DEPARTMENT OF
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Digital transformation in the healthcare sector: Drivers for adoption of digital healthcare technologies

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Abstract

The study explores factors that drive the adoption of digital healthcare technologies. In venturing into this emerging domain of research the study attempts to answer the following research question: *What drives the adoption of digital technologies in healthcare?*. The research utilizes a mixed-methods design by collecting and analyzing user data on a digital healthcare platform and semi-structured interviews with experts in the field. The study adopts a newly published framework for resistance towards e-health innovations as an analytical lens and is in addition based on related work on technology adoption. The thematic analysis of qualitative data highlights five key themes related to digital technology adoption in healthcare. The themes are discussed in relation to the theoretical framework to answer the research question. The study concludes that drivers for digital technology adoption in the healthcare sector could be attributed to aspects of efficiency, communication, interoperability, EHR and control by addressing barriers towards technology adoption. The goal of the study was to provide insights that could inform policy and practice, and contribute to the growing body of knowledge on digital technology adoption in the healthcare sector.

Keywords: Technology adoption, Healthcare sector, Drivers, Barriers, Digital transformation

Forewords

For starters, my greatest gratitude goes to Fredrik Svahn for supervising me during this project. His support and guidance helped immensely when encountering obstacles and when I wanted to bounce ideas. Secondly, I want to express my gratitude towards Healthcorp whom I collaborated with during the project. Setting up a space in the office for me to work in, the interviews and meetings, the lunch breaks and the conversations with everyone truly enriched the experience and the study. Lastly, I want to give a sweeping thanks and words of gratitude to my friends, family and partner who support me through thick and thin.

Thank you.

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Introduction

This study explores adoption of digital technology in the healthcare sector. What causes people to accept or reject information technology? This very question was asked in 1989 in the article *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology* published by Fred D. Davis, which has had a lasting impact on research in technology adoption. At the time of publishing, computers were increasingly becoming adopted in the workplace. Therefore researchers as well as practitioners were interested in understanding the process of adoption by the users.

Davis argued that due to effort being a finite resource, the probability of user acceptance was increased by perceived effort saved from technology usage. The framework presented by Davis then postulated perceived usefulness and perceived ease of use as fundamental determinants of user acceptance. The *Technology Acceptance Model*, or *TAM* in short, was therefore gaining traction due to its simplistic but powerful way of providing insight into user perception and behavior. Although an important and impactful contribution to research, Davis' article is narrow in focus due to putting emphasis on system use specifically on the individual level. Taking a broader perspective on information technology adoption, much research following Davis (1989) tries to explore information technology adoption on an organizational as well as societal level as a part of digital transformation (see *Related work on technology adoption*). Taking a broader perspective also means understanding the holistic concept. In other words, it is essential to consider how to define and think about the concept of digital transformation.

The healthcare industry is undergoing digital transformation, with the adoption of new technologies such as telemedicine, mobile health apps, and electronic health records (EHRs) becoming more common. In Sweden, the use of digital healthcare technologies has become a priority for the national healthcare system, with the goal of improving access to care, reducing costs, and enhancing patient outcomes (Hyppönen et al., 2013). However, despite the promises of digital healthcare, digital transformation in the healthcare sector is not consistently meeting the expectations (Lindroth et al., 2021) and resistance has been documented by researchers (Iyanna et. al., 2022). In fact, studies in COVID 19 times have noted a regression among doctors towards utilizing digital tools and instead opting for physical interactions (Mehrotra et al., 2020; Webster, 2020).

This study aims to contribute by exploring one subsector, namely the healthcare sector, in yielding further insights to this emerging domain of research. Mergel et al. (2019) define digital transformation in the public sector as "a holistic effort to revise core processes and services of government beyond the traditional digitization efforts" and are, among others (Morakanyane et al., 2017; Lindroth et al., 2022), shedding light on the lack of a coherent definition of digital transformation. Furthermore, the authors highlight the need for future research to put additional emphasis on a holistic approach. One important aspect of digital transformation is research on technology adoption. Knowledge in this field lends itself to

reveal how individuals and organizations came to embrace digital transformation and amounts to covering one of the elements of digital transformation as presented by Mergel et al. (2019).

In an article recently published by Iyanna et. al. (2022) a framework was presented that elaborated on functional, psychological and context-specific barriers to healthcare provider (HCP) and patient resistance to e-health innovations. In this study, this framework guides the formulation of hypotheses, interpretation of results and identification of drivers for digital technology adoption by exploring barriers. To further guide the data collection as well as research direction this study takes inspiration from related work on technology adoption and literature covering topics of digital transformation in the healthcare sector.

A thorough search of the relevant literature has identified developed frameworks for conceptualizing aspects of adoption but the level of generalizability is lacking in empirical evidence as well as an emphasis on barriers rather than drivers. In Sweden specifically, studies that explore the adoption of digital healthcare technologies are limited. Therefore, the goal of the study is to answer the following research question:

What drives the adoption of digital technologies in healthcare?

To answer the research question this study applies a mixed-methods research design and utilizes the framework presented by Iyanna et al. (2022) as an analytical lens. The potential theoretical implications of this study is to explore barriers to identify drivers for technology adoption, as well as providing testing of a modern framework for technology adoption in the healthcare sector. As for practical implications, the potential insights generated by this study can act as guidance for healthcare organizations on what some of the barriers to digital transformations are and how to address them. The thesis is structured as follows. Starting off, an overview of related work on technology adoption followed by a presentation of the theoretical framework on end-user resistance to e-health innovations. This is followed by the methodology, including research approach and context, data collection and analysis as well as methodological limitations. After this, a result section ensues, presenting the quantitative results and qualitative findings. Lastly, the thesis ends with a discussion tying together the insights and conclusions, including limitations and directions for future research.

Related work on technology adoption

The Technology Acceptance Model (TAM)

The article by Fred D. Davis has been considered an important and impactful cornerstone in technology adoption research. In the late 1980s computers were increasingly becoming adopted in the workplace. A valid measurement scale for gauging and understanding system usage was thus highly sought after. Therefore researchers as well as practitioners were interested in understanding the process of adoption by the users. Davis argued that due to effort being a finite resource, the probability of user acceptance was increased by perceived effort saved from technology usage. The framework presented by Davis then postulated perceived usefulness and perceived ease of use as fundamental determinants of user acceptance. Perceived usefulness was defined as the extent to which the user perceived a given system to increase job performance. Perceived ease of use, on the other hand, was defined as the extent to which a user perceived a given system to be free of effort.

Measurement scales were then formulated and utilized to, through empirical methods, predict user acceptance of systems. The most significant findings from this study was the support for the relation between perceived usefulness and system use. Follow-up studies by Davis et al. (1989) also found significant direct effects of perceived ease of use on system usage.

Instantiation: Implementing technologies

Another perspective on how technology gets adopted into organizations was through the notion of instantiation, as presented by Baptista and colleagues (2021). The article introduced a distinct perspective on how technology adoption occurs within organizations, by highlighting bottom-up processes in realizing strategic goals. Instantiation was defined as how the micro constitutes or performs the macro of strategy. According to the authors, the strategy became manifested through the bottom up interpretation and interaction between agents and artifacts, taking the sociotechnical system perspective, through *decoupling*, *reframing* and *recoupling*.

When new technology is introduced to automate certain processes there might be a perceived clash or divide between old patterns of use and the emergent new patterns of use. Baptista and colleagues (2021) called this *decoupling*. The notion of *reframing* was the spread of, the understanding, acceptance as well as creation of the logics and associated routines regarding the newly introduced technologies. Finally, the emerging practices made the overall strategical meaning explicit and were then instantiated through this bottom up, sociotechnical process. Baptista and colleagues (2021) called this *recoupling*. Only then, according to the authors, was the expression of the strategy truly materialized.

This study provides insight into the adoption process of technologies within a digital transformation strategy. While often being driven from a top down initiative (Singer et al.,

2015), it may be important to consider the significance of bottom-up, individual-level processes for a comprehensive understanding of successful implementation.

Drivers for adoption in SMEs

Yet another contribution to understanding the field of digital technology adoption was the article by Omrani et al. (2022). The authors highlighted how drivers could be analyzed through three different contexts. This study adopted the technology-organization-environment (TOE) framework (Tornatzky et al., 1990) to identify enabling factors for digital technology adoption in small and medium-sized enterprises (SMEs). According to the European Commission (2023), SMEs represented 99% of all businesses in the EU. Moreover, there has been a significant presence of SMEs in the healthcare sector (Zilber et al., 2019). Through applying the TOE framework Omrani and colleagues attempted to explore the effect of internal factors (technological and organizational) as well as external factors (environmental) on digital technology adoption. Data collected from 15 346 SMEs in EU and non-EU countries highlighted the emphasis on technological and organizational factors.

The technological context included existing IT infrastructures and previous digital technology exposure of organization members as driving the adoption. The authors argued for the importance of having a strong technological foundation and prior experience with technology as a way of establishing a "organizational preparedness". Organizational context implied factors such as innovation rate, employee skills, corporate regulation and financial resources. In addition, the authors emphasized cultural aspects, such as innovativeness and knowledge sharing, to play a critical role in establishing "organizational preparedness". The findings from this study thus provided support for internal factors as the main contribution of drivers to digital technology adoption. While, according to the authors, the influence from environmental factors were relatively low overall, business infrastructure was perceived as a significant driver.

