Department of Learning, Informatics, Management and Ethics (LIME),
Medical Management Centre (MMC)
Master's Programme in Health Economics, Policy and Management,
(2019-2021)
Degree Project, 30 Credits

Adopting a digital communication tool in primary care: a descriptive single case study in Sweden

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Declaration

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The thesis "Adopting a digital communication tool in primary care: a descriptive single case study in Sweden" is my own work.

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Abstract

Background: Adopting digital communication in primary care is a complex process, that was accelerated by the COVID-19 pandemic in several countries, including Sweden. However, there is still a knowledge gap on the effects of adopting digital communication in primary care and on how users perceive it.

Aim: Describe the adoption of a digital communication tool in a primary care centre in Sweden, and how it was perceived from the perspective of the health care providers using it.

Methods: A descriptive, embedded, single-case study was performed in a primary care centre in central Sweden, where a tool for digital communication has been adopted, Collabodoc Digital Kontakt. Data were collected through a summary report on utilization, observation and six qualitative semi-structured interviews with key informants from the primary care centre and the company that developed the tool. Analyses included descriptive statistics and qualitative content analysis. Three theoretical frameworks about digital care guided the process.

Results: The adoption and perceptions of Collabodoc Digital Kontakt were described following seven domains from the Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework: Condition, Technology, Adopters' system, Value Proposition, Organization, External system, Adaptation over time. The utilization of the tool was on average 182 contacts per month, with causes of contact including non-acute conditions and administrative issues. Young and adult females were the largest user groups. Despite health care professionals having some concerns and issues, the tool was adopted and overall perceived as positive by respondents.

Conclusions: The adoption of digital communication in primary care can be analysed with mixed methods. Further research about the role of leadership in the adoption process and the impact of digital communication on users' perceptions and inter-professional collaboration is suggested.

Keywords: digital communication, primary care, adoption, digitalization, NASSS framework

List of abbreviations

AI	Artificial Intelligence
CAT	Complexity assessment tool
CDK	Collabodoc Digital Kontakt
CEO	Chief Executive Officer
DC	Digital Communication
EMR	Electronic Medical Records
EU	European Union
HC	Hälsocentralen (Health Centre)
HCP	Health Care Provider
IT	Information Technology
KI	Karolinska Institutet
NASSS	Non-adoption, Abandonment, Scale-up, Spread and Sustainability
PC	Primary Care
PCC	Primary Care Centre
PEU	Perceived Ease of Use
PU	Perceived Usefulness
QCA	Quantitative Content Analysis
QR	Quick Response
TAM	Technology Acceptance Model
WHO	World Health Organization

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1. Introduction

Primary care (PC) is facing complex and urgent challenges. Meeting the increases in care demand driven partly by socio-demographic trends, such as ageing population and changing lifestyles, and chronic disease management needs, is even more difficult when we consider the rising economic pressures and budget cuts in health care. Against this backdrop, rapidly advancing technologies can potentially provide solutions to these challenges by introducing innovative and cost-effective means of service delivery. For example, digital tools can enable the communication between patients and health care providers (HCPs) at distance, with the potential of improving efficiency and access to PC while reducing costs.

1.1 Primary care in Sweden

The Swedish health care system is publicly financed and provides universal coverage (1). The national government determines the general objectives and regulations of the system, while local governments (regions and municipalities) manage the care provision, that is then different across the regions (1).

PC is expected to be the first care contact for the population, although it has no formal gate-keeping role in most Regions and patients are free to seek specialist or hospital care directly (1,2). There are more than 1.100 PC centres throughout the country, and they are usually team-based, i.e. care is provided by four to ten general practitioners in collaboration with other health care professionals, such as nurses (1,2).

In 2010, thanks to the Choice Reform, residents were allowed for choosing their PCC, and private providers for establishing PC practices, if they met certain defined criteria (2). Thus, competition became freer on the PC market as PCCs started to compete for patients.

1.2 Digital communication in the patient-provider interaction

Communication between patients and providers is a key ingredient for providing health care at all levels. It has proven one of the most important elements in chronic disease management (3), and it correlates to hospital re-admission rates (4). Communication is also crucial to increase patients' responsibility for their care and self-management (3,4).

Digital communication (DC) is part of ***digital health,*** i.e. the use of digital technologies for health (5) – a more detailed overview of the terminology used is available in **Appendix 1**. DC involves the use of digital systems to facilitate the information exchange among patients and HCPs separated by distance and/or by time (6). Thus, as other forms of digital health, it affects the interaction between patients and providers. The different types of DC tools can be classified as follows (6):

i. Synchronous digital patient-to-provider encounters (e.g. calls or video calls);
ii. Asynchronous digital patient-to-provider communication (e.g. text messaging, e-mails);
iii. Synchronous and asynchronous digital peer-to-peer communication (e.g. social networks, forums, online communities);
iv. Synchronous digital patient-artificial intelligence (AI) interactions (e.g. apps).

Furthermore, effective communication between patients and HCPs is one of the key factors of patient-centredness, defined as "care that is respectful of and responsive to patient preferences, needs and value" (7). There are doubts and concerns about the performance of DC in terms of patient-centredness compared to regular communication (7), its effects on the patient-provider interaction and ultimately on the quality of care (8).

1.2.1 Digital communication in primary care

DC in PC can include all of the above listed categories. Chats, remote contacts, video visits, remote or electronic consultations, chat-based triage, remote exchange of information between face-to-face encounters are only some examples (6,9).

The consequences of such innovative tools include changes in the role of stakeholders, efficiency, flexibility, reduction in waiting times, less apprehension than in-person visits and more freedom (7,10). Impacts of DC on the efficiency and costs of care delivery are still unclear, as there is some evidence of decreased costs with the same or higher quality (11), but there are also concerns about the time waste generated by video consultations (8).

Digital health in PC in Sweden has quickly grown since its introduction in 2014 (12), and it was even more accelerated by the COVID-19 pandemic (13). The digitalization process has included various forms of communication between patients and HCPs, such as video consultations, chat-based triage and online communication. As shown during the COVID-19 pandemic in many European countries (13), remote contacts and consultations in PC allow continuity in the care provision while avoiding infection transmission. DC has been used both for regular diseases and for mild COVID-19 cases, when patients do not need hospital level care but benefit from distant medical or professional support.

1.3 Complexity in health care

Health care organizations are characterized by a degree of complexity that makes adopting innovations difficult and rarely successful. Complexity is a feature of the life of organizations where different forces are colliding, with high levels of uncertainty and low levels of agreement, leading to “unpredictability, clashing counter-cultures, dissensus, contention, conflict, and inconsistency” (14). Within a complex organization the causal relationships among the different components are difficult to disentangle, and solving problems or addressing changes requires large amounts of data (14). Therefore, complexity can explain why technological and digital innovations in health care are so difficult to manage, and often fail to be adopted or scaled up (15,16).

More specifically, the lack of sufficient incentives for users threatens the adoption process (4). Indeed, one of the main causes of complexity is related to the motivation of users, both patients and HCPs. Without incentives users are resistant to change and will not modify their habits (4).

As care delivery is the output of complex processes, management strategies that try to address innovations with a linear approach are likely to fail (14,17). Indeed, most innovations in health care affect the whole care delivery process (15), which is the output of a complex non-linear network of different stakeholders with often conflicting values, interests, goals and policies (14,17). Therefore, implementing innovations in health care is “a social and political process” and requires non-linear approaches that take into consideration the full degree of complexity without any attempts of oversimplification (17).

1.4 Theoretical frameworks to analyse digital applications in health care

Among the different theoretical models for the adoption of innovations in health care, three relevant frameworks were identified and used in the present study (more details in **Appendix 2**).

The Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework (15) was used in two phases. NASSS is evidence-based and theory-informed, and it identifies seven domains across which challenges to adoption arise (**Figure 6** in **Appendix 2**) (15). Thus, it allows for analysing and explaining the complexity involved in the implementation of technology-supported programs and innovations (17). In the present study, it provided theoretical foundations to the study design, and it informed the qualitative content analysis (QCA) with its seven domains.

NASSS-CAT (Complexity Assessment Tool) is a practical instrument to measure complexity, and in the present study it was adapted to develop the interview guides (**Appendix 6**) (17). NASSS-CAT includes questions about operational logistics, social and political aspects, adaptation over time, and thus it also supported the creation of the initial codebook for data analysis.

The Technology Acceptance Model (TAM) is a scale for predicting and explaining the use of technology by measuring its perceived usefulness (PU) and perceived ease of use (PEU) (18). The theoretical basis for TAM model is that actual use of information technology (IT) is determined by users' acceptance of technology (**Figure 7** in **Appendix 2**) (19). Therefore, TAM was used in the present study as a source of additional dimensions to some of the NASSS domains. Although TAM alone is not sufficient for a full understanding of the complex changes brought about by innovations (15), it is important when analysing PU and PEU.

1.5 Issues and knowledge gaps

Despite the potential benefits of DC in PC, many questions and issues are challenging its spread and adoption, and there is currently a knowledge gap about its effects (12,20). Scarce evidence about these effects often prevents organizations and HCPs from adopting DC. Therefore, understanding how the different effects of DC are perceived by users is crucial in order to gain insights into its acceptance and adoption. Some of the main effects are listed in the following paragraphs.

The usability of DC threatens equity in access. Indeed, if DC becomes prevalent in PC, it might disrupt equity in access because of the digital divide (6,12), that is "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access IT and to their use of the Internet" (21). Also, the usability of technology by different patients' groups is often regarded as not equal, with concerns about access for the elderly (8,20).

DC poses important legal and administrative issues, including cybersecurity. Cybersecurity is the security of communications, operations and information, defined as "the protection against the threat of theft, deletion or alteration of stored or transmitted data within a cyber system" (22). Cybersecurity has high importance in health care, when dealing with sensitive personal data. The security and safety of IT processes, such as those involved by DC, are hard to assess for health authorities and HCPs (8,20), so patient safety and information integrity are often questioned (4). Therefore, users' perceptions of cybersecurity may impact adoption and utilization of DC.

The adoption of DC is also met by a resistance to change. On the one hand, patients may not like how "impersonal" DC can be (7), be worried about HCPs' decreased ability to assess care needs (23), and struggle with the new tasks and responsibilities they are assigned (7). On the other hand, HCPs may not be willing to change their care delivery processes and to start using new means of communication (7). Understanding how and when users experience this resistance to change may shed light on the adoption of DC.

Finally, there is a knowledge gap about how sustained the utilization of digital innovations is over time. More specifically, the COVID-19 pandemic has forced health care systems to shift towards DC (13), but it is still unknown how sustained this shift will be. Whether users perceive this shift to be long lasting or not may also affect the adoption process.

1.6 Relevance of the study

The study gives a contribution through the description of a real case and hypotheses generation on the adoption of DC in PC. By analysing the experience of a PCC adopting a DC tool in central Sweden, it is possible to describe the perceptions of users, understand which elements contribute to generating positive or negative effects in the given case, and formulate more general hypotheses.

The chosen intervention was considered relevant as it had distinctive features and a specific approach to the patient-provider communication, as described in **Section 3.2**.

The included PCC was the first one to adopt the tool, and thus users were early adopters. Thus, the case offered the opportunity of describing the characteristics of the PCC that enabled the adoption of a new DC tool, and those that challenged it. Such insights may be of general relevance, despite the case not being representative of other PCCs, by offering hypotheses on the challenges to the adoption of DC in PC.

Lastly, the COVID-19 pandemic highlighted the importance of DC, thus increasing the relevance of this study.

2. Aim and research questions

The aim of the study was to describe the adoption of a digital communication tool in a primary care centre in Sweden, and how it was perceived from the perspective of the health care providers that had started to use it.

Given the early stage of adoption of the tool, the purpose was not to perform an evaluation of its utilization, but to provide a general description of its adoption based on the personal experience of the users involved in the analysis and on utilization data.

The following research questions were addressed:

1. How was a digital communication tool adopted and used in a primary care centre in central Sweden?
2. How was a digital communication tool perceived by the health care providers that had started to use it, in a primary care centre in central Sweden?

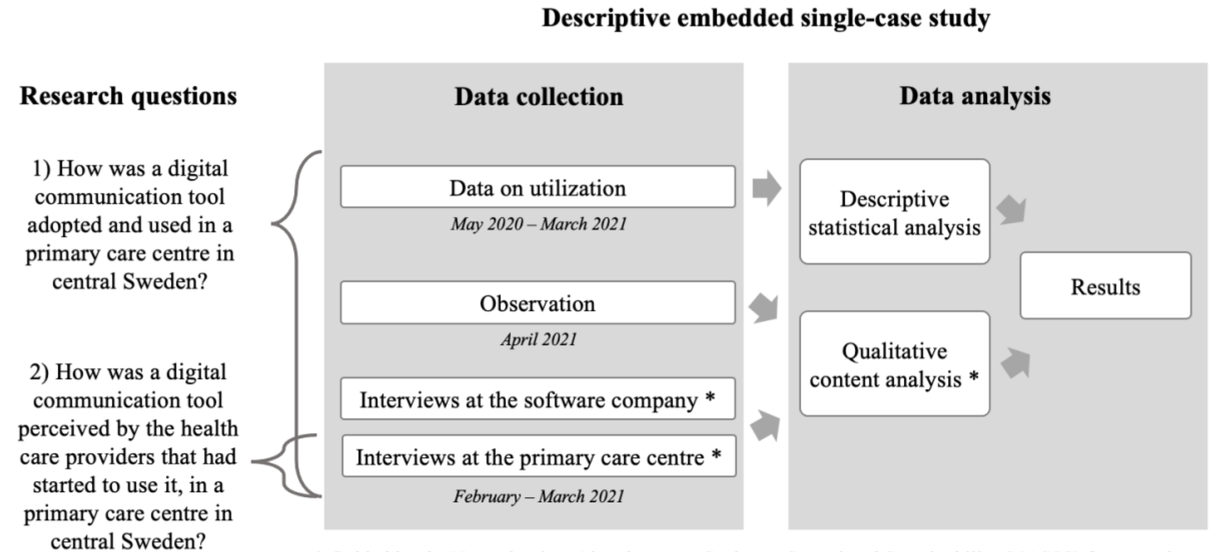
3. Methods

3.1 Study design

In order to answer the research questions a descriptive, embedded, single-case study was performed following a mixed-methods approach. Such an approach is appropriate in order to analyse a phenomenon within health services research focusing on the links between concepts and behaviours (24). On the one hand, quantitative methods allow to analyse volumes and frequencies of the variables. On the other, qualitative methods are necessary when dealing with processes and meanings not measurable in quantitative terms, while focusing on insight, discovery and interpretation of new data (25).

Therefore, quantitative and qualitative methods for data collection and analysis were employed to reply to the two research questions (**Figure 1**). Quantitative data were collected through a summary report on utilization and analysed with descriptive statistics. Qualitative data were collected through observation and interviews with key informants, and analysed with QCA. All data sources were used to reply to the first research question, while only interviews at the PCC were used for the second one.

Considering the design, a case study is an empirical inquiry about a contemporary phenomenon within its real-life context aimed at generating or refining theory (24,26), and thus it is suitable for studying complex social phenomena such as the interaction between patients and HCPs in the context of PC. The phenomenon is occurring naturally as opposed to an experiment, where the case is created or somehow controlled by the researcher, or to a survey, where a high number of cases are investigated simultaneously (26). Thus, a case study allows for understanding a specific problem or situation with great depth and insight (25) when the researcher is interested in the "how" or "why" (26). It is also an appropriate design when the boundaries between the phenomenon and the context are not easily defined and when "the number of variables of interest exceeds the number of data points (i.e., participants)" (26).



* Guided by the Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework, the NASSS-CAT (Complexity Assessment Tool) and the Technology Acceptance Model (TAM)

Figure 1. Methods employed in the study

The case study had a descriptive, embedded, single-case design (see **Table 4** in **Appendix 3** for a detailed description of the case study characteristics). The DC tool was at an early phase of adoption, users had a relatively recent experience of its implementation (less than one year), so it was possible to collect their perceptions with minimal recall bias. Summary quantitative data allowed for a general description of the utilization of the tool. Although specific theories on DC in PC were not found in the literature, the existing theoretical frameworks on innovating health care allowed for describing the features of the real case at hand thoroughly. Therefore, given data and theory availability, a descriptive design for the study was chosen. In addition, the study was designed as an embedded single case, since multiple sub-units for data collection (individual respondents) were embedded in a single case (a primary care centre).

3.1.1 Intervention and case selection

The DC tool was selected on the basis of relevance and access. The chosen intervention was considered relevant as it had distinctive features and a specific approach to the patient-provider communication, as described in **Section 3.2**. Access was offered by the contact between the author and the Chief Executive Officer (CEO) of the software company, which was available to being included in a scientific research.

All PCCs that had used the tool for at least two months were considered eligible to participate in the study. Using the tool means that patients could contact and communicate with HCPs online via the tool. Two months were considered a sufficient time frame for implementing the tool and then being able to reflect on the experience.

3.2 Description of the intervention

Collabodoc Digital Kontakt[1] (CDK) is a web platform developed by the company Collabodoc [2]. CDK offers a digital chat for patients contacting the PCC (alternative to phone calls) and video visits for care provision (alternative to in person visits). According to the classification presented above (**Section 1.2**), CDK allows for synchronous and a synchronous digital patient-to-provider encounters. It has been used in Sweden since May 2020.

