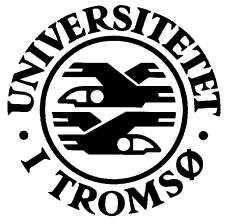

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Formative stages of the common medication card and potential challenges with implementation of this service

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Abstract

Western healthcare is provided in various levels in different organizations. Fragmented information flow and the need to improve the continuity of care has been a serious concern in healthcare system. Fragmented healthcare can result in medication errors that could have been avoided if information flow was organized better. Use of IT services in healthcare organization is seen as possible solution to reduce these mistakes.

Common medication card project in Norway was initiated as a part of national strategy for electronic cooperation in health and social sector. Two similar projects in Tromsø and Trondheim were studied. The intentions of these projects are to reduce medication errors and improve the information flow between primary and secondary healthcare levels.

This thesis is an interpretive study and has addressed the potential challenges with implementing the common medication card service. Interviews were the main data source.

The main challenges that could be met when implementing the common medication card are dealing with the distributed character of healthcare work and interdependency of medication information, as well as obtaining the sustainable use of this service. Changes in work routines and responsibility are likely to appear but the consequences of these changes are hard to foresee.

Keywords: Common medication card, implementation, challenges, information infrastructures, actor network theory

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1. Introduction

Western health care is provided in various levels and different organizations. Often it is divided in primary care which is provided by general practitioners, community health services – nursing homes and home care services, and in pharmacies, and secondary care, provided in hospitals and by specialists. Because of the aging of population lately a lot of attention is focused to improving the care provided in nursing homes and home care services. As people are increasingly using healthcare services in all these mentioned levels, it is very important to secure smooth and quick communication between different healthcare providers. Very often there is an insufficient exchange of vital information about patients' health state or medications in use. This is particularly essential for patients suffering from chronic diseases and older patients who are using a lot of medications. In this case to avoid adverse drug effects caused by interaction of drugs or other substances physicians should be very well informed about medications the patient is taking. Often such patients are suggested to bring with a list of their medications. One way how to cope with this problem is using a paper medication cards one can keep in the wallet. But this is not the best solution because such card can be lost. Also, it might not contain all the necessary information or it might not be written at all. There can as well be cases when patient is not capable of remembering his/her medications or keeping this medication list up to date.

This problem leads to medication errors, such as mismedication that is also a serious cause of hospitalizations and even deaths. It is estimated that in Norway there are approximately 160 000 of medication related errors per year that occur to non hospitalized patients. Approximately one third (50 000) of these errors could have been avoided (www.kith.no). Numerous studies concentrate on prescription errors (Dean, Schachter et al. 2002; Al Khaja, Al-Ansari et al. 2005; Dennison 2005; Guchelaar, Colen et al. 2005), some admit that these errors often occur because of similar names of drugs and many new generic drugs (AHA 2005).

Use of modern IT solutions and closer collaboration between different healthcare providers, for example linking laboratory data with pharmacies, seems to be a solution for safer

healthcare (Grasso, Genest et al. 2002; Schiff, Klass et al. 2003; Guchelaar, Colen et al. 2005).

Lately lots of attention is paid to computerized physician order entry (CPOE) systems that are suggested to be used together with clinical-decision support systems. There are great expectations from such systems (Kaushal, Shojania et al. 2003; Tamblyn 2004; Steele, Eisert et al. 2005). But there are as well some studies suggesting that such systems are not perfect. By reducing one kind of prescription errors they may induce new risks – data entry errors or there can be other problems caused by faulty systems (Bonnabry 2005; Koppel, Metlay et al. 2005; Aarts, Ash et al. 2007).

