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NOORA MESIÄ

ICT IN CHRONIC CARE

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Kroonisista sairauksista kärsivien potilaiden määrä on jatkuvassa kasvussa. Krooniset sairaudet, joihin lukeutuvat muiden muassa astma, sydänsairaudet sekä unettomuus, vaativat jatkuvaa lääkinnällistä hoitoa, rajoittavat potilaiden toimintamahdollisuuksia sekä vaivaavat kestoltaan yli vuoden. Krooninen potilashoito toteutetaan terveydenhuollon ammattilaisten sekä potilaan kanssa yhteistyössä siten, että terveydenhuollon ammattilaiset antavat ohjeita ja tukea, mutta he toimivat pääsääntöisesti valmentajina hoitosuhteessa.

Tieto- ja kommunikaatioteknologioiden (ICT) nähdään tarjoavan hyötyjä terveydenhuollon palveluille. Näihin teknologioihin kuuluvat muiden muassa päätöksentekoa tukevat järjestelmät, tietojärjestelmät sekä kommunikointijärjestelmät. Esimerkiksi terveydenhuollossa ICT:n tuottamien toimintojen avulla voidaan säilöä, hallita sekä siirtää dataa, saada tukea kliiniseen päätöksentekoon sekä tarjota hoitoa ja neuvontaa etäisesti.

Tämän työn tarkoituksena on selventää miten ICT:n hyödyntämisellä voidaan kehittää kroonista potilashoitoa. Tämän lisäksi kartoitetaan Leanin tarjoamat hyödyt krooniseen potilashoitoon. Työ toteutettiin osana Fujitsu Finlandin LeanMyCity-projektia, jonka tarkoituksena on suoraviivaistaa hoidon tarjontaa sekä työskentely-ympäristöä.

Tutkimus toteutettiin teoreettisen ja empiirisen tutkimuksen yhdistelmänä. Teoriaosuudessa käsitellään kroonisen potilashoidon ominaisuuksia, esitellään Suomen terveydenhuollon tilannetta ICT:n näkökulmasta, sekä tarkastellaan ICT:n ja Leanin tarjoamat mahdolliset hyödyt krooniseen potilashoitoon. Empiirisessä tutkimuksessa on haastattelemalla arvioitu tämän hetkistä kroonista potilashoitoa sekä ICT:n hyödyntämistä Suomen neljässä yliopistollisessa sairaalassa: Helsingissä, Kuopioissa, Tampereella sekä Oulussa.

Tutkimuksen löydöksistä voidaan todeta, että ICT tukee kroonista potilashoitoa mahdollistamalla helpompaa kommunikaatiota, parantamalla hoitoon pääsyä, tuottamalla informaatiota, keskittämällä huomiota sekä auttamalla oireiden seurannassa. Lisäksi hoidon potilaskeskeisyyttä voidaan lisätä asettamalla potilaan sähköisiin terveystietoihin automaattisia hälytyksiä, jotka parantavat potilaan turvallisuutta ja hoidon tehokkuutta. Koska Lean keskittyy virheettömyyteen, tämän hyötyihin sisältyvät muiden muassa odotusaikojen, toistuvien käyntien, turhien operaatioiden sekä virheiden väheneminen.

Empiirisen tutkimuksen mukaan tällä hetkellä tietojärjestelmät ovat kuitenkin liian vaikeita käyttää ja näiden sovittaminen tarjottuun hoitoon ei ole niin sujuvaa kuin pitäisi. Yhteentoimivuuden taso eri järjestelmien välillä vaatii paljon kehitystä. Jotta järjestelmien kehittäminen ja yhdistäminen olisi onnistunutta, tulee terveydenhuollon tuottajien mielipiteitä kuunnella huolellisesti heti kehitysprosessin aikaisissa vaiheissa.

ABSTRACT

NOORA MESIÄ: ICT in Chronic Care
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The amount of patients suffering of chronic conditions increases all the time, while the health care delivery is already struggling with the demands of the acute care patients. Chronic conditions, such as asthma, heart disease and insomnia, require continual medical treatment, restrain the ability to function and sustain longer than one year. It is estimated that by the year 2020 the elder population will outnumber the younger, which will increase the demand of chronic illness care even more. In chronic care, the collaborative execution of care and patients' self-management of their conditions are highlighted. Additionally health care professionals provide guidance, instructions and support.

ICT has been seen to provide benefits in regards of health care services. ICT includes for instance decision support systems, information systems and communication systems. For example the functions provided by ICT are related to storing, managing and transmission of data, clinical decision support and facilitating care and guidance from distance.

This study was executed in order to clarify how the utilization of ICT could improve the execution of chronic care. Also the benefits provided by Lean for chronic illness care are evaluated. This thesis was executed as a part of Fujitsu Finland's LeanMyCity project, which aims to streamline the delivery of care and to improve the working environment. By applying Lean methods, LeanMyCity aims to accomplish more with less.

The study was executed as a combination of theoretical research and empirical research. In the theory part the properties of chronic care, the state of Finnish health care, as well as the possible benefits that the utilization of ICT and Lean to the chronic care are examined. In the empirical part, the current situation of chronic care and the utilization of ICT systems are evaluated from four of the university hospitals in Finland.

From the findings in the research it can be concluded that ICT supports the chronic care by allowing easier communication, enhancing the access to care, providing information and supporting the management of chronic conditions. Also the planning and execution of care are improved, for instance by adding patient-centered alerts in to patient's health record, thus increasing the effectiveness of the treatment as well as patient safety. As Lean focuses on zero defects, the benefits provided by Lean include reduced waiting time, delays, repeat visits, unneeded procedures and errors. Lean aims to develop the treatment to be delivered in such a way that all steps in the processes provide value for the patient.

However, current information systems are seen to be too difficult to use, and their alignment to the given care is not as smooth as it should be. The level of interoperability between different systems requires a lot of improvement. For the development to be successful, the views of the health care providers must be recognized carefully early on.

PREFACE

I want to thank everyone who participated into this master's thesis process: especially the interviewees for valuable interviews, and my instructor Samuli Pekkola for the guidance throughout the writing process. Due to the valuable feedback received, this thesis is now at its current status. Also my thanks belong to Fujitsu Finland, especially to Mauri Mikkonen, for providing this opportunity.

Last but not the least, friends and family. Through all this time. Thank you!

Tampere, 12th of December 2015

Noora Mesiä

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TERMS AND DEFINITIONS

CCM	Chronic Care Model
CDSM	Chronic Disease Self-Management
CDSMP	Chronic Disease Self-Management Program
CDSS	Clinical Decision Support Systems
Chronic illness	Any kind of illness or condition, which requires continual medical treatment, restrains the ability to function and that sustains longer than one year (Kanste *et al.*, 2009a).
CIS	Clinical Information Systems
CMM	Community Matron Model
CPG	Clinical Practice Guidelines
CPOE	Computerised Provider/Physician Order Entry
EBM	Evidence-Based Medicine
ECCM	Expanded Chronic Care Model
HER	Electronic Health Record
EMR	Electronic Medical Record
EPR	Electronic Patient Record
ERP	Enterprise Resource Planning
IS	Information Systems
HIN	Health Information Network
HIS	Health Information System
HIT	Health Information Technologies
ICT	Information and Communication Technologies
JIT	Just In Time
KanTa	National Archive of Health Information. A collective name for several national medical information systems including for instance eArchive, ePrescription and access of citizens’ to their personal medical data (Winblad *et al.*, 2008)

Lean	A philosophy that sets out principles and practice of costs by eliminating waste and simplifying all manufacturing and supporting systems to maximize the value flow experienced by the customers (Burgess & Radnor, 2010; Stojkic *et al.,* 2014).
Living Strong	A project based on Chronic Disease Self-Management Program to improve the state on health and well-being of chronic care patients in Finland (Association of Finnish Local and Regional Authorities, 2015).
OECD	Organization for Economic and Cooperation and Development
PACS	Picture Archiving and Communication System
RIS	Radiology Information System
Self care	Care executed by individuals towards their own health and well-being, comparing the actions to lead a healthy lifestyle to meet the social, emotional and psychological needs, to care their long-term condition and to prevent further illness or accidents (Lorig, 1996; Harrison *et al.,* 2011).
Self-management	Individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes caused by living with chronic condition (Barlow *et al.*, 2011).
THL	The National Institute of Health and Welfare
VSM	Value Stream Map, a tool in Lean which aims to clarify the production line and divide all actions based on whether or not they add value to the customer. The actions which do not provide value should identified as waste and be removed from the production (Poksinska, 2010; Toussaint & Berry, 2013).
Waste	In Lean waste is defined as the functions in the production line that doesn't provide value to the customer and should be removed; in health care waste can be seen for example as overcapacity, duplicate procedures, repeat visits and waiting times (Kollberg *et al.,* 2006; Burgess & Radnor, 2013).
WHO	World Health Organization

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1. INTRODUCTION

As the challenges related to chronic care have increased continuously, and the demands set on health care delivery require constantly more development, the purpose of this thesis is to give understanding of how Information and Communication technologies (later referred as *ICT*) can be applied to chronic care in order to support and efficiency the provided care in health care system in Finland. In this introduction chapter the research background is introduced together with the problem statements, the research method and the outline of this thesis.

1.1 Research background

The expenditure for health care have been increasing in Finland yearly. In 2013 health expenditure increased 1,9 % from previous year (Matveinen & Knape, 2015). In international comparison, Finnish health expenditure in relation to GDP (9,0%) is slightly below the OECD average of 9,3 % (Matveinen & Knape, 2015).

The largest expenditure categories in 2013 were services in secondary health care and primary health care (Matveinen & Knape, 2015). Primary health care includes monitoring and promoting citizens’ health generally in addition to dental health care, medical, home health care, home-hospital and hospital health care, outpatient care, mental health care and rehabilitation services. Secondary health care contains services, which are performed by medical specialists and specialist-led teams. (Teperi *et al.*, 2009, p. 48; Kapiainen *et al.*, 2015)

Kanste *et al.* (2009b) state that approximately 25% of patients use 80% of health care services in Finland. Usually these patients suffer of multiple chronic illness of long-term conditions (Barlow *et al.*, 2002). According to Hämäläinen *et al.* (2013), chronic lifestyle illnesses will become more common in future. This is seconded by Muurinen *et al*. (2010, p. 13), as they state that the health care services are currently at a breaking point.

Chronic illness care differs from acute care for instance by its onset, duration, cause and uncertainty (Lorig, 1996). One especially highlighted aspect in chronic illness care is the patients’ role in self-managing their own conditions, since chronic care often requires extensive lifestyle changes regarding for example nutrition and exercising (Harrison *et al.*, 2011; Mills *et al.*, 2015). Hence the care provided by health care professionals for chronic conditions should be designed individually, having patient-centeredness in mind and taking the patients along with their families into the designing process (Lorig, 1996; Farrel *et al.*, 2004; Lawn & Schoo, 2010; Miller *et al.*, 2015).

United Nations present an estimation that by 2020 the older population will outnumber the younger population, which combined with the increasing prevalence of chronic illness creates a heavy demand on the finite resources in health care in both money and personnel (While & Dewsbury, 2011). According to Barlow *et al.* (2002), the burden of meeting the needs of the growing number of people with chronic health conditions falls upon already overstretched health care services that are struggling to cope with the demands of acute care. Elzen *et al.* (2007) stress the need for change in developing care, since the number of older people with chronic conditions is continuously increasing. In addition to aging population and chronic diseases, also spiraling costs, shortage of qualified personnel and epidemics are challenging the health care delivery (Yang *et al.*, 2015).

Due the challenges in health care service delivery, patient treatment chains are incomplete and the patients do not get equal treatment in both the availability and the quality of health care services. Yet access and equity are necessary characteristics of optimal health care systems, and patients expect that provided services are well organized and they are patient-centered. The large variations in health care quality and costs are signals of a lack of consensus regarding best practices in the organization of care delivery itself. (Teperi *et al.*, 2009, p 20; Bailsford & Visser, 2010; Muurinen *et al.*, 2010, pp. 13-14; While & Dewsbury, 2011)

The value of health service lies in the health outcome (Teperi *et al.*, 2009, p. 20). The value created by health care must be continuously improved, and every health care system will have to use its resources more effectively (Bailsford & Visse, 2010). At the moment most of the care delivery is not organized in a way that maximizes value: Teperi *et al.* (2009, p. 26) states that currently care is organized by specialty or intervention – the care of the patient's medical condition and rehabilitation are separate entities, that may even have competing interest. Too often the focus is on acute care, even with patients with chronic diseases (Kanste *et al.*, 2009a).

In addition, Teperi *et al.* (2009, p. 28) note that when patients see and meet many clinicians across multiple sites, no individual provider has the time or responsibility to ensure that patients understand what is expected of them. The complexity of uncoordinated visits may lead to confusion over the patients' responsibilities and uncertainty about who to ask for guidance regarding treatment and medications. Patients' treatment process is lacking a clear point of contact, even within the treatment of chronic illness care, which should be organized continuously and focusing on patient-centeredness. (Michie *et al.*, 2003; Poksinska, 2010). However, ICT have been seen as an answer for enhancing and improving health care delivery and its coordination (While & Dewsbury, 2011).

The World Health Organization (later referred as WHO) has stated that ICT holds great promise for improving health and health care around the world (Abott & Coenen, 2008). Haux (2006) lists the benefits of Health Information System (later referred as *HIS*) development including for instance the shift from paper-based to computer-based processing and storage of patient data. Patients and health consumers are seen as HIS users, which expands the use of HIS data not only for patient care and administrative purposes, but also for health care planning and clinical research with multitude health care professionals and providers (Grimson & Grimson, 2002; Haux, 2006; Hämäläinen *et al.*, 2013).

The use of ICT in Finnish health care is currently under development, and according Winblad *et al.* (2008), the appliance of ICT is going through a radical grow. Kivinen and Lammintakanen (2013) note that the emphasis in health care information systems development has been on clinical systems, such as electronic patient record (later referred as *EPR*). However, according to Alkio (2011, p. 165-166), the use of HIS is still relatively inefficient in Finland: for instance patient information system is rather shattered and currently there does not exist any one, holistic system for handling all national patient data.

Rapid changes in the operating context and characteristics such professional culture, complicated organization structure and management system, makes health care a complex environment for information systems (Kivinen & Lammintakanen, 2013). Saranto *et al.* (2007, p. 211) argue that the development of interoperable information systems is the greatest challenge is utilizing HIS. However, according to Yang *et al.* (2015), focusing on development of integrated HIS does provide for instance a possibility of enabling automation, integration and management of clinical and administrative functions in health care, thus having potential to lower costs, relieve the workload of health care professionals and obtain improvements in health care quality.

Also Lean has been seen as a philosophy which could enhance the quality of health care in health care delivery, especially within chronic care patients. Lean is a philosophy which focuses on developing the service delivery in a way that the value emphasized by the customer is maximized. The actions within the service delivery that do not add value are recognized as *waste*. As waste in health care can be recognized for example duplicate procedures of patients, repeat visits to health care centers, and waiting time, which do not add value. The most common outcomes in health care provided by Lean are for instance enhanced patient satisfactory, reduced bureaucracy and waiting, and improved, clarified treatment chains.

1.2 Objectives, research questions and limitations

The main objective of this thesis is to investigate how chronic care can be improved with utilizing ICT. There are also two additional research sub-objectives: first sub-objective is to investigate if there are currently local solutions carried out with good experiences, which could be adaptable to other health service providers in Finnish health care. Second sub-objective is to examine how Lean provides benefits to chronic illness care.

To reach the objectives of this research, the research questions for this thesis was stated. The answers to these questions will lead towards achieving the objectives. The main research question for this thesis is "***How chronic illness care can be improved with ICT?***". The answer for this question will be gathered from four supporting research questions, which are

1) *How chronic illness care is executed in Finnish health care?*
2) *How does ICT support currently these health care services and operations?*
3) *What are the needs in the future chronic illness care for ICT?*
4) *What kind of benefits does Lean provide to chronic illness care?*

Answers for supporting research questions were answered by using both theoretical and empirical approaches. The theoretical approach is executed based on the literature review. The empirical approach is executed by interviewing five health care professionals from four of the Finnish university hospitals with experience of chronic illness care.

The limitations for this thesis has been done due the relevance for this thesis. There are many ways of investigating how health care is carried out, but this thesis is limited to focusing on chronic care. The chronic care patients is the group which uses frequently health care services and creates the greatest costs to health service delivery. Geographically this thesis is limited to Finland, although this thesis takes comparison of how health care is carried out in other countries.

This thesis takes notion that many actions which are performed in health care industry occurs outside the hospital building, although the focus in health care system lies on hospitals. Therefore the whole patient's treatment chain is taken into account. This is highlighted with patients suffering of chronic conditions, since they have to self-manage their illness daily, not only when visiting hospitals (for example Lorig, 1996; Kanste *et al.*, 2009a; Lawn & Schoo, 2010).

Even though there are numeral of ways to carry out chronic care, the thesis presents three operational models which are carried out in Finnish health care, hence giving insight regarding the execution of chronic care. These three models are Chronic Care Model, Community Matron Model and Chronic Disease Self-Management Program, which have been selected because they have been piloted or utilized either wholly or partly in Finnish health care, and they have received good experiences when executed. These models also have a strong theoretical support behind them.

In the third supporting research question, it is presumed that ICT is utilized in the future chronic care. In the fourth research question, only the benefits of Lean is taken into consideration. Even though it is noted that applying Lean into health care does have challenges (for instance Grove *et al.*, 2010; Waring & Bishop, 2010; Radnor *et al.*¸2012), thies thesis premises that Lean is implemented successfully and it is beneficial in health care industry.

1.3 Research methodology and literature

The chosen methodology includes identification of paradigm, justification for choice of methodology and methods, and noticing limitations of the research design (Collis, 2013, p 11). The choosing of research methodology (*"How research?")* is influenced by the research philosophy (*"Why research?"*), which affects to the research approaches and strategies. However, choosing the philosophy is influenced by researcher's assumptions and perceptions regarding to the problem by affecting the research methodological choice and therefore ultimately to the research philosophy. (Holden & Lynch, 2004) Saunders *et al.* (2007) developed the research onion in order to describe the stages of which the researcher must go through when formulating an effective methodology for the research. The research onion has five layers which are illustrated in Figure 1 below.

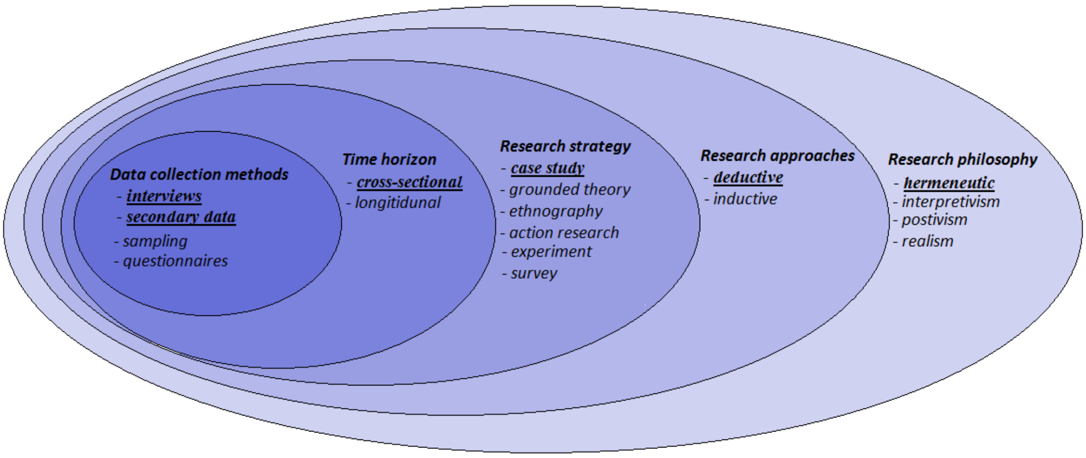


Figure 1. *Appliance of thesis to the research onion of Saunders et al. (2007).*

In the selected philosophy, approach, strategy, time horizon and data collection methods for the thesis are underlined and highlighted in the Figure 1. The first layer in the research onion is the research philosophy. All research is based on underlying assumption about the validness of the research and appropriate research methods (Myers, 1997). By understanding the philosophical stance taken in the research, the intended methods can be justified. The chosen philosophy implies researcher's position of reality (ontology) and the justification of what researcher consider as acceptable knowledge (epistemology) to identify the rationale for the chosen approach. (Johnston, 2014)

This thesis is stated to be hermeneutics by its philosophy. In hermeneutics the reality is seen to be too complex to be understood through observation, hence interpretation should be given more standing than explanation and description in order to achieve deeper levels of knowledge. However, the thesis includes properties of positivism, which considers that reality should be based upon scientific observations. For instance in this thesis an empirical study is executed, hence including research philosophy properties of positivism. (Gray, 2013, pp. 22-24). Thus, even though the selected philosophy is mainly hermeneutic, properties of positivism approach has been applied in this thesis.

The second layer in the research onion is research approach. Research approach is determined by the chosen philosophy and by ontological and epistemological beliefs of the researcher (Johnston, 2014). There are two research approaches in all research: induction and deduction. Inductive research involves the search for pattern from observation and fragmentary details and the development of explanations for those patterns through series of hypotheses. The hypotheses are tested against cases, modified and retested, until more testing are no more required, and a connected view of a situation is reached. In contrast, deductive research begins with a universal view of a situation from theories and hypotheses, and then moves on to observations, which either confirm or falsify the hypotheses. (Bernand, 2011, p. 7, Gray, 2013, pp. 16-18). This thesis is deductive from its approach.

Third layer in the research onion is research strategy, which explains how the researcher intends to carry out the work. The research strategy is influenced by the research philosophy and approaches, and selected strategy affects ultimately to the way of how data is gathered in the research. (Gray, 2013, p. 29). The selected research strategy for this thesis is case study.

The fourth layer of the research onion is time horizon, which is the time framework within which the project is intended to get completed. In the research onion there is two types of time horizons: the cross sectional and longitudinal. Cross-sectional study, such as this thesis, uses snapshot approach, where the data are collected at one point in time, and it is mostly used when the research is under pressure of time and resources. On the other hand, in longitudinal study the research changes and develops over time which also affects to the data collection. That means that data can be regathered in order to answer to the current state of the research (Gray, 2013, p. 35).

The fifth and final layer in the research onion is data collection methods. Data collection and analysis is dependent on the methodological approach used (third layer). Data collection methods include for example interviews, sampling and questionnaires. The way in which data is collected and analyzed affects significantly to the overall reliability and validity of the research (Saunders *et al.*, 2007).

Regardless of the approached used in the research, the collected data can be separated into two types: primary and secondary data. Primary data is that whish is derived from first-hand sources, for example from the respondents in survey or interview data (Gray, 2013, p. 352). Secondary data is data that have already been gathered by other researchers, for example from the conclusions of a research article or analyses conducted on statistical surveys, as well as interviews in earlier studies can be used as secondary data in the research. (Gray, 2013, p. 514) To this thesis both type of data are applied as reference.

In Table 1 on the next page is explained chosen layers from the research onion in Figure 1. The appliance of each choice is stated, as well as the reasoning why the selected methodology has been chosen. This table summarizes the research methodology for this thesis.

Table 1. *Summarized appliance of research onion for this thesis.*

Layer	Appliance	Reasoning why chosen for thesis
Hermeneutic	Earlier literature used in thesis gives only hints from the real world experience of chronic care and ICT's benefits; interpretations must be taken to achieve insight.	The expected results are based on earlier literature together with executed case study. From the empirical inquiry observations are analyzed by the researcher alone, hence observations cannot be said to be exactly scientific, since researcher's understanding together with previous experiences may affect analyzation of data and thus the results to achieve deeper knowledge of the topic.
Deductive	Introduced models are first explained as a literature states, followed by experiences to test the set hypotheses.	Theoretical introduction gives background for executing the interview and introduces the researcher to the topic. The hypotheses based on theory field is tested in the empirical part, from which analyses are taken in order to achieve the research objectives.
Case study	The selected operational models described act as case studies. By collecting information regarding utilization of care models and ICT, the hypotheses based on earlier literature are tested in the interviews.	Case studies describe the benefits and points of development from health care professionals' and patients' point of view. The case studies present empirical support for the thesis, which is otherwise rather theoretical. The interviews act also as case studies, describing how health care professionals see the utilization of ICT and operational models in chronic care as they stand in today's health care delivery. The development points gathered from case studies are concluded from the experiences of the case studies.
Cross-sectional	The interviews provide a snapshot of the current situation of chronic care and utilizing ICT in Finnish health care.	The thesis is executed only once by the researcher, giving understanding of current situation, and the study is not repeated by the researcher. The interviews executed and used literature are gathered during a short amount of time.
Interviews	Employees from the university hospitals in Finland are interviewed in order to get primary data from chronic care and utilization of ICT.	The interviewers are health care professionals with personal experiences of providing chronic care and utilizing ICT. They have opinions and experiences of both working and not working operational models and solutions. These aspects, related to Finnish health care, cannot be drawn from the earlier literature, if earlier studies regarding this topic have not been executed.
Secondary data	Earlier literature, such as scientific articles and case studies are used as reference to receive information and insight for this thesis.	Earlier studies presents for example the theoretical part of this thesis, the background for both chronic care operational models and ICT in health care. The interview statements are based on the theory behind the utilization of chronic care models and ICT, their properties and points for development.

One of the most common classification between research methods is distinction between qualitative and quantitative research methods. Quantitative research focuses on verifying hypotheses or finding patterns, as qualitative research focuses on understanding the important characteristics of typically small samples of data. (Myers, 1997) According to the deductive approach, the chosen research strategy as well as the data collecting methods, this thesis can be classified as qualitative research.

This thesis has both theoretical and empirical nature. The theory field of this thesis can be divided into three categories: first field is chronic care, second is chronic care operational models and final category is ICT in health care. Each theory field is based on the literature, which discusses the nature of the field in question. The literature for this thesis is selected from books and scientific journals related to health care and ICT. More about the literature and its reliability is described in chapter 6.3 Research assessment.

1.4 Thesis outline

This thesis consists of two different sections. First there is the theoretical part regarding chronic care, its execution in Finland and utilization of ICT in health care, which are covered in chapters 2, 3 and 4. The second section handles the empirical side of this thesis in the chapter 5. This is followed by discussion and conclusions. The structure of this thesis gathered in Figure 2 below.

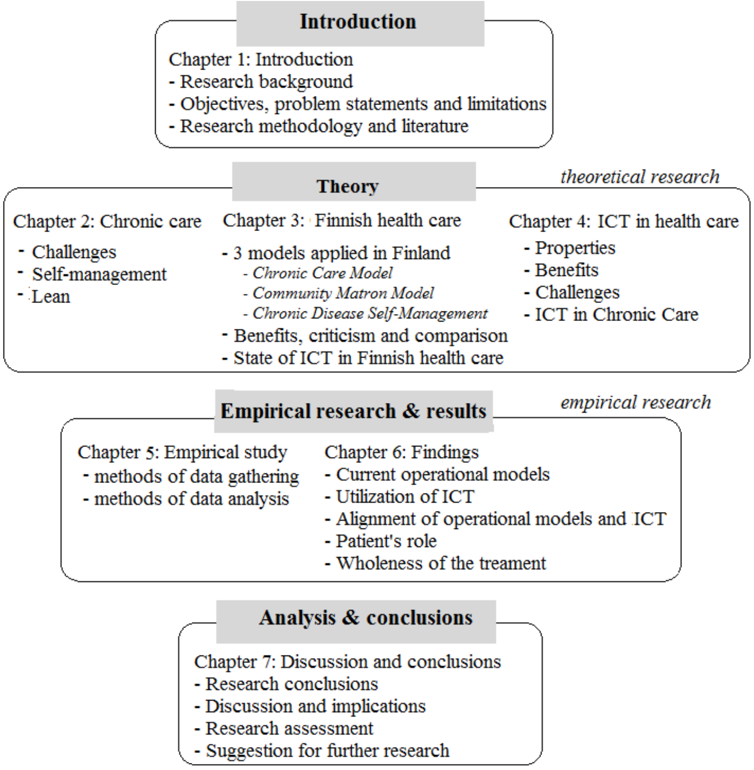


Figure 2. *Research outline.*

After introductions in the second chapter in the thesis presents the properties and challenges of chronic care and also clarifies the aspect of self-management in treating chronic conditions. In the second chapter also the benefits offered by Lean to chronic care are presented. In the third chapter the current state of Finnish health care is evaluated, regarding the operational models for chronic care and the state of utilizing ICT in health care. First operational models are generally introduced, which is followed by the introduction of the three utilized models regarding chronic care in Finnish health care. These models are presented, after which they are compare with each other. This is followed by presenting the current state of ICT in Finnish health care. Third chapter gives answer to the first supporting problem statement on its theoretical nature, and the Lean aspect examines the benefits of Lean in health care and hence giving an answer to the fourth supporting problem statement.