In 2013 Collabodoc also developed a different service for PC called "Lättakuten"[3]. It consisted of a dedicated area at the PCC where unplanned visits were streamlined through patient self-triage.

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[1] https://www.collabodoc.com/sv/vaart-erbjudande/digital-kontakt/

[2] https://www.collabodoc.com/en/

[3] Meaning "Light emergency". More info at: https://www.collabodoc.com/sv/vaart-erbjudande/laettakuten/

Lättakuten is described in details and studied elsewhere (27), but in summary its implementation resulted in a decreased number of visits and telephone contacts at the PCC, increased patients' satisfaction and improved quality of care.

The adoption of Lättakuten showed the importance of two of the core elements of Collabodoc, also relevant for CDK: physicians' involvement in PC delivery and patients' self-triage. These elements most likely contributed to the standardization of the care process, patient engagement, and improved access through increased efficiency and quality of the service (27). These elements were also at the basis for CDK, which aimed at facilitating the contact between patients and providers, regarding the human component of their interaction as crucial. Thus, CDK distinctive features were the absence of automatic replies to patients, and physicians' active involvement in the care delivery.

The aim of CDK was triaging patients before they booked a visit at the PCC and facilitating the decision-making process of HCPs. With CDK, patients could send their requests to the PCC 24/7 through a digital form, where they were asked a few triage questions (described below). Then, the request was handled by a team of nurses and doctors at the PCC during its regular opening hours. Thus, CDK did not aim to substitute physical contact in the patient-provider interaction, but rather to streamline the care delivery process.

3.3.1 The main components of CDK

CDK was made of two interfaces, the patient's and the HCP's.

In the patient's interface, once logged in, the patient went through a short triage process, that included the following questions – only the first one was mandatory:

1. What is the reason for contacting us today? Describe as thoroughly as possible.
2. What do you think is the cause of your condition? (Multiple-choice question)
3. Are you especially worried for something regarding your condition? (Open question)
4. What are your expectations for this meeting? (Open question)

The patient received a reply to the request in the following hours or days and could either follow-up on the chat or be invited to a video visit. In the latter case, a link was sent to the patient leading to the video solution Confrere[4], where the online visit took place at the scheduled time and date.

In the HCP's interface, once logged in, the main portal of Collabodoc at the PCC was visible (**Figure 8** in **Appendix 4**). From the main portal administrators were also able to create accounts for new users, assign roles to users, manage patient view and other settings. From there, all users could select CDK among the different services, and then choose one of the available views:

a. **Patient list**. List of all pending patients' requests, displayed with a status (new, ongoing or answered) and some of the main patients' information (**Figure 9 in Appendix 4**).
b. **Issue view**. For each request, patient's information, diagnosis, the conversation history, comments of HCPs (not visible to the patient) were displayed, ready to be copy-pasted into the patient's e-journal. From this view it was possible to reply to the chat, schedule a video visit with the patient and leave comments to other colleagues (**Figure 10 in Appendix 4**).
c. **Statistics**. Some graphs were shown with an interactive interface about the utilization of CDK at the PCC (e.g. frequency of the causes of contact, number of cases).
d. **Patient registration**. With this option HCPs were able to directly create an issue for a patient, in a provider-initiated digital contact. This option was useful when a digital contact was requested by the patient through other means (e.g. by phone) or if the HCP needed to get in contact with a patient, for example for a follow-up.

3.3 Study setting

At the time of the study (January – May 2021) only one PCC was eligible according to the selection criteria (**Section 3.1.1**), and thus participated in the study: Hälsocentralen Ripan (HC Ripan) in Östersund, in Region Jämtland in central Sweden.

Region Jämtland had a population of 130.810 inhabitants in December 2019, which was 1,3 percent of the entire population in Sweden (28). Population density was low and there were only eight cities, among which Östersund was the most populated (28). PC in Region Jämtland is provided by primary care centres (Hälsocentraler), children centres (Barnsjukvården) and tourist centres

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[4] https://confrere.com

(Turistläkarmottagningar) (29). These centres can be public, i.e. financed by taxes and managed by the Region, or private, i.e. managed independently. Private care providers may have agreements with the Region and thus receive compensation from tax money for the patients they treat, or be financed privately without such agreements (29).

HC Ripan is a small PCC that served a population of around 7.000 patients at the time of the study. It was privately managed in agreement with the Region. The staff at HC Ripan was composed of around 30 people, among which there were 5 administrative employees, 8 doctors, 10 nurses, and 8 other health care professionals (including psychologists and physiotherapists). CDK was introduced in HC Ripan in May 2020.

3.4 Study participants

Study participants for the interviews were selected among two groups of informants:

a) Employees at HC Ripan, the PCC.
b) Employees at Collabodoc, the company that produces CDK.

A third group of key informants, patients, was originally included. However, given the COVID-19 restrictions at the time of the study, the author was not allowed to meet patients in person, and given the emergency situation at HC Ripan HCPs were not able to support the digital recruitment of patients. Thus, in the absence of access to patients, the author was forced to exclude them from the study as participants. However, respondents described patients' experience and perceptions in their own view. Such opinions about patients' perspective may provide useful insights about the adoption of CDK. Indeed, HCPs are often driven by what they believe to be the best interest of patients, making their opinions important and relevant for the adoption of CDK. Methodological considerations in this regard are discussed in **Section 6.2**.

Strategic selection criteria were applied among eligible and available participants in each group. Strategic selection considers including people who represent different age groups, genders, backgrounds and roles (30). Thus, selected respondents should be able to offer a broad understanding of how a DC tool is experienced by different users.

Previous experience with CDK was a requirement to be eligible for the interviews, in order to make sure that only informants with familiarity with CDK would be included. Thus, employees at HC Ripan were eligible if they had worked with CDK for at least two months before the interview, both directly (i.e. providing health care services through CDK) or indirectly, that is using CDK in the administrative or organizational processes at the PCC. Employees at Collabodoc were eligible if they had been involved in the phases of design, development, launch or maintenance of CDK.

Access to study participants was enabled by Staffan Bjessmo, the CEO of Collabodoc, who forwarded the researchers' request to conduct interviews to the key informants. Direct access was not possible because of the lack of direct knowledge between the author and key informants, but after the first contact through S.B. the author communicated separately and independently with each of the potential study participants.

Potential study participants were informed about the study and its aim through a study information flyer, briefly describing the aim of the study, the involvement of study participants and its potential risks. Participants were informed that they could withdraw at any moment from the study, without providing any explanation. All participants expressed their consent to the interview orally and by signing a written consent form (**Appendix 5**).

3.5 Data collection

Data collection was carried out from different sources at the micro level, that is from individual users, and at the meso level, that is the organizational level. Data about the macro level, that is the broader context and national policies, were not collected as primary data but indirectly, as this level is included in one of the domains of the NASSS framework.

3.5.1 Summary data on utilization

Quantitative data on CDK utilization were collected from CDK platform, covering the period from May 2020 to March 2021. These data were provided by CDK already anonymized and summarized by request. No data were collected at the patient level. Data included the following variables: time and date of the request and of the replies, cause of contact, type of user that replied (e.g. nurse, doctor), age and sex of the user sending the request.

3.5.2 Observation

The author used CDK in a virtual demo session in order to gather first-hand experience of the workflow with CDK, since traditional in-person observation was not possible because of COVID-

19 restrictions. The demo session was conducted by the CEO of Collabodoc digitally via Zoom and it lasted around 45 minutes. Observation is important as it allows a better understanding of the context being studied, the perspective of different actors and the interactions among them (30).

The different views and functionalities of CDK were explored from the perspective of HCPs and of patients. Notes from the demo session contributed to a general understanding of the tool and they were incorporated in the findings about the Technology domain.

3.5.3 Interviews

Six semi-structured one-on-one interviews were conducted during February and March 2021. Since the study focused on the use and adoption of CDK in the patient-provider interaction, and on users' perceptions, interviews were considered as an appropriate research method. Indeed, interviews are the most common method of data collection in qualitative research, as they allow to gather information about non-observable phenomena, such as feelings, and intentions, from the perspectives of research participants in their context (30).

Interviews were semi-structured and aimed at encouraging interviewees to share their experience with CDK. Different to structured or standardized open-ended interviews, semi-structured interviews follow a set of pre-defined topics and questions in a guide that serves as a "checklist" (30). The possibility of changing the sequence and the wording of questions offers flexibility in approaching different respondents, while covering the same aspects of the phenomenon (25).

Two interview guides (**Appendix 6**) were developed in English for the two groups of informants, starting from validated templates, that is from the fourth version of NASSS-CAT tool (17) and from two published studies (31,32). TAM informed data collection in the first study, where a technology project was implemented in a PC setting in the United States (31). The second study (32) applied a modified TAM to an IT-system implementation project within the health care system of a Swedish region.

The interviews were conducted by the author one-on-one, i.e. separately with each participant, via an online video call service (Zoom[5]). They were audio-recorded with the interviewees' consent. Interviews were conducted in English and were transcribed by the author with the software Otter[6].

The length of the interviews was between 27 and 49 minutes, resulting in a total of 231 minutes of recording (**Table 1**). Half respondents were from the PCC, half from the software company. Respondents were labelled anonymously from R1 to R6, as defined by **Table 1**.

Table 1. Characteristics of the interviews' respondents

Respondent ID	Role	Sex	Interview's length (minutes)
R1	Managing role at HC Ripan	M	41
R2	Physician at HC Ripan	M	27
R3	Physician at HC Ripan	M	49
R4	Collabodoc employee (CEO)	M	49
R5	Collabodoc employee (sales team)	F	32
R6	Collabodoc employee (software developer)	F	34

3.6 Data analysis

3.6.1 Descriptive statistics

Quantitative variables about CDK utilization were analysed with descriptive statistics and presented either as distributions and ranges for numerical variables, or as percentages for categorical variables. Charts and graphs were also created to support results reporting.

3.6.2 Qualitative content analysis (QCA)

Responses to the interviews were analysed with QCA following a directed approach (33). The software NVivo[7] was used to perform the analysis.

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[5] https://zoom.us

[6] https://otter.ai/

[7] https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home/

QCA was chosen among other common methods for descriptive qualitative analysis, such as thematic analysis (34). Descriptive qualitative analysis methods aim at reducing large volumes of qualitative material (text) into “core consistencies and meanings” (30). More specifically, QCA is aimed at describing the characteristics of the content of the text, it is suitable for reporting common issues that appear in the data, and for quantifying the data, e.g. with the codes count (34).

The analysis followed a directed approach in order to build upon existing frameworks. QCA can follow different approaches, as explained by Hsieh and Shannon (33). Given the objective of the study, the directed approach was preferred as it gave the possibility of building upon existing frameworks, and it helped trace back the findings from the individual to the organization level. The analysis focused on the manifest content of the data, i.e. what is expressed in an explicit and literal way by the text, while latent content was not explored (35).

A research diary was written throughout the analysis phase, in order to keep the process as transparent as possible. Moreover, before starting the analysis, the author immersed herself in the texts by reading the transcripts in order to obtain “the sense of the whole” (34,35).

Following the best practices for directed QCA (35,36), an initial codebook was developed (**Appendix 7**), the meaning units of analysis were defined as sentences, and codes were classified in categories. A category is a set of manifest contents that share a commonality, and categories must be exhaustive and mutually exclusive (36). The categorization of codes was built on the NASSS domains (15), on the dimensions of NASSS-CAT tool (17) and of TAM (31,32).

Deductive coding was carried out by condensing meaning units into codes (36), so that at the end a final codebook was generated (**Appendix 8**). Meaning units were assigned to the codes from the initial codebook, or to newly generated codes if necessary, so in the final codebook the initial categories of codes were accompanied by new ones.

The frequency of categories, codes and words was analysed. Frequency is defined as the number of times each category or code is referenced in total. Then, patterns and interrelationships among different codes and concepts were identified and the main findings were developed.

3.6.3 Interpretation of findings

The interpretation of findings is an essential step in mixed-methods analysis. After computing descriptive statistics and focusing on the codes from the QCA, the interpretation of findings allowed for elucidation of meanings and testing of alternative explanations.

Results from quantitative data and from the interviews were triangulated in order to gather a more accurate understanding of the adoption and utilization of CDK. Data triangulation is a way of adding depth to a research by using different methodological approaches and increasing the validity of the study, as it allows to offset the weaknesses of each method (37).

3.7 Study period

The study was carried out between January and May 2021, and the different phases were organized as shown by **Table 2**.

Table 2. Study time frame

January 2021	February 2021	March 2021	April 2021	May 2021
Feasibility analysis				
Study design				
	Data Collection			
			Data analysis	
			Results reporting	

4. Ethical considerations

The integrity of study participants and data collection techniques and analysis call for relevant ethical considerations.

The interviews were conducted under the recommendations of the Declaration of Helsinki (38). Research participants were invited from different groups of stakeholders involved in CDK utilization. Interview questions did not touch upon individual health or any sensitive data, but only asked about opinions and experiences of using CDK. The identity of the interviewees was not disclosed in the results reporting, except for the CEO of Collabodoc, who agreed to sharing his perspective and being identifiable. Full transcripts of the interviews were not published. Participation could have been withdrawn at any time without giving any explanation. Participants were provided informed consent before the interview in oral and written form (**Appendix 5**).

Therefore, the risk of potential psychological harm caused by taking part in the interview was assessed to be minimal.

All data were handled and processed in accordance with the European Union (EU) Data Protection Regulation. All data and material collected for the study were stored on safe servers at Karolinska Institutet (KI). Only the researchers had access to it. Data (including audio recordings) are stored for 10 years after project completion, after which the material is thinned. Data collected in Sweden were handled within the research group and were not transferred to countries outside the EU.

There were no competing interests between the author, the supervisors or the companies affiliated with this project. No business agreements or payments were entered into between either the researcher and HC Ripan, or between the researcher and Collabodoc. Dr. Staffan Bjessmo, the CEO of Collabodoc, only acted as a reference for contacting the staff at Collabodoc and at HC Ripan. He was not involved in the selection of interview participants, the data collection or the analysis.

Neither patient data nor sensitive personal information on study participants were involved in the study, which was conducted as a master thesis and not as a research project. Therefore, no ethical approval from the Swedish Ethical Review Authority was required, as stated by the Swedish legislation on ethical approval for research involving humans[8] and by KI guidelines[9].

5. Results

5.1 Data on CDK utilization

In total, in the first 11 months of utilization (from May 2020 to March 2021) 2.003 requests were received through CDK, with an average of 182 requests per month (median: 192). The utilization of CDK increased for the first two months and then it stabilized around 200 contacts per month, in a range between 150 and 250 contacts per month (**Figure 11** in **Appendix 9**). During 33 out of 49

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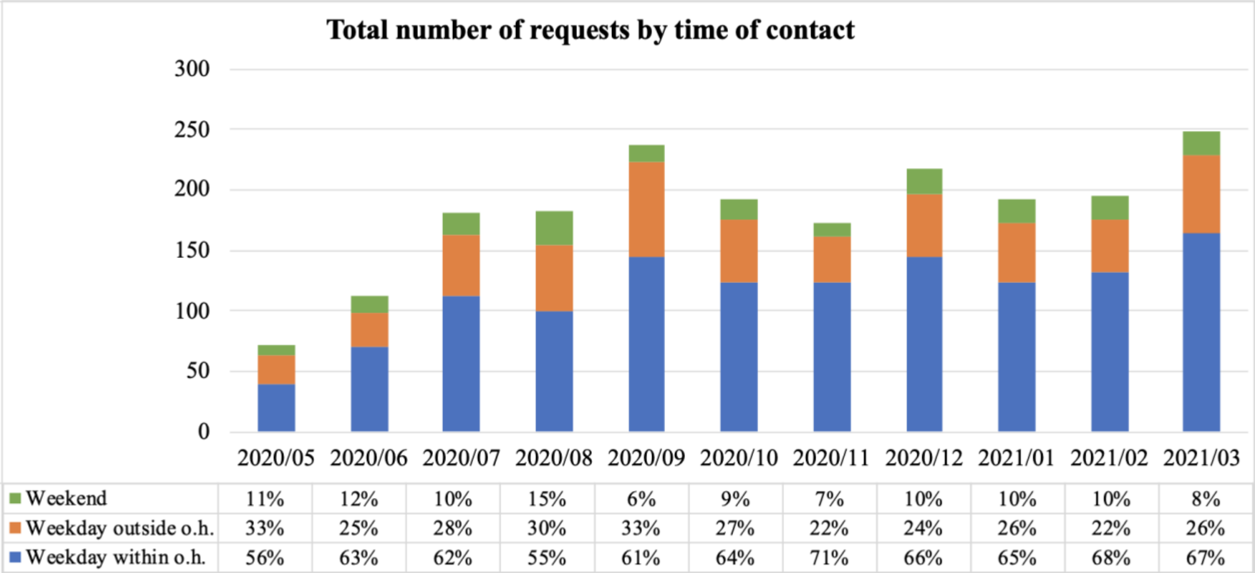
[8] Law 2003:460, available at: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-2003460-om-etikprovning-av-forskning-som_sfs-2003-460

[9] Etikprövning av examensarbeten: https://medarbetare.ki.se/etikprovning-av-examensarbeten

weeks (67%), the number of requests was between 30 and 60, which meant an average of 4 to 9 contacts per day (**Figure 12** in **Appendix 9**).