These trends in healthcare signal that support of IT technologies and closer communication between different health care providers will change the working routines and traditions of the medical practices. This is calling for more knowledge about intuitive incorporation of the technologies in a medical practice. With the introduction of an electronic patient record (EPR) system, information infrastructures begun to arose in health care settings. Building new information infrastructures is a live issue in these days. This is very complex process that involves collaboration and collective work. Many different interests have to be aligned; a lot of negotiating and standardizing must be done to create a good, usable infrastructure. In Norway and some other western countries building national health information infrastructures is a part of national strategy for healthcare improvements (NHII 2001; SHdir 2004). EPR is seen as a platform for building and developing a sharing of the medication information between different healthcare levels. Some western countries have been working on developing national electronic records that are containing some of essential information about patient such as medication information, information about allergies and immunization. Some other initiatives are considering patient owned electronic medical record, thus trying to solve privacy issues related to sharing of patient's medical information (NHS; Mandl, Szolovits et al. 2001; Valle, Cerizza et al. 2006).

Common medication card project in Norway is one of such potentially promising solutions for improving the healthcare. This is rather a large infrastructure that involves quite many actors from different healthcare institutions and levels. It is expected that common medication card service will help to overcome problems of poor information flow between

different healthcare levels. Common database will contains patient's medication information and information about allergies and it will provide all healthcare personnel involved in the treatment of the patient with the same, up to date medication information. The main intention of this service is to reduce medication errors that occur because of the lack of information about patient's medications. This service seems to be a big step forward fulfilling the visions about open systems and sharing of information over different levels in healthcare.

Even though it is absolutely necessary to have this service, implementation of such systems could bring some changes in the routines of healthcare personnel as well as some changes in the responsibility. To deal with these issues in the best possible way it is important to understand the complexities of work practices in healthcare sector. Obtaining sustainable use is another important issue when implementing new services in healthcare organisations.

The aim of this research is to answer the following research questions:

- What are the potential challenges while implementing the common medication card service?

- How to achieve the sustainable use of this service?

- How different driving forces influence the development of the common medication card projects in Tromsø and Trondheim?

- How can common medication card improve the collaboration between different health care providers?

- How use of the common medication card service could change the work practice in healthcare sector?

Common medication card service has some typical characteristics of information infrastructures it is installed base, shared and evolving. It has many parts involved in developing the service and has quite many potential users. To map out all the actors and see the connections between these actors use of the actor network theory can be helpful.

Consequently, in this study I used the actor network theory to analyze the complexities behind creating common medication card service.

This thesis will be organised as follows: in the next chapter the healthcare will be viewed in wider context, the third chapter will follow with brief overview of theory covering information infrastructures and actor network theory. Fourth chapter will describe the methods of this study and it will be followed by a case description. In the sixth chapter potential complexities will be discussed and the last chapter follows with conclusions.

2. Health care system

2.1. Organisation of Norwegian health care system

The Norwegian health care system is based on a decentralized model. It is organized on three levels – national, regional and local levels. Overall responsibility for the health care is on the national level with Ministry of Health and Care Services on the top. Furthermore, the regional level is represented by four regional health authorities. These are as follows health region South-East, West, Central Norway and health region Northern Norway; every region has at least one central regional hospital together with several local public and private hospitals. The regional health authorities are responsible for the specialist care. The third level - local level is represented by 434 municipalities and it has responsibility for primary health care, which also includes nursing care and home care services (Johansen 2006). Within the limits of legislation and available economic resources regional health authorities and the municipalities are formally free to plan and run public health services and social services as they want (www.helsetilsynet.no).

Due to a lot of challenges such as need to increase efficiency, improve the quality and continuity of healthcare, the authorities have aimed at establishing new reforms in the Norwegian healthcare sector.

One of these reforms was the introduction of the Regular General Practitioners scheme which was implemented in 2001. This scheme is based on a registration system where patients can sign onto the list of the GP of their choice. The aim of this reform was to improve the quality of the local medical services, to improve the continuity of care and ensure more personal patient – physician relationship. Up to date approximately 98% of the population have a regular general practitioner (Johansen 2006).

