Annika Vasalampi

ADOPTION AND USE OF A MOBILE SYSTEM AT HOME CARE

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ADOPTION AND USE OF A MOBILE SYSTEM AT HOME CARE

Vasalampi, Annika
Satakunnan ammattikorkeakoulu, Satakunta University of Applied Sciences
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Supervisors: Janssen, Bienke; Willems, Charles; Sirkka, Andrew
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The popularity of mobile applications is increasing in all sectors of care. Home care can benefit from electronic health record-based applications particularly, due to the distance of the patients´ home and care facilities. Multiple activities which were originally performed at the office with personal computers can now be performed at the presence of the patient. Mobile systems increase quality of care and help organizations to optimize their work flow. However, the adoption of technologies amongst care professionals can be poor. Implementing new technologies in care can be difficult as professionals have different background skills in using mobile devices and the fear of technology can be a big barrier for some of the homecare nurses. There can also be problems with the device, web-connections and the application.

The aim of this study was to find which factors have influence on adoption and use of a mobile system used at home care in the city of Nokia in order to further intensify the utilization of the mobile system and development of the application in collaboration with the service provider.

This research was a case study. Semi-structured interviews were conducted to 12 home care nurses to gain information about adoption and use of the system. Data was analysed by thematic content analysis. Three contextual inquiries took place and a task analysis was performed to identify phases of a mobile assisted home visit and phase-sensitive issues on using the system.

Perceptions of adoption and use of a home care mobile system are diverse. Only 25% of nurses use the system at every home visit. Some benefits of using the system are seen, such as possibility to read patient data during home visits. However, all 12 nurses indicated versatile problems on use, such as heavy weight of the device, lack of critical functions and constant malfunctioning of the system leading to a lack of trustworthiness towards the system.

In order to intensify the use of a mobile system at home care, multiple improvements to the system are required. This research enabled constructing an implementation plan based on a requirement analysis for service provider and recommendations for organizations and nurses using home care mobile systems. The requirement analysis consists of three major groups of requirements: device selection, application development and development of integrations between the mobile system and main patient information database. This thesis was produced in collaboration with EU Master Care &Technology cohort 2015-2017.

1 INTRODUCTION

Most of the home care organisations in Finland have started to use mobile applications to support homecare processes. The main reason for that is the need to optimize resources as the population is ageing rapidly and in the future, there will be fewer personnel to take care of increasing amount of patients. All processes must be cost-effective. The applications provide new possibilities in operational systems for staff planning to transform patient´s home visit details by a mobile phone or a tablet PC. Apps also enable most of the electronic health record-based functions to be performed at the point of care, in this case at patient's home. There is a law on the elderly services that obligates care providers to perform planning of the home care together with the patient (HE 218/2016). Portable devices and applications enable assessment and care planning of a patient at his/her presence. Well-functioning mobile system for organizing patient data in home care services includes functions which enable nurses to automate care plans, collect vital signs, make and handle notes about current and recent visits, to have access to crucial patient details, to collect timesheet and location data and to automatically verify visits on site (Herrmann, 2012).

In the home care at the city of Nokia, nurses started to pilot a mobile application called Lifecare home care at 2016 (version 1.1). Application allows nurses to access patient data and complete the home visit process including the required statistics and document-writing on the spot. Although the nurses are equipped with the latest technology, mobile devices such as phones and tablets, the adoption amongst the nurses at Nokia has been poor and utilization of this new technology has not been as extensive as the organization would have wanted. Using the patient information database at the point of care has benefits such as increasing patient safety and improving the workflow and productivity (Dewsbury, 2014; Alnanih, Radhakrishnan & Ormandjieva, 2012).

So far, experiences from the field indicate that nurses do not use the application as extensively as they could because of various problems in the process. There have been problems in implementing the technology in home care of Nokia, such as lack of training and achieving critical information of implementation process. That is a

worldwide problem in deployment processes of new technologies in care. A lot of applications have failed or there have been big issues in implementation (Zhang, Cocosila & Archer, 2010).

There are also differences in technological skills amongst the nurses. One of the biggest challenges of mobile development is to create user interfaces that are accessible to differentially-abled users (de la Harpe, 2014).

In Nokia home care, biggest barriers in usage have been problems with interfaces between administrative patient database and mobile application. That has led to decreased trustworthiness of the system, which can be one reason of poor utilization (Wälivaara, Andersson, & Axelsson, 2011).

Home care nurses are in the middle of the implementation process. Adoption of this new technology has been poor so far. Fortunately, the producer of the application has taken a more user-centred point of view during the process and nurses can participate to the development more in advance. Collaboration with end-users is a critical aspect of adoption and acceptance of new technologies (Zhang, Cocosila & Archer, 2010).

It seems that to increase the utilization of mobile devices and applications amongst home care nurses in Nokia, it is important to investigate the reasons why they are not utilized better. According to previous experiences, it has been difficult to separate user-based reasons from the technology based (devices, software and connections) reasons. The purpose of this study is to evaluate the home care nurses´ adoption process regarding the deployment of a mobile system (Lifecare homecare application and Acer Aspire Switch Series 10- tablet device) and the use of the mobile system in home care context in the city of Nokia, Finland. The focus is on the user experiences of home care nurses.

2 STATE OF THE ART

2.1 Home Care

Mosbys´ Medical Dictionary describes home care as follows: "A health service provided in the patient's place of residence for the purpose of promoting, maintaining, or restoring health or minimizing the effects of illness and disability" The dictionary also refers to home care as a service that can include nursing care and different kinds of therapies and services such as transportation. According to the dictionary, nursing can be provided by different professions, mainly registered nurses, licensed practical nurses and home health aide. According to de la Harpe, R. (2014) the main activities of homecare are to provide care services to patients at their homes. A sub-activity is the reporting, sharing and recording the patient data.

The Ministry of Social Affairs and Health in Finland is responsible for general planning, guidance and supervision of services aimed at older people. In Finland, there are 317 municipalities, which are independently responsible for providing social and health care services. According to the Act on Planning and Government Grants for Social Welfare and Health Care (733/1992), municipalities receive financial support from the Government in order to organize these services.

Each municipality organizes services independently, which means, for example, that they are responsible for organizing home help, housing services, institutional care and support for informal care. The way that services are organized may vary. Municipalities can provide services independently, they can organize and provide services together with another municipality, or they can provide a voucher to service users so they can buy services from a private service provider.

2.2 Mobile applications

Mobile applications are software applications used for mobile devices such as tablet computers and smartphones. They are usually called apps. While operating systems run the general functions of the computer device, mobile apps are self-standing pro-

grams used for specialized purposes such as VoIP communications, email, web browsing, and different kinds of commercial purposes. According to Flair, the popularity of apps originates from the mobile devices´ versatile possibilities to change the host device with the touch screen into anything from a calculator to a piano (Flair, 2013).

2.3 Mobile applications at home care

According to Dewsbury (2014), there are multiple software systems that can be used by nurses to manage work in the community. All the systems use the latest technology, often web-based. These systems offer an in-time, safe and encrypted ways to enable the nurses to use patient care plans, records and essential clinical information. Wälivaara et al. point out an important issue in the field of care. According to their studies, professionals in different fields have little or non-existing possibilities to access patient data in home settings. They also refer to the fact that the parallel use of electronic- and paper- based patient records could lead to decreasing patient safety (Wälivaara, Andersson & Axelsson, 2011).

An operational system for care planning integrated with well-functioning home care application enables the management to be more aware of the time used at home visits. This data can facilitate the service delivery to be provided at the correct time and to assist in allocating personnel resources more efficiently. In other words, the accuracy of reported durations of home visits can be improved (Eveborn, Flisberg, & Rönnqvist, 2006).

2.4 Adoption and implementation of a mobile system at home care

There are various studies about using mobile devices and applications in care. Zhang, Cocosila & Archer (2010) have studied mobile application and device adoption

amongst the home care nurses. According to their studies, a lot of applications have failed or there have been big issues in implementation. Problems in adoption arise from the poor collaboration with end- users at the development process of the application. Their analysis also claims that nurse´s perception of usefulness is the most important in the adoption of new technologies.

O´Mahoney, Wright, Yogeswaran and Govere (2014) agree with this aspect on their research. They also claim that most of the ICT-projects, worldwide have failed because of inadequate presence of the end-user in the application development process. They also indicate that end- users´ acceptance is a crucial factor in successful implementation (O´Mahoney, Wright, Yogeswaran, Govere, 2014).

Alnanih et al. (2012) have studied the importance of the quality of user interfaces for smart phone applications. They present a term MUI, Mobile User Interphase, and emphasise the importance of usability in applications. According to their studies, it is possible to improve workflow productivity by making notes to databases only once during the process, preferably at the site of care (Alnanih, Radhakrishnan & Ormandjieva, 2012).

The aspect of missing the possibility to transfer the electronic medical data from the home of the patient is shown in the research of Dhiliwal and Salins (2015). They also implicate that there are crucial challenges in development, adoption and use of many mobile applications, such as incomplete coverage of mobile networks, lack of standards and information overload.

Johansson et al. (2012) have studied nurses´ experiences on using mobile devices in nursing practices. According to their research, mobile solutions were perceived as useful. According to the study, the experience of usefulness arises from time savings, improved patient safety and quality of care deriving from the access to the necessary information (Johansson, Petersson, Saveman & Nilsson, 2012).