5.1.1 Time and day of access

Out of the 2.003 total requests, 533 were submitted during weekdays outside opening hours (8:00 – 17:00) and 190 during weekends (**Figure 2**). Considering the monthly proportions, on average 37% of requests were received outside regular opening hours – 27% during weekdays outside opening hours and 10% during weekends. These proportions were quite stable across the months of the study. Considering the preferred time of access (**Figure 13** in **Appendix 9**), more than half of requests were submitted in the morning (6:00 - 12:00) and 31% in the afternoon (12:00 - 18:00).



	2020/05	2020/06	2020/07	2020/08	2020/09	2020/10	2020/11	2020/12	2021/01	2021/02	2021/03
🟩 Weekend	11%	12%	10%	15%	6%	9%	7%	10%	10%	10%	8%
🟧 Weekday outside o.h.	33%	25%	28%	30%	33%	27%	22%	24%	26%	22%	26%
🟦 Weekday within o.h.	56%	63%	62%	55%	61%	64%	71%	66%	65%	68%	67%

Figure 2. Monthly numbers of requests through CDK (o.h. = opening hours)

5.1.2 Patient characteristics

Most of requests were submitted by female users (74%) aged between 21 and 60 years (**Figure 3**). The most active age group was that of younger individuals, between 21 and 30 years old. Children, i.e. individuals below 16 years of age, represent only 5% of contacts through CDK.

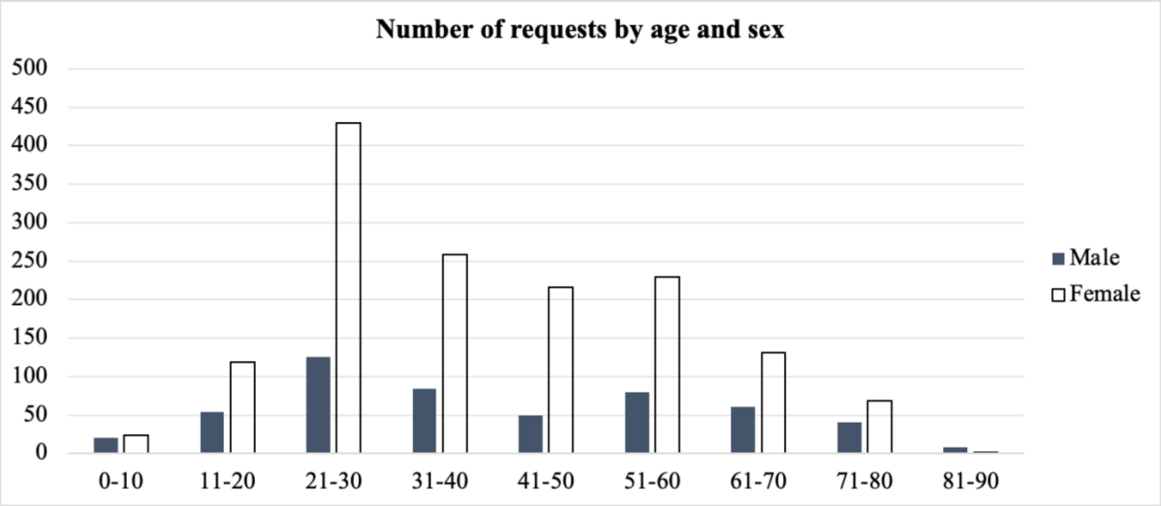


Figure 3. Number of requests by age and sex

5.1.3 Cause of contact

The cause of contact was selected by patients among a predefined list as the answer to one of the triage questions during the request process. In almost half of requests (48%) patients selected "other" as the cause of contact (**Figure 4**). 27% of requests were related to a specific symptom, pain or disorder identified by the patient among 12 categories, among which the most frequent were skin disorders, knee/foot pains and stomach disorders (**Figure 14** in **Appendix 9**). 16% of requests were related to an administrative issue, such as a sick leave note, a sick leave report or a prescription, 6% to a mental illness and 2% to a chronic disease.

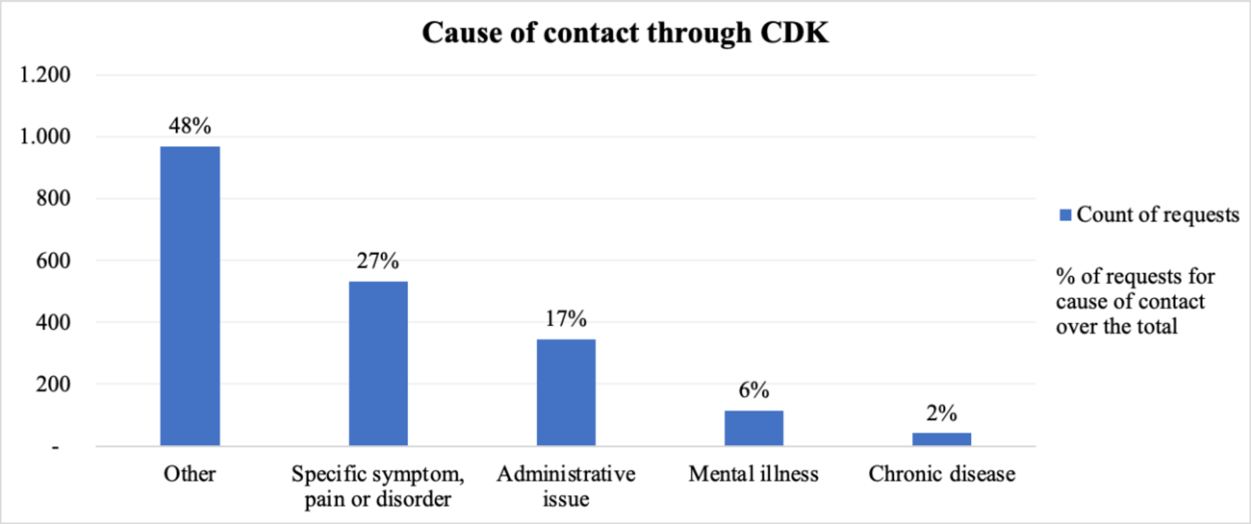


Figure 4. Cause of contact through CDK

5.1.4 Message flow

In the message flow generated by each request in the CDK chat, 75% of requests had up to 5 messages and in 5% of chats an invitation to a video visit was sent. The number of messages sent per request ranged between 1 and 21, with an average of 3,5 messages and a median of 3,0 (**Figure 15** in **Appendix 9**). In total, a video invitation was sent by the HCP in 91 chats, but this variable had low figures and high monthly variability, between 0 and 23 video visits per month (**Figure 16** in **Appendix 9**). Female between 21 and 30 years of age were the largest user group receiving video invitations (**Figure 17** in **Appendix 9**).

Considering the type of user replying to the requests, 80% of messages were covered by a nurse, 6% by a doctor and 5% by a secretary (**Figure 18** in **Appendix 9**). In 5% of chats multiple HCPs sent a message.

5.1.5 Issue length

Most requests took less than 24 hours to be closed, and the average issue length was decreasing over time. 76% of requests took less than 24 hours to be closed, 13% took between 24 and 48 hours, while 11% took more than 48 hours (**Figure 19** in **Appendix 9**). Issue length is defined as the difference between the time when the patient completes the registration of a request in the CDK system (immediately received by the PCC), and the time when the request is closed, that is when an HCP closes the case on CDK. Issue length ranged between 0 hours (a few minutes) and 288 hours (12 days), with a median of 10,5 hours and an average of 19,5 hours (**Figure 19** in **Appendix 9**). Issue length was decreasing over time, both considering the monthly and the weekly average (**Figures 20** and **21** in **Appendix 9**).

5.2 Interviews

Findings from the interviews and the observation were summarised based on the codes and their categories, the seven NASSS domains: Condition, Technology, Adopters' system, Value Proposition, Organization, External system, Adaptation over time.

Overall, considering the frequency of words used in the interviews (**Figure 22** in **Appendix 9**), the most used word was "patient" (used 252 times in total). Among the 12 most used words (obtained by deleting interjections and verbs from the top 50) were “digital” and “chat”, clear evidence of the importance of digitally supported communication.

5.2.1 Condition

i. CDK was used for non-acute and chronic conditions, and non-clinical needs

According to the interviewees, CDK was used to take care of “small” (R3) or “light” (R2) health problems where physical contact was not necessary, such as non-acute health issues (e.g. minor skin lesions), or for patients with chronic diseases (e.g. diabetes or blood pressure conditions) or mental disorders (e.g. depression, anxiety, burnout). Some issues were reported to be easy to address from distance, for example the renewal of drug prescriptions. On the other side, it was clear to respondents that more serious questions had to be redirected to a physical visit at the PCC: “I can’t take care of everything… but there’s quite a lot we can do from distance” (R3).

Many of the requests involved non-clinical issues, such as administrative questions – “where is my referral? Or: is this doctor back next week?” (R4). Video visits were used for follow-up visits: “if you need to deeper the conversation or need to clarify things” (R5).

ii. Most CDK users were of younger age

According to the respondents, most of the patients using CDK were of younger age compared to the average, and CDK was not often employed for the elderly, with which usual phone calls were more reliable. Thus, the chat was primarily used by the young – patients in their teens and young adults, with the exception of some very old patients.

However, the technology was designed for the general population, and no specific target groups or special patient characteristics were considered during its creation. At the time of the analysis, CDK was available only in Swedish, and the company was considering a future English translation.

5.2.2 Technology

i. Access to CDK was considered simple and secure

Access for users did not require to download an app, but to open CDK in a browser. Patients could find CDK when trying to get in contact with HC Ripan on the Region’s health care contact page where all PCCs were listed, as HC Ripan substituted the chat centrally chosen by the Region with

CDK. Alternatively, patients could find CDK directly on HC Ripan home page by clicking the link under the heading “Chat with HC Ripan” or by scanning the Quick Response (QR) code.

The registration procedure followed other common identification processes for both groups of users. For patients, the registration was done through a two-step verification process with BankID[10]. Once patients had successfully logged into CDK website, they could create a request. HCPs could access CDK with the same identification process and electronic certificate as for other IT systems in use at HC Ripan – either a two-step verification process or a SITHS-card system[11].

ii. CDK was not integrated with the Electronic Medical Records (EMR) system

CDK was not integrated with the EMR system, so patients needed to be searched for manually by HCPs and the information typed into the EMR at each use. However, all the sections in CDK were ready to be copy-pasted into the EMR, so the process was regarded as fast:

> Writing the patient journal takes me at least a few minutes every time, because I’m not very fast at typing. With CDK, you can be done with a patient in less than one minute. And that’s impossible if you hadn’t that (R2)

The lack of integration was due to technical reasons. Because of the large variety of existing EMR software it would have been hard for CDK to be compatible with all of them. In addition, CDK would have depended on the EMR software for any technical change or improvement, thus losing flexibility and reactivity. At the moment of the study, the lack of integration did not impair the process efficiency according to respondents. However, some worried that this could threaten the future scalability of CDK, as the manual integration between CDK and the EMR system may no longer have been sustainable when the patient volume increased.

iii. Minor technical issues and improvements during implementation

During the implementation, there were some technical problems, for example in the integration of CDK with the video visits provider. However, respondents considered these issues as minor, and that in general CDK worked fine: “There’s very little technical management from our side” (R6).

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[10] BankID stands for Bank Identification. It is a standard system for personal electronic identification

[11] SITHS stands for “Säker IT Hälsa och Sjukvård” (Safe IT Health and Care). It is a standard system used by Swedish health care organizations to enable secure access to their IT systems

Since its implementation CDK had not undergone any major change, but regular updates and upgrades of the software. Thanks to users' feedbacks, some improvements were implemented within the normal production cycle, but the basic concept had not changed.

iv. After the initial training, users perceived that barriers in using CDK were removed

After the initial training, HCPs reported to be in control of CDK functionality. During the implementation phase, the Collabodoc CEO was physically on site, and provided an introduction to physicians, nurses and medical secretaries, as well as working together with the nurses for the first weeks. No specific knowledge was required to use CDK, but basic digital skills (e.g. using a browser, and copy-pasting text) were sufficient. After a few months, HCPs were reported to feel they were starting to control CDK better and use it more and more.

Considering patients, there were some minor issues at the beginning, "for example the patient perhaps had forgotten the link, and you had to send the link once more, and so on, to really get into the video call" (R4). Thus, CDK was regarded as not ideal for the elderly that were not familiar with digital tools, but as suitable for all other patients.

v. CDK was regarded as easily usable and user friendly

Respondents found CDK easy to use and user friendly, and little technical support was necessary regarding its actual functionality. All respondents were asked what they thought were the main components of CDK and all replied by listing a few elements, such as a link, a chat, a video solution, a list of patients. Moreover, they all mentioned at some point how easy to use CDK was by using adjectives such as: user-friendly, intuitive, easy to work with, easy for patients to understand, simple build-up.

Accessing CDK online through a web link was considered as much easier than if it required a software or a mobile app, as potential issues related to downloading were avoided. In addition, HCPs reported to be able to easily send the link to any patient who contacted them by phone.

vi. The technology of CDK was perceived as secure, trustworthy and dependable

CDK was perceived as secure, and respondents considered this as one of its most important features. The technology was perceived as trustworthy and dependable. The triage process was also appreciated, "I haven't found flaws in that so far. I think it's pretty good" (R2).

5.2.3 Value proposition

i. Intended purpose and use of CDK

The purpose of CDK according to Collabodoc was to offer a digital version of the Lättakuten service, based on the principle that increased availability of care and accessibility of physicians reduces the actual number of contacts and visits: "CDK has a high level of interprofessional co-learning" (R4).

Different respondents had different opinions about the purpose of CDK. From the perspective of one of the HCP, CDK was an alternative way to offer health care and to communicate with patients, which became important especially during the COVID-19 pandemic as it provided the possibility to follow up on patients without physical contact. For another user, CDK provided an environment for the patient-provider interaction and a digital way to increase access to care, always in connection to a physical PCC where patients could go to if necessary.

ii. CDK was perceived as effective and efficient

CDK was considered to be effective and efficient by all respondents. Effective meant that it enabled DC between patients and providers. Efficiency was related especially to the triage, which provided a way to improve the decision-making process and enabled HCPs to meet the patient at the right time. Ultimately, according to respondents CDK made care delivery more efficient by providing services that did not need physical contact through digital means, and therefore it allowed for saving on physical resources.

iii. Perceived usefulness and value of CDK for HCPs

Interviewed HCPs appreciated the flexibility of CDK, as it allowed them to work from home or even from abroad, like with the Finnish doctors: "It's fascinating to see that we started it basically in the beginning of the year, and how natural and quite easy it has become to work like this" (R3).

According to respondents, time saving generated by the triage, the chat and video visits was also an important value of CDK. Thanks to the triage, HCPs knew in advance the reason of patient contact making the interaction more efficient, and different HCPs could participate in the communication flow on CDK chat when it seemed necessary. Thanks to the chat and the video visits, the communication was perceived to proceed rapidly and efficiently.

iv. CDK may bring negative value to HCPs

Asynchronous communication as in CDK chat bore some intrinsic limitations. There was no predefined time limit by which patients knew they would be answered, and thus they may have tried to contact the PCC by other means (e.g. by phone) if they perceived the matter as urgent. Similarly, if HCPs realized that a patient was in a state of emergency, they should have been able to contact them promptly without any uncertainty about the chat time lag. Thus, the delayed communication was reported to be a potential issue, even though not for non-acute conditions.

The triage process may also have created some value losses if patients did not provide correct information about their conditions, or if the first HCP who opened the patient’s request followed up with the wrong solution. In the first case, some patients provided false information in the written request:

> Some patients cheat, so they type in stuff that isn't true. Like "I've only had my symptoms for seven days", and then they say they've had stomach pain for half a year or something. But that's impossible to avoid (R2)

In the second case, the HCP misunderstood the patient’s need, and for example booked a video visit, during which it became clear that the patient would have needed a physical examination, or alternatively the patient was invited to a physical visit unnecessarily. In general, it was not easy for HCPs to choose between physical or digital follow-ups and visits, especially for nurses who were not trained to diagnose patients. Overall, this confusion may have generated unnecessary delays and work duplications in the care giving process.

v. Reported perceptions of CDK for patients

The issues described in the previous paragraph as potentially negative for HCPs may have generated a value loss also for patients. In addition, respondents advanced their own opinions about patients’ perception of CDK, based on their personal experience and interaction with patients.

According to the respondents, patients perceived value in the increased accessibility and availability of care, but there were no specific patient groups receiving the highest benefits from CDK. Access to care through CDK could have been perceived as more flexible, as patients could send a request from anywhere and at any time, not just during the regular opening hours of the PCC. Increased accessibility was regarded as especially important for patients who lived far away from the city centre, usually facing more barriers in reaching health care.

In addition, patients were reported to benefit also from waiting times shorter than usual. The communication flow was regarded as smoother than with phone calls, as without CDK patients used to call the PCC and then wait to be called back afterwards.

