators and how these are used to assess a certain construct, the measurement theory is conducted (Hair et al., 2017). Therefore, first the reliability and validity of the model is tested via several assessments. These assessments consisted of internal measurement validity, convergent validity, and consistency reliability of the first-order latent constructs. Besides, the heterotrait-monotrait ratio of correlations values and the cross-loadings between constructs were investigated (Hair et al., 2017). Evaluating the measurement validity estimates whether a construct measures what it is supposed to measure. Measuring the internal convergent validity enables this paper to estimate the degree to which a specific construct explains the variance of its indicators. Moreover, estimating the Internal consistency reliability determines the consistency of results over different items for the same test. Thereby it can be stated whether the correlation between items is strong.

Thereafter, the structural model and hypothesis were assessed. The structural model can only be assessed after analysis of the measurement model, as it is important to ensure the reliability and validity before the structural model can be confirmed. By assessing the structural theory, this study specified in which manner the constructs in the model are related to each other (Hair et al., 2017). Subsequently, the assumed relations were evaluated by its significance, and the coefficient of determination (R2). Thereby, estimating the predictive power of the model.

3.5 Ethical aspects

For ethical reasons, the research topic is formulated and clarified beforehand, and is presented to participants. Furthermore, participants must sign an informed consent before the participant can fill in the survey. Besides respondents have the right to withdraw at any moment. Survey data is collected anonymously. Thereby, the collected data may not relate to an identifiable natural person in such a manner that the data subject is no longer identifiable. Therefore, personal identifiers are excluded, and pseudonyms are used during data aggregation and reporting.

4. Results
4.1 Study characteristics

280 invitations have been sent to medical professionals in Dutch hospitals between 15 November 2022 and 7 January 2023. Medical professionals were invited to fill in the questionnaire via several methods. Invitations were sent via a post on LinkedIn, a blog via the platform of ICT&Health, direct connections in hospitals, general contact address of hospitals, and in most cases personal invitations via LinkedIn. During this period, invitees were able to complete the questionnaire anonymously. The data collection resulted in a response rate of 15,7% (n=47). Only 13 medical professionals were able to complete the questionnaire completely and are used for final analyses. Engaged medical professionals perform their profession at diverse departments, such as surgery, anesthesiology, dermatology, intensive care adults, pediatrics, nephrology, orthopedics, first aid, urology, geriatrics and somewhere else (table 1). Most of the medical professionals were practicing doctors (30,8%) or team leaders (23,1%). 46,2% of the engaged medical professionals worked at a top clinical training hospital, 15,4% at a general training hospital, 15,4% at another general hospital, 7,7% at a university medical center and 2 professionals somewhere else (table 2). Table 2 provides an insight of other demographics of engaged hospital departments, such as the department age, number of patients and the primary focus of care.

Table 1: demographics of participating medical professionals

Element	**Category**	**Frequency**	**Percentage of total**
Department	Anesthesiology	1	7,7%
	Surgery	1	7,7%
	Dermatology	1	7,7%
	Intensive Care Adults	1	7,7%
	Pediatrics	1	7,7%
	Nephrology	2	15,4%
	Orthopedics	1	7,7%
	First aid	1	7,7%
	Urology	1	7,7%
	Geriatrics	1	7,7%
	Something else	2	15,4%
Profession	ANIOS	2	15,4%
	Nurse	2	15,4%
	Team leader	3	23,1%
	AIOS	1	7,7%
	Doctor	4	30,8%
	Business manager	1	7,7%

Table 2: demographics of engaged hospital departments

Element	Category	Frequency	Percentage
Hospital type	University Medical Centre	1	7,7%
	Top clinical training hospital	6	46,2%
	General training hospital	2	15,4%
	Other general hospital	2	15,4%
	Something else	2	15,4%
Department age	0-5 years	2	15,4%
	6-10 years	1	7,7%
	11-15 years	0	0,0%
	16-20 years	2	15,4%
	21-25 years	0	0,0%
	>25 years	8	61,5%
Number of patients	<4000	4	30,8%
	4000-6500	1	7,7%
	6501-9000	2	15,4%
	9001-11500	1	7,7%
	11501-14000	0	0,0%
	>14000	5	38,5%
Primary focus	Insured care	10	76,92%
	Uninsured care	1	7,69%
	Both	2	15,38%

4.2 Quality of the included questionnaires

Overall, the quality of included questionnaires was poor, mainly due to a low respondent's rate of 15,7%. Non-response bias possibly occurred as there is a remarkable difference between the number of medical professionals that completed the questionnaire successfully (N=13) compared to medical professionals that did not complete the questionnaire (N=34) or did not respond at all (N=236).

Furthermore, Cronbach's Alpha coefficient was performed to measure the internal consistency of a set of questionnaire items. All constructs consistently measure the same characteristic and is therefore reliable, as Cronbach's alpha coefficients are higher than 0,818 (appendix D.1, table D1).

Besides, this study applied Harman's single-factor analyses to verify possible common method bias by conducting the exploratory factor analysis in SPSS. Unfortunately, the analyses show a variance of 55,2% (appendix D.2, table D2), which means that this study is biased and variation in the response is coming from the instrument.

4.3 Descriptive statistics

Descriptive statistics is performed to assess differences between constructs or groups. In general, distinction between groups is reported in terms of the mean (Price et al., 2020). Therefore, this study measured the mean of measurement items per construct and the mean of measurement items per construct per group (appendix D.3, table D3). Descriptive analysis showed that in general, respondents do not disagree and do not agree with the theorems about mHealth entrepreneurial alertness and mHealth assimilation at their hospital department (mean=3,8; mode=4,0) (figure 2; appendix D.3, table D4). Their agreement about the deployment of decision rationality (mean=4,9; mode=6,0) and strategic flexibility (mean=4,3; mode=5,0) slightly increases on average (figure 2; appendix D.3, table D4). Moreover, analysis show that the majority have a little agreement on theorems for deploying better results in patient service performance in comparison to other hospital departments (mean=4,9; mode=5,0) (figure 2; appendix D.3, table D4).