Institutional change

Complementing the notion of drivers arising from internal factors were the study by Dacin et al. (2002) on institutional change. Institutional theory, as the theoretical foundation for Dacin et al.'s study, focused on how institutions shape behavior. Dacin and colleagues argued that drivers for change in organizations stem from institutional pressures. Such institutional pressures included functional, political and social pressures.

Functional pressures included organizations' urge to change due to perceived performance problems or the expected utility gains associated with adoption of a certain practice. This echoed the sentiments made by Davis (1989) in how perceived usefulness can act as a fundamental driver for user acceptance. Political pressures, in contrast, related to the dynamic changes in political environment and power distribution that legitimized institutional arrangements. These environmental changes were thus believed to influence current practices' legitimacy and considerations of adopting novel ones. Lastly, social pressures related to drivers manifested through workforce diversity, divergent beliefs, dynamics of social

expectations as well as changes in laws. This also implied the influence of global factors such as best practices from other regions. Through the diversity of perspectives and norms existing practices could be challenged and thus lead to adoption of novel ones.

In addition, Dacin and colleagues emphasized the relation between legitimacy and the actions of actors in driving change in institutions. Legitimacy was further defined as the extent to which a novel practice aligns with existing norms, values and expectations given a certain instution's core values and overall goals. Actors in an institution could then play an active role in interpreting as well as responding to institutional pressures and legitimize novel practices, including the adoption of digital technologies.

Furthermore, Dacin and colleagues highlighted how institutional change has affected the healthcare sector. The authors argued for the shifts in practices and norms as influencing healthcare provider commitments and perceptions of ethical obligations towards patients. Toulmin (1990) called this part of the "de-moralization", the erosion of a moral calling for physicians as a result of changing institutional environments and the increased economic pressures in the healthcare sector.

Analytical lens: End-User Resistance to E-Health Innovations

In a recently published paper, Iyanna et. al. (2022) presents a framework on functional, psychological and context-specific barriers towards adoption of e-health innovation. This framework acts as the analytical lens throughout this study (see *Methodology*). In the article the authors presents these barriers through the perspective of HCP, organization, patient, end-user (i.e. HCP and patient) as well as discuss individual differences.

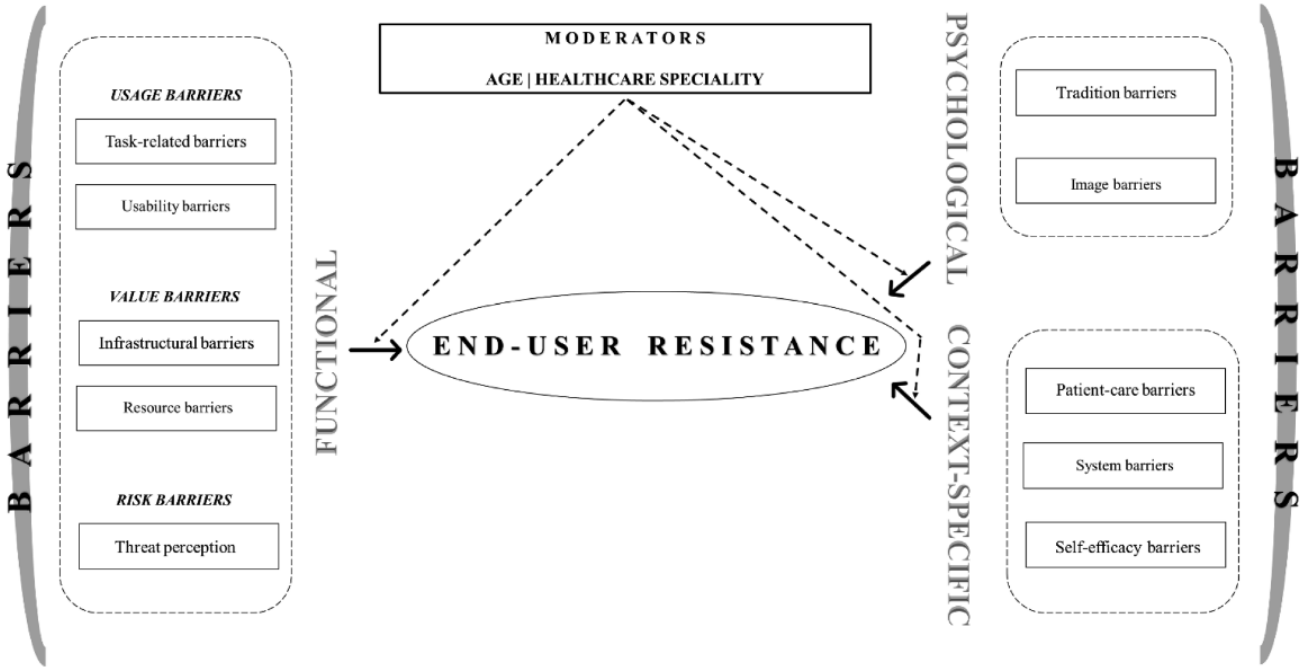

Fig. 1. ***A model of barriers towards end-user resistance. Adopted from Iyanna et al. (2022).***

Healthcare provider barriers

Task-related barriers refer to workflow changes, system use, time commitment, and communication challenges. *Patient-care barriers* relate to the impact of e-health innovations on the quality of provider-patient interactions, the correctness of diagnoses, and tracking progress. *System barriers* include issues associated with efficiency in using the system as well as the potential for human error.

Organizational barriers

Under the sub-theme of *threat perception*, healthcare organizations can be resistant to the adoption or continued use of digital technologies due to the perceived risks associated with them. Potential risks include routine system failure, medical liability, cyberattacks, data security concerns as well as patient privacy. The key obstacles in *infrastructural* barriers can be limited availability of hardware, quality of software, and planning and execution of the supporting work for digitalization.

Patient barriers

Usability barriers refer to patients' difficulties in using digital technologies, which include practical usability issues, technology anxiety, and language barriers. The authors argue that the complexity and confusion associated when using digital technologies can also lead to discomfort among patients. *Resource barriers* refer to the limited device or internet connectivity. The importance of understanding resource barriers may be particularly significant for elderly patients who do not have compatible mobile phones or internet access. According to the authors, poorer families can also face additional expenses, hampering their ability to engage with these technologies.

End-user barriers

Additionally, the authors discuss barriers that both HCPs and patients face while adopting digital technologies. *Self-efficacy barriers* arise from the limited abilities of end-users to use digital technologies competently. These barriers are linked to a lack of technical aptitude and computer use skills among HCPs and patients. *Tradition barriers* refer to the barriers experienced by end-users as a result of habits or an existent status quo. It further represents inhibiting factors such as patients' resistance to change, older patients who are not tech-savvy preferring the traditional way of doing things and hospitals' continued attachment to legacy systems. *Image barriers* are described as the degree to which end-users had negative perceptions about a particular innovation.

Individual differences

Iyanna and colleagues observed distinct age-related differences, with older patients having difficulty using e-health innovations. Additionally, individual differences in perceived barriers were noted across various healthcare specialties, particularly in mental health and dermatology, where face-to-face contact was often imperative, and using technology could at times worsen a patient's presentation.

The dynamic between drivers and barriers

Considering the notion of barriers then, what is the relation to drivers and why are barriers helpful in understanding drivers? One way of making the connection between the two is by exploring how we conceptualize these notions. Drivers can be conceptualized as resolutions to barriers, meaning drivers are the means by which barriers are addressed and surpassed. For instance, if one identified barrier is lack of infrastructure, a driver may be the implementation of a new and robust IT infrastructure. This would then clearly illustrate the dynamic as drivers as a means of overcoming barriers. Thinking about the dynamic between drivers and barriers in this fashion is also putting emphasis on how identifying shared underlying factors (e.g. infrastructure) may play a key role in hindering barriers as well as enabling drivers.

In addition, it may be important to consider temporal aspects, namely to recognize the dynamic between the temporal nature of drivers and barriers. A certain driver may not emerge or be effective as driving adoption until a certain barrier has been addressed. For example, putting effort into creating a user guide on installing a software (driver) on a hardware will not be valuable until the users have gotten access to the hardware (barrier).

This highlights how there can be temporal dependencies and sequential processes that need to be recognized to fully understand the adoption process.

Furthermore, thinking about drivers and barriers in a cause-and-effect manner may reveal how feedback loops can enable or diminish adoption. For instance, as the adoption process keeps processing in an organization, it is likely that with improved outcomes the impacts of the barriers will lose their effect. This could be manifested as how a steep learning curve may be daunting to begin with; but with increased user training and integration into everyday work routines and habits, this learning curve may no longer pose the same level of obstacle in influencing adoption and continued usage.

Taking all of this into consideration then, this study will adopt the stance of drivers as the means by which barriers are addressed and surpassed. In adopting this framework as an analytical lens, this study navigates the complexities of adoption, empowering healthcare organizations to navigate the journey towards digital transformation.

Methodology

Research approach

This study utilized the mixed-methods research design (Edmonds & Kennedy, 2017; Tashakkori & Teddlie, 2010). As Edmonds and Kennedy have highlighted, mixed-methods research design employs the blending of methods to yield a rich and at the same time empirically grounded foundation to explore and answer research questions. In this study, patterns and trends in adopting digital healthcare platforms were analyzed and semi-structured interviews regarding digital technology adoption were conducted with experts in the healthcare sector. For this endeavor the research was conducted as a sequential process, where the results of the quantitative analyses informed the subsequent qualitative process. This included forming hypotheses, testing it against quantitative data (provided by Healthcorp, a digital healthcare platform provider) and based on the analyses engaged in qualitative work through semi-structured interviews. In this way, this study attempted to capture the essence of the research question's query by utilizing the strength of both quantitative and qualitative methods respectively.