In 2002 another important reform was conducted, it was hospital reform and the main goal of this reform was to increase the efficiency. During this reform the ownership of the hospitals

was transferred from the counties to the central government sector, the hospitals were organised as enterprises and day to day running of the enterprises became the responsibility of the general management and executive board (Johansen 2006).

Even though there have been several important reforms and tries to improve continuity and quality of care in the Norwegian healthcare sector in last decades, there are still space for improvements and important issues that should be solved. One of such issues is the collaboration between primary and secondary healthcare. It has been suffering from insufficient real time information flow. In national health plan for Norway (2007 - 2010) it is mentioned that one of the main criticisms in reports and evaluations from user organisations is that the interaction is poor and the services are not cohesive enough both in the health service and in its interaction with other sectors (NHP 2007). The same problem has been mentioned already in previous years in national strategy documents.

> *"Large groups of patients are dependant on municipality health services and specialist health services functioning as a continuity of patient care. In many cases coordination is not good enough. This can lead to deficiencies in service provision, unnecessary hospital admissions, premature hospital discharges and inadequate follow–up from home nursing services, nursing homes and primary physician services." – Teamwork 2007 (SHdir 2004)*

The patients are moving between different health care providers, but their health related information is not following simultaneously. Consequently the quality of provided care is suffering from this fragmented information flow. Over the time patient – physician relationship has slowly changed to more equal collaboration, besides healthcare has turned from rather an individual project done by one physician to a teamwork with many different healthcare providers – physicians, nurses, pharmacists involved in continues care of the patient. Fragmented delivery of health care is a general problem acknowledged in most western health care systems. There have been numerous tries to overcome the fragmented information flow between different health care levels and find the ways to provide various health care providers with more or less similar information about the patient. Such notions as integrated care, shared care, continuity of care or interdisciplinary care are often used when suggesting the solution for fragmented healthcare problems. Well integrated care is seen as

the solution to several problems in healthcare sector. It is expected that integrated care will ensure coherent and effective health care services across disciplinary and institutional boundaries (Ellingsen and Munkvold). The overall tendency in western society nowadays is to be more informed and be able to access necessary information almost immediately. In healthcare telemedicine has taken the initiative of creating solutions for these problems and needs. Providing and sharing of information is essential for ensuring qualitative healthcare. Teamwork 2007 underlines that sharing and exchanging medical information is absolutely necessary to ensure the continuity of care:

> *"The main objective of continuity of care for patients and clients presupposes that the service providers who cooperate have access to updated information about, among other things, evaluations, and tests, use of medication and treatment that has been initiated." (SHdir 2004)*

2.2. National IT initiatives

For more than 20 years different telemedicine activities have taken place in Norway. Initially it was dealing with overcoming large distances in northern part of Norway thus seeking to deliver equal health care to all the population. In last years notion of telemedicine has been merging with wider used term e-health. Most of today's activities involve wide use of information technologies for delivering more integrated and better care in all health care levels. The Norwegian Centre for Telemedicine has a role as a national centre of expertise in the field of telemedicine. This organisation is working with developing and studying various telemedicine and e-health solution. But this is not the only organisation working with the use and implementation of information technologies in the Norwegian healthcare sector.

These initiatives are seen as very important on the national level and municipalities in Norway are involved in the developing of new information technology related solutions for improving primary health care. National guidelines have been written to describe a necessary development of the healthcare and the role of e-activities and telemedicine solutions in it. There are two major priorities in the improvement of health and social sector. The first

priority involves improving the information flow, but the second one deals with involving more new actors in the electronic interaction in health and social sector. Improved collaboration between various healthcare providers is tightly coupled with possible improvements in information flow between different healthcare givers. This issue of improved collaboration has been stressed in the plan for 2007 health care development – teamwork 2007. There are some problems named in Teamwork 2007 that describe the inefficient information flow in health and social sector:

> *"Information is often not available where it is needed, when it is needed and in the right form. Information is exchanged in ways that are time-consuming and/or insecure. Information goes along channels that are not continuous, some of them paper-based, others electronic, often using different electronic applications" (SHdir 2004).*