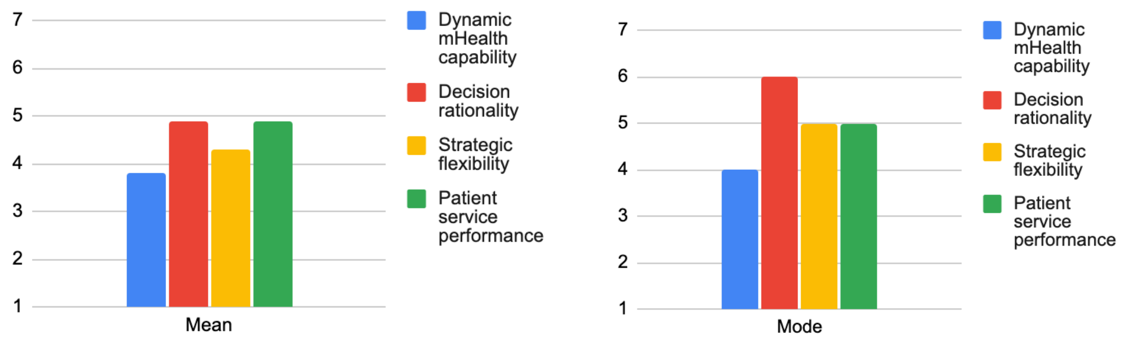

Figure 2: descriptive statistics. left: mean values of constructs; right: mode values of constructs

Focusing on the type of engaged hospitals, results show that University Medical Centers (mean=3,0) and other general hospital (mean=3,5) disagrees the most about the availability of dynamic mHealth capabilities in contrary to other hospital types (figure 3; appendix D.3, table D5). At the same time, University Medical Centers show the highest agreement on patient service performance (mean=6,0) (figure 3; appendix D.3, table D5). The highest agreement for strategic flexibility is found in general training hospitals (mean=5,0), where the highest agreement for decision rationality is found in University Medical Centers (mean=6,0) and top clinical training hospitals (mean=5,3) (figure 3; appendix D.3, table D5).

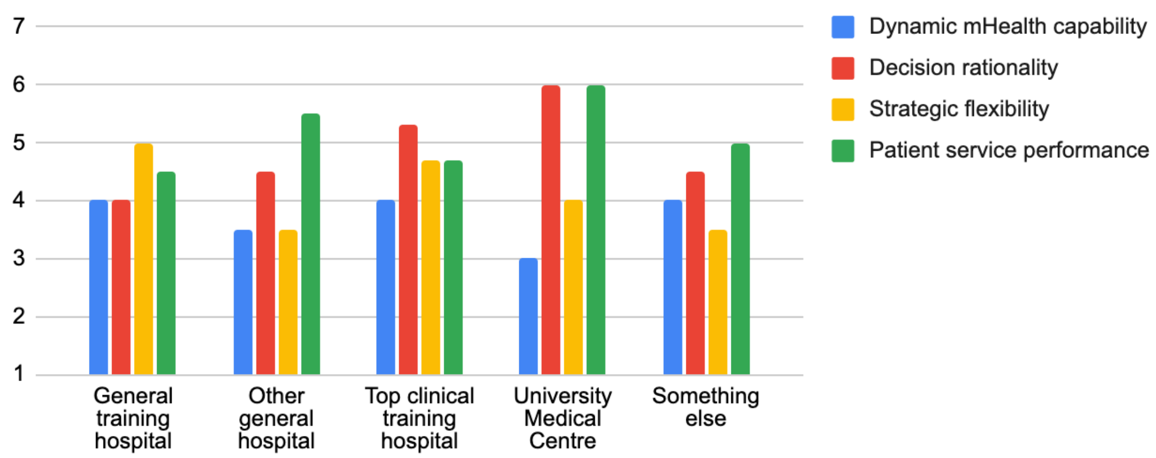

Figure 3: descriptive statistics hospital type

Strikingly, only a disagreement has been found for the construct dynamic mHealth capability at hospitals with less than 4000 patients or 9000-11500 patients, and strategic flexibility (mean=3,0) at hospitals with less than 4000 patients (figure 4; appendix D.3, table D6). For the remainder, all other show a neutral opinion or even a slightly agreement on the implementation of decision rationality, strategic flexibility, and patient service performance (figure 4; appendix D.3, table D6).

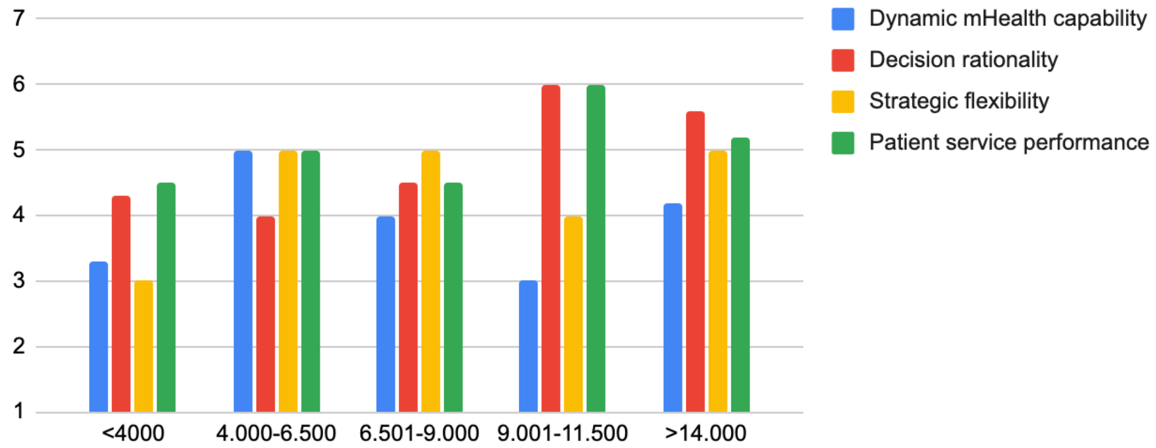

Figure 4: descriptive statistics number of patients

Besides, the analysis on department level shows remarkable results where the first aid department presents an agreement for all constructs (mean 6,0) (figure 5; appendix D.3, table D7). The anesthesiology department shows similar results were decision rationality, strategic flexibility and patient service performance also presents a level of agreement (mean=6,0) (figure 5; appendix D.3, table D7). The most disagreement was found in the geriatrics department (figure 5; appendix D.3, table D7), as this department strongly disagrees with strategic flexibility (mean=1,0), disagrees on dynamic mHealth capability (mean=2,0), little disagrees on decision rationality (mean=3,0) and no agreement nor disagreement was found for patient service performance (mean=4,0) (figure 5; appendix D.3, table D7).