Research context

This study was done in Sweden and in collaboration with a digital healthcare platform company. To protect the confidentiality of the company involved, it is referred to throughout this paper as Healthcorp. The context for technology adoption was firstly on getting quantitative insights on HCP and patient behavior on a digital healthcare platform. For this purpose data from four different healthcare receptions, using a digital healthcare platform, was collected. The receptions varied in characteristics: two receptions were fully online, digital centric and two receptions were hybrid, offering both digital and physical healthcare options. One of the receptions was a psychiatry reception while the other three were primary care receptions. Data from these receptions were used to answer $\mathbf{H_2}$ (see *Quantitative analysis*). Furthermore, usage data from 104 receptions (mixed digital and hybrid) were used to answer $\mathbf{H_1}$ (see *Quantitative analysis*). In addition, semi-structured interviews were conducted with experts in the healthcare sector. The following section covers data collection and the logic behind the sampling of data and interviewees.

Data collection

Quantitative data

In collaboration with Healthcorp certain parameters and their associated data sets in Healthcorp's database were identified. The criteria for selecting data on end-user behavior were three-fold: (1) the data needed to have high coverage, meaning Healthcorp could verify that data on a set of given parameters are valid, and (2) the data needed to have potential for yielding insights (3) the data needed be approved by Healthcorp for analysis to maintain HCP and patient personal data security. Based on these parameters the data collection process was

done with the goal of answering the research question. The outcome of this process resulted in 104 healthcare receptions in Sweden being used for one analysis to explore one generated hypothesis (**H_1**, see *Quantitative analysis*). Additionally, longitudinal data from four receptions were used to follow up the results on the previously mentioned hypothesis (**H_2**, see *Quantitative analysis*).

Data collection was done through access to Healthcorp's database on Microsoft Power BI (2023). On the database usage data generated through various interactions on the digital healthcare platform by HCPs and patients were stored and presented by utilizing the tools of Microsoft Power BI. Through the database the researcher could access numerous data sets generated and associated with platform usage. In addition to access to data sets the researcher could filter on different parameters (e.g. reception name, time period and initiator of digital interactions) and create customized data sets appropriate for the goal of the study. The data sets could then be presented through applying different graphs and figures available on Microsoft Power BI. Additionally, the data sets were then exported as XLSX files in table formats (see *Table 2* for an example).

On the platform provided by Healthcorp there was a functionality where after a completed video call booking (i.e. video appointment) patients were prompted to give a recommendation rating. This rating was to give an indication of how likely the patient was to recommend this type of interaction on a scale from 0-4. This rating was obtained from each patient and averaged to calculate the overall *Average Recommend Rating*. This could then be presented with different granularity in period (i.e. day/week/month/year). For example, imagine a HCP wanted to get an understanding on how likely patients were to recommend video meetings based on data during autumn. All ratings from September to November would then be constituting the basis to give an average recommend rating (between 0-4) for that period. This rating could then be used by managers, platform owners, HCPs and other stakeholders to get an understanding of how likely patients are to recommend video call bookings as a medium of interaction. The other variable used in this study was *% Video Call Booking Initiated By HCP*. This variable indicated the percentage of all video appointments that were initiated by HCPs, ranging from 0-100%. Finally, *% Video Call Bookings* were used. This variable indicated the distribution of physical and digital appointments. A value of 100% indicated all appointments were digital through video meetings while 0% indicated all appointments were done through physical visits.

Qualitative data

By utilizing the network of Healthcorp the sampling was done through purposeful sampling. According to Palinkas et al. (2015) purposeful sampling involved identification and selection of information-rich cases for the most effective use of limited resources. This included sampling individuals or groups that possess knowledge and/or were experienced with the phenomenon of interest. Given the context, available resources and goal of the study this approach was deemed appropriate for qualitative data collection.

With consultation and guidance from Heathcorp, 7 individuals with demonstrated experience in operational development and strong understanding in technology adoption in the healthcare sector were carefully selected for interviews from Healthcorp's network of industry professionals. In some cases, the interviewees had close connections to the receptions from which quantitative data was collected from. In total 8 semi-structured interviews were conducted during the project. *Interviewee 3* (see *Table 1*) participated in two interviews. The interviews ranged between 30-60 minutes long. One interview was done physically, with recording done on a computer. The other seven interviews were done fully digitally. Among the interviewees were four representatives from Healthcorp, two doctors and owners of receptions as well as one professor within healthcare improvement research. All interviews were conducted in Swedish and transcriptions were kept in Swedish to avoid semantic loss by translation (Abdulwahab et al., 2021). In accordance with the recommendations by Palinkas et al. (2015) on purposeful sampling, this study strived for an ethical approach in data collection. All interviewees were thus asked permission by the interviewer to record the interviews for the purpose of the study. *Table 1* presents information on the interviewees that participated in the study.

Interviewee	Role	Organization
Interviewee 1	Professor	University
Interviewee 2	Medical specialist	Reception A
Interviewee 3	Medical specialist	Reception B
Interviewee 4	Transformation Specialist	Healthcorp
Interviewee 5	Chief Product Officer	Healthcorp
Interviewee 6	UX Designer	Healthcorp
Interviewee 7	Integration Project Manager	Healthcorp

Table. 1. ***Interviewee roles and organizations.***

Data analysis

Quantitative analysis

Based on the research question, the theoretical foundation for this study as well as a result of initial and continuous discussion with Healthcorp two hypotheses were formulated which could be explored through the platform usage data available for the project.

According to the framework presented by Iyanna et al. (2022) *image barriers* can be described as the degree to which end-users have negative perceptions about a particular digital technology. Furthermore, these negative perceptions can in turn have a direct as well as indirect relation with the adoption of certain digital technologies. Direct relation in the sense that patients who perceive a technology as negative may also not opt for choosing said technology. Indirect relation in the sense that HCPs can abstain from utilizing a certain

technology due to having interpreted the negative perceptions from the patients point of view. In attempting to identify how these barriers may manifest in practice, Average *Recommend Rating* was used as a measure on capturing patient perceptions on a digital technology, namely utilizing video call bookings. This in turn could give an indication for HCPs how positive [negative] the patient perception was on video call bookings. Therefore, by also including *% Video Call Booking Initiated By HCP* a potential indirect relation between patient perceptions and HCP initiation could be explored. In addition, by including *% Video Call Bookings* it was possible to explore a potential relation between patient perceptions and usage of digital bookings in general. Given these assumptions, the following hypotheses were formulated:

- **H_1**: Average recommendation rating correlates positively with percentage of digital bookings.
- **H_2**: Average recommendation rating correlates positively with the percentage HCP initiated video call bookings.

Correlational analysis was conducted through Microsoft Excel (Version 2303) to explore these hypotheses and the results were discussed in relation to the framework presented by Iyanna et al. (2022), to explore and interpret its implications for drivers for technology adoption (see *Discussion*). *Table 2* presents an example of the data set being used for **Reception B** (see *Analysis of Usage Data: Patterns and Trends*).

YearAndWeek	# Average Recommend Rating	% Video Call Bookings Initiated By HCP
2018-W09	3.90	18%
2018-W10	3.95	6%
2018-W11	3.78	7%
2018-W12	3.83	14%
2018-W13	3.83	14%
2018-W14	3.71	6%
2018-W15	3.70	11%
2018-W16	3.85	10%
2018-W17	3.80	15%
2018-W18	3.81	14%

Table. 2. ***An example of the data set for Reception B.***

Qualitative analysis

The semi-structured interviews were transcribed from recordings and then prepared in separate documents for text analysis using ATLAS.ti Windows (Version 9.1.7.0). For initial exploration of the material a word list was generated. A Swedish stop list was created through scanning through the commonly used words in the word list to identify and filter out the frequently used conjunctions in the data. With the Swedish stop list implemented another word list was created and the most frequent words were identified to guide the coding process. Words such as “digital, patient, automation, resources” were identified as frequent words and were therefore used as keywords for regular expressions search. The text was then

coded to associate quotes with first-order codes. Given the international nature of research and English being the *lingua franca* of scientific communication the coding was done in English. This also allowed for a more direct comparison between other studies in the field as well as the theoretical framework of Iyanna et al. (2022) used in this study. This was an example of a translated quote that was coded *Administration* and *Value creation*:

> *We believe that certain tasks create value, such as meeting a patient and doing something good for that person, it creates value. All the stuff about receiving requests, finding times, preparing, all that, it creates no value. It's just administrative hassle that needs to be done until we get a small window to do something value-creating. We want the value-creating part to constitute the majority of the workday.*

Once first-order codes were in place another round of merging of codes was conducted by looking for similarities in codes and when found were merged into one coherent code. The resulting code was determined on how it best reflected the emphasis that emerged in the data. Examples of codes merging:

- *Savings*, *Investment*, *Economy* were merged into *Economy*
- *Fully automated* and *Automation* were merged into *Automation*
- *Value creation* and *Value capture* were merged into *Value creation*

