Success factors in implementing an e-health system in primary care

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Abstract

Healthcare organizations worldwide have struggled to implement e-health solutions, with projects frequently ending up delayed or above budget. Although it is generally assumed that digitalization has the potential to make healthcare more effective, the anticipated improvements have not been as apparent in healthcare as in other industries.

This thesis focuses on the pilot implementation of a privately developed e-health system in a large public primary care organization in Sweden. The purpose of the thesis is to identify success factors concerning this implementation.

The thesis employs a combination of deductive and inductive reasoning. Its theoretical foundation was derived from a literature review. A multiple case study was chosen as the research strategy, where each primary care unit represented a case. The case study included the collection and analysis of empirical data documented during and after the implementation, as well as interviews with five representatives of the company that had developed the e-health system who had extensively participated in the implementation.

This thesis concluded that the key factors to success in this implementation could be roughly divided into three categories: (i) local engagement of the primary care unit; (ii) local knowledge at the primary care unit; and (iii) well-defined and easily evaluated project goals. Furthermore, the difficulties in defining a successful implementation are highlighted. In addition to the conclusion, a set of suggestions is presented which could aid evaluations of e-health implementations in the future.

Acknowledgments

This thesis examines the success factors of the implementation of an e-health system in a primary care organization. The research was conducted at the Department of Biomedical Engineering at the Faculty of Engineering, Lund University. The case study was conducted at a Swedish e-health company which provided empirical data.

Firstly, I would like to thank my supervisor at the Faculty of Engineering, Martin Stridh, for the support and advice given during the writing of this thesis.

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List of Abbreviations and Glossary of Terms

CFIR Consolidated Framework for Implementation Research

Digitalization The changes associated with the application of digital technology in all aspects of human society. [1]

Digitization The conversion of analog data into a digital format. [1]

Drop-in reception The ability for patients to walk into a clinic and seek care spontaneously, without the need of an appointment.

E-health The organization and delivery of health services and information using information technology systems. [2]

FTE The Full-Time Equivalent is the sum of part-time and full-time employees, represented as the equivalent number of full-time employees.

MoM Median of medians

SKR Sveriges Kommuner och Regioner (Swedens Municipalities and Regions)

Subacute patient Patients which do not need to be assessed within three days (typically within one to two weeks).

Triage The process of making an initial assessment of a patient to decide on further management.

PCU Primary Care Unit

PWA Premises and Workflow Analysis

Contents

Chapter 1
Introduction

This chapter aims to provide contextual information on the topic of this thesis by describing the background and the e-health company that developed the solution that was implemented. Furthermore, the research purpose, research questions, and delimitations are presented.

1.1 Background

In 2016, the Swedish government and Sweden's Municipalities and Regions (SKR) published a new national vision: *Vision e-health 2025*. The vision states that, by 2025, Sweden will be the global leader in using the opportunities given by digitalization and e-health. The overall objective is to achieve a more accessible and equitable healthcare [3].

Efforts to advance healthcare are not unique to Sweden – globally the proportion of gross domestic product (GDP) spent on healthcare is increasing. In 1970, the average percentage of GDP spent on healthcare by developed countries was 5.3%, whereas the same figure had grown to 9.4% by 2010. Despite these expenditures, healthcare struggles to keep up with aging populations, inequalities in access, and increasing expectations among patients. Furthermore, there is no clear relationship between increased healthcare expenditure and quality of care. In this context, it is no surprise that decision-makers turn to digitalization as a solution to growing healthcare problems, most likely motivated by successes of digitalization in other sectors [4].

The general assumption is that storing patient information digitally, rather than on paper, reduces the fragmentation of information while enabling more effective information management. Digitally structured data allows healthcare professionals to more easily access patient information, which is important in most healthcare situations, from emergencies to management of long-term chronic conditions [5].

There are, however, further ways that the digitalization of healthcare could improve quality of care. Gellerstedt [6] argues that digital healthcare gives patients a more central role, enabling greater engagement in their own, as well as other patients', healthcare. Structured use of the enormous amount of data generated in healthcare has the potential to improve quality of care by more efficient and improved diagnoses and treatments.

Even though the potential in the digitalization of healthcare is huge, the transformation process involves numerous challenges [7]. Complexity and difficulty in implementing e-health projects is an international phenomenon. In Great Britain, many of the projects performed during the 2000s have been subject to delays and budget deficits. In some cases, the projects have even ended up negatively impacting the quality and effectiveness of care [8]. The large amount of failures in implementing e-health systems indicates a need to better understand the factors that influence the implementation process. Such an improved understanding could potentially facilitate more effective implementation of e-health systems [9]. Even though considerable research has been conducted on factors promoting successful implementation, implementation research within healthcare is still a relatively young science with more work that can be done [8].

1.2 The e-health company

The e-health company that participated in the implementation analyzed in this thesis was based in Sweden. It developed software based on medical evidence intended to provide easier access to high-quality healthcare for patients while simplifying workflows for healthcare professionals. The company developed a digital system developed for primary care, used by patients and healthcare professionals. The typical workflow with the e-health system is seen in Fig. 1.1, and below the workflow is explained step by step.

The patient needs to seek care
Many primary care visits start with the patient seeking care for new or recurring symptoms. In the system, the patient can start an appointment either by visiting the medical center (the green path in Fig. 1.1) or by starting a visit from home (the blue path in Fig. 1.1).

The patient answers medical questions
After starting the visit, the patient answers questions concerning his or her medical background and current symptoms. The system dynamically adapts the questions

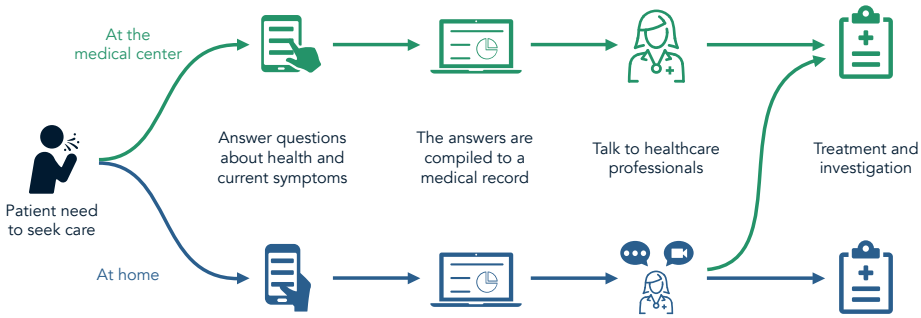

Figure 1.1: Typical workflow with the e-health system

asked based on the answers given by the patient, similarly to how a healthcare professional would.

Answers are compiled to a medical record entry
The answers are automatically compiled into a medical record entry, ready for a healthcare professional to read. This enables the healthcare professional to prepare for the consultation.

Talk to healthcare professionals
If patients seek care remotely, consultations can take place via chat or video call. If needed, the patient can be referred to the medical center – the remote consultation is thus converted into a physical one, and all previous documentation is saved. If the patient is seeking care at the health center, the consultation is conducted as usual.

Treatment and investigation
The automatically compiled medical record entry is only a draft, and the healthcare professionals can edit the documentation at any time. Based on the answers given by the patient, documentation support is provided to the healthcare professional in the form of suggestions and templates for e.g. examinations, diagnoses, and assessment texts, enabling easy and standardized administration. The healthcare professional is also supported during assessment via easy access to lab tests and medical guidelines which are also adapted based on the patient's answers.

1.3 The healthcare organization

In 2018, a large public healthcare organization in Sweden announced a procurement for a system enabling digital anamnesis and healthcare process support. The e-health company entered the procurement with their system. In the summer of 2018, it was announced that the e-health company won the procurement and that their system was going to be implemented in public primary care units (PCUs) run by the healthcare organization.

The e-health system was implemented in phases, starting with a pilot that began in June 2019 and ended in December 2019. However, one PCU used the system for three days before the other PCUs started; if this is included, the pilot started in May 2019. The pilot included eight primary care centers, one emergency center, and one fully digital health center. The clinics represented the diversity of PCUs in aspects such as size, patient demography, and workflows. No standardized workflow was implemented; rather, each PCU was able to choose for themselves how they wanted to use the system. This was one of the purposes of the pilot: to be able to retrospectively evaluate which combination of PCU prerequisites and implementation worked the best, as described in section 4.3.

1.4 Research purpose

The purpose of this thesis is to identify success factors in the implementation of the e-health system in primary care. With a better understanding of the implementation factors, the e-health company hoped to be able to better prepare and adapt any future implementation processes. Additionally, this thesis hopes to contribute knowledge concerning the implementation factors of e-health systems in primary care in general.

1.5 Research questions

The primary research question is:

- RQ 1: What are the key factors for a successful implementation of a e-health system in primary care?

To answer the primary research question, the following list of secondary research questions should be answered:

- RQ 2.1: What is a successful implementation?

- RQ 2.2: Which activities in the implementation process are particularly important?
- RQ 2.3: How does the PCU routines and prerequisites affect the implementation?

1.6 Delimitations

The focus of this thesis is on the implementation process at each PCU. It does not focus on the outer setting, such as the economic or political context. This includes the cost of the system, even though cost often is a highly relevant factor in the implementation of e-health [9] – since the system was procured centrally by the healthcare organization, it is assumed that the cost of the system did not affect the individual PCUs.

Chapter 2
Method

This chapter describes the work process and method of the thesis. First, the overarching research approach and strategy is presented and justified. Later, the methods of the literature study, data collection, and data analysis are presented.

2.1 Research approach

The two general research approaches are deductive and inductive reasoning. Deduction involves building a theory that is then tested on data. Induction is instead the idea of first gathering data to then build a theory. Deductive reasoning emphasizes moving from theory to data, the collection of quantitative data, and a highly structured approach; inductive reasoning instead emphasizes gaining an understanding of events, the collection of qualitative data, and a more flexible approach. However, research does not have to be one or the other; it is possible to combine the two approaches and, in fact, it can often be advantageous to do so [10].

In this thesis, a combination of deductive and inductive approaches was applied. First, literature was reviewed to build an understanding of success factors in previous implementations of digital systems in health care. Here, deductive reasoning was applied. Second, data were collected and analyzed to understand the implementation processes of the e-health system. In this part of the research, inductive reasoning was most appropriate. Finally, the theory and knowledge gathered from the first step were compared to the information and results gathered in the second step.

2.2 Research strategy

One of the biggest decisions to be made in doing research is the choice of research strategy. A research strategy is an action plan to achieve the goal of the research. The strategy should define the overview of the project, a plan of action, and a specific goal

that can be achieved [11]. As a research strategy, the case study method is suitable for research whose purpose is to understand complex relationships between factors as they operate within a particular setting [11]. As this applies well to this thesis's purpose and research questions, the case study strategy was chosen.

In case studies, data are gathered by monitoring a phenomenon during a certain period or by retrospectively collecting information concerning the phenomenon during a certain period [12]. Relationships and processes within social settings are usually interconnected [11]. The researcher should focus on describing and explaining these relationships and processes. The researcher should initially be guided by broad research questions, which after some exploration of data, are reformulated into more precise research questions [12]. In this thesis, the social setting was the implementation of the e-health system, and the cases were the individual PCUs. Hence, a multiple case study strategy was chosen for this thesis.

A case study can be performed by an external researcher who is unfamiliar with the social situation of the case; this is often referred to as outsider research. On the other hand, if the researcher is a member of the case study context, this is instead insider research. This thesis represents insider research. There are advantages and disadvantages in both cases. The insider researcher is often more familiar with the subject from start and should be able to pick up on subtleties more easily than the outside researcher. However, the prior knowledge about the subject could make it easier to overlook aspects that the outside researcher would have picked up on [13]. Since the author of this thesis has been a part of the social context being researched, these advantages and disadvantages of inside research have been considered throughout the research.

2.3 Literature review

A literature review of digital tools in healthcare was conducted. The goal of the review was to gain knowledge of previous implementation processes which could give insights into what contributed to success in those instances. The knowledge gained from the literature review was later compared with the information gathered regarding the implementation of the e-health system. The review also aimed to give insight into how one can determine if an implementation is successful or not.

In the article *A Guide to Writing the Dissertation Literature Review* [14], Randolph explains the process of conducting a literature review and compares it to that of conducting primary research. The key components are (i) a rationale for conducting the review; (ii) research questions or hypotheses that guide the research; (iii) an explicit

plan for collecting data, including how units will be chosen; (iv) an explicit plan for analyzing data; and (v) a plan for presenting data.

The rationale for this literature review was to lay the foundation for the rest of the thesis. In Randolph's article [14], several purposes are presented in both broad and narrow terms. The main purpose of a literature review is to demonstrate the author's knowledge about the field of study, including vocabulary, theories, and key variables. To make the purpose more concrete, the main purposes presented in Randolph's article were used as guides for this review. The main purposes are (i) delimiting the research problem, (ii) avoiding fruitless approaches, (iii) gaining methodological insights, (iv) identifying recommendations for further research; and (v) seeking support for grounded theory.

The research questions that guided this literature review were the same as for this thesis as a whole. However, the focus of the literature review was mainly on the secondary research questions.

A plan for collecting and evaluating literature was created and divided into four steps described in Fig. 2.1.

The first step of the data collection process often consists of an electronic search of academic databases and the internet [14]. For this review, the two databases used were Google Scholar and LubSearch. LubSearch is Lund University's search engine. The search terms used were combinations of the terms ”digitalization”, ”primary care”, ”implementation”, ”ehealth”, ”successful” and ”healthcare”. To find relevant literature, a set of inclusion criteria were determined. To be included in the review, the literature needed to be at most 20 years old, free to the public or accessible via the Lund University authentication service, and be published by trustworthy institutions and authors. Since databases like Google Scholar could present a large number of search results, an additional criterion was determined: If the search term resulted in a large number of papers, only the first 20 results were included for screening (given that it fulfilled the prior inclusion criteria). The purpose of the limit was to promote more search terms rather than only being able to investigate a few search terms, with reasonable time consumption.

If an article fulfilled the inclusion criteria, it was subject to the second step, screening. A summary (abstract, back cover, or equivalent) of the article was read and after reading the summary the literature was excluded only if the author of this thesis concluded the article as obviously irrelevant. The remaining papers were subject to the third step, further assessment.

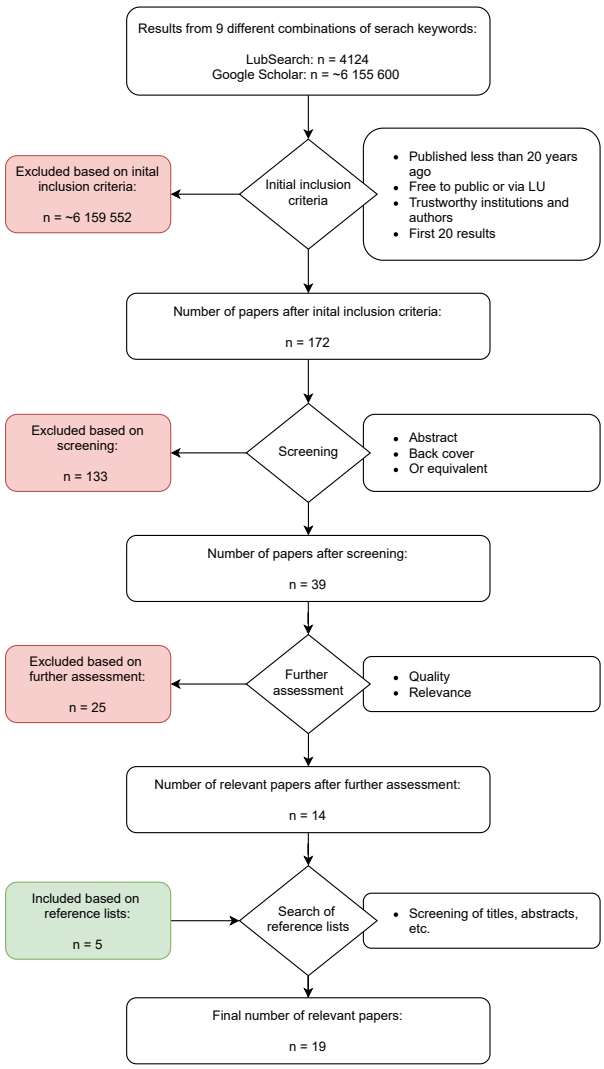

Figure 2.1: Flowchart of literature review process.

Further assessment entailed a thorough evaluation of the gathered data where the literature was read in detail. Continuously throughout the assessment information was extracted by coping relevant parts of the literature with the corresponding page

number into a central document.

In the fourth and final step, the references of the included literature were scanned. If any title of the references seemed particularly relevant, an assessment was performed and any relevant parts were added to the central document.

The result of the literature review was presented, mainly in section 4, of this thesis. A summary of the included articles is displayed in Table 2.1.

Table 2.1: Reference numbers of the articles derived from the review

[1] [2] [4] [5] [6] [7] [9] [15] [16] [17] [18] [19] [20] [21] [22] [24] [26] [27] [28]

2.4 Data collection

In case study research it is encouraged to use several data sources, the main ones being (i) available documents, (ii) interviews with informants, and (iii) via observation [12]. Since the pilot of the e-health system was already completed when this research began, observations could not be conducted. Thus, the primary data sources for the case study were documents and interviews.

The study of documents is an effective technique to understand the case study subject [12]. The documents used in this thesis, e.g. meeting notes, presentations, and reports were collected either from the e-health company internal intranet or through emails sent between the e-health company and the healthcare organization.

Interviews can be structured, semi-structured, or unstructured. A structured interview is similar to a questionnaire but is conducted face-to-face. There is a predetermined list of questions, which has the advantage of offering some kind of standardization. The structured questions and answers make the data analysis relatively easy. In the semi-structured interview, the researcher has a list of topics to be addressed. However, during the interview, the researcher is a bit more flexible in terms of the order of the topics discussed. The interviewee is allowed to bring forward ideas and speak more widely on the topics given. In the unstructured interview, the researcher introduces

a topic and allows the interviewee to speak freely for the researcher to discover information rather than to review it [11].

Since this thesis is a multiple case study in which PCUs were compared to each other, data needed to be structured in a way to enable easy comparison. Thus, the interviews held in writing this thesis were semi-structured, leaning more towards being structured than unstructured. The interviews were conducted following a predetermined list of questions which formed an interview guide. The interview guide was formatted based on the structure of the consolidated framework of implementation research (CFIR) which is presented in section 3.3.2.

The interview guide was divided into a general part and one PCU-specific part. The questions included in the general part were only asked once per interview, while the questions included in the PCU specific part were asked once per PCU. The PCU-specific questions were only asked if the interviewee had visited that PCU two times or more. For some interviewees, this meant a rather high number of questions, meaning that the structure of the interview was of importance to avoid interviews running overtime. The interview guide can be read as a whole in Appendix B.

The interviews were conducted online since the author of this thesis was geographically far from the interviewees and because travel was not an appropriate option, partly due to the ongoing covid-19 pandemic. The general part of the interview guide was always asked first, and the PCU-specific part was held second. However, the order of the PCUs was shuffled for each interviewee to minimize any biases in the answers. Notes were taken during the interview; notes for the general part were recorded in a text document and notes taken for the PCU-specific part were recorded in a spreadsheet. The purpose of recording the second part in a spreadsheet was to generate easily overviewed, structured data that could be sorted and filtered during data analysis.

In addition to documents and interviews, user data were collected from a evaluation report conducted by the healthcare organization.