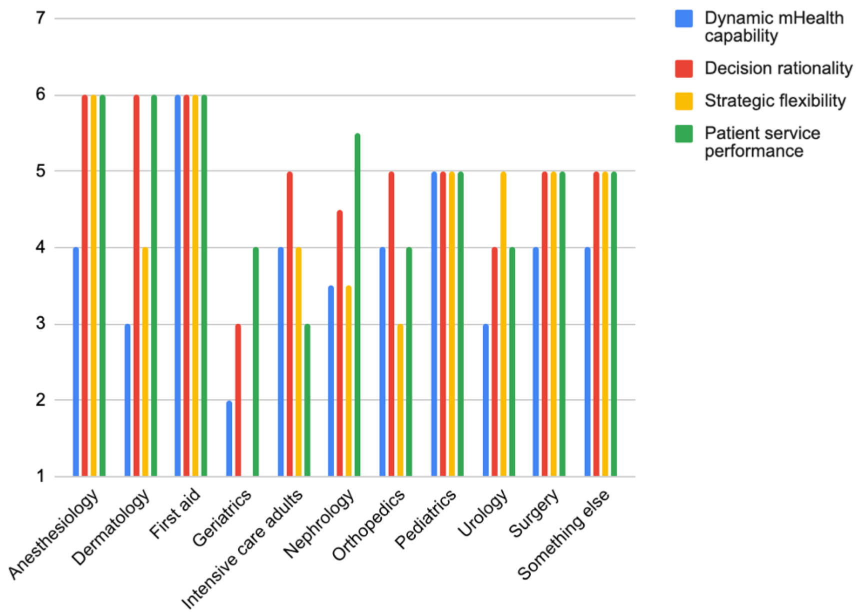

Figure 5: descriptive statistics hospital department

Furthermore, the most agreement for constructs was found by AIOS (=1) for decision rationality (mean=6,0) and patient service performance (mean=6,0). Overall, a little agreement was shown by ANIOS (N=2), doctors (N=4) and managers (N=1) (Appendix D.3, table D8).

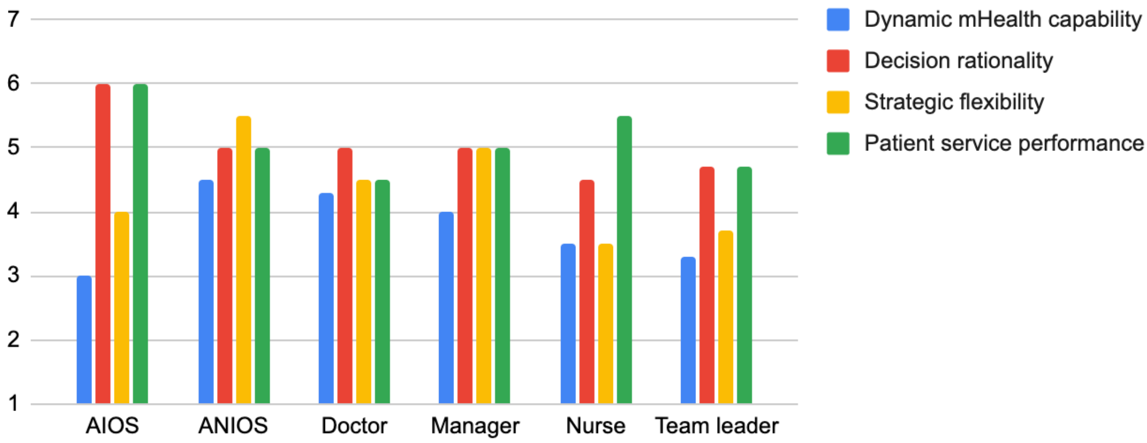

Figure 6: descriptive statistics profession

4.3 Correlation analysis

Performing data analysis by partial least squares (PLS) structural equation modeling (SEM) via SmartPLS urges a sample size of at least 34 respondents, as this study supposed a probability error of 5% and a statistical power of 80%. As the sample size (N=13) is lower than the required cases, this study chose a different analysis method to analyze the correlation and regression between variables and patient service performance.

Correlation by mean

To perform a correlation analysis between all constructs, the mean of measurement items per construct were measured and used for this analysis (appendix D.3, table D3). A tailed Spearman correlation analysis was performed via SPSS to indicate the correlation between variables and patient service performance. The analysis between antecedent and mediator constructs shows a non-significant low positive correlation between dynamic mHealth capabilities and decision rationality (r = .460; p = .057; N = 13) (appendix D.4, table D9). Nonetheless, a significant moderate positive correlation has been found between dynamic mHealth capabilities and strategic flexibility (r = .639; p = .009; N = 13) (appendix D.4, table D9).

However, if we split the dynamic mHealth capability into mHealth assimilation and mHealth entrepreneurial alertness some significant correlations do occur between the antecedent mHealth entrepreneurial alertness and mediator construct decision rationality. This study showed a significant low positive correlation between mHealth entrepreneurial alertness and decision rationality (r = .487; p = .046; N = 13) and strategic flexibility (r = .475; p = .05; N = 13) (appendix D.4, table D10). In addition, a significant positive high correlation was shown between mHealth assimilation and strategic flexibility (r = .710; p = .003; N = 13), whereas no significant low positive correlation was found between mHealth assimilation and decision rationality (appendix D.4, table D10).

The analysis between the mediator and outcome constructs showed a significant high positive correlation between decision rationality and patient service performance (r = .757; p = .001; N = 13*)* (appendix

D.4, table D10). In addition, a significant moderate positive correlation has been shown between strategic flexibility and patient service performance (r = .649; p = .008; N = 13) (appendix D.4, table D9).