This process resulted in generating a total of 114 codes. The next step in the analysis was to explore how the data could be further abstracted to yield insightful themes. By filtering the codes on groundedness it was possible to identify the most prominent codes. These codes were *Efficiency*, *EHR (Electronic Health Records)*, *Interoperability*, *Communication* and *Control*. By performing a code co-occurrence analysis these codes could then be further explored. Utilizing Sankey diagram for presenting the relation between the codes resulted in the following, when focusing on one of the codes as well as taken together, seen in *Figure 2* and *Figure 3*:

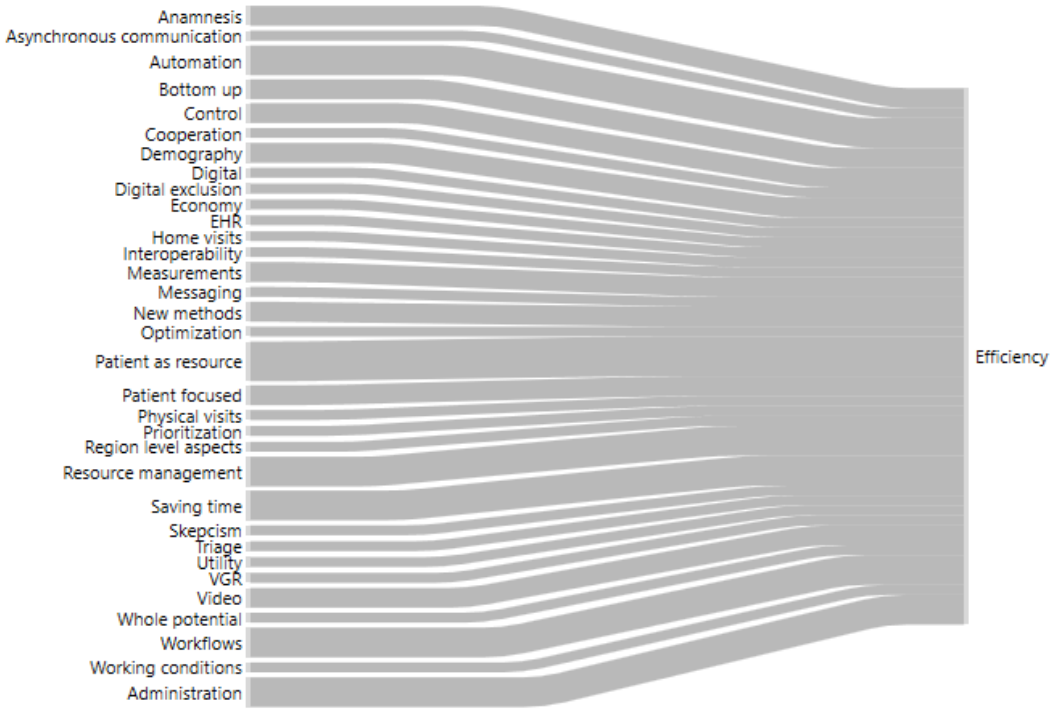

Fig. 2. ***A Sankey diagram representing the groundedness and relations to the code Efficiency.***

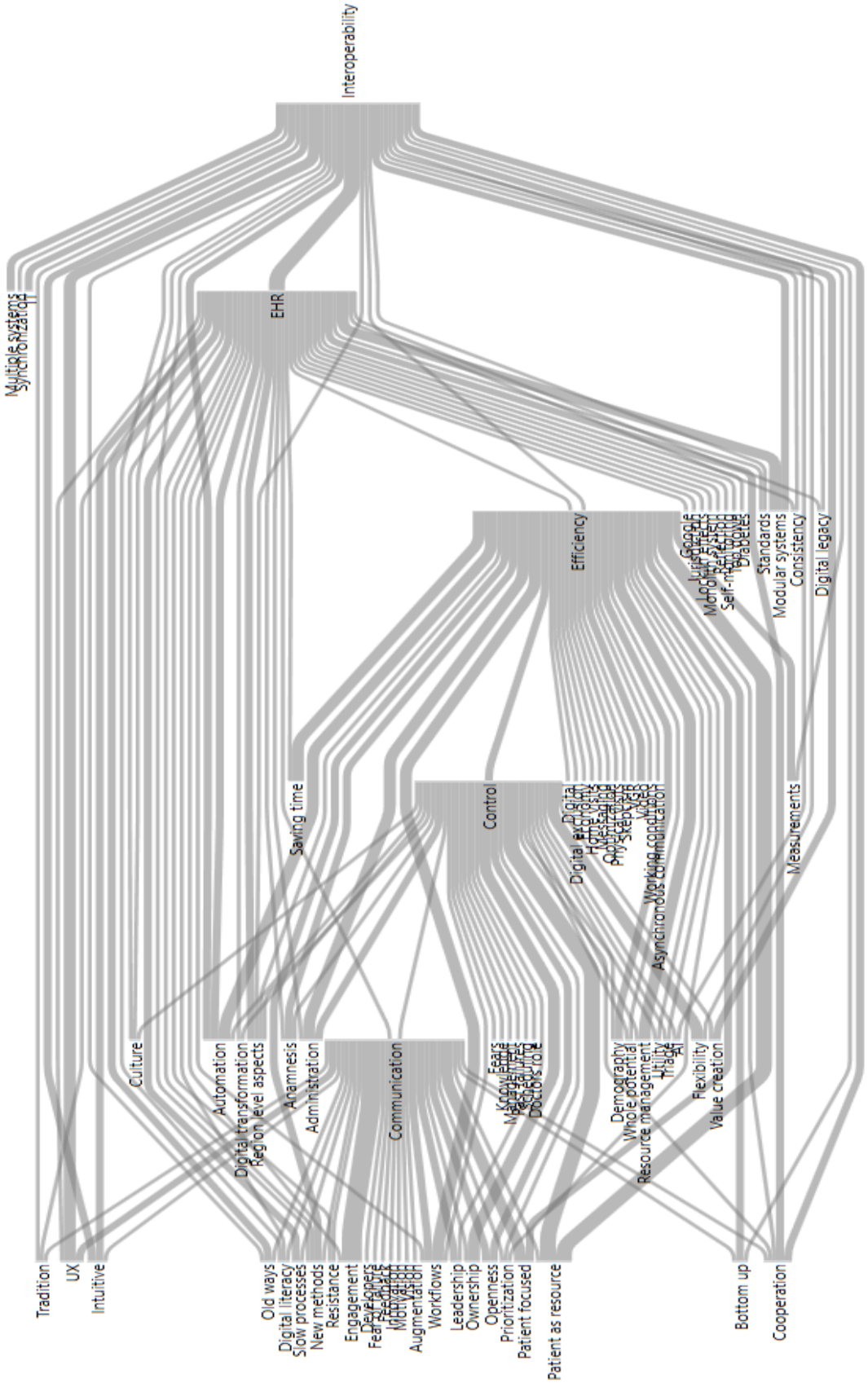

Fig. 3. ***A Sankey diagram representing the groundedness and relations to the codes Interoperability, EHR, Efficiency, Control and Communication.***

These five codes were then seen as the overarching themes in the data. With the themes in place, another round of fine tuning the relation between codes was conducted to establish coherence given the identified themes. This included identifying if there were relations between codes where there should not have been any or creating new relations if deemed necessary. Codes were merged, deleted or connected accordingly. After this process the findings of the qualitative analysis were presented by highlighting the emerging themes and through them making the narrative explicit for the reader (see *Interview Findings: Themes and Insights*). This was then discussed in relation to the quantitative results and through the analytical lens adopted from Iyanna et al. (2022) to gain further insights and draw conclusions to answer the posed research question (see *Discussion*).

Methodological limitations

During the quantitative data collection and analyzes there were variables that may have provided valuable complementary insights to the interpretation of the data. However, due to patient security and anonymity reasons, these were not available for this study. Examples of these types of potential control variables were age, gender and socioeconomic background (Bhandari, 2022).

Furthermore, the choice of sampling for semi-structured interviews was one possible limitation due to selection being done towards sampling individuals that had experience with operational development within the healthcare sector. Choosing to include patients rather than capturing the perceptions of the adoption process by secondary data sources (i.e. HCPs, researchers, representatives from Healthcorp) could yield a richer and more representative view on technology adoption. However, this was beyond the scope of this project.

All interviews were conducted in Swedish and no translation was done prior to qualitative analysis. The reasoning for this was to avoid semantic loss by translation (Abdulwahab et al., 2021). Instead, the language transition to English was done through the coding process. While the most significant semantic loss may have arisen if the transcriptions were translated to English, the potential for semantic loss by coding in English may also have been a contributing factor of error in the study. The coding process was conducted by one researcher. The validity, reliability and reduction of bias could be enhanced if multiple researchers were included in this process.

Additionally, the Master's thesis project was done within the boundaries of the Master's programme. This meant time and resources were limited to what was feasible given the circumstances of reaching certain goals and expectations set by the student as well as the university. This in turn affected the scope of the project.

Results

Analysis of Usage Data: Patterns and Trends

To explore $\mathbf{H_1}$ (*average recommendation rating correlates positively with percentage of digital bookings*) a correlational analysis on usage data on 104 receptions was conducted. The sampled data from these receptions were from the period of 2019-2022. Each data point represents a reception's average recommendation rating and percentage of video call bookings during this period. The values for video call bookings are represented from 0-100% on the X-axis. The values for average recommendation rating are represented on the Y-axis, on a scale from 0-4. For all of the 104 data points the average recommendation rating was 3,85 (*SD* = 0,157) and the average percentage of video call bookings was 33% (*SD* = 0,353). The correlational analysis revealed a non-significant weak positive correlation ($r(102) = ,17$, $p = ,088$) between recommendation rating and average percentage of video call bookings. This indicates that there was insufficient evidence in the sample to conclude that a non-zero correlation exists. See *Figure 4* below for the corresponding scatter plot with descriptions.