2.5 Data analysis

Denscombe [11] describes data analysis in five stages: (i) data preparation; (ii) exploration of the data; (iii) analysis of the data; (iv) presentation and display of the data; and (v) validation of the data. Further, the purpose of the analysis is to better understand a subject through a detailed examination. The collected data of this thesis are both qualitative and quantitative. The qualitative data is information gathered

from conducted interviews and documents. The quantitative data is the user data published in the healthcare organization's evaluation report. Both the qualitative and quantitative analyses were broadly conducted according to the five stages suggested by Denscombe [11].

The qualitative data were categorized according to each PCU. When the possibility was given, statements in documents were validated with statements in interviews and vice versa. The data were presented and key takeaways were summarized in tables for easy comparison and overview. Conclusions and interpretations were presented to explain any similarities or discrepancies. The quantitative data were mainly presented in tables to enable easy comparison.

Chapter 3
Theory

In this chapter, the theoretical findings about implementation of e-health systems, based on the literature review, are presented. Firstly, the broad strokes of the healthcare context are presented. Secondly, implementation in general and definitions of successful implementations are presented. Thirdly, different frameworks for evaluating e-health systems are presented.

3.1 Digitalization of healthcare

Digitization is the process of converting analog data into digital format. Digitalization is the changes associated with the application of digital technologies [1]. The digitization of medical records makes healthcare information more accurate, relevant, integrated, and available. This conversion of analog medical records improves the quality of patient information by minimizing error factors as "unreadable" handwritten information and transcription errors. However, even though the digitization of medical records is increasing, the rate of digitalization is low, despite it being considered one of the most effective methods of improving healthcare [15].

Despite anticipated outcomes such as improved quality of healthcare, increased patient safety, and more efficient workflows [15], difficulty in implementing new technology in healthcare is an international phenomenon [8]. One key problem has been to integrate e-health services into professionals' daily workflow, which fails to incorporate e-health as a natural part of the work routines [16]. Konttila et al. [17] found three main themes that influenced healthcare professionals' competence in digitalization: (i) strong professional knowledge and skills; (ii) specific attitudes of the professional; and (iii) psychosocial and organizational predictors. Strong knowledge and skills are required for the healthcare professional to be able to make autonomous and intuitive decisions in situations where technology caused ethical problems. One major finding related to the attitudes of the healthcare professional is that many profession-

als have negative attitudes towards technology education. Also, lack of motivation and change resistance negatively affects technology usage. In a psychosocial and organizational context, it is shown that competence in digitalization is promoted by organizational and collegial support and that digitalization requires regular education and usage.

3.2 Implementation

Implementation is the process of getting an intervention into use within an organization. It extends from the organizational decision to adopt some intervention to the routine use of that intervention [18]. The process can include, but is not limited to, procurement of software and hardware, operational planning, installation, configuration, running, testing, quality assurance, and significant change management initiatives [19].

Implementing new interventions involves complex changes, influenced by many factors: at a micro-level by personal factors such as attitudes of individuals and the properties of the intervention; at a meso-level by organizational factors such as readiness and resources; and at a macro-level by political and social factors [20, 21]. Because of this complexity, Chattopadhyay et al. [22] suggest that the process of implementation needs a systematic approach which is divided into three phases (see Fig. 3.1). The first phase consists of four functions: (i) capturing the background information of the individual health care unit, including available infrastructure, capacity, current problems with workflow and nature of patients; (ii) conducting a preparedness study; (iii) a gap analysis or requirement specification; and (iv) design of implementation strategies. Phase two is the execution which is based on the preparations made in phase 1. The third phase involves the evaluation of benefits, issues, constraints, etc.

Digitalization ultimately aims to bring benefits such as more effective work processes; however, during the implementation and adoption of a new system, work will increase [23]. Furthermore, Leonard [23] claims that the amount of work needed depends on five success factors: (i) amount of resistance to change; (ii) amount of training before and during implementation; (iii) amount of contribution from stakeholder groups; (iv) level of effective reporting on outcome measures during and after implementation; and (v) level of effectiveness in dealing with ”breaks”, i.e. unexpected problems during implementation.

To visualize how the adoption of technology relates to the workload over time, Leonard presents a figure seen in 3.2 [23]. The curve in the figure depicts the work required

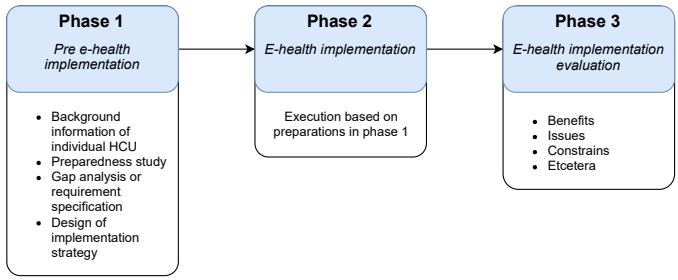

Figure 3.1: A systematic approach to e-health implementation process as suggested by Chattopadhyay et al. [22]

from the entire stakeholder group, from maintaining the overall system to the work required to make the change happen.

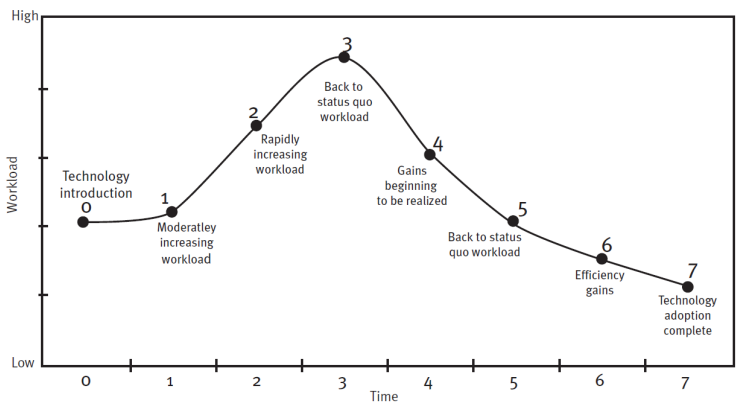

Figure 3.2: The technology adoption curve by Leonard [23].

The curve in Fig. 3.2 is general and it is hard, if not impossible, to identify where an organization is positioned on the figure. What can be said is that somewhere around Time 4 to 5, a critical point on the curve is reached, where the overall workload has decreased to the point where the system is sufficiently incorporated for the workload to approximately equal what it was before implementation.

If an implementation fails, it usually happens somewhere between Times 2 and 3. Leonard [23] claims that failure often originates from people within the organization

resilient to change, as explained in the following quote:

> *What normally happens is that, before the new system has been implemented, they preach about how bad things will be. Then, once implementation begins and the workload increases (which we know it must), they point to this as evidence that the system cannot work. [...] If these "resistors" have any power whatsoever, the system will be shut down before one ever reaches Time 4.*

Leonard [23] argues that the only way to combat this "attack" from resistors is to find "early adopters" i.e. people who like technology, embrace change, and are not afraid of making mistakes. Every successful implementation has had early adopters or other supporters to ensure that the implementation reaches Time 4. [23]

3.2.1 Change management

Change management could be described as going on a journey from one position to another. Before going on the journey, the purpose of the journey, the route, and the participants of the journey need to be addressed. Change management is essentially about handling the complexities of change, including planning, executing, and evaluating mentioned changes [24].

In the article *Critical Success Factors Relating to Healthcare's Adoption of new Technology: A Guide to Increasing the Likelihood of Successful Implementation* [23], change management in healthcare is exemplified with a story from an implementation of x-ray images in the mid-1990s:

> *In a large academic health science centre around the mid-1990s, the diagnostic imaging department was going through the final stages of the conversion to a completely film-less radiology process – in other words, moving to electronic images of x-rays and the like. During this conversion, the doctors were notified that their patients' x-ray results were ready, and they were then sent their patients' images by e-mails. By late morning of the first day of the transition, many doctors complained that they had yet to receive their patients' x-ray results. Apparently, the doctors did not check their e-mails.*
>
> *In an effort to ensure the success of the conversion, the imaging department then began to send the doctors the radiology results on a computer diskette or compact discs (CD-ROM, depending on the size of the file). Unfortunately, the doctors still continued to complain about the tardiness of the results. Even though they received the diskettes and CDs in a timely manner, they could not*

> *match the arrival of these hardware supplies to their own information needs. This is not to say that the physicians were not computer-literate; rather, they were inexperienced at identifying the connection between CDs and patient x-rays. So the imaging department hit upon a great idea: it continued to use the CDs but now sent them to the doctors via internal hospital delivery system in the traditional large x-ray envelopes. Recognizing the envelopes, the doctors opened them immediately, placed the CDs in their computers and started reviewing the results.*

In summarizing the key takeaways from the story, Leonard [23] concludes that although people despise change, those who do not adjust their work patterns to adapt to changes begin to fail. Conversely, people who succeed are those who accept changes and understand that the old ways of doing things will not work with new systems.

3.2.2 Successful implementation

Cohen [2] suggests that e-health intervention outcomes can be categorized into three categories shown in Table 3.1.

Table 3.1: Categorization of outcomes of e-health interventions (Cohen [2])

Category	Description
Success	Most of the stakeholders attain their major goals and they do not experience significant undesirable outcomes.
Partial failure	Major goals are not attained or there are significant undesirable outcomes, such as the system being implemented well behind schedule or at significantly greater cost than originally estimated.
Total failure	A system is never implemented or is implemented and rapidly abandoned.

Another relevant question is what ”successful” implementation means. There are examples in research where implementations met the organizational criteria of success but where the implementation did not function well in practice [8]. Cohen [2], mentions that there is evidence that approximately 40% of new IT systems meet some of their objectives and only 20% can be regarded as complete successes. Even though the amount of research evaluating the implementation of e-health systems is growing, the majority have ambiguous outcomes and just a few of them describe important

successes. This has in turn led to an increasing amount of systematic reviews describing ”barriers” and ”facilitators”, i.e factors which affect the implementation. Even though these reviews give some insight into what factors influence, the underlying mechanisms have not yet been well explained [20].

There have been efforts to create evaluation software where users answered questions regarding outcomes of the implementation on a scale of 0 - 10. A report was then generated based on the answers which indicated the success of an implementation [25]. Unfortunately, the program is no longer available, which made a further investigation of the specific questions impossible.

In their literature review, Lapointe et al. [26] identify three main themes of the impact of implementing e-health technology: (i) the impact on quality of care; (ii) impact on costs and efficiency; and (iii) impact on professionals' tasks and roles. However, despite an increase in research and investments, the evidence of the actual impacts of e-health is still inconclusive [26].

One reason why it is hard to prove the actual impact of e-health is the so-called *productivity paradox theory*. Even though it is a known observation within other business areas, in healthcare research, there are very few published articles using this theory. The theory consists of four domains: (i) measurement errors; (ii) time lag; (iii) redistribution of profit; and (iv) mismanagement of technology [26].

Measurement errors often relate to input and output not being properly measured, often due to poorly selected variables. In terms of input, the measure should be as wide as possible and include e.g. human resources, equipment, invested money, and change management. Faults in outputs are usually an insufficient number of variables only providing a limited view of reality. Time lag is often a neglected aspect of evaluating e-health impacts. Time lag is the time from investment in e-health to the gains from that e-health in the workflow is measurable. There are two factors most likely responsible for the time lag effect. The first factor is the delay in technology adoption, similar to the technology adoption curve in Fig. 3.2 as suggested by Leonard [23]. The second factor is that evaluation is done too soon after e-health implementations, before any real impacts can be measured. Again, parallels can be drawn to the technology adoption curve, where this would mean that evaluations are often performed before implementation reaches Time 6 and 7. The redistribution of profit refers to profits associated with investments being redistributed within the organization and therefore not necessarily being measured in the evaluation. Mismanagement of technology could be the result of poor management or poor implementation of e-health. In addition, since studies of e-health implementations often fail to associate findings

of quality of care or costs with the usage of technology within the organization, it is difficult to comprehend if impact, or the absence of it, originates from non-utilization or inappropriate utilization of e-health [26].

Lapoint et al. [26] suggest that an assessment of the impact of an e-health intervention requires the following: (i) identifying, accounting for, and accurately measuring a wide range of impacts (beneficial/adverse, expected/unforeseen effects); (ii) considering the context of implementation; (iii) adopting a multi-level perspective (individual, group, and organization); and (iv) taking into account the various stakeholders' perspectives (managers, health professionals, and patients) [26].

Cohen [2] argues that however success is defined, the perceived success or failure of e-health systems depends at least as much on social factors (such as culture, attitudes, and group norms) as on technical factors.

3.3 Evaluation of implementation

In research on the evaluation of e-health systems, some authors claim that it is impossible to make definitive statements regarding the connections or causes between input and output variables. It is also argued that e-health projects often have multiple goals that change over time, making the connection between process and outcome hard to interpret. Methods used to evaluate other medical products like medication, such as randomised controlled trials, are not as well-suited to evaluation of e-health systems, since they do not consider the contextual factors enough [2].

Instead of thinking of implementation as a technical problem solved with technical solutions, it is more reasonable to think of the clinical workspace as a complex socio-technical system, where people, organizational processes, and technology all interact. Since the social and technical elements are deeply connected, good implementation is one where both the social and technical elements are optimized simultaneously [2].

3.3.1 Frameworks for evaluation of implementation

Implementation is a complex process that is hard to execute. Gruber et al. [27] argue that there is no single way of implementing that works in all situations. The complexity is probably one of the main reasons why there are ongoing debates on what theoretical frameworks should be used to understand implementation processes [8]. Murray et al. [8] and Mair et al. [20] both use the Normalization Process Theory (NPT) framework to understand the factors that influence the implementation of e-

health. Gruber et al. [27] use the Expanded Systems Life Cycle (ESLC) framework, which aims to illustrate the full cycle of implementation divided into five steps: (i) planning, (ii) analysis, (iii) design, (iv) implementation, and (v) maintenance. Kilsdonk et al. [28] instead use the HOT-fit Evaluation Framework which incorporates the concept of fit between Human, Organization, and Technology. Hage et al. [29] use Pettigrew and Whipp's model of strategic management which divides the factors into three interactive elements: (i) context, (ii) process, and (iii) content.

This thesis, however, applied the Consolidated Framework for Implementation Research (CFIR) used by Ross et al. [9] in their systematic review of systematic reviews. The aim of the systematic review was to

> *provide a synthesis of the implementation of e-health literature that both acknowledges the multi-level complexity of implementation and also provides a framework for thinking about implementation in a way that is accessible and useful for those planning implementation such as health service managers, healthcare professionals and researchers.*

Of the above mentioned frameworks, the research by Ross et al., using CFIR, was deemed to be most in line with the planned method of this thesis. Thus, CFIR was estimated to be an appropriate framework for the scope of this thesis.

3.3.2 The Consolidated Framework for Implementation Research

The Consolidated Framework for Implementation Research (CFIR) is a "meta-theoretical" framework first published by Damschroder et al. [18] in 2009 which includes constructs from several existing theories. The constructs within each domain are believed to influence implementation positively or negatively; however, the interaction between the constructs is not taken into account. The purpose of the framework is to improve implementation science by providing consistent terminology and definitions. It consists of constructs partly to allow researchers to select the relevant constructs for each specific study. This enables the researcher to perform formative evaluations of health service implementations to more easily find out what works where and why [18].

CFIR consists of five domains: (i) the intervention characteristics, (ii) the outer setting, (iii) the inner setting, (iv) the characteristics of individuals, and (v) the process [18]. Each domain consists of constructs which in turn can have sub-constructs. A summary of CFIR is presented in Table 3.2.

Table 3.2: Summary of the Consolidated Framework for Implementation Research (Damschroder et al. [18])

CFIR domain 1 Intervention characteristics: key attributes of the intervention.		
CFIR construct	**CFIR sub-construct**	**Explanation**
Intervention source		Perception of key stakeholders about whether the intervention is externally or internally developed.
Evidence strength and quality		Stakeholders' perceptions of the quality and validity of evidence of the desired outcome.
Relative advantage		Perceptions of the advantage compared to alternative solutions.
Adaptability		The degree to which the intervention could be adapted to meet local needs.
Trialability		Ability to test the intervention on a small scale within the organization.
Complexity		Perceived difficulty of implementation and the need of significant reorientation and non-routine processes.
Design quality and packaging		Perceived excellence of the presentation and assembly of the intervention.
Cost		Costs of the intervention and costs associated with the implementation.
CFIR domain 2 Outer setting: economic, political and social context within which an organization resides.		
CFIR construct	**CFIR sub-construct**	**Explanation**
Patient needs and resources		The extent to which patient needs and barriers are known and prioritized by the organization.
Cosmopolitanism		How much an organization is networked with other external organizations.
Peer pressure		Mimetic or competitive pressure to implement and intervention.
External policies and incentives		External strategies to spread interventions.
CFIR domain 3 Inner setting: structural, political and cultural contexts through which the implementation process will proceed.		
CFIR construct	**CFIR sub-construct**	**Explanation**
Structural characteristics		Social architecture, age, maturity and size of an organization.

Table 3.2: Summary of the Consolidated Framework for Implementation Research (continued)

Networks and communications		Social networks and formal and informal communications within an organization.
Culture		Norms, values and basic assumptions of the organization.
Implementation climate		The capacity for change of involved individuals.
	Tension for change	The degree to which stakeholders perceive the current situation as intolerable or needing change.
	Compatibility	The perception of alignment between the meaning of intervention and the meaning communicated by the management.
	Relative priority	The importance of the implementation within the organization.
	Organizational incentives and rewards	Goal-sharing awards, performance reviews, promotions and raises in salary.
	Goals and feedback	Communicated goals, acted upon, and fed back to staff.
	Learning climate	A climate where leaders express their fallibility and need for staff assistance and input.
	Readiness for implementation	Indicators of organizational commitment to the implementation.
	Leadership engagement	Commitment, involvement and accountability of leaders and managers.
	Available resources	Level of resources dedicated to implementation including money, training, education, physical space, and time.
	Access to information and knowledge	Ease of access to information and knowledge about the intervention.

CFIR domain 4

Characteristics of individuals: individuals involved with the implementation and/or intervention.

CFIR construct	**CFIR sub-construct**	**Explanation**
Knowledge and beliefs about the intervention		Attitudes toward the intervention and familiarity with facts, truths, and principles.
Self-efficacy		Individual belief in own capability to execute actions in implementation.
Individual stage of change		What phase an individual is in in the process towards full use of the intervention.
Individual identification with organization		Perception of the organization and the individual's relationship to the organization.

Table 3.2: Summary of the Consolidated Framework for Implementation Research (continued)

Other personal attributes		To include the things left out by earlier constructs.
	CFIR domain 5 Process: activities in the implementation process.	
CFIR construct	**CFIR sub-construct**	**Explanation**
Planning		Method or scheme of tasks during the implementation process and how well these are developed before implementation.
Engaging		Involving appropriate individuals in the implementation through social marketing, education, training, etc.
	Opinion leaders	Individuals with a formal or informal influence on colleagues.
	Formally appointed internal implementation leaders	Coordinators, project managers, team leaders or similar.
	Champions	Individuals who dedicate themselves to supporting and driving implementation.
	External change agents	Individuals in an outside entity who influence the intervention decisions in a desirable direction.
Executing		Implementing according to plan.
Reflecting and evaluating		Quantitative and qualitative feedback about progress and quality of implementation.

Chapter 4
Empirical Data

In this chapter, the empirical data are presented. Firstly, the prerequisites and planning of the implementation are presented involving the following: (i) project goals; (ii) the implementation process; (iii) recommendations for a successful workflow; and (iv) intervention characteristics. Secondly, the PCUs are presented. Lastly, the healthcare organization's evaluation report is summarized and presented.

4.1 Planning and prerequisites

Preparation before actual implementation at each PCU consisted of planning for the implementation process, creating recommendations for workflow, technical adaptations, etc. The preparation work was a united effort by the e-health company and the healthcare organization.