Correlation by factor analysis

Furthermore, correlation can also be measured via factor analysis in SPSS. In this case a significant moderate positive correlation is shown between the antecedent dynamic mHealth capability and the mediator construct decision rationality (r = .605; p = .014; N = 13) (appendix D.4, table D11). Moreover, a significant high positive correlation has been found between dynamic mHealth capability and strategic flexibility (r = .710; p = .003; N = 13) (appendix D.4, table D11).

Additionally, decision rationality shows a significant moderate positive correlation on patient service performance (r = .665; p = .007; N = 13) (appendix D.4, table D12). Finally, strategic flexibility shows similar results as also a significant moderate positive correlation has been found with patient service performance (r = .566; p = .022; N = 13) (appendix D.4, table D11).

5. Discussion, conclusions, and recommendations

The urgency of mHealth entrepreneurial alertness and adaption can be clarified by improving services in hospital departments via the implementation of mHealth innovations. The study aims to verify whether patient service performance in hospital departments is positively impacted by dynamic mHealth capabilities via decision rationality and strategic flexibility. A questionnaire was expanded among medical professionals in Dutch hospitals to find out. Eventually, the theoretical model was assessed by 13 completed surveys. This study presents assumable support for the established hypotheses. In other words, that dynamic mHealth capabilities support patient service performance in hospital departments. It is critical to say that this study can only stay with an assumption as only a correlation assessment was performed. The essential assumption is further explained in the next chapters: theoretical contributions, practical implications, limitations and future research.

5.1 Theoretical contributions

This paper assessed four theoretical contributions. First, this paper verified whether dynamic mHealth capabilities improved decision rationality of hospital departments. Significant moderate positive correlations between dynamic mHealth capabilities and decision rationality were found, which indicate a coherence between both constructs. These findings are coherent with previous literature. Similar findings are found in the study of Wetering et al. (2021a), where the patient sensing capability was significant positively impacted by digital dynamic capabilities in hospitals. Moreover, the positive correlation is relatable to the recent findings of the study of Wu et al. (2022), where a positive effect was found between dynamic eHealth capabilities and decision rationality in hospital departments. The outcome of this study suggest that hospital departments should put energy and time into the development of dynamic mHealth capabilities to support the synergetic effects that outline decision rationality. However, at the same time, we should bear in mind that the founded coherence does not equal causality, and therefore the first hypothesis is still not proven. Focusing on the descriptive analysis, an agreement of the deployment of decision rationality in hospitals was more present at top clinical training hospitals and university medical centers. This would suggest that these hospitals have a better sensing capacity, than other hospitals. Nonetheless, little difference was found between the opinion of decision rationality between profession types. More interestingly is the only disagreement score for decision rationality at geriatric departments. Further research could investigate why there is such a great difference in opinions between geriatric departments compared to other departments for all constructs. To generalize these findings, a bigger and evenly distributed group should be engaged in future research.

Secondly, this study verified a second hypothesis which assessed if dynamic mHealth capability positively affects strategic flexibility. This study found a significant high positive correlation between dynamic mHealth capability and strategic flexibility indicates a coherence between both constructs, which is in line with the drafted hypothesis. Wetering et al. (2021a) supported the urgency possessing dynamic capabilities to enhance innovation and high-quality medical services via competences such as sensing and responding to the patient. Relatable findings are found in the study of Wu et al. (2022), where a positive effect was found between dynamic eHealth capabilities and strategic flexibility. The positive significant correlation proposes that the deployment of dynamic mHealth capabilities in hospital departments ensures higher levels of strategic flexibility. However, as the same accounts for the first hypothesis, the founded coherence does not equal causality, and therefore the second hypothesis cannot be answered. Besides, current results suggest that only general training hospital departments can deploy strategic flexibility, as all other hospital types showed a neutral opinion or even a disagreement about the current ability to deploy strategic flexibility. The type of department seems to be less dependent as multiple departments show an agreement for the current deployment of strategic flexibility. Further research could elaborate not only on assessing the effect between both constructs, but also depending variables such as hospital type.

From the mediating and outcome perspective, two other hypotheses were lined up. The third hypothesis refers to the effect of strategic flexibility on patient service performance. Correlation analysis showed a significant high moderate correlation between strategic flexibility and patient service performance indicates a coherence between both constructs. Likewise, these findings relate to the findings of the study of Nadkarni & Narayanan (2007) where a positive relationship have been found between strategic flexibility and firm performance. Moreover, a significant role has been shown for strategic flexibility to gain operational benefits in the recent study of van de Wetering (2022). According to Zhou et al. (2019) a three pathway have been proved as significant mediation effects have been found between a sensing capability and technological innovation, followed by company performance. Thus, indicating a mediating effect between reconfiguration and performance via technological innovation. The significant coherence of this study suggest that hospital departments should embrace strategic flexibility to support an increasement of patient service performance. Nonetheless, the third hypothesis remains unanswered as this study was only able to assess the coherence. The departments of urology, surgery, pediatrics, first aid and anesthesiology are departments that shows high levels of agreement for both strategic rationality and patient service performance. These findings could rise questions about whether the found correlation does only apply for these departments and their processes and services. For this reason, additional research is advised as this study cannot generalize these findings towards other Dutch hospitals due to the low respondent's rate.

In addition to the first three hypotheses, the fourth hypothesis verified whether decision rationality positively impacts patient service performance. The growing empirical support for the coherence between decision rationality and firm performance (Haarhuis & Liening, 2020) is supported by this study, as a significant positive correlation was found between decision rationality and patient service performance. These findings relate to the study of Wetering et al. (2021c) where patient service performance was positively impacted by a similar capability, namely via a sensing capability. The positive significant correlation proposes that hospital departments should invest increasing decision rationality to boost patient service performance levels. Notwithstanding, the results of this study cannot answer the hypothesis as only correlation was measured. The University Medical Centre is the only hospital that shows high levels of agreement (mean=6) for both decision rationality and patient service performance. These findings could rise questions about whether the found correlation does only apply for this type of hospitals. AIOS and AINOS professionals seem to be more positive and show similar level of agreements between decision rationality and patient service performance. Further research should verify whether the variable profession could influence the results.