The guidelines are also followed by numerous activities for improving the health care. There are several national and local projects that are working with problems mentioned above such as overcoming the lack of information and delays in health care, especially when it comes to providing the same medical information in different healthcare levels and reducing the medication errors caused by lack of information about patient's medications. To reduce these mistakes, improve healthcare and ensure the continuity of care, some changes in distribution of functions and responsibilities in healthcare are needed. Often such changes are accompanied by new needs. Many of the present projects in healthcare sector have concentrated on nurses' role in the health care and how to improve their work. Electronic interaction is seen as an option for these improvements.

> *"Electronic professional networks can strengthen cooperation between different service providers. If these types of network are to function well, the cooperating partners must have access to a common information base." - Teamwork 2007*

Such projects related to IT use in healthcare as Sesam, ElinK and multidose are created to overcome these problems and test the usefulness of various potential electronic solutions.

There are five lighthouse projects conducted in five municipalities and all of them are working with improving the communication and collaboration in the community healthcare.

This is a national initiative that is supposed to identify needs, potential gains and possible applications for electronic interaction within municipal health and social services, and between social and specialist health services. Sesam is one of the lighthouse projects; it is conducted by the National Centre for Telemedicine (NST) in Tromsø municipality. The intention of this project is to improve coordination and continuity in the health care sector by using electronic communication between nurses, GPs and hospital. The project was initiated in 2004 and was terminated in June 2006. During the project period the nurses in the nursing home and home care service could communicate with GP through question and answer service. This service was organised via secure emails. Discharge letters and laboratory results were communicated electronically. A part of the Sesam project was a wound clinic – a possibility for nurses in nursing home to consult with the specialists in the hospital by providing them with digital photos of wounds.

ElinK is a nation wide project that also concentrates on the community care nurses and their communication with GPs, specialist care and causality clinics. Similarly to Sesam also in this project the communication is planned to be organized in electronic way (ELIN-project; www.sykepleierforbundet.no).

Trondheim municipality is participating in one of the lighthouse projects and is working with reducing of medication mistakes. Multidose is a local effort, a project that can be seen as a first step to reducing these mistakes, it involves the home care service, general practitoners and pharmacy. The aim of this project is to ensure that the patient is getting the right medication and to reduce medication errors that happen because of the poor communication between all involved parts. The next, bigger and even more important step is the electronic medication card which will be located in a consent based core medical record (www.trondheim.kommune.no).

On the national level another very important project is e-prescription, the development and implementation of common prescription database. The implementation of this solution is already underway; it will be tested in the real life from 2008. It is planned that by 2011 approximately 80% of all prescriptions will be electronic (SHdir; www.farmasiforbundet.no). This solution can be closely linked to another project and is potential an important part of this previously mentioned solution – the core medical record (common medication card).

These are just few of the national efforts for overcoming the fragmentation health care and improving the information flow between various health care providers.

2.3. International efforts/activities

Also on the international level there are multiple efforts to overcome previously mentioned problems with fragmented information flow and improving the continuity of care. Reduction of medication errors is one of the main goals in western health care. ICT has been seen as a solution for some of these problems. Use of the modern IT solutions and closer collaboration between different healthcare providers, for example linking laboratory data with pharmacies, seems to be a solution for safer healthcare (Grasso, Genest et al. 2002; Schiff, Klass et al. 2003; Guchelaar, Colen et al. 2005).

Lately lots of attention is paid to the computerized physician order entry (CPOE) systems that are suggested to be used together with clinical-decision support systems. It is seen as a way to reducing medication errors. There are great expectations from such systems (Kaushal, Shojania et al. 2003; Tamblyn 2004; Steele, Eisert et al. 2005). But there are as well some studies suggesting that such systems are not perfect. By reducing one kind of prescription errors they may induce new risks – data entry errors or there can be other problems caused by faulty systems (Bonnabry 2005; Koppel, Metlay et al. 2005). Besides these systems are not really serving to all the health care providers for creating a united care plan for patient. One of the problems with CPOE is that often designers of these systems have not considered well enough the complexity of work practices and the distributed nature of tasks in healthcare systems (Aarts, Ash et al. 2007).