4.1.1 Project goals

To evaluate the pilot, project goals were determined. There were 11 different parameters to evaluate, which are presented in Table 5.1. All parameters were in some way supposed to be evaluated by recording baseline data before the implementation. The recorded parameters were then planned to be recorded during and/or after the pilot to be able to compare the parameters. Some parameters were quantitative and some were qualitative.

Quantitative parameters were measured by each PCU separately. The measurements were reported through an Excel document sent out by the healthcare organization in November 2018 and the deadline for return was 15 February 2019. The project goal reporting document, hereafter called PGR document, was structured to try to receive as comparable and uniform measurements as possible. However, not all measurements reported by the PCU could be related to one specific project goal. Further-

more, some requested measurements assumed one way of workflow which had limited or no applicability to some PCUs. The measurements in the PGR document mostly focused on the number of patients being assessed per day by doctors. However, the number of patients being assessed at the drop-in reception was also measured, if the PCU had a drop-in reception. Also, the nurses' administration time was measured manually over two days recorded in the PGR document. According the information found during the writing of this thesis, the PGR document was only sent out to the PCUs before the pilot – therefore, the only other quantitative data used for comparing with the baseline data were the user data generated by the e-health system.

Quantitative parameters that were planned to be measured before the pilot were never measured. However, quantitative data were gathered after the pilot via surveys and interviews, the results of which are presented in section 4.3.

Table 4.1: Project goals

ID	Parameter	How is the parameter measured
G1	More consultations ended by a nurse[1]	Through statistics in the current booking system
G2	Increase in number of consulted patients with the same staffing	Through the current booking system
G3	Decrease in average administration time	With and without tools
G4	Decreased dictation time	Manual measurement
G5	Quicker assessment of patients visiting drop-in reception	Measuring patient visit times before and after
G6	Increase in patients' perception of the quality of care	Measure patients' perception of the given care before and after
G7	Increased benefits for the staff, e.g. easier patient visits, standardized documentation, more time for assessment, and less time spent on administrative work	Measure and qualitatively review these parameters before and after the project.
G8	Being able to book doctor's appointment for new patients within three days	Measure and qualitatively review these parameters before and after the project.
G9	An increase of acute patients being assessed (receiving an appointment) the same day	Measure and qualitatively review these parameters before and after the project.
G10	Decrease the time for subacute patients to receive an appointment	Measure and qualitatively review these parameters before and after the project.

[1] A consultation ended by a nurse in this case means that the patient never needs to see the doctor for that active visit.

4.1.2 The implementation process

Information regarding the planned implementation process was sent out to all PCUs in November 2018. The information was sent as a document including the different activities in the implementation process, recommendations for workflow, and frequently asked questions. The initially planned activities of the implementation process are presented in Table 4.2.

Table 4.2: Planned implementation process sent out to PCUs in November 2018

Activity	Location	Duration	When (in relation to Go-Live)
Introductory Meeting	At PCU	One hour	Three to four months before
Premises and Workflow Analysis (PWA)	At PCU	One hour	Three to four months before
Superuser Education	Central	Full day	One month to one week before
Go-Live Education	At PCU	Half day	As close to Go-Live as possible
Go-Live (start using the e-health system)	At PCU	Half day	
Booked visits Education	Online	One hour	One month after

The public procurement was won by the e-health company in September 2018. A few days later, an appeal was sent in by a competitor to overturn the procurement decision. While the appeal was being tried, some preparatory work was still performed, and the implementation (although not the use of the e-health system) was started on a limited scale. The appeal was overruled in February 2019, although by this time the initial implementation plan was heavily delayed, and in March the healthcare organization's project group sent information to all PCUs stating that as the project had been very delayed, the project plan needed to be updated. At this time, the implementation process had already been started and all Introductory Meetings and Premises and Workflow Analyses had already been held. In the information sent, it was stated that because of the delays PCUs would probably need to go live first during the summer. To avoid Go-Live during the summer, when the majority of PCUs staff members are on vacation, it was decided that one PCU would be started before the summer and that the rest would go live after the summer. Since the already drawn-out implementation process now would be even longer, a workshop was added as an additional activity.

The implementation process in terms of the different activities leading up to Go-Live was more or less the same for each PCU. However, it was decided by the healthcare organization that each PCU got to decide how they wanted to use the system when it was live. During the implementation process, each PCU got recommendations re-

garding workflows and routines, but the final workflow was entirely up to the PCU. The reason for this decision was that this would enable comparison between different workflows, which was one of the purposes of the pilot. The final implementation process is presented in Table 4.3.

Table 4.3: The final implementation process

Activity	Location	Duration	When
Introductory Meeting	At PCU	One hour	Nov-Dec, 2018
Premises and Workflow Analysis 1	At PCU	One hour	Nov-Dec, 2018
Workshop	At PCU	Half day	May, 2019
Premises and Workflow Analysis 2	At PCU	2-3 hours	Jun-Jul, 2019
Go-Live Education	At PCU	Half day	May-Sep, 2019
Go-Live	At PCU	1-2 full days	May-Sep, 2019
On-site Support	At PCU	Varying hours per PCU	May-Dec, 2019
Booked Visits Education[1]	On-site	One hour	Dec. 2019

Introductory Meeting
An introduction was held at each PCU, where the e-health company and the healthcare organization's project group presented the project and the system for all staff members. The project was usually presented by representatives of the healthcare organization's project group, and the system was introduced by representatives from the e-health company. During the presentation, PCU staff members were able to ask questions.

Premises and Workflow Analysis
Following the Introductory Meeting, the e-health company and the healthcare organization's project group conducted a Premises and Workflow Analysis (PWA). This activity was first performed during November to December 2018. However, because of the delay in the project plan, it was decided that an additional PWA was conducted by the e-health company representatives. The arrangement was similar; however, the second PWA lasted longer and was more in-depth than the first PWA. The PWA consisted of three events: (i) an interview with the management, (ii) a premises walk-through with the management, and (iii) interviews with PCU staff members.

The interview with the management was both quantitative and qualitative. The quantitative parts brought up topics like staffing, number of incoming phone calls, etc. The qualitative parts handled topics like the current workflow, planned workflow when using the e-health system, and expectations and concerns regarding the implementa-

[1] The booked visits were only implemented at one of the PCUs in the pilot

tion. The purpose of the PWA walk-through was to support the PCU management in deciding on new workflows and routines.

After the interview, all participants walked through the key areas of the premises, e.g. waiting room, front desk, examination rooms, etc. For each area, it was discussed where hardware and information material should be placed to provide the best service for the patients using the e-health system at the PCU.

In the last step of the PWA, interviews were held with PCU staff members. These were in many ways similar to the quantitative part of the management interview. The purpose of staff member interviews was to get a sense of the staff members' knowledge and attitudes towards the project as a whole. The results of the staff interviews, such as communication between management and staff and the attitudes and opinions of individual staff members, could give indications about the readiness of implementation at the PCU.

Documentation was recorded throughout the PWA by the e-health company. After the PWA, a report was created and sent to the healthcare organization and the individual PCU. The PWA report was formatted as a PowerPoint presentation, summarizing the topics discussed during the PWA. The external report also contained recommendations of workflow in the form of patient journey maps and images with the suggested placement of hardware and information material. An extract from a PWA report is shown in Fig. 4.1.

Superuser Education
The purpose of the Superuser Education was to educate staff members from each PCU to become local experts in the system. They would act as the first line of support for colleagues with questions about the system. However, even though the activity was planned in the initial project plan (seen in Table 4.2), it was never executed.

In emails sent to the PCUs in May 2019, the Superuser Education was still planned to be conducted before Go-Live, and the exact dates for the Superuser Education were to be sent out later. However, this is the last time the author of this thesis has found any information regarding Superuser Education. It is determined that, although material for a Superuser Education was prepared, the healthcare organization never sent an invitation to the PCUs for such an educational session. Hence, no Superuser Education was held during the pilot.

Workshop
Prior to Go-Live at the first PCU, a workshop was held by the e-health company.

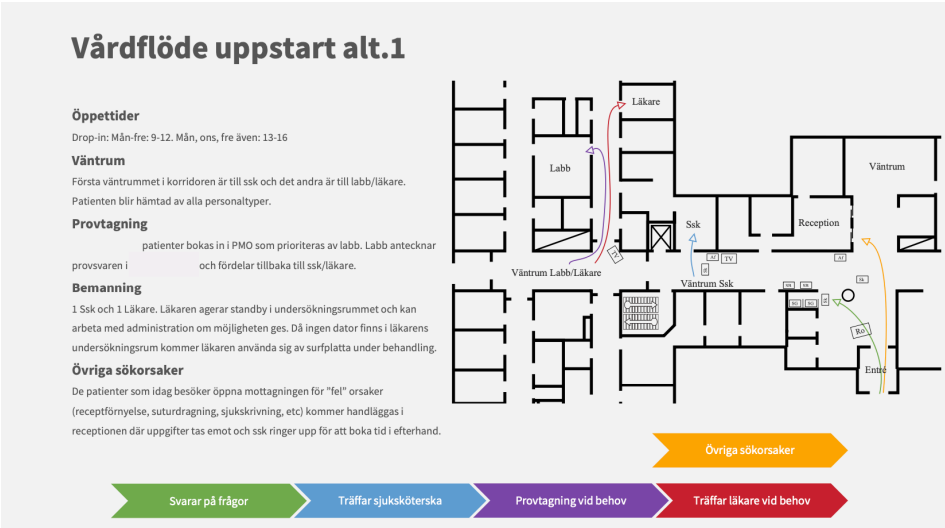

Figure 4.1: Extract from a PWA report showing recommendations for workflow

The workshop was not a part of the initial implementation plan, but was added as an activity before the summer, since the delay caused by the appeal created an opening in the project plan. The purpose of the workshop was to give the PCU staff an extra opportunity to test the system. The workshop entailed representatives from the e-health company visiting the PCU for a few hours. Several tablets were set up in an open space that was restricted to staff members e.g. the lunch room. Any interested staff members were welcome to try the system with the assistance of the e-health company representatives. Even though the workshop was only planned for the first PCU, the project group subsequently decided that it should be added to the implementation process for all PCUs.

Go-Live Education

The day before Go-Live, representatives from the e-health company held an educational session on the PCU. It lasted 3 hours and was divided into two parts: First, a presentation of the system was held. Second, the PCU staff members were allowed to try the system on tablets brought by the e-health company.

Go-Live

At Go-Live, the system was used live for the first time at the PCU. To support the staff members, the e-health company employees were present on-site. According to the plan, the e-health company representatives were intended to be on-site at least

during the Go-Live day, with the option of the day after as well, if the PCU staff required additional support after the Go-Live day.

On-site Support
Even though the plan involved the e-health company being on-site one to two days during Go-Live, the number of days supporting on-site became much more than that. The amount of on-site support per PCU varied depending on the PCU.

4.1.3 Recommendations for successful workflow

In May 2019, the reports from PWA 1 were sent to each PCU. The reports contained specific recommendations about the workflow for each PCU, in addition to general recommendations. In June 2019, an email was sent to all PCUs with general recommendations on workflow and implementation. The recommendations focused on leadership and change management. These recommendations are presented in Table 4.4. There were also workflow recommendations for each role at the PCU, including step-by-step instructions of consultation with the system. The details of the ”role-specific” workflow recommendations exceed the depth of workflow presented in the thesis; hence, they are not presented.

Table 4.4: Recommendations for a successful implementation

Recommendations for successful change management
All staff members that will use the system should be trained.
The staff members with the most interest in the implementation should use the system during the first days.
It is recommended to start with a few staff members who, in turn, can support and guide colleagues.
It is strongly recommended that the manager is present during the starting period.
Support and regular check-ins with staff members are important. A check-in before and after every work shift will enable staff members to reflect on and evaluate the use of the system.
Close collaboration and good communication within the team are important for a successful implementation.
Try make staff members aware that adopting new workflows is a journey requiring patience and that ups and downs are a natural part of the adoption.
The implementation is facilitated by routines established among the staff members.
During the starting period, be especially aware of patients who need support in the waiting room.
Recommendations for a successful workflow
Initially, it is recommended that one nurse and one doctor staff the the e-health system reception, only assessing unplanned visits.
It is recommended that the e-health system reception is open each morning between 08:30 and 11:00.
It is recommended that patients calling to the PCU do not receive a booked appointment; instead, they are referred to the drop-in reception.
It is recommended that the nurse in the telephone triage refer the patient to the drop-in reception, thus transferring the patient flow and workload from the telephone triage to the e-health system.

4.1.4 Intervention characteristics

The first domain of CFIR explains the intervention characteristics. The content of this section is based on the interviews with the e-health company employees and from documents such as meeting notes and field documents from activities conducted during the implementation process.

Intervention source
The general opinion of the interviewees was that stakeholders within the project knew that the e-health company was the manufacturer of the e-health system. Within the the healthcare organization's project group, there was no doubt since the system was purchased through public procurement. However, there were a small amount of PCU

staff members that did not know which company developed the system. However, basically everyone understood that the healthcare organization had not developed the system.

Evidence strength and quality
The interviewees claimed that the healthcare organization project group and other stakeholders within the healthcare organization believed that the system was of high quality. During the implementation process, the system was presented at Introductory Meetings, and at these meetings, the overall opinion was positive towards the system. When the system was live the opinion varied more, even though the overall opinion still was mostly positive. A factor that potentially affected the perceived quality of the system was the change management, as indicated by an interviewee:

> *[...] difficulties in change management, such as changes in workflows, the transition to drop-in receptions, and staff members not being adequately trained made a negative impression on the system itself.*

Adaptability
The system was highly adaptable during the implementation. The system was updated once a week, meaning that changes to the system could be made available very quickly. New features or changes to existing features were developed based on feedback from individual users as well as requests from the healthcare organization's project group. However, many requests from the healthcare organization came from feedback from the PCUs. Most of the changes and improvements were overarching for all PCUs and were made available for all PCUs. However, quite a few changes were made for individual PCUs as well. The most prominent example of this is PCU-D, where the system was entirely adapted to their infection reception[1] and the unique workflows of that reception.

Trialability
The e-health system had an educational environment that is built to be as similar to the real system as possible. This enabled users to try the entire system without the risk of exposing real patient data. The educational environment was used on several occasions throughout the implementation process, for instance during the Workshops and the Go-Live Education.

Complexity
The system required various amount of reorientation and non-routine processes based on how the individual PCU used the system. Though even for the PCUs doing the

[1] A reception only for patients with symptoms of infectious diseases, like cough, sore throat, etc.

least amount of reorientation, a large amount of change management was still needed since the system enables an entirely new way of consulting patients. All PCUs needed to make adjustments to workflow whether they wanted to or not, and this was one of the biggest concerns with the entire implementation, as discussed by one interviewee:

> *[...] the PCUs chose what changes to do in the workflow. Some chose to adapt and some did not want to adapt. We came with recommendations, but in the end, it was the PCU and the healthcare organization who decided how the system was used.*

Design quality and packaging
The majority of the staff thought the system was well assembled and easy to use. However, opinions were divided, and some people thought the system was difficult to use. The staff members' perception of the ease of using the system was investigated by the healthcare organization in their evaluation, the results of which are seen in section 4.3.

4.2 The primary care units

Ten PCUs participated in the pilot: eight healthcare centers, one emergency center, and one fully digital healthcare center. The PCUs had been picked to represent the diversity amongst PCUs in aspects such as size, patient demography, and workflows.

A summary of the PCUs is presented in Table 4.5. Here key information about the PCU before the implementation is presented. The data originate from activities conducted early in the implementation process. The PCUs are sorted chronologically by Go-Live week.

There are some missing data in the table. In the case of PCU-B, the reason is that PCU-B did not exist before the implementation – it was a fully digital PCU, created solely to use the e-health system in a digital workflow. However, there are also some missing data regarding the number of employed doctors and nurses. The reason for missing data was either because the PCU never reported the data or that the reported data was wrong. One probable cause of the wrongly reported data is that almost every PCU had a substantial number of part-time employees; therefore, some PCUs reported the number of full-time employees, and some reported Full-Time Equivalents (FTE)[1].

[1]The Full-Time Equivalent is the sum of part-time and full-time employees, represented only as full-time employees.

It is clear when comparing the drop-in workflows of each PCU, that there were big variations in the different workflows. Some PCUs did not even have drop-in receptions. The number of open hours per week stretches from 0 to 45, and the number of patient visits per week could be as low as 20 and as high as 1 125. Since a drop-in reception or telephone are usually the two main contact ways for new patients seeking care in primary care, the number of phone calls could be an interesting parameter. Another interesting parameter were the amount of drop-in patients that needed assessment by both the nurse and doctor. A few PCUs therefore reported the approximate amount of patient visits that were ended by a nurse.

What can be interpreted as strange is that even though some PCUs did not have drop-in receptions, they still had drop-in patient visits. In these cases, the PCU did not announce a drop-in reception publicly to patients. However, some patients still came unannounced to the PCU, and these visits were then counted as a drop-in patient visits in this summary.

Table 4.5: Summary of the PCUs before implementation

PCU	A	B[1]	C	D	E[2]	F	G	H	I	J
Go-Live week (2019)	22	26	32	34	35	36	37	38	38	39
Registered patients	14,200	n/a	11,600	11,400	0	9,500	4,200	14,200	10,400	8,800
Employed doctors	n/a	n/a	18	12	0[3]	13	3	18	n/a	7
FTE[4]doctors	11,24	n/a	n/a	11,5	n/a	7,25	n/a	n/a	n/a	7
Employed nurses	n/a	n/a	10	8	20	11	3	20	n/a	7
FTE[4]nurses	10	n/a	n/a	7,2	10[5]	8,9	3	n/a	n/a	5,5
Drop-in reception	Yes	n/a	No	Yes	Yes	Yes	No	Yes	Yes	No
Opening hours (weekdays /weekends)[6]	M/C	n/a	M/C	M/C	E/F	F/C	C/C	M+3A/C	M/C	M/C
Sum of drop-in hours per week	7,5	n/a	20[7]	7,5	45	45	0	24	12,5	20[7]
Drop-in staffed by (nurses/doctors)	2-3/2-3	n/a	1[8]/ 0[9]	2/1	8-10/4-5	1[10]/2[10]	0[11]/ 0	1-2/0[9]	2/3-5	1/0[9]
Estimated number of drop-in visits/week	50-200	n/a	75	75-150	1 125	50	20[11]	145	150	60
Estimated visits ended by nurse	n/a	n/a	n/a	50%	25%	n/a	n/a	n/a	33%	n/a
Phone calls per week	800	n/a	830	1 000	575	700	300	850	n/a	700

[1] A fully digital PCU, established solely to use with the e-health system. Hence, no data prior to implementation exist.
[2] An emergency center with purpose of consulting patients during hours when the regular PCUs are not open.
[3] The emergency center is staffed by doctors employed at other PCUs, on a rotating schedule.
[4] The Full-Time Equivalent is the sum of part-time and full-time employees, represented only as full-time employees.
[5] For PCU-E, the Full Time Equivalent represents the number of nurses working each shift
[6] M: Mornings; C: Closed; E: Evenings; F: Full day; A: Afternoons
[7] Does not announce a drop-in reception to patients, but still performs triage on unannounced patients coming to the PCU during the day.
[8] A nurse sitting at the front desk performed initial triage. The patient was either sent home or booked to a nurse or doctor.
[9] No doctor actively sitting in the drop-in reception. However, there were several free appointments each day reserved for drop-in patients.
[10] Because the drop-in reception had few patients, the staff working in the drop-in reception performed other tasks like telephone triage and administration when no drop-in patients were present.
[11] Even though there was no drop-in reception, unannounced patients came anyway. Unannounced patients were added to the same queue as if they would have called from home and were later assessed by the nurse performing telephone triage.