According to respondents, the triage process could have empowered patients by offering them time to think about their needs and the opportunity to express them. Going through the CDK questions avoided the risk of patients forgetting what their issue was, which was considered a problem especially for older patients, who sometimes forgot the reason why they came in for a visit. Some patients were reported to like the chat function, for the freedom it offered in expressing their issues, and thus they came prepared to the interaction with an HCP:

> I think it is very good for patients. They can sit down at their home and write their questions, and there's no stress as when they are on the phone (R1)
>
> Patients also usually feel that they've had the chance to type in what they want us to know (R2)

Moreover, video visits were reported to make the DC more humane, even when seeing the patient was not necessary from a strictly clinical perspective. Thus, the patient-provider interaction was perceived as improved by respondents, as expressed by some:

> It's easier to connect with patients, it's easier for them to trust you if they can see you… Even if you don't do anything specific over the video, it gives a better patient-caretaker relationship, bound, maybe trust when you see the other person, and you can show that you're sincere and show your emotions over the video. I think that's good (R2)
>
> It gives a lot more than a normal conversation, because it's not like a physical meeting, but it's not that far away (R3)

However, according to respondents, CDK may have also brought negative value to patients, in particular with regards to equity in access and continuity of care. Firstly, as other forms of DC, CDK could have affected the digital divide. For example, individuals that did not have Internet access or a Bank ID could not use CDK, and thus their ability to access health care may have been limited. However, respondents did not think that CDK was a threat to equity in access, as "technically we are in a good situation now, and we can assume that most people can [use digital tools], if they want, or if they have the personal ability to do it" (R3). Secondly, CDK could have limited the continuity of care, since patients did not know which HCP would take care of their digital requests. If patients were used to having interactions with only one doctor, writing in a chat could be unusual or uncomfortable for them. However, respondents claimed that in most cases patients could not decide which HCP would answer their phone call or visit them even with regular communication means, and the disruption in this sense was regarded as minimal.

5.2.4 Adopters' system

i. Changes in the care delivery process with CDK

Some HCPs were assigned specific responsibilities and tasks at the PCC to support the adoption of CDK. A medical secretary was responsible for IT and the application management of CDK. She was in charge of setting up accounts for new users, keeping contact with Collabodoc on the technical side, and coordinating every HCP working with CDK. Nurses were responsible for the daily distribution to the available doctors, nurses and medical secretaries of the requests from CDK and for giving a status to each request.

After a discussion among HCPs, each had a daily schedule of chats to reply to and pre-booked video visits. Many requests from patients were not clear-cut medical or administrative questions, so a discussion to evaluate each request was carried out. The dialogue among HCPs happened in person, on the regular phone or on CDK system by commenting on patients' requests. If necessary, the patient was redirected to a midwife, a psychologist or a physiotherapist at the PCC. "It's quite dynamic", said one doctor (R3).

Since January 2021, some doctors based in Finland were hired by HC Ripan to work on CDK remotely. Their collaboration with the other HCPs was completely based on remote communication via phone calls and CDK. At the time of the study, they were active one day a week.

ii. The role of HCPs was perceived as not changed since the adoption of CDK

CDK brought in some changes in the tasks of HCPs, whereas their role and responsibility were perceived as not affected according to respondents. While with regular care HCPs needed to answer the phone and perform physical visits, with CDK they had additional activities, such as discussing about and triaging patients, distributing the patient workload, using the chat, and performing video visits. Therefore, despite the new daily routine, according to respondents the responsibility of patient care did not change, as it ultimately remained in the hands of the head of the PCC, collaboratively shared by all HCPs.

iii. HCPs adopted CDK even if not everybody liked it

After the initial uncertainty, CDK was adopted by the HCPs at HC Ripan, with varying levels of utilization. At the beginning of the implementation process, HCPs felt some disruption and uncertainty about how to assign tasks among them, and how to design the patient flow.

Respondents reported that after some time certain HCPs started to like CDK, whereas others accepted CDK as a new way of working without liking some of its features.

> It has opened my eyes to another way of working, and maybe it taught me that sometimes it's good to try new ways of working, not to get stuck in the old ways, because a lot of things we do are inefficient and can be more efficient. … I don't find it annoying or disruptive in any way (R2)
>
> It is easy to work with (R1)

iv. Internal collaboration was perceived as improved thanks to CDK

The discussion about patients' requests was carried out by different HCPs jointly for around 50-60% of requests, while 50-40% was taken care of by nurses only. According to respondents, for the nurses it was not natural to know what kind of requests could be taken care of by digital means, so the distribution process was difficult and, at the beginning, not many requests were assigned to video visits. Doctors were reported to have conflicted opinions about this, since on the one side they appreciated the nurses not asking for support, as it saved the doctors' time, but on the other it was more likely for the process to "go wrong", e.g. the nurses booked a physical examination instead of a video visit.

CDK system was reported to support the collaboration among HCPs, and the dialogue among the different care providers could happen directly on CDK's website:

> All healthcare personnel see the same information. So, if the nurse logs in, or the doctor or a secretary or psychologist or whatever, everybody sees the same information. … It's a foundation for a much more collaborative way of working together, that is not possible if you have a strict dialogue with the patient and the nurse on the phone, because then the secretary is not engaged, and the doctor is not engaged (R4)

According to respondents, the dialogue among HCPs determined a significant change in the internal processes at HC Ripan, where nurses and doctors were not used to collaborating.

> I think one year ago there was some border between nurses and doctors. Both of them were unhappy. The doctors didn't trust maybe the nurses, or they thought they worked double than the nurses... But now they can discuss very easily, when they see the questions from the patients. I think this has been much better, I think they have a very good collaboration (R1)

Teamwork was one of Collabodoc principles, and CDK was considered to enable it also among other professionals at HC Ripan (e.g. physiotherapist).

> [Health care providers] really like teamwork, for what I've heard. The communication improved and nurses get to know a little bit more about certain cases and they understand 'Okay, these cases we have to delegate to the doctors' (R5)

v. Reported changes in the role of patients and their attitudes

Respondents advanced their own opinions about how patients' role changed after the adoption of CDK. Therefore, the following statements should be considered as a partial reporting of patients' experience of CDK by third-parties.

According to respondents, CDK increased patients' responsibility in their own care and their tasks changed. Instead of physically going to the PCC, they had to fill in the triage questions, and their answers were the foundation of the interaction with the HCP.

In addition, respondents reported that patients' relatives, informal caregivers or those living with them had the possibility to be involved directly in the interaction with HCPs. For example, if necessary, they could join a video visit, or during the request process they could remind the patient of important information regarding their health issues.

In general, patients were reported to have a positive attitude towards the DC tool and to not have experienced any problems due to the lack of physical contact. During video visits, nobody was reported to complain or made negative comments. In some cases, the initial scepticism some had disappeared after seeing how effective the digital contact was. According to respondents, even the fact that some doctors were not in Sweden was not perceived as a problem:

> When I call them on the phone, they notice I call from another country and they can comment on that. Most of them don't, but some do. They are just surprised, not in a positive nor negative way, not negatively or positively. … And since I speak Swedish, it's quite the same. They notice that the video contact works, and they get the issues resolved. It has to do with how you discuss and how you explain things (R3)

5.2.5 Organization

i. The adoption took time

HC Ripan was reported to be not satisfied with the Regional tool for DC, so it was willing to try a new system: "I think quite a lot of doctors and nurses don't think the Regional tool was so easy to use and so straightforward" (R5). However, it was not easy for HCPs to change their usual workflows or to adopt a new digital solution on a regular basis:

> Care personnel is not always top notch regarding IT, new online tools and so on (R5)
>
> The healthcare is a conservative field. In a Hälsocentral you do things in a certain way, and it's quite difficult to change it. So, I think that to get this digital leap made, we had to have some kind of forced situation, like the Coronavirus. Because otherwise it's a field where routines or procedures are not easily changed (R3)

As a result, CDK was not employed at its full capacity from the beginning, but it took time to consider it as part of the care provision system:

> It may be automatic to put all the patients on the physical doctors list, and we have to remember: 'You get to put patients on [the digital visits] list too, we can do this too'. But it's not very easy, or it doesn't come natural for the nurses and the staff. … I think that's just a matter of time. And also, people have to get used to it (R3)

HCPs were reported to have different attitudes towards the adoption of CDK. Some were more prone to use it, some were more afraid, but the differences were on the individual level and not homogenous within groups. According to respondents, there were different experiences among nurses and doctors, both in terms of technology and of how to deal with the workflow.

> Some perhaps find it really nice and happy and easy. But others, that perhaps were really used to just having an oral or a phone call dialogue with the patient, think it's a little bit more compelling to change and do something in another way (R4)

ii. No serious difficulties were reported during the implementation

The implementation process of CDK was progressive and it was facilitated by the familiarity of HC Ripan with Collabodoc. At the beginning, only two HCPs worked with CDK:

> Often when you start something new in healthcare you are a little against it, and you try to find something wrong. But we left a doctor and a nurse work with it, focus on it for two, three weeks. And then we let the other come in (R1)

In addition, CDK was similar to other Collabodoc products (i.e. Lättakuten) and HCPs were familiar with Collabodoc concept. Thus, respondents considered the implementation of CDK as overall simple.

Although respondents believed that the implementation process could have been smoother, the interviewed Collabodoc employees were satisfied with it and regarded some misalignments as inevitable when implementing the tool for the first time.

Overall, the implementation was regarded as successful by all respondents, and even the collaboration with the Finnish doctors worked well after a few months.

> The nurse was sitting and working with the Collabodoc. And then she was very proud: 'Look here, I can now handle 15 patients!' (R1)
>
> I think, in general, they're quite happy with it (R5)

iii. The adoption of CDK was supported by three conditions

According to respondents, one of the most important conditions for the adoption of CDK was the established relationship with Collabodoc. Respondents from HC Ripan expressed trust in the CEO of Collabodoc, especially since “he is a doctor and knows the rules” (R1).

Secondly, CDK did not require any effort from a technical point of view.

Thirdly, the leadership structure of HC Ripan and the fact that it was private supported CDK implementation. As HC Ripan was a small PCC, there was only one level of leadership, that worked closely with the daily activities and the patient flow. Being a private centre, the leader was more independent from the Region and did not need to undertake the public tender procedure when choosing new suppliers. Thus, the decision-making process was reported to be quicker.

iv. CDK was perceived to bring value to the PCC as a whole, despite some barriers

Overall, the perception of CDK among HCPs was positive. Phone calls time was reduced, the nurses had more time to meet patients in person. There were no pre-defined time slots, e.g. 15 minutes per patient, so each patient could take the necessary time.

> I think that there will be more quality also in physical meetings (R1)
> I think it benefits both sides [patients and providers] … I think it’s solving some problems” (R2)

Nevertheless, working with CDK affected the entire care delivery process and it generated two barriers. Firstly, it was harder to get temporary substitutes on board: “People need to learn how the system works before they can start working in it. It doesn’t need to take long, but sometimes we’ve had rental doctors, who had a little bit of a hard time” (R2). Secondly, confusion might have risen from the fact that there were different ways to contact the PCC (e.g. telephone, email, CDK), and thus HCPs needed to check various inboxes.

5.2.6 External system

i. National and local regulations were reported to affect CDK adoption

According to respondents, a change in the health authorities’ attitude towards digital innovations enabled the adoption of CDK. Generally, health authorities were reported to be quite conservative regarding innovation, and the system to be rigid, where most services had to be provided with physical meetings. Thus, when authorities changed the regulations, certain patients' needs were allowed for being taken care of digitally: “That's a big leap” said one of the respondents (R3).

Cybersecurity and data privacy regulations (e.g. GDPR[12]) had to be taken into consideration when designing and implementing CDK. For example, patient data were stored on Swedish servers, produced and maintained by Swedish companies, to avoid any conflict in terms of foreign servers and cloud regulations.

Considering the legal requirements about medical responsibility, CDK did not change the usual responsibilities at PCCs, and it complied with the law.

ii. There were external hurdles to the adoption of CDK

The Region's recommendation and general believes about care availability were reported to potentially hinder the adoption of CDK. Indeed, the Region recommended the use of a specific DC tool, so that PCCs were not incentivised to choose a different one.

In addition, there was a spread belief that the easier it was to contact the PCC, the more patients would have done it unnecessarily, so PCCs were generally trying to keep patients away. Thus, increasing the accessibility and responsiveness through CDK seemed counterintuitive, despite evidence from published studies supported the opposite.

iii. Perceived differences between CDK and its competitors

According to respondents, there were several competing solutions on the Swedish market for DC in PC, and their features were similar, so it was quite difficult for PCCs to understand the differences. CDK was reported to have a lower price than other solutions, to be user friendly, and to potentially provide HC Ripan with a competitive advantage.

From the perspective of the interviewees at Collabodoc, the main difference between CDK and other solutions was its human component, e.g. the lack of AI-automated replies to patients and the importance of collaboration among HCPs.

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[12] General Data Protection Regulation, the European privacy and security law: https://gdpr.eu/

iv. CDK did not affect the external collaboration with other HCPs

According to respondents, CDK had no impact on the collaboration of HC Ripan with external HCPs, such as hospitals. CDK did not provide any way to contact them, and thus it did not facilitate the communication. CDK was focused on the patient-provider communication rather than on the provider-provider channel.

v. COVID-19 affected the timing of the implementation of CDK

All respondents believed that COVID-19 played a role in the PCC's decision to start the implementation of CDK. The interest for a digital solution became more cogent and urgent during the COVID-19 pandemic, but COVID-19 did not affect any of the technical features of CDK:

> I think that to get this digital leap made, we had to have some kind of forced situation, like the Coronavirus… I think the Corona disease forced us into this situation, but this is probably something that would have happened anyway, but it might have taken 10 years (R3)
>
> I think that the COVID situation speeded up our development of CDK. Because, in the meanwhile, we saw that physical visits to healthcare were reduced in terms of restrictions… the COVID crisis was the catalyst for speeding up the development process (R4)
>
> COVID has had a lot of effect on how digital products are being used, and the amount of use. But I think that this product was always intended for that kind of use (R6)

5.2.7 Adaptation over time

No major changes were expected in the next future

Changes to CDK were expected within its normal production cycle. As new ways of treating patients, new algorithms, new therapies and also new diseases appeared, CDK needed to be updated and improved. "Software development is always improvement over time" (R6). However, the whole system was not expected to be reworked or rebuilt over time, as patient behaviour was not believed to change radically.

Similarly, further changes to the organization of the PCC were not expected, as HCPs were satisfied with the new care delivery process, and they hoped for it to last into the future:

> I think this way of working has come to stay (R3)
>
> For the future I think we are right on spot with this kind of solution, it makes it very easy to access care, and makes it close to the patient… I hope for that future (R4)

6. Discussion

6.1 Main findings

The aim of the study was to describe the adoption of a digital communication tool in a primary care centre in Sweden, and how it was perceived from the perspective of the health care providers that had started to use it. The main findings were summarised as answers to the two research questions.

6.1.1 Adoption of a digital communication tool in primary care

Results indicated that most of the requests were for non-acute conditions and non-clinical needs, in line with previous literature findings (10,12). However, almost half of patients selected the category “Other” in their request, indicating that the specific cause of contact was either not available in the list, available but not understandable, or they had no knowledge of it. Alternatively, it could also mean that patients preferred to skip the question. According to Collabodoc’s CEO, most of these requests were of administrative nature, but a more detailed analysis would be necessary. This finding could highlight a negative element of the triage process, and its impact on patients’ preferences and CDK utilization should be further analysed.

Considering patient groups, most CDK users were of young or adult age, between 21 and 60 years, and the majority were female, in line with previous literature results about users of digital care (8,10,12,20). Indeed, female are higher consumers of health care in general, and of digital care in particular, while the young consume digital care more than the elderly (8,10,12,20). Although access to CDK was considered simple and secure by all respondents, it would be necessary to further explore the perceptions of patients and the reasons behind their choice of using or not using DC and CDK. Only then it would be possible to assess the impact of CDK on equity in access and on the digital divide (6).

As expected (7,10,39), accessibility to care increased since around 40% of requests were filed outside the opening hours of the PCC. Waiting times for patients were regarded as low, given that the majority of requests were answered in less than 24 hours. Although interviewees considered it an improvement compared to regular waiting times, it could not be confirmed from a quantitative perspective because of the lack of comparison data. In addition, the time to complete a request (issue length) decreased over time, indicating that the process became more efficient, either because of HCPs' learning curve or because more of them started to use CDK.

Although utilization data indicated that CDK was gradually adopted, some issues were reported by respondents. Even if none of the HCPs expressed any reluctance in using the chat, contrarily to previous findings (7), at the individual level not all HCPs were reported to have a positive attitude about changing their working routines, as also found in the literature (7,40). Moreover, temporary workers were reported to have difficulties in joining the PCC, since the care delivery process with CDK differed substantially from the standard. Also, using multiple channels of communication was reported as a potential work duplication. Indeed, HCPs were forced to monitor two channels (CDK and phone calls) in order to manage the contacts with patients. Over time, if not addressed, this duplication could disincentivise the utilization of CDK.

According to respondents, the implementation was facilitated by the lack of special IT requirements, the trust in the software company, and the leadership of the PCC. The training sessions and the development of guidelines were facilitators to the implementation, as found by previous literature (9). The leadership of the PCC provided strong internal guidance towards the adoption of CDK, in line with the literature (41,42) indicating that the clarity of purpose and being ground in the medical aspects of the patient-provider relationship are key factors for a growth mindset, where the organization is learning new ways of working rather than just focusing on improving performance. However, further considerations about the effectiveness of leadership and organizational learning would require more data.

External legal and administrative requirements were reported not to be a barrier to adoption, contrary to previous literature findings (4,8,20). The Regional regulations and the leadership of the PCC were considered as facilitators in overcoming these otherwise common barriers.

The biggest improvement in the care delivery process was considered the increased internal collaboration among HCPs. As opposed to one previous study (7), their role was not considered as changed, while CDK supported information sharing and collaboration in the decision-making process, in line with another study (39). Formally, only 5% of requests had replies from multiple HCPs and 80% were taken care of by nurses, but these figures do not mirror the discussions that may have preceded the actual message exchange in the patient chat. Interviewees reported that the introduction of CDK helped solving some problems in the communication among different HCPs, but more data would be necessary to measure this effect.