Muller et al address the growing need for improved data communication in health care sector and admits that it is necessary to overcome the barriers of software heterogeneity and lack of standards especially in cross-institutional shared care communication (Muller, Uckert et al. 2005). It is essential for good patient management to receive adequate information in the time of discharge from an acute care institution. The study by Raval et al concludes that

there are substantial inadequacies in communication to community physicians at the time of discharge of a patient from the hospital (Raval, Marchiori et al. 2003).

Primary care physicians and specialists and improvements in their work routines have been in the focus of healthcare development. But as nurses are gaining more responsibility and more tasks, thus becoming a more important player for ensuring better continuity of care, insufficiencies in their daily work practices are discovered and need for improvements has been noticed.

"Nurses are working with the patients every day, not the doctor" – general practitoner

It has been noticed that nurses are the ones that spend most of the time with patients but are not provided with all the necessary info. Nursing documentation is considered as potentially important part of multiprofessional patient record in Finland. To make use of this information, it is suggested that it would be necessary to develop nationally unified and standardized nursing documentation (Tanttu and Ikonen 2006).

A study in Germany admits the importance of the nurse's role in the health care but as well infers that not always nurses have benefit from various e-health activities in the country. It is stressed that e-health applications could help improving continuity of care by embracing all health care providers, and supporting cross sector communication. The ability of including nurses in e-health supported patient care is highlighted (Hubner, Giehoff et al. 2006).

There are also some broader activities in this field on the European and world level. The society has become mobile, it's moving from place to place to work or travel. Moving from one country to another has become quite usual, especially in the EU countries which have many common directives and offers job opportunities to EU citizens from different countries. Consequently, travelling, studying or working in foreign country has become common these days. The borders are vanishing and a lot of information is travelling with its owners. These trends lead to changes in healthcare sector that deals with providing similar health related information to all involved in the providing of health care. There are many projects related to this both in national level in various countries and also EU level.

One of such intentions is proposal to build the European Patient Summary, which seems to be quite complex and ambitious system. Due to the potential international use, this system should be able to cope with the problem of multilingualism and be suited for multilateral use (Valle, Cerizza et al. 2006).

National Health Service in United Kingdom is working on developing the Summary Care Record. It is supposed to contain important data set of current medications and allergies and adverse reactions. This information will be uploaded form GP systems, initially as text and subsequently in code form. Over time the content will increase. Members of public will be provided with a secure and personal health portal accessed through the internet; this will also allow them to view their Summary Care Record (NHS 2006).

Scotland's solution – Emergency Care Summary, used in real life since 1st of September 2006, it contains name, birth data, GP's name, identifying number, information about any medications prescribed by GP, allergies (NHS). The intentions of the common medication card project go even further adding information from pharmacies.

In France in August 2004 a national project – Dossier Medical Personnel was initiated. This project aims to provide each French citizen with a unique, centralized electronic patient record, accessible by all healthcare professionals, as well as citizens. The internet is planned to be a core tool, it will be used for exchanging the health data between different users and sources. This health record will be complementary to healthcare provider's own patient records. An experimental phase of project was scheduled for May 2006 (eHealth-IMPACT 2004).

The main focus is on providing the same information in different health care levels. Patient summaries and emergency care record are just some of the projects with this intention.

Information technology use in healthcare has expanded steadily from administration applications to more clinically oriented systems. In 1988 health information system conference was held in Nijmegen in Netherlands, one of the themes identified in this conference was the need for a centralized database with global distribution. Today after nearly 20 years, it is still a vision and there are numerous attempts to reach it. Truly

successful health information system stories are not common, but failures are highly visible, widespread and costly (Giuse and Kuhn 2003).