Fourth chapter introduces the current use of ICT in health care in general level. This chapter is divided into four sections. The first part presents the properties of ICT in health care, which is followed by expressing the benefits and challenges that literature review has shown towards ICT in health care in general. After the literature review of benefits and criticism, the focus is shifted to the benefits that ICT could provide especially to chronic care. This gives answer to the second and third supporting questions on their theoretical background.

Second, third and fourth chapter covers the theoretical part in this thesis. The fifth and sixth chapters are related to the empirical nature of this thesis. In the fifth chapter, the methods for the empirical study and data analysis are stated. After the methods are introduced, each of the interviews are analyzed individually and finally the findings of the empirical study are presented in the chapter 6.

The sixth chapter ties together the theoretical background presented in the earlier chapters. Chapter three together with chapter six answers to the first supporting research question, and chapter four together with the sixth chapter answers to the second supporting research question. Also the answer to the first additional research sub-objective is gathered from the chapter six.

Chapter six of findings is followed by conclusions and discussion, in where the answers to all sub-questions are stated and hence gathered the answer for the main problem statement. In this chapter also the research analysis and assessment is carried out, as well as suggestions for future research. Finally comes summary, references and appendixes.

2. CHRONIC CARE

This chapter is divided into two sections. In the first section of this chapter the properties of chronic care are introduced. This includes the challenges of chronic care and the aspect of patients' self-management in treating the chronic conditions. In the second section of this chapter, the benefits that Lean could provide to the care and treatment of patients suffering of chronic conditions are presented. The benefits of Lean are evaluated from both the patients' and the health care professionals points of view.

2.1 Challenges in chronic care

World Health Organization (*WHO*) has stated chronic diseases to be the leading cause of illness burden, disability and death globally and a major focus for health policies and health care systems internationally (Drennan *et al.*, 2011). Long-term disease or chronic disease means any kind of illness or condition, which requires continual medical treatment, restrains the ability to function and that sustains longer than one year, defined by Kanste *et al.* (2009a). Chronic conditions include for instance asthma, back pain, cancer, depression, diabetes, heart disease, insomnia, and stroke (Barlow *et al.*, 2002; Mamykina *et al.*, 2015).

The patients suffering of chronic conditions constantly stretch health services that are already struggling to cope with the demands of acute care patients (Barlow *et al.*, 2002). The increasing number of especially older people with chronic conditions implies a need for new means to delivering care (Elzen *et al.*, 2007). Kanste *et al.* (2009b) noted in their study that in Finland approximately 80 % of health care services are used by 25 % of customers, who usually suffer of long-term conditions and hence have a need for chronic care. The large majority of inpatients of health centers were older people with chronic diseases: the average age of these patients was 75 years (Teperi *et al.*, 2009, p. 50). A significant part of the care provided during the study performed by Vuorenkoski *et al.*, (2008) was long-term care; 54% of inpatient days were for patients who stayed in the unit for more than six months.

One arising problem is the temporary treatment that patients with multiple diseases receive in situations when their chronic illness is not in balance. Their illness is not evaluated as a whole, but merely the acute symptoms are treated. There are rarely preventive operations, even though prevention and management of chronic conditions are becoming increasingly important. Too often the focus is set on acute care and cure. It is critical to improve chronic care from reactive treatment to more specialized care, which is both patient-based and customer-based and is executed within primary health care. (Lorig, 1996; Elzen *et al.*, 2007; Kanste *et al.*, 2009a; Lawn & Schoo, 2010)

Elzen *et al.* (2007) have defined that the impact of chronic conditions on welfare is substantial, it varies according to condition, and it usually affects all aspects of functioning and well-being. The challenges the patients with chronic illnesses with their families are facing include for example dealing with symptoms, disability, emotional impacts, lifestyle adjustments and obtaining helpful medical care (Wagner *et al.*, 2007). Corbin and Strauss (1988) presented three types of work that chronic disease involve, which are presented in Table 2 (Lorig, 1996).

Table 2. *Work types caused by chronic conditions (Corbin & Strauss, 1988; Lorig, 1996).*

Type of work	Example
Necessitated by the disease	Visit with health professionals, taking medications, maintaining a therapeutic exercise regime
Maintaining everyday life	Employment, chores, family responsibilities
Dealing with altered view of future	Changes of life plan, which may results in frustration, anger and depression

Chronic disease differs from acute disease for example by its onset, duration, cause, diagnosis, outcome and uncertainty, yet still health care services are focused on curing the acute disease. Also the roles of both patient and the health care professionals differ in acute and chronic care. In the acute care model, the health professionals are active while the patient is generally passive; in the chronic care model, the health professionals and patient are partners in executing the care. The shift from symptom-based, acute approach to disease prevention in order to meet the chronically ill patient's needs is required. (Lorig, 1996; Kanste *et al.*, 2009b; Sund *et al.*, 2010)

According to Teperi *et al.* (2009, p. 21), in the era of chronic conditions the ability to manage disease within the context of patient's daily life must be taken into account. However, they see the current way of organizing chronic care being both inconvenient and costly, by requiring patients to visit physician offices or to be admitted to hospitals. Additionally, according to Kanste *et al.* (2009a), even though many patients with long-term conditions do get quality care and service, there are evidence pointing out that many patients suffering chronic conditions do not get the treatment that they would need.

Managing chronic disease often requires extensive lifestyle changes and consistent attention from the person with the disease as well as the care provider (Miller *et al.*, 2015). However, the health care services offered to chronic care patients are not flexibly integrated with each other. Indeed, the treatment process with chronic care usually crosses the boundaries of organizations, which may lead to fragmented treatment with no perception of the care process as a whole. These fragmentation and uncertainty could lead to unnecessary health center visits and treatment episodes as well as institutionalization. (Kanste *et al.*, 2009a; Teperi *et al.*, 2009, p. 27)

2.2 Self-management in chronic care

The challenges in organizing health care, ageing populations, increases in the costs of medical care and the economic downfall have led to increasing interest in the role of self-care in the management of chronic conditions, as Harrison *et al.* (2011) argue. They define self-care as being the care taken by individuals towards their own health and wellbeing. It consists of the actions patients take to lead a healthy lifestyle to meet their social, emotional and psychological needs, to care their long-term condition and to prevent further illness or accidents (Lorig, 1996; Harrison *et al.*, 2011). Hence self-management involves both the adoption of new behaviors as well as changes in existing behaviors (Michie *et al.*, 2003).

Self-management refers to the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with chronic condition, defined by Barlow *et al.* (2001). In the self-management model, health care professionals are responsible for the medical management, but the patient is responsible for the daily management of the illness, applying self-management components (Lorig, 1996). As a self-management components Barlow *et al.* (2001) lists for example information regarding patients' condition treatment, drug management, symptom management, life style (e.g. exercise, nutrition and diet), social support and communication.

According to Miller *et al.* (2015), chronic disease self-management (later referred as *CDSM*) has been conceptualized in medical literature as the actions persons with chronic diseases take concerning medication and treatment compliance, safety, event management and lifestyle management. Self-management is a process that affects and leads to outcomes. Internal, individual characteristics such as knowledge, self-efficacy and self-regulation have been shown to affect CDSM. Therefore interventions have been developed in order to alter these characteristics and hence improving CDSM outcomes. (Miller *et al.*, 2015) The National Health Priority Action Council has defined the key features of successful self-management for chronic conditions to be as:

- having knowledge of the condition and/or its management
- adopting self-management care plan agreed and negotiated in partnership with health care professionals, significant others and/or caretakers and other supporters
- actively sharing in decision-making with health professionals, significant others and/or caretakers and other supporters
- monitoring and managing signs and symptoms of the condition
- managing the impact of the condition on physical, emotional, occupational and social functioning
- adopting lifestyles that address risk factors and promote health by focusing on prevention and early intervention
- having access to, and confidence in the ability to use support services

(Lawn *et al.*, 2001)

Wagner *et al.* (2007) observe that chronic disease interventions that positively affect patient well-being necessarily include systematic efforts to increase patients' knowledge, skills and confidence to manage their condition. The level of self-management is depending on variety of factors, including patients’ perception of health and illness as well as effective communication with health care professionals (Michie *et al.*, 2003). There are several interventions developed leading to improve the CDSM outcomes (Miller *et al.*, 2015). These programs are developed to increase perceived self-efficacy, along with providing medical care and education, hence empowering patients to take better control in the management of their chronic disease and therefore improving the outcomes (Farrel *et al.*, 2004). Lorig (1996) sets criteria for self-management education programs which are:

- content presentation focused on patients’ perceived needs
- practice and feedback in new skills, including decision making and problem solving
- attention to emotional and role management in addition to medical management
- use of techniques to increase patients’ confidence in their ability to manage their conditions
- emphasis on the patients’ active role in the physician/patient relationships

Despite the growing recognition that CDSM is one of the most vital health care issues, Farrel *et al.* (2004) note that success in the management of chronic disease is limited. However, they acknowledge that self-management programs have shown positive effects on health promotion, patient education, clinical practice, and patient outcome. Lorig (1996) states that self-management model assists patients in gaining skills and the confidence to apply these skills on daily life. Michie *et al.* (2003) stress the importance of patient-centeredness in chronic care. They define patient-centeredness in chronic care as being the combination of health care professionals actions of (i) discussing patients’ beliefs regarding to the chronic disease and its management and (ii) activating the patient to take control of the consultation and the management of his or her illness.

Lorig (1996) presents three distinguishing features of self-management model to be (i) dealing with the consequences of disease illness, not the physiological disease, (ii) being concerned with problem solving, decision making, and patient confidence, rather than prescription and adherence, and (iii) placing patients and health professionals in partnership relationships. In the care models that are applied in Finnish health care and presented in this thesis, the focus lies on the patients’ self-management and self-management support. According to Vallis (2015), behaviors are strongly associated with health outcomes, and the behavior changes will lead to improved health. He states that patients’ ability to change their behavior and therefore receive better outcomes is influenced by the relationships established with their health care providers.

In the center of chronic care are the patients, since they are the principal care-givers. Each day it is the patient who makes a decision whether or not to take the medicine, to eat healthy, or to exercise. Patients and their families manage daily treatments, symptoms and lifestyle modification caused by the disease. This creates a challenge in chronic care to get the patients and their families involved to the treatment and to make the decisions that are beneficial regarding the patient's treatment. (Farrel *et al.*, 2004; Lawn & Schoo, 2010; Miller *et al*., 2015)

Even though many patients are aware that the life style changes are necessary, they still fail to implement them. This is an important aspect that health professionals must understand and acknowledge. The co-production of health by patients and the health care professionals is a key factor in chronic care. In this partnership, health care professionals are primary responsible for the medical management of the disease and the patient is primarily responsible for the daily management of the illness. (Lorig, 1996; Bodenherimer *et al.*, 2002b; Farrel *et al.*, 2004; Teperi *et al.*, 2009, p. 78; Lawn & Schoo, 2010; Miller *et al*., 2015)

Jerant *et al.* (2004) note that active self-management has a significant therapeutic value, since higher adherence is associated with improved outcomes even in situations, where the treatments themselves seem to be ineffective. They see self-efficacy to be one particularly promising feature in self-management programs and state higher levels of self-efficacy to be associated with more optimal self-care behaviors. Farrel *et al.* (2004) argue that increasing perceived self-efficacy along with providing medical care and education can empower patients to take control in the management of their chronic disease, hence improving the outcomes. Due active self-management patients can improve short-term outcomes, which eventually reduce the risk of long-term complications and premature death (Christensen & Remler, 2007).

Barlow *et al.* (2001) see self-management to be one of the means of bridging the gap between patients' needs and the capacity of health care social services. Also Mead *et al.* (2010) emphasize that effective self-management can reduce costly hospital readmissions and complications associated with chronic disease, as well as help patients achieve healthier outcomes and better quality of life. However, they note that patients can have obstacles in caring for their chronic conditions, for example low-income patients are more likely to lack the resources necessary to manage their chronic illness.

According to Barr *et al.* (2003), there exists two great barriers preventing the spread of self-management education. First, the lack of trained personnel makes self-management courses unavailable in many primary care settings. Second, people with chronic conditions have gotten used to the medical model with being dependent of professionals, and therefore the idea of a patient-physician partnership is unfamiliar. Vallis (2015) also cautions that self-management support might result in too much focus being placed on patients' responsibility, which could create a judgmental environment for the patients.

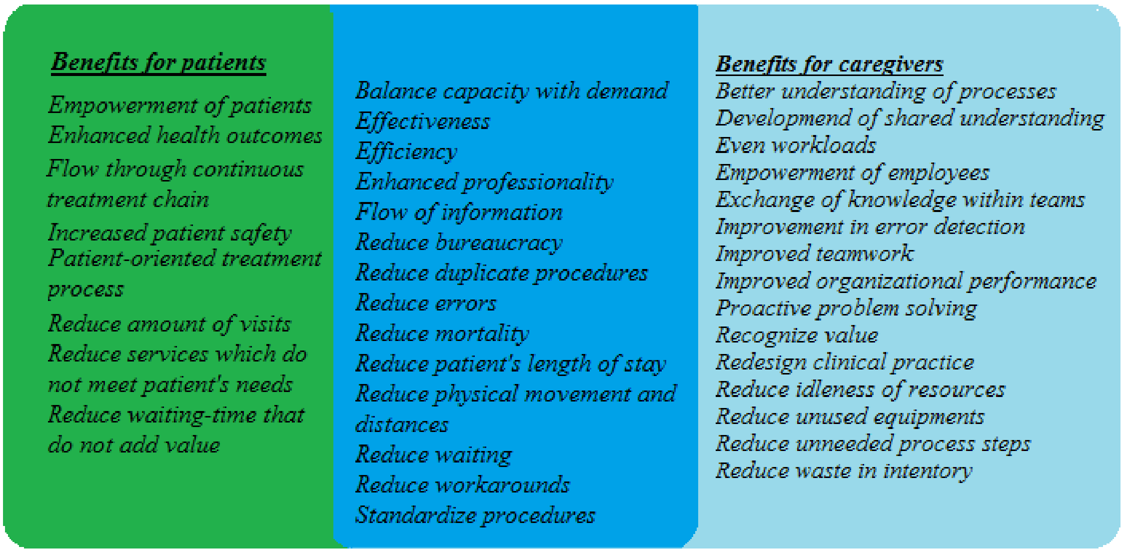
2.3 Lean in chronic care

The roots of Lean lie in Toyota Production System and the main idea in Lean is to focus on the customer and design the production line in a way that it provides value to the customer in each step. If there are functions in the production line that does not provide value, so called *waste,* they should be removed. Lean management means creating more value for the customer by using fewer resources. This is brought by receiving deeper understanding of quality and productivity, hence leading to continuous improvement. Lean is applied in various types of organizations all over the world, and health care is one area where Lean has a lot to offer, aiming to identify and remove the waste to provide better as well as safer care to patients. (Toussaint & Berry, 2006; Näslund, 2008; Grove *et al.*, 2010; Poksinska, 2010; Burgess & Radnor, 2013; Stojkic *et al.*, 2013).

Kollberg *et al.* (2006) argue that Lean's focus on zero defects, continuous improvements and Just-In-Time (later referred as *JIT*) makes Lean production especially applicable in health care. Since Lean determines to minimize the waste in production, in health care obvious applications of Lean include for instance eliminating of waiting times and delays, repeat visits and duplicate procedures. Also unneeded movements of patients and employees, duplicate and inappropriate procedures, errors as well as services which do not meet patient's needs are recognized. (Kollberg *et al.*, 2006; Devine *et al.*, 2010; Poksinska, 2010). Mazzocato *et al.* (2010) noticed also a need and willingness to improve the organizational performance, unclear procedures and staff unaware of problems, workarounds, multiprofessional and hierarchical organizations, status differences, physician autonomy, inconsistent team communication and a culture of blame being common contextual characteristics in implementing Lean to health care.

The most common outcomes of using Lean in health care included time-savings and timeliness of service, reduction of waste in inventories, cost reductions, and productivity enhancements in resources. Several quality aspects were also acknowledged, including reduction in errors or mistakes, patients' satisfaction, reduced waiting times, length of stay, bureaucracy and reduced mortality. Also a number of intermediate outputs were also reported, including reduction in a process, reduction in staff walking distance, increased process understanding, staff engagement and willingness to collaborate, calmer, less stressful and more focused working environments, ordered and more predictable work, reduced time to resolve error alerts, increased number of signaled errors and improved teamwork. (Joosten *et al.*, 2009; Mazzocato *et al.*, 2010; Poksinska, 2010; Waring & Bishop, 2010)

Some of the outcomes are easier to measure (for example time-savings and patients' time of stay) than others (for example patients satisfactory and employees engagement). Still Lean has proven to be beneficial for both the patients and the caregivers - the continuous improvement in care delivery and aiming to perfection (for example effectiveness and efficiency) is the fundamental principle in Lean thinking and is without a doubt beneficial for both the patients and the health care professionals (Kollberg *et al.*, 2006; Toussaint & Berry, 2013).. However, the benefits cannot be separated to be only for patient or only for health care givers; instead, the benefits of Lean intersects, and the utilization of Lean can be seen as beneficial from both the patients' and the health caregivers' point of view. The benefits provided by Lean toward health care are gathered to Figure 3 below.



Benefits for patients

Empowerment of patients
Enhanced health outcomes
Flow through continuous treatment chain
Increased patient safety
Patient-oriented treatment process
Reduce amount of visits
Reduce services which do not meet patient's needs
Reduce waiting-time that do not add value

Balance capacity with demand
Effectiveness
Efficiency
Enhanced professionality
Flow of information
Reduce bureaucracy
Reduce duplicate procedures
Reduce errors
Reduce mortality
Reduce patient's length of stay
Reduce physical movement and distances
Reduce waiting
Reduce workarounds
Standardize procedures

Benefits for caregivers
Better understanding of processes
Developmend of shared understanding
Even workloads
Empowerment of employees
Exchange of knowledge within teams
Improvement in error detection
Improved teamwork
Improved organizational performance
Proactive problem solving
Recognize value
Redesign clinical practice
Reduce idleness of resources
Reduce unused equipments
Reduce unneeded process steps
Reduce waste in intentory

Figure 3. *Benefits of Lean provided to health care for patients and caregivers (Kollberg et al., 2006; Toussain; t & Berry, 2006; Näslund, 2008; Joosten et al., 2009; Grove et al., 2010; Mazzocato et al., 2010; Poksinska, 2010; Waring & Bishop, 2010; Burgess & Radnor, 2013).*

As can be seen from Figure 3, the benefits of Lean are related to the whole process of patient treatment. Mazzocato *et al.* (2010) recognized four general components of Lean interventions used in health care, which are (i) methods to understand processes in order to identify and analyze problems, (ii) methods to organize more effective and/or efficient process (iii) methods to improve error detection, relay information to problem solvers and prevent errors from causing harm, and (iv) methods to manage change and solve problems with scientific approach. Poksinska (2010) recognizes that Lean adaption increases employees proactive attitude towards problem solving without having to accept workarounds any more, but instead take initiative to resolve problems. Lean helps development of shared understanding of what is important, which helps members of different professions to communicate and see how their roles and their responsibilities relate to the bigger picture (Mazzocato *et al.*, 2010).

The fundamental customer in utilizing Lean to health care must be the patient, and the value provided by health care services to the patients is the benefits to the patient's health outcomes. Critical success factors, such as medical quality, accessibility and comfort, treatment, respect and participation to the treatment are of interest for specifying value from a patients' perspective. As mentioned earlier, the current way of organizing health care consists of fragmented processes that do not add value to the patients (for example Teperi *et al.*, 2009). Lean aims to simplify the processes in care delivery by understanding what adds value to the patient's health outcome, while eliminate the waste. The current, fragmented way of health care requires a shift in how the flow of patient care delivery is perceived and organized, targeting the focus on the patients rather than the doctors, nurses and other clinician staff. The thought about value stream and continous flow aims to break down the silo mentality, enabling changes to occur across functional boundaries, leading to non-stopping service improvement (Kollberg *et al.*, 2006; Joosten *et al.*, 2009; Mazzocato *et al.*, 2010; Poksinska, 2010; Burgess & Radnor, 2013).

One concrete way of using Lean tools in health care is to collect the detailed tasks executed in care delivery into Value Stream Map (later referred as *VSM*), which enables analyzation of the tasks in the treatment process from the value provided to the patient's health perspective. The actions consider the flow of both information and materials within the overall supply chain. The idea in VSM is to analyze the each step in the current production of the service and analyze whether or not the step actually adds value to the customer; the identification of value stream means the identification of chronological flow of activities that add value. The identified steps that do not add value are recognized as waste and hence should be removed from execution. Thus the remaining value chain would include all aspects of patient health, and after all activities associated with the care, the results of value stream, the patient's health output, should be increased. (Kim *et al.*, 2006; Abdulmalek & Rajgopal, 2007; Näslund, 2008; Gove *et al.*, 2010; Poksinska, 2010; Devine *et al.*, 2010, Toussaint & Berry, 2013)

As one benefit of Lean implementation the empowerment of the employees was recognized by providing them with the necessary tools to improve processes in their area of work: the focus is not only in taking care of the patient, but also in finding ways to improve the treatment process in order to find better ways of taking care of the patients in future. This should result in better treatment chains and especially increased patient satisfaction. The employees should also have deep knowledge regarding the current process and their ability to add value to patient's treatment. For example waiting time in patients' treatment chain can be recognized as value adding (such as recovery time after a surgeon) and not-value adding, such as waiting in the ward for the next procedure chain to begin. (Joosten *et al.*, 2009; Poksinska, 2010; Toussaint & Berry, 2013)

The opportunity to develop health-care value chain analysis is analogical with the development of integrated health-care systems, which require a shift from focusing on departments and single entities to an enterprise-wide approach, as Devine *et al.* (2010) note. They argue that enterprise-wide VSM would determine where the greatest cost competencies and efficiencies lie in the value stream. The location of health care bottlenecks is not obvious and a rigorous analysis is needed to make an important contribution (Young *et al.*, 2004).

Toussaint and Berry (2013) note that VSM clarifies priorities and guides the staff to know what tasks are the most important in the whole service delivery. The standardized practices cause clarity about how things should be done and they make workarounds and lack of routines more noticeable, which enables stakeholders in HIN to promptly address deviations (Mazzocato *et al.*, 2010). Also the recognition of the bottlenecks reduces idleness of resources, such as unused equipment (Young *et al.*, 2004).

One improvement technique proposed by Lean is 5S-technique, which involves the reorganization of activities along five principles: (i) 'sort' (or organize) the work are, (ii) 'set' (or order) the work area, (iii) 'shine' (or ensure) the cleanliness of the work area, (iv) 'standardize' to ensure the task are routinely completed, and (v) 'sustain' through fostering a disciplined culture toward improvement. In health care this approach is noted to reduce the problems of hospital-acquired infections. 5S-technique aims to redesign clinical practices and resources around streamlined, efficient and value-adding care pathways. (Waring & Bishop, 2010)

JIT is an important aspect in Lean, which strives to eliminate waste within the production system and answer customer's needs of what is needed when it is needed. Giving care just-in-time is also one benefit accomplished by integrating ICT into health care. Both the patients and the health care professional should avoid the actions that do not add value in the patient's treatment process. Even though not all patient activities and demands can be predicted, such as acute care in emergency department, JIT still enables balance for the demand for care with the capacity. The JIT production is also in line with patient's empowerment and increased self-management as well as in health care it enables patients to 'pull' value when they need health care services. In the best case scenario, the treatment is given to the patient precisely when needed. (Ash *et al.*, 2003; Kim *et al.*, 2006; Kollberg *et al.*, 2006; Abdulmalek & Rajgopal, 2007; Näslund, 2008; Mazzocato *et al.*, 2010)

3. OPERATIONAL MODELS AND ICT IN FINNISH HEALTH CARE

In this chapter the current situation of Finnish health care is stated. The chapter is divided into two sections: first the state of the care of long-term diseases and chronic conditions in Finnish health care are presented as well. The three different care models utilized in Finnish health care regarding chronic illness treatment are:

1. Chronic Care Model, utilized in health centers in Espoo
2. Community Matron Model, utilized in health centers in Oulunkaari
3. Chronic Disease Self-Management Program, piloted in health centers in Espoo, Helsinki, Kuopio, Jyväskylä, Oulu, Turku, Vantaa and South Karelia Social and Health Care District (Eksote)

At first the models are explained by their theoretical background, which is followed by presenting the benefits and criticism towards the model based on earlier literature. This is followed by presenting the model's utilization in Finnish health care, in hospitals or health centers where they are applied in to. After all models has been introduced and the benefits and criticism has been presented, their properties are summarized and they are compared with each other in order to find the strengths, similarities, differences and points for development for each operational model.

On the second part of this chapter, the current situation of ICT in Finnish health care is introduced. This includes the general properties of ICT which have been implemented in Finnish health care, as well as the future state of where the health care in Finland may be according to the current development plans. Also the future challenges are noted in the second section of the third chapter.

3.1 Operational models

Mahdavi *et al*. (2013) describe operational models as the common language in which problems and improvements arising in the design of services can be generally formulated and addressed, and on which solution methods can be based. Operational models for health services, as defined by Mahdavi *et al.* (2013), are formal descriptions of operations performed to deliver a health service, with the purpose of facilitating operational decision making. Providing the appropriate medical care involves decision making in terms of planning and management of the limited health care resources (Harper, 2002).

A common current practice, according to Harper (2002), is to plan and manage hospital capacities through a simple deterministic approach, for example using average patient flows, average needs, average length-of-stay, and average duration of operations. A generic framework for modelling hospital resources in Harper's (2002) point of view acknowledges and incorporates the need for necessarily detailed, stochastic, flexible and user-friendly operational models, to aid both the planning and management of hospital resources. However, he argues that the challenges including to patient flows, patient needs, and utilization of hospital capacities involve for example complexity, uncertainty, variability, constraints and scarce resources.

Appropriately detailed operational models are seen to be powerful tools for good planning and management decisions. For example capacity planning in hospitals is largely a strategic decision: the total number of nursing beds must be planned carefully to answer the needs towards the whole hospital as well as in various specialities too. Management tools should allow the user to examine resources in detail in order to maximize the utilization, hence providing a more efficient use of health care resources. In the Figure 4 is illustrated the principle of how operational models are determined. (Harper; 2002; Mahdavi *et al.*, 2013)

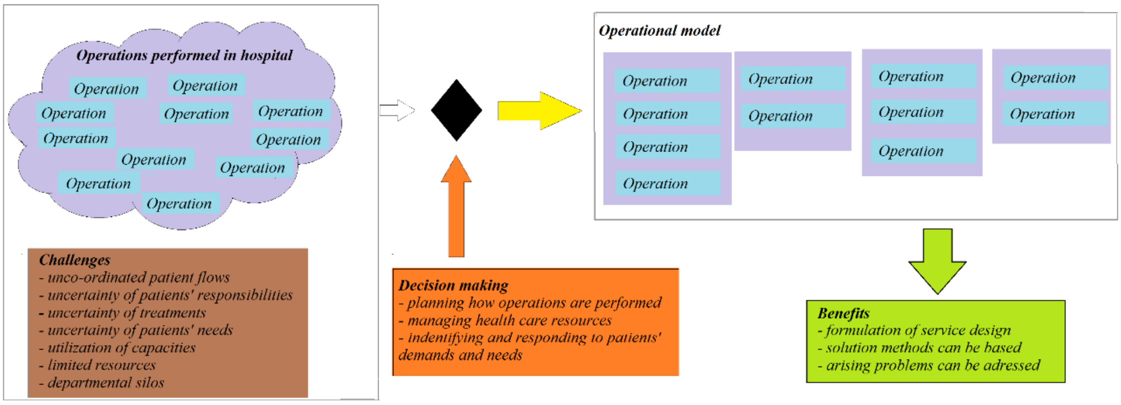


Figure 4. *The principle of operational models (aligning Harper, 2002; Teperi et al., 2009, p. 27-28; Mahdavi et al., 2013).*

As can be seen from Figure 4, creating operational models enables formulation of service design and gives a background to which solution methods can be based on. Carefully planned operational models can also hinder arising problems that can be recognized and addressed, hence enabling ways of improving outcomes. Mahdavi *et al.* (2013) state that in health care an operational model describes operations, which uses the resources in response to the patient's demand. The value of this service lies in the health outcome. Teperi *et al.* (2009, p. 27) argue that the current way of organizing health care in departmental silos does not maximize the value experienced by patients. Patient flows, patient needs and utilization of hospital capacities, such as variability and limited resources, involve complexity in the current situation (Harper, 2002).