As expected (7,39), CDK increased the flexibility of working routines of HCPs, and allowed them to work remotely, even from abroad as in the case of the Finnish doctors. Overall, HCPs reported time savings thanks to CDK, even if a productivity analysis would be necessary to support this hypothesis.

As described by previous literature (39), the triage was considered to give patients more time to reflect about the purpose of their requests, without the pressure coming from the presence of an HCP. Based on respondents’ perception, most patients seemed to like this new routine. However, data from patients would be necessary to understand patients’ preferences and assess the potential changes in their role and tasks.

Finally, COVID-19 affected the implementation of CDK by making it more urgent for the PCC to be able to provide patient care remotely. The inevitability of the situation generated by the pandemic could also explain why HCPs were more willing to accept DC than they would have been normally (8). Although previous literature considerations (13) suggest that future utilization could vary based on the evolution of the pandemic, participants expected the utilization of CDK to remain stable for the next future, without any major changes, since the care delivery process at the PCC was already adjusted to digital care, as found elsewhere (39).

6.1.2 Perception of digital communication for HCPs

There was a slight misalignment in the perspective of different respondents about the intended purpose of CDK. For HCPs it was an alternative way to offer health care and an environment for the patient-provider interaction, while Collabodoc employees underlined the possibility for increasing the degree of collaboration and interprofessional co-learning among HCPs. This lack of understanding of the potential benefits and intended use of CDK might reveal why some HCPs had a negative approach to the tool and did not adopt it promptly (9). In addition, it may suggest that the tool was not suitable for its intended purpose and its features should be adapted. Thus, further data should be collected to gain a better understanding of this issue.

According to respondents, patients may have benefited from increased accessibility and flexibility of care, and from a more humane approach to DC thanks to open questions in the triage, personalised messages, and video visits, in line with literature findings (10). However, the low proportion of video invitations sent through CDK compared to respondents' expectations indicated that video visits were still not fully integrated in the care delivery process, despite HCPs' awareness of their potential benefits. Even though the optimal proportion between physical and video visit was still unknow, this confirmed the general difficulties with DC (9,40).

Moreover, two main issues were reported to create disadvantages for HCPs and for patients: the delayed communication in the chat and errors in the triage process. The first issue is intrinsic in asynchronous communication. The lack of synchronicity is not a problem *per se*, as long as patients with acute conditions have alternative communication channels, as found elsewhere (39). The second issue is not technical but related to the collective effort necessary to address patients' requests. Insufficient collaboration among HCPs increases the probability of duplicating the workload, which is also intrinsic in PC, and a common concern for HCPs adopting digital tools (9).

6.2 Methodological considerations

6.2.1 Limitations

Common limitations of a case study design are the lack of systematic handling of data and the impossibility to pursue scientific generalization (26). In order to address the first issue, different methods for data collection and analysis were triangulated and results was reported in a cohesive way. Considering generalizability, the aim of the study was to describe the adoption of a single DC tool in a single case by applying previous theoretical frameworks. Thus, results provided the basis for hypothesis generation and future replication, rather than universal claims. As common for case studies, describing the features and the adoption of a specific tool in a specific context allows for understanding that situation with depth, generating insights that then need to be analysed in different context and/or with different interventions. Replicability and variation of cases can ultimately contribute to bridging scientific knowledge gaps.

Qualitative interviews as a data collection method bear some common threats to validity (37). The first is inherent to their dependability on the skills and on the subjectivity of the interviewer. In order to minimize this risk, interviews were semi-structured (30) and the interviews guides, despite being a beta-version (17), provided essential support. The second threat to validity is the research participants’ bias (37), when participants feel internal or external pressure to give certain replies. For example, HCPs may be inclined to please their supervisors rather than complain. In order to minimize this potential bias, participants were informed before enrolment in a clear and transparent way (**Appendix 5**) that their answers would not have been disclosed with anyone else other than the research team, and that no consequence would have derived from them.

Moreover, potential drawbacks of the QCA are the use of a predefined codebook and the presence of only one coder. Firstly, using a predefined codebook provides the risk of a “non-naturalistic” perspective, as the researcher might be biased towards the initial theory or hypotheses, thus being more prone to confirming rather than to challenging it (33). However, in this study the framework for deductive coding was not in favour of a particular theory, but rather allowed for a complete assessment of the dimensions involved in the phenomenon, and new codes were created inductively whenever necessary. In addition, the directed approached allowed for an avoidance of the common pitfall of embedded designs, that is to remain at a lower level than the one actually being analysed (26), in this case the individual level instead of the organizational one. Secondly, given time and resource constraints it was not possible to involve more than one coder in the coding process, but the coder tried to proceed in an ordered and transparent manner.

Overall, the study was carried out by one single author, and thus it bore some intrinsic limitations. Indeed, by nature qualitative methods may be affected by the subjectivity and the experience of the researchers. Thus, in order to minimise the risk of biases, standard procedures in preparing the interview guides, conducting the interviews, analysing the responses and describing the results were followed and the entire process was reported with transparency. Thus, although data collection and analysis were carried out in the best possible way given the constraints, and trustworthiness was preserved. the reader should be aware of potential biases

Considering the data sources, the study had several limitations, such as the lack of direct observation, the exclusion of patients, the limited access to quantitative data, and the limited number of interviews conducted among HCPs. Firstly, considering the lack of direct observation at the PCC, given the ongoing COVID-19 pandemic at the time of the study, the author was not allowed to physically visit HC Ripan and to directly observe the workflow around CDK. However, the virtual observation session (**Section 3.5.2**) allowed for understanding the functioning of the tool. Secondly, patients were not included in the study due to lack of access. Respondents were asked about patient experience, and their opinions were considered as valuable, given their knowledge of the care process and understanding of patients. However, their opinions may substantially differ from the real perspective of patients, and thus results were analysed and reported with the awareness that key stakeholders were missing from the study, and further research in this direction was suggested. Thirdly, the utilization database was not longitudinal, and the number of unique users was unknown. However, this was inevitable in order to protect patients' privacy, and ultimately it was not considered to affect the main findings. Lastly, several users were contacted and some interviews were eventually cancelled due to the COVID-19 pandemic. Therefore, data were analysed with the awareness that the interviewed users were key informants, but they did not represent the entire population of HCPs at the PCC. Nevertheless, insights and perceptions from the respondents were considered useful for advancing ideas and hypotheses about the experience of HCPs about the adoption of a DC tool.

Finally, the study was carried out within the first year of utilization of CDK. Thus, it did not aim at analysing how sustained the adoption and utilization of CDK may be over time, and therefore the validity of findings should be considered as limited to the study period.

6.2.2 Strengths

The study design and methods allowed for focusing on a real-life case and to use the experiences of those involved with the technology to draw a better understanding of DC.

In addition, the timing of the study was advantageous as it was carried out right after CDK's implementation and during its first year of utilization. Thus, it allowed to capture recent impressions and opinions from users about the adoption of CDK with minimal recall bias. However, such opinions only mirrored the respondents' experience within the first year of utilization, and they should not be considered as definitive, but susceptible to change over time.

Another strength of the current study comes from the three theoretical frameworks that were integrated together to shape data collection and analysis. These frameworks were considered solid by previous literature and allowed for building a thorough analysis of the case at hand.

6.3 Implications

The study showed that a mixed-methods approach enables the descriptive analysis of the adoption of DC in PC. In particular, adopting a DC tool in PC involves different levels of complexity in the different NASSS domains. Thus, it is necessary to evaluate the various components of an organization in order to disentangle the underlying mechanisms and interrelations. Only by adopting such an approach can complexity be addressed successfully.

Despite its limitations, a few implications may arise from the study with regards to the analysed context and the described intervention, although they should not be generalised.

Firstly, implementing DC in PC without major issues may be considered as possible under some conditions. In particular, it was suggested that strong and determined leadership may guide HCPs towards innovating the care delivery process, despite their individual levels of readiness to change.

Secondly, DC may be perceived as humane and positive by HCPs, by avoiding automatic replies in the digital chat and by providing video visits.

Finally, DC may be regarded as not suitable for acute conditions and emergency situations, when the asynchronous communication may be an obstacle, and for all patient groups, especially for the elderly. Thus, it should not be regarded as a substitute of physical meetings or become the only method of contacting the PCC.

6.3.1 Future research

Future research on the adoption of DC in PC should collect more data from HCPs and include patients, in order to better understand their experiences of their new roles and tasks. Exploring users’ feedback on the specific features of the technology, such as the triage process, could shed light on which factors make it humane as opposed to mechanical.

In addition, future research should explore and measure the relationship between DC and inter-professional collaboration, their determinants and perceptions from the perspective of HCPs.

Considering the implementation process of digital innovations, it would be valuable to study the role of leadership, and further analyse what factors make it effective.

Lastly, more quantitative data on health care utilization should be analysed, in order to estimate costs and outcomes, and to perform comparisons between digital and in-person care. Self-reported outcomes such as users’ satisfaction and perception of the quality of care should also be measured with *ad hoc* scales, and jointly analysed.

7. Conclusions

The study describes the adoption and perceptions of a tool for digital communication in a primary care centre in central Sweden, by analysing utilization data and interviewing key informants among health care providers and technology providers.

According to respondents, the tool was implemented without major issues and perceived as humane and positive. The leader of the primary care centre was reported to act as a facilitator in the implementation process, and the shift to digital communication was hastened by the COVID-19 pandemic. Respondents considered the technology user-friendly, waiting times for patients decreased, and internal collaboration and flexibility of the working routines for health care providers increased.

Uncertainty and potential issues emerged about the limited utilization of video visits, the delayed communication in the chat, the triage process, equity in access and continuity of care. Therefore, future research should further explore these aspects, especially by taking into consideration the perspectives of patients and health care providers.

7.1 Acknowledgements

I would like to thank my supervisors Carl Savage, who supported me since last year to design the study, and Mats Brommels, who helped to draw insights and conclusions from the study. In addition, I would like to thank George Keel for his continuous support and prompt help.

I would like to thank Staffan Bjessmo for his support, and the employees at Collabodoc and HC Ripan who gave their time to the interviews, making this study possible.

I would also like to thank Professor Anna María Napoles, who shared the interview guides from her study and thus helped my data collection process.

Finally, I want to thank my classmates, for sharing the journey at KI, my friends in Sweden, and my family and friends in Italy.

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Appendix 1: Terminology

1a. Digital health

Digital health is defined as the use of digital technologies for health, and it is considered as “a broad umbrella term” encompassing the following areas (5) (**Figure 5**):

- ***eHealth,*** “the use of information and communications technology in support of health and health-related fields”;
- ***mobile health****,* or mHealth, “the use of mobile wireless technologies for health”;
- other emerging areas, such as “the use of advanced computing sciences in ‘big data’, genomics and artificial intelligence (AI)”.

Digital health can be considered a more recent evolution of the concepts of telemedicine and telehealth. ***Telemedicine*** is defined as “the provision of health care services, clinical information and education over a distance using telecommunication technologies” (43). The concept of telemedicine was introduced in the 1960s and it developed before the Internet was invented. The term ***telehealth*** is usually regarded as more encompassing than telemedicine (43), with a broader scope towards health promotion and disease prevention (44). Therefore, ***DC*** in health care can be considered as a subset of digital health.

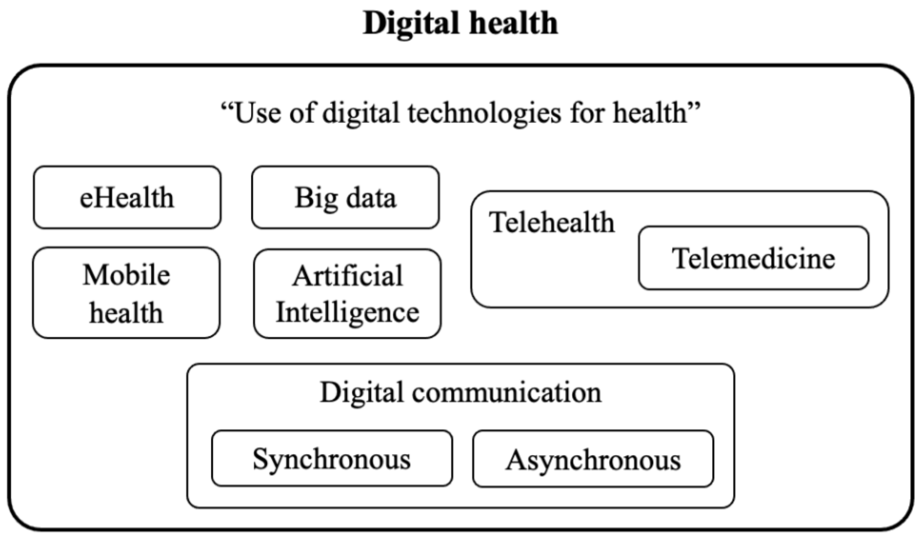


Figure 5. Concepts included in the definition of digital health

1b. Primary care

Following the World Health Organization (WHO) (45), ***primary health care*** is defined as "whole-of-society approach to health that aims to maximize the level and distribution of health and well-being" through three components:

1. Providing health promotion, protection, prevention, cure, rehabilitation, and palliative care;
2. Systematically addressing the broader determinants of health;
3. Empowering individuals, families and communities to optimize their health.

Primary care centres (PCCs) are the health care organizations providing primary health care, and they should strive to offer all of the three components. Thus, according to a more operational definition, PCCs are "patients' first point of access for non-urgent, chronic and preventive care services, encompassing responsibility for the provision of accessible, continued, comprehensive and coordinated care" (27). PC and PCCs are organized differently across countries and often even within the same country, and different HCPs are involved in the delivery of care.

1c. Implementation and adoption

Among the different ways in which innovations can spread, ***implementation*** is a set of "active and planned efforts to mainstream an innovation" (17), in contrast with passive phenomena such as diffusion. Implementation may lead to the ***adoption*** of an innovation, that is "the decision by an individual to engage with, and make full use of, an innovation" (17). However, the two concepts are separate and not necessarily consequential, as a technology may not be adopted if its implementation fails, or it may be adopted even if implementation was not planned – although the latter is unlikely in health care. As a result of multiple innovations being adopted, ***digitalization*** occurs.

Appendix 2: Theoretical models for digital care

2a. NASSS Framework

The Non-adoption, Abandonment, Scale-up, Spread and Sustainability NASSS (NASSS) framework was developed in 2017 by Greenhalgh et al. (15) through the hermeneutic analysis of published articles and case studies. The framework identifies seven domains (**Figure 6**) and, within each, a number of sub-domains, that allow for measuring the level of complexity. If complexity is high in multiple domains, it can pose significant challenges to the adoption of innovations, ultimately leading to failure.

NASSS has already been employed as a reference framework in several studies. It can be applied prospectively, in order to inform the design of a new technology or to support the planning of its implementation, or retrospectively, in order to analyse and learn from previous implementation projects (15). To our knowledge in March 2021, NASSS was applied to analyse and evaluate 14 programs and case studies, three of which in Sweden (**Table 5**).