These failures can be explained as a consequence of the technology oriented nature of development and implementation of information technologies in healthcare sector. Lately more socially oriented approach has been seen as a solution. Berg states that success of implementation is often socially negotiated and organisational issues are an important aspect, because some technological difficulties can be a result of poorly managed development process (Berg 2001).

This is a common problem that many telemedicine solutions even though prove to be good and necessary, fail to be implemented in working practice and be used after testing period is over. Often these solutions are of an experimental nature and suffer from a lack of long-term funding and organisational commitment (Cornford and Klecun-Dabrowska 2001; May 2001; May and Ellis 2001). Requirements for both stability and flexibility have caused problems in the development of telemedicine solutions and also while evaluating these solutions (Finch, May et al. 2003). Person from Norwegian Centre for Informatics in Health and Social Care admits experiencing a problem of telemedicine solutions that fail to be well integrated in Norwegian healthcare sector.

> *"We have very many projects that are good and are demonstrating that this is a very good solution, but after the project in finished nothing happens because this was not integrated in the solution that the healthcare personnel are using and no one was willing to take the costs here to implement it." - project member from KITH*

Even though failures of telemedicine solutions are widely discussed, there are some very successful solutions that have managed to be fully integrated in healthcare practice. One of such examples is teleradiology, it is now completely integrated in the healthcare system and often it is even forgotten that this is a telemedicine initiative. This success story partly can be explained by the work routines that were connected to radiology. Part of being a radiologist was to work distant from the patient and to analyze the examination pictures, the main change brought by teleradiology was digital images.

Health information system conference in Heidelberg sets a tendency towards systems that are less technology centric and more oriented to the variety of the social environment within which they are meant to be used (Giuse and Kuhn 2003). Ability to see the technology in society and organisation where it is expected to be in use might be a key to more successful use of information technologies in healthcare sector.

3. Theory

Western healthcare providers and politicians are increasingly stressing the need to make more health related information available to everyone who is involved in providing healthcare. Since more than one physician was involved in treating the patient and primary and secondary care emerged, it has been common to share patient's health related information. But sharing of this information has been rather fragmented and insufficient. Traditionally information was shared on the paper –laboratory test results, referral letters, discharge letters, diagnoses by specialists, prescriptions. This is where actual information infrastructure in healthcare has emerged. Introduction of information technologies that are closely integrated in healthcare organisations is taking this sharing of health related information to another level.

So far rather stand-alone information systems have been used and sharing of information between different healthcare levels still has been quite fragmented and not so well developed. Consequently, shift to more integrated and complex systems has taken place. The development of these systems is influenced by complexity and specific nature of healthcare service. Usually healthcare is provided by more than one institution and often there is collaboration between different organisations. This complex nature of healthcare and intention to deliver better, more qualitative, continues and less fragmented health services has led to the further development of information infrastructures in this field.

2.1. Information infrastructures

According to Shortliffe, a system in a general sense is defined as an organized set of procedures for accomplishing a task (Perreault and Shortliffe 2001). Usually, information systems are created because an information process is very common, very complex or in some way very critical. The role of such system is to reduce effort of decision making, other

complexities or minimize the likelihood of error (Coiera 2003). Characteristics of traditional information systems development are as follows:

- One individual component
- Delimited with a clear purpose
- Assumes closed systems with organisational boundaries
- Developed within a hierarchical structure – a project (top down)
- Central control

Such information systems are used for improving efficiency through automation of human activities within working processes. This shows technology as a fixed set of functionalities with purpose that is self evident. Technology is seen as a tool in this case. Implementation of such systems is under control, its consequences are planned and problems are mostly related to technical issues concerning the automation of tasks (Cordella 2004).

Information systems are closely tied to the working practices they are supporting. This close relation to the working practice is inscribed into the system, thus making the system unique and local, but not universal. Information systems are seen as highly dynamic (Hanseth, Jacucci et al. 2006).