Next, the three different care models utilized in chronic care in Finnish health care system are introduced. All these models apply patients' self-management, and the relationship between the patient and health care professionals are in critical role. Patient is in prime role in executing the agreed treatment plan, as health care professionals act in supportive role.

3.2 Chronic Care Model

Wagner (1998) presented a model for effective chronic illness care, which identifies the specific practice and system changes in order to improve the care of patients with chronic illness. Originally the model was attempted to summarize the general features of programmatic efforts to improve chronic illness care that actually improved patient outcomes. The Chronic Care Model (later referred as *CCM*) is a framework for translating general ideas into specific, locally distinctive applications. (Wagner *et al.*, 1999; Barr *et al.*, 2003; Munukka *et al.*, 2010, p. 28) Wagner's CCM is illustrated in Figure 5 below.

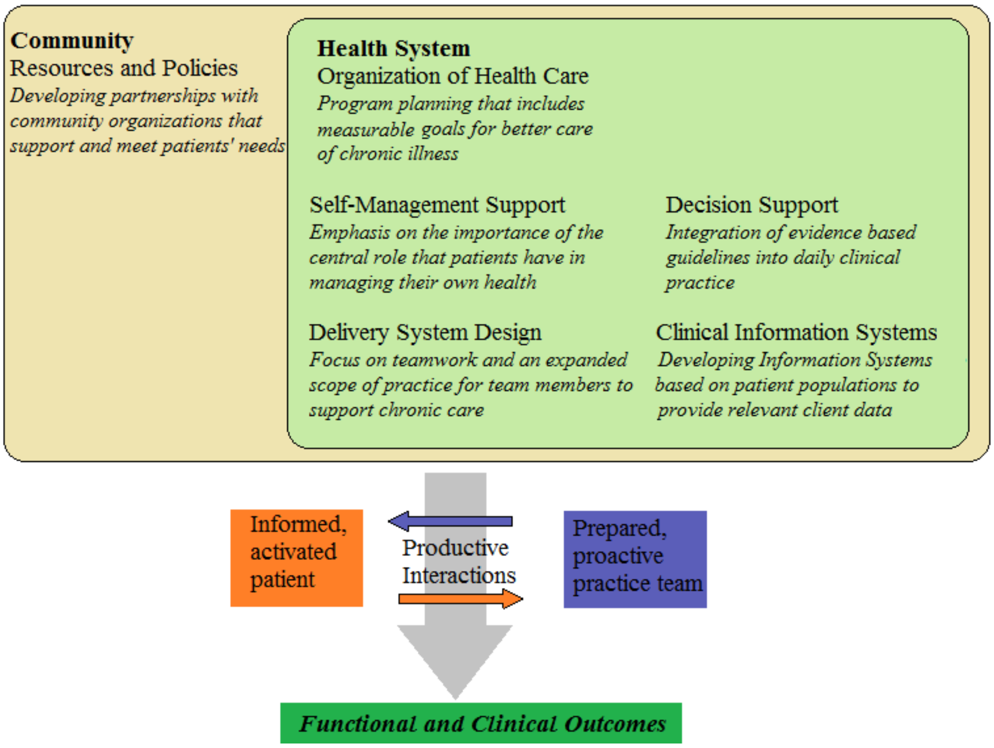


Figure 5. *A model for effective chronic illness care (aligning Wagner et al., 1999; Barr et al., 2003).*

The aim of CCM presented in Figure 5 is to transform the patients care from acute and reactive to proactive, planned and population-based. CCM is developed to accomplish these goals through a combination of effective team care and planned interactions in co-operation with informed, activated patients. The components of health systems, self-management support, decision support, clinical system design and Clinical Information Systems (later referred as *CIS*) are enhanced by more effective use of community resources and policies. These policies determine for example the cooperative planning of patient treatment between health care professionals and patients. In CCM, the desired outcomes include measure of clinical care, health status, satisfaction, health care utilization and cost. (Wagner *et al*., 1999; Coleman *et al.*, 2009; Barr *et al.*, 2003*;* Munukka *et al.*, 2010, p. 28)

CCM views the health system as a part of the larger community, and *resources and policies* is a component provided by the community are applied in providing care according to CCM. Effective chronic illness management requires an appropriately organized health care system linked with necessary resources available in the broader community. The resources and policies in the community includes for example the identification of effective programs and provides access to critical supportive and educational services outside the organizations network, which may otherwise be unavailable for health care systems. (Wagner *et al*., 1999; Barr *et al.*, 2003)

Effective *self-management support* helps patients and their families cope with the challenges caused by chronic illness and its treatment (Barr *et al.*, 2013). Self-management support is important aspect in treating chronic illness, since patients with chronic conditions self-manage their illness daily by deciding for example what to eat and do they consume prescribed medications (Bodenheimer *et al.*, 2002b). Self-management support includes for example educational resources, skills training and psychosocial support (Barr *et al*., 2003). Successful self-management programs rely on a collaborative process between patients and providers to define problems, set priorities, establish goals, create treatment plans, and solve problems along the way (Wagner *et al*., 1999).

In CCM, self-management education teaches problem-solving skills in order to allow patients to identify their problems and provide techniques to help them make decisions and take appropriate actions to manage their condition. A central feature of self-management education in CCM is the patient-generated short-term action plan for one to two weeks, including realistic, proposing behavior that patients are confident they can accomplish. The purpose of action plans is to give patients confidence, which fuels internal motivation in managing their disease. (Bodenheimer *et al.*, 2002b)

Decision support in effective chronic illness management program assures that providers have access to the expertise necessary to care for patients. Mostly used are evidence-based practice guidelines or protocols. Decision support provides education and specialist support information, which is especially useful for primary care providers, who may be less familiar with the latest techniques for special condition treatment. (Wagner *et al*., 1999; Barr *et al.,* 2003)

Delivery system design is a necessity in effective chronic illness management - practice team members need clear, complementary roles. Many of the management functions requires the delegation of care from a manager, who has the knowledge and time to carry out the range of tasks, that are required to manage complex chronic conditions. These tasks include assessing and interacting with patients for example in planned visits, ensuring proper management and organizing protocols for regular, planned follow-ups for the patients. (Wagner *et al.*, 1999, Barr *et al.*, 2003)

In *CIS* the first step is to establish a database for individual practices that include information about the performance and results of important elements of care. Timely and useful data about individual patients is a critical feature regarding the effectiveness of CCM. The information must be available for health care teams in order to call in patients with specific needs and to deliver a care plan for the required needs. CIS may include for example surveillance system that provides alerts, recall and follow-up information (Wagner *et al.*, 1999, Barr *et al.*, 2003)

Productive interactions between *informed, activated patients* and the *prepared, proactive practice team* leads to improved functional and clinical results for disease management as the results of such collaborative care. Preparation in practice team's matter means having necessary expertise, information, time and resources to ensure effective clinical management of patients' treatment. Informed, activated patient means that patients must also have the information and confidence to make best use of their involvement regarding their own care process, in align with their practice team (Wagner *et al.*, 1999; Bodenheimer *et al.*, 2002b; Barr *et al.*, 2003).

3.2.1 Benefits and criticism on CCM

Traditionally health professionals are seen as experts, but in CCM, people with chronic conditions are their own principal caregivers and health care professionals act as consultants, who support the patients. In CCM patient empowerment means that patients, who are informed by health care professionals, accept responsibility to manage their own condition and they are encouraged to solve their own problems. Health care professionals are also expected to take a look into patient-defined problems, which can be eye-opening, since patient's perception may be different from the health care professionals' perception. (Wagner, 2000; Bodenheimer *et al.*, 2002a; Bodenheimer *et al.*, 2002b; Grimson & Grimson, 2002; Barr *et al.*, 2003)

Bodenheimer *et al.* (2002b) performed a research of self-management education results in chronic illness regarding asthma, diabetes and arthritis self-management via using CCM. In the research they note that interventions are not standardized across clinical trials and therefore it is difficult to generalize the impact of self-management education on clinical outcomes. As conclusion it was achieved patient education programs teaching self-management skills being more effective than when lecturing only information. Also self-management education was seen effective in improving outcomes and reducing costs in certain circumstances, such as for groups of patients with a variety of chronic conditions. (Bodenheimer *et al.*, 2002b)

Coleman *et al.* (2009) examined the evidence regarding CCM's effects on chronic patient care. They found evidence of improved care, for example patients were more knowledgeable, used recommended therapies more often, visited emergency department less often and experienced fewer days in the hospital. Also only implementation and usage of some components of CMM elements have been resulted with higher quality of care, higher patient satisfaction and improved health outcomes. This was found interesting, since the implementation of whole CCM has been found being complicated. (Bodenheimer *et al.*, 2002a; Coleman *et al.*, 2009)

Barr *et al.* (2003) note the criticism regarding the "Community Resources and Policies" component in the CCM, stressing how this component is inadequately defined and does not describe the strategies needed to effectively promote health and prevent disease. However, they present a way of integrating population health promotion into prevention and management of chronic disease by broadening the original CMM. The goal of the integration is to direct additional efforts to reduce the burden of chronic disease via supporting people and community to be healthy. So called Expanded Chronic Care Model (later referred as *ECCM*) was developed to address the requirement regarding the "Community Resources and Policies" component in CCM. This is illustrated in Figure 6. (Barr *et al.*, 2003)

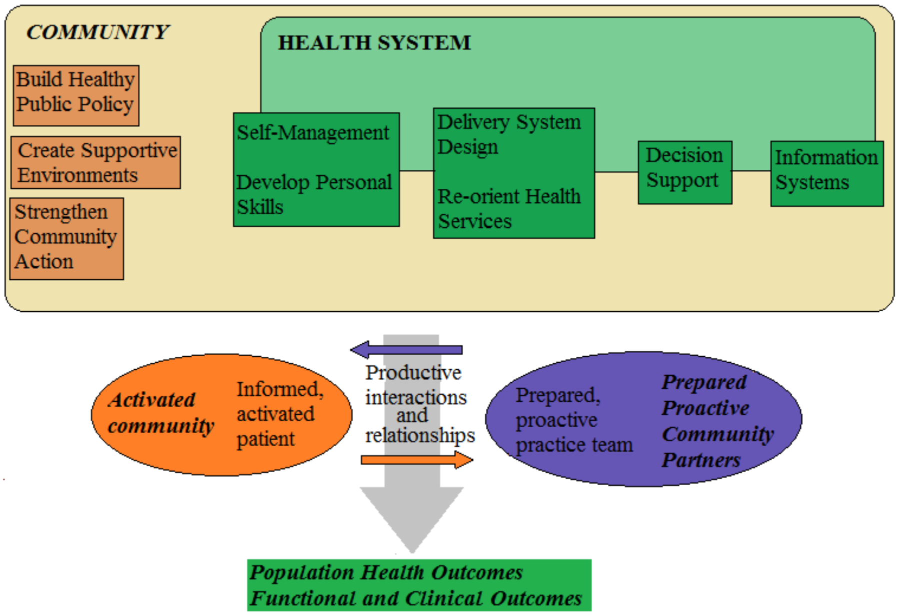


Figure 6. *Expanded Chronic Care Model (modified from Barr et al., 2003).*

In Figure 6, the inner oval represents either the health system or an individual health care organization. ECCM includes a porous border graphically representing the flow of ideas, resources and people between the community and the health system. The four characteristics of the original CCM– self-management, delivery system design, decision support and information systems – creates a circle in between the health system and the larger community. These four areas can be integrated within the health care organizations and the community, having impact on both of them in order to address both the delivery of health care services and population health promotion. (Barr *et al.*, 2003)

ECCM is action-driven model, which was meant to broaden the focus of practice to work towards health outcomes for individuals, communities and populations. Additionally to the original model, population health promotion and clinical treatment have been integrated into ECCM, therefore expanding the lower half of the model “Productive interactions and relationships”. The informed, activated patients are a part of activated community, and prepared, productive practice teams are part of community partners. (Barr *et al.*, 2003)

Also new properties were added to the model, aligning the action areas of population health promotion and clinical treatment. These properties have been defined by Ottawa Charter for Health Promotion as the following: (i) develop personal skills, (ii) re-orient health services, (iii) build healthy public policy, (iv) create supportive environments and (v) strengthen community action. Improved health of population results from positive and productive interactions and relationships among community members, healthcare professionals, organizations, individuals and community groups. (Barr *et al.*, 2003)

3.2.2 Case: Patient-based CCM in Espoo

The starting point for developing the patient-based CCM in Espoo was to equalize the health care balance for long-term disease patients, such as asthma, diabetes and hypertension, and to minimize the related diseases. The focus of the process was on developing the treatment for those patients, who already had the chronic disease. Additional goal was also to clarify and rational the operations in health care and allocate the resources appropriately. The development process took place between years 2006-2009 and it was based on Wagner’s CCM. (Munukka *et al*., 2010, pp. 28-29)

The development process was executed as a part of city’s strategic development plan. The roadmap for development was created in tight cooperation between the project organization gathered from nurses and clinicians and other stakeholders. Also the hospital of Vantaa, the Hospital District of Helsinki and Uusimaa (HUS) and various patient organizations involved to the developing process. Since the project organization included nurses and clinicians from local health centers, the members were able to advance the operation models and culture at their work places, as well as the new developed methods were able to be piloted in individual health center before implementing for wider use. From these pilots, important feedback was received for the development process. (Munukka *et al.*, 2010, pp. 29-30)

Report showed that before the development process, the patients of chronic diseases were treated unequally, since the procedures variated between health centers and even between employees in the same health center. Only individual written instructions or process flowcharts were available in health centers, and there did not exist any general flowchart nor guideline for common procedures. Even recommendations for treatment chains were only local and on high level, without much concrete content. (Munukka *et al.*, 2010, p. 30)

In the early stage of the developing process, a research of the current status of health center's operations was executed. Research indicated that for example the continuity of treatment was rather unclear both from patients' and nurses' point of view. In some cases, such as hypertensions, it is critical to ensure the seamlessness of the treatment chain. Also research showed that patients did not agree with the local health recommendation's view regarding how their illness and its treatment will affect their daily lives. The research revealed many areas that needed development and set the focus on them. The developed model is illustrated in Figure 7. (Munukka *et al.*, 2010, pp. 30-31)

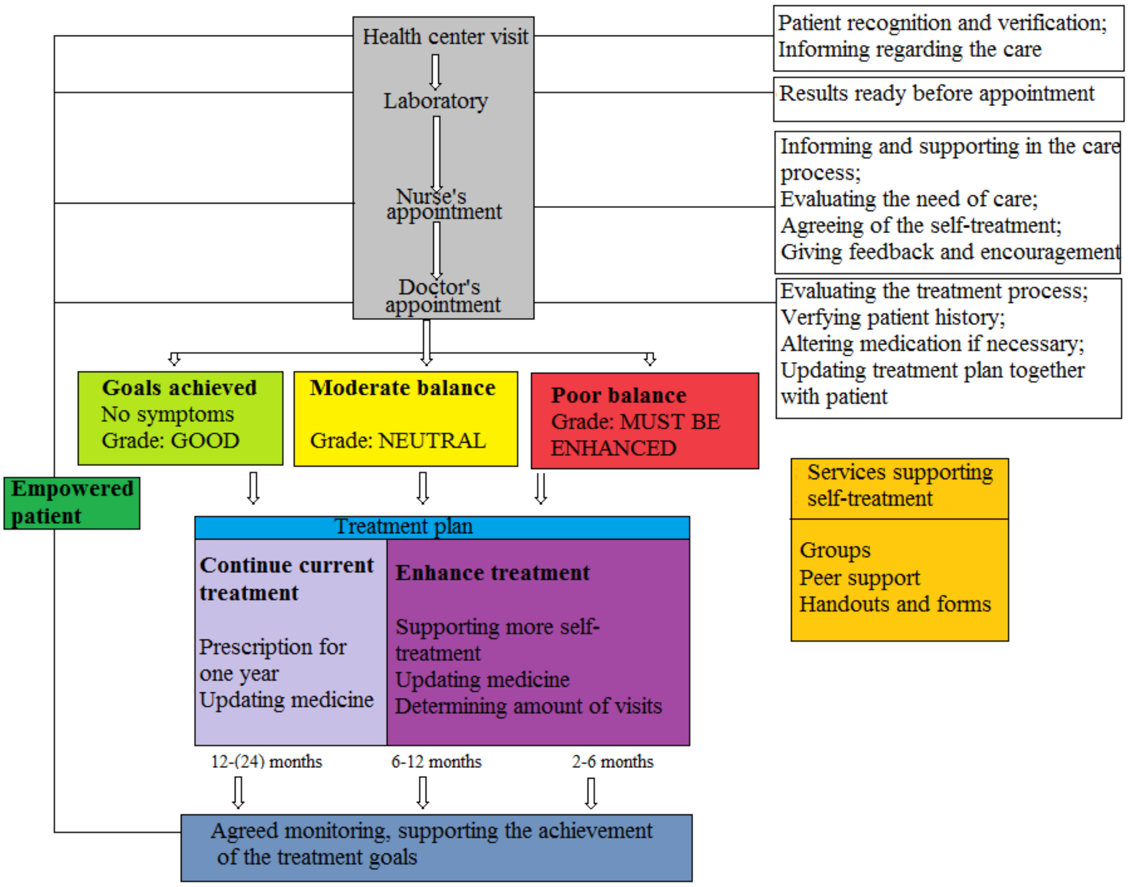


Figure 7. *Patient-centered chronic care model in the health centers of Espoo (aligning Munukka et al., 2010, pp. 32-35).*

As can be seen from Figure 7, in the care model it is clearly described work distribution from patient's appointment making to doctor's appointment, including the responsibilities in treatment process in each sector, instructions for operations and the forms supporting the operations. In the center of patient-centered chronic care model is patient's self-treatment and the collaboration of the patient and the health care professionals. One goal of the model is to change the way of thinking health care professionals giving orders from to patients into seeing health care as a collaborative relationship, where the health care professional acts as a coach for the patient. (Munukka *et al.*, 2010, pp. 33-35)

The model is based on a consistent service concept that provides an integrated management system that enables for instance the notion of patient’s own activities and demands by segmenting and creating individual treatment plans. Patient is a key player, and the role of a health care professional is to be one player in the whole treatment process of the chronic disease. Patient is the one responsible of executing the treatment. (Munukka *et al.*, 2010, pp. 32-34).

During the whole treatment process, patient evaluates his or her self-treatment process and how he or she can independently take care of his or her own health, including the ways of daily life. This helps the patient to commit to the treatment process, as well as to take account of how his or her own actions has effect on treating the chronic disease: therefore patients accept responsibility to manage their conditions. The goal of the care treatment model is more empowered, independent and self-acting patient than in the earlier stages of the treatment. (Bodenheimer *et al.*, 2010b; Munukka *et al.*, 2010, pp. 33-36)

Related information, such as treatment recommendations and services for supporting patients’ self-treatment has also been included to the model. Patient’s health is evaluated either yearly or after two years. Depending on patients’ state of health the goals for treatment will be set. The treatment plan including appointments and monitoring is binded on the goals, and it is updated along the treatment process. Appointments for monitoring current status of health depends on the balance of patient’s health and how the goals have been achieved. Generally resources are allocated to the patients who need the care the most. (Munukka *et al.*, 2010, pp. 33-34)

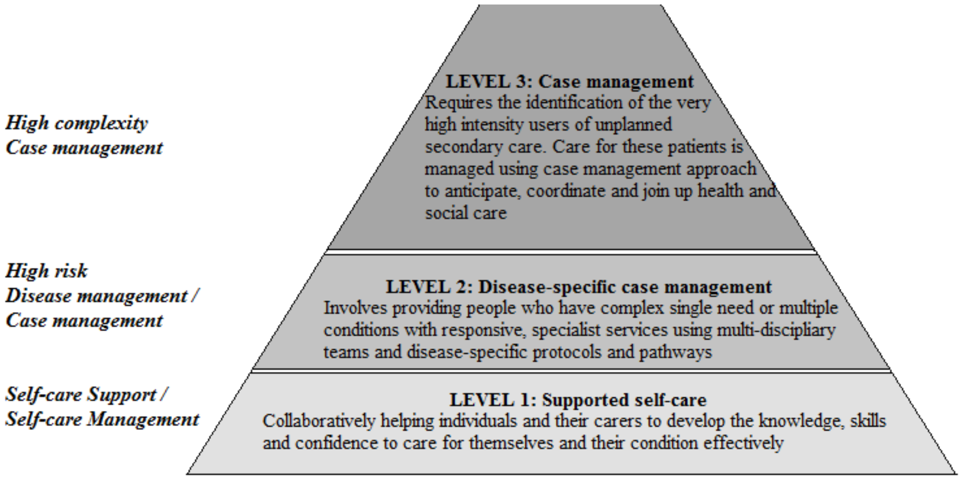
During the development process it was noted that chronic illness balance have been positively affected, as well as patients’ active involvement regarding changing the way of their daily lives along with the self-treatment process. The doctor’s appointments have not been seen necessary, if all seemed to be clear in the nurse’s yearly monitoring appointment. This has freed up resources to those patients who more critically need doctor’s appointment. (Munukka *et al.*, 2010, p. 41)

In 2009 almost half of the employees in the health centers involved to the development process evaluated the care model and it suitability to their work. The results and feedback were mostly very positive and in conclusion the development process seemed to be a success. Most of the employees felt the model to be effective and an excellent working tool in the treatment and monitoring of chronic illness patients. Supervisors also noted that the model is useful when a new employee is being trained to the job. As results, responsibilities were clarified and scheduling was easier due the care model. Employees also felt self-treatment process enabling the patients’ tighter commitment to the treatment, and the health care professionals acting more as coaches, encouraging to continue with the healthy way of living. (Munukka *et al.*, 2010, pp. 41-43)

3.3 Community Matron Model

The roots of Community Matron programme lies in England, where Department of Health strengthened the National Health Services by designing a new community matron role to care for the patients with highly complex needs and who use unplanned health care services intensively. Community Matron Model (later referred as *CMM*) is based on a programme executed in USA called *Evercare*, which was meant to help patients with chronic illnesses to improve their independence, wellbeing and avoid the need to go into hospitals. The purpose of CMM is to improve health care results for people with long-term conditions, as well as reduce service use through patient-centered, proactive care and case management in primary care and community settings. (Girot & Rickaby, 2008; Kanste *et al.*, 2009a)

In the center of CMM lies a role of the community matron, which is also referred a case manager. A community matron is a new type of specialist clinician or a nurse, who will identify suitable patients, assess their needs while working with local general practitioners and primary care teams to develop tailored personal plans to prevent worsening of the condition and to prevent unplanned admission to hospital (Murphy, 2004) The aim of the programme, as defined by Department of Health, is to treat patients sooner, nearer to home and earlier in the course of disease (Sargent *et al.*, 2007). The condition model of the United Kingdom's National Health Services, to which the CMM is based on, is illustrated in Figure 8 below.



LEVEL 3: Case management
Requires the identification of the very high intensity users of unplanned secondary care. Care for these patients is managed using case management approach to anticipate, coordinate and join up health and social care

LEVEL 2: Disease-specific case management
Involves providing people who have complex single need or multiple conditions with responsive, specialist services using multi-disciplinary teams and disease-specific protocols and pathways

LEVEL 1: Supported self-care
Collaboratively helping individuals and their carers to develop the knowledge, skills and confidence to care for themselves and their condition effectively

Figure 8. *The long-term conditions model (aligning Girot & Rickaby, 2008).*

As shown in Figure 8 above, the role of community matron is designed by Department of Health to manage the care of those with highly complex needs. A community matron, who is usually an advanced practitioner and highly qualified nurse, plans a tailored and suitable personal treatment plan for the patient according to his or her condition (Murphy, 2004; Girot & Rickaby, 2008; Chapman *et al*., 2009; Kanste *et al.,* 2009a). Policies defined by Department of Health emphasize that community matrons are expected to treat from 50 to 80 patients, who are the most vulnerable and very high intensity patients with multiple long-term conditions (Sargent *et al.*, 2008). The new role of community matrons is aimed to provide personalized and coordinated care to ensure that those with highly complex needs experience a seamless journey through the health and social care system (Girot & Rickaby, 2008).

Due to working closely with patients, community matron attempts to reduce service use through preventing admission and early discharge, and also by providing more information as well as motivation for the patients' self-treatment process. Matrons need to be able to work across organizational boundaries in the network between primary, secondary, social care and the voluntary sector in order to secure the best services possible for people with long-term conditions. The model also offers flexible integration between primary and secondary care. (Murphy, 2004; Kanste *et al.*, 2009a; Munukka *et al*., 2010, p. 54)

Community matron role has been defined by Kanste *et al.* (2009a) to consist of offering customer-based services, individual treatment, guidance and support self-treatment. Essential in CMM is the relationship between the patient and the nurse acting as community matron. For the patient it is important to understand his or her own situation and the effects it has on his or her life. (Kanste *et al.*, 2009b) The Department of Health has described the role of the community matron as:

- Identify suitable patients for case management and stratify risks
- Carry out a comprehensive assessment of patients and carer needs
- Develop a personalized care plan
- Pro-actively support patients in the community
- Review care plans and changing needs
- Manage patients journeys proactively across organizations
- Act as primary co-ordinator of care – always aware of patients' situations
- Call on expertise and skills of other professionals to execute the care plan

(Chapman *et al*., 2009)

According to Kanste *et al.* (2009a), there are five elements highlighted in CMM, which are: (i) executing clinical research and treatment, (ii) aligning the treatment process in order to avoid overlapping services without dropping out from the process, (iii) individual guidance for the customer, (iv) representing customer taking care of customer's rights and interests in service management, and (v) offering psychological support. Especially important factor is the offered psychological support, including social support and supporting networks, as well as taking the whole family into the focus. Kanste *et al.* (2009a) argue that it is especially the psychological support provided by nurses, which separates community matron model from other service management models. They argue the psychological support having been as important as the execution of clinical treatment.

Providing easily understandable information for the patients and their families in order to self-treat using best practices and make decisions based on the knowledge regarding their own health care is one important aspect in service management. The availability and easy connectivity, treatment's continuity and regular communication are important in the treatment process from the patients' point of view. Essential in providing services is to provide, maintain and develop the services as near the patient as possible. (Kanste *et al.*, 2009a; Chapman *et al.*, 2009)

The whole treatment plan is based on the patient's needs and goals, while it is planned in deep teamwork within the patient and his or her family, along with health care professionals. The main goal of the treatment plan is not only to treat the illness, but also to maintain the surviving and quality of patient's daily life. For the treatment to be patient-centered, it is important to clarify patients' needs as well as what is important to him or her together with the expectations towards the treatment. It is important to have deep insight in patient's life along with his or her health issues. In the treatment plan, different actors are identified along with their responsibilities; how does the patient involve to the treatment, what different units do and what is their part in the whole treatment process. The aim is to keep the treatment in balance, provide guidance, decrease the complications, increase patient's dependency and increase the quality of patient's life. (Girot & Rickaby, 2008; Kanste *et al.*, 2009a)

3.3.1 Benefits and criticism on CMM

CMM is intended to enable patients to make better informed choices and improve self-treatment (Murphy, 2004). By using case management, the high intensity users at increased risk of hospital admission can be identified and therefore monitored and supported in order to reduce the hospital admission (Chapman *et al*., 2009). However, Kanste *et al.* (2009b) recognize the challenge of identifying the high intensity users from regular patients: how they are recognized and how the value that they receive from the care can be maximized?

The research performed by Chapman *et al*. (2009) shows that CMM have been seen being beneficial for chronic care. In their research which included 31 health and social care professionals, the community matron role was seen as effective tool in meeting the medical and social needs of patients through patient education, developing patients' self-management of their health condition and monitoring the needs. The research showed that using community matron approach adopted a more systematic approach to patient education, which led to better self-management of patients' conditions. In addition, according to a research performed by Sutherland and Hayter (2009), the patients are more responsive to treatment regiments due the close partnership between nurses and patients. They argue that this may be result of the possibility to be able to discuss problems and understand the importance of compliance.

The community matrons also appear to have more time to dedicate to patient education, the were able to address both patients' medical and social needs while providing a single point of access to patients and a link between primary and secondary care. Community matron have proved to be a good resource for other professionals in primary care because of their enhanced skills and breadth knowledge of the available services, and in secondary care during hospital ward rounds and through working closely with hospital physician. The role of community matron can also improve team working, patient care patterns and enhance knowledge and skills for staff working in primary care. (Chapman *et al.*, 2009)

The role of community matron and case management process is stated to be designed to reflect national quality measures and evidence-based practice, with performance being measured against quality indicators. However, CMM receives also criticism in terms of threatening patients' autonomy, reducing individual care and being based on cost-effectiveness rather than quality care. (Sutherland & Hayter, 2009). Murphy (2004) states that community matron is a tough and challenging job to do well and the complexity and difficulty is often underestimated. Sargent *et al.* (2008) argue that community matron's caseload sizes shifts the care from proactive to reactive task-focused care, which is exactly the opposite as what is expected from community matrons. They see the amount of patients to be too high, and suggest that approximately 40 patients constitute a manageable caseload threshold.