4.2.1 PCU-A

Structural characteristics
PCU-A was an urban health center with 14,200 registered patients. Before implementation, PCU-A had a drop-in reception open 1,5 hours each morning. The patients could seek care for almost anything. The drop-in reception was staffed by 2-3 nurses and 2-3 doctors each morning. Nurses started assessing patients at 8:30 and doctors at 9:00.

Implementation climate
In notes from the implementation, it was stated that the manager was enthusiastic and energetic. However, the manager was new on the job and was not fully aware of all internal routines yet. The manager was positive towards changes in workflow and had an expressed ambition to enable the nurses to finish more visits by themselves with help of the system.

From the interviews conducted with the e-health company employees, there was consensus that the management was engaged and committed to the implementation, but that they had a hard time engaging the staff members, as quoted by one interviewee:

> *The management was involved but had a hard time engaging the staff. There was something at the PCU which led to a bad climate. [...] The management wanted the implementation to succeed but were not able to engage the staff.*

Planning for the implementation process
PCU-A was the first PCU out and were planned to go live before the vacations in the summer. In March, the planned implementation process was updated due to the delays caused by the appeal. In this update, it was decided that PCU-A was going to start before all the other PCUs, that were planned to start after the summer. One of the reasons was that PCU-A could be used as a live example for the other PCUs to visit.

Executing the implementation process
Of the events described in Table 4.3 all events except PWA 2 was executed. However, the system was only used for three days until the PCU paused its participation in the pilot.

On the first day, it was obvious that the healthcare organization's preparations were not fully finished. Four identified problems were not prepared: (i) the personnel were not added as users in the system; (ii) the tablets were not properly configured; (iii) there was missing hardware such as tablet stands and waiting room screens; and (iv) there were technical issues that had not been resolved.

Regarding the technical issues that had not been resolved, there were problems with the healthcare organization's subcontractors being late in configuring the databases. This was discussed in correspondence between the e-health company and the healthcare organization after the first day:

> *In summary - it went as well as it could today, which is impressive considering that all the technical set-up was not ready yet and that the 5-week delay from the subcontractors led to us not being able to fully test the system [...]*

On the second day, 25 patients were consulted by two nurses and two doctors. Even though the number of patients was rather high considering a new workflow, there were several alarming details observed by the e-health company staff present on-site. The first problem was that PCU-A staff did not know the diagnosis codes being used in the system. As said in correspondence from the e-health company to the healthcare organization project group:

> *Here we need clear communication that the primary care within the healthcare organization has decided and communicated that it is ICD-10 that is being used. If you want we can of course use KSH97-P instead, but my recollection tells me that we decided on ICD-10.*

Another problem observed was the missing hardware and information material. The healthcare organization's information material was not finished in time. Thus, there was no information about the system presented to the patient in the waiting room. Furthermore, the tablets, which were used by the patient, did not have a stand to be placed in. In addition to this, the tablets were not configured correctly, leading to the tablet screens turning off after some time, making it impossible for patients to use.

In total 61 patients were consulted at PCU-A before the project was stopped. During the three days live, there were three nurses, two doctors, two lab personnel, and four secretaries that had worked in the system. Still, several of these staff members that had not participated in the Go-Live Education, which was mentioned correspondence between the e-health company and the healthcare organization project group after the first day of implementation:

> *Unfortunately we will need to pause after Wednesday to wait for the rest of the staff members to be trained since they did not participate at the decided-upon education date.*

Two days after the implementation was paused, the e-health company and the healthcare organization's project group held a meeting to evaluate and discuss the three first

days of the e-health system being used live. During this meeting, several actions were decided for the coming implementations, to avoid similar problems. The decisions resulted in new checklists and recommendations being sent out to the remaining PCUs during the summer.

4.2.2 PCU-B

Structural characteristics
PCU-B was a wholly new type of PCU, which was created based on the e-health system. The PCU was fully digital, which meant consultations were never face-to-face. Instead, patients were only assessed via chat. Because of this, PCU-B was not bound to any physical premises. Rather, the PCU was staffed by personnel from other PCUs in the healthcare organization, and the staff often worked from their ”home” PCU.

Implementation climate
A manager and team leader were appointed and created new routines from scratch. Since there were no previous workflows to take into account, it was more or less a clean slate where routines were adapted based on the best way of working with the e-health system. The new management was both engaged and committed to the implementation, and the new PCU received the necessary resources.

Planning for the implementation process
Since PCU-B only had the e-health system workflow to take into consideration and because it was started on a small scale, it was possible to start during the summer.

PCU-B did not share the same implementation process as the rest of the PCUs and did not follow the plan presented in Table 4.2. This was reasonable since many activities were not relevant for a newly started PCU. The only activity planned before going live was that the personnel would be trained before using the e-health system.

Executing the implementation process
The first training session included the limited number of initial users of the system. The system was at first used on a smaller scale with patients with a limited number of complaints being able to seek care online. Since the idea was to be able to assess patients from their homes, the patient complaints were limited to the types of symptoms that usually is appropriate to treat from the home, e.g. skin problems, cough, and renewal of prescriptions.

The first training sessions were held by the e-health company, for new users. Eventually, the training was instead held internally by the management, who by this point

had been working in the system enough to feel comfortable to teach it themselves. In a sense, the members of management became unofficial superusers of the system.

Another big difference in workflows compared to the usual way of consulting patients was that the PCU-B assessments were via asynchronous chat, meaning patients did not need to sit and wait for the healthcare professionals. The patients were notified when the healthcare professional had answered, and the patients could reply at any time. This also had the advantage of healthcare professionals being able to assess several patients at the same time.

Another thing that separates PCU-B from the other PCUs was the absence of onsite support. The personnel had a phone number to the e-health company's support, but otherwise, the personnel learned to use the system mostly by themselves or via internal education. In total, PCU-B completed 2602 visits, which was most of all PCUs.

4.2.3 PCU-C

Structural characteristics
PCU-C was a health center in the outskirts of a medium-sized city with 11,600 registered patients. Before implementation, PCU-C had a "partial" drop-in reception. This means that they did not announce that they had a drop-in reception to their patients, yet, for 4 hours a day, a nurse sitting at the front desk triaged patients coming unannounced to the PCU. After being triaged by the nurse, the patients were either sent home or received a booked appointment with a nurse or a doctor who had time slots reserved for this kind of patients. These time slots were also available for patients calling in. Approximately 10 patients per day were booked from the front desk and 10 patients were booked via telephone triage.

Implementation climate
During the PWA the management gauged that the majority of employees were positive towards the project. A few staff members were skeptical about using the system. The main concern was transitioning to a drop-in workflow. The concerns were valid since the PCU had previously had a drop-in reception where up to 60 patients per day was not unusual; this led to bad working conditions and stress for the staff. The concern was that the e-health system workflow would cause this to happen again.

During the interviews with the e-health company representatives, it was consensus that the implementation of the e-health system was of high priority within the PCU and that there was high engagement from the management, who in turn were also able

to engage the staff members. The management appointed an internal project group that had weekly meetings to discuss routines and change management. They did also introduced daily sync meetings, before and after the drop-in reception, in which the staff members that were going to use the system got the chance to discuss and evaluate the workflow. The PCU had appointed the deputy manager as an implementation leader within the PCU.

On-site representatives from the e-health company observed a few opinion leaders within the PCU. The opinion leaders were mainly doctors. The most vocal among these contributed to a more positive attitude towards the system. However, there were a few doctors that were more negative. The other staff members did not have as strong opinions, at least not in a way that was noticed by the e-health company's representatives.

Planning for the implementation process
At first, mostly unannounced patients coming to the PCU got the option of registering in the e-health system. Since there was no open drop-in reception, this limited the number of patients seeking care initially. After a while, the e-health system was incorporated into the existing "partial" drop-in reception. This meant that most patients instead were booked via the telephone triage. This led to the telephone triage nurses gaining better control over the intervals between patient visits. The patients received booked appointments but were told to come in a bit early to register in the e-health system before the visit.

Executing the implementation process
During the first week of live usage, the PCU created a document with local routines that was sent to the e-health company for feedback. In the document, details regarding the entire workflow were stated, specifically adapted to PCU-C. The document mentioned e.g. what symptoms they limited the patients to, how measurements and tests were managed, and when the daily sync was and what should be discussed during it.

In meeting notes from October, the e-health company representatives reported the following status from On-site Support: (i) Good leadership; (ii) want to continue only directing patients from telephone triage with limited causes of visits; (iii) want to feel comfortable using the system before expanding – however, they are becoming more positive to expanding; and (iv) good collaboration between nurses and doctors.

In the meeting notes is was also stated that the manager was satisfied and thought that the new workflow worked well. The manager also believed that the limited num-

ber of patient symptoms was one of the main reasons why the implementation had worked out so well. PCU-C registered 1208 finished patient visits throughout the pilot.

4.2.4 PCU-D

Structural characteristics
PCU-D was a medium-sized healthcare center with 11,400 registered patients, located in a village. Before implementation, PCU-D had a drop-in reception open 1.5 hours each morning where patients were able to seek care for nearly anything. What was unique about PCU-D's drop-in reception was the high percentage of patients seeking care for complaints which are usually treated by a specialist nurse at a booked appointment, e.g. measuring blood pressure, wound dressing, and removing stitches.

When arriving at the premises, the patient did not need to register at the front desk. Instead, the patient collected a queue ticket and was subsequently called in by a nurse. The drop-in reception was staffed by two nurses and one doctor. The nurse always did initial triage. The management estimated that approximately 15 to 30 patients visited the drop-in reception each day and that about 50 percent of the patients also needed to see the doctor. Since the drop-in reception was located a quite far from the main entrance of the PCU, a reoccurring problem was that drop-in patients accidentally went to the front desk first. Since patients did not need to register at the front desk, patients were often frustrated when they had waited in the queue to the front desk, only to be immediately referred to the drop-in queue.

Implementation climate
The manager believed that the employees in general had a positive attitude towards the project. However, some of the doctors had raised questions about the medical evidence behind the decision support. They worried that if the staff was going to use the decision support a lot, the medical evidence behind the decision support needs to be updated continuously.

Management was disappointed with the communication regarding education. The management team stated that the communication was good at first, but as the implementation process progressed, information was delivered with very short notice, and there was some mixed information from the healthcare organization and the e-health company. The main concern was to fitting the training in the schedules, as it was decided that all employees were supposed to participate.

Planning for the implementation process

As many staff members as possible were intended to participate in training and use the e-health system from the start. 11-12 doctors rotated on the drop-in reception, and the drop-in reception was open for 1.5 hours per day which meant that each doctor was going to use the e-health system somewhere around 1,5 hours every other week. 7-8 nurses rotated in the drop-in reception, meaning that it was planned they were going to use the e-health system approximately 1,5 hours every week.

Executing the implementation process
Initially, two nurses and one doctor used the e-health system in the drop-in reception. The previous drop-in workflow was similar to the workflow recommended during the implementation. However, since the majority of patients visiting the drop-in reception did seek care for complaints that did not need any triage by the healthcare personnel, the system was not used to its full potential. Since one of the main features of the recommended workflow was to use the automatically compiled documentation as support for triage and assessment, this feature is not used if the patient only needs to e.g. remove stitches.

From the e-health company meeting notes in October, the following observations were reported: (i) There is a lack of management; (ii) problematic patient visits; (iii) problems with change management with the nurses and there is no support from the management – they feel abandoned; and (iv) there are problems with the WiFi-connection. From the meeting notes, following observations was also reported:

> *There is a negative trend among the staff and especially the management. They are satisfied with their old workflows and easily fall back into old habits when using the system. [...] It is hard to turn this negative trend around when management is not on board. They need to change their workflow, and to do that, we need the healthcare organization on our side.*

4.2.5 PCU-E

Structural characteristics
PCU-E was an emergency center located in a large city. The purpose of an emergency center is to treat patients in hours when their regular health center is closed. Therefore, the emergency center was only open on evenings and weekends, and it did not have any registered patients. The emergency center was open for four hours on weekday evenings and twelve hours on weekends. The emergency center mainly assessed drop-in patients and had a large geographical area to cover, which meant that the workflow was rather different from all other PCUs.

The emergency center workflow before using the e-health system most often started with patients coming spontaneously to the drop-in reception, although patients were able to call in for an initial assessment. If the nurse in the telephone triage decided that the patient needed to visit the emergency center for further assessment, the patient was referred to the drop-in reception without receiving a booked appointment. At the clinic, the patient was first assessed at the front desk. If further assessment was needed, the patient sat down in the waiting room and was later called in by a nurse. If the patient needed to see the doctor or take any lab tests, he or she again waited in the same waiting room. Another important difference to the other PCUs was that the emergency center did not employ any doctors; instead, doctors from other health centers staffed the emergency center on a rotating schedule.

Implementation climate
During the PWA, management mentioned that some parts of the workforce were not on board. They had concerns that the patient would not answer truthfully and therefore generate faulty documentation in the system. However, the management strongly believed that if the initial use of the e-health system showed good results, the attitude of the employees would change.

During conducted interviews with the e-health company employees, it was the general opinion that the management at PCU-E was much involved and engaged in the pilot. Though it was also mentioned that since they did not employ the doctors, they naturally did not have the same authority as normal.

Planning for the implementation process
Since the emergency center did not employ any doctors, management was not able to demand that any doctors participate in training. The e-health system was planned to be used by one doctor and one nurse. The intention was for all nurses to participate in training.

Executing the implementation process
PCU-E went live in July 2019, although during the first four weeks it was only used on a very small scale, staffed by the e-health company healthcare employees. This was done to test the system in the healthcare organization's environment.

Since PCU-E more or less consisted of several drop-in receptions, the system was used in one of these drop-in receptions, in parallel with the others. The patient always started by queuing to the front desk in the waiting room. In the waiting room, staff members could offer the patient to use the e-health system. These patients did not need to see the front desk; instead, they registered in the e-health system and were

then assessed directly by a nurse.

According to the e-health company's internal meeting notes, representatives on-site had observed that the rotating staffing was a challenge. On several occasions, personnel who have never been trained or even seen the system before were staffing the e-health system reception.

4.2.6 PCU-F

Structural characteristics
PCU-F was located in a small town and had 9,530 registered patients. Before using the e-health system, PCU-F had a drop-in reception open from 8:00 to 17:00 every day. The drop-in reception treated all patients who experienced any acute symptoms. The drop-in reception was staffed by one nurse and two doctors. However, since rather few patients sought care that way, they simultaneously performed other tasks: the nurse also performed telephone triage, and the doctors assessed patients with booked appointments. The main way of contact for patients was through telephone triage; therefore, the drop-in reception only had approximately 10 patients per day (roughly one patient per hour).

Implementation climate
During PWA, the manager stated that attitudes towards the planned changes were mixed among the staff. A few staff members saw the system as a problem, but the majority were looking forward to trying something new. However, there had been some concerns in discussions of details in the workflow, mostly regarding the nurses. In interviews with the e-health company representatives, the picture of a fragmented working group was amplified. A few staff members were clearly against the project, but some were in favor of it.

In PWA meeting notes, it was stated that PCU-F had a hard time deciding which patients should be referred to the drop-in reception using the e-health system and which should receive a booked appointment with the doctor. It was a sensitive topic within the PCU. The nurses were worried that the nurse staffing the drop-in reception with the e-health system would not have time to perform telephone triage simultaneously. The nurses believed that they were too few to be able to make the planned changes in workflow. Since the PCU relied heavily on telephone triage, and since one of the recommendations was to transfer the workload from telephone triage to the e-health system, there was a risk that the patient's medical history would be collected twice: first by the nurse over the telephone and then by the e-health system at the PCU.

Planning for the implementation process
Approximately 3 nurses and 5 doctors were planned to participate in training. The rest of the workforce was then going to be educated internally. The e-health system was planned to be used in the drop-in reception from 8:00 to 11:00 each day with one nurse and one doctor working with it. PCU-F had assigned an internal project group which had prepared a routine for the workflow. The routine stated that the majority of patients would still be directed from the telephone triage. Any patient that was being directed to the clinic to use the e-health system was also booked into the clinic's existing booking system.

Executing the implementation process
During the PWA the manager explained that communication from the healthcare organization had been unclear. They had some questions about education and Go-Live since the healthcare organization had mailed two different dates regarding these activities. They had not received any information about the duration of the training either, which made planning within the PCU difficult.

PCU-F used the e-health system in their drop-in reception, but, in contrast to their existing drop-in reception, they only used the e-health system in the morning. Patients who had booked appointments with the nurse or who came unannounced were directed by the front desk to register with on a tablet in the waiting room.

From the e-health company internal meeting notes in October, the following was noted: (i) there is resistance from one nurse who think the automated documentation is wrong; (ii) the same person also perceived longer waiting times for the patient; and (iii) when talking to other nurses, they perceived the e-health system as easy to use.

Another problem observed was that nurses in telephone triage were asking too many questions to the patient over the phone instead of referring the patient to the drop-in reception, thus not properly transferring the workload from telephone triage to the e-health system. Another problem was that the nurses never sent the patient directly to the doctors in the system, even though it was decided from the telephone that the patient needed to see the doctor. All patients were first consulted by the nurse, which led to unnecessary waiting times for the patient. The staff members believed that the majority of patients were positive to using the system.

One additional problem identified by the e-health company representatives was that no one from the staff helped patients while they registered in the e-health system. The front desk was in a sequestered area and the receptionist rarely left the front desk,

which caused problems if patients needed help.

4.2.7 PCU-G

Structural characteristics
PCU-G was a health center in a small village, with 4,200 registered patients. Before implementation, PCU-G did not have a drop-in reception. Instead, the staff wanted all patients to call in before any visit. Although they did not have an official drop-in reception, they had approximately 4 drop-in patients per day. Those patients explained their complaint at the front desk and were added to the same queue as patients calling to the PCU. When it was the drop-in patient's turn, the patient was assessed by the same nurse who was staffing the telephone triage. If needed, the patient received a booked appointment with the doctor.

Unique for PCU-G is the number of both staff and registered patients, which is much smaller than all other PCUs. In total, three doctors worked at the PCU. However, there was only one permanently employed doctor (who was also the manager). The other two doctors were consultants hired externally, which meant those positions could change on a day-to-day basis.

Implementation climate
During PWA the manager stated that the employees were overall positive towards the project. One concern, however, was the staffing, since they only had three doctors of whom two were hired as consultants. The hired doctors would not participate in training, and there was a shortage of doctors in general. This caused concerns about being able to staff the e-health system. Since the PCU was so small, the nurse staffing the telephone would continue to work as before, with the addition of using the e-health system.

PCU-G did not want to adopt a drop-in reception. They did not have an open drop-in reception because they had so few patients and tried to get every patient to call in advance. The manager was new in the position and had not been involved at the start of the pilot and thus not signed up for using the e-health system.

Planning for the implementation process
The plan was for only the manager (as a doctor) and one nurse to participate in the education. Since the nurse staffing telephone triage also assessed drop-in patients, the plan was to continue with the same workflow. If the nurse assessed a patient over the telephone and wanted to see that patient in person, they would refer that patient to the drop-in reception and register in the e-health system. Similarly to the previous

workflow, the nurse would alternate between telephone triage and assessing patients with the e-health system.

Executing the implementation process
The concerns turned out to be valid. Since the doctors mainly worked at the clinic temporarily, it was hard to get any continuity. This in combination with the low number of patients visiting the clinic per day made the usage very limited. PCU-G paused the project after only 38 patients been assessed through the system.