Despite the found significant positive correlations (figure 7), this study cannot answer the hypotheses. Nevertheless, the significant positive correlations indicate the possible urgency of developing dynamic mHealth capabilities in hospital departments to support patient service performance via a positive stimulation on decision rationality and strategic flexibility. Nonetheless, we should stay careful about the made assumptions as the found positive correlations are based on a small group of respondents.

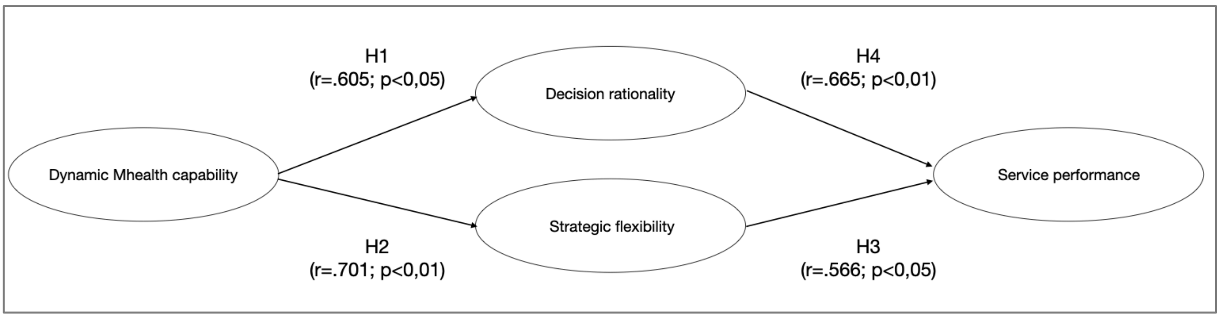

Figure 7: coherence hypotheses theoretical model by factor correlation

5.2 Practical implications

To maintain or improve service performance in hospital departments it is important to determine what the effect is of dynamic mHealth capabilities, and via which variables these capabilities could increase service performance levels. This study discovered a significant positive coherence between dynamic mHealth capabilities, strategic flexibility, and decision rationality. Moreover, significant positive coherences were found between strategic flexibility and patient service performance, and decision rationality and patient service performance.

Previous studies were able to show significant effects on operational benefits. The study of Wu et al. (2012) showed a positively effect of hospital process capabilities on patient performances. Furthermore, van de Wetering (2022) have shown that strategic flexibility has a crucial mediating role to gaining operational benefits. In addition, Wu et al. (2022) elaborated further on eHealth alertness and assimilation, which both influence eHealth exploitation, which enables organizations to improve their service performance and gain thereby greater innovation in processes and services.

In contrast to previous research, this study focused on the effect of one of the innovative HITs, namely mHealth in hospital departments in the Netherlands. Based on these results, this study implies that hospital departments should see the potential of embedding dynamic mHealth capabilities to increase their decision rationality and strategic flexibility capabilities as these capabilities are assumed to be positively correlated to patient service performance. If medical professionals are open to the innovative HIT mHealth, and can embrace dynamic mHealth capabilities in their organization, hospitals are of greater chance to improve their processes and services. Therefore, hospital departments should implement dynamic mHealth capabilities proactively. To do so, hospitals should analyze the current state of dynamic mHealth capabilities, strategic flexibility, and decision rationality in all departments. From this point, hospitals can mention resources that are required to resolve low capabilities, strategic flexibility, and decision rationality.

5.3 Limitations and future work

This study had some limitations that should be further addressed for future work. First, unfortunately, this study was not able to collect enough completed questionnaires to perform the suggested method PLS-SEM to assess the positive effect between dynamic mHealth capabilities and patient service performance due to the low response rate. The gained response rate (15,7%) did not comply with the estimated response rate (30-50%) for internet questionnaire following Saunders et al., (2019). Future research should take this limitation into account to take sufficient time and different approaching methods to make sure that enough completed questionnaires are collected. Caution should be conducted when generalizing the results to all hospitals in the Netherlands. Moreover, the same accounts to generalizing the results to hospitals abroad, as the social, cultural, economic, and political setting of this study might have an influence on the results.

Some hospitals and medical professionals clarified that they were not able to fill in the questionnaire as there was little time, due to privacy, or they received many requests of other research groups already. To increase the respondents' rate, the research group of this study could ask themselves whether answering questions related to the size of the hospital (number of patients, employees, or fulltime employees) is a necessity. A lot of the incomplete surveys were filled in up to these types of questions. Due to the obligation, respondents were not allowed to fill in the following questions when the demographic questions were not filled in completely. Some respondents indicated afterwards that they were not able to fill in these specific questions. Dropping the obligation to fill in these fields could lead to a rise of the respondents' rate.

Besides, this study specified only an obligated study size and did not mention the required distribution of hospital type, department type, profession type and number of patients. Having a bigger sample size with an evenly distributed population could verify whether the results could be generalized to all hospitals and departments in the Netherlands.

To elucidate whether an effect occurred between the constructs, it is advised in future research to perform PLS-SEM in contrary to a correlation assessment. Unfortunately, performing correlation has its limitations in contrast towards PLS-SEM. Correlation belongs to the first-generation analyses of correlations. This chosen method involves bivariate correlation, which uses the average scores of measurement items to measure coherence between constructs. This technique only reflects the coherence to a single construct. Following Shao et al. (2022), causality cannot be measured via correlation when it is conducted to cross-sectional data. Besides measuring causality, performing PLS-SEM enables studies cross-loadings across other untargeted items (Shao et al., 2022). Decision rationality could possibly cross load item measurements individually of strategic flexibility, which thereby impact the patient service performance. This is not considered in the correlation bivariate option, as items are averaged and are correlated separately.

For this study, a quantitative method was chosen to assess the effect of dynamic mHealth capabilities on patient service performance. For future research, this study advises to explore the effect even more by conducting triangulation. Using more than one method enables this study to verify the confirm the validity, credibility, authenticity, analysis, and interpretation of the outcome of the questionnaire (Saunders et al., 2019). Performing a mixed methods study design enables studies to elaborate on the quantitative outcomes by in depth interviews for example. Hereby depth, complexity and richness will be added to the outcome (Saunders et al., 2019) and could thereby strengthen the results. Thereby, studies could clarify more about the relationships in the theoretical model or the reason of and belief in the implementation of dynamic mHealth capabilities. A more dynamic view of the effect of dynamic mHealth capabilities on patient service performance possibly provide new indications for further investigations.