The extent to which nurses have adopted community matron roles have been associated with four different variables: (i) the clarity of policy guidance, (ii) the concordance with professional values, (iii) local practices and policies, and (iv) the personal vision of community nurse (Drennan *et al.*, 2011). The need for training is huge (Murphy, 2004). However, the results of being in community matrons' role have been found educational: in the research performed by Chapman *et al.* (2009), the participants of the research saw the community matron role to develop their professionally, further advance their nursing skills and giving them more autonomy. This has led to both increased job satisfaction and patient care, as argued by Chapman *et al*. (2009).

However, Murphy (2004) points out the uncertainty of community matron role: some studies have referred community matron concept as a team process rather than one person's role, and in one case the term community matron referred to a nurse who coordinates care over the phone. Drennan *et al.* (2011) noted that the role of community matron was seen to duplicate or overlap the work of social worker or care managers. This is also noted in the research by Chaman *et al.* (2013); there was no definite job description, and the lack of information and role definition caused difficulties not only in the participants' own work but also when working with others due potential role conflicts. Kanste *et al.* (2009b) also mention the difficulty of measuring and pointing out the exact value that is created by implementing CMM. In addition, Girot and Rickaby (2008) acknowledge the need for organizations to develop their infrastructure to support the new roles, and to provide protected time to learn in practice.

3.3.2 Case: Nurse-led CMM in Oulunkaari

Patients that need high intensive health services are the patients who visit health centers more frequently than average municipal citizen. In Finland, the amount of frequent users is estimated to be 5-8%, and their part of doctors' appointments is approximated to be between 24-32%. Usually these patients also have multiple diseases and their quality of life is worse than an average patients. In Oulunkaari these high frequent patients have been recognized by the amount of health center visits, by having at least eight appointments within one year. The CMM utilized in Oulunkaari is illustrated in Figure 9 below. (Munukka *et al.*, 2010, pp. 52-53)

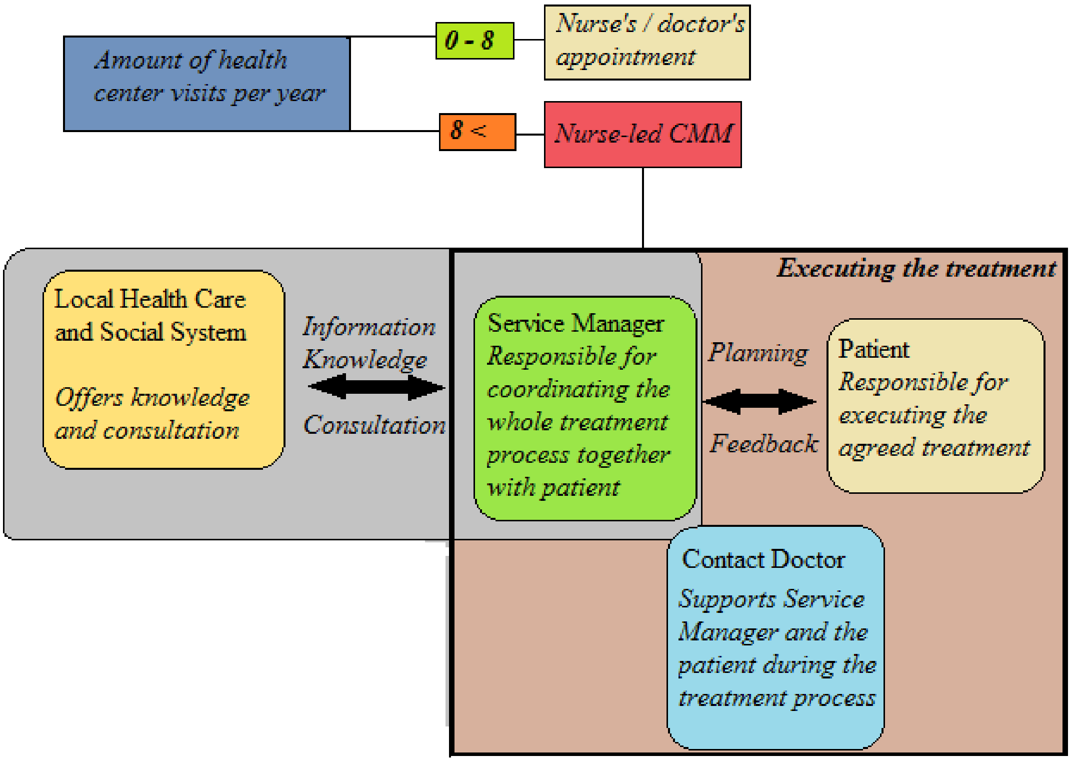


Figure 9. *The structure of the nurse-led CMM in Oulunkaari (applied from Munukka et al., 2010, pp. 53-57).*

The utilizing of CCM model illustrated in Figure 9 for treating patients with multiple diseases have been taken into focus in Oulunkaari by offering nurse-led CMM. This model has been taken into pilot in health centers located in Ii, Pudasjärvi, Utajärvi, Vaasa and Yli-Ii. In this programme, a local nurse in health center acts as a service manager, which is similar to the role of community matron, offering tailored and coordinated health care for the patients. The service managers are independently responsible for patient care and service co-ordination. (Kanste *et al.*, 2009b; Munukka *et al.*, 2010, pp. 53-54)

Reports have shown that before the adaption of nurse-led CMM, the patients with multiple diseases did not get the kind of treatment that apply to their needs, nor services that were aligned with each other. The treatment process have been seen fragmented and organized in separate silos, where no-one took responsibility of the patient's treatment process as a whole. Due to this uncertainty patient did not know who is responsible for his or her treatment and he or she may seek information and treatment from wrong providers. This has led to uncontrolled and unpractical use of health care services. (Munukka *et al.*, 2010, pp. 53-54)

In Oulunkaari's CMM, patients with multiple diseases visit mainly their named service manager who is responsible of coordinating and planning the whole treatment process together with the patient. To most patients also an own contact doctor is assigned in the health center. The doctor works in tight co-operation with the service manager and participates to the execution of the treatment process together with the patients, as shown in Figure 9. The goal of this service delivery model is to increase patients' quality of life and decrease unplanned treatment periods by offering patient-based, anticipatory service management. (Kanste *et al.*, 2009b; Munukka *et al.*, 2010, pp. 53-57)

Multitalented coordination between different organizations is in the center of Oulunkaari's service delivery model. For this to be successful, must professional nurses work seamlessly in co-operation, with knowledge of local health care and social service systems in order to answer to patients individual and complicate treatment needs. An important issue is to create a flexible patient-based entity of the whole treatment process to simplify the complex and shattered health services. (Munukka *et al.*, 2010, p. 54)

Detailed and patient-based planning of treatment is a key player in nurse-led CMM. Patient-based means that the treatment is planned to fill patient's expectations and values: patient takes an active role in the planning process together with the multi-professional care team. In the treatment plan different responsibilities are determined to concern every stakeholder in the treatment process. (Munukka *et al.*, 2010, pp. 53-57)

The network operating in the treatment process must have flexible connectivity in order to fulfill the needs of patients with multiple diseases. For example telecommunication enables the geographically dislocated actors to participate to the treatment, including health center nurses, specialized doctors as well as the patient. Via using telecommunication, the patient is able to get information related to his or her treatment without going physically to the health center. This has decreased the amount of health center visits. (Kanste *et al.*, 2009b; Munukka *et al.*, 2010, p. 56)

Patients have reported service delivery model to be significant. It has been important to patients to have their own service manager who has the time and interest in their daily lives. The quality of life and managing their daily lives has had increased effect among the patients with multiple diseases. The patients can have impact on the planning, executing and monitoring their treatment process. Also service managers emphasizes the operation model reasonable by giving a chance to focus on patient’s situation and plan the whole treatment process as a whole and individually. (Kanste *et al.*, 2009b; Munukka *et al.*, 2010, pp. 57-58)

3.4 Chronic Disease Self-Management Program

One of the successful implementations regarding CDSM outcomes is Chronic Disease Self-Management Program (later referred as *CDSMP*). The CDSMP consists of classes given by trained leaders with chronic disease to community groups of 10 to 16 participants. The participants are individuals with multiple chronic conditions, and they can vary between participants, since people with chronic conditions usually have similar concern and problems. (Lorig, 1996; Farrel *et al.*, 2004; Dorig, 2010; Harrison *et al.*, 2011)

Lorig (1996) notes that patient education programs which are aimed at specific diseases, could leave the patient with multiple chronic conditions with confusion and conflicting information and therapeutic regimes. Therefore the CDSMP does not limit to any long-term conditions, instead it is developed for use of any long-term condition. These classes meet every week for six weeks, led by trained tutors with personal experience of long-term condition. During these meetings, participants are introduced with techniques to deal with everyday problems, while taking note the emotional and psychological side of chronic disease management. (Lorig, 1996; Farrel *et al.*, 2004; Harrison *et al.*, 2011; Miller *et al.*, 2015)

Elzen *et al*. (2007) define CDSMP to be a self-management program that focus less on the problems related to one specific disease. Instead, they argue, the focus is on the general management of the problems that are the same for patients with different chronic conditions. The six week course is delivered from a scripted manual, including relaxation, sleep management, nutrition, exercise, fatigue, medication and communication skills modeling of behaviors, problem solving and individual decision making, designed to improve self-efficacy and self-care skills (Harrison *et al.*, 2011; Farrel *et al.*, 2015).

An individual’s self-efficacy derives from four sources: previous performance accomplishments, vicarious experiences (e.g. seeing others succeed), verbal persuasion and mood behavior. The CDSMP is grounded in self-efficacy theory, which states that if participants have confidence that they can do something, they will probably accomplish it. (Jerant *et al.*, 2005) To build self-efficacy, participants need to (i) increase their skills through contracting and feedback, (ii) experience modeling by having lay leaders with chronic conditions teach the course and by encouraging course participants to help each other in decision-making and problem-solving exercises, (iii) reinterpret their physiological symptoms by evaluating the many possible causes for each symptom, which allows them to choose from different solutions, and (iv) make small continual change through verbal persuasion and reinforcement. (Lorig, 1996)

The CDSMP includes activities that touch on each source of influence on self-efficacy. The group sessions focus on problem solving as a group to overcome difficulties with mastering universal self-management tasks. Also a participant-driven personal action plan are defined for making incremental steps toward long-term self-management goals. To keep the CDSMP content patient-focused, the program deals with problems such as pain, mobility and fatigue, not diseases. (Lorig, 1996; Jerant *et al.*, 2005)

The CDSMP is an example of a complex intervention, which involves a number of potential active ingredients; for example course content, session adherence, course quality and group process. As active ingredients vary, there are a variety of different outcomes of the CDSMP, including satisfaction, maintenance of contact with a group, volunteering to become a tutor for later courses, and conventional health outcomes. Different mechanism are important in driving different outcomes. For example the adoption of specific behavioral techniques might be associated with the skills of the tutor, but the general satisfaction with the course might be most closely associated with perceptions of the group process. (Harrison *et al.*, 2011)

3.4.1 Benefits and criticism on CDSMP

According to Miller *et al.* (2015), in CDSMP patients incorporate multidimensional strategies that meet their self-identified needs. This requires patients to continually evaluate their perceived health status. Dongbo *et al.* (2010) list four reasons why CDSMP is suitable for different kinds of patients: (i) people with chronic diseases have similar concerns and problems, (ii) people with chronic conditions can learn to take responsibility for their daily management of the diseases, involving the physical and emotional problems, (iii) lay people with chronic conditions can teach CDSMP as effectively, or even more effectively than health care professionals, and (iv) the process of self-efficacy taught in CDSMP is as important than the subject matter taught.

In the analysis presented by Harrison *et al.* (2011), the CDSMP course was associated with statistically significant benefits in terms of self-efficacy and self-reported health, which was also seen likely to be cost-effective. Additionally, both Farrel *et al.* (2004) and Jerant *et al.* (2005) note the improved self-efficacy, self-management behaviors and health status while reducing hospitalization and emergency visits. However, Miller *et al.* (2015) note that although outcomes such as health status have been improved by CDSMP, these changes are often short-lived. They acknowledge that the positive outcomes have been found disappearing after five years, hence being insufficient for persons with chronic diseases that last a lifetime. In addition, contrasting to the earlier positive results, in the study performed by Elzen *et al.* (2007) no significant effects of using CDSMP were found.

The role of lay leader as being one of the group members has received good experiences related to the actions in the group. It is presumed that if the lay leader would be a health care professional, there would be enormous pressure toward the person regarding to what group member should do. There is also a psychological aspect of having a leader with same experiences as the patients; member of the group may act in the patient's role when talking to health care professional and say what he or she thinks is expected as a patient. The health care professional may also find it difficult decline giving instructions that are based on professional knowledge and experiences. This may lead to situation, where patients are merely following the rules determined by the leader instead of taking responsibility of the self-management of their condition. (Association of Finnish Local and Regional Authorities, 2015)

Jerant *et al*. (2005) raised two concerns that are shadowing the success of CDSMP: firstly the evidence of self-efficacy having actually meditate effect of the program about the outcomes. They argue that a better understanding of the mechanisms of the program's effect might allow for refinements to increase its potency. Second is the effectiveness of CDSMP in improving outcomes without the group elements. Since usually these programs are executed by gathering the participants physically to the same place, individuals with severe functional impairments or unreliable transportation may not be able to participate to this kind of program. (Jerant *et al.*, 2005)

3.4.2 Case: CDSMP in Finland

In 2012 a project called *Living Strong* (*"Arkeen Voimaa"* in Finnish) based on CDSMP started in order to improve the state of health and well-being experienced by health care clients and encouraging them to become active and assume more responsibility of their own well-being. The project is implemented by the Association of Finnish Local and Regional Authorities, the Ministry of Social Affairs and Health and the cities participating in the project: Espoo, Helsinki, Jyväskylä, Kuopio, Oulu, Turku, Vantaa, and the South Karelia Social and Health Care District (Eksote). The period of implementation was from 2012 to 2014. (Association of Finnish Local and Regional Authorities, 2015)

The Association of Finnish Local and Regional Authorities was responsible for managing, organizing and the governance of the project. The executive board was gathered from representative from each of the participating cities, Association of Finnish Local and Regional Authorities and from the Ministry of Social Affairs and Health. The development of the project was assigned to a project group, which included all educated master-trainers from Kuopio, Jyväskylä, Turku, Helsinki, Espoo and two employees from the Association of Finnish Local and Regional Authorities, which act as project manager and project coordinator. Organizing the *Living Strong* project is part of the actions of the cities. Even though the common rules are being followed in each of the projects, local solutions are noted and the execution of groups is aligned to fit them. The purpose of the groups is to follow the execution of the action, leading voluntary lay leaders and enable the continuity. (Association of Finnish Local and Regional Authorities, 2015)

The execution of *Living Strong* projects need a license, which includes the training of the lay leaders in the University of Stanford. The lay leader are voluntary over 18 years old persons suffering also from some kind of long-term disease. The license includes also the material for the lay leaders and books and forms for the customers. The licenses determines explicitly how the CDSMP meetings should be executed, and the only changes that can be done to the given material are due the appliance to Finnish society and service delivery. (Association of Finnish Local and Regional Authorities, 2015)

The groups in *Living Strong* are for the patients suffering of any kind of long-term disease. Diagnoses, ages and gender does not matter. The size of groups is from 10 to 16 patients. In the group meetings the focus lies on gathering mutual experiences and solutions to common problems are searched for example via brainstorming or using different problem solving methods. (Association of Finnish Local and Regional Authorities, 2015)

The members to the groups are hired mainly by the health care professionals, but also by social and employment and business services. While cooperation between different actors is vital in this project, the lay leaders are hired exclusively by health care professionals and they give guidance for leading the group meeting. In Figure 10 is illustrated the cooperation between health care professionals, group members and lay leaders. (Association of Finnish Local and Regional Authorities, 2015)

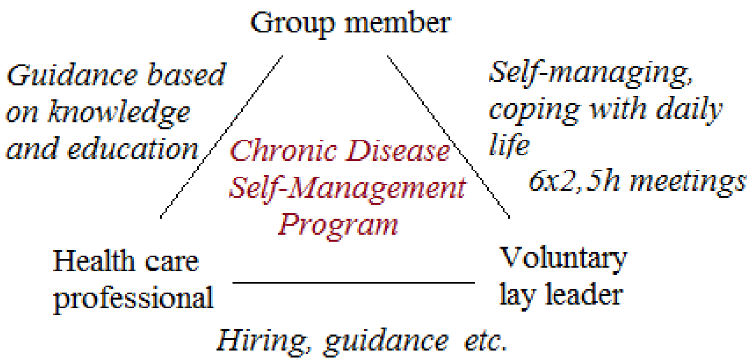


Figure 10. *Relationships between health care professional, member and leader.*

The *Living Strong* project consists of six weekly group meetings. The duration of one meeting is two and half hours, while the focus of the meetings is on developing ways for group members to cope better with their daily life, as shown in Figure 10. The participation to the groups is possible during the first and the second meeting. The groups are closed after the second meeting, after which it is not possible to participate to that exact group, but one has to wait for another one to begin. Every member that has participated to at least four sessions are included to the follow-up survey, which takes place both in the end of the project (sixth meeting), and after six months from the end of the project. (Association of Finnish Local and Regional Authorities, 2015)

In October 2012 first *Living Strong* groups were executed in Turku, Kuopio, Jyväskylä and Espoo. In 2013 groups started running in Vantaa, Helsinki, Lappeenranta and Oulu. The experiences asked from group members have been usually really good. Members have felt that they have received more strength and that they can manage their daily lives a lot better than before the program. They also have found good ways to solve problems related to their chronic conditions as well as received new knowledge and guidance. Some have felt the group sessions to be like therapy for them. (Association of Finnish Local and Regional Authorities, 2015)

3.5 Comparison of CCM, CMM and CDSMP

All the operational models presented has similarities and differences when compared with each other. A summarization of the models and their benefits has been gathered to the Table 3 below. Their properties are summarized in the following Table 4 on the next page.

Table 3. *Summarized comparison of the presented operational models in Finland.*

Model	Summary	Benefits
CCM	The general features of chronic care are summarized, such as coproduction of health outcomes, as part of community, in order to improve patient outcomes.	Empowered, knowledgeable patients self-manage their conditions with the support of health care professionals, leading to for instance enhanced self-management skills and fewer health center visits. Activated and informed community (patients) and prepared, proactive community partners (practice team) together by interacting productively and forming relationships create collaborative care, leading to improved health outcomes.
CMM	Community matron identifies patients with complex chronic conditions, and plans their care to treat patients with more personalized, coordinated care.	Patients care is individually tailored to suite the specific needs, according to the condition. Community matron works in tight cooperation with all the parties participating to the care, especially with the patient. The patient is encouraged to self-treat the chronic conditions, and the patients along with their families are offered psychological support and easily understandable information regarding the treatment of the chronic conditions.
CDSMP	A class consisting of patients with varying chronic conditions meet weekly to learn self-management skills and share experiences.	Patients are given guidelines and instructions for improving self-efficacy and self-care skills. The lay-leader has personal experiences of suffering chronic conditions, and the content of the group meetings focuses on the patients, not on diseases. The meetings introduce techniques to deal with everyday problems, noting the psychological aspect. Patients are encouraged to evaluate their perceived health status and to take responsibility of their self-management skills.

As can be seen from earlier chapters and from Table 3, the presented operational models have similar properties regarding the care of patients suffering of long-term conditions.

The general properties of chronic care and the properties of chronic care models based on earlier are summarized to the below Table 4. Into the Table 4 is also marked whether or not the other care models fulfills the property applied in the model (marked with ‘x’).

Table 4. *Properties of the presented operational models related to chronic care.*

General properties of chronic care	**CCM**	**CMM**	**CDSMP**
Health care professional and patients act as partners	x	x	
Shift from reactive care to proactive care	x		
Encourage to self-manage chronic conditions	x	x	x
Assist gaining skills to cope with the disease	x	x	x
Patient-centeredness	x	x	x
Patients’ beliefs of disease are noted	x	x	
Patient is activated to take control of self-managing	x	x	x
Properties of CCM			
(Developing of) care utilizes external resources provided by community (e.g. programs, education)	x	x	x
Self-management includes goals and action plans	x		x
Health care professionals are provided decision support, such as education and new techniques	x		x
The roles and responsibilities are clearly designed	x	x	
The timely information of patients’ condition is available for the health care professionals	x	x	
Patients are informed of the care process	x	x	
Patients are empowered, accepting responsibility of managing own condition	x	x	x
Properties of CMM			
Patients are offered tailored, suitable care plan	x	x	
Patients are provided coordinated care	x	x	
Care is planned in co-operation between organizational actors (e.g. primary and secondary care)	x	x	
Care is reviewed in co-operation with the patient	x	x	
Patients are provided psychological support		x	x
Patients has a clear point of contact		x	
Patients are provided easily understandable information of self-managing chronic disease	x	x	x
Patients’ specific needs are noted in the treatment	x	x	
Properties of CDSMP			
Care is not limited to any specific disease			x
Patients are educated with general management of problems related with chronic conditions			x
Patients are focused on dealing with everyday problems (such as pain), not disease			x
Patients continually evaluate their health status	x	x	x
Patients self-efficacy skills are developed and evaluated	x	x	x

As Table 4 illustrates, especially CCM and CMM has a lot in common – CDSMP varies by the properties from the two presented models. This is natural, since the nature of

CDSMP differs from the CCM and CMM models. CCM and CMM are operational models developed to the health care delivery, grounded on the current way or organizing care. CDSMP, on the other hand, tackles to the problems related with chronic care from another direction. In CDSMP the health care professionals provides support and knowledge to the group meetings via the lay-leader, but it is the patients who, by cooperating and acting together, create the treatment and the outcomes. The Table 3 and Table 4 will be later referred to, when the possibilities of ICT in the execution of chronic care is put into focus.

3.6 State of ICT in Finnish health care

In this subchapter the state of utilizing ICT in Finnish health care is introduced. The chapter is divided into two parts; firstly is the current state of ICT in Finnish health care introduced, which is followed by stating the challenges risen from the earlier literature, regarding the execution of ICT supported health care in Finland. Also the future plans for Finnish health care is presented, including the forthcoming social welfare and health care reform.

3.6.1 Current state of ICT in Finnish health care

In 2012 the National Institute of Health and Welfare (THL) produced a report regarding eHealth and eWelfare in Finland. By Hämäläinen *et al.* (2013), eHealth is defined as “use of information and communication technology logically and at distance in health care”, and eWelfare as “use of information and communication technology as well as electronic information management in social care”. The survey describes the status and trends in health care ICT, and the usage of eHealth in Finland in 2011.The survey included data from 140 public health care centers delivering primary care and all the 21 public hospital districts delivering secondary and tertiary care. A sample of private sector service providers is also included to the survey. (Hämäläinen *et al.,* 2013).

According to Saranto *et al.* (2007, p. 24), information systems that are currently used in health care in Finland can be divided into three categories: clinical systems for handling patient data, Enterprise Resource Planning –systems (later referred as *ERP*) for governance and specialist systems which support both clinical and ERP-systems. Hämäläinen *et al.* (2013) noticed that electronic information exchange between organizations has progressed rapidly, and electronic referrals, discharge letters and multilateral regional electronic patient data depositories are more advanced and common. Infrastructure at the local level has changed from paper records to electronic documentations, Hämäläinen *et al.* (2013) summarize.

The electronic information exchange between organizations is regulated by Personal Data Act (523/1999), Act on Health Care Professionals (559/1994), Act on Experiments with Seamless Service Chains in Social Welfare and Health Care Services and with a Social

Security Card (811/2000) and Act on Electronic Handling of Social and Health Care Customer Information (159/2007). Patients' data can only then be exchanged if patient has agreed upon it and the exchange is regulated by the law. (Winblad *et al.*, 2008). Porter (2009) acknowledges that electronic information exchange will enable value improvement, but only if they support integrated care and outcome measurement. Simply automating current delivery practices will be a hugely expensive exercise in futility. (Porter, 2009)

EPRs, which are digitalized collection of the medical and treatment information of patient, are currently being widely used in secondary and primary health care, and its implementation has been emphasized in national policies. In the survey provided by Hämäläinen *et al.* (2013), EPRs were used as the only source of patient narratives in more than 90% of all the primary health care centers and in most of the hospitals. EPRs use structured data, which makes it easier to handle and re-use gathered data by different kind of users. The usage of documents that are standardized and structured, which can be modified via using different kind of views, simplifies the data exchange between different operators and systems in patient care. (Saranto *et al.*, 2007, pp. 96-99; Winblad *et al.*, 2008; Lammintakanen *et al.*, 2010).

Radiology Information System (later referred as *RIS*) is an entity of applications guiding the functions of radiological departments. In RIS for example referrals and appointments are determined, patients' visit information are managed, patients' records to picturing devices are channeled, registered and archived with doctor's statements, the utilization rate of radiology department and user's information and profiles are managed. The utilization of RIS is a requirement for utilization of PACS, which is utilized in every hospital districts in Finland. The utilization of PACS creates a solid ground for regional and national archiving of health related pictures. This kind of archiving is a requirement for creation of digital saving and viewing of patients' pictures and results, which increases patients' availability to their own health records. (Winblad *et al.*, 2008)

Electronic referral exchanges between hospitals are used in situations, where the hospital receiving the referral takes the responsibility of the patient's treatment from the sender by receiving the patient's medical case summary. Also electronic consultation service is used in order to get advice regarding the patient's treatment from the unit receiving the referral. In such case the responsibility of patient's treatment is still at the sender. Consultation was also given via televideo-consultation and via receiving electrocardiography (*ECG*) telemetrically from the ambulances. (Winblad *et al.*, 2008)

The National Archive of Health Information (later referred as *KanTa*) is a collective name for several national medical information systems, including electronic archive of patient records (eArchive), electronic prescription (ePrescription), the national Pharmaceutical Database and online access of citizens to their personal prescription and medical data (eAccess). The eArchiving system is a unique solution for a centralized EPR repository, enabling data transfer between health service providers and empower patients to browse their own EPR. However, eArchiving is regulated to require patients’ permission before utilizing it. The health care professionals are mandatory to log in to KanTa system with strong electronical identification, before the patients’ data is available for managing, transferring and examining. (Winblad *et al.*, 2008; Hämäläinen *et al.*, 2013)

3.6.2 Challenges and the future state of ICT in Finnish health care

However, the development of HIS has been largely uncoordinated in the national level, and Teperi *et al.* (2009, p. 83) sees one reason to be partly due to the decentralized health care system. As a results several non-interoperable information systems are often used even within a single health care organization. This inhibits information exchange both within and across provider organizations. Thus the inability to communicate and the lack of HIS standards undermines both the ability of HIS to enable value measurement as well as to restructure care delivery around the integrated care for medical conditions. (Fieschi, 2002; Abott & Coenen, 2007; Teperi *et al.*, 2009, p. 83) The development of KanTa have been seen as one answer to this issue (Hämäläinen *et al.*, 2013).

In the study performed by Lammintakanen *et al.* (2010), nurse managers have several electronic information systems to fulfill their management functions: (i) human resource management (for example IS for rostering, continuing education and recruitment), (ii) financial management system (for example IS for budgeting and travel management), (iii) operational/clinical IS (for example EPR) and (iv) IS for communication and information sharing (for example internet, intranet and email). Even though some of the nurse managers felt that utilizing IS has strengthened their role as managers, the use of IS was not common among the nurse managers, and not all used the systems. Even within the same organization, the IS utilization is fragmented and the flow of information was not guaranteed. (Teperi *et al.*, 2009, p 83; Lammintakanen *et al.*, 2010)

Nonetheless, the nurse managers in the study of Lammintakanen *et al.* (2010) were optimistic in regards to the future use of IS. The manager nurses did not identify uses of IS for managerial purposes in future, but they reflected on the issue and the benefits merely from clinical perspective. Indeed, as stated in chapter 4.1.1, the benefits for clinical functions and patient care are significant.