The doctors did not participate in the Go-Live Education. However, the rest of the staff did participate. Some efforts were made with Go-Live Support, but since consultant doctors were frequently replaced, it was hard to get the consistency needed.

4.2.8 PCU-H

Structural characteristics
PCU-H was a health center in a small town, with 14,200 registered patients. Before implementing the e-health system, they had a drop-in reception staffed only by nurses. The patients could seek care for anything, even problems that were not acute, for instance renewal of prescriptions. The nurses who did the initial assessment were able to end approximately 90% of the drop-in patient cases by themselves. The few patients that needed to see the doctor would get a booked appointment, which could be several hours after the nurse's initial assessment.

Implementation climate
During the PWA, the managers explained that the doctors were negative towards staffing a drop-in reception as they were used to consulting as little as 2-3 patients per day from the drop-in reception. With the e-health system, they were worried that they would need to consult many more patients. Management was also aware that the old workflow was not perfect, as many patients seeking care at the drop-in reception should really have been assessed elsewhere. For instance, it was common for patients to visit the drop-in reception to renew their prescriptions, which would preferably be done online or over the telephone. Despite this awareness of the shortcomings of their current system, they explained that the patients were used to it, and that it was not likely to change easily.

During the PWA, the e-health company representatives observed that management was unconfident and felt that the doctors would have a large influence on the implementation. The concern was that there could potentially be a problem if the doctors

did not comply with the new workflow. A potential risk was raised in that the managers might lack the authority to drive the changes needed for the implementation. During the PWA, the managers' thoughts about how the staff members would perceive the changes in the workflow were:

> *The doctors are negative since they have 2-3 patients per day coming from the drop-in reception; the rest are assessed by the nurse. They believe that when they work with the e-health system in the drop-in reception, they will need to assess many more patients.*

Regarding the question of what change management would be required for their planned workflow to run smoothly the manager answered:

> *The doctor working with the e-health system will be on standby doing administrative tasks, since very few patients from the drop-in reception need to see the doctor today. The doctors have a rather negative attitude to this workflow.*

After the PWA, the e-health company representatives raised concerns regarding the patience of the PCU staff in terms of change management. The concerns were based on another quote from management:

> *One large risk is that the employees after one week of using the e-health system get the feeling that it is worse than the current workflow.*

The manager was new to the position and was appointed right in the middle of the implementation, i.e. shortly before Go-Live. From interviews with the e-health company representatives, the PCU-H managers were described as engaged in the project itself, but lacking full control of the PCU workflows. The general belief among the interviewees was that there were more opinion leaders at PCU-H compared to the average PCU. These were mostly doctors, among whom there seemed to be both positive and negative influences.

Planning for the implementation process

In planning the workflow, two different workflows were discussed: the e-health system was either going to be used in the current drop-in reception, or as a separate reception, parallel to the old drop-in reception. There was no plan to limit the hours that the e-health system was going to be used. Since no doctor staffed the old drop-in reception, this was planned to change with the use of the e-health system.

Executing the implementation process

The e-health system was used in the already existing drop-in reception, open every day

9:00 to 12:00 and 13:00 to 16:00 three days a week. The reception was staffed by two nurses, compared to one before the use of the e-health system. Even though it had been planned that one doctor would staff the reception, it is unclear if this was the case. Because the doctors did not staff the drop-in reception previously, this meant a rather big change in workflow for the doctors.

In October, the deputy manager was interviewed by the e-health company. In the interview, it was stated that PCU-H had: (i) fewer patient visits on acute doctor times; (ii) less need for on-call appointments for doctors. However, there were also some drawbacks: (i) too many questions were asked to the patient during registration; (ii) nurses believed the process of transferring the documentation in the e-health system to the EHR system was cumbersome; (iii) secretaries were uncomfortable in helping patients when needed during registration; and (iv) there was a problem with the WiFi on the premises. In addition to this, the deputy manager also wished that the e-health company would send a doctor to the PCU to explain the system in more detail to PCU-H's doctors.

During On-site Support, the following problems were observed by the e-health company representatives: (i) lack of teamwork; (ii) old routines and structures; (iii) doctors and nurses worked against each other; (iv) the nurses were disappointed with management because they did not demand that the doctors help the nurses more; and (v) large WiFi problems.

4.2.9 PCU-I

Structural characteristics
PCU-I was a health center in the outskirts of a city, with 10,400 registered patients. Before implementation, PCU-I had a drop-in reception where the majority of the patients were assessed. This means that patients could seek care for basically anything. The drop-in reception was open 8:00 to 12:00 and staffed only by nurses for the first two hours. At 10:00 the doctors started receiving patients. Since patients were triaged from 8:00 but could not see a doctor before 10:00, it was common for patients to go home for a few hours instead of waiting on-site.

Implementation climate
During interviews with the e-health company representatives, it was concluded that the manager was very engaged and had many long-term visions for the system. However, there were some tensions between the manager and some of the doctors as mentioned by one interviewee:

> *Yes, there was strong leadership, with the exception that they did not want to go across some of the doctors.*

Among the staff members, there was one doctor, in particular, that was a strong, negative opinion leader. The doctor was openly negative already from the first activity of the implementation process (the Introductory Meeting). In the field notes from the Introductory Meeting it was stated:

> *The doctor had many questions with negative implications during the presentation. The doctor tried to create the perception that the implementation would mean a lot of unnecessary work [...]*

When it came to the nurses and secretaries, both groups were positive and engaged in the project.

Planning for the implementation process
PCU-I was the only PCU that did not book in a time for the second PWA, meaning that a relatively large amount of information is missing.

Executing the implementation process
The entire PCU was engaged in the project since the system was used in the entire drop-in reception from the start, which meant that the majority of patients were consulted via the drop-in reception. The system was used with the same workflow as previously. This meant that patients arrived between 8:00 and 12:00. Patients arriving before 10:00 had to wait for the doctors if the nurse referred that patient to a doctor. From the e-health company internal meeting notes in October it was reported: (i) there is a large individual resistance to change; (ii) local chaos.

4.2.10 PCU-J

Structural characteristics
PCU-J was an urban health center with 8,800 registered patients. The PCU did not have a drop-in reception. However, one nurse was available three hours in the morning for triaging any unannounced patients arriving at the PCU. When patients arrived, they registered at the front desk and sat down in the waiting room. The patients were then fetched by the nurse. If the nurse deemed that a patient needed to see a doctor, the patient received a booked appointment. The doctors had a few free appointments each day for these patients.

Implementation climate

During the PWA it was observed that quite few patients visited the drop-in reception. Management was determined to have a gradual starting phase, to integrate the e-health system step-wise into the existing workflow over time. Management appeared confident and did not seem afraid of driving change. They felt prepared in that they had established clear responsibilities between the employees.

The manager was more or less neutral towards the project – not overly engaged, but not completely disinterested. However, the manager was upset about the communication regarding the implementation process. The manager felt that they had not received the required information, i.e the purpose of each meeting and which employees that should be present.

Planning for the implementation process
Three doctors, three nurses, and three lab personnel were planned to participate in training. Initially, it was planned that the e-health system was only supposed to be active three days per week for three hours per day.

The recommended the e-health system workflow, using an open drop-in reception, did not suit the old workflow at PCU-J. Since they did not want to start an open drop-in reception, PCU-J needed to find another way of implementing the product.

Executing the implementation process
There were few participants at the Go-Live Education, though this was in line with the plan from the management. The system was used in a "partial" drop-in fashion, in which the patients mainly received booked appointments via telephone triage. When arriving at the clinic for their appointment, patients registered in the e-health system and were then consulted by a nurse who could send the patient to the e-health system doctor if needed.

According to the e-health company meeting notes from October, a few observations were made: (i) the secretaries feel uncomfortable using technology, which creates a bad mood; (ii) the number of questions asked by the nurses in telephone triage were very different for each nurse, and some nurses asked far too many; (iii) some nurses had not understood that it was possible to send a patient directly to the doctor; (iv) teamwork had become much better; (v) in general, the staff focused more on the drop-in reception now; (vi) the doctors were unsure about editing in the documentation; (vii) overall, the staff seemed happy with the automatically compiled documentation and with the e-health system as a whole.

During the pilot, management stated that good outcomes were: (i) improved team-

work; (ii) good patient flow between nurse and doctor; (iii) the personnel staffing the the e-health system reception only focus on that reception and did not have other tasks during the reception. Bad experiences were: (i) tablets not configured properly; (ii) sometimes the anamnesis was wrong; (iii) sometimes the nurses in telephone triage asked too many questions, and then the patients perceive that they need to repeat themselves when registering in the e-health system. Some nurses did not know that they could send the patient to the doctor directly without seeing the patient.

4.3 The healthcare organization evaluation report

The healthcare organization evaluation report has been published. However, since it is not easily accessible for the general public, a summary of the report is presented in this section. In addition, to preserve the anonymization of the healthcare organization and the e-health company, the reference to the report is left out of this thesis.

One of the main objectives of the project as a whole was to evaluate the pilot, in particular the PCU prerequisites and implementation methods used. In doing this, there was no standardized workflow implemented; rather, each PCU was able to choose themselves how they wanted to use the system. The methods of the evaluation as described in the report:

> *The evaluation is a descriptive analysis since the PCUs are too different in implementation, and there is no control unit to compare with. The alternative would have been to compare with how it was before implementation, but the baseline data gathered during 2018 turned out to be too inconclusive because of new workflows, the staffing situation, etc., to be reliably used in comparison.*

The evaluation report consists of four parts: the first one contains user statistics from the e-health system, the second a patient survey, the third a survey sent to PCU staff members, and the fourth in-depth interviews with PCU staff members.

4.3.1 Results

When the evaluation was conducted, 11,959 patient cases had been managed with the e-health system over 25 weeks. The key takeaways were that patients were positive about the system and that the staff surveys indicate large variation in terms of user acceptance, both within and between PCUs. It was concluded that the data indicated that PCUs which implemented the system successively rather than rapidly in terms of the number of involved staff members initially showed more positive feedback.

One interesting parameter in the evaluation is the time spent by healthcare professionals on editing documentation. The edit times were presented together for the physical PCUs while PCU-B was presented separately. The plots are shown in Fig. 4.2 and 4.3 respectively. This parameter was measured manually in the project goal reporting (PGR) document, where the overall average administration time for nurses was 3 minutes and 34 seconds.

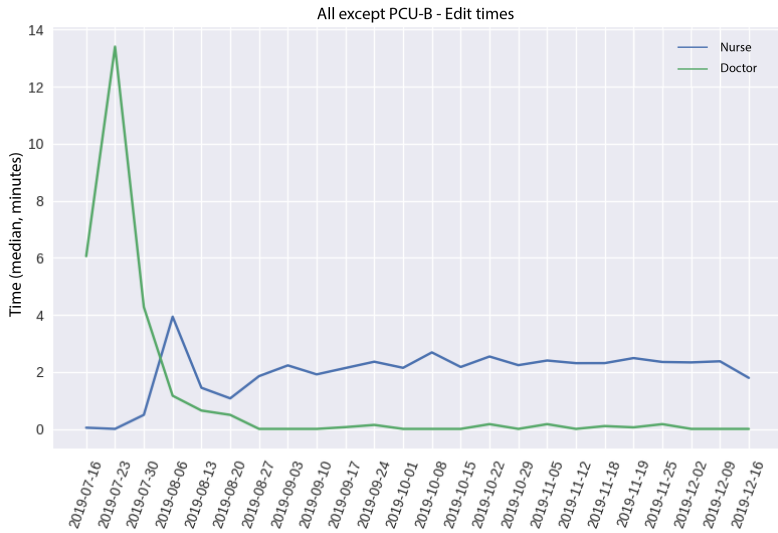

Figure 4.2: Edit times for all PCUs except PCU-B[1]

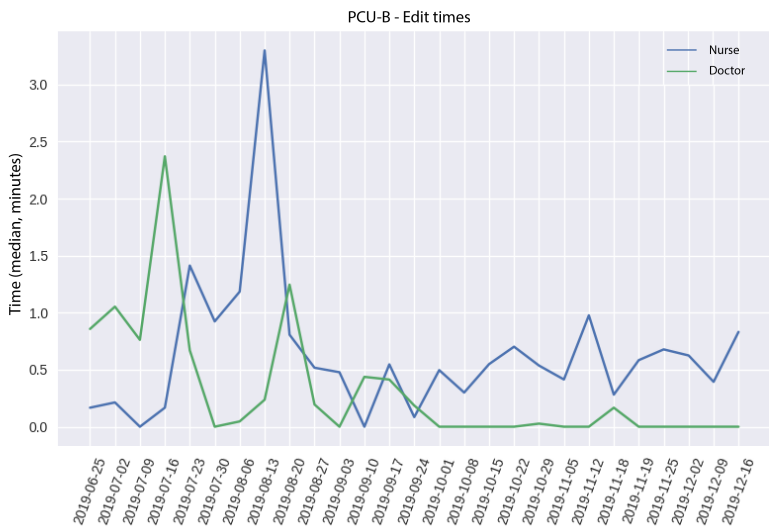

Figure 4.3: Edit times for PCU-B[1]

[1]Plots rendered based on data from the healthcare organization's evaluation report

In addition to figures, different parameters were presented for each PCU. In Table 4.6 some of these parameters is presented.

Table 4.6: Data from the PCUs

PCU	A	B	C	D	E	F	G	H	I	J	*All*
Finished visits	n/a	2602	1208	782	2775	771	n/a	1568	1569	646	*11959*
Visits ended by nurse	n/a	49%	32.9%	65%	43.5%	52%	n/a	57%	59.8%	27%	*39.2%*
Median patient registration time (min)	n/a	5.8	6.2	5.49	5.25	6.13	n/a	6.03	6.33	5.82	*6.3*
Median visit duration (min)	n/a	114.5	54.4	49.8	66.2	49.6	n/a	47.3	77.8	47.9	*64.7*

4.3.2 Empty visit cases

An ”empty” patient case means the healthcare staff register a patient, without the patient having answered any questions before the visit. The main use case was if a patient was unable or unwilling to register in the e-health system, but staff still wanted to use the system during the consultation.

This feature also enabled a comparison of the editing times for staff when the documentation is automatically compiled versus when it is not automatically compiled (meaning that the healthcare professional needs to write all documentation manually). This corresponds to ”Real cases” and ”Empty cases” respectively in Fig. 4.4. The comparison is made based on the selected diagnosis, and the edit times only include measurements for nurses. If there were more than 10 ”empty cases” with the same diagnosis, the diagnosis was included in Fig. 4.4. From the plot, it is clear that for visits where the nurses had to write the documentation by hand, the edit times, in general, are longer. A limitation of the comparison is the lack of randomization in patient allocation to each group, as discussed in the previous paragraph.

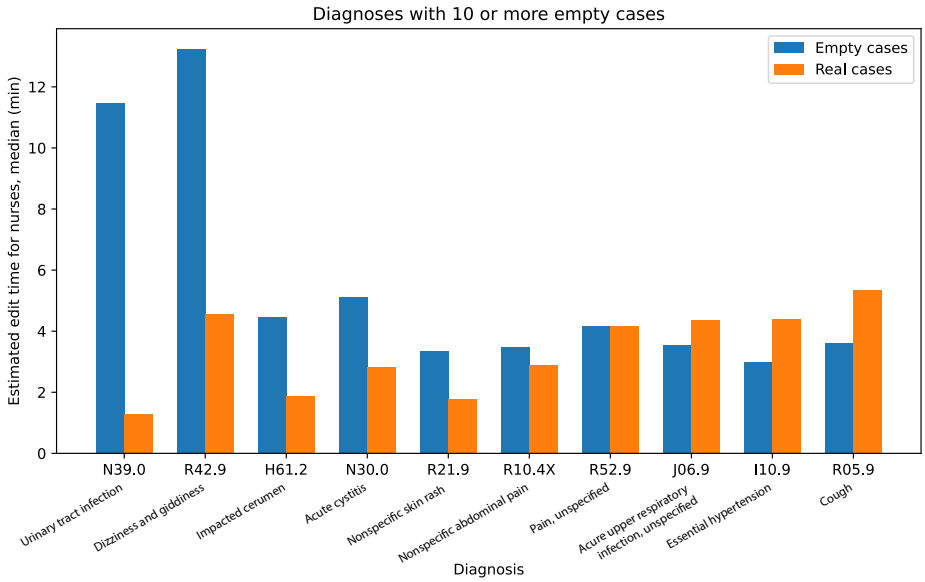

Figure 4.4: Estimated edit times for nurses[1]

4.3.3 Patient survey

During two weeks in November, patients were able to respond to the survey they had completed their visit. Patients could respond on a 1-10 scale in which 1 represented *"strongly disagree"* and 10 *"fully agree"*. 123 patients responded, and the results are presented in Table 4.7.

Table 4.7: Median results from 123 patient answers, with answers provided on a 1-10 scale.

Statement	**Median**
The digital form was easy to use	9
I was able to provide the information I wanted about my health	9
I got the help I needed though my visit	10
In the event of similar problems in the future, I would like to use the digital for again	9
I would recommend others to use the digital form	9
My experience is that the visit was improved with help of the digital form	9
Median of medians	*9*

[1]Plots rendered based on data from the healthcare organization's evaluation report

4.3.4 PCU staff survey

A survey was sent to PCU staff members. Staff who had participated in training and worked more than 5 times in the system the last month were included. PCU-E, PCU-D, and PCU-F had a response rate below 45%, which was set as the minimum threshold, and were therefore not included in the evaluation. The median responses are presented in Table 4.8.

Table 4.8: PCU staff member survey results, from 65 respondents, with answers provided on a 1-10 scale.

PCU	H (n=15)	J (n=6)	C (n=13)	I (n=14)	B (n=17)	*MoM*
I received enough information and education prior to using the system independently	7	5.5	9	6.5	9	*7*
I believe the system adds value prior to the patient assessment	2	6	7	5	9	*6*
I believe the system is easy to use	5	7.5	9	8	9	*8*
I believe the system contributes to more time for the patient meeting	1	5.5	6	3	n/a	*4.25*
The system enables me spending less time documenting	3	7	8	6	10	*7*
It is easy to reach health guidelines through the system	4	7.5	8	5	8.5	*7.5*
I believe the teamwork between different categories of staff members is improved by using the system	1	6	7	5	n/a	*5.5*
I would recommend my colleagues in other health organizations using the system	2	5	8	5	9	*5*
Median of medians	*2.5*	*6*	*8*	*5*	*9*	

4.3.5 Interviews

Interviews were held at each PCU. The interviewees were PCU managers and representatives from each staff category that had been involved with the project. However, because of different circumstances, some staff categories were not represented in all interviews, and in two PCUs, only management representatives were present. The evaluation report presents a summary of questions and answers based on the interviews. Below is a free text representation of the evaluation report summary.

Preparations
The information before go-live was considered adequate. During preparations, staff members had at least two opportunities to try the system themselves. This was considered beneficial by some and a concern by others. The concern mentioned was that it could be hard to find time for the staff to try the system. In general, training was considered successful, but several respondents wished follow-up training some time after go-live. Several PCUs suggested using superusers.

During preparations, it was hard to know whoever the healthcare organization or the e-health company was in charge of the ordering of hardware. Several PCUs also had trouble ordering hardware, and some had trouble with the Wi-Fi. Several PCUs wished for better information about when the healthcare organization should be contacted and when the e-health company should be contacted. It was however highlighted that questions sent to the healthcare organization or the e-health company were rapidly replied to, and the weekly letters were good. The majority of PCU managers did not participate in the weekly briefings held by the healthcare organization. When representatives from the e-health company visited on-site they were good support and were perceived as professional and knowledgeable. Sometimes the internal communication within the e-health company did not work. Someone wished that there was more contact with the healthcare organization.