2.5 Success and Failure factors

Michel-Verkerke and Spil, (2013) introduce the USE IT- adoption model, which is an updated version of USE IT-model by Shuring et al. (2006) to explain success and

failure factors of information systems. They define success from users´ perspective. Using the system and being satisfied with it are seen as success. On their research, relevance of the system seems to be the most influential determinant and perceived usefulness being element of relevance is found to be the most important factor in adoption of an ICT-system in healthcare.

The USE IT-adoption model contributes as a theoretical background of this research. Michel-Verkerke & Spil (2013) updated the original USE IT-model and introduced THE USE IT-adoption-model to predict and evaluate adoption of information and communication technology in healthcare at 2013. USE IT- adoption-model combines theories about diffusion of innovations and adoption and provides a questionnaire and interview-model to evaluate and predict the success of an information system. On USE IT- adoption model, the focus is on a user´s perspective.

 The USE IT- adoption model is chosen as a theoretical frame of this research, as it is mentioned to provide more detailed and specific results in comparison to other, older models. The USE IT adoption- model is argued to give added value due to its´ micro and macro-level distinction of each determinant. TAM2 was discarded as outdated for not having such benefits as to study the micro-and macro levels with clear distinction. One of my objectives was to intensify the implementation and organizational level-information is crucial in such a task.

The original USE IT-model consist of two different dimensions, the domain dimension which is about social aspects in the user domain and the technical aspects in the information technology, and the innovation dimension which has two constructs: the product and the process (of implementation or development).

Figure1. USE-IT model by Shuring et al. (2006) introducing two dimensions the four determinants.

USE IT		Domain	
		User	Information Technology
Innovation	Product	Relevance	Requirements
	Process	Resistance	Resources

These two dimensions make four following determinants: relevance, requirements, resistance and resources. Each of the four dimensions are considered on micro (individual user) - and macro (organizational) - levels. The distinction between the micro- and macro levels is clearer on an updated model. Hypotheses can be formulated from the relations between the USE-IT determinants. Relevance and resources seem to be the most important determinants (Michel-Verkerke, & Spil, 2013). Four determinants of USE IT-adoption model with micro- and macro- levels are presented in appendix 4.

Zhang et al. (2010), address that many applications have failed or haven´t been implemented as predicted. They studied Canadian homecare nurse´s adoption of mobile information. They based their study on technology acceptance model 2 in mobile homecare nursing. Technology acceptance model 2 adds an extension for the original Technological acceptance model (Venkatesh & Davis, 2000). Their study was the first attempt to scientifically investigate user adoption of mobile systems by homecare nursing personnel, through a pertinent information systems research model. They based their study on user factors presented in previous studies. User factors were 1.Subjective norm, 2.Output quality, 3.Perceived usefulness, 4.Image, 5.Job relevance, 6. Result demonstrability, 7.Perceived ease of use and 8.Adoption intention. According to their research, the adoption of new technology is achieved only if the individual if he/she can see usefulness in it. Homecare nurses tend to see the use-

fulness of using mobile ICT, if they think that people important to them in their jobs think that they should use the technology. Also an influential colleague can have big impact on the perception of usefulness of individual. Job relevance, result demonstrability, and output quality were found not to have influence on adoption intention. There can be a bias, as no support for this statement was found from other studies. As a surprise, prior computer skills did not have any influence on the adoption intention either (Zhang, Cocosila & Archer, 2010).

2.6 Benefits of using mobile systems at home care

According Dewsbury (2014), the benefits of using mobile ICT in homecare, are various. Ability to access and update patient data at the point of care was seen as the most important feature. Patient safety was seen to increase as the information is fresher in the memory of the user, in comparison to wait to have access to an administrative base and write in retrospect. Dewsbury also sees the continuity of care as a benefit worth mentioning. With mobile ICT, personnel can also be monitored, so this gives the management of homecare, a tool to provide extra safety for the personnel (Dewsbury, 2014).

Wallis (2012) emphasizes the role of the leadership in her article of the use of E-health in care context. Nurse leaders should be skilled and empowered users of ICT and especially health information. That argumentation is supported also with the research of Zhang et al, addressing the fact that home care personnel tend to see the usefulness of using ICT on their duties if they perceive that people important to them in their jobs think they should use the technology (Zhang, Cocosila & Archer, 2010). Wallis (2011) also points out the managerial aspect. In her survey, nurses' use of E-health tools was studied. The conclusion of this study is as follows: "Nursing leaders need to develop expertise to integrate core informatics competencies in nursing practise to meet demand for the provision of high quality care with restricted resources". She also indicates that nurse leaders are in the focus in encouraging widespread implementation of technology (Wallis, 2012).

In their study, Wäliwaara et al. (2011) brings out the results of previous research which shows that implementation of technology is low and care providers seem to be the biggest barrier. The mentioned reasons of poor implementation were the costs of equipment, the lack of training and increased workload. They also present the possibility that ethical issues can be a significant reason for resistance in implementation of technology. On their research of mobile distance-spanning technology (MDST), a lot of problems arise from the interfaces between the administrative patient database and electronically transferred data. There were also difficulties in 3G- connections. Those problems could decrease the perceived trustworthiness of the system (Wälivaara, Andersson & Axelsson, 2011).

On the research of Johansson et al. (2012), nurses stated that the lack of time was the main reason for not using mobile device more often. One important aspect was that mobile device was not a better alternative, if they already had available tools that fit better to their work habits. On the study, 12 nurses and nursing students out of total 19 agreed that the use of mobile device could save time allowing more time to be spent with the patient. There is a contradiction in time usage that implicates that the biggest problem is in changing the work routine. Most of the participants in the study assumed that mobile device can increase patient safety. On the previous research that the study was based on, had found that nurses found using the technology uncomfortable due their poor technological competence or computer shyness. As a result of this study, it was stated, that end-users´ views in further development of mobile devices and applications must be taken into account in order to have good results in implementation (Johansson, Petersson, Saveman& Nilsson, 2012).

2.7 Security, legal and ethical issues related to mobile systems

Strong authentication- policies on desktops are not always adapted for mobile devices. Indeed, mobile devices require frequent authentication as they often lock themselves automatically when not in use for a short period. Therefore the authentication methods must be free from manipulations. Ehrler et al. indicate another risk in usage of mobile device in handling patient data. The risk of theft is bigger in using mobile

devices, because of the smaller size. Smaller device can also get lost easily, and patient data can be accessible to someone who steals or finds it (Ehrler, Wipfli, Teodoro, Sarrey, Walesa & Lovis, 2013). IT security can also be a heavy investment that nevertheless must be made since this information is protected by law (Crandall, 2014).

In Finnish legislation, patient records are broadly defined. They include technically recorded information or documents created, used or received in terms of carrying out or organising the treatment of a patient (Nevalainen & Puustinen, 2014).

In Finnish legislation, there is an act of Electronic Processing of Patient and Customer Data. There have been recent modifications to the act. New obligations relate to security the data systems, data protection and functionality. According to obligations, the producer of a data system is responsible for classification and necessary instructions subject to implementation, operational use and maintenance of the data system. The producer has to notify the Finnish National Supervisory Authority for Welfare and Health (Valvira) of a data system to be taken into production. Valvira maintains a public register of data systems (Nevalainen & Puustinen, 2014).

All the patient information that nurses produce in the homecare at Nokia goes to the Patient Data Repository, called Kanta. Patient information held in the repository is available to the service provider that entered the information. Disclosure of the information to other healthcare service providers requires consent from the patient. All data transfers between the healthcare system and Patient Data Repository are encrypted. Every access to patient records is entered in a log which permits ex-post control (Nevalainen & Puustinen, 2014).

According to studies mentioned, there are lots of benefits on using mobile solutions at home care, such as increased quality of care, saving time and increasing patient safety. The results of the literature search are parallel to the experiences from the field of home care in the city of Nokia. However, the results of this literature review indicates, that problems of utilization and adoption are very complex and subtle matter. The perceived usefulness seems to be the biggest factor in adoption. As long as nurses have a well-functioning parallel system, such as administrative patient information database, it can be difficult to internalize new work habits. End-user cannot

solve problems related to malfunctions in the system during the home visit. Actions must be taken before nurses can benefit from the mobile applications and devices fully. Presence of the end-user is a necessity that has to be taken into consideration in home care mobile application development process. In order to find reasons for inadequate utilization, evaluating the success and failure factors in adoption and implementation of the mobile system used at Nokia home care, consisting of Lifecare home care application and tablet-device is important.

Factors of technology adoption from the perspective of nurses have not been previously studied at Finnish home care context. To gain insights of how the mobile technology can support nurses on their daily work, it´s important to find out perceptions of home care nurses.

3 RESEARCH DESIGN

3.1 Objectives

The purpose of this study is to evaluate the home care nurses´ adoption process regarding the deployment of a mobile system (Lifecare homecare application and tablet device) and the use of mobile system in home care context in the city of Nokia, Finland. The focus is on the user experiences of home care nurses. The aim is to obtain information in regard with adoption and user experiences on use of the system in order to further intensify the deployment and use of mobile system in home care by offering instructions to the organizations using the system and to the product supplier Tieto Welfare & Healthcare co. The research task is to find out the current state of the adoption process and utilization of home care nurses and to investigate the problems in it to gather information about changes that need to be made so that the system can support nurses on they work routines the best possible way.

3.2 Research question

How could the mobile system, consisting of Lifecare homecare application and Acer Aspire Switch series 10- tablet device, support home care nurses well on their daily work at home care in the city of Nokia?