The social welfare and health care reform has been under development in the Governmet Programme from year 2011. The objective of the reform of social welfare and health care services is to reduce inequalities in well-being and health, as well as manage costs. The social welfare and health care services will be combined on all levels. The aim is to create seamless service chains for the provision of key social welfare and health care services while improving the functioning of basic services. One important aspect in the social welfare and health care reform is the freedom of choice model, which aims to strengthen basic services and to ensure people's rapid access to care. (The Ministry of Social Affairs and Health, 2015)

Social welfare and health care information systems will be integrated and the overall architecture of the systems will be developed and its implementation monitored on a national level (The Ministry of Social Affairs and Health, 2015). According to Erhola *et al.* (2014), the social welfare and health care reform enables the new ways of supporting, coordinating and integrating social welfare and health care with information management and administration. They argue, that currently information management and administration varies a lot between hospitals. Usually these variations include information systems that are not interoperable with each other, which is a safety risk for patient security and causes duplicate work and examination. The development of both (i) information management and administration, as well as (ii) health care in Finland is shown in the below Figure 11.

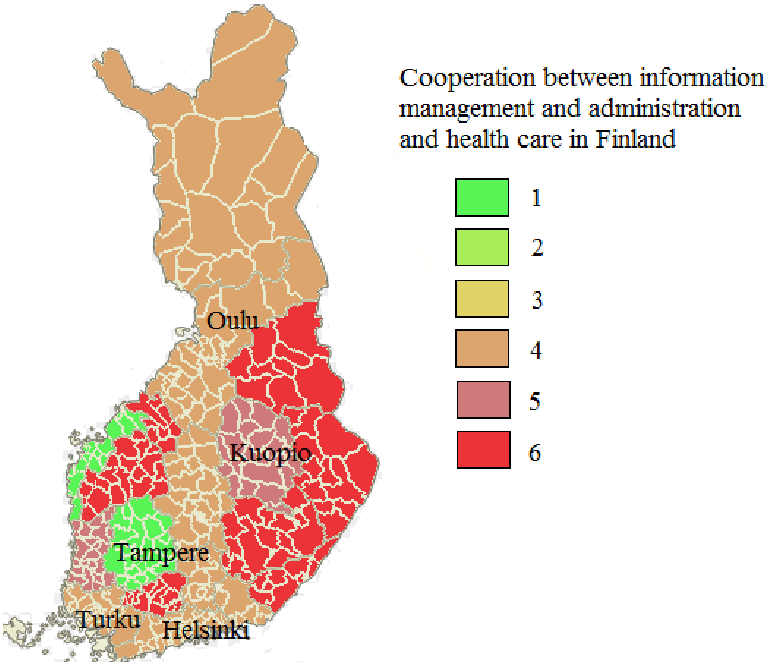


Figure 11. *Cooperation between information management and administration and health care in Finnish hospital districts (adopted from Erhola et al., 2014).*

As can be seen from Figure 11, the cooperation between information management and administration and health care varies between different hospital districts. Maturity level 1 is for poor maturity, where for example different information systems do not cooperate with each other. On the contrary, level 6 is for high maturity level, where information systems are interoperable and the coordination of IT services is in-line with the needs of health care services. The maturity level is influenced by the coordination of hospital district and by the information system solutions, both of which are evaluated from 0 to 3. For example HUS got grade 3 regarding the level of coordination of hospital district, but grade 1 regarding the consistency of different information systems; thus the maturity level is 4. (Erhola *et al.*, 2014)

According to Erhola *et al.* (2014), and as can be seen from Figure 14, the strongest cooperation between information management and administration and health care is in Hospital District of Northern Savo (Kuopio University Hospital). For example Etelä-Savo and Pohjois-Karjala got an evaluation of 3 from coordinating hospital districts and 3 from consistency of different information systems, thus leading to total maturity level of 6. In Etelä-Savo an important project was the integration of network infrastructure between the hospital district of Southern Finland and the hospital district of Eastern Finland, which has led to a tight cooperation between the two hospital districts. They share mutual information systems that communicate with each other; thus the IT solution in Hospital District of Northern Savo is consistant. (Erhola *et al.*, 2014)

The weakest cooperation is in Pirkanmaa Hospital District (Tampere University Hospital). In Pirkanmaa Hospital District the weakest individual region is Pirkanmaa, since all the other regions got higher evaluations (Etelä-Pohjanmaa 6, Kanta-Häme 6, Päijät-Häme 4). In Pirkanmaa the coordination between hospital districts got grade 1 and the consistency of different information systems got 0. The IT solutions was seen to be too complicated and shattered, even though some level of consistency has been created within the last few years. Different hospitals used three different patient information systems, resulting in hospital not being able to see or use other regions information; instead, everything works on their own, which causes a huge amount of additional work. (Erhola *et al.*, 2014)

There are two projects for acquisition of social welfare and health care information systems: Apotti and Kiila. Apotti is located mainly to Helsinki and HUS, and Kiila is between hospital districts of Etelä-Karjala, Kymenlaakso, Etelä-Savo (only the hospital district of Southern Finland; hospital district of Eastern Finland is not included), Keski-Suomi and Medi-IT. In both of these projects the participants are included as in the role of service delivery and both of these projects implicate for a will and need to achieve a more mature level of integration between hospital districts. (Erhola *et al.*, 2014)

The responsibilities and roles of both organizing and developing services are yet to be carefully evaluated to make sure that quality of service is maintained. The services must be available and their quality must be continuously increased. The IT solutions in the future are seen to have a significant role in delivering equal social welfare and health care. Especially avoiding overlapping and incompatible solutions, increasing patient information systems compatibility and developing and describing overall architecture are seen to have a notable importance. (Erhola *et al.*, 2014)

4. ICT IN HEALTH CARE

In this chapter, the current situation of applying ICT generally in health care are introduced. This chapter is divided into four sections: first the general properties of ICT in health care are examined, followed by presenting the benefits that ICT could provide to health care. Thirdly the challenges related to the utilization of ICT are presented. This is followed by shifting the focus on chronic care, as the benefits of the utilization of ICT in chronic care are presented.

4.1 Properties of ICT in health care

Lupianez *et al*. (2010) observed that it is increasingly difficult to practice modern medicine without information technologies. Information technologies utilized in the health care context are usually referred to as Health Information Technology (later referred as *HIT*), which refers to the applications for processing information, involving both computer hardware and software that deals with the storage, retrieval, sharing and use of health care information data, as well as knowledge for communication and decision making (Dobrukowski *et al.*, 2014). The technologies in health care are divided by Christensen and Remler (2007) into four categories: (i) technologies to support patient education and self-care, (ii) patient-provider and provider-provider communication (iii) electronic data storage and sharing between providers, and (iv) technologies to combine the earlier three.

Three elements are essentials in the use of information technology in health care: organization, individual and information systems (Lammintakanen *et al.*, 2010). Information systems have both technical level of communication, as referring to the accuracy and efficiency of the system producing information, and semantic level, such as the effect of the information to its receiver (Deloine & McLean, 2003). Haux (2006) defines HIS to be complexes or systems of processing data, information and knowledge in health care environment, aiming to contribute to a high-quality, efficient patient care.

The key role of ICT in health care, according to United States National broadband Plan, is to improve health and health care through enhancing care delivery, coordination, and engagement with patients (While & Dewsbury, 2011). ICT enables coordination and monitoring of treatment, surveillance, response, education and communication in health care (Abott & Coenen, 2008). Health care professionals frequently face situations where they have to use multiple forms of patient data and consult other professionals in order to make decisions on the most effective treatment for the patient (Pavlopoulos & Delopoulos, 1999).Without having appropriate access to relevant data, practically no decisions on diagnostic, therapeutic or other procedures can be made related to patient’s health, with fatal consequences (Haux, 2006).

The technologies of ICT in health care are categorized by Black *et al.* (2011) into three different areas based on their functions: (i) storing, managing and transmission of data, (ii) clinical decision support, and (iii) facilitating care from a distance. Patient data can be stored for example to Electronic Health Records (later referred as *EHR*s) and to Picture Archiving and Communication System (later referred as *PACS*), from where they can easily be managed and transmitted to the clinicians whenever needed. As clinical decision support, for example Computerized Provider Order Entry (or Computerized Physician Oder Entry, later referred as *CPOE*) can be used by clinicians in order to review and communicate orders and referrals related to patient care. For facilitating care from distance, teleconsultation and for example EHRs together with CPOEs enable clinicians to make decisions based on real time information regarding the patient care, when the patient is still on the way to the hospital in an ambulance. (Pavlopulos & Delapoulos, 1999; Winblad *et al.,* 2008; Black *et al.,* 2011; Hillestad *et al.*, 2015).

According to US Institute of Standards and Technology, EHR is defined to be “a longitudinal collection of patient-centric health care information available across providers, care settings and time”, and it is a central component of an integrated health information systems (Black *et al.,* 2011). EHRs save time from copying, searching paper files and decipher handwriting as was earlier in paper-based processing and storage of patient data (Christensen & Remler, 2007).Within EHRs are Electronic Medical Records (later referred as *EMR*s), which are digital versions of the paper charts containing the medical and treatment history of the patients in one practice. Then EPRs, which include patients’ relevant medical information, yet exclude for example lifetime records, dental records and behavioral care records. EPRs are mean to improve the patients’ involvement to the care, according to Grimson and Grimson (2002).

Patients’ medical information can be contained in various forms of information types, including for example images, video, sounds and texts. PACS is a way of archiving, exchanging and handling patients’ medical data digitally. (Pavlopulos & Delopoulos, 1999). The benefits of PACS have been for example productivity of radiology services, reduced transit time, improved access to recently stored and archived images, reducing of physical space requirements for images and the assessment of cost relating to purchasing and processing radiology pictures and film. However, the impact of access due system “loss” and downtime was seen as a worrying quality, since access was sometimes impeded by the new workflows, resulting in a decrease in opportunistic interactions between clinicians and radiologists. (Black *et al.*, 2011)

Clinical Decision Support Systems (later referred as *CDSS*) are computer programs designed to help health care professionals make clinical decisions and find solutions based on reliable information (Winblad *et al.,* 2008). According to Black *et al.* (2011), these systems have highly variable levels of sophistication and configurability ih regards to inputs, knowledge bases, inference mechanisms and outputs. For example ePrescribing is a stand-alone CDSS for clinicians to enter, modify, review and output or communicate medication prescription. Black *et al.* (2011) found that ePrescribing enabled more accurate communication between prescribers, patients and pharmacy.

Haux (2006) argues that CDSS should extend the access to systems for health care givers and patients as well as new types of data and health monitoring opportunities. The functions provided by CDSS have been characterized into three different groups by Bakken *et al.* (2008), depending on how they can be utilized by health care professionals: (i) provide information management, (ii) help clinicians focus attention and (iii) giving patient-specific consultation. These functions are gathered to Table 5 below.

Table 5. *Categorization of CDSS based on their functions (Bakken et al., 2008).*

Function	Purpose	Example
Information management	Enable access to information needed by the clinician, but do not help apply information to the task at hand	Electronic resources, such as bibliographic database, knowledge base and education materials.
Focusing attention	Remind the user for example of problems that might otherwise be overlooked, and relevant care protocols.	Abnormal laboratory values and potential drug interactions.
Patient-specific consultation	Provide custom-tailored assessment or advice based on sets of patient-specific data.	Decision analysis, diagnostic support, protocol and treatment eligibility.

CPOE systems are typically used by clinicians to enter, modify, review, and communicate orders, and return results from laboratory tests, radiological images and referrals. The orders can be integrated with patient data and PACS images, and they also have explicit purpose of electronic transfer of orders and return of results. They are expected to gain efficiency and time savings within health care delivery. (Black *et al.*, 2011) CPOE enables clinicians to set alerts and reminders to patients' EMR so that the real time information regarding for example warning about potential interaction with patient's other drugs, comes available to the clinicians when entering an order (Hillestad *et al.*, 2015). Usually CDSS's properties in focusing attention have been implemented also to for example CPOEs and ePrescribing systems (Bakken *et al.*, 2008).

4.2 Benefits of utilizing ICT in health care

ICT in health care can increase the efficiency, equality and quality of health care, while lessening the impact of geographical distances and providing access to health care for those patients, who have earlier been beyond the reach of adequate care, for example due long distance differences to the health care services. ICT enables rapid and global access to new therapies, technologies and knowledge recourses. (Abott & Coenen, 2008) Yang *et al.* (2015) list the functions that can be provided via ICT, including decision support, electronic communication, clinical documentation, results management and patient support. In Figure 12 are summarized the benefits of ICT in health care.

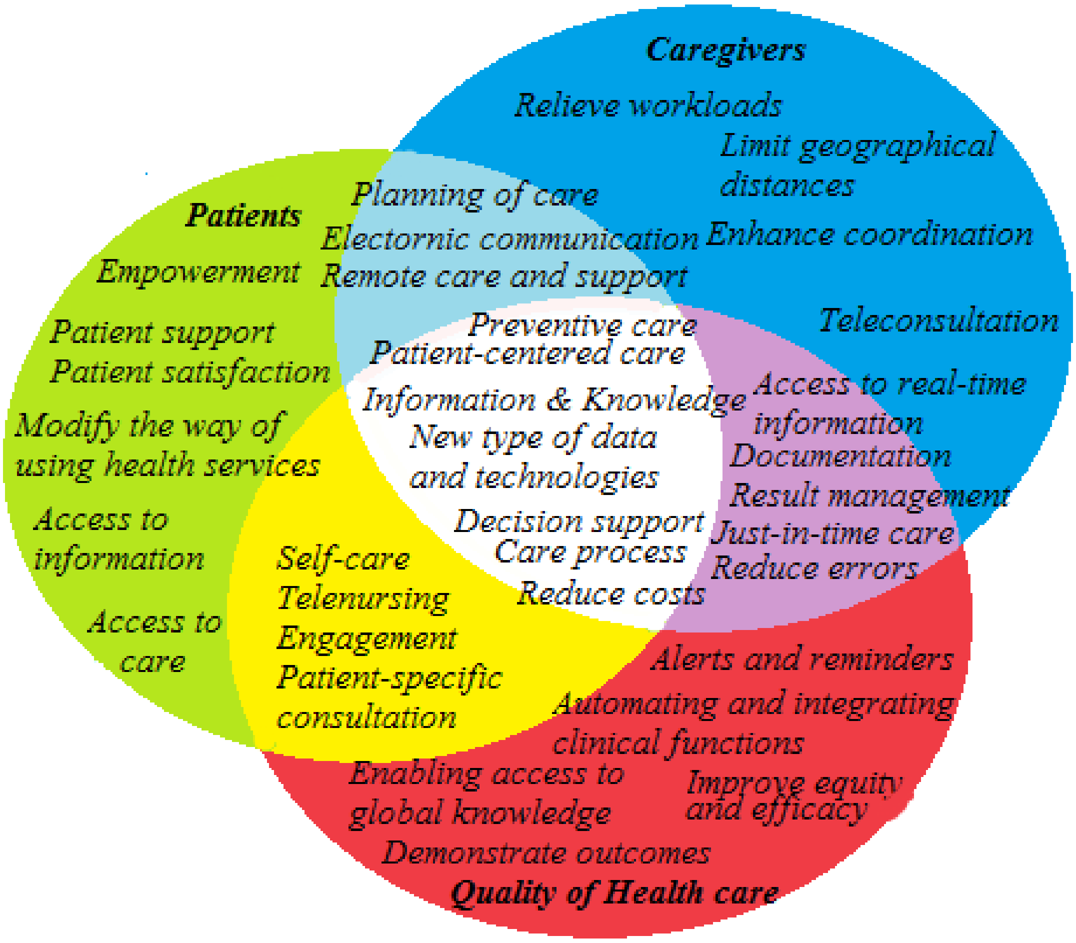


Figure 12. *Benefits of ICT in Health Care (Haux, 2006; Fieschi, 2002; Christensen &* Remler., *2007; Abott & Coenen, 2008; Bakken et al., 2008; Black et al., 2011; Buntin et al., 2011; While & Dewsbury, 2011; Yang et al., 2015).*

As illustrated in Figure 12, the benefits of ICT in health care can be categorized to three different classes: the benefits towards patients, the benefits towards health care professionals and the benefits towards quality of health care in general. However, these functions are not separated, but instead they intersect with each other. For example patients are more satisfied and have better access to care than without using ICT. For the caregivers ICT have been noted to relieve workloads and limit geographical distances. Care can be provided via telenursing, which is beneficial for both the patient and the caregiver. The quality of health care have been improved with utilization of ICT by for example automating and integrating clinical functions and hence reducing medical errors, in order to lead to increased patient safety and satisfaction. (Fieschi, 2002; Abott & Coenen, 2008; Bush *et al.*, 2009; Buntin *et al.*, 2011; Yang *et al.*, 2015)

According to Abott and Coenen (2008), ICT can be used to manage and distribute information in order to impact health, improve efficiency, demonstrate contributions of outcomes, and to offer knowledge as well as communication lifeline to isolated providers, patients and caregivers around the world. For example CDSS is meant to lead to improved practitioner performance in variety of care activities, such as provision of preventive care, diagnosis and disease management, and ways in which these care activities are delivered (Black *et al.*, 2011). The possibility of adding and utilizing alerts and warnings in CPOEs has increased patient safety, according to Hillestad *et al.* (2015).

The benefits of ICT in health care can be used to improve the quality of health care by making the given care more efficient and demonstrating contributions of§ outcomes, while reducing direct and indirect costs at the same time. Utilizing ICT also offers knowledge and communication lifeline for isolated providers, patients, and caregivers around the world. For example health care networks help care providers access the right information as they need it, resulting the share of knowledge and information to grow rapidly. The patients are increasingly demanding information related to their health care and they now know their rights better as decision makers, which is referred as patient empowerment. (Fieschi, 2002; Christensen & Remler, 2007; Abott & Coenen, 2008).

Bush *et al.* (2009) see as advantages of HIS the possibility to improve service quality, operational efficiency, patients' satisfaction and patients care. In the research performed by Buntin *et al.* (2011), 142 (92 %) articles out of 154 studies showed positive or mixed-positive (over-all positive results with at least one negative aspect of HIT) results. The positive findings included for example access to care, preventive care, improved and effective care processes, patient satisfaction and safety, and provider satisfaction. Yang *et al.* (2015) also note the possibility of enabling automation, integration and management of clinical and administrative functions in health care, thus having potential to lower costs, relieve the workload of health care professionals and obtain improvements in health care quality. The costs based on moving physically is radically lowered by ICT. Distance communication allows health care providers to call for skills that are unavailable locally as well as make decisions based on the automatically analyzed data (Fieschi, 2002).

At first HIS were primarily intended to support health care professionals and nurses, but later on the recognition of direct support for patients have been noted. HIS has the potential to modify the way in which people use health services both by increasing access to information, providing other forms of support remotely, and enabling patients for self-care, such as for seeking health information and help them with health related questions. Hence the patients' self-management is strongly supported by utilizing ICT in health care. (Haux, 2006; Hämäläinen *et al.*, 2011; While & Dewsbury, 2011, Yang *et al.*, 2015).

Abott and Coenen (2008) presents four different success stories from global perspective of how ICT have been utilized. First, ICT has enabled distance education programs in nursing, which reach out geographically distributed individuals. The opportunity to interact, share knowledge, discuss global health issues and share cultural perspectives across nations can increase cultural competence by raising awareness of and appreciation for global health issues. Second is the use of technology to deliver nursing care and conduct nursing practice. Telenursing or telehealth expands health care services to underserved areas, calling for skills that are unavailable on the spot. (Fieschi, 2002; Abott & Coenen, 2008)

Third success story are the interoperable EHR systems, which are solution for sharing data and information among various sources. Interoperability and connectivity to distributed data repositories are creating a challenge around EHR systems. Standards facilitate sharing of data, information and knowledge and they are a foundation for system interoperability. Adoption of EHR should lead to major health care savings, reduce medical errors, thus increasing patients' safety and improve health, as well as empower patients to take responsibility of their own health. Abott & Coenen, 2008; Forsström *et al.*, 2012) The benefits of EPRs are gathered in Table 6.

Table 6. *The benefits of using EPRs (Forsström et al., 2012)*

Increased availability of knowledge	Knowledge is not tight to organization, which enables the usage of information between different organizations.
	Knowledge is available whenever and wherever
	Patient has access to his or her own health records.
Increased quality of treatments	Electronic data can be gathered from regional and national registers.
	Structured knowledge can include for example reminders and decision making supporting applications to guide care giving models.
	Comparison and benchmarking between health care organizations and actors are more efficient.
	Health care actors have real time status of patients' health state.
Decreased duplicate information	Information is written only once and it is available automatically in different contexts.
	Errors related to information copying (e.g. medical treatment) is decreased.
	Electronic referral, receipts, feedback, statements and other documents can be generated from the medical record.
Better tools for management	Patient government and billing can be automatized
	More accurate and real-time reporting makes following of costs and quality easier.
	Knowledge-based decision making and leading are more efficient.
Possibility to electronic care	The electronic enhance between patient and health care professional is possible.
	Usage of self-care applications is part of the health care processes.
	The quality of patient information will get more efficient

Finally, fourth success story is knowledge management and knowledge generation in nursing. The management and generation of new nursing and heath care knowledge are deepened and advanced as new evidence, new perspectives and new discoveries are shared among global nurses (Abott & Coenen, 2008). This is seconded by Haux (2006) by recognizing the inclusion of new types of data (such as DNA or protein data) and new types of technologies (for example for health monitoring there are wearable devices which measure continuously without manual intervention) as the benefits provided by ICT in health care.

Ash *et al.* (2003) state that the CPOE adoption include medical error reduction and provision of just-in-time-feedback for physicians. According to Hillestad *et al.* (2015), the alerts and reminders set in CPOE have made information available for physicians in order to make decisions based on the real time information regarding the patient care. Clinical Practice Guidelines (later referred as *GPC*) with standardized protocols have helped clinicians to provide consistent care, and Bakken *et al.* (2008) noted that computer-based reminders increase compliance with preventive care GPCs.

Haux (2006) recognizes the shift in the use of data in HIS. Earlier he noted that it was almost exclusive to use HIS data for patient care and administrative purposes, with only some use for quality management and controlling. However, later the ability to use HIS data has extended so that primarily used data for patient care can also be utilized in health care planning and for clinical research. Haux (2006) premises that this possibility will have a continuous influence to medical statistics and epidemiology, for example of designing different studies and methods for data analysis.

4.3 Challenges in utilizing ICT in health care

Nevertheless, using ICT in health care is relatively challenging and it is not always successful. Buntin *et al.* (2011) found in their research ten studies (out of 154 studies) containing negative overall findings, due to the implementation of HIT. Fieschi (2002) stresses the importance of supporting the necessary infrastructures while providing the academic and organizational conditions required for this support by public authorities. Additionally for example the general lack of demonstrated cost-effectiveness barriers the adoption of ICT (Christensen & Remler, 2007).

Berg (2001) concludes, that implementation of comprehensive information systems in health care practices include many more failure stories than success stories. Avison and Young (2007) listed the properties of failures in health care information systems in United Kingdoms. In addition to high cost and high profile, they also noted (i) poor project management, (ii) inappropriate structure of the health system, (iii) organizational uncertainty, (iv) piecemeal nature of IS development, (v) the lack of fit between ICT and applications, work practices, the environment, and the culture they are expected to support, (vi) the lack of robust, widely accepted evaluation methods, particularly with respect to cost, and finally (vii) the pressure to roll out new ICT services before fully evaluating the pilot projects.

Forsström *et al.* (2012) point out the usage of outdated systems with weak usability properties, leading towards weakened productivity and both wasted work hours and efforts. Bush *et al.* (2009) list as HIS related challenges the lost opportunities, wasted resources and consequent unfavorable performance. Abott and Coenen (2008) add to the list also misalignment of incentives, resistance, an unskilled workforce, concern about impact on productivity and lack of standards and interoperability. Fieschi (2002) stresses that the development of standardization, semantics and terminology standards as well as improvements in the interoperability of software components have an essential role to play in the respect of utilizing HIS.

Technical difficulties in the implementation process can be the result of poorly managed development process. Users might not be sufficiently involved in the design process which might lead to illogical user interface or non-logical functions in the system. The schedule may be unrealistic while vendors included in the process may not have the products ready on time. The need for health informatics competencies has grown among the health care providers while the lack of education has been stressed. (Berg, 2001; Lammintakanen *et al.*, 2010; Buntin *et al.*, 2011) DeLoine and McLean (2003) argue that for the IS to be successful, must the combination of the system's and information's quality be good enough, so the users will actually use the IS as expected. The combination of quality of system and information leads to use and user satisfaction. This collaboration will cause an individual impact, and these individual impacts collectively result in organizational impact. The IS success model of DeLoine and McLean (2003) is presented in Figure 13 below.

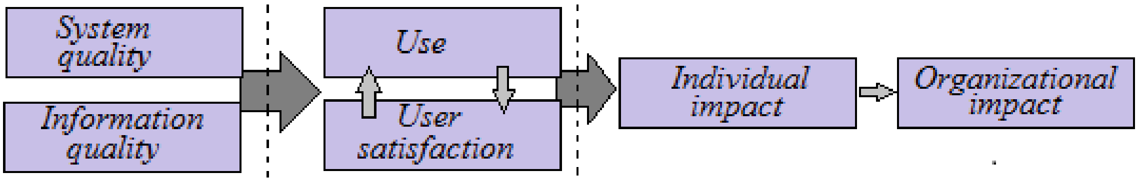


Figure 13. *Information System success model (aligning DeLoine & McLean, 2003).*

In Figure 13, system quality is measured for example in terms of ease-of-use, functionality, reliability, flexibility, data quality, portability, integration and importance. Information quality is measured by for instance as accuracy, timeliness, completeness, relevance and consistency. Individual impacts were measured as quality of work environment, job performance and decision-making performance. (DeLoine & McLean, 2003) In HIS, it is vital that information quality is accurate and timely enough in order for the physicians to make decisions based on vital patient data (Haux, 2006).

Lupianez *et al.* (2010) note that nurses apply ICT and the internet into practice at a significantly lower rate than doctors. They identified barriers such as poor organizational support, lack of training and time for nurses. They conclude that the integration of IT within nursing practice demands technological, organizational and professional innovations. Lammintakanen *et al.* (2010) stress that nurses often lack the necessary information and decision-making support to manage their responsibilities effectively. On the contrast, While and Dewsbury (2011) suggest a lot of ways how nursing can be improved by applying ICT, for instance virtual health promotion sessions with one nurse working with a group of people simultaneously.

Haux (2006) argues that the strategic information management has to be considered as an important task in the continuing process of maintaining and improving HIS in order to improve health care. He states that institutional information management strategies will have to be accompanied by regional, national and international strategies, not only in health care institutions such as hospitals. Bakken *et al.* (2011) also noted the importance of an informatics infrastructure for evidence-based practice and patient safety. He also identified the components of such an infrastructure: data acquisition methods and user interfaces, health care data standards, data repositories and clinical event monitors, data mining techniques, digital sources of evidence of knowledge, communication technologies, CIS, and informatics competencies.

For rapid and successful progress of HIS, Haux (2006) recognizes six areas for development: (i) appropriate IS architectures supporting patient-centered, shared care, from networking care facilities in health regions to home care, including for example diagnostic and therapeutic telemedicine and health monitoring, (ii) methods for the strategic management of HIS, especially concerning information processing in health care regions, (iii) methods for modeling and evaluating HIS as well as studying their properties through evaluation studies, (iv) comprehensive EPR, providing appropriate access for health care professionals as well as patients, supporting patient-oriented use of patient data, (v) powerful, innovative ICT tools for the various users of HIS, (vi) methods for medical data analysis based on the new IS architecture and EPRs and considering the broad variety of data types.

However, the common understanding of information systems, according to Avison and Young (2007), is as an “enterprise-type” model, where application of ICT in health care services supports business functions rather than through person-to-person contact. Arguing for better person-to-person models demanded by health care, Avison and Young (2007) view that there is a great need to understand how the collegiate and interpersonal elements of care delivery could be embodied better in the information systems used in health care delivery. They argue that attempts to build solutions merely around smaller units in health care, such as hospital or clinic, and then connecting them lead to suboptimal usage and communication barriers due the fragmented infrastructure.

This argument is seconded by Fieschi (2002), as he states how changes in medical practices are inducing a switch from hospital information systems to health care information systems. This statement is also a proposition to fulfil the areas for development in the infrastructure recognized by Haux (2006). Fieschi (2002) presents how Health Information Network (later referred as *HIN*) need to be designed and developed in a way that switches the decision-making from an individual level to a group level activity. The design model is shown in Figure 14 below.