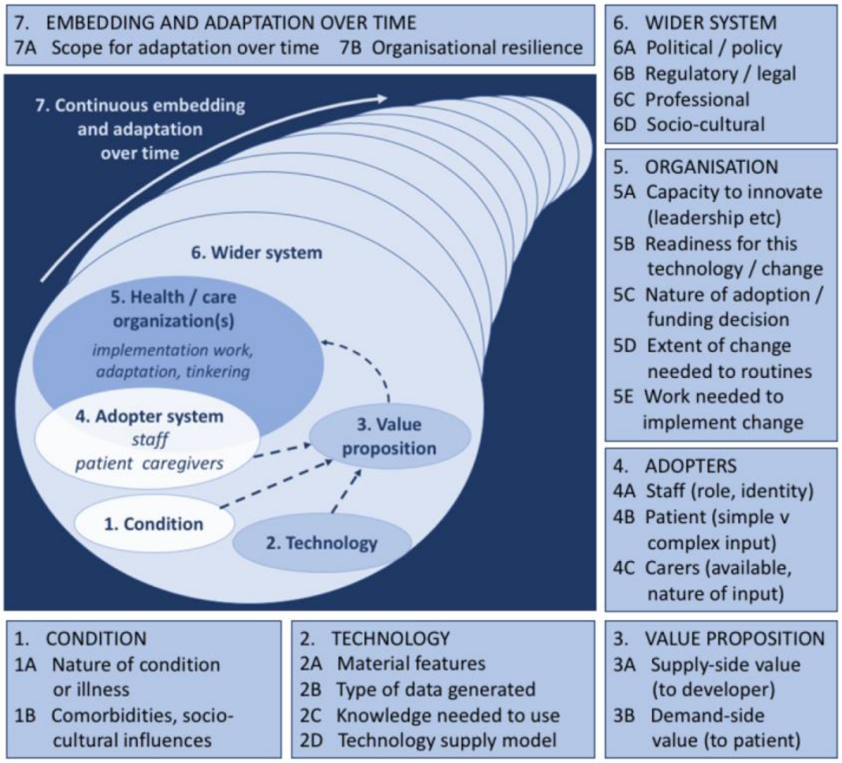


Figure 6. The Non-adoption, Abandonment, Scale-up, Spread and Sustainability NASSS framework (Greenhalgh et al. 2017)

Table 3. Articles applying the Non-adoption, Abandonment, Scale-up, Spread and Sustainability framework

Article	**Author(s)**	**Country**	**Year**
Agile requirements engineering and software planning for a digital health platform to engage the effects of isolation caused by social distancing: case study	Edward Meinert, Madison Milne-Ives, Svitlana Surodina, Ching Lam	UK	2020
Analysing the role of complexity in explaining the fortunes of technology programmes: empirical application of the NASSS framework	Trisha Greenhalgh, Joe Wherton, Chrysanthi Papoutsi, Jenni Lynch, Gemma Hughes, Christine A'Court, Sue Hinder, Rob Procter, Sara Shaw	UK	2018
Barriers and enablers to adoption of digital health interventions to support the implementation of dietary guidelines in early childhood education and care: cross-sectional study	Alice Grady, Courtney Barnes, Luke Wolfenden, Christophe Lecathelinais, Sze Lin Yoong	Australia	2020
Developing an integrated caregiver patient-portal system	Margaret L. Longacre, Cynthia Keleher, Marcin Chwistek, Michelle Odelberg, Mark Siemon, Molly Collins, Carolyn Y. Fang	US	2021
Experiences from implementation of internet-delivered cognitive behaviour therapy for insomnia in psychiatric health care: a qualitative study applying the NASSS framework	Josefin Kadesjö Banck, Susanne Bernhardsson	Sweden	2020
Explaining the mixed findings of a randomised controlled trial of telehealth with centralised remote support for heart failure: multi-site qualitative study using the NASSS framework	Chrysanthi Papoutsi, Christine A'Court, Joseph Wherton, Sara Shaw, Trisha Greenhalgh	UK	2020
Exploring the challenges of implementing a web-based telemonitoring strategy for teenagers with inflammatory bowel disease: empirical case study	Alie Dijkstra, Anke Heida, Patrick Ferry van Rheenen	Netherlands	2019
How can technology support quality improvement? Lessons learned from the adoption of an analytics tool for advanced performance measurement in a hospital unit	Sara Tolf, Johan Mesterton, Daniel Söderberg, Isis Amer-Wåhlin, Pamela Mazzocato	Sweden	2020
Implementation of artificial intelligence (AI) applications in radiology: hindering and facilitating factors	Lea Strohm, Charisma Hehakaya, Erik R. Ranschaert, Wouter P. C. Boon, Ellen H. M. Moors	Netherlands	2020
Shaping innovation and coordination of healthcare delivery across boundaries and borders. A comparative case study	Rosemary J. Hollick, Alison J. Black, David M. Reid, Lorna McKee	UK	2019
The NASSS framework for ex post theorisation of technology-supported change in healthcare: worked example of the TORPEDO programme	Seye Abimbola, Bindu Patel, David Peiris, Anushka Patel, Mark Harris, Tim Usherwood, Trisha Greenhalgh	Australia	2019
Using Complexity Assessment to Inform the Development and Deployment of a Digital Dashboard for Schizophrenia Care- Case Study	Andreas Gremyr, Boel Andersson Gäre, Trisha Greenhalgh, Ulf Malm, Johan Thor, Ann-Christine Andersson	Sweden	2020
Video consultations for older adults with multimorbidity during the COVID-19 pandemic: protocol for an exploratory qualitative study	Eng Sing Lee, Poay Sian Sabrina Lee, Evelyn Ai Ling Chew, Gayathri Muthulingam, Hui Li Koh, Shu Yun Tan, Yew Yoong Ding	Singapore	2020
Virtual reality cognitive therapy in in-patient psychiatric wards: protocol for a qualitative investigation of staff and patient views across multiple national health service sites	Poppy Brown, Felicity Waite, Sinéad Lambe, Laina Rosebrock, Daniel Freeman	UK	2020

2b. NASSS-CAT Tool

The NASSS-CAT tool was created in 2020 by merging the NASSS framework with the Complexity Assessment Tool (CAT) (17). CAT was developed by Maylor et at. (46) as a 32-item scale to measure and understand the complexity involved in project management. The aim of CAT is to lead active complexity management, as opposed to the natural progress of project management, where actors do not experience a project as complex until their knowledge increases, that is when they become aware of all challenges involved (46).

The objective of NASSS-CAT tool is to identify the multiple aspects of complexity involved in the implementation of technology-supported innovations (17). Thus, the tool provides for each of the seven NASSS domains a list of sub-areas and aspects to be explored and assessed to support active project management.

Four validated versions of the NASSS-CAT tool were co-designed, tested on a real case (47) and validated, and are meant to be used at different stages of project management (17). They consist of two validated survey instruments to be used at a preliminary stage of project management, one survey instrument (third version) that monitors complexity over time, and one guide (fourth version) for conducting semi-structured interviews. The aim of the fourth version, used in the present study, is "to help a participant construct a sensemaking narrative of the (perhaps meandering) fortunes of a complex implementation project" (17) and thus it was considered as fitting to the study purpose.

2c. Technology Acceptance Model

The TAM was developed by Davis in 1989 as a tool for predicting users' acceptance of computers, as he realized that IT held the potential to transform office work, but availability of technology did not mean actual use (18). Thus, he developed and validated a 20-item scale to measure two theoretical constructs, perceived usefulness (PU) and perceived ease of use (PEU) of technology (18). PU was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance", while PEU was "the degree to which a person believes that using a particular system would be free of effort" (18).

The theoretical basis for the TAM is that actual use of IT is determined by users' acceptance of technology (**Figure 7**) (19). Acceptance can be defined as "behavioural intention to use", it can be measured by end-users' satisfaction, and it is determined by users' attitude towards using IT (19). Thus, knowing the factors that influence attitude is crucial in order to be able to promote acceptance and actual use. Beyond the two factors originally included in TAM, PU and PEU, others were added over time, such as "subjective norm", that is the social influence from others (e.g. colleagues) that affects end users' positive or negative evaluation of IT (48).

TAM has been largely applied and reviewed over the decades in different fields, among which health care and digital health (19). A review of TAM applications in digital health found that it has satisfactory results in predicting clinician acceptance and use of technology, and that additional variables and dimensions should be added to TAM from a theoretical perspective in order to increase its predictive capacity in practice (19). Examples of these dimensions are self-efficacy (users' confidence in their own ability to use the IT), controllability (users' capacity to use the IT according to their volitional control) and facilitating conditions (users perceive that barriers are removed, and they receive sufficient support in using the IT).

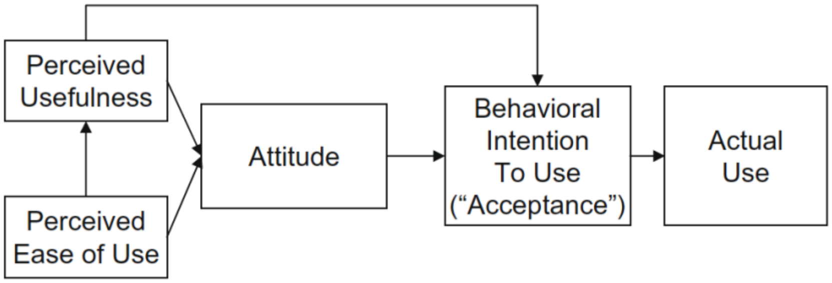


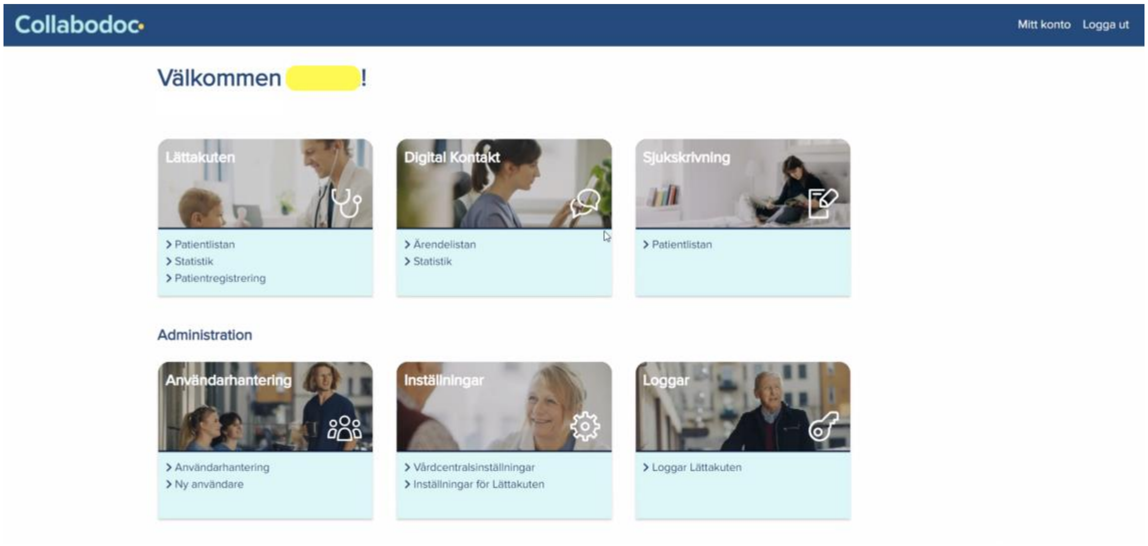
Figure 7. Representation of the Technology Acceptance Model (Holden & Karsh 2010)

Appendix 3: Study design

Table 4. Case study characteristics (Patton 1990, Yin 2014)

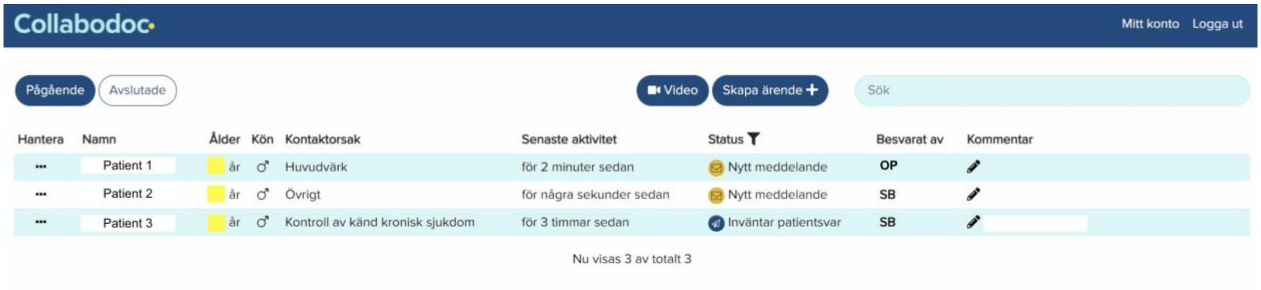
	Dimensions			
	Type	**Design**	**Unit of analysis**	**Rationale**
Definition	Purpose of the case study, based on the extent of previous literature and on data availability	Number of cases being analysed	Number of units of analysis	Reason(s) for selecting a case study
Characteristics of the present study	Descriptive: aimed at understanding the features of a phenomenon, uncovering the various factors involved in it, and generating theories	Single: one object (case) is analysed	Embedded: multiple units of analysis are employed as data collection levels for each case	Common (or typical): case with similar features to other cases in the population it is taken from
Other possible characteristics	Exploratory: aimed at formulating questions and hypothesis testing Explanatory: aimed at analysing in more depth and explaining the underlying mechanisms of a phenomenon based on established theories	Multiple: more than one objects (cases) are analysed	Holistic: one unit of analysis is employed as a data collection level for each case	Extreme (or deviant): case that takes on extremely high or extremely low values

Appendix 4: Images of Collabodoc Digital Kontakt



Välkommen [redacted]!

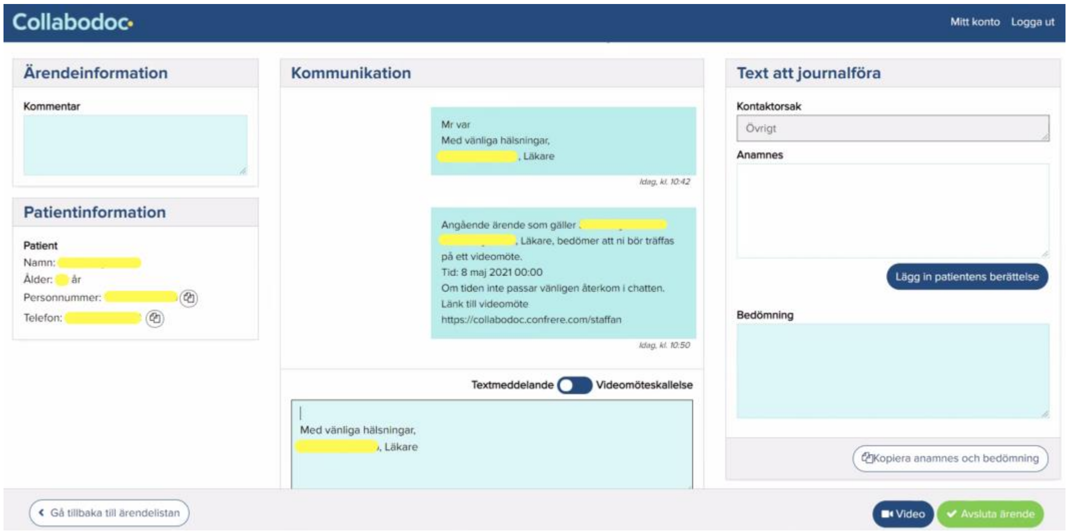
Figure 8. Collabodoc main portal (health care providers' view)



Hantera	Namn	Ålder	Kön	Kontaktorsak	Senaste aktivitet	Status	Besvarat av	Kommentar
•••	Patient 1	[redacted] år	♂	Huvudvärk	för 2 minuter sedan	Nytt meddelande	OP	✎
•••	Patient 2	[redacted] år	♂	Övrigt	för några sekunder sedan	Nytt meddelande	SB	✎
•••	Patient 3	[redacted] år	♂	Kontroll av känd kronisk sjukdom	för 3 timmar sedan	Inväntar patientsvar	SB	✎

Nu visas 3 av totalt 3

Figure 9. CDK list of requests (health care providers' view)



Ärendeinformation

Kommentar

Patientinformation

Patient
Namn: [redacted]
Ålder: [redacted] år
Personnummer: [redacted]
Telefon: [redacted]

Kommunikation

Mr var
Med vänliga hälsningar,
[redacted], Läkare

Idag, kl. 10:42

Angående ärende som gäller [redacted]
[redacted], Läkare, bedömer att ni bör träffas på ett videomöte.
Tid: 8 maj 2021 00:00
Om tiden inte passar vänligen återkom i chatten.
Länk till videomöte
https://collabodoc.confrere.com/staffan

Idag, kl. 10:50

Textmeddelande ● Videomöteskallelse

Med vänliga hälsningar,
[redacted], Läkare

Text att journalföra

Kontaktorsak
Övrigt

Anamnes

Bedömning

Figure 10. CDK patient's request (issue view of health care providers)

Appendix 5: Informed consent for study participant

Questions about participation in the research study

Do you want to participate in the research study? In this document you get information about the project and what it means to participate.

What kind of project is it and why do you want me to participate?

This research project focuses on a digital communication tool called "Collabodoc Digital Kontakt" (CDK), a web platform where patients can contact their primary care centre online via chat and video calls.

Digital tools can enable communication in primary care between patients and health care providers at distance, which improves access to care and efficiency while reducing costs. This has been particularly important during the COVID-19 pandemic, as digital communication helped the continuity of care for many patients while avoiding the spread of the infection.

Despite the rapid spread of digital communication in primary care, evidence of its effects and benefits is still not conclusive. Thus, it is important to analyze and assess the implementation of digital communication tools to gather more evidence and knowledge about digital primary care. Furthermore, it is important to capitalize the efforts exerted by health care systems during the pandemic and evaluate the experience of digital primary care from the perspective of all stakeholders.

Thus, this research project employs mixed methods to analyze the implementation and utilization of CDK. CDK users (patients, caregivers and software developers) are asked if they want to participate in semi-structured interviews with a researcher to talk about their experience and perception of care delivery with CDK. Then, their responses are analyzed using qualitative methods to gather more understanding of the effect and results of CDK.

The study is conducted by a group of researchers at Karolinska Institutet. The work is supervised by Carl Savage at the Clinical Management Center in the LIME department. The principal researcher for the project is Karolinska Institutet. Principal research means the organization that is responsible for the study.

How is the study done?

The research is based on studying the introduction and use of CDK through individual interviews with key informants. With this written information, we want to ask you to participate in an interview.

If you choose to participate in the interview, you will be interviewed by one or two researchers from Karolinska Institutet. The interview takes place in a single room at your workplace or online via videocall and takes about an hour. The questions are about your experience of using or developing CDK. The questions are open so that you are free to describe your experiences in your own words.

Your answers will be audio-recorded if you provide your consent. Only the research team will have access to them, and your identity will not be disclosed in the study reports or in any publication that may follow. In the event that we will use interview quotes and descriptions where you may be identified as a person with special insight into the organization, we will ask for your consent to use this before dissemination.

Possible consequences and risks of participating in the study

Research results could lead to a greater understanding of how CDK is impacting the relationship between patients and healthcare professionals in primary care.

There are no known specific risks of participating in similar interviews. Sometimes certain topics can be sensitive for some people, which can possibly cause discomfort. You can of course inform the interviewer during the interview or contact the interviewer afterwards to discuss how you feel and come up with a solution.

The analysis will cover the material collected through primary search and interviews. Results from the analysis will be reported only at group and organizational levels.

What happens to my information?