Sub questions related are:

1. What are home care nurses' perceptions on adoption and use of the home care mobile system?

2. Which factors influence to the adoption and use of the mobile system according the home care nurses at Nokia?

3. What changes, related to usability, should be made to the home care mobile system in order to intensify the adoption and use?

3.3 Methods

The approach of this study is qualitative. The study has characteristics of a case study. In research using case study methodology, the researcher seeks to obtain a thorough knowledge and present a clear picture of an individual, a program, or a situation. With the goal of investigating a contemporary phenomenon within its real-life context, case studies may include observations, interviews, anecdotes, vignettes, direct quotes, audio-visual materials, psychological testing, documents and reports, analysis, and naturalistic summaries. The richness of detail from these multiple sources makes case studies fascinating. In addition, the researcher typically provides key issues to illustrate the complexity of the situation. Often, the researcher ends with lessons learned or implications that might be applicable to similar cases (Range, 2014).

Case study research has advantages and disadvantages. Advantages include being well-suited for the study of certain phenomena. Case studies may also provide engag-

ing demonstrations to support a theory and can inspire new techniques or new applications of existing techniques. Disadvantages include depending on what researchers choose to include, as their choices may be biased. Also, subjectivity makes it easy to see what researcher expects to see and the phenomenon or person chosen for the case may not be representative. Case study research is a qualitative experimental method. The term qualitative refers to the fact that researchers collect data in face-to-face situations by co-operating with selected people in a natural setting such as a work place, a home, or a community (Range, 2014).

3.4 Data collection

Interviewing is a common method used in small-scale research. In semi-structured interview, the interviewer sets up a general structure by deciding in advance the ground to be covered and the main questions to be asked. The detailed structure is left to be sorted out during the interview, and participants have a heavy degree of freedom in what to talk about, how much to tell, and how to express it. Semi-structured interviewing is a very flexible technique for small-scale research. It is not suitable for studies involving large numbers of people, but is helpful in case studies (Drever, 1995). It also seems to provide researchers with more in-depth information, enable to explore more on answers given by the respondents, and gain more insight into mechanisms contributing to answering research questions.

In this study, methods for gathering data are semi-structured interviews based on the USE IT-determinants and contextual inquiries. The themes of the interviews are based on the four determinants of the USE-IT model and it´s dimensions mentioned before, to take it to the deeper level.

As there are only 12 available nurses on the organization, all nurses were asked to participate on the interview (criterion sampling) and 3 of them to contextual inquiry. The participants were approached face-to-face. Sampling for the latter was done by choosing participants from different age-groups and levels of experience using the mobile system and experience of working at home care (maximum variation sampling). All participants agreed to participate.

An existing USE IT-Interview model was used as the basis of the interview and adjusted to fit research questions. Interview guide included each determinant as a theme (relevance, requirements, resistance and resources).

Researcher is the author, one of the public health nurses and BcS. Researcher is female with background experience on conducting two previous qualitative studies during prior education. The researcher has a very close relationship with participants as a colleague and supervisor as an admin- user of the mobile system. Relationship was established prior to study commencement. Participants know the interviewer very well, most of them have working history together with the researcher for more than five years. The personal goal and reasons for doing the research are clear to all participants, as there has been a previous pilot process concerning the mobile system and various problems in adoption and use of the system have occurred during. The topic is closely related to researchers existing description of work tasks. As there was an existing risk of assumptions based on the previous experiences of the mobile system and for preventing bias related, the process was closely monitored by a supervisor from the organization that is not closely related to the topic. Due to the fact that participants must feel free to address also negative thoughts towards the implementation, an external interviewer was used to perform interviews. Interviews took place at home care facilities between 12th of March and 30th March at Nokia.

Contextual inquiries were conducted to identify phases of mobile assisted home visit and to pinpoint problematic situations during the home visit to gain insights mainly to the sub- question 3: What changes, related to usability, should be made to the system in order to intensify the adoption and use?

Holzblatt & Jones (1993) describes contextual inquiry as a technique that gives the user a chance to participate in the design of general purpose systems. It is a technique where the researcher works with users to facilitate in articulating their current work, experiences and practices. It provides insights of the nature of user´s work through inquiry with users.

According to Holzblatt & Jones, contextual inquiry offers advantages over other customer research methods, such as open-ended nature of the interaction making it possible to reveal tacit knowledge about their own work process that users themselves are not consciously aware of. Traditionally, tacit knowledge has been hard for re-

searchers to uncover. Results of contextual inquiries can be analysed by using task analysis.

The information collected by contextual inquiry is highly reliable. Surveys and questionnaires assume the questions they include are relevant. Traditional usability tests assume the tasks the user is asked to perform are significant. Contextual inquiries focus on the work users need to perform, done their way, so it is always relevant. And because it is their own work, the users are more engaged to it than they would be to a sample task.

The information produced by contextual inquiry is also highly detailed. Methods, such as surveys produce high-level information but not the detailed work practice data needed to design products. It can be difficult to get this level of detail any other way (Holzblatt & Jones, 1995).

Three contextual inquiries took place between 4th March and 12th March at home of three home care patients. Three individual nurses were observed and interviewed during home visits to identify phases of mobile assisted home visit process and problems occurring during each phase.

Interviews were audio- recorded and contextual Inquiries visually recorded to collect the data. The duration of the interviews was restricted to 1 hour due to the limited resources of the research. A task analysis was performed to analyse data gathered during contextual inquiries. According to the Usability body of knowledge (2016) The general term Task Analysis can be applied to multiple techniques for identifying and understanding the flow, the structure and the attributes of tasks. Task analysis identifies the actions and cognitive processes required for a user to complete a task or achieve a particular goal. A detailed task analysis can be conducted to understand the current system and the information flows within it. These information flows are important to the maintenance of the existing system and must be incorporated or substituted in any new system. Task analysis makes it possible to allocate and design tasks appropriately within the new system. The functions to be included within the system and the user interface can then be accurately specified.

3.5 Reliability and validity of this methodological approach

In science, reliability means consistency of findings and possibility to replicate the research (Thyer 2010). Thyer refers to Le Compte and Goetz (1982), claiming that reliability of qualitative research has to do with the level of repeatability of the study, based on the data gathered. Reliability and validity of the research being essential to the quality, there are certain issues that need further elaborating. External reliability on this case has an issue. As the researcher is one of the home care nurses of the organization and also a project manager of the previously conducted pilot of the software, there is a risk that it can influence the participants of the study. There are implications that all perceptions of the mobile system are not positive, so there was a risk that participants feel they can´t express all their negative experiences freely. When conducting contextual inquiries, the impact could have been even stronger. The presence of the patient can also influence the answers as nurses are not familiar to express negative thoughts at the point of care. Using an external interviewer, the results might differ from the results gained when project manager is performing the interviews. This problem was discussed further with the participants, emphasising the value of their real inner thoughts and the distinction between roles of a project manager and researcher.

Validity in science, according to Thyer (2010), means accuracy of findings. Reliability is seen as a precondition of validity. It can also be seen as credibility, which includes the idea of truthfulness and researchers´ responsibility to offer evidence that leads to accurate insights of the study.

Internal validity on this case can be compromised as the researcher has a really close relationship with the topic. As the implementation of the system has been a major task and big amount of time has been used to solve problems around the system, there was a possibility that the researcher had assumptions related to the reasoning why the system is not adopted and used to its maximum potential. To avoid this, interview guide was checked by members of the board of ICT-department of the city and members of the digital work environment- group established to intensify the utilization of new technologies in the organization.

According to the manager of elderly services at the city of Nokia, permission from the Medical-ethical committee does not need to be asked, as patients are not observed during the data collection. Research permission from the organization and informed consent were required.

A development manager of the service provider has been informed with intentions to evaluate the software as a part of the mobile system. Reaction from the company has been positive and the development team is looking forward to see the results of this study.

Contextual inquiry was tested to fit into the research design earlier during previous module of EU- Master Care & Technology cohort 15-17.

3.6 Analyzing the data

Qualitative data received from interviews and contextual inquiries was coded and analysed using USE IT- adoption model on micro and macro levels in terms of thematic content analysis and using the USE IT- dimensions as themes. Subthemes formed naturally under micro- and macro-levels of each determinant as interview model was constructed to facilitate that.

Gibbs describes Thematic coding as follows: "Thematic coding is a form of qualitative analysis which involves recording or identifying passages of text or images that are linked by a common theme or idea allowing one to index the text into categories and therefore establish a framework of thematic ideas about it" (Gibbs, 2007).

There is a variety of different approaches to thematic analysis. Each option is still a form of thematic coding. These include: Grounded theory; Interpretative phenomenological analysis; Template analysis and Framework analysis.

The form of thematic coding in this study was a template analysis. The website of university of Huddersfield describes the stages of template analysis as follows: Template analysis involves the development of a coding 'template', which summarizes themes identified by the researcher(s) as important in a data set, and organizes them

in a meaningful and useful manner. Hierarchical coding is emphasized, using broad themes such as 'responses to illness', encompassing successively narrower, more specific ones including 'changed relationships' and 'changed relationships with health professionals'.