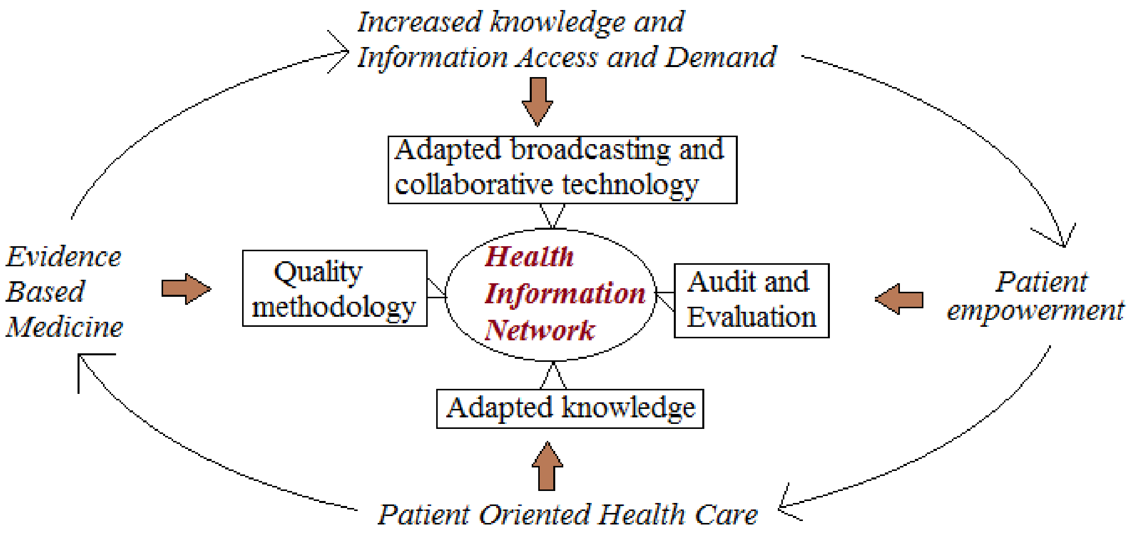


Figure 14. *Health Information Network (HIN) model (modified from Fieschi, 2002).*

In Figure 14 Fieschi (2002) expands the positive feedback loop between the information age, consumer/patient empowerment and Evidence Based Medicine (later referred as *EBM*) proposed by Eysenbach *et al.* (1999). The adapted knowledge from internet by patients challenges the EBM, which pressures the caregivers to give high quality care with patient-oriented aspect as well as pressures them to use electronic evidence based resources. As health care professionals follow consumers into the information age, this will further increase the demand and the provision of information on the internet, thus leading to the positive loop with even more patient empowerment and patient oriented health care. (Eysenbach *et al.*, 1999; Fieschi, 2002)

Internet and the telecommunication technologies allows group support systems and computer-mediated communication systems to provide support, which enables the level of knowledge to be accessible to both health care professionals and patients. Moreover, the technologies and routines used in clinical settings will increasingly distribute that knowledge. The available information and knowledge that is demandable by patients creates greater patient empowerment, thus leading to more patient-oriented care. (Fieschi, 2002) However, Yang *et al.* (2015) acknowledge that the patients' use of IT for self-care is often limited. They particularly note the higher risk population segments such as elderly, having special needs in using IT for self-care.

Integrative approaches need to be supported together with HIN to exchange different data and to develop models to integrate different sources of evidence. These supported networks consequently allow the development of "continued care" concept, as the results of positive loop. The decision making and management model will become an experience-sharing model, where potential options are appraised, discussed with the patient and/or other health care professionals. Essentially every issue is being deliberated before a shared decision is made. (Fieschi, 2002) Health care is a product of teams and such teams are reliant upon the sharing of data, information and knowledge, which are facilitated by standards. Interoperability requires international standards in many dimensions such as messaging, security, language, ethical information use as well as ICT management. Basically all areas have an impact on the delivery of health care, for example via EHRs. (Abott & Coenen, 2008). The appliance of Lean tools provides the opportunity to develop health-care value chain analysis, which is analogical with the development of integrated health-care systems. This requires a shift from focusing on departments and single entities to an enterprise-wide approach and is analogical with the HIN proposed by Fiechi (2002).

4.4 ICT in supporting chronic care

While and Dewsbury (2011) state that the range of ICT applications within health care are most evident in the field of long-term conditions and chronic disease management. In the study of Rosser *et al*. (2009), the researchers got to a conclusion that technology based self-management system could provide a practical method for both monitoring chronic illness health status as well as delivering therapeutic interventions to promote desired health behaviors.

Christensen and Remler (2007) see management of chronic diseases to be a prime candidate to benefit from ICT: since chronic conditions require continuous management of symptoms and monitoring of current health status, ICT enables transmission of self-monitored data and the health care professional can give feedback to that data in real time. Additionally, While and Dewsbury (2011) list as benefits such as improved treatment adherence, disease knowledge and reduced hospital admissions arising from the use of telemonitoring in various forms. For example they found frequent text messaging to be helpful supporting weight loss in overweight adults. In the study performed by Cady *et al*. (2009), the unplanned hospitalizations decreased from 74 to 35 in a year by giving telephone-based care coordination and case management.

Fieschi (2002) recognizes the change in patient behavior relate to increase of health-related information requests. The patients are now better informed and self-managing; they actually want to be part of the health decision process and are increasingly requesting access to the data contained in their medical records. Chronic diseases involve time-consuming measurements in addition to the changes required in the life style (Barlow *et al.*, 2001). Christensen and Remler (2007) state that internet sites for gathering general medical information are already widely used for self-managing; for example for diabetes there are guides about self-care products, and a variety of firms have created interactive websites for people living with chronic conditions to ask for guidance. However, Fieschi (2002) sees caregivers lagging behind patients in use of internet as a resource.

Yet even though While and Dewsbury (2011) propose some evidence regarding the effectiveness of ICT in supporting chronic care, there is little evidence showing the different utilization types of ICT and the key characteristics of the most successful initiatives and for whom they are best suited. However, realizing the potential of ICT in chronic care creates new forms of health care delivery and changes to already existing forms of health care. ICT enables fast and frequent communication between patients and health providers, which allows better monitoring of patient adherence to disease management. Frequent collection of data allows physicians to act more quickly and adjust treatment regimens. Additionally the assembly of information from different sources such as laboratory tests, pharmacy, and hospital data, in one EMR allows for better overview of patient status. Wider and more rapid dissemination of information and information analysis, presentation and interpretation allow many more health care professionals to provide quick input to the chronic care of the patient. (Christensen & Remler, 2007; Hillestad *et al.*, 2015)

For example the self-managing of own conditions will be eased with ICT, since ICT can automate the integration and analysis periods, hence supporting both the self-care and the communication in the patient-physician partnership. Also the social benefits provided by ICT are significant; for example better health outcomes, lower direct resource use and lower indirect costs. Also the cheaper and eased communication between patient and health care provide has been seen beneficial especially in case management situations. Even the well-managed chronic patients have regular visits to their case manager, and that cost can be lowered radically via utilizing ICT and lessening the need for patients and family members to plan schedules, travel and wait for appointments. (Christensen & Remler, 2007)

The operational models presented in the third chapter have included utilizing ICT in them. For example one component of CCM is CIS, which refers to using ICT tools in order to find relevant patient data and use the community resources and policies more effectively. For example knowledge of different treatment methods and programs are included in CIS, and are thus available when planning and executing care. Also alerts of changed patients' health status can be implemented in CIS, and automated recall and follow-up messaging, which lessens the manual work of health care professionals. (Wagner *et al.*, 1999; Barr *et al.*, 2003)

5. EMPIRICAL STUDY: CHRONIC CARE IN THE UNIVERSITY HOSPITALS

This chapter focuses on the empirical part of this thesis. In the empirical study, from one to two doctors from four of the five university hospitals of Finland were interviewed. These hospitals are located in Helsinki (HUS), Kuopio (KYS), Tampere (TAYS) and Oulu (OYS). The university hospital of Turku (TYKS) was also included to the interviewing process, but unfortunately no interviewees were able to be reached from the university hospital of Turku. The interviewees were selected so that their actions in the hospital would be as similar as possible in order to get a good baseline for comparison between the hospitals. Both females and males were interviewed.

There are two objectives for this study: first, it is expected to get insight of the differences between the university hospitals of Finland currently, regarding both the utilization of ICT and execution of chronic care, as well as their combination. Second objective is to find out if there are any operational models currently executed in one hospital that would be beneficial for other hospitals to apply.

The data for this study were gathered by interviewing doctors who work closely with chronic patients and use ICT in their daily work. The hospitals in this study were Helsinki University Hospital, Kuopio University Hospital, Tampere University Hospital and Oulu University Hospital. The chosen interview method was structured interview. The used interview body can be found in the Appendix A. In the interview, there were five different categories which are:

1. Current operational models related to chronic care
2. Current situation related to utilizing ICT and IS
3. Current situation of aligning operational models and ICT & IS
4. Patients’ role in the current way of executing operational model
5. Wholeness of the treatment (patients in the alignment of operational models and ICT)

The amount of doctors wished to be interviewed was determined to be one to three doctors from each of the hospital districts. However, due to tight timetables and schedules, only one doctor from each of the hospital districts were able to be interviewed, Tampere excluded, where two doctors participated to the empirical study. Nevertheless, the interviews of at least one doctor from four university hospitals in Finland offered valuable information regarding the state of operational models in chronic care and ICT in health care from the health care professionals’ point of view, which cannot be drawn from the earlier literature.

In the following chapter, first the methods of data gathering are explained. This is followed by presenting the methods of data analysis that create a ground for the findings of the empirical study. The findings are presented in the following chapter 6.

5.1 Methods of data gathering

In the beginning of the interview, two general questions related to the interviewee were asked relating to the doctor's role in the hospital and the actions that the doctor does in the daily work. The interviewees were asked first few open questions related to the category at hand in order to get a clarification of what the interview is actually consisting in general and to make it clear that the interviewee and the interviewer are talking in the right terms. The purpose of the interview questions were also to get the interviewer familiar with the phenomenon. After the introduction to the category the interviewees were inquired to give ratings to given statements in scale from 1 to 5. In the scale 1 stands for "*very poor*", 2 for "*poor*", 3 for "*average*", 4 for "*good*" and 5 for "*very good*". All categories consist from two to four open questions and from five to seven statements. The statements were based on the theoretical background proposed in earlier chapters, which can be seen in Appendix B. In Appendix A, the open questions are in green background and the statements in violet.

Since patients suffering of chronic conditions include for instance asthma, back pain, cancer, epilepsy, diabetes, heart disease, headaches and insomnia (Barlow *et al.*, 2002; Mamykina *et al.*, 2015), the interviewees selected were specialists from the field of neurology or internal medicine. The executed interviewees and their fields of specialty are gathered in the Table 7 below. Also the time and length of the interviews are presented, as well as the way of executing the interviews.

Table 7. *The specialties of the interviewees and the properties of the interviews.*

University hospital	Specialty field	Time and length
Helsinki	Internist	25.11.2015 28 minutes
Kuopio	Neurologist	26.10.2015 38 minutes
Tampere	Internist	12.11.2015 37 minutes
	Internist	20.11.2015 38 minutes
Oulu	Neurologist	27.11.2015 31 minutes

As can be seen from Table 7, all of the interviews were executed in a phone call. In each of the interviews the interviewees were asked if the interview could be recorded, so that it is possible to check later on exactly what the interviewee had said, therefore minimalizing the possibility of misunderstandings in the analysis. If interviewee would have said no, the interview wouldn't have been recorded and the analyzation would have been made based on the data gathered during the interview. It was beneficial for this study that recording was not an issue for any of the interviewees.

In the beginning of the interviewing process to each hospital district, an individual application for executing the interview together with the plan for the execution of the empirical part of this study was delivered. This was in order to get permission to execute the empirical study. The interviewees were requested from each of the hospital districts by contacting the contact person of each hospital district, regarding the permission for executing the research in that hospital district in question and inquiring if the contact person would know any appropriate candidates as interviewees. The contact persons received the study plan for the empirical part of this thesis and the interview questions, in addition with the appropriate documents and forms for requesting the research permission.

Also before beginning of the interview, a brief introduction of this study was given in order to clarify why the interviewer had been asked to participate in this study. Also the structure of the interview was briefly explained so that the interviewee knew what to expect. Time approximation for one interview was from 30 minutes to 50 minutes, depending on the interviewee. The shortest interview took 28 minutes and the longest 38 minutes, as can be seen from Table 6.

The structure for the interview was the same in every interview. The difference in time estimation was due to the open questions and reasoning for the numeral evaluation the interviewee gave for the question at hand. The reasons behind the numeral evaluation give important information for the study that a mere number could not provide. The interviewing process took approximately three hours.

All of the interviews were singular interview, with only one participant as an interview. This was beneficial since it gave the possibility to ask for clarifications if the interviewer was not clear of what the interviewee has said, or what he or she meant. The interviews executed in a phone call were also easier to execute as individual interviews, since the telecommunication makes it more difficult to follow the progress of interview without being concretely at place. For example speaking over another interviewee leads to a blur in the phone call, from which is difficult to understand what either of the interviewees tried to say.

The interviews were executed in a phone call, even though it would have been possible to execute them also face to face. The greatest obstacle for executing face to face interviews were the limited resources and also the distance between the different hospital districts. Uneven timetables and schedules were also the main reason why most of the interviews were executed individually, even though the possibility to execute few interviews in a group was considered.

The benefits of taking multiple participants into an interview would have included resource saving (the interviewee’s working time), enabling the interview in a very tight schedule that the interviewees had. The benefit of group interview could have been, in addition to resource saving, to get the interviewees build on each other’s opinions and receive multiple insight in one interview. For example one colleague said something that another one had not though about, which may have led to new kind of thinking within the interviewees. However, the uneven schedules between the interviewees in a hospital district were the main reason why the group interviews were excluded.

5.2 Methods of data analysis

The questions presented in the interview were planned in advance. Once all the interviews were completed, the process of data analysis started. In the beginning of the analysis process, the recorded interviews were littered to an explicit form. The littering process took quite a long time (approximately six hours) since the amount of recorded data was vast; the amount of littered interviews was over 22 pages.

After the literation process the numeral evaluations were examined. The results were compared by categorization and by individual answers. The reasons for given numeral evaluation was highly stressed, since the objectives of this empirical study lied within the answers. For example if there were high anomalies between answers, the given reasons could hint why these anomalies appear. The given numeral evaluations were put into a table and compared with each other, while the findings are presented in the next chapter. The summary of given numerical evaluations can be found from Appendix C.

The findings are categorized by the fields which the questions belong to. Each category was analyzed individually, by looking through all the interviews and analyzing the given numeral evaluations and especially stressing the given reasoning and arguments. By collecting the interviews and gathering opinions and point of views which reasoned the given numeral evaluations, a picture of the current state of each category in the university hospital at hand was formed. After analyzing each of the interviews, a picture of the state of each university hospital in Finland has been gathered from the interviewee’s points of view.

In next chapter the findings of the empirical study and the analysis executed from the interviews are presented. The chapter gives valuable information of how chronic care is executed in Finland and how ICT is currently used in it. The focus is especially set on the users’ point of view how the utilization of ICT tools, such as patient information system, is affecting to the daily work and to the treatment of patient wellbeing.

The chapter is followed by a chapter of discussion, where the findings and the theoretical background of this thesis are compared with each other. In this chapter, the research conclusions are presented as well as the discussion and implications created during the research process. The chapter pinpoints also suggestion for further research in this field, based on the findings of the empirical study and the theoretical background created in earlier chapters.

6. EMPIRICAL STUDY: FINDINGS

In this chapter the findings of the research are presented. The findings are divided into five sections, one for each category evaluated in the interviews. First the current operational models are introduced, followed by the utilization of ICT and then the alignment of operational models and ICT. Patients' role in the execution of chronic care is analyzed after this, and finally the results regarding the wholeness of the treatment are presented.

In the tables where the evaluations are presented 'He' stands for Helsinki (HUS), 'Ku' for Kuopio (KYS), 'Ta' for Tampere (TAYS) and 'Ou' for Oulu (OYS). The cell 'Avg' is the average of all given answers. The questions marked with (*) in the below tables are questions of which answers are analyzed as the opposite – if an interviewee evaluated the statement with number 2, the result shown in below tables are presented as 4. The questions are stated in this way for achieving different aspects and views of the topic. These questions are marked with (*) in the Appendix A and Appendix C as well, but the given numeral evaluations are the ones given by the interviewees.

6.1 Current operational models in chronic care

The first section of the interview covered the currently used operational models in chronic care. In some of the interviews, the term operational model was found misleading or complicated. The concept of operational models include the execution of the treatment, to which for example the roles, responsibilities and instructions are included. The numerical evaluations regarding the first five statements are gathered to the Table 8 below.

Table 8. *Numeric evaluations: the current operational models.*

Statement	He	Ku	Ta	Ta	Ou	**Avg**
Roles and responsibilities are determined	4	4	4	5	4	4,2
Supports succession in daily work	4	3	4	4	4	3,8
Sets challenges to daily work (*)	3	2	5	3	3	3,2
Supports patients' needs and treatment	4	4	3	4	4	3,8
Challenges work environment (*)	4	4	4	4	4	4,0
Overall average of the category:						**3,8**

In the interviews the current operational models were seen to describe and determine roles and responsibilities clearly, as the average value of the statements given was 4,2. The interviewees felt the roles of the each participant of the treatment process from the health care specialists' point of view being clear, and a certain hierarchy order was recognized and emphasized. One interviewee described the strengths of the current operational models as:

> "*The follow-up of patient's condition is a clinical surveillance and there are certain things that should be monitored and followed. [--] We have clear phases and systems for evaluating the patients' symptoms and adverse effects from medicines. [--] One strength I recognize is the fact that patients are actually seen during the appointments, I for example have a long experience regarding these chronic conditions, so this is a personalized strength. [--] When a patient comes to the visit for the first time, nurses interview the patients and make few tests before hand... So the roles are clear, yes.*"
> - Neurologist 1

However, the chronic conditions and multiple diseases that the patients may have at the same time causes complications for the roles and actions in the operational models; this have led to situations where a specialist of one field must also take notion of many aspects that are not actually included to the specialist's field of expertise. One interviewee described the variations in the roles of operational models as following:

> "*Every field is an own specialty, everyone has an own role in the treatment and everyone has focused on a certain field more specifically than the others. Thus the roles are clear [--] However, when people are suffering of multiple diseases at the same time, since the diseases are not fair in a way that only one disease at a time, that would act in a certain way that can be known beforehand... Even though a doctor is specialized to a certain field, (he or she) is still forced to treat many kinds of things.*"
> - Internists 1

The operational models were not seen to be the reason for the succession in daily work, even though they were viewed to be beneficial in daily work. The average value of the answers was 3,8. Many interviewees noted the importance of clear roles and models which have been modified to the state they are now, for instance regarding and supporting the treatment. However, the challenging environment in health care and the hectic nature of work were seen as the main reason for challenging the succession in the daily work.

> "*Succession... Yes, it does support succession, based on our model it is possible to do your work well. It has been smoothed to be such within the years.*"
> - Internist 1

When asked does the operational models cause challenges to the daily work, the average value of answers was 3,2. The structures and responsibilities determined in the operational models were noted in a few interviews as causing challenges. It was seen that doctors seems to have too much responsibilities.

> *"The models are good in a way, but the operational models are really clinical... The work is based heavily on the clinical experience and skills of the doctor. There are some things that you can support and do, but when making decisions, the selections you mark as important... it is quite vulnerable.*"
> - Neurologist 2

> "*One challenge is that still not everyone do as has been determined...“by the book”. Even though the model has been modified for more than ten years now.*"
> - Internist 2

> "*Maybe I feel that in a way doctors have certain things that they are in charge of, and there are too many things, and you can't predict the coming day... There are questions and things that can't be predicted and days usually always stretches. You will be interrupted by the nurses, for example. [--] Maybe not all responsibilities are so clear, some nurses take more responsibility, while other nurses ask everything.*"
> - Internist 3

When asked about whether or not the operational models support patients' needs and treatment, the operational models were seen either to be beneficial or to be developed and planned to be beneficial from the patients' treatment's point of view. The average value of answers was 3,8. The clear responsibilities and roles were seen effective and beneficial also in the patients' point of view. However, not everyone found the determination of responsibilities and roles being successful.

> "*When we have agreed that doctor describes medicine and nurses guide patients how to use them... I find that reasonable and being patients' benefit.*"
> - Internists 3

> "*I think this is quite strong, too [--] that is where we have targeted them to be, at least. How much they actually support, will be depend of the resources that we have.*"
> - Neurologist 1

Regarding the question “does the operational model create challenges or obstacles for the work environment”, it was not seen as a reason for stress or lowering well-being of the heath care personal. The average value of answer related to work environment was 4,0. Few interviewees felt clearly that operational models do not increase stress or cause challenge for the work environment, but few were not certain how to answer to this questions. Nevertheless, the reasoning for the given numeral evaluations highlighted that it is not the operational models that cause stress or decreases well-being within the work environment; instead the hectic nature of the work and continual rush was seen to be one main reason for this.

> "*No they don't, this is certain.*“
> - Internist 2

> "*This is hard to answer [--] No, I don't think so... Everyone works with their skills. The stress comes from the volume, not from the methods that we have... Instead it is that we have quite a rush. But it is not related to what we do and how we do it.*“
> - Neurologist 1

> “*This may be other way around, they increase well-being.*”
> - Neurologist 2

> “*I don’t know if they cause obstacles… or stress. No, maybe it is not the operational models, it is the hectivity.*”
> - Internist 3

All in all the average value of the first category was 3,8. Especially the clear roles were highlighted, but also the uneven load of responsibility and tasks was noted too. The hectivity and unpredictable nature of work was the main reason for challenging the succession in daily work. The operational models themselves were seen to be beneficial for both the patients and for the health care professionals.

6.2 Current utilization of ICT in chronic care

The second section of the interview regarded the currently used information systems and ICT tools, and their appliance to chronic care. Some answers took notion of the ongoing development process of new tools, but the answers were given by evaluating the current status. The numerical evaluations regarding these six statements are shown in the Table 9 below.

Table 9. *Numerical evaluations: the current utilization of ICT in care.*

Statement	He	Ku	Ta	Ta	Ou	**Avg**
ICT tools supports daily work	4	5	2	2	3	3,2
ICT tools challenges daily work (*)	3	2	2	2	2	2,2
ICT tools apply to their meant tasks	4	4	2	1	2	2,6
ICT tools works holistically together	3	3	1	3	3	2,6
ICT tools supports patients’ needs	4	5	2	4	4	3,8
ICT tools causes challenges to the care (*)	4	2	4	2	2	2,8
Using ICT tools is beneficial for treatment	4	4	2	4	5	4,0
Overall average of the category:						**3,0**

When opening the second section of the interview, the interviewees were asked if they had any specific information systems or applications related to chronic care in their unit. Few hospitals had an own system, for example an application for evaluating the level of pain or development of the disease. One application was for creating an index for measuring the state of rheum, that patients fill when they come to the appointment.

> “*Once the patients come, they will a form via a touch screen. We can see the results from the computer. They mark how much they have pain and what joints are aching or have swelled, and the application counts a certain level for measurement.*”
> - Internist 3

In few hospitals such a system was under development. The future was stated to hold a lot of promise for such systems, and development of systems was seen in general as positive thing. One interviewee concluded the strengths of using information systems:

> "*The strengths of using electronical information systems is that the information is collected in a certain systematic way, and I see this as a strength in the future. Currently the data is archived in varying ways; I do in a certain way and another doctor does it differently, and reports in (his or her) own way. It is difficult to understand from another doctor's patient records and texts what is the current situation related to the patient's condition.*"
> - Neurologist 2

However, the current situation of ICT tools and information systems received a quite a lot of criticism. The interviewees were strongly frustrated with the current information systems, which included many different systems that were not seen as user-friendly. Waiting time and the need to use a different tool for a different purpose with no seamless integration nor communication between each other was highlighted in a few interviews.

> "*When every unit in Finland has started to develop their own system, as a result they do not communicate with each other. This is really annoying and frustrating when information does not flow, and then they get tangled, after each click you see this… rolling icon… And it may take over a minute for the page to switch to another.*"
> - Internists 1

The utilization of the information systems was seen to support the daily work, but the given numeral evaluation variated between the interviewees. The systems were seen to include functions that are significant in patient care and the time savings for achieving information was seen as a different maker, when compared with the old paper-form system. It was seen beneficial for both the patients and the health care professionals, that neither the patients nor the health care staff were forced to carry information in paper form. All the patient related data is stored and retrievable in electronic form, even though achieving all the necessary information was seen rather challenging.

> "*If there is no numeral data… From verbal description it is challenging to conclude how the situation was the last time… Especially when the doctors change as they usually do. Thus they [information systems] offer a significant help.*"
> - Neurologist 1

> "*The systems work and they support the daily work weakly, unfortunately. Gathering some information may be faster when compared to the old papery form [--] especially ePrescription, when we can see what the patients has actually been given.*"
> - Internist 1

Nevertheless, the information systems were seen to cause challenges to the daily work. Especially the need for studying and learning the new systems was highlighted in most of the interviews. Also the unnecessary waiting time and work caused by using ICT and information systems were pointed out in many of the interviews. The used systems weren't seen to be user-friendly at all; instead they were seen to be too complicated and including too much moving around from one window to another in order to get all the necessary data.

> "*Yes, they delay our work… Especially if we get a new employee who can't use them, there will be a lot of mistakes. At this moment information systems causes us a lot of challenges…*"
>
> - Neurologist 2

> "*From the papers we could see by one looking how the patient's condition has behaved in two past weeks, for example blood pressure, fever, what liquids patient has received, what medicine… Now we need to open a new window for everything, close another one, open another one… and we are forced to remember, because the windows can't be combined or shown in chronologic order, or to get different variables, like blood pressure, pulse, medication… This wouldn't be too hard to execute… [--] But the problem is that the ones developing them do not know how we use them, and we who do use them can't speak in the technical language what it is that we want…*"
>
> - Internist 1

The evaluation for appliance to the appointed tasks variated between the interviewees. Some felt that they apply without issues, while other saw that the appliance was highly incomplete and unsuccessful. For example development processes that were executed in a too tight schedule was seen as one reason for the incomplete appliance.

> "*Well… I haven't seen any system that does not apply to its tasks. Usually they work.*"
>
> - Internists 2

> "*This is hard to say, we don't have so many systems. But it is important that they are similar and the way how to use them does not differ. If we have for example five different patient groups and one doctor uses five systems, and they all are different from each other, it is a catastrophe.*"
>
> - Neurologist 1

> "*Now when we got KanTa and situation has changed and the tasks have gotten more challenging… Our patient data system has difficulties with KanTa, other hospitals haven't had such a challenges… It was easier before, it has been made to be so difficult for some reason. The development process was executed in rush.*"
>
> - Neurologist 2

The interviewees were asked do the current information systems work holistically. This category received an overall evaluation value of 2,6. The own systems were seen too complicated and navigation from one system to another too difficult. Also the communication with other systems, outside of hospital's own systems, was seen incomplete.

> "*Work holistically, that is what they don't do. Even a person who is not a doctor knows that it would be nice to see patient's medication and get some pictures, for example how the medication is related to a certain blood value, how it has developed and see the change by time's function, but this is not possible. Earlier this kind of information was given, when there was a simple paper form, where certain variables were marked and the events were able to be concluded. Now it needs time and a quite lot of effort to open all the necessary windows and trying to remember all the variables.*"
> - Internists 1

> "*How they work together.. If you think different systems, you would think that it would be easier to navigate from one system to another, with today's technology it should be easier to get from laboratory tests to X-ray pictures.*"
> - Internists 3

> "*Some systems do not communicate… communicate with each other, searching information is challenging and difficult. The systems in health centers do not work with our system very well. They communicate but they are stiff. The alignment is still very incomplete.*"
> - Internists 2

The used information systems and ICT tools were seen beneficial regarding patients' needs and treatment. Especially the ability to see older records, all the test results and the development of the disease were highlighted. However, the low usability lowered the given evaluations, and the overall evaluation was 3,8. The challenges related to developing the current ICT tools and systems was also noted here.

> "*Yes, for example there is medicine administration which alerts if there is conflict between patient's medicines, and then there is ePrescribtion from where we can see the medication if patient can't remember… So it increases the patient safety.*"
> - Neurologist 2

> "*Laboratory tests, X-ray tests… all information is available and can be reached with a few clicks on the computer.*"
> - Internists 2

> "*They do give important information. They are slow and clumsy to use, but they do at least work and support the treatment.*"
> - Internists 3

> “*Unfortunately it feels like they have been developed by someone who is not aware of what we are after, and then when we have this heavy organization, it is challenging to get through even the tiniest of change… that may be implemented after a year.*”
> - Internists 1

When stated that ICT tools cause challenges to the treatment, the numeral evaluation value was 2,8. The possibility to see how the chronic conditions have developed over the years created a demand for health care professionals to react and intervene, if the direction of patients’ health status seems to be going towards the wrong direction. This was seen as a benefit from patients’ point of view, but at the same time causing challenges to the limited resources.