Besides, the cross-sectional study design enabled the researchers to verify whether a positive effect is noticed between constructs. However, to study the change and development in hospital departments, a longitudinal study design is proposed.

5.4 Conclusions

This study implies that hospital departments should see the potential of embedding dynamic mHealth capabilities to increase their decision rationality and strategic flexibility capabilities as these capabilities are assumed to be positively correlated to patient service performance. This study presents assumable support for the established hypotheses. The main findings of the research are significant positively correlations between for all hypotheses. However, it is critical to say that this study can only stay with an assumption as only a correlation assessment was performed. Therefore, no positive effect has yet been shown between dynamic mHealth capabilities and patient service performance. For this reason, future research is required to elaborate further on the possible effect of dynamic mHealth capabilities on patient service performance.

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Appendix A: literature research

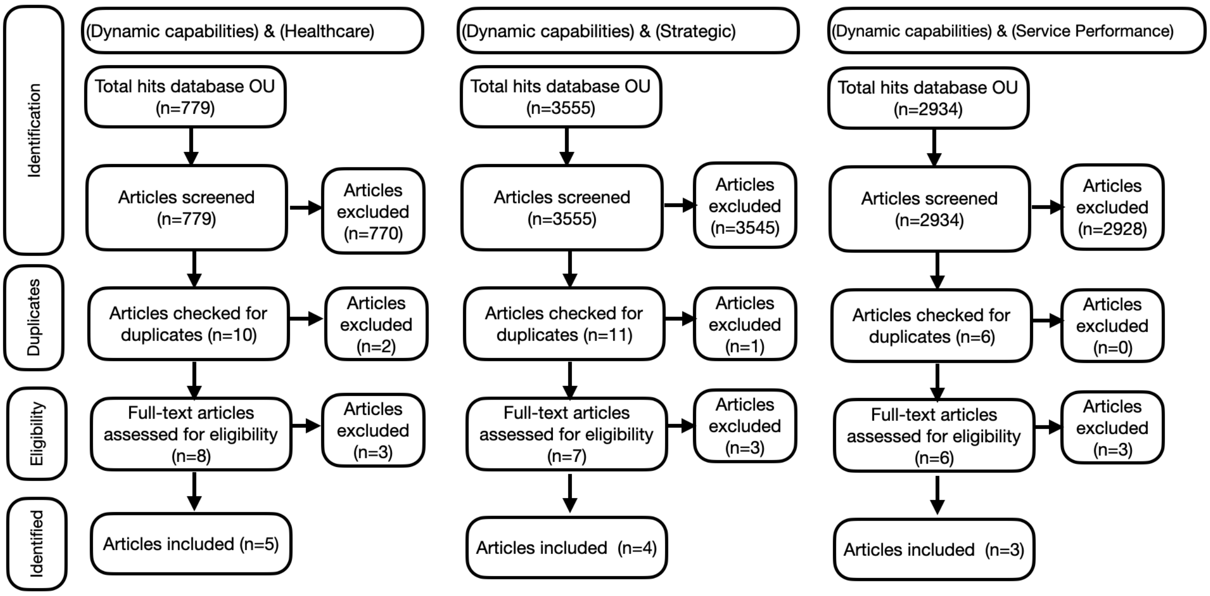

Figure A1: Systematic review. The search was undertaken on June 19, 2022 at the online library of the Open University

Table A1: Inclusion and exclusion criteria for identification

Inclusion	**Exclusion**
Articles published between January 1, 2010 – now	Articles published before June 1, 2022
English language	Other language
Refereed journals and books	Other literature types
Title article corresponds to query	Title article does not correspond to query

Note: the search was undertaken on June 19, 2022, at the online library of the Open University.

Table A2: Inclusion criteria for eligibility

Eligibility	**Inclusion**
Relevance	The article: - corresponds to the generated research question(s); - covers aspects of dynamic capabilities; - supports or contradicts generated research questions.
Value	The article: - conducted similar study designs; - show sufficient precision;
Sufficiency	The article: - referred towards authors that are often mentioned in this subject.

Table A3: Articles eligible for inclusion for this study (N=15)

Queery	(Dynamic capabilities) & (Healthcare)	(Dynamic Capabilities) & (Strategic)	(Dynamic Capabilities) & (Service performance)
References	Leung (2012) Wu & Hu (2012) Wetering (2021a) Wetering (2021c) Sermontyte-baniule et al. (2022)	Teece et al. (2016) Zhou et al. (2019) Haarhuis & Liening (2020) Van de Wetering (2022)	Zhou et al. (2019) Wetering (2021a) Wetering et al. (2022)
Snowball technique	*from Sermontyte-baniule et al. (2022):* Pundziene et al., (2021)	*from Teece et al. (2016):* Teece et al. (1997) Teece et al. (2007) Teece et al. (2014) *From Haarhuis & Liening (2020):* Shimizu & Hitt (2004) Nadkarni (2007) Naldi et al. (2014)	*Not applicable*
Total	6	10	3
Total (du-plicates excluded)	17		

Appendix B: demographics of hospital departments

Table B1: Demographic items and measurement items

Demographic item	Measurement item
Hospital type	*Please indicate the hospital type you are working now.*
	a. University medical center; b. Top clinical training hospital; c. General training hospital; c. Other general hospital.
Department age	*Please indicate the department age.*
	a. 0-5 years; b. 6-10 years; c. 11-20 years; d. 21-25 years; e. over 25 years.
Number of patients	*Please indicate the number of patients in the department.*
	a. <4000; b. 4000-6500; c. 6500-9000; d. 9000-11500; e. 11500-14000; f. >14000.