Analysis started with some priori themes, which derived from the four determinants of USE IT- model and were expected to be relevant to the analysis. Once priori themes were defined, the first step of the analysis was to begin reading through the data, marking in segments that appeared to tell the researcher something important to the research questions. When segments corresponded to a priori themes, they were coded as such. Otherwise, new themes were defined to include the relevant material and organized into a template, which was undertaken after initial coding of a sub-set of the data. This template was then applied to the whole data set and modified in the light of careful consideration of each transcript. Once a final version was defined and all transcripts were been coded to it, the template was used as the basis for the interpretation of the data set and the writing up of findings. This approach was chosen based on the fact that it is suitable to analyze data from semi-structured interviews and it most familiar for the researcher. Ti also has long history in health research and social sciences.

The amount of data coders to code the data was based on the USE IT- adoption model determinants on micro- and macro level. All data was coded based on dimensions of each determinant on both micro- and macro levels (see appendix 4). The main themes were identified as four determinants mentioned before. Additionally, primary process was identified as one of the main themes. No software was used to manage the data. Participants were given a change to provide feedback on the findings. Participant quotations were presented to illustrate the findings. Each quotation was identified. Major themes were presented in the findings as well as a discussion of minor themes on reporting the study.

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist by Tong et al. (2006) was used to report all information on method section.

4 RESULTS

All respondents of this research are female home care nurses. Age of the respondents varied between 28 and 63 years and their experience of home care from one year to 26 years. Information of their age and experience in working at home care and using home care mobile system are presented in figure 1.

Figure 1, Respondents

Respondent	Age	Years of experience at home care	Experience in using mobile solution
1.	36	2	1,5 years
2.	63	18	1,5 years
3.	59	23	1,5 years
4.	39	1	3 months
5.	61	22	6 months
6.	42	14	1,5 years
7.	55	2	1,5 years
8.	28	5	1,5 years
9.	33	12	6 months
10.	60	17	1 year
11.	45	15	1,5 years
12.	51	21	1,5 years

Results of this study are presented according to themes and subthemes described in USE IT- adoption model. First, primary processes of home care nurses are widely described based on the answers of the respondents to gain insights on the context of home care nursing at the organization. Then some primary processes- related subthemes are introduced, such as mobile assisted home visit process and it´s phases. Four main themes (Requirements, Relevance, Resources and Resistance) are discussed on micro- and macro- levels. Sub themes derived from the content analysis are divided under respective main theme and (see figure 1). Definitions of each subtheme are derived from USE IT-adoption model and are presented in italics in the beginning of a respective chapter.

Figure 2, Themes and sub- themes of the analysing process

Primary process

- Inter- professional/ inter- organizational communication
- Accessibility of other caregivers
- Mobile assisted home visit

Requirements

- Macro- requirements
  - Exceptions or disturbances in coordination of care
    - ICT- based, human- related and patient-related
- Micro- requirements
  - Development ideas
    - Application, Integration, Device

Relevance

- Macro- relevance
  - Economic improvements
  - Social/environmental improvements
  - Functional improvements
  - Saving of time and effort
- Micro- relevance
  - Perceived usefulness
  - Here and now value

Resources

- Material resources
  - Hardware and software
- Immaterial resources
  - Time resources
  - Personal capabilities

Resistance

- Macro- resistance
  - Lack of support
- Micro- resistance
  - Parochial self-interest
  - Lack of trust
  - Low tolerance of change
- Use of tablet device at home visits

4.1 Primary process

All participating nurses were home care professionals from the organization of elderly care in the City of Nokia. 11 out of 12 worked as home care team nurses which means that they each have their respective team of practical nurses to be responsible of. One of the participants was an extra nurse who substitutes when one or more of the nurses are off duty. When asked about their primary work all of them mentioned home care nursing and responsibilities as being a leader of the team and responsible of the care of all patients of the team. In addition, most of them mentioned various sporadic tasks that a home care nurse performs when taking care of their patients, such as health promotion, assessment of patient performance, blood samples, ulcer treatment and medical treatment. Home visits seem to be the main focus of work activities of home care nurses. They described their work to be traditional, basic nursing, even when 10 out of 12 nurses use more than half of their work hours doing indirect care, as an advisor of practical nurses or updating care plans. Nurses expressed their work to be challenging, diverse and with good quality.

All of the nurses have individual responsibilities, such as hearing aid- policlinics, educational- and training responsibilities and variable amount of paper work that can take up to 80% of their working hours, leading to a situation where they spend less and less time at home visits.

4.1.1 Inter- professional/ inter- organizational communication

Work of a home care nurse at the City of Nokia requires extensive amount of collaboration with other organizations and operators that are simultaneously responsible of the care of patients, such as hospitals, policlinics of special heath care and third sector operators. Nurses also work in close collaboration with family members and other caregivers. Other home care professionals, such as social workers, doctors and supervisors create a complex and diverse net of multidisciplinary context where nurses

are in a key role to ensure the continuity of care. That was seen as a major challenge as all collaboration is not always proficient.

Nurses have varying experiences of the collaboration with other organizations or actors. The quality of collaboration was seen both negative and positive. It was mentioned that collaboration inside organization is better than with other organizations. Diverse patient information databases were seen as one of the biggest problems in collaboration. The need for more collaboration with municipality- based actors, family members and others, such as special health care clinics and third sector was seen clearly. Face to face meetings were suggested by one of the nurses to fix the gap, but it was clearly addressed that there is no time to have meetings. One of the nurses formulated this thought as follows:

"This is now just an idea but I think that others can also relate to this. I think the only way to solve this problem is to sit down and talk to each other. Saying that, I also know that organizing meetings with family members is nearly impossible during working hours as family members work as well and it´s nearly impossible to attract other professionals to the home visits. They´re not used to work at home environments. That means we need efficient mobile solutions to maintain discussion…" (Respondent 3)

Nurses feel that communication, continuity of care, accessibility of operators and confidentiality are the most important things in contact with other organizations or actors. Half of the nurses mentioned, that gaining information from other care facilities is difficult and slow. Diverse information systems mentioned before were seen as a hindering factor in continuity of care. Inside organization, delayed patient data input was also seen as a problem in situations when home care nurse sends patient to hospital but is not able to write documentary about the case prior hospitalization.
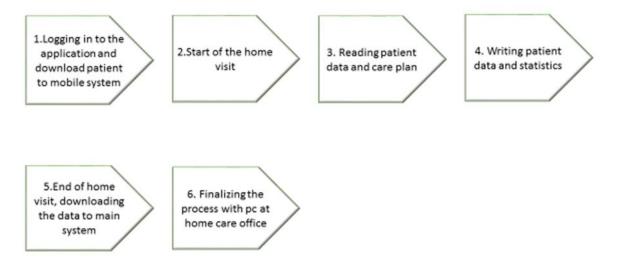
4.1.2 Accessibility of other caregivers

Accessibility of other caregivers was seen as an important matter. Three nurses emphasized the importance of instant access to doctors or policlinics via telephone and

criticized low accessibility at the moment. As there are no shared information systems, direct phone calls become into very high importance.

4.1.3 Mobile assisted home visit process

8 out of 12 nurses have used the system since it was first deployed on the organization. Four of the nurses have used it since they started to work at home care 3-6 months ago. When asked about mobile assisted home visit process, all 12 nurses were able to identify most of the phases of the process as they are presented on figure 3.

Figure 3, Phases of mobile assisted home visit

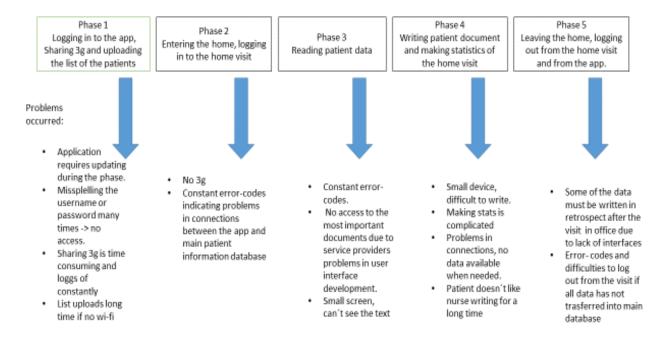The process starts when nurse logs in to the tablet and application. On some cases, the visit can be visible on the system if the information of it has been delivered from home care ERP-system (Enterprise Resource Planning, LapsCare3). That can be the case if nurse has informed the system operators prior to the visit. If not, the information has to be downloaded manually. When nurse enters the home location, she

starts the visit and clock starts to measure time. During the home visit, nurse reads care plan to see the tasks that have to be performed during the visit. Nurse can also read patient data, such as medication information or, for example, details of previous visits to the hospital or doctor. After all tasks are performed, nurse produces data including statistics of the visit and tasks and measurements done during the visit. During the end of the visit, nurse stops the time verification and application then sends the information to the main patient information database Effica. After all home visits of the day, she returns to the home care office and finalizes the process by adding all data that is not possible to insert to the application, such as blood pressure- and INR measurements. (International Normalized Ratio, related to anticoagulant-treatment)

Contextual inquiries showed that majority of nurses use the system, at least on some tasks of the home visit. Nurses appreciate features that are functional and see the benefits of real time documenting, possibility to read patient data and makes statistics at home environment. Nurses are familiar to use fully functional main database so similar functionalities are expected from the mobile system.

However, some phase sensitive- issues were addressed on the process as shown on figure 4. Some of the issues were visually visible on the recorded data and some issues were reported by the participant during the inquiry.