> “*We can have views how chronic conditions have behaved within time and how they proceed, for example we can draw a beautiful line of how headaches have occurred - are there more or less than earlier [--] But they also force us to react to the changed situations more effectively if see the conditions more clearly. We need to have the possibilities to intervene. But the patient benefits, that is for certain.*”
> - Neurologist 1

> “*Do they cause challenges… yes, there has been… for example today I faced a new kind of problem, so yes they do, for the moment…*”
> - Neurologist 2

> “*Greatest challenge is when we have a new system, there is so much time just waiting when they just won’t work, and it takes weeks to learn the new system.*”
> - Internists 2

The utilization of ICT tools and information systems was seen important and beneficial when related to the treatment process. The overall evaluation value was 4,0. Still there was found a lot of room for improvement, and for example the amount of time used for saving data which cannot be utilized was stated as a major degrading feature.

> “*From the patient’s and (his or her) treatment’s point of view it is beneficial that we have information systems, but they could work better than they do now.*“
> - Internists 3

> “*Of course it benefits if we could get that kind of information… We save a huge pile of information that we can’t use properly. [--] Even though nurses document most of their time, we are doing “knowledge work”, the information is lost. It does not support the treatment of the patients and it demands a lot…*“
> - Internists 1

Overall evaluation value for the second category was 3,0. ICT tools were seen beneficial and they were seen to offer support for both health care professionals and for the patients.

However, the low usability of current systems and the collaboration between different systems were highlighted in almost every interview. It takes time to learn a new system and there may be resistance against change when new systems are brought in to use.

6.3 Current alignment of operational models and ICT in chronic care

The third section of the interview included alignment of ICT and the operational models in the current care. This included for example do the utilization of ICT tools and information systems support the execution of treatment and do information systems provide information that is needed in the treatment. The numerical evaluations regarding these six statements are shown in the Table 10 below.

Table 10. *Numerical evaluations: the alignment of operational models and ICT.*

Statement	He	Ku	Ta	Ta	Ou	**Avg**
Alignment fits together	4	3	3	5	3	3,6
Alignment is still incomplete (*)	2	2	3	4	1	2,4
ICT tools support execution of treatment	4	4	3	3	2	3,2
ICT tools restrict execution of treatment (*)	3	4	3	4	2	3,2
Information systems can't provide information needed in the execution of care (*)	4	4	2	2	1	2,8
ICT tools can be applied in executing the treatment aligned by the operational model	4	5	3	4	4	4,0
Overall average of the category:						**3,2**

In the first statement the interviewees evaluated how the alignment of operational model and ICT fit together. Generally this section received good evaluations, and the overall evaluation value was 3,6. However, few interviewees found the statement to be difficult to evaluate, since there existed not so many different information systems. The development of information systems without considering the actual execution of treatment was noted by one interviewee:

> "*Supporting system communicates with other systems, but we don't have so many information systems and we don't know how they work… There is a registry under development, which is aligned with the operational model, but it isn't ready yet.*"
> - Neurologist 1

> "*This is somewhere in the middle… Quite many information systems are being developed without taking notion of the operational models. I mean, the operational models aren't always taken into account and the information systems aren't aligned with the operational models, even though they should be.*"
> - Neurologist 2

However, as a contrast to the previous statement, the evaluation value for incompleteness of the alignment was 2,8. The incompleteness of the alignment was reasoned with the lack of systems, and the low interoperability of the systems. Bad experiences and the usage of information systems was seen to slow down the execution of care. Also some roles in operational model were not seen to be aligned with the usage of information systems; for example documentation and billing was not seen to be a task for a doctor, but meant to be a task for secretary, for instance.

> "*It is really incomplete… For example the communication with our systems and the systems in health centers. I mean, the level of communication is so low.*"
> - Internists 2

> "*The tasks we are forced to do are not aligned with the execution of care… We (doctors) need to do so many tasks that actually belong to secretaries, for example billing… So the alignment is incomplete, but it may never get any better than this. But I'm against it that we are forced to do someone else's job… We spend our time doing secretary tasks and that is not the core work that we should do.*"
> - Internists 3

The answers to the statement of ICT tools supporting execution of treatment received varying evaluations. Few interviewees felt that the information systems support treatment, for example by providing the needed information. Also the systematic documentation of what has been done to the information systems was seen to be beneficial for the treatment. Nevertheless, once again the low usability and interoperability lowered the overall evaluation value, which was 3,2.

> "*The patients' treatment benefits, as well as our operational models. We have certain operational models that everyone executes and every doctor woks in (his or her) own way, but this standardizes the work such as documentation.*"
> - Neurologist 1

> "*Usually the information systems… I think the systems do not (support), when we have so many systems, we should have only one… Now we are forced to switch. Everything should be in one system. This way of executing treatment via information systems does not work, we work with what we have and how we can.*"
> - Neurologist 2

Regarding the statement of how ICT tools restrict the treatment received an overall evaluation value of 3,2. Even though the information is stored in to the information systems, the fetching of needed information was found to be too difficult. Additionally the uneven roles and the responsibilities that are determined in the operational model as well as using of ICT tools rose as a lowering aspect.

> "*Some information can't be found, either easily nor at all… But then we just work and manage without it.*"
> - Internists 2

> “*The operational models, roles and responsibilities, and how does the knowledge flow… I don’t agree that the roles are defined as they should be. It is good that we have systems, but they are clumsy and they should be better, now they challenge us, and the roles, too.”*
>
> - Internists 3

For providing information needed in the execution of the care received an overall evaluation value of 2,6. For example few interviewees explained that the patient texts from the visits of local health centers cannot be seen, and health care professionals are forced to request that information, either from the patent or from the health center. Also the need to apply the needed information was highlighted, since all the needed information cannot be seen directly from the information systems. This was easier earlier, when all the variables were coded to the paper forms. The lack of information systems rose also as a major affecting factor.

> “*Yes, there are things that I would like to see but can’t. For example I can only see what has happened in here (to the patient), but I’m not able to see the texts from health center, if they have not added us to the distribution loop.*“
>
> - Internists 3

> “*Absolutely. We are forced to seek the information. We can’t know how the patient manages in (his or her) daily life, we can’t see the real situation. So we are forced to call them and that is difficult and demanding.*”
>
> - Neurologist 2

> “*Yes, they do help us and provide necessary information quite easily… However not always, there are cases when the information must be sought.*”
>
> - Internists 2

> “*At this moment we don’t have information systems, so the question can’t be answered very well, yet. We have only one information system, and it does provide the necessary information. But that may be because we have been included to the development process of the system.*”
>
> - Neurologist 1

The final statement in the third section was to evaluate how the utilization of ICT tools and information systems apply in to the execution of the treatment. The overall evaluation value was 4,0. As reasoned earlier, the information systems and operational models were seen to be beneficial for the treatment.

All in all, the overall evaluation value to the whole category was 3,2. Even though the systems seemed to be incompletely aligned with the execution of the care, their benefits were not denied. However, the development of systems was strongly argued to be extracted from the operational models, and it was highlighted that they should be aligned more heavily in the planning phase.

6.4 Patients' role in the current way of executing chronic care

The fourth section of the interview took notion of the patients' role in the treatment. The section aims to clarify how the patient is committed to the treatment and whether or not he or she is activated and while knowing the roles and responsibilities. One aim of the statements was to clarify if the patients are aware of how they are responsible for the actual execution of the treatment, as highlighted in the earlier chapter of this thesis, as well as in the literature used as reference. The numerical evaluations for these six statements are shown in the Table 11.

Table 11. *Numerical evaluations: the patients' role in the care.*

Statement	He	Ku	Ta	Ta	Ou	**Avg**
Patient's role is clear	4	4	5	3	3	3,8
Patient is aware how care will be executed	4	4	3	4	3	3,6
Patient has a clear point of contact for searching knowledge regarding the care	3	4	4	4	4	3,8
Information flows seamlessly	3	4	3	3	3	3,2
Information flow needs development (*)	4	3	1	3	1	2,0
Patients have an active role in the treatment	3	4	4	4	4	3,8
Overall average of the category						**3,4**

The role of the patient was seen to be clear, as the overall evaluation value was 3,8. Even though the acceptance of the responsibility in the treatment was not always accepted by the patients, they are usually aware and how they are responsible for carrying out the treatment. The level of activity and responsibility is corresponding to the conditions of the patient.

For example young adults are usually more active than the elderly patients, and they are more willing to accept the responsibility while seeking information on their own and acting in the partnership with a doctor. They also are more ready to give out their opinion, if for example they are not ready to eat the medicine described by the doctor. This is inline with argument of creating treatment in co-operation.

> "*This is related to the condition of the patients. The elderly is not so active. Younger patients are following the world and they are seeking information on their own, they are really activate. And if the older patients are not activate, usually their relatives are.*"
>
> - Neurologist 1

> "*Yes, it is, and at least it should be. Especially when talking about patients with chronic conditions, there must be co-operation. If the doctor selects a medicine that patient is not ready to take, it is clear that (he or she) won't take them.*"
>
> - Internists 1

> "*If a patient is in a wakened state of mind, of course (he or she) is not active. However, usually they do know what is expected of them. Usually the patients are given knowledge and choices, but it depends on the patient. Patient usually is aware, but (he or she) does not do what we are asking, for example quit smoking.*"
>
> - Neurologist 2

Usually the patients are aware of the execution of care, as the average value of the statement was 3,6. This is, too, according to the patient's state of mind and acceptance of carrying responsibility of his or her treatment. The patients are offered knowledge about the treatment, and it is up to them whether or not they want to use that information. Additionally the way of presenting information in an understandable form is a challenge to the health care professionals.

> "*The awareness is getting better every day. On the other hand we offer information and the knowledge that the patient has increases all the time, according to the information (he or she) receives. But sometimes the patient does not want to receive the information and they live in beliefs or in something someone else, like their neighbor, has said…*"
>
> - Neurologist 2

> "*When we are talking about chronic conditions, we have given time for the patient groups, there should be time to discuss. Patients are aware and knowledgeable, and they are able to inquire if there is a need for escalation.*"
>
> - Neurologist 1

> "*There are included so many things that are hard to understand and perceive, when we are talking about the functions of internal organs and their structures… Quite many times I have heard a patient describing what the disease is that (he or she) has, and usually that is not the true case. There are a lot beliefs and perceptions included. Some patients are aware of the conditions really well, but others are not, that varies a lot.*"
>
> - Internists 1

The statement regarding the clear point of contact for the patients received an overall evaluation value of 3,8. The patients are given information and they are aware of the phone numbers to where they can call in order to receive more information. However, the availability of such numbers was noted to be in a poor level in some cases. Also internet is filled with forums and knowledge bases related to the diseases, administrated for example by pharmacies.

> "*We have phone numbers for patients, but the availability should be better.*"
> - Internists 1

> "*Patients search information from the internet, except the elderly. The patients have a named nurse and they can call (him or her). The nurse sees the patient regularly.*"
> - Internists 2

> "*We have this system to where patients can call in order to ask questions and then the nurses guide patients and give them information and websites. They are quite aware and the patients know how to seek information.*"
> - Internists 3

> "*Pharmaceutical industry is really active on this one, they have own websites and forums. Patients can receive information from hospitals too, and they have their own system for supporting the treatment. In the elderly patient group we have groups to where patient's diagnosis is sent, so a third sector is also included as a point of contact.*"
> - Neurologist 1

Information flow was not seen seamless, and the interviewees felt that there should be development. The overall evaluation value for the statement of seamless information flow was 3,8. On the other hand, the need for development received an overall evaluation value of 4,0. However, concrete proposals how information flow should be developed were not presented. Usually the limited resources challenges the information flow, and the communication skills of the health care professional as well as the patient.

> "*There is always room for enhancement. But how to develop, I don't have any proposals. Patients could think together in groups and the nurses could act as links, and the patients could chat with the nurses, but all that takes resources, more than we have. If there occurs a lot more contacting than now, then we would be in trouble.*"
> - Neurologist 1

> "*Well… if the patient feels that it is hard to contact us… and sometimes, for many reasons, the information just won't go through, no matter how hard we try.*"
> - Internist 3

> "*Patient may give totally false information, or the nurse may overestimate the patient's ability to receive information and offer too difficult information. [--] But how could we develop the information flow so that patient would the give us right information… Patient may 'color' the information, that is humane, but we would need enough basic information for executing the treatment… This needs a lot of development.*"
> - Neurologist 2

As for an active role in the treatment, the overall evaluation value was 3,8. Patients are seen activate participants in the treatment, and they are the ones executing the treatment. However, in some cases the patients' are not able or willing to accept the responsibility over the decision making that relates to their own treatment and its execution. In these cases the responsibility of making decisions stays with the health care professionals, even though patients' opinions are taken into account.

> "*We listen to the patient and (his or her) opinions, for example relating to medication planning, different products and how to use them, we always listen patient's wishes. But in the end we as health care professionals have the responsibility of the treatment, and we have the responsibility to decide what the best possible means are. Patients may have perceptions and beliefs, so the responsibility to make decisions is with the health care professionals.*"
>
> - Neurologist 1

> "*Patient is the expert of (his or her) own health. If a doctor is a medical expert, and a nurse is also included in execution of the treatment. But patient has an important role and we are forced to consider the care in co-operation, and of course now when we talk about long-term conditions, where patients can make decisions. [--] Although some patients feel that these matters are too difficult, so they won't make decisions but they want to transfer the responsibility to the doctors. But that also is a decision made by the patient, so they are really active.*"
>
> - Internists 1

The overall evaluation value for the fourth category was 3,4. It seems that in some cases, there are still patients who will not participate to the co-creation of the treatment; instead they still expect that nurses and doctors give the instructions for a patient to follow. However, this state is changing all the time as there are also more and more patients who are ready to take the responsibility over treating own conditions.

Additionally these patients seek actively more information, different possibilities and are committed to the planning of the treatment too, not only the execution. As a result the care is shifted from reactive to proactive, as the responsibility over the planning and executing the treatment is shifted from health care professionals to be co-created together with patients. As this is the foundations of effective chronic illness care, the baseline for development seems to be in a good state.

6.5 Wholeness of the treatment in chronic care

In the final section of the interview, the whole treatment was evaluated. The evaluation of the whole care takes notion of the whole treatment chain, its logicality and operability. This included the patients' and care personal roles and responsibilities, utilization of ICT and the execution of care, as well as the occurrence of incompleteness in the treatment chain and the flow of information. The evaluations of the final six statements are gathered to the below Table 12.

Table 12. *Numerical evaluations: the wholeness of the care.*

Statement	He	Ku	Ta	Ta	Ou	**Avg**
The treatment is a logical entity	4	4	3	4	2	3,4
Participants are aware of roles and responsibilities, including the patient.	4	4	4	4	4	4,0
Imperfect treatment episodes does not occur	3	3	1	2	4	2,6
Access to the patient' recent status of health	2	2	2	2	2	2,0
Patient must take care of the information flow (*)	3	2	3	3	2	2,6
Patient has the most recent knowledge of treatment and its continuity	3	4	3	4	4	3,6
Overall average of the category:						**3,0**

The treatment, which is in-line with the operational model and is supported by ICT tools and information systems, was seen to be a logical entity, with an evaluation value of 3,4. The division of responsibilities and roles have been smoothed within the years, and the utilization of ICT tools and participation of the activated patients were found to be functional. However, the recent changes in the information systems did lower the evaluation from one interviewee's point of view. The changes have occurred recently, just two months ago, and not everything has yet been able to get applied to the new ways.

> "*At this moment it is rather un-logical. Two months ago it was logical, but now…*"
> - Neurologist 2

> "*I think it is logical, but the question is how we can see the logic… I'm sure it is logical but it is hard to describe. From user's point of view it isn't that logical.*"
> - Internists 1

> "*At least I believe that we have everything in order. This has been smoothed for so long, updated… for more than 15 years. And this model, guidance, is printed and it can be found from our intranet.*"
> - Internists 2

The roles and responsibilities are clear to everyone in the treatment, according to the interviewees. The overall evaluation for the statement received a value of 4,0. Still, the patient's level of commitment to the treatment and the actual execution of the care varies a lot.

> "*Yes it is. I'm sure that the patient also know what (he or she) is expected. I think that if we could get the data into visual or numeric form that would motivate the patient even more to committing to the treatment. [--] I'm not certain how patients execute our advice, but at least we try to give them good lifestyle proposals.*"
> - Neurologist 1

> "*When we get a new patient and a new diagnosis, we go through the patient's responsibilities in a very detailed level. And on the next time, we update them.*"
> - Internists 2

Imperfect treatment episodes do occur, even though the responsibilities are clear. Average value for this statement was 2,6. Reasons may be related to the systems, for example they have not sent a new follow-up request to the patient, or the patient just doesn't show up.

> "*Our nurses take care that the patient comes, and if they notice that patient has not visited laboratory tests, they will call the patient... so they always take care of that the patient has taken all the needed tests before coming to the appointment. [--] We don't have that many patients, who just aren't coming.*"
> - Internists 3

> "*I think there is discontinuity, at least because we can't promise that the nurse-doctor -relationship is a long-term, or the patient-care team -relationship... Because employees shift jobs or retire... That causes discontinuity, which is one cause.*"
> - Neurologist 1

> "*Yes there occurs. There are always situations, either because the systems don't work or usually because of the patients, they are absent and will not come even if we regularly invite.*"
> - Internists 1

According to the interviews, the access to the patients' recent health status is on low level – the overall evaluation value was 2,0. Hospitals can't see what has happened to the patient in his or her daily life, and some are not able to see at all what has been done in local health centers. In some hospitals there are connections between the hospital's system and the health center's system, but the interoperability of these systems was not seen to be very functional. The unavailability is strongly linked to the patient's responsibility to take care of the information flow, which received an overall evaluation value of 2,6.

> "*We can't see at all if patient has visited in health center, and what has happened there. That is a weakness, we can't know if a patient has visited (his or her) own doctor and got a needle on (his or her) knee, we can't know this unless the patient tells us.*"
> - Internists 3

> "*We don't always have the most recent information, because the systems are shattered and they don't communicate with each other. The patient must take care of the information flow in some level, but on the other hand the patient does not have to carry a pile of folders related to (his or her) care, because they are all in electronic forms.*"
> - Internists 1

> “*We see patient so rarely that we don’t know how the patient manages in (his or her) daily life. Usually it is along with the follow-ups, we go and check the recent EHR’s. There are no alerts, we have to check them manually. And then the patient can tell us.*”
>
> -Internists 2

Usually the patient has the recent knowledge of his or her treatment and its continuity. The evaluation value for this statement was 3,6. This too varied between the patient groups: other patients were very aware of how their treatment continue, while others need to be informed in more detailed level.

> “*I think that they are. Patient is always included in the distribution, and the information is also saved to KanTa. So the patient should be very aware.*”
>
> - Neurologist 1

Overall the final category got an evaluation value of 3,0. The treatment seems to be quite whole, even though discontinuities occur and the recent health care status cannot be seen with the information systems. The roles and responsibilities are clearly determined, and patients are aware of what are expected of them.

6.6 Conclusions of the interviews

As conclusions of the interviews executed the received answers were mostly in-line with the earlier literature. Especially the challenges related to utilization of ICT presented in interviews aligned the challenges presented in chapters 3.6.2 and 4.3. The overall evaluations of the categories are gathered to Table 13 below.

Category	Evaluation
Current operational models in chronic care	3,8
Current utilization of ICT in chronic care	3,0
Current alignment of operational models and ICT in chronic care	3,2
Patients’ role in the current way of executing chronic care	3,4
Wholeness of the treatment	3,0

The current operational models were seen to support succession in daily work, and they were not seen to cause challenges, but the determination of roles and responsibilities was seen uneven by few interviewees. Utilization of ICT were seen to support the daily work and the needs of the patients’ treatment, but the challenges caused by the utilization were highly stressed. The low usability and interoperability with other systems, amount of time wasted waiting and difficultness to learn were few affecting reasons for the low evaluation value.

The alignment of operational models and ICT were seen to be incomplete, and it would seem that once ICT tools and information systems are taken into action, they are not aligned with the current operational models. Instead, the current models are aligned with the usage of new systems and tools. This is a major factor affecting to the evaluation.

As for the patients' role in the treatment, it was seen to be clear, and patients are mostly aware of what are required of them, and they actively take part to the treatment process. Patients are informed and they know how to seek information, but still the information flow was seen to require development. Finally the wholeness of the treatment was analyzed to be quite whole, as all participants are aware of their roles and responsibilities.

After the statements, the interviewees were also asked if there was something else they would have liked to say. One interviewee pointed out that the nature of the work that doctors and nurses do is very humane, and thus it may be difficult to get them into numeric form and bring them into information systems. That together with bad user experiences of earlier information systems may cause resistance against the development and implementation of the new systems.

It was stressed that when new information systems are to be released and implemented, it must be taken carefully into account that the usage of these systems should not increase the amount of work too much – otherwise the resistance against change is inevitable. Also the different information systems that are linked should be more interoperable with each other. The usability of the information systems received criticism in the open section as well. They were seen to be old-fashioned and slow, and their shattered nature was strongly stressed. The connectivity between other systems was noted too, as one interviewee criticized the difficulty to learn how to use the systems.

> "*Information systems should be developed in such way that the usage is linked with the work, but they can't take too much time away from the patient.*"
> - Neurologist 1

> "*If we want to use information systems, this just won't work that saving information is as slow as it is today. It should be other way around, it should be more efficient.*"
> - Neurologist 2

> "*When hospitals have this system, which is old and bad… You have to take a week to learn this current system, and you can't know a thing if someone won't tell you. I would hope that we would have better systems that would function. And that we would have a connection to health centers that we could see what they do. The patients are expecting this kind of system to exist, already.*"
> - Internists 3

There seems to be lot of challenges with the alignment of health care and information systems, still. Another interviewee mentioned, that the problems presented in this study which are related to the usage of information systems are brought up and raised already many times. On the next chapter, the discussion regarding to the findings are presented.

7. DISCUSSION AND CONCLUSIONS

In the first section the answers to the supporting research questions are stated. On the second section of this chapter, the answer to the main research question is collected. This is followed by the critical assessment of this thesis, where the reliability and validity are being evaluated. Finally comes suggestions for further research.

7.1 Research conclusions

Answer to the first supporting research question was gathered from chapters 3 and 6, and to the second from chapters 4 and 6. Chapters 2 to 5 gave answer to the third supporting research question, and chapter 2.3 gave answer to the final question. The answers to the supporting research questions are gathered to the below Table 14.

Table 13. *Supporting research questions and the answers to them.*

Question	Answer
How chronic illness care is executed in Finnish health care?	All the presented models applied self-management and the patient-physician relationship in some level, as shown in Table 4 (p. 39). In the interviews it was stated that roles and responsibilities are clearly determined, including patients. The patients' wishes are listened when the treatment is planned in co-operation. However, the responsibility of make decisions regarding to the treatment lies still with the health care professionals. Patients are responsible for maintaining the life style changes and monitor the development of the disease, and health care professionals support patients in this. Patients are actively given information regarding their disease and its management. Also patients have a point of contact in case they have questions regarding of their treatment. Patients and their relatives are active and they know how to seek information and demand care when needed. By focusing on self-management and the co-creation of welfare together with health care professionals, the patients' have received better self-management skills and new ways to solve problems relating to the chronic conditions that they have to live on daily basis.
How does ICT support currently these health care services and operations?	ICT provides a way for patients to get better access to care with the help of telecommunication and access to support groups on-line. Patients' information are systematically documented into EHRs, from where they can be checked whenever needed, by the patient or by the health care professionals. This also decreases the amount of duplicate information and errors, as the information is written and archived only once. There are also applications that the patients fill when coming to the follow-up meetings, which help evaluating the development of the disease. From ePrescriptions the health care professionals can see the medication that the patient has actually taken. If health care professionals need consultation from another hospital, telecommunication enables the knowledge to be available within minutes.

	Information systems can be used to provide information, help focusing attention and giving patient-specific consultation. These properties are needed when handing data related to the chronic care. Especially focus attentions, such as alerts, are needed so that there are no possibilities to endanger the patient's state of health. While giving patient-specific consultation the patient suffering of chronic conditions may receive new kind of treatment, which haven't been offered to him or her earlier. As all the patient visits and changes in the diagnosis or the behavior of the disease are always documented and monitored, the information systems can send alerts if the development of the disease is going into wrong direction.
What are the needs in the future chronic illness care for ICT?	The amount of patients suffering of chronic conditions increase all the time, and the focus of care should be shifted on preventing care. Patients and health care professionals need to have a relationship, where the care is co-created. The importance of self-management must be stressed. One self-management platform is internet sites, where medical information has been gathered to help patients self-manage their conditions. Also caregivers must follow patients to use internet as a resource, while strengthening the patient-physician partnership as the communication gets easier. ICT enables the transmission of self-monitored data and the health care professionals can give feedback to the patients' self-monitored data. The lack of standards and interoperability between different information systems lowers the usability of ICT in health care. Due to the social welfare and health care reform, the social welfare and health care information systems will be integrated and the overall architecture will be developed on a national level. Currently the variety between different hospital districts is huge, regarding to the maturity level of the used systems, and the evaluations in the interviews as well. There is a strong need for greater level of interoperability and coordination of how the systems should be developed in such way that they can communicate with each other without additional work, and that their usability does not create challenges into delivering care. This is highly demanded, for at the moment, different systems do not communicate with each other even at a satisfactory level. While this is not only a safety risk, it also causes a lot of waste, such as duplicate work, and fragmentation to a treatment of a patient. The low usability was mentioned in every interview; in some cases the interviewee felt that information is collected, but cannot be utilized nor achieved from the information systems. While usability is weak, learning to use the systems is difficult, productivity decreases and both work hours and efforts are wasted.
What kind of benefits does Lean provide to chronic illness care?	Lean focuses on zero defects and continuous improvement. The elimination of waste includes waiting time, delay, repeat visits, unneeded movements, duplicate procedures, errors and services which do not meet patient needs. As the processes are simplified, the functions, processes and organizational performance are clarified, awareness of problems is increased and amount of workarounds decreased. By applying Lean tools, such as VSM and 5S, the whole flow of the patient's care is recognized, thus the care delivery and the ways of work can be enhanced. Both the patients and the employees benefit, as shown in Figure 3 (p. 16).

The main research question for this thesis is "*How chronic illness care can be improved with ICT?".* To answer to this question, the execution of chronic care is divided into four sections. In the Table 15 has been gathered how ICT can support these features, and thus the Table 15 concludes the answer to the main research question.

Table 14. *ICT supporting and improving chronic illness care.*

Feature of chronic care	**Support and improvements provided by ICT**
Shift from reactive care to proactive care	Patient-specific definitions can be determined into EPRs. These include for example alerts and notifications, which aid in monitoring of the disease and its development. Patient may fill self-management information regarding his or her conditions to information systems. That information may be collected for example by a specific application tailored only for the required task, and they can also be visualized into a graphical form. The information is automatically analyzed and thus taken under notion when evaluating the treatment and considering preventions and changes.
Ensuring the continuous evaluation and monitoring of the care	As the patients' treatments are clarified and the operational models have been described, the patients' journey through care delivery can be surveilled and visualized. By analyzing the continuity of the care is enhanced. ICT tools enable automatic analyzation, alerts and reminders of medication, symptoms and follow-ups times. These functions minimize the risk of fragmentations in the patients' treatment and helps monitoring. The elimination of fragmentations improves the shift from reactive care to proactive, as the possibility for a patient to be dropped out of the care is decreased, such as how conditions are developing and how the patient's coping with the disease is enhanced.
The real time information of patients' condition is available for the health care professionals	The treatment is executed in co-creation. ICT provides ways to communicate flexibly in the relationship, which enables the possibility to receive information of the current situation of patients' wellbeing. The patient's information are readable as well as transformable only if the patient has agreed upon this. Messaging between health care professionals and patients can be executed by in a secure way so that no-one else can access this information. By allowing flexible messaging between a patient and health care professionals, the relationship becomes stronger. As the health care professionals may answer to the questions regarding of the treatment and receive information of the patient's current state of health, they are also able to react quickly to the changed situations, if necessary. Also the patient may give feedback on how the treatment is working and how he or she manages the daily life with and the symptoms. This knowledge is readable by the health care professional within minutes, and changes to the treatment can be made.