Appendix C: Construct and measurement items

Table C1: Construct items and measurement items

Construct	Measurement item	Literature
Antecedent Dynamic mHealth capabilities	*Please indicate the ability of your department to: (1 Strongly disagree - 7 strongly agree)*	
	MHealth entrepreneurial alertness MAL1 Our hospital is aware of mHealth technology trends that affect care services. MAL2 Our hospital identifies new mHealth opportunities to reform health care procedures. MAL3 Our hospital acquires emerging technologies for mHealth. MHealth assimilation MAS1 Our hospital aligns clinical and care-delivery systems with mHealth. MAS2 Our hospital converges mHealth with management competence to develop mHealth services. MAS3 Our hospital employs mHealth to enhance or expand existing care services.	(Wu et. al., 2022)
Mediator Decision rationality	*Please indicate the ability of your department to: (1 Strongly disagree - 7 strongly agree)*	
	DR1 Analyzes relevant information extensively before a decision is made. DR2 Uses quantitative analytical methods to decide DR3 Searches for information extensively to decide	(Haarhaus & Liening, 2020)
Mediator Strategic flexibility	*Please indicate the ability of your department to: (1 Strongly disagree - 7 strongly agree)*	
	SF1 We can develop plausible business scenarios based on drivers for change. SF2 We are able of developing an optimal strategy for each scenario. SF3 We can shape the capabilities needed to implement the core strategy. SF4 We can produce the intended results.	(Wetering, 2022)
Outcome Patient service performance	*We perform much better during the last 2 or 3 years than comparable departments from other hospitals in (1. strongly disagree - 7 strongly agree)*	
	PSP1 Increasing patient satisfaction.* PSP2 Providing high-quality service.* PSP3 Improving the accessibility of medical services.** PSP4 Improving the availability of medical services.** PSP5 Increasing the reputation of our hospital in the market.**	*(Wetering et al., 2022) ** (Wu & Hu, 2012)

Appendix D: Results

D.1 Cronbach's alpha

Table D1: Reliability statistics constructs questionnaire

Construct	Scale item	N of items	Cornbach's alpha
Dynamic mHealth capabilities	MAL1		
	MAL2		
	MAL3	6	0,917
	MAS1		
	MAS2		
	MAS3		
Decision rationality	DR1		
	DR2	3	0,818
	DR2		
Strategic flexibility	SF1		
	SF2	4	0,960
	SF3		
	SF4		
Patient service performance	PSP1		
	PSP2		
	PSP3	5	0,944
	PSP4		
	PSP5		

D.2 Exploratory factor analysis

Table D2: Exploratory factor analysis - total variance explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings				
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.444	55.156	55.156	15.444	55.156	55.156
2	4.060	14.499	69.655			
3	2.521	9.003	78.658			
4	1.877	6.704	85.362			
5	1.139	4.069	89.431			
6	0,819	2.926	92.357			
7	0,640	2.284	94.641			
8	0,498	1.777	96.418			
9	0,394	1.406	97.824			
10	0,325	1.159	98.983			
11	0,174	0,621	99.604			
12	0,111	0,396	100.000			
13	3,06E-12	1,09E-11	100.000			
14	1,35E-12	4,84E-12	100.000			
15	6,90E-13	2,46E-12	100.000			
16	5,51E-13	1,97E-12	100.000			
17	3,97E-13	1,42E-12	100.000			
18	2,96E-13	1,06E-12	100.000			
19	1,59E-13	5,69E-13	100.000			
20	1,23E-13	4,40E-13	100.000			
21	2,61E-14	9,31E-14	100.000			
22	-1,38E-13	-4,93E-13	100.000			
23	-3,47E-13	-1,24E-12	100.000			
24	-4,56E-13	-1,63E-12	100.000			
25	-5,44E-13	-1,94E-12	100.000			
26	-5,90E-13	-2,11E-12	100.000			
27	-7,23E-13	-2,58E-12	100.000			
28	-1,31E-12	-4,69E-12	100.000			

D.3 Descriptive statistics

Table D3: mean values of construct items per reponse-ID

Response-ID	Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
3	3	4	5	4
6	1	3	2	4
8	2	3	1	4
12	3	6	4	6
15	6	6	6	6
16	5	5	5	5
20	3	6	5	5
21	6	6	5	7
36	4	5	3	4
42	4	6	6	6
43	4	5	4	3
44	5	4	5	5
48	4	5	5	5

Table D4: Descriptive statistics summary

		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
N	Valid	13	13	13	13
	Missing	0	0	0	0
Mean		3.84	4.92	4.31	4.92
Median		4.00	5.00	5.00	5.00
Mode		4.00	6.00	5.00	5.00
Std. Deviation		1.463	1.115	1.494	1.115

Table D5: Descriptive statistics summary hospital type

Hospital		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
General training hospital	Mean	4.00	4.00	5.00	4.50
	N	2	2	2	2
	Std. Deviation	1.41421	.000	.000	.707
	Median	4.00	4.00	5.00	4.50
Other general hospital	Mean	3.50	4.50	3.50	5.50
	N	2	2	2	2
	Std. Deviation	3.535	2.121	2.121	2.121
	Median	3.50	4.50	3.50	5.50
Something else	Mean	4.00	4.50	3.50	5.00
	N	2	2	2	2
	Std. Deviation	2.828	2.121	3.536	1.414
	Median	4.00	4.50	3.50	5.00
Top clinical training hospital	Mean	4.00	5.33	4.67	4.67
	N	6	6	6	6
	Std. Deviation	.632	.516	1.033	1.033
	Median	4.00	5.00	5.00	5.00
University Medical Centre	Mean	3.00	6.00	4.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	3.0000	6.00	4.00	6.00
Total	Mean	3.8462	4.92	4.31	4.92
	N	13	13	13	13
	Std. Deviation	1.46322	1.115	1.494	1.115
	Median	4.0000	5.00	5.00	5.00

Table D6: Descriptive statistics summary hospital department

Department		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
Anesthesiology	Mean	4.00	6.00	6.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	4.00	6.00	6.00	6.00
Dermatology	Mean	3.00	6.00	4.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	3.00	6.00	4.00	6.00
First aid	Mean	6.00	6.00	6.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	6.00	6.00	6.00	6.00
Geriatrics	Mean	2.00	3.00	1.00	4.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	2.00	3.00	1.00	4.00
Intensive care adults	Mean	4.00	5.00	4.00	3.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	4.00	5.00	4.00	3.00
Nephrology	Mean	3.50	4.50	3.50	5.50
	N	2	2	2	2
	Std. Deviation	3.535	2.121	2.121	2.121
	Median	3.50	4.50	3.50	5.50
Orthopedics	Mean	4.00	5.00	3.00	4.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	4.00	5.00	3.00	4.00
Pediatrics	Mean	5.00	5.00	5.00	5.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	5.00	5.00	5.00	5.00
Something else	Mean	4.00	5.00	5.00	5.00
	N	2	2	2	2
	Std. Deviation	1.414	1.414	.000	.000
	Median	4.00	5.00	5.00	5.00