Figure 4, problems occurred are shown phase by phase (task analysis)

Phase 1
Logging in to the app,
Sharing 3g and uploading
the list of the patients

Phase 2
Entering the home, logging
in to the home visit

Phase 3
Reading patient data

Phase 4
Writing patient document
and making statistics of
the home visit

Phase 5
Leaving the home, logging
out from the home visit
and from the app.

Problems
occurred:

- Application
  requires updating
  during the phase.
- Missplelling the
  username or
  password many
  times -> no
  access.
- Sharing 3g is time
  consuming and
  loggs of
  constantly
- List uploads long
  time if no wi-fi

- No 3g
- Constant error-codes
  indicating problems
  in connections
  between the app and
  main patient
  information database

- Constant error-
  codes.
- No access to the
  most important
  documents due to
  service providers
  problems in user
  interface
  development.
- Small screen,
  can't see the text

- Small device,
  difficult to write.
- Making stats is
  complicated
- Problems in
  connections, no
  data available
  when needed.
- Patient doesn't like
  nurse writing for a
  long time

- Some of the data
  must be written in
  retrospect after the
  visit in office due
  to lack of interfaces
- Error-codes and
  difficulties to log
  out from the visit if
  all data has not
  trasferred into main
  database

During the contextual inquiry, one out of three participants was not able to finalize mobile- related tasks during the home visit.

- Phase 1, logging in to the application, sharing 3g and uploading the list of pa-tients

At the beginning of home visit, nurse started the application and immediately the application informed her of a necessary update. Nurse agreed to proceed and update started. It took a long time and after the update, some parts of the user interface were not functional. She was able to read care plan and other patient data but other tasks were not successful after the update. Other nurse had issues with 3g connection of the device. She was not able to use device´s SIM- card so she had to share connec-tion from her smart phone. That was perceived time- consuming. Downloading pa-tient lists to the system can sometimes last very long time and two of the nurses in-formed that they usually stop using the system for the day, if that happens.

- Phase 2, entering the home and logging into the home visit

All nurses were able to do the tasks required using mobile system. However, they indicated that occasionally they had experienced problems including error-codes that

they did not understand as they were presented in English. Some issues were solved by time and sometimes they had to contact technical support to solve the problem and proceed.

- Phase 3, reading patient data

Two out of three participants experienced that they have no access to all data they would have needed at home visit due to service provider´s inability to provide all documents visible to the system. One of the nurses felt that she does not see all the text, as the font size is too small and not adjustable. However, they all agreed that they were able to access most of the information they needed and were able to take care of the patient without compromising patient safety.

- Phase 4, writing patient documentation and making statistics

Writing the patient data was seen somewhat difficult due to the size of the device. One of the nurses said, that she always writes all possible patient data at home. Two indicated that they usually start at home and continue at office. One was afraid that patients do not like her to write for a long time at home. Occasionally the documentary had been written to wrong section of the system and been fixed later on pc, at office.

- Phase 5, leaving home, logging out from the home visit and from the system

Nurses had experienced the majority of the problems at phase 5. When all the data is in the system, it is supposed to be delivered to the main patient information database, and many times there are problems in the transporting the data. That issue was visible at one contextual inquiry. Nurse explained that when problems exist during the last phase, all information produced gets lost and all work goes to waste. Sometimes the data can be restored but usually that is too late and nurse has already done the documentation twice by the time.

- Phase 6, documenting the remaining information at office with personal computer

Even when everything goes by the plan, there is information that cannot be delivered using the system and has to be inserted to the main database later on. Examples of that information are listed on development ideas of the system. Phase 6 was not observed at contextual inquiry due to the structure of the daily routines and it being out from the scope of mobile assisted home visit. Some comments about forgetting to continue the documentation afterwards were presented during contextual inquiries.

Since the beginning of mobile system usage at home care, some nurses reported that they have had more mistakes on organizing next appointments and producing the rest of the patient data as they have already done part of the documentation at home. Some information has to be hand written using pen and paper. That was seen as unnecessary double documentation. If it is not done, some information can be forgotten.

4.2 USE IT- Determinant: Requirements (of the mobile system)

"The degree to which the user needs are satisfied with the product quality of the innovation"

4.2.1 Macro-requirements/Exceptions and disturbances in coordination of care

"Strategic general requirements and tactical approach is the degree in which the users agree with the objectives and methods used"

When asked about what exceptions or disturbances make care or the coordination of care that nurses provide fail, the answers were divided into three categories: ICT-based, human- related and patient-related. The biggest disturbance was clearly failing of ICT-systems, particularly home care application or the device. 11 nurses indicated that no work is possible during the system error situations. If home care application does not work, nurses have no idea where to go or what to do. Usually during system failure of the home care application, the main system is still working and the information can be gathered from the main database. These situations are mentioned to have decreased trustworthiness of the system and some of the nurses do not feel comfortable to go to home visits relying only to the application.

 Two nurses mentioned that mobile system failure extends the timeframe from home visit to documentation and leads to missing details if they have not taken notes from the home visit. During broader errors, all connections can be down and there is no access to any data. That can paralyze the whole organisation and, according to one nurse, lead to decreased patient safety.

Human-related disturbances mentioned were situations when one or more of the nurses are unexpectedly out of work and workload has to be distributed again during the day. That prevents the work routines to be performed as planned. Continuous interruptions by phone during home visits were seen as a major disturbance. However, nurses are used to that and one of them mentioned that actually there is no day that goes by the plan and nurses must learn to live with that. Patient- related disturbances addressed were situations when home visit cannot take place if patient is not at home.

The knowledge of the reasons, why the organization had decided to implement a mobile system varied among the participants. 10 nurses were not sure of the reasons and multiple explanations were addressed. Increased and transparent direct patient time, use of documentation at home, real time documentation, organizing work and patient involvement were mentioned. Two participants mentioned that they had been forced to use the system and no questions about their willingness were asked.

Half of the nurses perceived development of mobile system very important with regard to developing the chain of care. Two nurses mentioned ICT-development in general to be the main focus in development. Two out of 12 addressed that primary care and special health care should have integrated information systems in order to maintain patient safety. Lack of information in general seemed to be an issue that nurses wanted to change. Two out of 12 did not see any relevance in mobile or ICT development concerning the chain of care.

ICT overall was seen at very important role on daily work of all 12 participants. Only one saw it as inevitable nuisance. Some nurses described it to facilitate their work and three out of 12 indicated that they are totally dependent on ICT.

When asked, if there was any end-user involvement during the development process of the system, majority of responders mentioned that they had been a part of a pilot study of home care application. However five of them did not see their role very significant in the process. Three of them felt that they had nothing to say to the development process. Four nurses were not present during development phase. Those who participated described their contribution being mainly reporting of problems and development ideas related to user interface or content of the application.

4.2.2 Micro-requirements/Development ideas

"Functional and performance requirements specify what the content of the innovation should be."

Present version of the application gives nurses possibility to have mobile access to patient information, such as contact- information and patient information. It enables real time documentation and offers a calendar view on patients of the day. It also gives mobile access to tasks to be performed at home visits and message-function to pass information from the home visit to a caregiver that enters the location next. One nurse described function as follows: *"For example, if I do the laundry and leave washing machine on at morning, it´s easy to leave a message to the app and someone coming later can take care of it later."* (Respondent 2) Nurses see added value particularly on functionalities that facilitate continuity of care or sharing information.

When nurses were asked about development ideas regarding of the present version of mobile system, the ideas were easily divided into application based, integration-based and device-based, where device- based were seen the most important ones (See figure 5). Application-based ideas were also mentioned by most of the nurses. Only one of the nurses felt that 3g- connections needed improvement.

Figure 5, the most important development ideas mentioned by participants.

(Device: Acer Aspire switch weight 1.15 kg)

Development ideas	Amount of answers
Lighter device*	6
Possibility to insert more patient data	5
Technical reliability	5
Possibility to organize follow up activities	4
Integration with mobile phone	2
Possibility to read more patient data	2
Proper screen and keyboard*	1
Medication information demonstrated more clearly	1

The most important device-based development idea was to select lighter device. At the moment all nurses use tablet device Acer Aspire switch weighing 1.15 kg with keyboard. It also has touch screen and possibility to remove keyboard when the weight goes down to 0,63kg. Most of the participants mentioned the weight of device to be a hindering factor on using the system. The most important application-based development idea was to create more interphases between the app and the main database. Nurses want to be able to insert all patient data gathered at home visits using the application so that they don't have to supplement their documentation later to the main system with pc. During the study, Lifecare home care application version 2.5.0.0 was used.

EHR (Electronic Health Record) - based information was mentioned as the most important information about the patient by every participant, when asked about the information that nurses need when they provide care. Access to EHR from the home location by mobile system was seen critically important but somewhat inadequate at the moment. Some of the information, such as recent visits to hospitals, doctor appointments, medical charts and laboratory results are available and used widely but there is some critical information that is not available via mobile system, such as blood pressure measurements, laboratory orders and INR-charts. That leads to the situation, where nurses need to familiarize themselves with patient information prior to home visit and carry paper notes when going to home visits. That was seen, by some of the nurses, as major disturbance as it forces them to open main patient information database for gaining information before home visits.

Limited time frame of available medical history in mobile system was mentioned to be one of the most problematic issues. Mobile system enables access only to information not older than three months. If patient has not seen a doctor or been hospitalized in 3 months, no information was available.

Care-and service plans are other essential form of information that nurses cannot perform without. Those are available via mobile solution but are not always up-to-date and therefore cannot be trusted at all times. Nurses mentioned that they also need basic information about the patient, such as address, telephone number or contact information of family members. Access to that information is usually possible via mobile system.