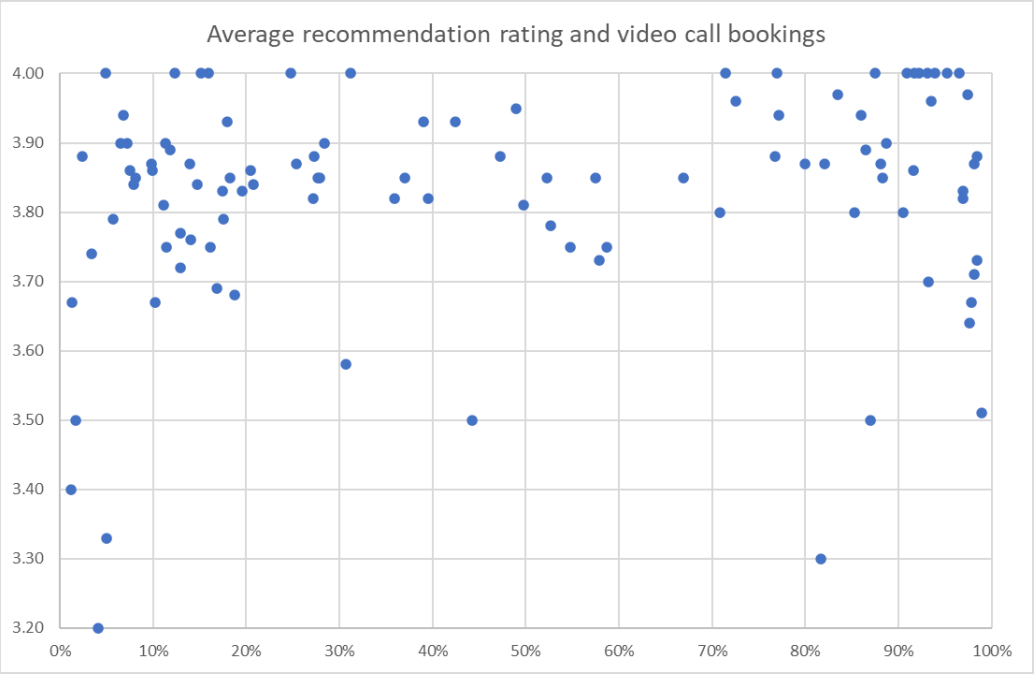

Fig. 4. ***A scatter plot representing the relation between recommendation rating and percentage of video call bookings. X- and Y-axis have been adjusted for visual clarity.***

To explore $\mathbf{H_2}$ (*average recommendation rating correlates positively with the percentage of HCP initiated video call bookings*) correlational analyses were conducted on four different receptions. The data points were generated by looking at the values weekly for each reception. This meant that each data point represents the average recommendation rating and percentage of HCP initiated video call bookings for that week. Results from one reception were later excluded due to an insufficient number of data points. The scatter plots below presented in *Figure 5-7* displays the relations between average recommendation rating and

percentage of video call bookings initiated by HCP for **Reception A-C**. The values for video call bookings initiated by HCP are represented from 0-100% on the X-axis. The values for average recommendation rating are represented on the Y-axis, on a scale from 0-4. The following section presents the results from **Reception A-C** respectively.

Reception A

The sampled period for this reception was August 2022 to March 2023, resulting in 36 data points. During the analyzed period the average amount of HCP initiated video bookings were 72% and average recommendation rating was 3,68. The correlational analysis revealed a non-significant weak positive correlation ($r(34) = ,21$, $p = ,227$) between recommendation rating and average percentage of HCP initiated video call bookings. This indicates that there was insufficient evidence in the sample to conclude that a non-zero correlation existed. See *Figure 5* for the corresponding scatter plot.

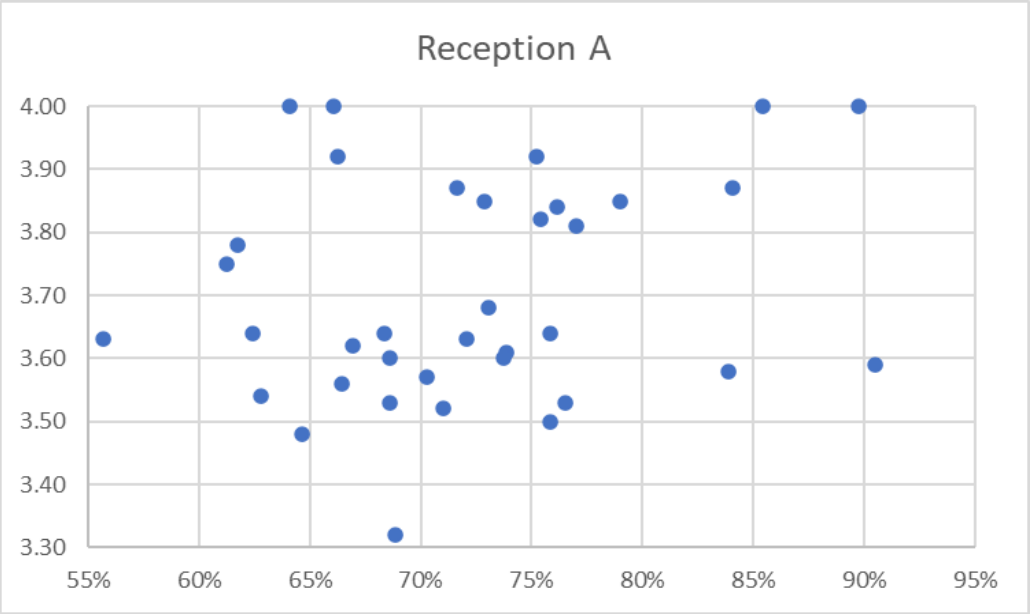

Fig. 5. ***The scatter plot represents the relation between average recommendation rating and percentage of video call bookings initiated by HCP for Reception A. X- and Y-axis have been adjusted for visual clarity.***

Reception B

The sampled period for this reception was February 2018 to September 2020, resulting in 268 data points. During the analyzed period the average amount of HCP initiated video bookings were 16% and average recommendation rating was 3.82. The correlational analysis revealed a significant weak negative correlation ($r(266) = -,12$, $p = ,047$) between recommendation rating and average percentage of HCP initiated video call bookings. This indicates that there was evidence in the sample to conclude that a non-zero correlation existed. Interesting to note for this reception was how the ratio of HCP initiated video call bookings were nearly reversed. See *Figure 6* for the corresponding scatter plot.

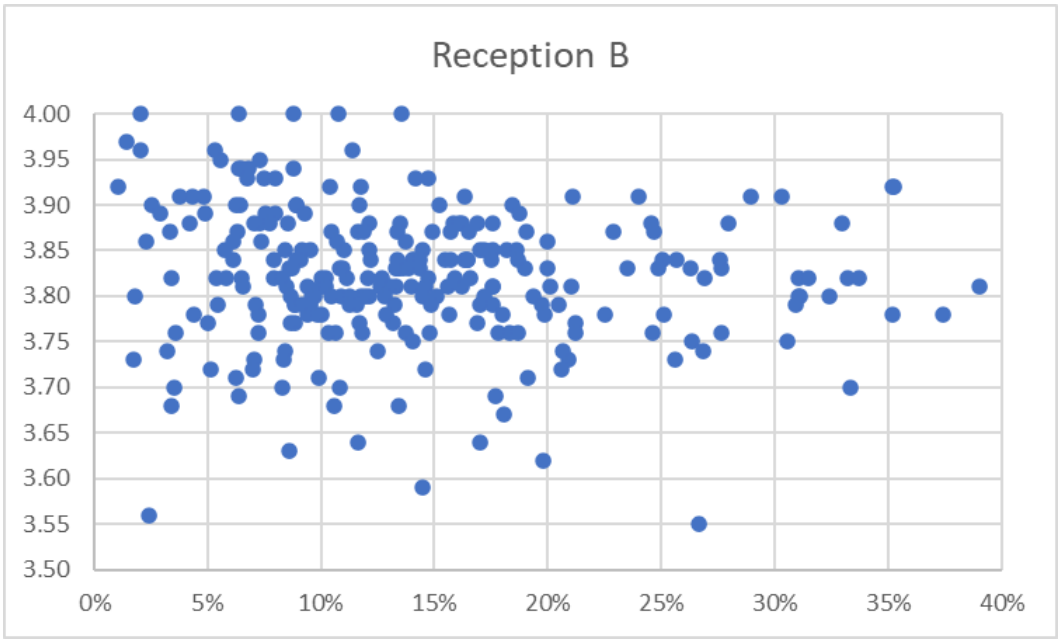

Fig. 6. ***The scatter plot represents the relation between average recommendation rating and percentage of video call bookings initiated by HCP for Reception B. X- and Y-axis have been adjusted for visual clarity.***

Reception C

The sampled period for this reception was February 2018 to September 2020, resulting in 270 data points. During the analyzed period the average amount of HCP initiated video bookings were 4% and average recommendation rating was 3.79. The correlational analysis revealed a non-significant weak negative correlation (r(268) = -,11, p = ,083) between recommendation rating and average percentage of HCP initiated video call bookings. This indicates that there was insufficient evidence in the sample to conclude that a non-zero correlation exists. See *Figure 7* for the corresponding scatter plot.