We will collect and register information about you. Through the interview, we will collect information about your experience with CDK.

All data is handled and processed in accordance with the EU Data Protection Regulation. The interview is recorded digitally to facilitate the researchers' analysis work and will then be transcribed. Only the researchers will have access to it. Data (including audio recordings) are stored for 10 years after project completion, after which the material is thinned.

The person responsible for your personal data is Karolinska Institutet. According to the EU Data Protection Regulation, you have the right to access the information about you that is handled in the study free of charge, and if necessary get any errors corrected. You can also request that information about you is deleted and that the processing of your personal data is restricted. If you want to access your information, please contact the project manager at Karolinska Institutet (see contact information below). The Data Protection Officer is Mats Gustavsson (Legal Department at Karolinska Institutet), mats.gustavsson@ki.se tel: 08 52486473. If you are dissatisfied with how your personal data is processed, you have the right to lodge a complaint with the Data Inspectorate, which is the supervisory authority.

Data collected in Sweden will only be handled within the research group that is active in Sweden and will not be transferred to countries outside the EU.

How do I get information about the results of the study?

Contact the responsible researcher (see contact information below) if you want to receive the information collected about you or future study results. You will receive them a digitally.

Insurance and compensation

Since your participation in the study does not involve any physical intervention by the research team, there is no risk of injury. You will keep working in your natural work environment and perform normal tasks under normal conditions. The study provides no compensation for your time or other expenses linked to the project.

Participation is voluntary

Your participation is voluntary, and you can choose to cancel your participation at any time. If you choose not to participate or want to cancel your participation, you do not have to state why, nor will it affect your future care, treatment or work.

If you wish to cancel your participation, please contact the person responsible for the study (see below).

Responsible for the study

Responsible for the study is Carl Savage: +46-(0)8-524 879 00, carl.savage@ki.se

For any question please contact: Carla Sacchi, +46 (0)767-037968, carla.sacchi@stud.ki.se

Consent to participate in the study

I have received oral and written information about the study and have had the opportunity to ask questions. I may keep the written information.

☐ I agree to participate in the study "Digitally supported communication in primary care: an exploratory case study of its adoption and application".

☐ I agree that information about me is processed in the manner described in the research person's information.

Place and date	Name and surname	Signature

Appendix 6: Interview guides

6a. Interview guide for Collabodoc Digital Kontakt staff

Patients' Condition

1. Does the target population for Collabodoc Digital Kontakt have social or cultural features that need to be taken into account when designing the technology?

    a. Are some of them likely to have better socio-economic conditions?
    b. Are some likely to have low/high health literacy (poor understanding of what is wrong and how to manage it)?
    c. Are some likely to have low/high system literacy (poor understanding of how to navigate the health or care system)?
    d. Are some likely to have low/high digital literacy (poor understanding of technologies and how to use them)?
    e. Are some of them likely to have problems understanding the language used by health care providers?

Technology

2. How do you think CDK is perceived by users (patients and health care providers)?
    a. What knowledge / support do you think is needed to use CDK?
    b. Does CDK feel user-friendly in your opinion?
    c. What types of support do you provide to users (patients and health care providers)?
3. What is the technology supply model of CDK?
    a. To what extent do you think CDK implies major changes to the way health care is delivered?
    b. To what extent does implementation require staff to do their jobs in a different way and/or interact with different people or teams?
    c. To what extent does implementation require new or different steps in the care pathway (e.g. new administrative processes)?

Value proposition and value chain

4. In your own words, what problem are you trying to solve with CDK?
    a. What results are you expecting?
    b. Is it turning out as you have hoped?

Adoption system

5. Can you describe how patients and caregivers use CDK?
    a. How has the patient's role changed in your opinion?
    b. Is there a special patient group who you think has had the most benefits from CDK?
    c. Do you know if CDK has allowed a better or increased cooperation among care providers, for example, hospitals?
6. Do you think that the utilization of CDK has been affected by the spread of COVID-19?
    a. In which ways and why?

Organization

7. How did the introduction of CDK go?
    a. Who were the key people?
    b. Did you provide any training to users?
8. What were the conditions for being able to introduce it, for example resources, support, time, skills?
9. How was it received from health care staff?
    a. Differences between staff group?

Wider system

10. Are there external factors that affect CDK? (e.g. policy, regulations, IT systems)
11. Does CDK have a lot of competitors?
    a. How is the competition affecting your work?

Embedding and adoption over time

12. How has the work and the use of CDK developed over time?
    a. Did you need to make any changes?
    b. Do you think you will need to make any more change?
13. To what extent do you think CDK will become obsolete or require updating in the next 3-5 years?
    a. To what extent can the technology be adapted to take account of future changes?
    b. To what extent will the technology supply model change?

Conclusion

I have no more questions: do you have anything you want to add or ask before we end the interview?

Thank you so much for taking the time to participate in this interview.

6b. Interview guide for health care providers

1. What is your role at the health care centre?

Patients Condition

2. Which patients use Collabodoc Digital Kontakt (CDK)?
    a. What needs do they have?
3. Does the target population for Collabodoc Digital Kontakt have specific social or cultural features?
    a. Are some of them likely to have better socio-economic conditions?
    b. Are some likely to have low/high health literacy (poor understanding of what is wrong and how to manage it)?
    c. Are some likely to have low/high system literacy (poor understanding of how to navigate the health or care system)?
    d. Are some likely to have low/high digital literacy (poor understanding of technologies and how to use them)?
    e. Are some of them likely to have problems understanding the language used by health care staff?

Technology

4. What are CDK main components?
    a. How do you access data with CDK?
    b. How do patients and caregivers use CDK?
5. What knowledge is needed to use CDK?
6. What support is needed to use CDK?
7. Does CDK feel user-friendly?

Value proposition and value chain

8. In your own words, what problem is CDK trying to solve?
    a. What results are you expecting?
    b. Is it turning out as you have hoped?

Adoption system

9. What has changed since you started to use CDK?
    a. How did your work change?
    b. In what way is CDK affecting your other tasks?
    c. In what way do you think CDK improves or impairs your work performance?
    d. How has the patient's role changed?
    e. What results have you observed for patients?
    f. Is there a special patient group who you think has had the most benefits from CDK?
    g. How has the cooperation with other care providers changed? For example, hospitals?
10. What benefits have you experienced compared to previous ways of working with patients?
11. What challenges have you experienced compared to previous ways of working with patients?

Organization

12. How did the introduction of CDK go?
    a. Who were the key people?
    b. Did you have any training?
13. What were the conditions for being able to introduce it, for example resources, support, time, skills?
14. How was it received from staff?
    a. Differences between staff group?
15. Did CDK affect the clinic workflow or patient flow in any way?
    a. How so?
    b. Why is that?

Wider system

16. Are there external factors that affect how you work with CDK? (e.g. policy, regulations, IT systems)
    a. Are there any hurdles or difficulties?

Embedding and adoption over time

17. What have you learned from working with CDK?
18. How has the work and the use of CDK developed over time?
    a. Did you need to make any changes?
    b. Do you think you will need to make any more change?

Conclusion

I have no more questions: do you have anything you want to add or ask before we end the interview?

Thank you so much for taking the time to participate in this interview.

Appendix 7: Initial codebook

Table 5. List of codes created deductively at the beginning of the analysis

Category	Code name	Definition
Condition or Need	Specific patient characteristics	Diseases or medical conditions of the patients that use CDK the most
	General patient characteristics	General features of the patients that use CDK the most
Technology	Impact on care delivery process	Changes in the care delivery process due to the implementation of CDK
	Usability / Perceived ease of use / Controllability	How easy to use (usability), easy to control (controllability) and user friendly is CDK
	Dependability / Performance (bugs)	How trustworthy and dependable is the technology of CDK
	Interdependencies	Integration of CDK with other IT systems in use at the primary care centre
	Main components	The main components of CDK - what elements it is made of
	Self-efficacy	Users are confident in their own ability to use CDK
Value proposition	Negative value	CDK brings negative value to users (e.g. losses, destabilization, hidden costs)
	Effectiveness	CDK is effective, i.e. it works well and produces the results that were intended
	Safety	CDK is safe, i.e. it does not produce any harm or danger
	Value and perceived usefulness for health care providers	Perceived usefulness and value of CDK for health care providers
	Value and perceived usefulness for patients	Perceived usefulness and value of CDK for patients
Adopters / Adoption system	Perceived usefulness for the organization	CDK is perceived to bring value to the primary care centre as a whole
	Changes in provider role	Changes in the role of health care providers since the adoption of CDK
	Changes in patient role	Changes in the role of patients since the adoption of CDK
	Job relevance	Impact of CDK on the job performance of health care providers
	Knowledge required	Knowledge required to use CDK
	Patients benefitting the most	Some patients are perceiving the highest benefits from CDK
	Subjective norm	The adoption of CDK by its users is influenced by the opinion of others or by prejudices
	Facilitating conditions	Users perceive that barriers are removed and they receive sufficient support in using CDK
Organization	Attitude towards innovation	Attitude of the primary care centre towards innovation and CDK and capacity to adopt
	Implementation's difficulty	How difficult was the implementation process of CDK
	Implementation's success	How successfull was the implementation process of CDK
	Readiness to change	Readiness to change the care delivery process of the primary care centre
	Resources and conditions	Specific internal resources or conditions that supported the adoption of CDK
External context	Laws and regulations	National or local regulations involved in CDK implementation
	Competition	Other market players influence the adoption or implementation of CDK
	External hurdles	There were external hurdles to the adoption and implementation of CDK
Adaptation over time	Adaptation of CDK	The adoption of CDK will require changes of CDK in the next future
	Adaptation of the organization	The adoption of CDK will require changes of the organizaton in the next future

Appendix 8: Final codebook

Table 6. List of all codes used in the analysis, their type and frequency

Domain	Code name	Definition	Type	Frequency
Background	Study participants	Info on study participant	Inductive	18
Condition or Need	General patient characteristics	General features of the patients that use CDK the most	Deductive	9
	Patients' needs	Needs of the patients that use CDK	Inductive	9
	Specific patient characteristics	Diseases or medical conditions of the patients that use CDK	Deductive	9
Technology	Changes of CDK	Technical changes of CDK during the implementation	Inductive	5
	Dependability / Performance (bugs)	How trustworthy and dependable is the technology of CDK	Deductive	11
	Impact on care delivery process	Changes in the care delivery process due to the	Deductive	21
	Interdependencies	Integration of CDK with other IT systems in use at the	Deductive	13
	Main components	The main components of CDK - what elements it is made	Deductive	17
	Self-efficacy	Users are confident in their own ability to use CDK	Deductive	6
	Supply model	Supply model - how CDK works	Inductive	25
	Usability / Perceived ease of use / Controllability	How easy to use (usability), easy to control (controllability) and user friendly is CDK	Deductive	17
Value proposition	Effectiveness	CDK is effective, i.e. it works well and produces the	Deductive	16
	Intended purpose	Intended purpose and use of CDK	Inductive	18
	Negative value	CDK brings negative value to users (e.g. losses,	Deductive	11
	Safety	CDK is safe, i.e. it does not produce any harm or danger	Deductive	9
	Value and perceived usefulness for health care providers	Perceived usefulness and value of CDK for health care providers	Deductive	12
	Value and perceived usefulness for patients	Perceived usefulness and value of CDK for patients	Deductive	12
Adopters / Adoption system	Changes in patient role	Changes in the role of patients since the adoption of CDK	Deductive	5
	Changes in provider role	Changes in the role of health care providers since the	Deductive	9
	Collaboration	Impact of CDK on the internal collaboration	Inductive	14
	Facilitating conditions	Users perceive that barriers are removed and they receive sufficient support in using CDK	Deductive	11
	Job relevance	Impact of CDK on the job performance of health care	Deductive	5
	Knowledge required	Knowledge required to use CDK	Deductive	6
	Patients benefitting the most	Some patients are perceiving the highest benefits from CDK	Deductive	0
	Patients' attitude	Attitude of patients towards innovation and CDK in	Inductive	8
	Perceived usefulness for the organization	CDK is perceived to bring value to the primary care centre as a whole	Deductive	11
	Subjective norm	The adoption of CDK by its users is influenced by the opinion of others or by prejudices	Deductive	1
Organization	Attitude towards innovation	Attitude of the primary care centre towards innovation and	Deductive	14
	Implementation's difficulty	How difficult was the implementation process of CDK	Deductive	18
	Implementation's success	How successfull was the implementation process of CDK	Deductive	16
	Readiness to change	Readiness to change the care delivery process of the	Deductive	4
	Resources and conditions	Specific internal resources or conditions that supported the	Deductive	8
External context	Competition	Other market players influence the adoption or	Deductive	9
	External collaboration	Impact of CDK on the external collaboration with other	Inductive	4
	External hurdles	There were external hurdles to the adoption and	Deductive	3
	Laws and regulations	National or local regulations involved in CDK	Deductive	6
	COVID19	Impact of COVID19 on the adoption and utilization of	Inductive	11
Adaptation over time	Adaptation of CDK	The adoption of CDK will require changes of CDK in the	Deductive	13
	Adaptation of the organization	The adoption of CDK will require changes of the	Deductive	3