Surgery	Mean	4.00	5.00	5.00	5.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	4.00	5.00	5.00	5.00
Urology	Mean	3.00	4.00	5.00	4.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	3.00	4.00	5.00	4.00
Total	Mean	3.84	4.92	4.31	4.92
	N	13	13	13	13
	Std. Deviation	1.463	1.115	1.494	1.115
	Median	4.00	5.00	5.00	5.00

Table D7: Descriptive statistics summary profession

Profession		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
AIOS	Mean	3.00	6.00	4.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	3.00	6.00	4.00	6.00
ANIOS	Mean	4.50	5.00	5.50	5.00
	N	2	2	2	2
	Std. Deviation	2.121	1.414	.707	1.414
	Median	4.50	5.00	5.50	5.00
Doctor	Mean	4.25	5.00	4.50	4.50
	N	4	4	4	4
	Std. Deviation	.500	.816	1.291	1.291
	Median	4.00	5.00	4.50	4.50
Manager	Mean	4.00	5.00	5.00	5.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	4.00	5.00	5.00	5.00
Nurse	Mean	3.50	4.50	3.50	5.50
	N	2	2	2	2
	Std. Deviation	3.535	2.121	2.121	2.121
	Median	3.50	4.50	3.50	5.50
Team leader	Mean	3.33	4.67	3.67	4.67
	N	3	3	3	3
	Std. Deviation	1.527	1.528	2.309	.577
	Median	3.00	5.00	5.00	5.00
Total	Mean	3.84	4.92	4.31	4.92
	N	13	13	13	13
	Std. Deviation	1.463	1.115	1.494	1.115
	Median	4.00	5.00	5.00	5.00

Table D8: Descriptive statistics summary profession

Patients		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
<4000	Mean	3.25	4.25	3.00	4.50
	N	4	4	4	4
	Std. Deviation	2.217	1.500	1.826	1.732
	Median	3.00	4.00	3.00	4.00
>14.000	Mean	4.20	5.60	5.00	5.20
	N	5	5	5	5
	Std. Deviation	1.095	.548	1.225	.837
	Median	4.00	6.00	5.00	5.00
4.000-6.500	Mean	5.00	4.00	5.00	5.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	5.00	4.00	5.00	5.00
6.501-9.000	Mean	4.00	4.50	5.00	4.50
	N	2	2	2	2
	Std. Deviation	1.414	.707	.000	.707
	Median	4.00	4.50	5.00	4.50
9.001-11.500	Mean	3.00	6.00	4.00	6.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
	Median	3.00	6.00	4.00	6.00
Total	Mean	3.84	4.92	4.31	4.92
	N	13	13	13	13
	Std. Deviation	1.463	1.115	1.494	1.115
	Median	4.00	5.00	5.00	5.00

D.4 Correlation

Table D9: one-tailed Spearman correlation

		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service performance
Dynamic mHealth capabilities	Correlation Coefficient	1.000	0,460	0,639**	0,532*
	Sig. (1-tailed)	.	0,057	0,009	0,031
	N	13	13	13	13
Decision rationality	Correlation Coefficient	0,460	1.000	0,593*	0,757**
	Sig. (1-tailed)	0,057	.	0,016	0,001
	N	13	13	13	13
Strategic flexibility	Correlation Coefficient	0,639**	0,593*	1.000	0,649**
	Sig. (1-tailed)	0,009	0,016	.	0,008
	N	13	13	13	13
Patient service performance	Correlation Coefficient	0,532*	0,757**	0,649**	1.000
	Sig. (1-tailed)	0,031	0,001	0,008	.
	N	13	13	13	13

*** Correlation is significant at the 0.01 level (1-tailed)*
** Correlation is significant at the 0.05 level (1-tailed).*

Table D10: one-tailed Spearman correlation

			Alertness	Assimila-tion	Decision rationa-lity	Strategic flexibility	Patient ser-vice perfor-mance
Spearman's rho	Alertness	Correlation Coefficient	1.000	0,764**	0,487*	0,475	0,429
		Sig. (1-tailed)	.	0,001	0,046	0,050	0,072
		N	13	13	13	13	13
	Assimilation	Correlation Coefficient	0,764**	1.000	0,357	0,710**	0,504*
		Sig. (1-tailed)	0,001	.	0,116	0,003	0,040
		N	13	13	13	13	13
	Decision rationality	Correlation Coefficient	0,487*	0,357	1.000	0,593*	0,757**
		Sig. (1-tailed)	0,046	0,116	.	0,016	0,001
		N	13	13	13	13	13
	Strategic flexibility	Correlation Coefficient	0,475	0,710**	0,593*	1.000	0,649**
		Sig. (1-tailed)	0,050	0,003	0,016	.	0,008
		N	13	13	13	13	13
	Patient service performance	Correlation Coefficient	0,429	0,504*	0,757**	0,649**	1.000
		Sig. (1-tailed)	0,072	0,040	0,001	0,008	.
		N	13	13	13	13	13

*** Correlation is significant at the 0.01 level (1-tailed)*
** Correlation is significant at the 0.05 level (1-tailed).*

Table D11: correlation matrix Factor analysis

		Dynamic mHealth capabilities	Decision rationality	Strategic flexibility	Patient service per-formance
Correlation	Dynamic mHealth capabilities	1.000	.605	.710	.554
	Decision rationality	.605	1.000	.716	.665
	Strategic flexibility	.710	.716	1.000	.566
	Patient service performance	.554	.665	.566	1.000
Sig. (1-tailed)	Dynamic mHealth capability		.014	.003	.025
	Decision	.014		.003	.007
	Strategic flexibility	.003	.003		.022
	Patient service perfor-mance	.025	.007	.022	