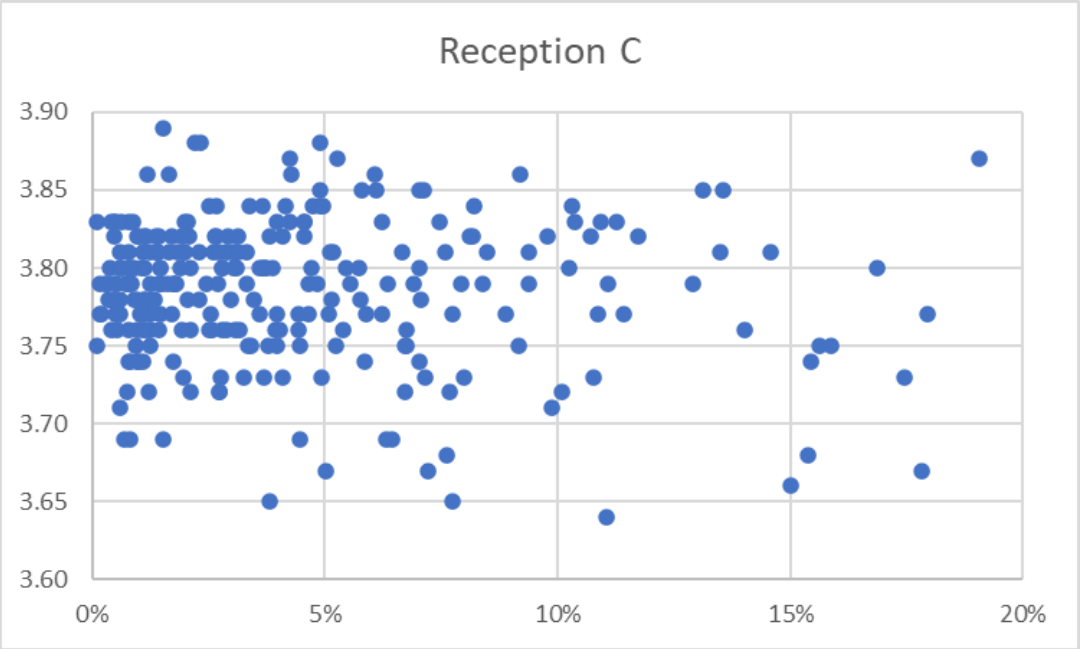

Fig. 7. ***The graph represents the relation between recommendation rating and percentage of video call bookings initiated by HCP for Reception C.***

Interview Findings: Themes and Insights

In this study 8 semi-structured interviews were conducted to explore and answer the research question; *What drives the adoption of digital technologies in healthcare?*. To accomplish this, a set of 7 interviewees were selected through purposive sampling with the goal of interviewing individuals with significant knowledge and/or experience with operational development as well as technology adoption in the healthcare sector. Through thematic analysis key themes that captured the essence of the interviewees' experience and perception was identified. These themes were *Efficiency*, *EHR (Electronic Health Records)*, *Interoperability*, *Communication* and *Control*. In this section these key themes were presented with corresponding quotes that support the findings. In the next section, *Discussion*, the findings were discussed through the analytical lens of Iyanna et al. (2022).

Efficiency

According to the interviewees, leveraging the possibilities presented by digital technologies adoption could be driven by achieving efficiency. Through automation digital technologies

could both save time and money through utilizing asynchronous communication such as messaging as well as video meetings instead of physical visits. In addition, through the usage of machine learning automation of anamnesis as well as triage provided another potential source of efficiency. Furthermore, according to multiple interviewees reducing the time spent on administration for healthcare providers was the focus for a significant part of digitalization processes. Achieving that has meant streamlined workflows for healthcare providers. An important success factor that was identified was the notion of acknowledging and utilizing patients as resources to effectivize the healthcare process through a bottom up perspective. This included opening up the scheduling process to let patients select the times that were the best fit for them. The quote below presented an example of efficiency in change of workflows following a digitalization process on a reception in Sweden:

> *The technology and systems are not the most important in my world, it is the change in ways of working that really matters. By changing their ways of working they now have the same workforce but have achieved 100% availability. They even have days where they have occasional periods of respite.*

By utilizing Sankey diagram representation of the relations between the codes that arose in the data, the granularity of the theme could be further highlighted. In *Figure 8* the codes that were connected to *Efficiency* further encapsulated how this theme was manifested. Noteworthy was the connection between the themes themselves. For *Efficiency* this was notable with connections to *Interoperability*, *EHR* and *Control*. *Control* in particular could be identified as a significant element. In addition, *Automation*, *Patient as resource*, *Saving time* and *Workflows* emerged as the most frequently co-occurring codes.

Fig. 8. ***A Sankey diagram representing the groundedness and relations to the code Efficiency.***

EHR

The significance of how adoption of digital technologies was related to the EHR (Electronic Health Records) systems was highlighted throughout the interviews. Implementing EHR

systems was noted as a slow process which could take years from requirement specification, procurement to implementation. EHR systems were then used daily and all other digital technologies that were considered for adoption had to be in consideration to how it fitted with the EHR systems. According to one interviewee the transition from analog health records to EHR was the "only serious digitalization process the healthcare sector has experienced". A recurring aspect was how inertia manifested through attachment to the EHR systems. Being mindful of interoperability with other digital technologies and the EHR systems was noted as a success factor for driving adoption. In addition, adopting a cooperative and communicative mindset that acknowledged the workflow aspects associated with the EHR was highlighted as important success factors in addressing these barriers. The quote below presented an example of how the relation to the EHR systems was perceived:

> *There is an unwarranted belief in the EHR system's capacity to solve all problems. And if the problem is not solved, or, if the solution is not related to the EHR system, there is no need for it. It is part of the digital legacy, how you are raised in it.*

Figure 9 presented the relation between *EHR* and its corresponding codes. Similarly to *Efficiency* there were connections between themes and *EHR*; *Communication*, *Efficiency* and *Interoperability*. Most notably, *Interoperability* was not only the most significant connection between the different themes, but it was also the most frequently co-occurring code in general, followed by *Slow processes*.

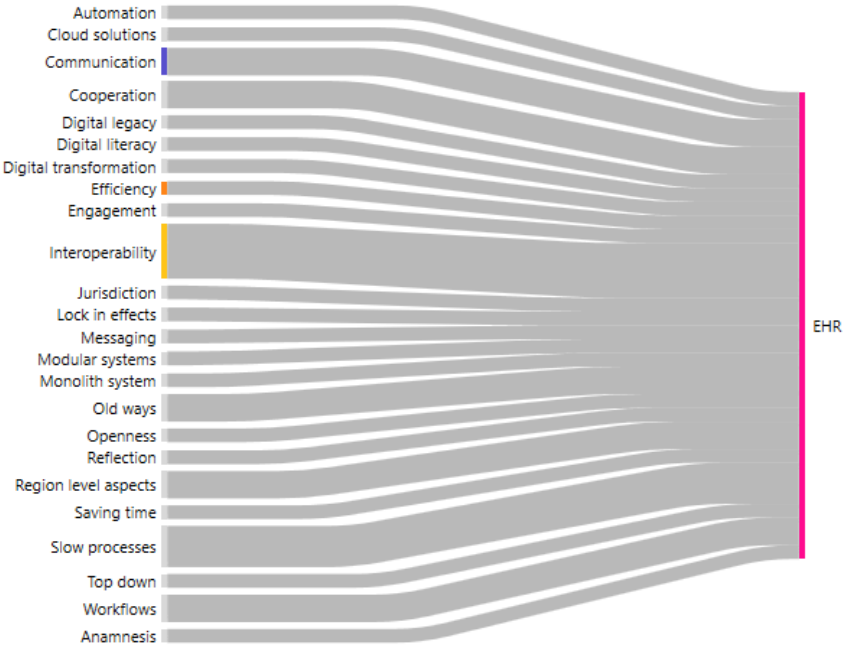

Fig. 9. ***A Sankey diagram representing the groundedness and relations to the code EHR.***

Interoperability

In addition to the significant association with interoperability and EHR there were other aspects of interoperability that were recurring throughout the interviews. Most notably, it was highlighted that digital technologies that were modular as well as had user experience as a focus were more likely to be adopted. This could be achieved by building an understanding of

the structures present in the everyday worklife of healthcare providers such as ways of communicating patient status, scheduling as well as digital legacy. The quote below presented an example of how having modular systems were of significance:

> *If everything is going to be built as a monolithic system and no one wants to let anything else in, then it will be impossible to have any kind of bottom up perspective and then there will be anarchy. But if everything is built more kind of like a module configuration and you can configure more, then that enables you to have a wider flora of things.*

Figure 10 presented the relation between *Interoperability* and its corresponding codes. In addition to *EHR* being the most frequently co-occurring code, *Efficiency* had a connection albeit not a strong one. Furthermore, *Digital legacy*, *Modular systems*, *Old ways* and *UX* emerged as the most significant codes.