Some of the characteristics mentioned above, because of their restrictive nature, can also be seen as weaknesses of information systems, especially when it comes to a wider use. Such approaches might fit well in small, isolated organisations, but may be more problematic in large ones. When independent organisations collaborate in different levels, various organisations merge; it becomes more difficult to define clear organisational boundaries and more than one component is involved. In such time of rapid changes, a particular level of flexibility is needed, but an information system with clearly defined purpose might not be open and flexible enough. A top down approach in development of system might result in not noticing some small, important details of the working process. This might lead to a design of frail systems. A mix of top down and bottom up approaches could be more fruitful. This means an integrated approach where the top provides the framework in which the details are supposed to be grounded. In more open systems, it is harder to provide central control. This is another limitation of traditional information systems.

Contemporary trends in western countries are speed, complexities, emerging, large, international organisations with multiple components and purposes. Increased diffusion of information technologies in organisations and society has resulted in an escalated level of interdependencies among single information systems so it has become very difficult to think about independent information systems rather than information infrastructures (Hanseth 2004). To cope with those trends, overcome the limitations of information systems and ensure a better collaboration over different levels of various organisations, existing traditions had to be changed. These changes evolved towards more integrated and open information systems. This opens the stage for information infrastructures that are more suited for today's situation and could overcome some of the problems mentioned above.

Etymologically, "infrastructure" is the combination of the Latin prefix *infra* which means bellow, underneath and the suffix *structura* which means "the way in which an edifice, machine etc is made or put together" (OED). Primarily this word was used to describe part of the construction of buildings, roads etc. In such context the infrastructure is fixed, unchanging foundation upon which the building is constructed. It is a long term and permanent installation and by definition it is stable and unchangeable because it provides the basis for further development of construction (Cordella 2004).

Using the notion of information infrastructure in socio-technical setting implies acknowledging the human, technological, organizational, social and legal issues. When describing the vision of the national information infrastructure (NII) it is seen as a nationwide, invisible, seamless, dynamic web of transmission mechanisms, information appliances, content, and people. Report about National Health Information Infrastructure suggests that it should have three dimensions: personal health, healthcare and population health dimensions. Some basic elements of such infrastructure are defined in the report. They include values, practices and relationships, laws and regulations, privacy, standards, technology, systems and applications (NHII 2001). This vision pictures infrastructure as a large scale system, which is not developed form scratch. An important aspect of infrastructure is integration and interdependency. Usually these systems have broad purpose; they have no particular start, nor termination date and no centralised control, they might have some side-effects. These side effects and complexities may be caused by many, different human and non-human artefacts involved in the creating and use of information

infrastructure. It is considered that information systems and organisations are shaping each other.

> *"An information system and its organisational context each have transformation effect on the other. They are more like the reagents that react to and change each other's properties in a chemical compound then the inert elements that retain their properties in a chemical mixture" (Currie and Galliers 1999)*

Some similarities between different definitions can be seen, for example Hanseth defines the characteristics of information infrastructure as follows:

- Shared – information is shared between different various users. NHII has *three dimensions*, which means that information is widely shared and used for various purposes involving patients, healthcare providers and even state. *Values, practices* and *relationship* also fit in this category because knowledge and information hopefully will be shared equally by all.

- Evolving – traditionally it is considered that information infrastructures are growing over the time and organizational boundaries. This process is influenced by the complexity of technologies, social relationships and structures. Infrastructure is evolving through both conscious and unintended actions carried out by a number of different actors.

- Open – openness is characterised by unlimited number of users and no particular and strict borders. Just as three dimensions of NHII that covers all the states.

- Standardised – standards are one of the millstones that provide possibility to communicate between different systems on different levels both organizational and technical. *Standards* are essential part of NHII as well, just as *laws and regulations* that work similar to standards, creating the framework of an infrastructure and organising more proper

communication. *Privacy* aspect also is in the way standard that should be considered carefully. Bowker and Star also mention that standards are necessary for plugging in other infrastructures and tools. Standards are serving as a tool for stabilising the infrastructure.