There were four ways for nurses to get access to information that they need: from main patient information database Effica with pc at office, via mobile system at

home visit, by reading notes or care plan at home and by asking patient or other care giver. All nurses used main database daily. Nurses describe some of the patient information to be easy to access from home location, but most of the home visits also require information that has to be retrieved from main database beforehand. Reasons for not being able to get access to critical data are mostly application-based.

Also connection-based problems exist. On remote locations, 3g is not always functional and if nurse has not downloaded patient data to mobile system on range of 3g mobile network, it can be impossible to get the information on some cases. Lack of information can also derive from access rights. One of the nurses mentioned, that information from social services and mental healthcare are not accessible to home care nurses even from the main patient information database. Half of the nurses are satisfied with the overall accessibility to the patient data, but only three out of 12 feel they can perform home visit with information that mobile system provides.

All nurses produce patient data from home visits. It can be separated into statistics and narrative text. Narrative text is structured with FinCC and phrases are widely used. Nurses mainly produce narrative data of care procedures, care planning and assessing functionality of the patient. Statistics consists of time used at home visit, ICPC2-codes and SPAT-codes. 10 out of 12 nurses use mobile system at home visits, but only three of them at every visit.

Perceptions of the quality of mobile system vary amongst home care nurses. All nurses mentioned lack of functionalities or somewhat low trustworthiness to be the biggest issue to decrease the quality. Some nurses mentioned, that they were not able to identify the reasons for malfunctioning. Some nurses identify that mobile system is fine when it works. It has benefits such as fluency of work routines and increased patient safety due to the easy access to real time patient data. However, repetitive malfunction has led to the situations when nurses do not even take the device with them to home visits. Most of these situations are related to service provider´s server issues or maintenance breaks.

10 nurses out of 12 found positive qualities from the system and 11 nurses had development ideas. Positive qualities were described vague, for example, as follows:

"Well, I like it mostly. I would not go back to using only PC. I like that I can write and read data and I can share information in real time." (Respondent 2) Or: *"It is new technology and it is here to stay, I don´t want to stand in the way of development. "*(Respondent 11)

Operating with two or more information systems was seen as a big hindering factor on full utilization of the system. Double documenting and unpredictable behaviour of the system was mentioned as well. Nurses, who were able to separate application-based problems from device-based, indicated that the device and operating system itself caused majority of the problems in terms of missed updates, overheating of the device and other errors that have occurred, such as breakdown of a battery or dys-function of a touch screen. Sometimes the system does not accept password, or ac-cepts at third attempt. Timeouts of the operating system and the application leads to several pass word enters per day, as nurses can have as many as eight home visits daily.

 All of these problems are insolvable during the home visit and leads to not using the system on that visit or that day. If support is not available, the device can stay unused for many days. One of the nurses told, that she no longer carries the device with her, as addressed issues have not been solved. With a huge amount of work duties, she wants to work efficiently, and mobile system does not facilitate that. *"If it does not work, it goes back to my bag for the rest of the day. I don´t care why it does not work…"* (Respondent 4)

4.3 USE IT-Determinant: Relevance

4.3.1 Macro-relevance

"The degree, to which, the user expects that the IT- system will solve his problems or help to realize his actually relevant goals."

- Economic improvements

Nurses did not see that mobile system could facilitate any economic improvements at this stage of maturity. Some nurses knew that one reason for implementation was related to economic value by optimizing workflow.

- Social/environmental improvements

Peaceful and quite environment for documentation was seen important. That re-quirement hardly can be met as there are disturbances both at home environment and at the office. Some nurses emphasized patient experience to be the important factor

on their work and two of them did not see possibility for real-time documentation at home to enhance patient experience. The biggest quality related feature was possibility for real-time documentation, which was seen to improve continuity of care. Mobile system development was also seen to facilitate customer oriented approach as the patient is present during the whole documentation process. On acute situations, mobile is seen to enable perform home visit without any prior familiarization to patient information. Only two out of 12 feel that quality of care cannot be increased by developing mobile system. One of the nurses formulated her thoughts as *"Mobile system does not take care of the patient"* (Respondent 12) and *"Nurses must be able to maintain good quality of care regardless of mobile system".* (Respondent 6) Being dependent on mobile system was not seen as desirable state by one nurse.

- Functional improvements

Three participants mentioned functional information systems to be the most important thing to develop and emphasized the role of those tools as facilitators towards better care. Mobile system itself improves functions related to real-time documenting.

- Saving of time and effort

Most of the nurses mentioned planning of work activities and time handling to be the most important factor related to their work.

4.3.2 Micro-relevance

"The degree, to which, IT-use helps to solve the here-and-now problem of the user in his working process."

- Perceived usefulness

Five nurses addressed lack of perceived usefulness when using the system. Some preferred using mobile application rather via mobile phone than tablet device. That preference was argued with the fact that tablet- device does not give any extra value to the process. Use of tablet would be justified if there were additional features facilitating documentation or receiving patient information.

- Here and now value

Reduction of required time to do documenting was seen as an improvement to previous situation when documenting was done after home visits. Planning of work activities is closely related to gathering patient information. Some nurses felt that it can now be done at home visit, but most still maintained the habit of checking details from main database beforehand. One nurse mentioned documenting with mobile system at home to be less complicated and fluent compared to documenting with personal computer at office, after home visit.

Nurses mentioned that organization has not had enough doctor resources lately, and collaboration with them has been insufficient. Some nurses indicated that there is not enough time for practical nurses to perform all tasks mentioned at care plan during home visits. Working with inadequate time-resources causes insufficient communication within the team and as the turnover rate is high among the personnel, nurses feel it is not guaranteed that all instructions of care are followed accurately. That puts accurate care plans at mobile system into a critical position.

4.4 USE IT-Determinant: Resources

"The degree to which material and immaterial goods are available to design, operate and maintain the system."

4.4.1 Material resources

- Hardware and software

All home care nurses are equipped with mobile phone, tablet device and personal computer or laptop. They use Lifecare home care application, patient information database Effica and other applications such as raisoft.net for patient assessment and e-mail, laboratory software Web-lab and Sphinx for searching information about

medication. They also use multiple portable medical devices which they consider as ICT.

When asked about the quality of technical support of systems, two participants were not sure how technical support works and where to call if they have problems. Majority of participants were aware of technical support and perceived it to be accessible but somewhat slow. Some nurses felt that support is not adequate as all development ideas given have not been elaborated further. Physical presence of technical support was seen very important and recent shortage of support has had negative impact on work flow. Patient safety was seen decreased due to lack of technical support.

Specified support for home care devices and applications was however seen professional and of good quality when present. Training and processing of development ideas was perceived somewhat adequate and some nurses mentioned they could have been more active themselves on pursuing help when needed. Familiarization of the mobile system was mostly comprehensive according to majority of nurses. Changes in system and new updates require personal training sessions, which majority felt that they have had access to. Nurses have send print screens of errors to home care system specialist and they have been forwarded to ticketing system of product supplier, if they have not been solvable by system specialist at home care.

4.4.2 Immaterial resources

- Time resources

Two of the nurses felt, that there is no possibility to allocate time to adopt new solutions. They indicated that if employer could invest more time resources to training and learning new work routines, adoption could be smoother.

- Personal capabilities

Distractions or surprising events at home visit can cause some misuse of the system. Nurse can forget to log in or out from home visit or forget to bring the device with her. Two nurses also mentioned that there are some motivational issues and their own attitude is to blame for not using the system. Personal features, such as poor eyesight combined to small screen size, were mentioned by one of the nurses.

4.5 USE IT-determinant: Resistance

4.5.1 Macro-resistance

"The degree, to which, the surroundings and locality negatively influence the users of IT."

- Lack of support

Majority of the participants had perceived colleagues and supervisors supportive and encouraging them to use the system. However, some indicated that they had been pressured rather than supported. That statement was mainly argued with the fact, that there was no choice to decide whether to use the system or not.

4.5.2 Micro-resistance

"The degree, to which, IT-users themselves are opposing or postponing the IT-change."

- Parochial self-interest

Two nurses addressed that they are not particularly interested on using ICT. Only five participants perceive mobile system development to be crucial in increasing the quality of care. Other five does not see it essential but somewhat important. Some participants had almost identical answers on the question on not using the system. It can indicate that respondents have discussed or even infected each other with some negative thoughts of the system. The myth of patients not tolerating the use of the system at home seemed to derive more from nurses´ own experiences than real life. When nurses were asked about which work routines they would miss the most, if removed from their job description, contact with the patient, home visits, traditional nursing, and contact with colleagues and family members of the patient were mentioned. There have been multiple changes on work routines of home care nurses lately and half of participants mentioned, that some of their favourite tasks have already been removed from them to other professionals. There was also a concern that in-

creased use of technology could lead to decreased direct or face to face-contact with patients, colleagues or family members.

- Lack of trust

One of the nurses declared her no- use as follows: *"There is no point of carrying the device around the city, as you never can be sure, whether it works or not. If there is no system failure, you find your battery empty or your text to be vanished at some point of the day anyway."* (Respondent 4) Some nurses think that using the system is so slow that it does not give any added value in terms of facilitating the home visit process or saving time as they still need to use the main patient information database Effica daily to complete the documentation process.