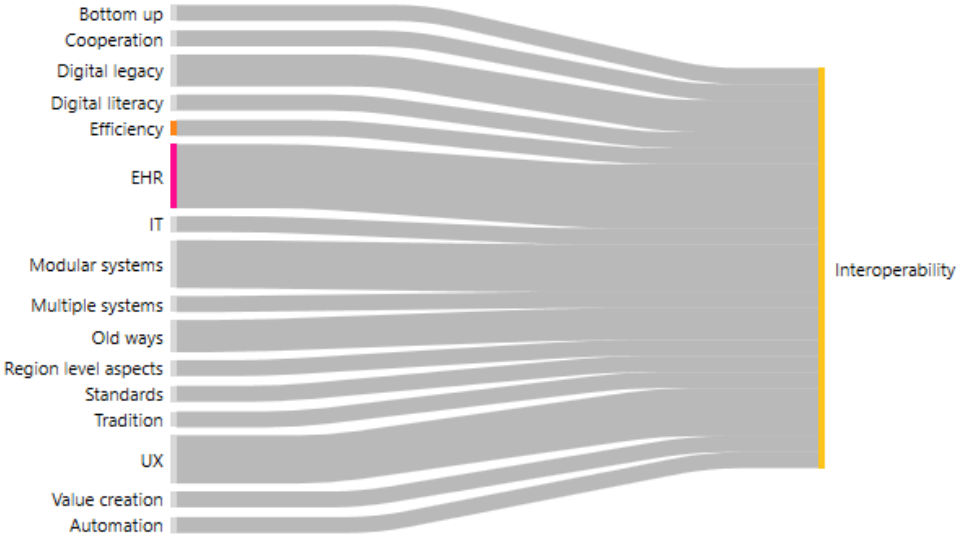

Fig. 10. ***A Sankey diagram representing the groundedness and relations to the code Interoperability.***

Control

As previously mentioned, the adoption of digital technologies could supposedly afford a novel way of working with asynchronous communication and automation of certain work tasks enabled by machine learning. In the interviews it was highlighted that being able to take ownership of that transition from a bottom up perspective was of significance for successful adoption. The balancing act of top down and bottom up interests was further emphasized as a necessity. The most recurring aspect regarding control was coming back to the notion of patient as a resource and the implications in control it meant for HCPs. Utilizing patients as a resource also entailed letting go of previously held control on scheduling as well as environmental factors (i.e. video appointments and asynchronous communication through messaging in place of physical visits). Exhibiting flexibility and acknowledging past failures as learning lessons rather than future prediction were also emphasized as important factors. The quote below presented an example of a Healthcorp representative's perspective on the significance of relinquishing control and giving more options to patients:

> *I believe it is easier to get the healthcare sector to change when it is the patients that are pushing for it. We have seen it a lot in our implementations where the ones who dare to give more control to the patients also see a lot of relief, efficiency. Additionally, you also see that the adoption is increased.*

Figure 11 presented the relation to *Control* and its corresponding codes. *Communication* and *Efficiency* had co-occurrence with *Control*, with *Efficiency* having the most significant relation among the themes. Furthermore, the most frequently co-occurring codes in addition to *Efficiency* were *Patient as resource*, *Ownership* and *Flexibility*. Additionally, *Control* had numerous relations to other codes, however with lower frequency of co-occurrence.

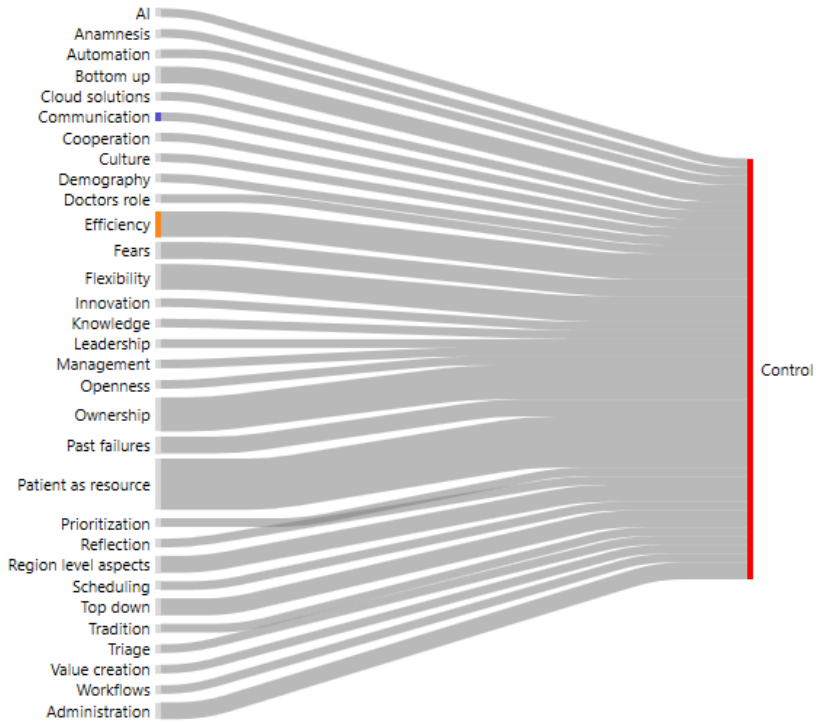

Fig. 11. ***A Sankey diagram representing the groundedness and relations to the code Control.***

Communication

The last key theme that was highlighted as driving adoption of digital technologies was aspects of communication. From the interviews it was made apparent that acknowledging the bottom up perspective and engaging the healthcare providers as well as patients in the adoption process was of significant importance. In practice this philosophy meant creating information flows between management level to end-user level to facilitate a patient focused goal in adoption of digital technologies. In addition, the interviewees put emphasis on the importance of leadership in addressing potential skepticism by being transparent to healthcare providers as well as patients prior to digital transformations. The quote below presented an example of a doctor's perspective on the significance of engagement and transparency:

> *If you do not have any trust capital to begin with and you are just pushing new things on your staff it won't end well. Then we start looking for things to worry about and what's not working. If you involve your staff from the beginning and they know why you are making a change and what we hope to achieve, then I believe people will approach things with a happier and more open mindset. This is where I believe we fall short in healthcare, especially in larger organizations.*

In *Figure 12* the corresponding codes and its relation to *Communication* was presented. Among the identified themes, *Control* and *EHR* was co-occurring with *Communication*. Notable for these relations were their lesser significance in relation to the other, frequently co-occurring codes. The most significant codes were *Bottom up*, *Engagement* and *Patient focused*.

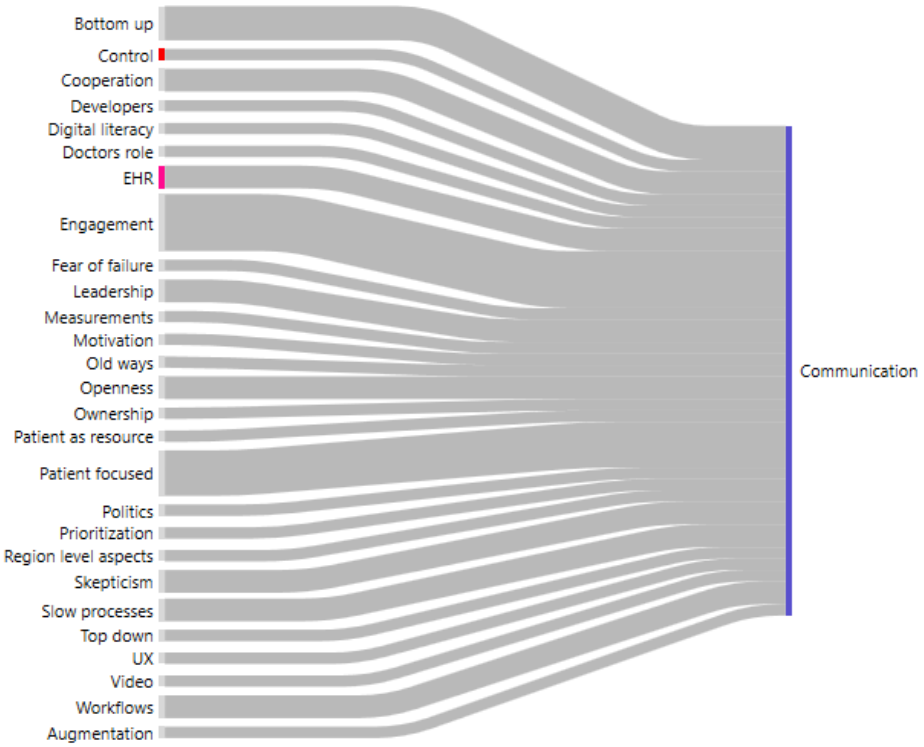

Fig. 12. ***A Sankey diagram representing the groundedness and relations to the code Communication.***

Discussion

The research question for this study was: *What drives the adoption of digital technologies in healthcare?* In exploring what drives the adoption many different perspectives were drawn upon to untangle a highly complex and dynamic environment.

The hypotheses generated prior to quantitative analysis were:

- **H_1**: Average recommendation rating correlates positively with average percentage of digital bookings.
- **H_2**: Average recommendation rating correlates positively with the percentage of HCP initiated video call bookings.

The correlational analysis revealed no significant relation between recommendation rating by patients and the percentage of digital bookings (i.e. video appointments) for the selected sample of receptions and period. In other words, there was no evidence to indicate that there seemed to be a relation between the rating given by patients on a given way of interacting digitally and the percentage of digital bookings. **H_1** was thus rejected.