Patient-centeredness; care is tailored, suitable and coordinated. Patients are encouraged to actively self-manage their conditions.	ICT tools, such as decision making support systems, can be used to aim focus on properties that are determined directly from the patient's ERP. It is also possible to get patient-specific consultation in order to provide diagnostic support from patient-specific data. These enhance the patient-centeredness. The patient's flow through the care delivery may be analyzed and visualized in order to enhance the coordination of care, thus increasing the continuity. ICT has lowered the geographic distances, so if the patient's care requires a need for specific consultation, the knowledge is reachable by telecommunication easily. Thus the treatment of the patient can be developed based on the needs of the patient, rather than on the availability of skilled resources. As the care can be tailored to meet the demands of the patient's conditions, the resources available regardless of geographic distances create flexibility, cost-savings and enable better usability of the highly demanded knowledge. Secure messaging between the patient and the physician who is responsible of the treatment enables the coordination and evaluation of the care. If a patient feels that the treatment is not working or the symptoms are getting worse, this message can be provided to the physician easily in a secure way. The execution of care can thus be re-evaluated in co-operation to meet with the patient's current conditions, needs and wishes. By keeping the information flow flexible the entire treatment can be increased. This also means that patient conditions are evaluated as a whole, not only by based on acute symptoms when patient visits the physician next time. The HIN model proposed by Fieschi (2002) in Figure 14 (p. 54) encourages for the information exchange between the activated patients and health care professionals. As a result new ways for executing care in co-creation can be found, as new information is offered to both parties. External databases, such as websites, knowledge bases and support groups, may be utilized both in the planning and in executing the tailored treatment. This allows new kind of opportunities for the execution of treatment, resulting in enhanced outcomes and finding new ways of executing care effectively. Applying new kind of techniques may strengthen the patient's commitment to the self-managing of the chronic conditions. As patients and health care professional give feedback of the new techniques, their knowledgeability and utilization in chronic care are expanded in result of the evaluations and outcomes.

As shown in the Table 15, ICT has a lot to offer for the care of chronic illness. The implementation of such properties, however, is a task that needs a lot of coordination and planning before the properties can be implemented into action. Still, once the benefits of ICT in chronic care are recognized, the development processes of current systems and new kind of solutions can take place.

Regarding the planning of the requirements for the ICT tools and information systems, it would be important to include the views and opinions of both health care professionals and patients in order to ensure the functions and features fulfill the needs of both groups. As health care professionals are the priority user group for such systems, it is highly important for these to fulfill the needs and requirements set by the treatment of chronic conditions. These requirements are best known by the patients and the health care professionals, since they both live with these requirements every day.

7.2 Discussion and implications

Based on the executed empirical study, currently ICT is not very widely used in Finnish health care in terms of chronic care. According to the interviews, most university hospitals use only the general patient information system as an ICT tool in their daily operations. The systems and their utilization varies greatly between different hospital districts, as well as the users' satisfaction towards the systems. Usually the systems were seen to be beneficial, but the challenges that occur while using them was remarkably often.

As it is highly stressed in the evaluations, the usability and thus the user satisfactory of the current ICT tools and information systems is on a poor level. When learning to use the system, there is a huge amount of time needed from the employees just to get understanding of how the systems work. As shown in Figure 13 (p. 52), user satisfactory and the usage of systems are highly connected.

Used information systems were not seen to work holistically, and the navigation within the system were seen to cause a lot of additional work. The information was not seen to be available in a form that fulfills the needs and expectations, and getting the needed information was seen to be too demanding and difficult. As system quality, information quality and user satisfaction are in a low level, the individual and thus organizational impact received from utilization of information systems are remarkably decreased.

In addition to the low user satisfactory of the systems, the interoperability of the current general systems was evaluated to need a lot of improvement. The communication of the current systems with other systems leaves a lot of hoping. There are problems especially with the communication of systems within the local health center, but within the hospital's own information systems, as well. On the other hand, in some hospital districts any kind of communication and electronic information exchange in the health centers was not available at all.

The used systems were not seen only to be slow and difficult, but also their development were seen to be a very bureaucratic process. First of all, the current systems do not seem to fulfill the expectations and the needs of health care professionals. Additionally it was argued that patients' needs cannot be completely supported with utilization of the current systems. These need a lot of development, but according to the interviews neither patients', nor health care professionals' opinions are listened well enough in the development process, or at least that was the opinion. One interviewee stated that if development ideas are finally taken into consideration after several proposals, the new updated version may be useable not until the next year.

One view that came up from the interviews was the alignment of operational models and ICT; currently operational models are aligned to the used ICT tools and systems, when it should be other way around. The used ICT tools, information systems and their usage should be aligned with the operational models and the execution of care. The study of Erhola *et al.* (2014) showed that the variety of cooperation between information management and administration and health care in Finland differs enormously between different hospital districts. The maturity level takes notion of how IT services and coordination are in-line with the needs of health care services.

When compared to the evaluation of the maturity levels (chapter 4) and the findings from the executed empirical study (chapter 6), these maturity level evaluations seem to be in-line with the findings of this thesis. Erhola *et al.* (2014) found Helsinki to have the highest maturity level and Tampere to have the weakest. In the empirical study, over-all evaluations stated in Helsinki regarding the utilization of ICT were remarkably higher than the evaluations that were made by the interviewees from Tampere. Naturally there are opinions and experiences which affect to the evaluations, but nonetheless the overall average value to the category from Helsinki was 3,7, while Tampere gave 2,4.

The purpose of ICT is to support the executive operations, not to challenge and create a need to apply the selected methods to fit into the utilization of tools and systems. The maturity level of used systems can be increased by aligning the systems to support the operational models. This, however, requires the listening and the understanding of health care professionals in order to understand how the given chronic care is structured, planned and executed.

Currently there are projects for acquisition of social welfare and health care information systems, Apotti and Kiila. The aim for both projects is to achieve a more mature level of integration between hospital districts. While this development is highly needed, the alignment between the different ICT systems, however, has seen to be causing complications. In the interview from the university hospital where acquisition project took place recently, there have been a lot of new kind of difficulties in the collaboration between the hospital's information systems and the ones that were determined in the project. According to the executed interview, the development process and implementation of the acquisition project was executed in a too tight schedule, hence leading to the current situation of utilizated of information systems that don’t communicate with each other.

Therefore one point for getting ICT to better support chronic care is to listen to the opinions of health care professionals in the development process of the information systems. They have the knowledge of how the treatment is actually executed and what kind of information they would want to get from the systems, for example what kind of calculations, variables and graphs would be important information in the execution of the care. Also they know the current systems and how they work and function, as well as specially what kind of problems have been found in the systems that causes challenges.

As for developing the information systems, the designation of new properties (such as alerts and notifications for enhancing the patient safety and focusing attention on the right processes) need to be executed by the ones that actually live and work with the chronic care patients on daily basis. Caregivers and patients have the deepest understanding of what are the issues which need the most focus. They have experience and know what kind of information is important to be available in order to ensure the continuous care and safety of patient.

By including health care professionals into the development process, the requirements of the systems can be aimed to meet more of the actual needs in the health care. While including health care professionals into the development process, it must be stressed that the needs and requirements for the systems must be clarified in order to avoid misunderstandings. One interviewee was concerned that the health care professionals cannot express the demands and requirements in such a way that the developers would understand them. Hence the developing process must enable communication and sharing of opinions, and the whole picture of the development process must be available all the time. Therefore the misunderstandings occurred should be corrected as soon as possible.

For the chronic conditions there are currently only few regional solutions mentioned, such as applications or software, that were used especially with patients suffering of chronic conditions. One example mentioned was an application where patients can mark all the joints that have been swollen or aches more than normally. However, most of the interviewees did not recognize any specific ICT tool, system or application that could be usable when executing and maintaining care for chronic conditions. Such a solution was found very useful in the monitoring of the patient’s current condition, according to the interviewee. In the development process of this kind of a system, the opinions and views of both patients and health care givers should be heard as well. Both of these groups recognize the need for such specific tools, applications or software for chronic conditions, and can set the requirements for this kind of systems to fulfill the needs of the patient’s treatment.

By having a specific application for monitoring chronic conditions, patients could be easily instructed to give the information needed in the monitoring of the patients' treatment. These applications could reveal the direction to where the patients' conditions are developing, as well as give feedback of how patients are managing the self-management of the disease. The information gathered by the applications could be tailored in a way that they would benefit not only the patient, but also present important information to the monitoring and planning of the treatment and its execution for the health care professionals. Additionally, if it seems that the welfare of the patient is developing into a wrong direction, the data saved into EPRs and applications is able to send alerts to notify the health care professionals to consider if there should be changes in the medication or living styles, for example.

When acquisition projects, such as Apotti and Kiila, are executed, the current operational models and used ICT tools as well as information systems should be evaluated in the beginning of the project. While the aim of these projects is to increase the usability, interoperability and connectivity of different systems as well as enhance the information exchange between different operators, the baseline for such project is to evaluate the state and functionality of current systems of each participant. This, however, seems to have been overlooked earlier. In one interview the interviewee told that a lot of problems have occurred due to the development process, when the comparability of the systems already in use were not taken into account enough. As a result the challenges relating to the usage of ICT tools and information systems have increased significantly.

7.3 Research assessment

The purpose of this thesis was to examine how chronic care can be improved by utilizing ICT, as stated in chapter 1.2. The objective was approached by taking a literature view to the operational models executed in Finnish health care, specifically related to chronic care. This thesis also states the benefits for the health care in general together with the advantages provided especially for chronic care by the implementation and utilization of ICT. Also an empirical study took place, where five health care professionals from four university hospitals in Finland were interviewed in order to get an understanding of how chronic care and the utilization of ICT in health care are actually managed.

In general, this study can be considered as successful in terms of the research questions: the main research question together with the presented supporting research questions were answered in chapter 7.1. The main research question presented an answer to the main objective of this thesis. The additional objectives stated were to find if there are regional solutions which could be adaptable elsewhere, as well as to examine the benefits provided by implementing Lean into chronic illness care. The answer regarding the regional solutions were examined in the empirical study, and the answer to the fourth supporting research questions revealed the benefits of Lean.

The research strategy was a deductive research based on hermeneutic research philosophy. As stated in chapter 1.3, earlier literature used as a reference provides only pieces of the real world experience of chronic care and ICT's benefits. These pieces created a hypothesis, which was tested in the empirical part of this thesis. The analysis concluded from the results revealed the answers to the research questions presented in chapter 1.2. The results gathered from the literature as well as from the interviews are, however, approached through understanding and interpretations. This means that the results concluded can be affected by the previous experiences and understanding that the researcher has of the topic on beforehand.

The research aligned the limitations set in the chapter 1.2. Even though general properties of health care were examined when investigating the benefits provided by ICT for the health care, the main focus lied on chronic care. Additionally the examination of operational models and the empirical study were geographically limited to Finland. Lean aspect of this thesis was examined purely by evaluating the benefits provided by Lean, even though the implementation of such a philosophy into action has undeniable challenges. This aspect, however, is to be investigated in some other research.

Validity of the research refers to the accuracy and trustworthiness of instruments, data, as well as findings in the research, and according to Bernand (2011, p. 41) it is the most important aspect in the research. Validation means cross-checking information from different sources in order to ensure its consistency, and agreements between the sources of information (Pratt & Loizos, 1992, pp. 72-73). Reliability of the research refers to whether or not the same answer can be achieved by redoing the research (Bernand, 2011, p. 42).

The executed empirical study was a case study from four different university hospitals in Finland. The amount of interviewees was five, which is a relatively small sample size. However, this provides a snapshot of the current situation of chronic care, which is inline with the chosen time-horizon.

Most of the articles used as a reference for this thesis have been often cited by other articles. The amount of citations can be stated as one meter of article's impact factor. Generally the amount of citations is high (more than dozens of hundred), but there are few exceptions with less citations. These exceptions are either new publishes (for example Erhola *et al.*, 2014 with 6 citations), or they are written in Finnish and have quite a narrow subject (for example Kanste *et al.*, 2009b). According to the amount of citations, the referenced articles and books can be stated as being scientifically valid.

To the Table 15 on the next page are gathered the scientific articles from which the references have been selected to this thesis. Table 15 also presents the latest SCImago Journal Rank (SJR) ratings given to the journals. The SJR is widely used to assess and analyze scientific articles. The values are emphasized as Quartiles from Q1 to Q4, where Q1 is the highest value and Q4 the lowest. If the article had multiple categories in SCImago

Journal Rank database, the most suitable in terms of Health care was chosen – for example American Behavioral Science had 5 categories (Sociology and Political Science, Education, Social Science, Social Psychology and Cultural Studies), in which case the category of Education was selected, according to the theme of the Lorig's (1996) article. The Quartile values presented in Table 15 were searched 21.11.2015.

Table 15. *SJR ratings of the journals used in this thesis as references.*

Journal	SJR	Journal	SJR
American Behavioral Science	Q1	Journal of Advanced Nursing	Q1
British Medical Journal	Q1	Journal of Biomedical Informatics	Q1
Bulletin of the World Health Organization	Q1	Journal of Clinical Nursing	Q1
Business Process Management Journal	Q1	Journal of Hospital Medicine	Q1
Canadian Journal of Diabetes	Q2	Journal of Management Information Systems	Q1
Clinical Nursing Research	Q2	Journal of Nursing Management	Q1
Effective Clinical Practice	N/A	Journal of Telemedicine and Telecare	Q1
Ethnography	Q1	Journal of the American Medical Informatics Association	Q1
European Business Review	Q2	Leadership in Health Services	Q3
European Journal of Operational Research	Q1	Managed Care Quarterly	N/A
Finnish Journal of eHealth and eWelfare	-	Mayo Clinic Proceedings	Q1
Health Affairs	Q1	Medical Care Research and Review	Q1
Health and Social Care in the Community	Q1	MIS Quarterly	Q1
Health and Technology	Q3	Nursing Outlook	Q1
Health Care Management Science	Q1	Patient Education and Counseling	Q1
Health Systems in Transition	Q1	PLoS Medicine	Q1
Hospital Quarterly	Q2	Procedia Engineering	N/A
International Journal for Quality in Health Care	Q1	Quality and Safety in Health Care	Q1
International Journal of Health Care Quality Assurance	Q3	Qualitative Inquiry	Q1
International Journal of Medical Informatics	Q1	Quality Management in Health Care	Q1
International Journal of Productivity and Performance Managem.	Q1	Sairaanhoitaja – Sjuksköterskan	N/A
International Journal of production economics	Q1	Socio-Economic Planning Sciences	Q1
Jama	Q1	Social Science and Medicine	Q1

It must be noted that five journals do not have a value for Quartile, and that there are two journals with value of Q4 and four with Q3 in year 2015. *Finnish Journal of eHealth and* *eWelfare* is a scientific journal established by the Finnish Social and Health Informatics Association and the Finnish Society of Telemedicine and eHealth (FinJeHeW, 2015), but it was not able to be found from SJR database, thus it is marked with ‘-‘. The journals, which are marked with ‘N/A’, have not been evaluated with SJR rate in the year 2014. *Effective Clinical Practice* was given the last Quartile value in the year 2005 (Q1), *Managed Care Quarterly* in 2009 (Q4) and Sairaanhoitaja in 2003 (Q3). *Procedia Engineering* does not have any evaluation or Quartile value in SCImago Journal Rank. However, when the Wagner’s (1998) article was published in *Effective Clinical Practice*, its SJR was Q1. When the article of Wagner *et al.* (1998) published in *Managed Care Quarterly,* the journal got SJR rank of Q1 as well. Additionally the article of Kanste *et al.* (2009b) was published in *Sairaanhoitaja – Sjuksköterskan* in 2009, but there is not given Quartile available;

Procedia Engineering is available in SCImago Journal Ranking, but there is no Quartile value for it. Thus the article of Stojkic *et al.* (2014) published in *Procedia Engineering* cannot be evaluated by the SJR value. Also worth mentioning is that the journal *Hospital Quarterly* changed its name after the publication of the article of Barr *et al.* (2003) used as reference; the journal is now named *Healthcare Quarterly*.

However, even though there are few exceptions in the SJR rankings of the used reference, generally the Quartile values that the journals have received are good. Thus, the literature used as reference in this thesis is mostly academically seen to be articles with good quality. There are also books and reports used as reference, and three websites were used as a reference by Association of Finnish Local, Regional Authorities, Finnish Journal of eHealth and eWelfare as well as by the Ministry of Social Affairs and Health. The detailed literature used in this thesis are listed in References (p. 91).

7.4 Suggestions for further research

This thesis has presented how ICT can be beneficial in chronic care, as in health care in general in Finland by analyzing both the literature as well as the current situation by an empirical study. However, many of the presented enhancements are only discussed in theory. Thus there is a vast need for actual actions to take place, where the development of the current utilization of ICT should be increased and modified to better serve the needs of chronic care.

As many times stated, the actual needs of care should be clarified when these developments are taken under consideration. This means taking the views of the patients’ as well as the health care professionals into the development process. Also in the current situation, utilization of ICT and the execution cannot be overseen or undermined. In order to avoid the resistance towards change, the development processes should be applied in to current operational models. The used systems should not require a change of how the care is executed, but in the contrary the systems and ICT tools should support this execution.

For example the alignment process of local information systems and KanTa has been seen to cause difficulties and challenges for the utilization of ICT tools. As this kind of national development projects are taking place, the wholeness of the systems and their interoperability must be highly stressed. For these projects to be successful, the opinions regarding the functionality of current systems as well as the wishes and demands of the future systems must be taken into consideration in a very detailed level.

The follow-up surveys of the operational models presented in the chapter 3 would be interesting, since by evaluating how the operational models have been seen to affect the treatment of patients suffering of chronic conditions. While all the operational models stressed the importance of self-management, it would be beneficial to see if the ability of the patients' to accept and take the responsibility over the self-management of the conditions has truly enhanced. Additionally, if the changes have been found to be effective and should they support the execution of the treatment, properties and suggestions of such an enhancement could be offered to other care delivers as well.

While the amount of patients with chronic conditions increases all the time, the importance of carrying the responsibility over one's health conditions must be shifted to the patients. Also the shift from reactive to proactive care can be enhanced, as the patients are more aware of the possibilities and opportunities available for managing their conditions. The importance of support groups, such as CDSMP, cannot be underlined here. In addition, it would be valuable to receive understanding of how support groups, either virtual or local, actually do increase the self-efficacy, self-management skills, ability to accept responsibility as well as the psychological effects of managing the symptoms and the daily life.

As currently the delivering of care varies highly between the different operators, it would be beneficial for all the participants that certain steps and actions in the treatment would be standardized. This could minimize the amount of fragmentations and imperfect treatment episodes. Lean could be seen as one solution to support this kind of continuity, as stated in chapter 2.3. The appliance of Lean in health care, however, is still not widely recognized. As has been stated in this thesis, it is possible to improve the care delivery (both health care in general as well as chronic care), although there are not yet many implementations. Thus the experiences, either good or bad, are not widely known.

Hence, in order to actually recognize the benefits that Lean provides to health care, there is a need for examining such an implementation. This type of study should be executed in a close communication with the employees who take part in the implementation process. The employees of a health center or a hospital where such an implementation project could take place, should be tightly included into the planning process. This enables the possibility to receive feedbacks and comments on how the project is succeeding in the regards of the set objectives, and whether or not there is a need for change in the implementation process.

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APPENDIX A: INTERVIEW QUESTIONS

Scale for statements from 1-5	
1	very poor
2	poor
3	avarage
4	good
5	very good

Overview about the interviewee

1 In what position / role do you work in?
2 What kind of actions include to your work?

1. Current operational models in chronic care

3 What kind of operational model (OM) you have for chronic patients?
4 What are the strengths of the model?
5 What kind of development needs you find in the OM?
1 Current OM determines clear roles and responsibilities to each participants.
2 Current OM supports succession in daily work.
3 Current OM sets challenges to the daily work. (*)
4 Current OM supports the needs and treatment of the patients
5 Current OM creates obstacles / challenges to work environment

2. Utilization of Information Systems in chronic care

8 How does using Information Systems (IS) affect your daily work?
9 Do you have a special IS just for chronic patient care?
6 Utilized IS support daily work.
7 Utilized IS challenge daily work. (*)
8 Utilized IS apply to the tasks they are meant to.
9 Utilized IS work holistically.
10 Utilized IS support the needs and care of chronic patients.
11 Utilized IS set challenges to the patients’ treatment.
12 Utilizing IS is beneficial for patients’ treatment.

3. Aligning the operational model and Information Systems

13 Utilized IS and OM fit together.
14 The alignment of IS and OM is still incomplete. (*)
15 IS supports the execution of the OM.
16 IS restricts/challenges the execution of the OM. (*)
17 Current IS cannot provide the kind of information that is needed in execution of OM.
18 IS can be straightly applied in executing the type of care aligned by the OM.

4. Patient in the execution of the operational model

10 How information flows between the patient and the participants of the treatment?
19 The patient has a clear role as a participant of the OM.
20 The patient acknowledges the execution of OM and his/her treatment process.
21 There is a clear point of contact for searching knowledge, e.g. for patient's treatment.
22 The information flow between patient and the participants of the treatment is seamless.
23 The information flow between in the treatment is incomplete (*)
24 The patient has an active role in executing his/her treatment.

5. Wholeness of the treatment (patient in the alignment of IS and OM)

25 The treatment executed by IS supported OM is a logical process.
26 Participants of the treatment are clearly aware of their roles and responsibilities.
27 Imperfect treatment episodes does not occur in the treatment process.
28 Person treating the patient has access to the recent status of patient's health condition.
29 Patient must take care of the knowledge flow within the treatment process. (*)
30 Patient has the most recent knowledge regarding his/her treatment and its progress.

APPENDIX B: REASONING FOR THE INTERVIEW STATEMENTS

No.	Theoretical reasoning
1, 19, 20, 26	Chronic conditions require consistent attention from both the patient and care provider (Miller *et al.*, 2015). Self-management means patient's ability to manage the chronic illness daily with health care professionals being responsible for the medical management (Lorig, 1996; Barlow *et al.*, 2001). Self-management care plan should be agreed and negotiated in partnership (Lawn *et al.*, 2001).
2, 20, 24	Self-management affect positively patient well-being, including systematic efforts to increase patients' knowledge, skills and confidence to manage their condition (Wagner *et al.*, 2007). The CDSM programs are aimed to improve the outcomes and increase self-efficacy along with providing medical care and education. This empowers patients to take better control in self-managing their conditions. (Farrel *et al., 2004;* Miller *et al.*, 2015) This also emphasis on the patients' active role in the physician relationships (Lorig, 1996).
3	Self-management models may be limited to deal with the consequences of disease illness, not the physiological disease (Lrig, 1996; Farrel *et al.*, 2004). Patients are the principal care-givers and if they do not make the decisions to follow the negotiated treatment plan, there is very little health care professionals can do. (Bodenheimer *et al.*, 2002b; Farrel *et al.*, 2004; Lawn & Schoo, 2010; Vallis, 2015)
4	Patients' enhanced ability to self-manage their conditions leads to better symptom and lifestyle modification in order to follow the negotiated treatment (Farrel *et al.*, 2004; Lawn & Schoo, 2010; Miller *et al.*, 2015). Active self-management has also a significant therapeutic value (Jerant *et al.*, 2004).
5	Operational models in health care include complexity, uncertainty and variability due patient flows, patients' needs and hospital capacities. These cannot be predicted, which leads to stressful environment. (Harper, 2002; Poksinska, 2010)
6	HIS are systems utilized to process data, information and knowledge in health care environment, aiming to contribute to a high quality, efficient patient care (Haux, 2006). ICT is meant to improve health care through enhancing care delivery, its coordination and the engagement with patients (While & Dewsbury, 2011). Multiple forms of data is needed in order to make decisions related to patients' treatment in the most effective way (Pavlopoulos & Delopoulos, 1999).
7	Without access to relevant data, no decisions on diagnostic can be made related to patients' treatment. This could lead to fatal consequences. For example weak usability, lack of education, weak interoperability with other systems and systems downtime can cause access problems to necessary information. (Fieschi, 2002; Haux, 2006; Abott & Coenen, 2008; Black *et al.*, 2011; Forsström *et al.*, 2012)
8	For example CDSS is meant to lead to improved practicioner performance in variety of care activities; for instance alerts and warnings can be beneficial when adding patients' information to CPOE (Abott & Coenen, 2008; Hillestad *et al.*, 2015).
9	The importance of infrastructure in utilizing ICT in health care is mandatory (Fieschi, 2002). Many IS implementations have failed due inappropriate structure and piecemeal nature of IS development. The benefits of IS can be seen being departmental and fragmented, not enterprise-wide. (Avison & Young, 2007).

10, 12, 30	ICT enables better access to information and hence increases the self-management of patients (Grimson & Grimson, 2002; Haux, 2006; While & Dewsbury, 2011; Forsström *et al.*, 2012). For example telenursing is a possibility for example ask guidance and advice without being physically at the hospital, (Abott & Coenen, 2007; Yang *et al.*, 2015). Also updated EHRs keep health care professionals updated with the current situation or patients' health (Forsström *et al.*, 2012; Hillestad *et al.*, 2015).
11	For example usage of outdate systems with weak usability leads to wasted efforts and unfavorable performance (Bush *et al.*, 2009; Forsström *et al.*, 2012) Fragmented implementation process leads to suboptimal usage and communication barriers (Avison & Young, 2007). Lack of training lessens the benefits of ICT (Lupianez *et al.*, 2010). The patients' use of IT for self-care can be limited (Yang *et al.*, 2015)
13, 15, 18, 25, 28, 30	Chronic conditions require consistent attention from both the patient and care provider (Miller et al., 2015). The EHRs show the development of patients' health condition to health care professional, who acts as a coach to the patient. All parties including to the treatment process are aware of their responsibilities and they have access to the needed information regarding the current state of patients' health (Lorig, 2006; Forsström, 2012; Hillestad *et al.*, 2015).
14, 16, 17, 29, 30	For example the updated data of patients' health is not provided or necessary participant to the treatment process lacks access to it. Hence decisions based on knowledge cannot be made. The EHR is not updated and does not show the current situation. Patient must himself/herself make sure that the physician is aware of the current situation in order to make decisions based on reliable knowledge, since IS does not provide this kind of information. (Haux, 2006; Black *et al.*, 2011; Forsström *et al.*, 2012)
21, 22, 23	Informed patients are aware of the treatment process and its execution (Wagner *et al.*, 1999). Utilizing ICT enable patients for seeking health information and answer to the health related questons (While & Dawsbury, 2011; Yang *et al.*, 2015). However, the treatment process with chronic care usually crosses boundaries of organization, which could lead to fragmented treatment with no perception of the care process as a whole. This could lead tu uncertainty with no clear point of contact. (Kanste *et al.*, 2009a; Teperi *et al.*, 2009, p. 27; Poksinska, 2010)
25, 27	The fragmented treatment process could lead to situations where the only one aware of the whole treatment process is the patient. The treatment process should be developed so that there occurs no uncoordinated visits. EHRs should include the updated documentation of patients' health condition, and the knowledge should be available whenever and wherever in order to avoid medical errors and increase patient safety through the patients' treatment process. (Teperi *et al.*, 2009, p. 27; Poksinska, 2010; Forsström *et al.*, 2012; Hillestad *et al.*, 2015).

APPENDIX C: COLLECTION OF THE GIVEN NUMERAL EVALUATIONS IN THE INTERVIEWS

	KYS	TAYS	TAYS2	HUS	OYS	**Average**
2. Current operational models						
1	4	4	5	4	4	4,2
2	3	4	4	4	4	3,8
(*) 3	4	1	3	3	3	2,8
4	4	3	4	4	4	3,8
5	2	2	2	2	2	2,0
				Overall average:		**3,4**
2. Utilization of Information Systems						
6	5	2	2	4	3	3,2
(*) 7	4	4	4	3	4	3,8
8	4	2	1	4	2	2,6
9	3	1	3	3	3	2,6
10	5	2	4	4	4	3,8
11	4	2	4	2	4	3,2
12	5	2	4	4	5	4,0
				Overall average:		**3,3**
3. Aligning the operational model and Information Systems						
13	3	3	5	4	3	3,6
(*) 14	4	3	2	4	5	3,6
15	4	3	3	4	2	3,2
(*) 16	2	3	2	3	4	2,8
17	2	4	4	2	5	3,4
18	5	3	4	4	4	4,0
				Overall average:		**3,4**
4. Patient in the execution of the operational model						
19	4	5	3	4	3	3,8
20	4	3	4	4	3	3,6
21	4	4	4	3	4	3,8
22	4	3	3	3	3	3,2
(*) 23	3	5	3	4	5	4,0
24	4	4	4	3	4	3,8
				Overall average:		**3,7**
5. Wholeness of the treatment (patient in the alignment of IS and OM)						
25	4	3	4	4	2	3,4
26	4	4	4	4	4	4
27	3	1	*2*	3	4	2,6
28	2	2	2	2	2	2,0
(*) 29	4	3	3	3	4	3,4
30	4	3	4	3	4	3,6
				Overall average:		**3,2**