- Low tolerance of change

Two nurses clearly indicated that reasons for poor adoption are mainly on their own attitudes. They do not like to use new technology or fear that patients do not accept the use at home visit. Most of them wanted to be clear that they are not against change in particular, but changes must facilitate processes and be rewarding in terms of usefulness in order to be successful.

4.5.3 Use of tablet device at home visits

Not all home care nurses use tablet device at home visits as figure 6 shows. Reasons for not to use, can be divided into three categories: device based issues, application usability issues and human related issues (patient or employee).
Device based reasons mentioned were the heavy weight of the device or other difficulties to carry it around and problems on starting the tablet or logging in. Low duration of battery had also disturbed the use. Application based issue mentioned was a system failure and human related reasons e.g. impression that patient does not approve tablet use, or has cognitive impairment so that she or he does not understand why nurse is using tablet during home visit.
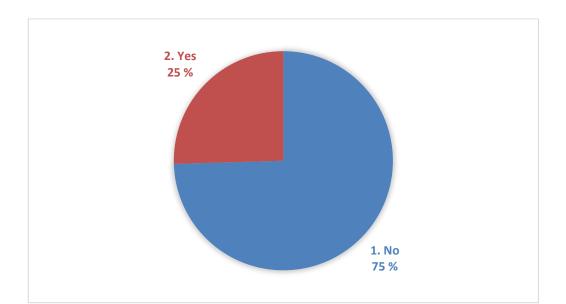
Figure 6, use of tablet device on every home visit

Two nurses were particularly worried that using tablet at home visit can harm the contact between nurses and patients. They perceived device usage to be disrespectful to patients and also shared their own negative experiences on doctor visits where they had felt that the doctor is not paying attention to them but the computer.

The amount of time and energy that nurses are willing to invest in familiarization of new information systems vary. Majority of nurses addressed that employer should take better care of time resources, when implementing new systems. Also training and education should be organized better. Two nurses particularly mentioned not to be very interested in ICT in general and not willing to invest time or energy in something they do not fully understand or experience meaningful or reasonable. Changing work routines is a very slow process and requires great amount of time and energy according to some participants.

There are some other current ICT-development projects on the organization. Three of the nurses are very aware of those and relate to them mainly positively. One of the nurses addressed that mobile system development is more important than other ICT-development and would prefer that most resources would be directed towards it instead of other ICT-development.

5 CONCLUSION AND DISCUSSION

5.1 Conclusions

Home care nurses´ perceptions on adoption and use of the mobile system are diverse. All12 nurses have used the system and see the benefits, such as increased patient safety due to real time documentation and possibility to read patient data during home visit. However, the research findings show that adoption is not complete and majority of nurses only use some features of the system or use it only complementing the use of the main patient database. Nurses would prefer a system that enables communication also outside their own organization and are frustrated to poor state of sharing information due to various patient information databases used regionally. The mobile assisted home visit – process proceeds through all phases on only four cases out of 12. Michel-Verkerke & Spil (2013) consider information system to be successful if the user is using it and is satisfied with it. Considering that, the adoption of the system can be seen successful on only 25% of the cases of this study. However, full satisfaction is not fulfilled even on those four cases. It indicates that in order to intensify the use of a mobile system, multiple improvements to the system are required.

The mobile system can support home care nurses better on their daily work if following preconditions are elaborated further:

- Home care mobile system reaches higher level of maturity by the means of requirement analysis (Figure 7). That includes functions and features related to device selection, application development and integration development between the system and other patient information systems. It also requires close collaboration between service provider and home care organization.
- Recommendations for the organization and nurses are implemented in the organization (Figure 8)

Results indicate that main factors influencing to the adoption and use of the mobile system are perceived usefulness, weight of the device and reliability of the system at daily use.

5.1.1 Perceived usefulness

Those nurses, who do not use the system daily, indicated that they do not perceive the system useful. According to Michel-Verkerke & Spil, relevance is found to be the most important factor in adoption of an ICT-system in healthcare. Results of this study seem to verify this statement. As nurses cannot perform the whole home visit-related documentation with mobile system, they still are depending on the main database. As they are still forced to use the main system, saving time or other benefits that the system could produce, are not gained. As long as the system provider is unable to meet those needs in terms of product development, the system is not perceived useful therefore not used fully.

5.1.2 Other influencing factors

Other influencing factor seems to be the weight of the device, as half of the participants addressed that lighter device was the main development idea for the system and heavy weight as one reason for them not to use the system.

Third influencing factor can be identified from the results as well. It is the reliability of the system. Nurses, who are not using the system regularly, mentioned that they did not trust the system fully. There had been too many situations when they were not able to use the information they needed or were not able to produce patient documentation during the home visit due to a malfunction of the system. Sometimes they had been without any information, not even knowing which patient or address they were supposed to go to.

5.1.3 Recommendations for service provider and organizations

Required changes related to usability of the system can be addressed through development ideas.. As mentioned before, the weight of the device is something that can

easily be considered when constructing a mobile system for home care. All the data that nurses need should be accessible on the application. This data consists of chart-formed documents such as INR- , blood pressure- and blood sugar charts that are not accessible via the application at the moment. Nurses also need more visibility to older patient data and full access to restore all data that they produce during home visit. In addition, ability to schedule new appointment, organize laboratory tests and update care plans at home are crucial tasks that cannot be performed via application on current version. Developing such functions to the system by means of integrations between main patient database and mobile application would facilitate mobile assisted home visit to the level that no documentation after home visit is necessary.

The service provider Tieto Co. has been contacted and development manager of the application will be provided with requirement analysis based on the development ideas gathered during interviews. Even though service provider is only responsible for the application at the moment, it can also benefit from experiences related to device used, methods of training and perceptions related to implementation process. In the future, service provider could be interested in redesigning their home care mobile services. The whole system including the application, device, training and change management support for management could be operated as one embedded service.

Figure 7, requirement analysis (* Device: Acer Aspire switch, series 10)

	Development idea				
1. Device selection	Lighter device*	Undisputed function	Proper screen and keyboard	Smaller device*	
2. Application development	Save-button to confirm that information is not lost	Possibility to rearrange headlines when writing patient data	Medication information should be demonstrated more clearly	Possibility to make laboratory orders	More preset phrases to facilitate writing patient data
3. Integration development mobile + main EHR	Faster real time synchronization between main database and mobile system, also other patient information systems.	Possibility to schedule appointments and organize laboratory tests	Possibility to insert and read all critical (also older) patient data	Less maintenance breaks	No new functions before existing ones are working

Some nurses addressed that lack of training and technical support can affect the adoption and use. These issues must be solved by enabling resources to education and maintenance of the system. Nurses seem to value support that is accessible and easy to contact. Unfortunately technical support is limited to service desk at the moment and it usually cannot solve user problems immediately when they exist. So if nurses have problems with the system at home visit, it usually means no use for that day. Nurses need more training on using the mobile system and could benefit from technical support while on home visit. Regular training sessions could offer hands-on training with admin user or trainer from service producer.

During the implementation, some nurses felt that they have been pressured to use the system. They indicated that they had nothing to say when choosing the system. Reasons of implementation were not introduced to nurses. These facts are self- evident to decrease motivation to adopt. In order to internalize new work routines, it is crucial to share information about the reasons of implementation. That requires high level of change management skills from home care management.

Figure 8, recommendations for organization and nurses

Training should be provided to nurses regularly. Non-stop workshops and troubleshooting with admin- user or trainer is recommended.

Technical support for using the system must be real-time and could be provided to nurses via chat- function.

New nurses could benefit from hands- in support at home visit for using the system.

Resources for training and technical support must be secured.

On acquisition of devices, weight of the device must be considered carefully.

Change management support for managers should be provided to organization during implementation.
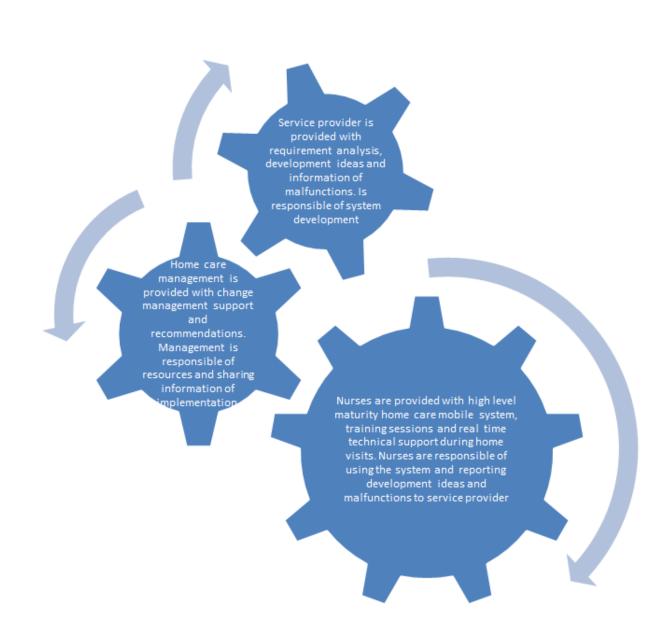
Recommendations for organization and requirement analysis can be used together to create a mobile system implementation plan for the organization. On figure 9, responsibilities and efforts of each stakeholder are presented. This can be seen as an iterative process, as user requirements can change on the turbulent context of home care. System development is fast and service redesigning inquires user- involvement to be successful. This implementation plan is based on the results of this study and authors own experiences as admin- user and trainer of the system during the pilot and use of the system after deployment.