The e-health system
The staff, especially the nurses and secretaries, reported that the system was easy to use. Some interviewees mentioned that patients with sore joints might have trouble using tablets. Opinions regarding if the system added value *prior* to the patient meeting were divided. Another key area brought up was the need to trust the documentation generated by a colleague to avoid doing the same work twice. Regarding the question of whether the e-health system affects the time spent on patient management, one interviewee had no opinion, one believed it was the same, and the remaining respondents were divided equally between believing that it saved time and that it lost time. It was, however, pointed out that the system enabled more available doctor's appoint-

ments. At PCU-E, the e-health system reception managed a larger proportion of the total patients compared to the traditional workflows.[1]

In general, doctors did not notice any difference in time spent doing administration. Nurses and secretaries believed that it saved time; however, sometimes it took time to correct inaccuracies generated by colleagues, e.g. misspellings, abbreviations, etc. Regarding the question of whether they perceived that more visits could be ended by a nurse without requiring the involvement of a doctor, two interviewees did not know, one believed that fewer were ended by a nurse, and the rest believed that more visits were ended by a nurse. In general, the administration time surrounding the patient consultation was not believed to be affected by the system. The system did not have an apparent effect on the usage of medical service (e.g. lab and radiology).

Medical guidelines
Everyone believed that the guidelines presented in the system added value and that they were easily accessible. All PCUs except one believed that the easily accessible guidelines added value, especially for the less experienced staff members. There was also a consensus in that the easily accessible guidelines had an educational effect in that the users' knowledge was continuously updated.

Workflow and working environment
Three PCUs reported that the teamwork was not affected by the system, two that the teamwork had increased, and one PCU that it had been worse. PCU-E reported that staff members who were positive towards the system also reported that teamwork had increased. Something that harmed the working environment was having many drop-in patients in the waiting room at the same time. Some PCUs mentioned that drop-in receptions could render periods of uneven patient flow, which, in combination with being new to the e-health system, could cause stress. At one PCU, secretaries and nurses found that the working environment had been improved because they could better plan their work.

At some PCUs, the nurses and secretaries' roles were strengthened. Some secretaries reported that they now were more involved in the team than previously. Four PCUs described an increase in accessibility for the patients, in part because the e-health system reception increased the available doctor's appointments and the number of patient assessments. Waiting times for acute patients were also shortened. Three PCUs reported no difference in patient accessibility.

[1]PCU-E used the e-health system as a drop-in reception in parallel with 3-4 traditional drop-in receptions.

Lessons learned and additional comments
The importance of follow-up education and/or superusers was highlighted. Another lesson learned was that it is recommended to start gradually in terms of possible patient complaints and the number of involved staff members. The healthcare organization and PCU managers needed to be clear about where the organization is headed and communicate that changes in workflow and routines are needed in the future. Emergency centers should go-live later than other PCUs when more doctors are used to the system from using it at their ”home” health center.[1]

Three PCUs would have recommended other colleagues to use the system, three did not answer and one unit could partly recommend it and partly not. However, there was consensus that the healthcare organization should continue to work with and use the e-health system. They agreed that they have to adapt to digitalization and that the implementation should be allowed to take time. Additional comments mention that the dialog with the patients was important. Also, each PCU must think about how they should use the e-health system and that it was positive to review workflows and routines. Continuous education was mentioned as important. The last comment was that they would likely see more value when using further functions in the e-health system, like chat and annual visits.

[1] Emergency centers like PCU-E were staffed by doctors from other PCUs on a rotating schedule and do not employ doctors themselves.

Chapter 5
Data Analysis

In this chapter the data gathered are analyzed. Firstly, the PCUs are analyzed based on the project goals presented in Chapter 3. Secondly, factors that are believed to have impacted the implementation are presented and compared with the results of the evaluation. Thirdly, suggestions for improving the quality of evaluations of future implementations are presented.

5.1 Evaluation based on project goals

According to Cohen [2], the outcome of an e-health implementation should mainly be evaluated based on whether its goals were attained or not (see 3.1). Accordingly, the following section is an attempt to evaluate each PCU based on the project goals set up for the pilot. The goals are presented in Table 5.1. The table also describes how each goal was evaluated. As can be seen, the evaluation methods vary between goals, mainly because of inadequate or missing data. If data before the implementation were available, they were compared with data generated during the pilot. In cases where baseline data were unavailable, the evaluation was generally based on how a parameter developed over time, i.e. if trends could be spotted. For qualitative project goals, the evaluation was based on surveys and interviews conducted by the healthcare organization seen in section 4.3.

Since most of the data were insufficiently adequate or certain to draw any firm conclusions from, a grading system was created which acknowledged this problem. Hence, the grades are not definitive, but rather indications of a goal being attained or not, based on a subjective and objective analysis by the author of this thesis. The grading system is presented in Table 5.2. Since PCU-A and PCU-G had very limited user data, they were never graded. However, they are still presented since it could be interesting to see the comparisons between all PCUs.

Table 5.1: Methods for evaluation of project goals

ID	Project goal	Evaluation based on
G1	Increase of consultations ended by a nurse	Comparison of estimates made before implementation and user data from the pilot
G2	Increase in number of consulted patients with the same staffing	Deemed to contain too many error factors to evaluate
G3	Decrease in average administration time	Comparing measured nurses' administration time before implementation with estimated nurses' edit times from the pilot.
G4	Decreased dictation time	No data available for evaluation
G5	Quicker assessment of patients visiting drop-in reception	No baseline data available for evaluation
G6	Increase in patients' perception of the quality of care	Patient survey conducted by the healthcare organization
G7	Increased benefits for the staff, e.g. easier patient visits, standardized documentation, more time for assessment, and less time in administration	Staff member survey conducted by the healthcare organization.
G8	Being able to book doctor's appointment for new patients within three days	The data available deemed inadequate for evaluation
G9	An increase of acute patient's being assessed (receiving an appointment) the same day	The data available deemed inadequate for evaluation
G10	Decrease the time for subacute patients to receive an appointment	The data available deemed inadequate for evaluation

Table 5.2: Grading system for the evaluation of project goals.

Grade	Description
+	Leaning towards a positive outcome.
0	Outcome not possible to conclude.
-	Leaning towards a negative outcome.

5.1.1 G1 - Increase of consultations ended by a nurse

In the PGR document[1] sent to the PCUs, this parameter was not reported. During PWAs, this parameter was estimated by some PCUs; however, not all PCUs reported it, and the reported numbers were only estimations. The percentage of patient visits concluded by a nurse using the e-health system is available in the healthcare organi-

[1]The project goal reporting (PGR) document was sent to the PCUs in November 2018. Each PCU reported measurements related to some of the project goals.

zation's report. Table 5.3 contains the available data regarding this project goal. The grade was determined based on comparing the estimated visits ended by nurse prior to implementation with the visits ended by a nurse during the project.

Table 5.3: Evaluation of project goal G1

PCU	A	B	C	D	E	F	G	H	I	J	*All*
Data prior implementation											
Estimated visits ended by nurse	n/a	n/a	n/a	50%	25%	n/a	n/a	n/a	33%	n/a	*n/a*
Data from the project											
Visits ended by nurse	n/a	49%	32.9%	65%	43.5%	52%	n/a	57%	59.8%	27%	*39.2%*
Grade	*n/a*	*0*	*0*	+	+	*0*	*n/a*	*0*	+	*0*	*0*

The rather high variation of the percentage of visits ended by a nurse could depend on what type of complaints the patients had. At PCU-C, the complaints patients could seek care for with the e-health system was limited to more acute symptoms, in need of more investigation, which could be the reason for the rather low number of visits ended by a nurse. PCU-D, which had a high amount of patients seeking care for issues not requiring investigation (like measurement of blood pressure), instead had a much higher percentage of visits being ended by a nurse.

5.1.2 G2 - Increase in number of consulted patients with the same staffing

The second goal focused on the number of patients being consulted. This data was specifically asked for in the PGR document sent to the PCUs before implementation. However, two aspects make this measurement hard to interpret. Firstly, it was stated that the PCU should fill in the number of consultations finished at the drop-in reception from 8:00 to 12:00, staffed by one nurse and one doctor. However, it was never explained how PCUs should report if they had a different workflow from the one assumed by the PGR document. Secondly, the PGR document was never reported during or after implementation, so the baseline-data reported through the PGR document before the implementation could never be compared with the equivalent measurements in the same format. Instead, baseline data were compared with user data in the e-health system that are not fully comparable with the reported PGR measurements.

In evaluating the number of consultations per week, several factors affect the outcome: (i) drop-in reception open hours; (ii) drop-in reception staffing; (iii) type of patient's causes of visits; and (iv) the drop-in reception workflow in general. In Table 5.4, some of the factors influencing the number of consultations per week are presented. The number of patient visits before implementation was reported during the PWAs, but only as an estimate by the managers. The number was not presented as visits per week (it was often reported as patients per shift or patients per hour), so the estimates have been converted to enable easier comparison. This is why some estimations have a rather low "resolution".

The open hours are presented as intervals during the day according to the following: "M": Mornings; "C": Closed; "E": Evenings; "F": Full day; "A": Afternoons. The open hours are divided into intervals, since we do not know the exact hours the drop-in receptions were open when using the e-health system. When comparing open hours before and during implementation, all PCUs seem to have kept their open hours more or less the same when using the e-health system. Though, as mentioned, it can not be fully certain that the open hours were the same when using the e-health system as before implementation.

The majority of PCUs have more or less the same staffing as before implementation. PCU-E is unique in that they used the e-health system drop-in reception in parallel to four traditional drop-in receptions. The e-health system was used in one of the receptions, so the number of visits is approximately 1/5 of the total amount of estimated visits before implementation. PCU-C, PCU-H and PCU-J have in common that they before implementation consulted drop-in patients even though no doctor was staffing the drop-in reception.

Finally, when comparing the number of visits, there are two significant error factors. First of all, the number of visits before implementation is only an estimate. Second, the number of visits published in the healthcare organization's evaluation from the pilot are only the total amount of visits. The number of visits per week are therefore estimated by dividing the number of visits in total on the number of weeks the system was active, meaning that if a PCU had a more gradual start, with intentionally fewer patients initially, this will affect the estimate. In addition to this, for the estimated number of visits per week during the pilot to be fully comparable with the estimated number of visits before implementation, it must be assumed that the system was used all days of the week, for the same number of hours each day, which we can not with certainty determine that it was. For example, if the e-health system reception had to close down one day because of lack of staffing, this day would contribute to the

estimate as if the reception were open but no patients were consulted.

As mentioned, PCU-E was the only PCU that used the e-health system in one of several parallel drop-in receptions. In the healthcare organization's evaluation, it was stated that the e-health system reception was able to manage more patients compared to the parallel, traditional drop-in receptions. The other PCUs that had a drop-in reception before implementation more or less incorporated the e-health system into their existing workflow straight away. However, it is not determined that all patients visiting the drop-in reception used the e-health system. The e-health system had a feature for healthcare professionals to include patients who did not want to use the system, but it is not known to what extent this feature was used by the staff.

One problem with this project goal is that the number of consultations at a drop-in reception is mainly determined by the number of patients arriving at the reception. One way of establishing if more consultations could be finished is to look at the individual time for each visit, but since there already is a project goal mentioning this exact topic (G5), this project goal is very similar, but harder to evaluate since the number is mostly determined by the patients. Furthermore, everything mentioned in this section assumes that the project goal referred to the number of consultations at the drop-in reception and not at the PCU in general, which is not fully clear. However, if the project goal referred to the number of consultations in general, one has to take into account the indirect effects the e-health system had, e.g. the number of phone calls, the number of available doctor's appointments (brought up in section 5.1.8), etc.

Since there are so many factors that potentially impact the number of visits, it is hard to draw any conclusions. What could be determined is that the PCUs had approximately the same number of or slightly fewer visits compared to the estimated number of patients before implementation. Comparing the number of visits with the staffing and open hours, the number of visits seems reasonable as the number of visits per week seems to increase with an increase in staff members and open hours. However, because of the mentioned uncertainties, it was decided to give all PCUs the grade "0".

Table 5.4: Evaluation of project goal G2.

PCU	A	B	C	D	E	F	G	H	I	J
Data prior to implementation										
Drop-in reception	Yes	n/a	No	Yes	Yes	Yes	No	Yes	Yes	No
Open hours (weekdays /weekends)[1]	M/C	n/a	M/C	M/C	E/F	F/C	C/C	M+3A/C	M/C	M/C
Drop-in staffed by (nurses/doctors)	2-3/2-3	n/a	1[2]/ 0[3]	2/1	8-10/4-5	1[4]/ 2[4]	0[5]/0	1-2/0[3]	2/3-5	1/0[3]
Estimated drop-in visits/week	50-200	n/a	75	75-150	1 125	50	20[5]	145	150	60
Data from the project										
VE used as parallel reception	No	Online	No	No	Yes	No	No	No	No	No
Initial open hours (weekdays /weekends)[1]	M/C	M/A	M/C	M/C	E/F	F/C	C/C	M+3A[6]/C	M/C	M/C
Usually staffed by (nurses/doctors)	2/2	1-2/1	1/1	2-3/1	2/1	1/2	0/0	2/1	2/4	1/1
Finished visits in total	n/a	2602	1208	782	2775	771	n/a	1568	1569	646
Estimated visits per week[7]	n/a	96	58	60	139[8]	45	n/a	105	105	46
Most common diagnosis	n/a	Rash	RTI[9]	Hyper-tension	RTI[9]	RTI[9]	n/a	RTI[9]	RTI[9]	RTI[9]
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*

[1] M: Mornings; C: Closed; E: Evenings; F: Full day; A: Afternoons

[2] The drop-in reception consisted of a nurse sitting at the front desk performing initial triage. The patients were either sent home or booked to nurse or doctor.

[3] No doctor actively sitting in the drop-in reception. However there were a number of time slots each day reserved for drop-in patients.

[4] Because the drop-in reception had very few patients per hour, the staff working in the drop-in reception performed other tasks like telephone triage and administration when there were no drop-in patients present.

[5] Even though there was no drop-in reception, unannounced patients came anyway. Unannounced patients were added to the same queue as if they would have called from home and were later assessed by the nurse in telephone triage.

[6] Also open on afternoons three days a week (Monday, Wednesday and Friday)

[7] Estimated by dividing the number of finished visits with the number of active weeks in the system

[8] The e-health system reception was one of five receptions, so increasing the number with a factor 5 would give a more fair comparison with the estimated number of visits prior implementation.

[9] Respiratory tract infection

5.1.3 G3 - Decrease in average administration time

The administration time is hard to measure. Before the implementation, in the PGR document, the nurses' administration time was reported by manually measuring the administration time for two days. The overall average administration time for nurses before the implementation was measured to be 3 minutes and 34 seconds per patient case. Unfortunately, the editing times in the e-health system for each PCU were not presented in the report. However, if comparing 3 minutes and 34 seconds to the plots in Fig. 4.2 and 4.3, it is clear that the median edit times for nurses are below 3 minutes and 34 seconds for the absolute majority of the pilot. What is also apparent is that the edit time of the doctors is close to zero almost every week. The cause of this is probably a combination of four main factors: (i) the doctor not needing to edit because of the automatically compiled documentation; (ii) majority of manual edits already being made by nurses; (iii) doctors may have chosen to dictate documentation rather than type it; and (iv) that visits where the patient never needed to visit the doctor was counted as no edit time.

In the the healthcare organization evaluation report, the interviewed staff members claimed that the administration time for doctors was about the same as before implementation and that nurses and secretaries generally saved time. Another part of the report indicating reduced administration time is the empty visit cases shown in 4.4. This plot reduces the error factors since it calculates edit time directly from user data, in which an empty visit case very much simulates how visits are managed without document support given by the e-health system. A limitation of the comparison is that the type of patients for whom empty cases were created may differ from those who used the e-health system as intended, even though the ultimate diagnosis was the same.

Since the PCUs individual baseline-measurements were not available and the edit times during the pilot were not presented on a PCU level, it is not possible to say anything about the administration time on the PCU level. However, comparing the overall nurses edit times with the overall edit times during the pilot, one can conclude that the administration time seems to be shorter when using the e-health system. Because of this each PCU recieves the grade ”0’,’ but the combined grade was set at ”+”.

Table 5.5: Evaluation of project goal G3.

PCU	A	B	C	D	E	F	G	H	I	J	*All*
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	+

5.1.4 G4 - Decreased dictation time

This parameter was not included as a measurement in the PGR document. There is a dictation function in the e-health system; however, this was only used for a limited number of visits throughout the pilot. Even if it were possible to see trends in the few visits where dictation was used, it would still not be comparable with the dictation time before using the e-health system.

Table 5.6: Evaluation of project goal G4.

PCU	A	B	C	D	E	F	G	H	I	J
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*

Because there were no data to evaluate this project goal, the grade is set at ”0” for all PCUs.

5.1.5 G5 - Quicker assessment of patients visiting drop-in reception

The assessment times of the drop-in reception were not a parameter included as a measurement in the PGR document, so there are no baseline data to compare with. Thus, the grade was set at ”0” for all PCUs.

Table 5.7: Evaluation of project goal G5.

PCU	A	B	C	D	E	F	G	H	I	J
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*

5.1.6 G6 - Increase in patients' perception of the quality of care

No measurements or qualitative analyses were made before implementation regarding this project goal. However, surveys were conducted during the pilot in which patients answered questions about their perception of using the e-health system. The results of the survey were presented in the RS evaluation report; however, only the total was shown, not the results for each PCU.

All statements included in the survey (seen in Table 4.7) are in some way related to this project goal. Since all statements received a median score of 9 or 10 on a 1-10

Table 5.8: Evaluation of project goal G6.

PCU	A	B	C	D	E	F	G	H	I	J	*All*
Median of medians	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*9*
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	+

scale, it was concluded that this project goal was attained. Since the result of the survey was presented in total and not for the individual PCU the grade is set at ”0” for every PCU and the grade ”+” is set for the column ”All”. The results are presented in Table 5.9.

5.1.7 G7 - Increased benefits for the staff

The project goal as a whole is stated as *Increased benefits for the staff, e.g. easier patient visits, standardized documentation, more time for assessment, and less time on administration*. Easier patient visits are very much a subjective opinion, and to fully evaluate the standardized documentation one would need to compare the final medical records. This makes both these aspects of the goal hard to evaluate. However, the automatically compiled documentation is formatted in a standardized format, and since the most common number of edits by the staff members was zero, this means that the majority of the documentation remained in the standardized format. In regards to assessment time and decreased administration, this was reflected in project goals G3 and G5, but could also be evaluated subjectively. In the healthcare organization’s evaluation, it was stated that the medical guidelines added value for the healthcare professionals; also, three of the PCUs believed the medical quality was improved since the medical record is of higher quality than before implementation.

Table 5.9: Evaluation of project goal G7.

PCU	A	B	C	D	E	F	G	H	I	J
Staff survey median of medians	n/a	9	8	n/a	n/a	n/a	n/a	2.5	5	6
Grade	*n/a*	+	+	*0*	*0*	*0*	*n/a*	-	*0*	+

Even though the healthcare organization’s evaluation presented summaries of qualitative interviews, it was decided to grade this project goal based on the staff survey results for two reasons: (i) it contained quantitative data, making it easier to compare; and (ii) the answers from the interviews never stated which PCU said what, precluding a comparison between PCUs. The staff survey was on a 1-10 scale. The grade was set to ”+” if the overall median of medians was 6 or higher; ”-” if the overall median of medians was 4 or below; and ”0” if the median of medians was between 4 and 6.