Appendix 9: Figures and tables describing the results

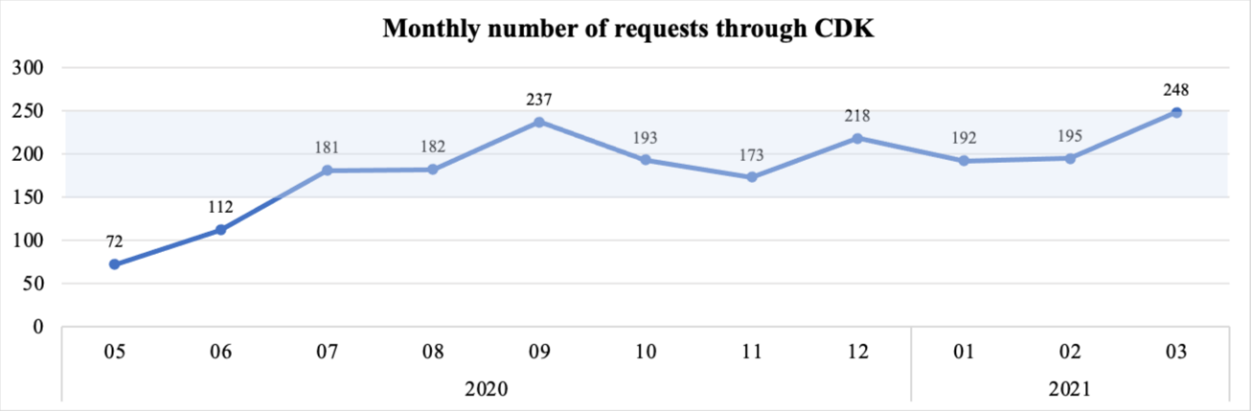


Figure 11. Monthly number of requests through CDK

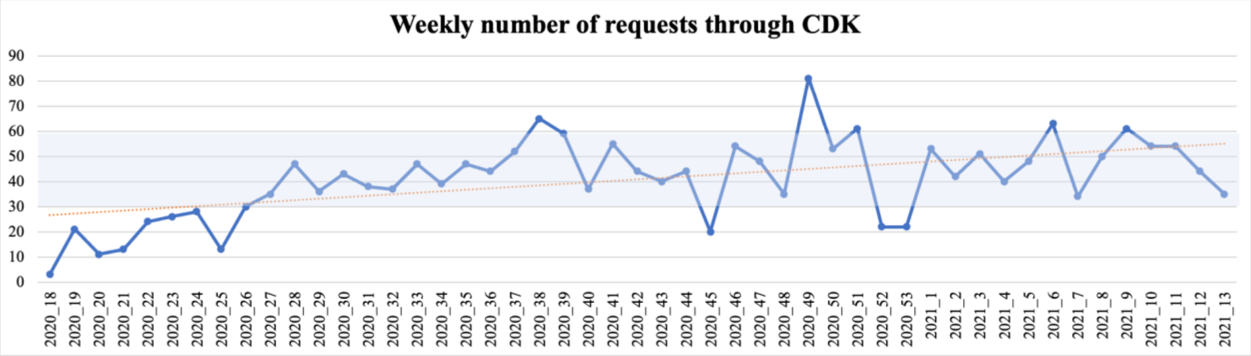


Figure 12. Weekly number of requests through CDK

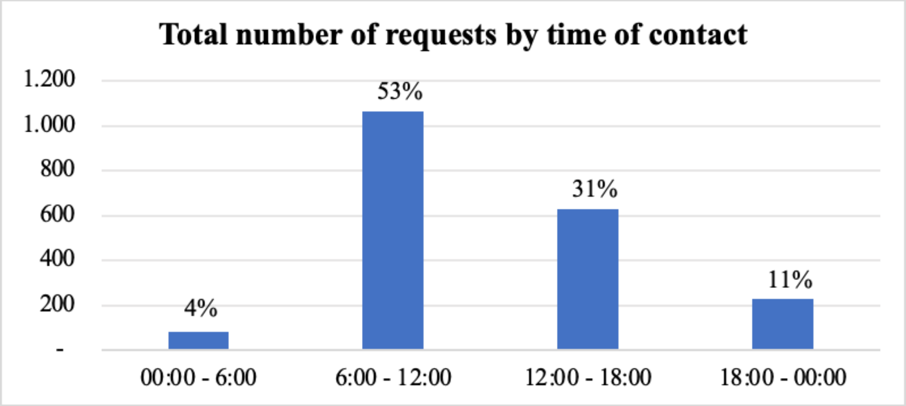


Figure 13. Total number of requests by time of contact

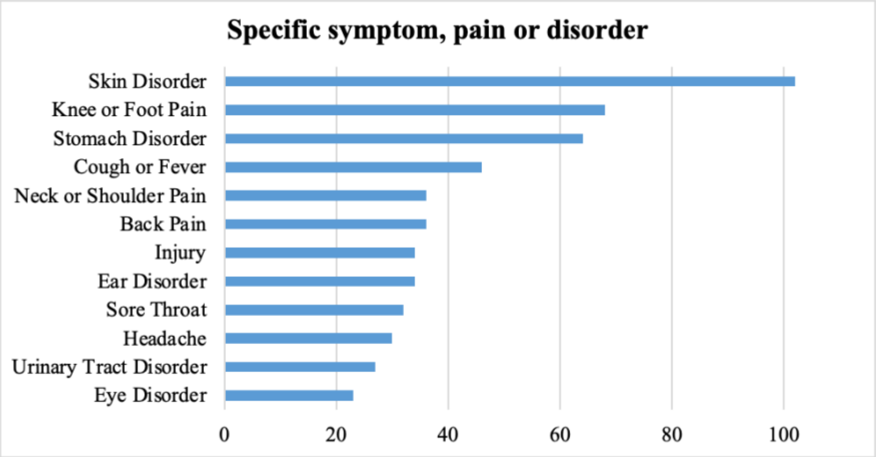


Figure 14. Detailed cause of contact for the requests with clinical needs

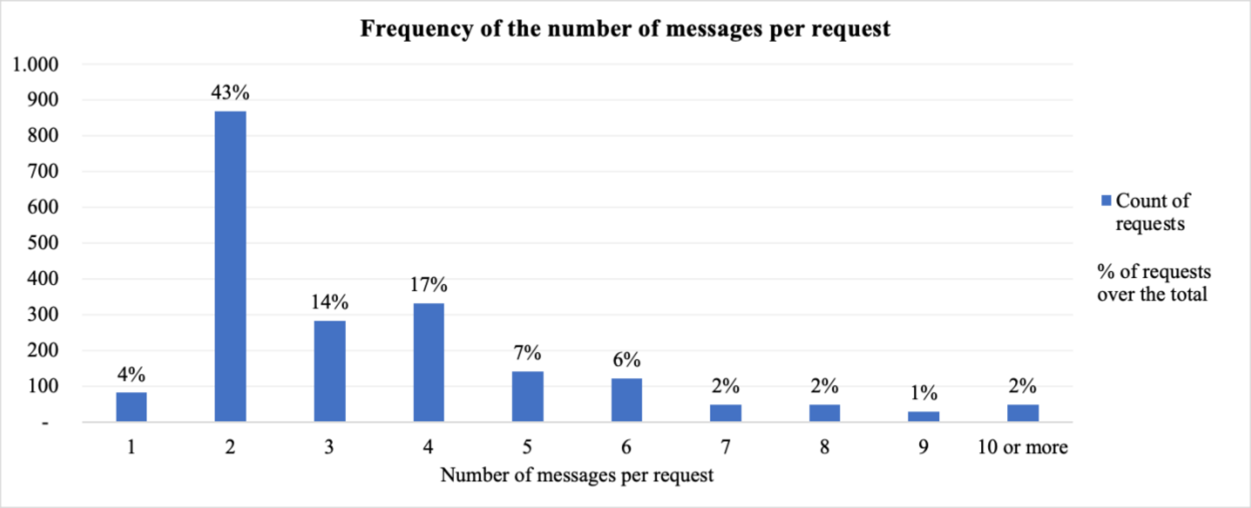


Figure 15. Frequency distribution of the number of messages per request (or chat)

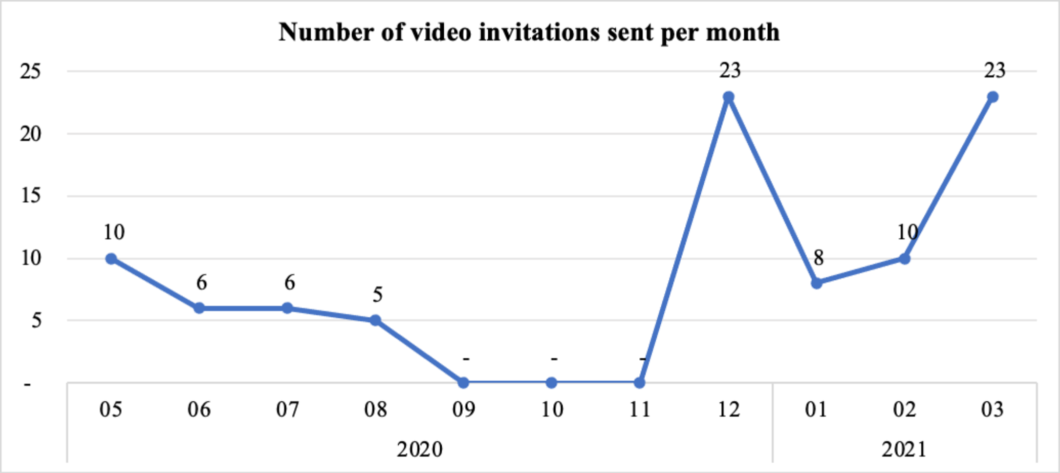


Figure 16. Number of video visit invitations sent

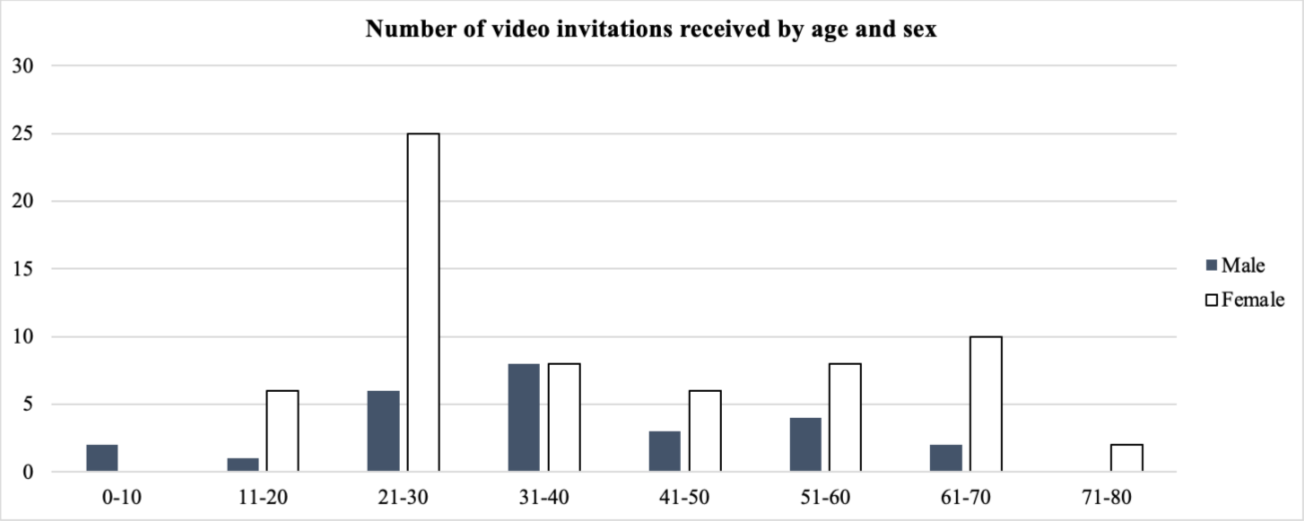


Figure 17. Age and sex of users that received a video invitation

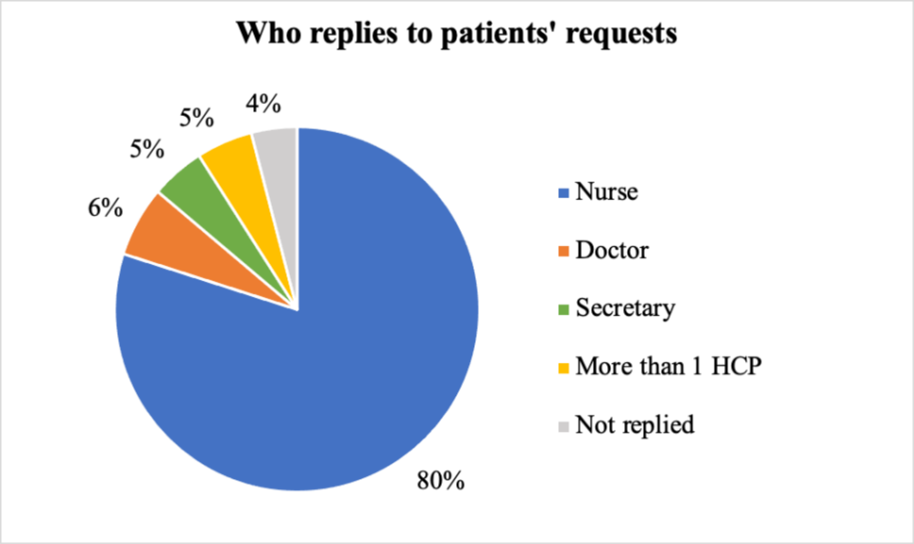


Figure 18. Proportion of requests by type of user that replied

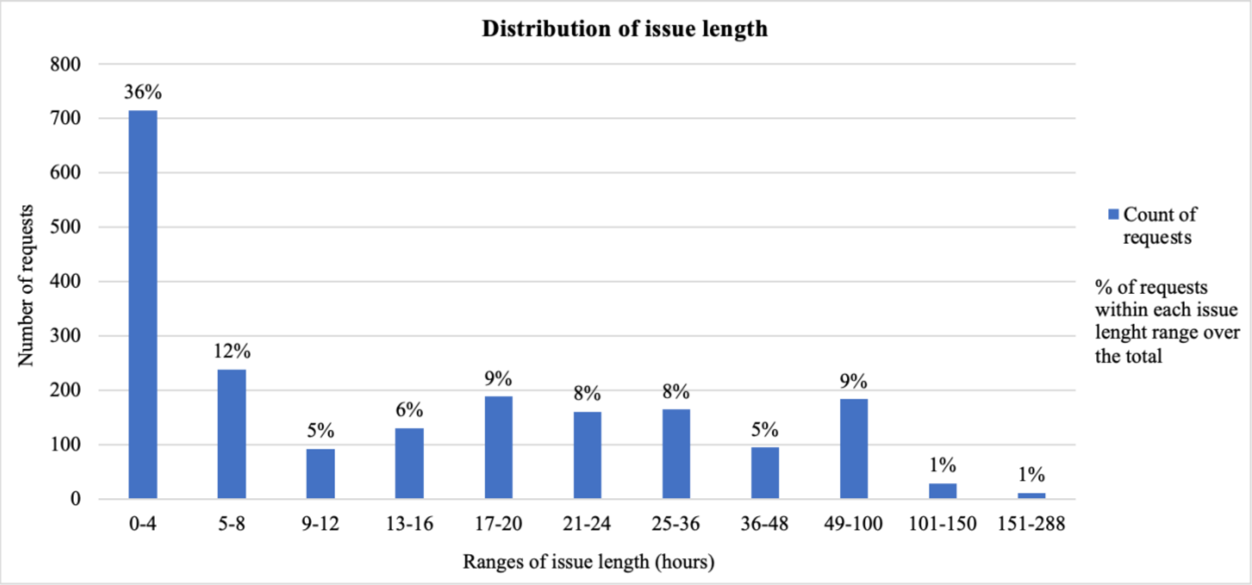


Figure 19. Distribution of issue length (hours)

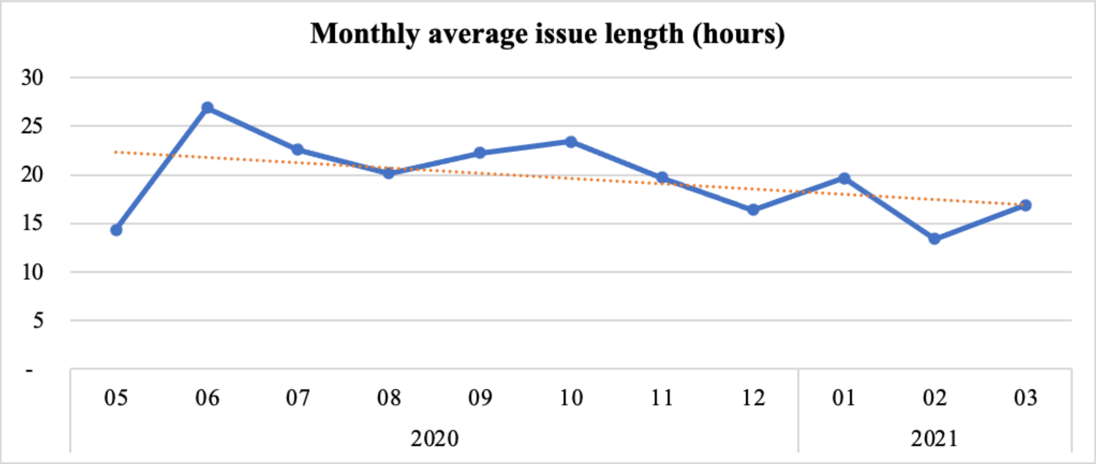


Figure 20. Monthly average issue length (hours)

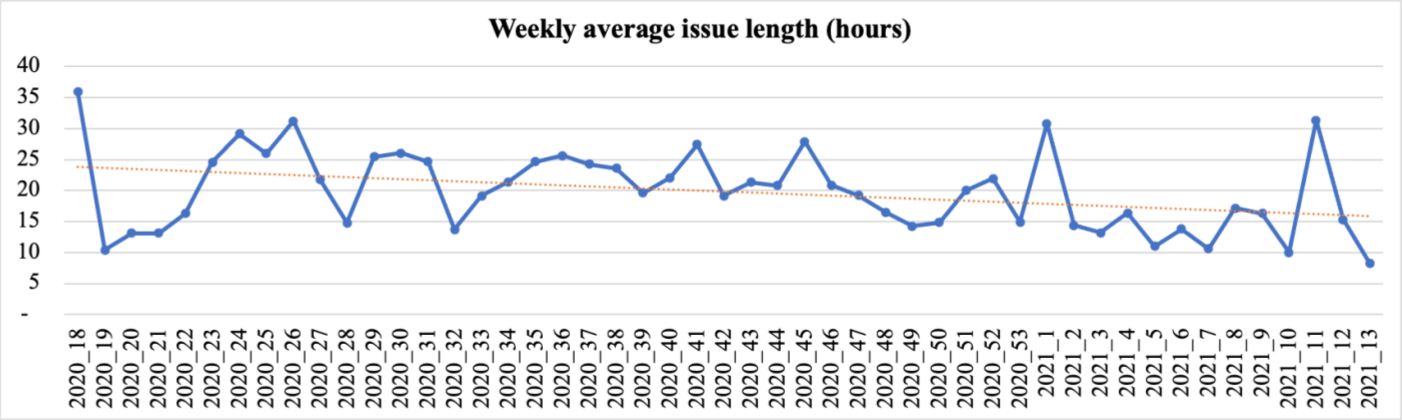


Figure 21. Weekly average issue length (hours)

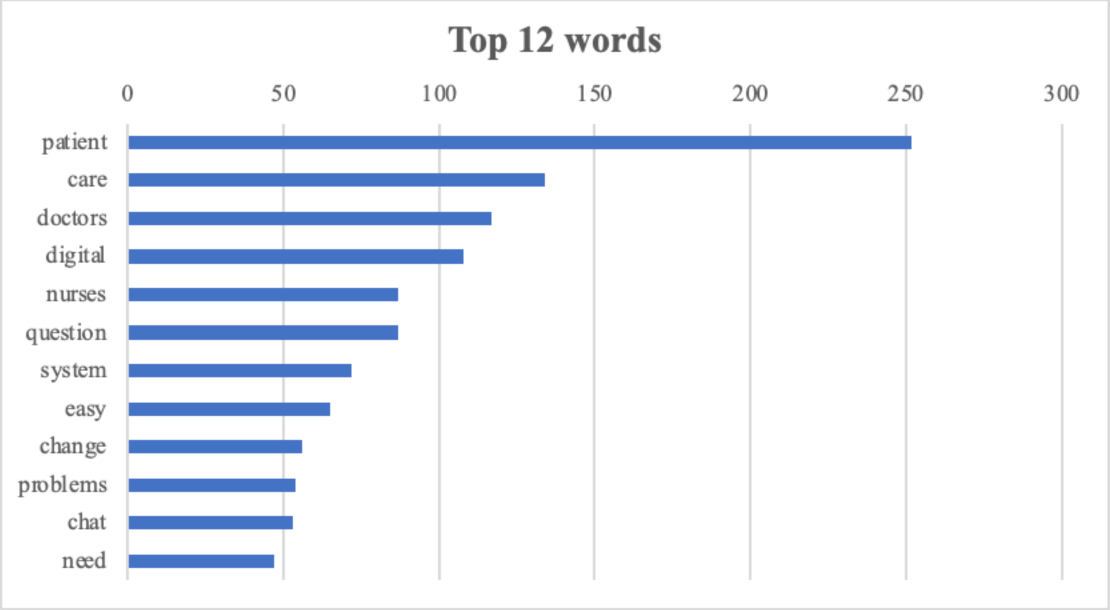


Figure 22. Top 12 words used by interviewees