Steps towards successful implementation can be described as follows:

1. Service producer is provided with requirement analysis.
2. Service producer develops a new version of the application based on the analysis.

3. Service producer redesigns mobile system service by embedding device support MDM (Mobile Device Management), training, device acquisition and change management support for home care management as one service.
4. Home care management allocates time- and financial resources to training and technical support of the system.
5. Nurses are provided with mobile system of high maturity- level. Nurses provide service provider with requirement analysis when new requirements appear.

Figure 9, Implementation plan

5.1.4 Reliability and validity

In the beginning of the study external reliability was expected to have issues. As the researcher is one of the homecare nurses of the organization and also a project manager of the previously conducted pilot, there was a risk that it influences the participants. It was clearly seen that all perceptions of the mobile system were not positive. The decision to use external research assistant to perform interviews was justified, as participants expressed also their negative experiences widely. It also had a negative aspect. During transcription of the data, it was clear that some respondents could have given more information if there had been more elaboration on questions from the side of the interviewer. During the analysing process, it became clear that positive aspects of the mobile system were overshadowed by negative aspects. That could have been prevented by rephrasing some questions on the interview guide. However, that phenomenon clearly indicates the negative attitudes towards the system at this level of maturity.

This research can be seen as a successful attempt to gain insights on adoption and use of a mobile home care system as all 12 home care nurses participated and shared their experiences. USE IT- interview guide was a helpful base on development of interview questions. USE IT-adoption model was relevant, yet complex, theoretical frame for the research and guided the whole process safely to the end. However, it probably suits better for big scale quantitative research, as it has interesting hypotheses that could not be tested during this research due to its qualitative nature. For further research, it would be interesting to find out how other home care organizations have perceived adoption and use of mobile systems and how the situation changes when the system obtains more mature state.

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Appendix I

The USE IT – interview protocol, altered

Only the main questions are listed. Additional questions to further explore given answers are not listed.

	Primary process
1.	What care do you provide? How do you act at your tasks? How long have you used mobile system (Tablet-device + mobile application Lifecare homecare)?
2.	What other tasks do you have apart from providing care? How much time or energy do these tasks take from you?
3.	What exceptions or disturbances make that this kind of care or the coordination of this care fails?
7.	What other care providers or institutions are simultaneously involved with the care for your patients?
8.	How do you experience the cooperation with other care providers in respect to the providing of the care?
9.	With what care providers should you cooperate (more)?
10.	What do you find important in the contact with other care providers?
	Requirements
11.	What information about the patient do you need to perform your job properly? How do you receive the information you need? Is it possible to receive the information during the home visit?
12.	Does this information suffice?
13.	What information do you generate yourself when providing care? What information do you produce and where?

14.	How do you appreciate the quality of the mobile system?
15.	Were the right end-users involved with making or selecting this system?
	Relevance
16.	What do you experience, for you personally, as important in your daily work when you look at the care you provide?
17.	What aspects in the ability to provide care, do you experience as a bottleneck or problem?
18.	Do you know proposals for improving the mobile system?
19.	How important are these proposed improvements in the chain of care in relation to other possibilities to improve aspects of your job?
20.	In what way could the use of ICT matter to you?
21.	What aspect of your job would you miss, if it would be removed?
	Resources
23.	What ICT-facilities do you have at your disposal at your workplace?
24.	What of these ICT-facilities do you use when providing care?
25.	Is the technical support sufficient to guarantee the quality of the system?
26.	Do you have support to implement mobile system?
	Resistance
27.	To what extent are you convinced that the use of ICT is necessary to improve the providing of care? Do you use tablet device at every home visit? If not, why?
28.	Do you experience obstacles when implementing mobile solution? If you do, which are the biggest obstacles?
29.	How much time and energy do you think you can find to implement the changes that will occur when introducing innovations and ICT in this kind of care?
30.	Do your colleagues or managers stimulate you to participate in changes?
31.	Can you name other innovation-projects this organization is working on?

Appendix 2. Informed consent (nurses)

Tämä tutkimus on osa EU Master- Care & Technology-maisteriohjelman opinnäyte-työtä. Tutkimuksen tarkoituksena on selvittää kotihoidon sairaanhoitajien ja tervey-denhoitajien tablet-laitteiden käyttöä ja sopeutumisprosessia liittyen Lifecare- koti-hoito-ohjelmaan. Haastattelut tullaan nauhoittamaan. Analysoinnin jälkeen aineisto tullaan asianmukaisesti hävittämään. Tutkimukseen osallistuminen on vapaaehtoista ja haastattelun voi keskeyttää ja tutkimuksesta vetäytyä missä tahansa tutkimuksen vaiheessa.

Tarkoitus on haastatella kaikki Nokian kotihoidon sairaanhoitajat ja terveydenhoita-jat jotka ovat käyttäneet Lifecare- kotihoito-ohjelmaa työssään. Haastattelujen lisäksi tutkimukseen kuuluu kotikäynneillä tapahtuvaa havainnointia. Havainnointeja teh-dään yhteensä vain kolmella kotikäynnillä, joten tämä ei koske kaikkia hoitajia. Ha-vinnontiin osallistuvilta hoitajilta ja kotikäyntien asiakkailta pyydetään suostumus erikseen.

Tämän tutkimuksen tutkimussuunnitelma on lähetetty Nokian kaupungin hoitotyön johtajalle, joka on myöntänyt tutkimusluvan.

Tutkimuksesta vastaava tutkija on Annika Vasalampi ja haastattelut toteuttaa Aino Marjamaa. Haastattelut toteutetaan työaikana aikavälillä 10.3- 30.3.2017. Puolistruk-turoidun haastattelun kesto on noin tunti. Haastateltavat saavat kysymykset tiedok-seen ennen haastattelua.

Osallistun tutkimukseen ja suostun siihen että vastauksiani voidaan käyttää tutkimus-tarkoituksiin

Nokialla_____
päivämäärä ja allekirjoitus

Appendix 3. Informed consent (patients)

Tämä tutkimus on osa EU Master- Care & Technology-maisteriohjelman opinnäytetyötä. Tutkimuksen tarkoituksena on selvittää kotihoidon sairaanhoitajien ja terveydenhoitajien tablet- laitteiden käyttöä ja sopeutumisprosessia liittyen Lifecare- kotihoito-ohjelmaan. Kattavan tutkimusaineiston aikaansaamiseksi tutkimukseen kuuluu asiakkaan luona kotikäynnillä tapahtuvaa havainnointia joka videoidaan. Analysoinnin jälkeen aineisto tullaan asianmukaisesti hävittämään.

Tässä tutkimuksessa ei haastatella tai videoida asiakasta eikä käytetä asiakastietoja millään tavalla. Havainnointeja tehdään yhteensä kolmella kotikäynnillä. Tämän tutkimuksen tutkimussuunnitelma on lähetetty Nokian kaupungin hoitotyön johtajalle, joka on myöntänyt tutkimusluvan. Tutkimuksesta vastaava tutkija on Annika Vasalampi. Asiakkaalla on oikeus kieltäytyä siitä, että hänen kotikäynnillään videoidaan hoitajan tablet-laitteen käyttöä.

Suostun siihen että kotihoidon sairaanhoitajaa/terveydenhoitajaa videokuvataan kotikäyntini yhteydesssä.

Nokialla _____

päivämäärä ja allekirjoitus

Appendix 4. Four determinants of USE IT-adoption model with micro- and macro-levels

USE IT		Domain dimension	
		User	Information & Communication Technology
Innovation dimension	Product	**Relevance** **Macro-relevance** Definition: The degree to which the user expects that the ICT-system will provide benefits / create value for his profession or organization. Dimension: 1. Quality of product / service (care) 2. Effectiveness of organization 3. Support of collaboration 4. Efficiency of organization **Micro-relevance:** Definition: The degree to which the ICT-system helps to solve the here-and-now problem of the user in his working process and provides benefits Dimensions 1. Task support 2. Effectiveness (quality of care) 3. Efficiency (reduce workload) 4. Customer (patient) satisfaction	**Requirements** **Macro-requirements** Definition: the degree to which the user is satisfied with the general product quality of the ICT-system. Dimensions: 1. Quality of infrastructure 2. Availability of infrastructure 3. Quality of software **Micro-requirements** Definition: the degree to which the individual user needs are satisfied by the ICT-system. Dimensions: 1. Information quality 2. Accessibility (anywhere, anytime) 3. Compatibility 4. Interface satisfaction 5. Interoperability
	Process	**Resistance** **Macro-resistance** Definition: The degree to which the surroundings and locality negatively influence the users of ICT Dimensions: 1. Quality of Implementation / change process (clear objectives, top management support, information) 2. Participation (user involvement) 3. Opportunity to change 4. Ability to change **Micro-resistance** Definition: The degree to which the individual user rejects (does not adopt) the ICT-system 1. Lack of trust 2. Low tolerance of change 3. Negative consequences	**Resources** **Macro-resources** Definition: The degree to which material and immaterial goods are available to design, operate and maintain the ICT-system. *Material* 1. Costs (money) 2. Implementation effort / training effort 3. System (hardware) quality / infrastructure quality/ *Immaterial* 1. Human resources 2. Service and support quality 3. Training facilities **Micro-resources** Definition: The degree to which the individual user is capable of using the ICT-system. *Material:* Access to infrastructure / technical resources *Immaterial:* 1. Capabilities (physical, cognitive) 2. Experience / education