5.1.8 G8, G9, and G10 - Indirect effects

The three last goals were focused on the accessibility of the patient as an indirect result of the e-health system being used in the PCU. The project goals were stated as: *G8 - Being able to book doctor's appointment for new patients within three days*; *G9 - An increase of acute patients being assessed (receiving an appointment) the same day*; and *G10 - Decrease the time for subacute patients to receive an appointment*. The three last goals were all parameters directly measured in the PGR document. Unfortunately, the PGR document was never sent out during or after the pilot, so these parameters were never measured when the e-health system was in use. In the healthcare organization's evaluation, these parameters were included as questions during interviews.

Even though the parameters are quantitative, the staff got to share their perception of accessibility. In answering the question of whether the e-health system increases accessibility for the patient, four PCUs described an increase since the e-health system reception led to more available doctor's appointments as well as shorter waiting times for acute patients.

Table 5.10: Evaluation of project goal G8, G9 and G10.

PCU	A	B	C	D	E	F	G	H	I	J	*All*
Grade	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	*0*

Even though the healthcare organization's evaluation states that there was a general perception that the accessibility was increased as a result of using the e-health system, the author of this thesis does not conclude that it is enough to set the grade of "All" to "+". Thus, all PCUs instead received the grade "0", seen in Table 5.10.

5.1.9 Summary of project goals

Table 5.11 is a summary of the project goal grades, where the final grade is the sum of each grade presented above.

It is apparent when summarizing the grades that the majority of project goals are difficult or impossible to evaluate properly. The *Final grade* for each PCU only consists of one of ten project goals. One of the biggest problems with the project goals is the hard time comparing baseline data which was also mentioned in the healthcare organization's evaluation:

> *The evaluation is a descriptive analysis since the PCUs are too different in implementation and there is no control unit to compare with. The alternative*

would have been to compare with how it was before implementation, but the baseline-data gathered during 2018 turned out to be inconclusive because of new workflows, the staffing situation, etc., to be reliably used in comparison.

The baseline data were measured by the PCUs themselves, which leaves room for interpretation on the PCU level, potentially affecting the measurements. In addition to this, the PGR document was only used before implementation and not during or after the pilot. Instead, the quantitative baseline data were compared with similar parameters from the e-health system. However, there is uncertainty when the parameters are measured differently before and after the project. The healthcare organization's evaluation report never mentioned any qualitative measurements before implementation and only presents the qualitative results made after implementation.

In this thesis, success was evaluated by using the predetermined project goals. However, regardless of how the success is defined, the perception of success or failure depends at least as much on the local implementation climate and subjective opinions as on objective measurements, as argued by Cohen [2]. This is why when discussing influencing factors in section 5.2, the final grade is presented, but also the grades of G1 and G7, which are the only project goals that influence the individual PCU final grade. This is to give nuance to the final grade but also to represent both objective and subjective outcomes.

Table 5.11: Summary of grades.

PCU	A	B	C	D	E	F	G	H	I	J	*All*
G1	*n/a*	*0*	*0*	+	+	*0*	*n/a*	*0*	+	*0*	*0*
G2	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	
G3	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	+
G4	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	
G5	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	
G6	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	+
G7	*n/a*	+	+	*0*	*0*	*0*	*n/a*	-	*0*	+	
G8-G10	*n/a*	*0*	*0*	*0*	*0*	*0*	*n/a*	*0*	*0*	*0*	*0*
Final grade	*n/a*	+	+	+	+	*0*	*n/a*	-	+	+	++

5.2 Influencing factors

In this section, the different factors which might have influenced the implementation are presented.

5.2.1 Intervention characteristics

The intervention characteristics undoubtedly impact the implementation of said intervention. However, in this implementation, when it comes to the (i) intervention source, (ii) evidence strength and quality, (iii) relative advantage, (iv) trialability, and (v) design quality and packaging, no differences have been observed between each PCU. Therefore, it has not been possible to conclude if they had any sort of impact on an organizational level.

The adaptability of the intervention is the intervention's ability to adapt to meet local needs. Even though this seems like a factor that could vary a lot at the PCU level, it was rather general for this implementation, in the sense that each PCU was able to request changes to the system. If a request was approved by the healthcare organization's project group, the e-health company developed the feature, but instead of enabling it to the PCU requesting the feature, it was usually enabled for all PCUs. Since the majority of these requested features were developed, this indicates high adaptability. However, the effects of new features on the PCU level was not recorded, so a comparison between PCUs has not been possible. However, one case which could have been compared was the PCU-D infection reception which was developed, tailor-made to PCU-D's prerequisites and requests. However, since the infection reception only was live for two weeks, there were insufficient data to compare differences to the previous workflow.

Key takeaways
No key takeaways have been observed regarding the general intervention characteristics.

5.2.2 Compatibility and complexity

The compatibility of the system with the PCU workflow describes the effort needed by the PCU to use the system as recommended. If the system has low compatibility with the PCU workflow, this indicates that the PCU needed to change workflows and routines more than a PCU with high compatibility. In addition to the compatibility, the implementation could be more or less complex. The complexity of the implementation was higher when it required more non-routine processes and significant reorientation. The digitization, i.e. the change from an analog to a digital workflow, means a high complexity that requires a lot of change management, independent of the compatibility. The compatibility aspect is hence an additional layer on top of the complexity aspect. However, the two relate to each other and are therefore presented together in this section.

The e-health system was planned to be used in drop-in reception as a triage and process system at first, then, in a second phase, the system was to be used for booked appointments. The e-health system's ability to automatically compile a medical record based on the patient answers during registration makes the system particularly good in a triage setting, fitting well in a drop-in reception. This is probably the main argument as to why the initial implementation and recommendations were focused on using the e-health system in a drop-in workflow.

However, based on the information rendered from different events during the implementation process, it is obvious that the term "drop-in reception" has very different meanings depending on the PCU as well as the individual describing it. Some PCUs had what is here referred to as a "traditional" drop-in with the three main factors: (i) a reception open a few hours each day where patients did not need to have a booked appointment; (ii) staffed by at least one nurse and one doctor; and (iii) assessing mainly patients with acute symptoms like infections, trauma, etc. What is not obvious, though, is that this is only one of many definitions of a "drop-in reception". Of the PCUs in the pilot, no "drop-in reception" was exactly like the other, and numerous variations existed. In addition to the three main factors mentioned above, there were several other factors that could vary, e.g. how the lab worked, what lab tests were used when, if triage was performed at the front desk, management of payment, etc.

The following event underscores that the definition of drop-in reception could be different even on an individual level: During the planning of the implementation, the PCU managers were asked to report information about their current workflow. By coincidence, for one PCU both the manager and the deputy manager answered, unaware of the other's responses. When asked if the PCU had a drop-in reception, the two answers were different, even though the managers tried to explain the same drop-in reception.

The recommendation of using the e-health system in a drop-in reception meant that the compatibility was much related to if the PCU already had a drop-in reception. Since some PCUs did not have a drop-in reception before implementation, they naturally had lower compatibility with the workflow recommended. This was the case for PCU-C, PCU-G, and PCU-J. None of these PCUs had a drop-in reception before implementation. Funnily enough, no one started a drop-in reception in conjunction with implementing the e-health system. Both PCU-C and PCU-J started by letting unannounced patients use the e-health system, but they rather quickly transitioned back into their previous workflows: a kind of "partial" drop-in reception where the

patients using the e-health system were referred to via telephone triage. In PCU-G's case, they barely used the system at all, and when it was used, it was not in the form of a drop-in reception.

Another aspect of the drop-in reception which also impacted the compatibility of the system was the type of patient complaints being assessed at the drop-in reception. At PCU-D and PCU-H, patients who had non-acute complaints, e.g. removal of stitches, blood pressure measurement, and renewal of prescriptions, were still assessed in the drop-in reception. The general workflow is that these types of complaints are treated via booked appointments. Even if these types of patients were assessed through the e-health system, there is no real profit in letting these patients register, since the healthcare professional does not need a compiled medical record to be able to take a patient's blood pressure. For these complaints, the registration was more of an unnecessary step in the workflow.

In the healthcare organization's report, it was stated that each PCU purposely got to choose their preferred workflow themselves. There were a set of recommendations provided, summarized in Table 4.4, which explained the overall recommended workflow. There were also recommendations on a more detailed level, which the PCU had to make decisions about, e.g. if lab personnel was using the e-health system, which lab tests were entered in VE, if receptionists were using VE, if secretaries would support doctors or nurses or both, to what extent the system was implemented initially (number of unique users, possible complaints), management of payment, who supported patients registering in the waiting room, etc. Thus, a big responsibility was laid on the management of the PCU to decide the final workflow. Also, they had to make these decisions with rather limited knowledge of the system. Maybe it would have been better to have a predetermined workflow from the project group and making it a requirement for participating in the pilot was to adapt to an established workflow intended to make use of the system as much as possible, rather than just presenting recommendations.

Table 5.12 displays the PCUs with the three main factors of a drop-in reception, mentioned above. The PCU prerequisites are then compared with the recommendations given. Even though the recommendations did not specifically mention that the system initially was to be used mainly for acute patients to ease triage and acute assessment, it is implicated through the explanation of workflow. E.g. in the project plan, it was stated that the initial phase is for acute visits and the latter phase is for booked appointments. In Table 5.12, a final compatibility grade was given, where 0 indicates low compatibility and 3 indicates high compatibility. A point was given for each of the following conditions: (i) if the PCU had an open drop-in reception; (ii) if that

drop-in reception was staffed by at least one nurse and one doctor (the e-health system workflow assumes tight teamwork between the personnel using the e-health system, and the teamwork between nurses and doctors is particularly important); and (iii) if the drop-in reception was for acute complaints (if the drop-in reception assessed both acute complaints and non-acute complaints such as removal of stitches, no point was given).

Table 5.12: Comparison of system/PCU compatibility.

PCU	A	B	C	D	E	F	G	H	I	J
Drop-in reception	Yes	n/a	No	Yes	Yes	Yes	No	Yes	Yes	No
Drop-in staffed by (nurses/doctors)	2-3/2-3	n/a	1[1]/0[2]	2/1	10/4	1[3]/2[3]	0[0]/0	1-2/0[2]	2/3-5	1/0[2]
Only acute complaints	Yes	n/a	n/a	No	Yes	Yes	n/a	No	Yes	n/a
Compatibility grade[4]	*3*	*0*	*0*	*2*	*3*	*3*	*0*	*1*	*3*	*0*
G1	*n/a*	*0*	*0*	+	+	*0*	*n/a*	*0*	+	*0*
G7	*n/a*	+	+	*0*	*0*	*0*	*n/a*	-	*0*	+
Final grade	*n/a*	+	+	+	+	*0*	*n/a*	-	+	+

When analyzing Table 5.12, the PCUs that stand out from the rest are PCU-B, PCU-C, PCU-G, and PCU-J, which did not have open drop-in receptions before implementation, thus scoring 0 on the compatibility grade. Both PCU-C and PCU-J had a nurse ready to do triage for any patients still visiting the PCU unannounced, but this was not considered a drop-in reception by the PCU themselves. In the case of PCU-G, patients visiting unannounced would be added to the same queue as patients calling the PCU, and the patients would be triaged and assessed by the nurse staffing the telephone. Since these PCUs received 0 on the compatibility grade, we can assume that they had more work to create new routines and use the system in a way that suited their workflows. Because of this, we can also assume that these four PCUs had the most reorientation and non-routine processes, i.e. highest complexity of implementation.

One reasonable assumption would be that the lower the complexity, the easier the

[1]The drop-in reception consisted of a nurse sitting at the front desk performing initial triage. The patients were either sent home or booked to nurse or doctor.

[2]No doctor was actively participating in the drop-in reception. However, there were a number of time slots each day reserved for drop-in patients.

[3]Because the drop-in reception had very few patients, the staff working in the drop-in reception were performing other tasks like telephone triage and administration when there were no drop-in patients present.

[4]0: Low compatibility and 3: High compatibility

implementation, and ultimately the higher success of the implementation. However, there seems to be no correlation between the compatibility and final grades at all. In fact, if there is any correlation it rather points to the subjective opinion among the healthcare professionals, as represented by the staff surveys (G7), conducted as a part of the healthcare organization's evaluation (seen in 4.8). In these surveys, we notice that PCU-B, PCU-C, and PCU-J were the PCUs with the highest median score on the staff survey, while all having a compatibility grade of 0.

One theory based on these observations is that more complexity in implementation means subjectively more positive attitudes. Reading the statement in isolation would probably not make any sense. However, higher complexity could mean that more change management and engagement from the organization is required. As described in section 3.1, the competence of healthcare professionals in digitalization of e-health is promoted by organizational and collegial support. Thus, one can believe that a more complex implementation requires more engagement of colleagues and the organization as a whole, thus promoting change management.

Another statement strengthening this theory is that of the e-health company internal meeting notes from On-Site Support where the following was said about PCU-D (scoring 2 on the compatibility grade):

> *We see a negative trend with the staff and the management. They are satisfied with the previous workflow and easily fall back into old habits when using the system. [...] It is hard to turn this negative trend around when the management is not on board. It is required that they change their workflow and to do that we need the healthcare organization on our side.*

Another theory as to why PCU-B, PCU-C, and PCU-J were particularly successful in the subjective opinion of the staff members could be that these workflows tend to be less stressful than the drop-in receptions. PCU-B had an asynchronous workflow where patients did not wait in queue for consultation. PCU-C and PCU-J both had a workflow where the majority of patients assessed with the e-health system were referred via telephone triage. Even though this led to the patient needing to explain their symptoms twice per visit (first in telephone triage and later in the e-health system), it meant PCU-C and PCU-J could dictate the inflow of patients. The open drop-in receptions could lead to many patients seeking care at the same time, causing stressful situations, which was something mentioned during interviews in the healthcare organization's evaluation. One can assume that the healthcare professionals needed to manage the situation of many waiting patients in combination while learning a new system meant even more stress.

Key takeaways
The key takeaways are: (i) Compatibility between the system and PCU previous workflow does not seem to affect the success of the implementation; (ii) the definition of a "drop-in reception" is different depending on PCU workflow, but also the individual describing it; and (iii) high PCU engagement indicates success in implementation.

5.2.3 Implementation climate

A summary of observations regarding the implementation climate of each PCU is summarized in Table 5.13. The observations are based on interviews with the e-health company representatives and internal documents from activities during the implementation process, e.g. the PWA and On-Site Support.

Four of the ten PCUs changed managers during or just before implementation. This probably affected the implementation in several ways. A new manager has many things to learn about the organization as a whole, and the implementation of a new system is only one of the new things to manage. We can also see that of the four PCUs with new managers, three PCUs (PCU-A, PCU-G, and PCU-H) received negative total grades or did not finish the pilot. The exception here is PCU-B, which did have new management. However, PCU-B was a completely new PCU without previous routines, and workflows needed to be considered, and management could fully focus on the e-health system workflow. Besides, the manager was previously the manager at PCU-H and was therefore already involved with the project.

Beside PCU-B, PCU-C and PCU-F both created routines describing the workflow while using the e-health system, and also sent them to the e-health company for feedback. Two of them (PCU-B and PCU-C) have positive final grades, which might indicate a correlation between creating routines and having a successful implementation. However, it is not determined that other PCUs never created routines. If they did, they were not shared with the e-health company in any way.

In quite a few PCUs, the ability to engage staff members was questioned by the e-health company representatives. Most often, it was specifically the doctors that were hard to manage, which was the case at PCU-E, PCU-H, and PCU-I. PCU-E naturally comes with challenges because the doctors have a rotating schedule, resulting in a high number of unique users. In the cases of PCU-H and PCU-I, there is no obvious reason why the management was not able to engage the doctors.

One conclusion which can be drawn from the observations in Table 5.13, is that if there were negative opinions leaders within the PCU, they probably were doctors.

Table 5.13: Summary of observations regarding the implementation climate.

PCU	Observations	*G1*	*G7*	*Final grade*
A	Management new on the position, not fully aware of all internal routines yet. Enthusiastic and energetic. High personal engagement, however, had a hard time engaging staff members. Among the staff members there were a few opinion leaders, mostly doctors that had negative attitude towards the project. There were no staff members driving the implementation.	*n/a*	*n/a*	*n/a*
B	Management new on the position (the manager transitioned from being manager at PCU-H). The management was engaged, committed, and was driving and leading the implementation. The management created new routines from scratch based on the e-health system. Since there was no physical premises where staff members were working, there was not really room for any opinion leaders.	*0*	+	+
C	There was a high engagement from the management who worked actively in developing new routines and collecting patient feedback. The management communicated well with the personnel and understood change management. There was one doctor who was very positive and engaged in the project from start, but there were also negative opinions, though not as prominent as the positive doctor. The deputy manager was from start appointed as a formal implementation leader. In addition to this, a local project group was formed that had weekly evaluation sessions.	*0*	+	+
D	The deputy manager and a few staff members helped and drove the implementation. Some individuals of the management was reluctant to make large changes in workflow. The communication within the management was inadequate. There was no prominent opinion leader among the staff.	+	*0*	+
E	The management was engaged in the pilot. However, PCU-E did not employ its doctors and therefore had a hard time engaging them. The deputy manager did much regarding practicalities to help the implementation; otherwise, there was no one among the staff members driving the implementation. There were no prominent opinion leaders observed.	+	*0*	+
F	The management was engaged and did local evaluations while having a high presence at the e-health system reception. There was no formally appointed implementation leader; however, there was a local project group that created internal routines before implementation started. The staff was described as fragmented and the management had some trouble uniting and engaging the fragmented staff. One doctor was a prominent opinion leader, having a negative attitude from start to finish.	*0*	*0*	*0*
G	The manager was new on the position, had not signed up on the project, and was reluctant about the recommended drop-in workflow. The nurses were generally positive, and one of the nurses was appointed as an implementation leader. One secretary mentioned that he or she did not want to change workflows, but was not regarded as being a prominent opinion leader.	*n/a*	*n/a*	*n/a*
H	The manager was new on the position, appointed during the implementation. The management was engaged and had a high presence at the e-health system reception. The deputy manager and a secretary were appointed to drive the implementation. The management had a hard time managing the doctors. A few of the older doctors had a negative attitude towards the project, which was also mentioned by the management to the e-health company.	*0*	-	-
I	The manager was engaged, but had a hard time managing the doctors and did not want to oppose the doctors' group. A few doctors had negative attitudes and one doctor, in particular, had a very negative attitude from day one of the implementation. The nurses and secretaries were in general positive. No staff members were driving the implementation.	+	*0*	+
J	The manager was a bit sceptical towards the project initially and was described as not overly engaged but not completely disinterested. There were no staff member driving the implementation and there were no prominent opinion leaders observed.	*0*	+	+

At PCU-B, PCU-D, PCU-E, and PCU-J there were no prominent opinion leaders observed. At PCU-A, PCU-F, PCU-H, and PCU-I, doctors with negative opinions were observed. At PCU-F, only one doctor had strong opinions, but at PCU-A, PCU-H, and PCU-I there were at least a few negative doctors.

At PCU-I there was especially one doctor who was negative towards the project, but there were also similar opinions from other doctors. At PCU-H, the negative attitudes with the doctors were anticipated by the managers themselves, as quoted by the manager:

> *The doctors are negative since they have 2-3 patients per day coming from the drop-in reception – the rest are assessed by the nurse. They believe that when they work with the e-health system in the drop-in reception, they will need to assess many more patients.*

Based on the information above, in combination with the subjective opinions from the staff survey (G7) where PCU-H scored a median of medians of 2.5 and PCU-I scored 5, the following conclusions can be drawn: There seems to be a correlation between the presence of negative opinion leaders and the subjective opinion of the PCU. This correlation is in line with articles by Leonard [23] and Konttila et al. [17], which both claim that negative attitudes and resistance to change have a negative impact on the implementation. One can assume that the negative attitude among the doctors could have spread within the PCU, affecting the general opinion, and ultimately the staff survey results. The healthcare organisation's evaluation also mentions that, of the staff roles answering the survey, doctors overall scored lowest while secretaries scored highest.