For **H_2**, in all but the case of **Reception B** there was no significant correlation to be found. A significant positive correlation could not be found in any of the receptions. Meaning, the result from receptions from these analyses could not give evidence to **H_2**. In other words, there was not conclusive evidence to indicate that there seemed to be a relation between HCP initiation of video appointments and average recommendation rating by patients. Taken together, **H_2** was thus rejected.

What the quantitative analysis, however, did provide was an initial exploration of the notion of *image barriers*. As a reminder, *image barrier* in Iyanna et al.'s (2022) framework refers to the degree to which end-users have negative perceptions about a particular digital technology. The correlational analyses attempted to explore how these *image barriers* could be manifested in practice in the healthcare sector. For **Reception B** there was a significant weak negative correlation, in opposition to the postulated hypothesis, **H_2**. The implications of this would be to question the notion of *image barriers'* influence altogether. However, it is worth mentioning that in addition to only finding weak negative correlation in one reception, causation cannot be determined from a correlational analysis. This then acted as a catalyst for raising the question whether support for *image barriers* could be found as an element of driving adoption in the qualitative data.

The qualitative analysis was conducted on the basis of 8 semi-structured interviews. Emerging from the thematic analysis were five themes that represented the essence of the interviewees' experience and perceptions regarding digital technology adoption in the healthcare sector. The themes were *Efficiency*, *EHR (Electronic Health Records)*, *Interoperability*, *Communication* and *Control*. Taking these themes together painted the

narrative of a complex environment that had requirements and interests from different points of views that needed to be balanced to achieve successful adoption of digital technologies. Much like how Iyanna et al. (2022) presented barriers from different points of views, similar notions about drivers for adoption could be identified throughout the qualitative analysis in this study.

And the similarities did not end there. *Task-related barriers* referred to the workflow changes, system use, time commitment and communication challenges. This resonated well with the findings on *Efficiency*. Aspects of efficiency that addressed *Task-related barriers* were identified. Change of workflows by time saved through automation of certain tasks was identified as a significant driver for adoption. In addition, emphasis in administration tasks and the necessity of managing workflows related to administration emerged as a significant element. This was an example of how *task-related barriers* could manifest in practice and how they could be addressed.

In addition, aspects of *Communication* were one of the key themes arriving in the data which also has connections to *task-related barriers* as well as *infrastructural barriers*. This was expressed in the significance of having transparency in communication prior to adopting digital technologies. The importance of the facilitation of communication channels was also highlighted in the interviews. This echoed similar sentiments to Omrani et al. (2022) in how the emphasis on technological context could aid "organizational preparedness", increasing the probability of success of technology adoption. In extension, the relevance of communication aspects could also be applied to *image barriers*, with the end goal of achieving a positive mentality towards adoption. This both highlighted how *image barriers* could be manifested in practice in the healthcare sector and how they could be addressed. The slow process of implementing EHR systems from start to finish, how EHR systems caused inertia due to the attachment to and habits associated with using it could also be seen through the lens of *infrastructural barriers* and *tradition barriers*. Adopting a communicative and cooperative mindset that acknowledged these factors was identified as success factors for addressing these barriers.

Furthermore, *infrastructural barriers* and *tradition barriers* could both be associated with aspects of *Interoperability* and *Control*. The digital infrastructure within the healthcare sector could be identified to affect how interoperability had to be managed in relation to digital legacy and in relation to the possibility of status quo in the organizations. The philosophy change that was identified as necessary when talking about notions such as patient as resource were aspects of control. These were then necessary to consider when planning and executing supporting work for digitalization to increase the likeliness of adoption. Furthermore, it was highlighted how it was necessary to address the status quo in relinquishing control from a HCP perspective to give more control to patients, resonating well with addressing *tradition barriers*.

Figure 13 illustrated the relationship between the barriers adopted from the Iyanna et al. (2022) framework and themes that arose, in the context of digital technology adoption in the

healthcare sector. The arrows signified the themes which addressed the corresponding barrier. The dashed line between *Interoperability* and *EHR* signified the strong connection between the two themes. This could be interpreted as the potential influence between the two themes and how they related to the corresponding barriers.

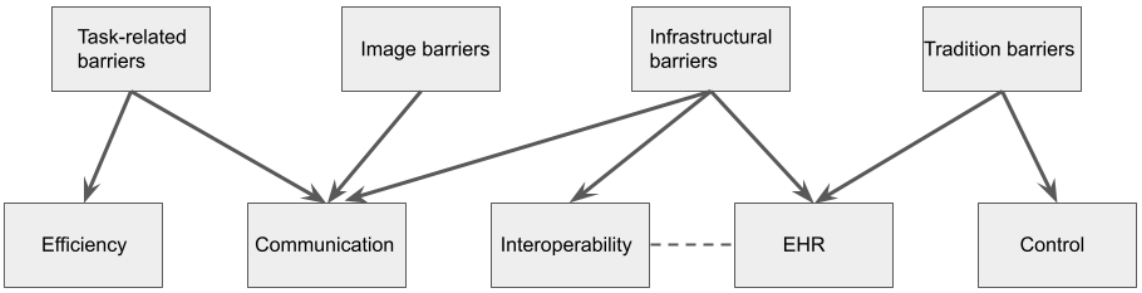

Fig. 13. ***A conceptual model that illustrates the relationship between barriers and themes.***

In summary, the findings generated in this study found support for concepts presented by Iyanna et al. (2020). Moreover, the study concluded that drivers for digital technology adoption in the healthcare sector could be attributed to aspects of efficiency, communication, interoperability, EHR and control by addressing the barriers towards technology adoption; *Task-related barriers*, *Image barriers*, *Infrastructural barriers* and *Tradition barriers*.

Limitations, contributions and the road ahead

The research gap was engaged through applying a mixed-methods approach for empirical testing as well as conducting research in an under-researched setting. This study aimed to provide empirical evidence as well as qualitative insight to drivers of digital healthcare technology adoption. Nevertheless, like all studies, be it mixed-methods design or quantitative or qualitative methods respectively, this one was not without its flaws. The accuracy of the quantitative analysis would likely have been improved if individual-level variables could have been controlled for such as age, gender and socioeconomic background. These could have helped cover alternative explanations and confoundings in exploring the relations between these variables. Moreover, using longitudinal usage data as a basis for quantitative analysis introduces factors to take into consideration. Due to data being collected over a certain period of time, there is an unpredictability in the variation of individuals that generate the usage data. In this study that could be manifested as different demographics of patients generating the recommendation ratings at different times. In addition, variation in other contextual factors may have been affecting the results, such as; different rules and regulations being in effect and time of the year. When conducting the correlational analysis there was an assumption made on the stability of the relationship between the variables. This assumption has been defined in research as stationarity (Myers, 1989). Stationarity assumes stable relationships between variables over periods of time. Longitudinal data, however, may as previously argued for exhibit nonstationarity, meaning relationships between variables

does in fact change over time. Accounting for nonstationarity, then, would likely have increased the accuracy of the results of the correlational analysis in this study. In sum, these limitations should be considered when reflecting on the validity and reliability of the quantitative analysis.

As a fundamental part of qualitative research the coding process affects all sequential inferences and identification of themes and abstraction of the data. In this study the coding process was done by one researcher alone. Countermeasures against developing bias in the coding process was taken by going through the codes in iterations to retain coherence and validity. However, it cannot be excluded that bias may have arisen nonetheless. Additionally, different themes may have emerged if the sampling process was done through applying different criteria (e.g. resulting in interviewing patients instead). Other contextual factors that may have affected validity were the fact that this study was conducted in Sweden. Generalizability cannot be guaranteed for countries in other parts of the world.

The theoretical contributions from this study were the testing and utilization of a modern framework that presents barriers towards e-health innovations. In applying the framework by Iyanna et al. (2022) in this study as an analytical lens to identify what drives the adoption, it has tried to highlight how these concepts may manifest in the healthcare sector and how they could be addressed. For this specific context the overall themes that emerged had multiple and overlapping connotations with the notions presented by the framework. This could both give support to the validity of the framework as well as explore how these concepts may be expressed in a real life setting. For instance, this study could concretize how tradition could be expressed through digital legacy such as EHR systems as well as status quo in control relationships between HCPs and patients and how it could be addressed.

For practical relevance these insights could be leveraged to address the relevant requirements and interests that have been highlighted as needing careful management to give organizations in the healthcare sector better conditions for succeeding in adoption of digital technologies. Studies like this one could then have the impact of bridging the gap between academia and practice in the healthcare sector. Reflecting on the themes that arose in this study and their interplay with the framework presented may give guidance to other organizations in the healthcare sector in how to utilize frameworks akin to Iyanna et al.'s (2022).

For future research it could be a valuable approach to replicate a similar study in other settings to determine validity, reliability and explore how well these findings could be generalizable to other contexts. This could include conducting a similar study in other parts of the world as well as other healthcare settings. In addition, certain aspects of the Iyanna et al. (2022) framework were neither covered nor given support by the results and findings in this study. These aspects were *patient-care barriers*, *system barriers*, *self-efficacy barriers*, *threat perception*, *usability barriers* as well as *resource barriers*. For instance, understanding how the notion of *threat perception* as an aspect for technology adoption manifests and could be managed could be a relevant topic to explore, due to the emergence of artificial

intelligence and the implications on personal data security. Exploring this and other aspects could hence be a fruitful venture for future research endeavors.

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