Two of the PCUs (PCU-C and PCU-F) appointed local project groups which worked with management in creating routines and evaluating the ongoing implementation. Since PCU-C received a total grade of "+" and it was not possible to conclude anything regarding PCU-F, it could potentially be the case that a local project group is a success factor during implementation. However, it is not certain that there were not local project groups at any other PCU.

Some PCUs did have appointed implementation leaders driving the implementation. In some cases, the implementation leader was a member of the management, in others, the implementation leader was a staff member. However, at PCU-A, PCU-I, and PCU-J there were no apparent implementation leaders. When comparing this information with the final grade, no conclusion could be drawn.

Key takeaways

The key takeaways are: (i) creating routines could lead to more successful implementation; (ii) a higher presence of strong negative opinion leaders (especially among doctors) has a negative impact to the success of the implementation; and (iii) the presence of local project groups could lead to a more successful implementation.

5.2.4 The implementation process

The planned implementation process was the same for all PCUs except PCU-B, which was treated differently since it was a new PCU. Chattopadhyay et al. [22] suggest that a systematic implementation process should be divided into three phases (see Fig. 3.1). During phase 1, four activities should be conducted: (i) background information of the individual PCU; (ii) preparedness study; (iii) gap analysis or requirement specification; and (iv) design of implementation strategy. The three first activities were managed during the PWAs, which brought up both background information of the PCU and the planned workflow. After the PWAs, the e-health company analyzed the results, where PWA reports including individual recommendations were sent back to the PCU, corresponding to a gap analysis. The design of the implementation strategy was the planned implementation process seen in Table 4.2.

The second phase explained by Chattopadhyay et al. [22] is executing the implementation according to the preparations made in the first phase. Of the six activities planned to be executed (seen in Table 4.2), the Superuser Education was never requested to be performed as an individual activity. The Booked visits Education was executed; however, it was only executed at PCU-H at the end of the pilot.

The third phase as suggested by Chattopadhyay et al. [22] was an evaluation of the implementation. The healthcare organization conducted an evaluation based on the project goals set up before implementation. However, the majority of project goals set up were not possible to evaluate properly, as discussed in section 5.1.9 and 5.3.

Considering this, the implementation process during the pilot was mostly conducted according to the theory, especially the first and second phases. Even though the third phase was conducted, it was not conducted in the best possible way.

Having the Superuser Education as a separate activity might have helped the implementation of each PCU. By having local superusers, the local knowledge about the system would have increased, including the possibility of local education through the superusers, without the need for additional external education from the e-health company. Superuser Education was also asked for by the PCU personnel, as stated in the healthcare organizations evaluation report. One can assume that having local

knowledge and support would have decreased the need for the e-health company representatives' On-site Support. This is also in line with Konttila et al. [17] and Leonard [23], who claim that the education of healthcare professionals is a factor of success in implementing an e-health system.

One interesting comparison is that of the PCU-B implementation process compared to the rest PCUs. Of the activities in Table 4.3, PCU-B only had the Go-Live Education. However, since PCU-B was started on a rather small scale, several training sessions were held for new staff, and since the management participated in these sessions in combination with using the system themselves, they in some sense became superusers. However, this is not the only aspect that differs from the other PCUs – since PCU-B only worked with the e-health system reception, they did not need to manage or do any changes to other receptions or workflows, but could rather fully focus on the e-health system workflow.

One thing which is estimated to have had a large negative impact on the planning and execution of the implementation is the appeal which was tried from September 2018 to February 2019. Not only did it delay the project, but it also stretched out the time between the activities in the implementation process. In the planned implementation process seen in Table 4.2, both the Introductory Meeting and Premises and Workflow Analysis were planned to be held three to four months ahead of go-live. Even while the appeal was ongoing, the implementation process was started; Introductory Meetings and PWAs were held in November to December 2018, and Go-Live was in August to September for most PCUs[1], 8 to 10 months instead of 3 to 4 months later as planned. Even though the system was introduced to the entire PCU during the Introductory Meetings, it is safe to assume that many details were not remembered by the staff members 8 to 10 months later.

To manage this problem, workshops were added in May 2019, where the e-health company representatives visited the PCU for half a day to let the personnel try the system in a test environment. However, this event was not mandatory – the personnel were encouraged to participate in the workshops, but it was not a requirement. The main source of knowledge of the system was supposed to be Go-Live Education, but since these were not mandatory either, some staff members worked in the system without proper education and sometimes without even having seen the system at all before using it. As mentioned above, this is not in line with Konttila et al. [17] and Leonard [23], who claims that the education of healthcare professionals is a factor of success in implementing an e-health system. The recommendations from the

[1]PCU-A started in May and PCU-B in June; the others started between August and September.

e-health company was that all staff members should participate in education before using the system, however, the enforcement was ultimately the healthcare organization's responsibility.

Key takeaways
The key takeaways of this section are: (i) the implementation process conducted in the pilot was mostly executed according to theory; (ii) the absence of local superusers probably led to more on-site support; (iii) because no education event was mandatory, on several occasions personnel used the system without proper knowledge; and (iv) the appeal led to a drawn-out implementation process.

5.2.5 Rapid or gradual start

The healthcare organization's evaluation presented that staff members tended to respond more positively at PCUs which had adopted a more gradual start to the implementation. A more gradual start in this case means fewer users and a limited number of patient complaints initially. Table 5.14 compares two key figures with the results of the evaluation.

Table 5.14: Key figures of visits per week.

PCU	A	B	C	D	E	F	G	H	I	J
Estimated visits per week[1]	n/a	96	58	60	139[2]	45	n/a	105	105	46
Limited complaints initially	No	Yes	Yes	No	No	No	No	No	No	Yes
G1	*n/a*	*0*	*0*	+	+	*0*	*n/a*	*0*	+	*0*
G7	*n/a*	+	+	*0*	*0*	*0*	*n/a*	-	*0*	+
Final grade	*n/a*	+	+	+	+	*0*	*n/a*	-	+	+

Analyzing the Table 5.14 allows for some interesting observations. First of all, two key figures have been obtained regarding the number of visits per PCU. They are (i) the estimated number of visits per week and (ii) if the PCU workflow was adopted to only allow for limited reasons for patient visits initially. When comparing the number of visits per week it is hard to distinguish a pattern. However, comparing if the PCU initially adopted limited reasons for visits indeed confirms the healthcare organization's report stating that the PCUs limiting the number of causes initially seem

[1] Estimated by dividing the number of finished visits with the number of active weeks in the system.
[2] The e-health system reception was one of five receptions, so increasing the number with a factor 5 would give a more fair comparison with the estimated number of visits prior implementation.

to score better on the staff survey (G7).

In addition to the limited number of reasons for patient visits, the healthcare organization's report states that limiting the number of professional users was also considered a part of the gradual start. One reason to why this is the case could be that fewer users per week meant that each user got to use the system more consistently with more active hours working in the system, leading to higher individual knowledge of the system. This is also in line with Konttila et al. [17], who suggest that the competence of healthcare professionals in digitalization is promoted by the healthcare professionals using the system more frequently.

Another aspect of the gradual start is how to choose which patients should be selected to be a part of the gradual start. A rapid start indicates that all patients are allowed to use the new, digital way of seeking care from the start, while a gradual start means that the PCU need to actively decide which type of patients should be allowed to use the digital reception. This raises the question of how to select and categorize these patients; should the patients be categorized by their conditions, should they be categorized by their age or should they be categorized in another way? One could assume that the most equal decision is to let all patients use the system equally from the start, but is it the most ethical decision in the long term, if that decision could lead to a less successful implementation overall? However, since these aspects were not in detailed studied during the writing of this thesis, no conclusions could be made.

Key takeaways
The key takeaway of this section is that a gradual start of the implementation in terms of number of possible patient complaints and the number of professional users indicates higher chances of successful implementation.

5.3 Suggestions for improved evaluation

One problem during the implementation was the evaluation of the predetermined project goals, as discussed in section 5.1.9. When writing this thesis, other ways of evaluation were considered, which could improve future evaluations. In this section, those ideas are presented.

5.3.1 Indirect measurements

While user data from the e-health system are easily accessible, the system can of course only show statistics from direct usage, like the number of patients, most common rea-

sons for visits, etc. Although data generated enable high-resolution analysis, it can not fully explain how the usage of the e-health system affects the PCU as a whole. The healthcare organization's evaluation reported that the use of the e-health system leads to e.g. more available doctor's appointments. However, since the number of available doctor's appointments was available in the PCU booking system, it was not possible to see these types of indirect impacts by only analyzing data from the e-health system.

Constant measurement throughout the project
Many of the goals of this project depended on baseline data reported in the PGR document. First of all, the parameters that were measured were not entirely objective and left room for interpretation by each PCU. This makes comparisons between PCUs uncertain, and the more room for interpretation of each PCU, the higher the risk of receiving different measurements. However, if one assumes that the same person would do the measurements at each PCU and that that person did measurements in the same way before, during, and after implementation, these measurements would hopefully be comparable within the PCU. During the pilot, though, there was no indication of these PGR documents being sent out other than before the implementation. One possible cause of this is that most of these parameters could be exported from the e-health system, which was much more convenient for the PCUs than doing manual measurements. However, since the parameters are measured very differently (one manually by the manager, and one via user data in the e-health system), the comparison becomes very uncertain.

If a project goal is intended to be measured by comparing baseline data with data from using the e-health system, the parameters should still be measured in the same way before, during, and after implementation. Another option is to create a PGR document that is tailored to generate measurements which is comparable with the e-health system user data. However, this is very hard, and even if the instructions are very clear, there will always be room for interpretation of manual measurements.

Phone calls
In the recommendations seen in Table 4.4, it is stated that the workload of the telephone triage should be relieved by using the e-health system as a drop-in reception. However, the actual effect of this was never evaluated. It would have been interesting to count the number of phone calls per week before and after implementation. One positive aspect of the phone calls is that it is an objective measurement, easy to compare both within the PCU as well as between PCUs.

An additional aspect of this measurement would be to compare the average phone call length before, during, and after implementation. Since patients with complex

symptoms were to be referred to the e-health system reception, it could be expected that using the e-health system would reduce the average duration of telephone calls. This is a measurement that also should be easy to export and to compare.

5.3.2 Goals on PCU level

One way of engaging the management and staff members of the individual PCU could be to set up specific goals for each PCU. What is made clear while writing this thesis is that the workflows and routines of each PCU were very different. Because of this, it may be a good option to create goals individually with each PCU, which could bring value and nuance to the overarching project goals.

Chapter 6
Conclusion

This chapter concludes the thesis. Firstly, the findings are summarized and explained through the research questions. Secondly, the thesis' contribution to theory are presented. Thirdly, the limitations of the thesis are described. Lastly, suggestions for future research are presented.

6.1 Summary of findings

The purpose of this thesis was to identify success factors for the implementation of the e-health system in primary care. The implementation has been studied through reviewing documents, conducting interviews, and analyzing user data from the e-health system. Below are the conclusions from the findings, divided into the research questions created at the start of this thesis.

6.1.1 RQ 1: What are the key factors for a successful implementation of a e-health system in primary care?

The key factors to a successful implementation rendered from this thesis could be roughly divided into three factors: (i) local engagement of the PCU; (ii) local knowledge at the PCU; and (iii) well-defined and easy-to-evaluate project goals.

The local engagement of staff members and management is considered a key factor. Patterns indicate that the presence of local project groups working actively with the implementation such as creating routines had a positive impact on the implementation. Furthermore, the presence of negative opinion leaders seemed to impact the implementation negatively.

During implementation, training in the system is one of the most important activities. In the implementation process, there were several indications that local knowledge of

the system was limited during the process, as discussed in section 6.1.3. One potential reason why a gradual start seems to correlate with the success of implementation could be that the local knowledge of the system was allowed to accumulate. Involving a few users meant that each user worked more hours in the system, thus increasing the individual knowledge of the system.

The evaluation of the implementation is an important part of the implementation process. To achieve well-defined project goals, it is essential that the parameters chosen are easy to measure and compare before, during, and after the implementation and that parameters are measured the same way each time. Furthermore, it is recommended to have both quantitative and qualitative goals since the perception of success is as dependent on subjective opinions as objective results.

6.1.2 RQ 2.1: What is a successful implementation?

An implementation could be considered successful when most stakeholders attain their major goals and do not experience significant undesirable outcomes, as argued by Cohen [2]. However, since baseline data which laid the foundation for the evaluation of this project were inadequate, it was not possible to use this definition for the majority of the project goals. Furthermore, this definition of success heavily relies on the quality of the project goals and the data to support the evaluation. Because of the limitations of the baseline data, the success or failure presented in this thesis are only estimates and not definitive. To try to prevent a similar situation for future implementations, suggestions for improvement in terms of evaluation and project goals were presented.

Another thing to consider is that efficiency gains resulting implementation of new technology have a time lag [23, 26]. Before any gains are visible, the workload will rather increase first as shown in Fig. 3.2. This should be taken into consideration when determining project goals to evaluate the implementation, as well as their timing.

Measuring the success of the implementation by evaluating project goals is one definition of success. However, regardless of the definition, the perception of success or failure depends at least as much on the local implementation climate as on objective measurements, as argued by Cohen [2]

6.1.3 RQ 2.2: Which activities in the implementation process are particularly important?

Four key lessons were concluded regarding the implementation process: (i) the implementation process conducted in the pilot was mostly executed according to theory; (ii) the absence of local superusers probably led to more on-site support; (iii) because no education event was mandatory, personnel used the system on several occasions without proper knowledge; and (iv) the appeal led to a drawn-out implementation process.

The implementation process mainly followed theory. However, the most prominent exception was the lack of evaluation, caused by inadequate baseline data. Since the position of superusers was not clearly enforced by the PCUs or the healthcare organization centrally, there were no staff members formally responsible for supporting colleagues. The presence of Superusers was also requested by staff members in the healthcare organization evaluation. In addition to this, the healthcare organization did not require that staff members undergo training before using the system, which probably led to personnel using the system incorrectly. The appeal led to a drawn-out implementation process, which meant there were long intervals between activities. It was hard to do anything regarding the appeal, other than waiting to start the implementation until it was established that the implementation actually would start. The common denominator of the three latter factors is that they limited the staff members' knowledge of the system.

6.1.4 RQ 2.3: How do the primary care unit routines and prerequisites affect the implementation?

The comparison of the compatibility of each PCU with the recommended workflow presented in Table 5.12 shows that rather than there being an advantage of having high compatibility with the recommended workflow, there seems to be an advantage to have little to no compatibility. The cause of this is believed to be because limited compatibility requires the PCU to engage more in developing new routines and workflows. When it comes to staffing prerequisites, having few employees probably makes it harder to dedicate resources to drive the implementation, which was the case of PCU-G.

6.2 Contribution

The contribution to theory is the usage of the Consolidated Framework for Implementation Research (CFIR), which was developed as a general framework for evaluation of e-health implementation. Each new publication using a common framework can contribute to refining the framework to achieve a reference standard for this type of research. Another contribution to research is the insight into the different variations of data analysis that could be conducted when using sophisticated e-health interventions in primary care. It gives insights into potentials of data-driven change management made possible with automatically generated user data. Lastly, even though the influencing factors are solely based on the implementation of one e-health system, one can assume that some factors are also applicable to other e-health interventions.

6.3 Limitations

One of the limitations of this thesis is the author's perspective. The author's perspective is from that of the manufacturer of the intervention, trying to find what factors to focus on for future implementations. Much more information could be investigated by doing more research on a micro-level. e.g. interviewing and observing individuals using the system. There are also probably more factors that influenced this implementation that were not mentioned in this thesis. Another limitation of this thesis was that interviews were held online because the author of the thesis was geographically far away from the interviewees and because of the ongoing covid-19 pandemic.

The inadequate amount of data available was a limitation of the pilot in itself, which of course limited this thesis as well. In addition, the thesis was made retrospectively, which increased the risk of overinterpreting the fit of the summarized data compared to if hypotheses were predefined and validated.

6.4 Future research

As this thesis was written from the manufacturer's perspective, it would have been interesting to conduct the equivalent research from the PCU perspective. One of the most important factors of the implementation appears to be local engagement, so research on this topic could give deeper insights into what impact the engagement of the PCU has on intervention success. A third perspective could be one of the patients, where research could give insights into how the system brings value to the patient.

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Appendix A: Conducted Interviews

Role	Date	Duration
Doctor	2020-10-16	150 min
Nurse	2020-11-05	120 min
Customer Experience Specialist	2020-11-11	120 min
Nurse	2020-11-12	120 min
Doctor	2020-11-15	120 min

Appendix B: Interview Guide

Introduction

- Introduce myself and the purpose of this thesis.
- Go through the suggested agenda of the interview.

General questions

CFIR domain 1 - Intervention characteristics

- Intervention source - Was the stakeholder's perception that the intervention was internally or externally developed?
- Evidence strength and quality - Did stakeholders perceive the intervention to be of high quality and having validating evidence of the desired outcome?
- Relative advantage - Was there a perception amongst the stakeholders that the system had an advantage compared to alternative solutions?
- Adaptability - To what degree could the intervention be adapted to meet local needs?
- Trialability - Could the system be tested on a small scale within the PCU?
- Complexity - Did the implementation require significant reorientation and non-routine processes?

- Design quality and packaging - Was the system perceived as well designed and assembled?

Visted PCUs

- Which of the PCUs have you visited more than one time?

PCU specific questions

The following questions were asked for each PCU that the interviewee had visited more than one time.

CFIR domain 3 - Inner settings

- Structural characteristics, networks and communications, Culture - Please give a short introduction to the PCU (i.e size, social networks, culture, workflow)?

Implementation climate

- Tension for change - Based on the current situation, was the PCU in need of change?
- Compatibility - Was the system well aligned with the current PCU workflow?
- Relative priority - Was this implementation of high importance within the PCU?
- Organizational incentives and rewards - To what extent did the PCU have internal incentives and/or rewards following a successful implementation?
- Goals and feedback - To what degree were goals clearly communicated, acted upon, and fed back to staff?
- Learning climate - To what extent did leaders express their own fallibility and need for staff assistance and input?
- Readiness for implementation - To what extent were there indicators of the PCUs' commitment for implementation?
- Leadership engagement - To what extent was the leadership committed to and involved in the implementation?

- Available resources - To what extent did the PCU dedicate resources to the implementation (i.e. training, education, physical space, and time)
- Access to information and knowledge - To what extent did staff at the PCU have easy access to information and knowledge about the system?

CFIR domain 5 - Process

Planning and executing

- Was there a well developed scheme of tasks to be completed during the implementation?
- If there was a set of tasks, was the implementation executed according to these tasks?

Engaging

- Opinion leaders - Did the PCU have formal or informal opinion leaders who had an effect on the engagement of the PCU in general?
- Formally appointed internal implementation leaders - Did the PCU have formally appointed (internal) implementation leaders?
- Champions - Were there any individuals within the PCU who dedicated themselves to help support and drive the implementation?
- External change agents - Were there any individuals outside the PCU influencing the intervention decisions in a desirable direction?

Reflecting and evaluating

- Was there any quantitative and/or qualitative feedback about the progress and quality of implementation to the PCU?