- Heterogeneous – it consists of various technical and non-technical components such as humans, knowledge, and technology. This is one of the basic concepts of actor network theory. *Practices and relationship, technology, systems and applications* are such heterogeneous components that are necessary for building information infrastructure. Large infrastructures are built over the time and different elements are added in different periods, the older elements are influencing the design of newer elements. This characteristic also contributes to heterogeneity of the infrastructure.

- Installed base – existing technologies and infrastructures influence and form the new infrastructure, just as NHII report admits that *technology, systems and applications* are some of the basic elements of this infrastructure. Also Bowker and Star finds this feature as an important part of information infrastructures (Bowker and Star 1999; NHII 2001; Hanseth 2004).

Such Hanseth's suggested characteristics of information infrastructure as *opened, shared* and *heterogeneous* can be compared or find to be similar to Bowker and Star's offered *embeddedness* – infrastructure is being embedded in other structures, social arrangements and technologies; *transparency* and *reach or scope*, which means that information infrastructure can be used for more than one purpose and it doesn't have to be reinvented each time when new task is added. Bowker and Star are more explicit when describing information infrastructure and suggest also that it can be *"learned as a part of membership"*; it has *"links with conventions of practice"* and *"is fixed in modular increments, not all at once or globally"*. The changes in infrastructure take time, negotiations and adjustments.

It is hard to analyze information infrastructures, because good, usable systems disappear almost by definition. As easier they are to use and quite often as bigger they are, the harder they are to see. Often they become visible only after breaking down (Bowker and Star 1999). As mentioned above standards are essential part of any information infrastructure, without them communication between different parties could not be organized in a smooth way. Nowadays standards are more and more taking the control over the world, especially western world; production, manufacturing, communication, medicine, shoe and clothes' size etc everything depends on standards. Clearly it is hard to stand out of the standard, but every standardisation represents only one perspective of some process or thing and it means that something is always left out. Standardisation is a very political, time consuming process where a lot of negotiations are involved and a lot of compromises are found. Its intention is to uniform, simplify things and create order in particular settings. Consequently, not always it is possible to reach, as in case with reflexive standardisation where efforts and actions towards standardisation and stability lead to an opposite result (Hanseth, Jacucci et al. 2006).

Hanseth and Monteiro have explored the nature of technical standards by studying different levels of inscriptions embedded in technology. The conclusion is that inscriptions are stronger, the more the infrastructure is aligned and hence more effective is the inscribed program of action (Hanseth and Monteiro 1998).

Standards have an ability to bring people from different disciplines and backgrounds together with various technologies and instruments (Timmermans and Berg 1997; Hanseth, Jacucci et al. 2006). It is suggested that four kinds of standards can be distinguished:

- Design standards – set structural specifications for components of social and/or technical systems for example size of hospital beds or sizes of injection needles.

- Terminological standards – ensure the stability of meaning over different sites and times, for example ICD.

- Performance standards – set outcome specifications and often are used to regulate professional work.

- Procedural standards – specify processes, like clinical practice guidelines (Timmermans, Berg 2003).

Standards can be also seen as limiting the growing infrastructure, and reducing the flexibility of information infrastructure.

> *"Integrated information infrastructures are in fact increasing the level of interdependencies which reduces the ability to deal with changes and unpredictable events." (Cordella 2004)*

There are studies that argue that the deployment and implementation of information infrastructures is not a linear process that follows a predefined path of action. The dynamics of daily use have some influence on these processes, events, circumstances and unpredictable courses of action are shaping the trajectory of the deployment of an infrastructure (Cordella 2004). This is seen as a dynamic relationship which is shaping the involved parts and being shaped both by technology, users and environment. Cordella suggests replacing notion of "information infrastructure" with "information infrastructure in action" because this reflects better the true nature of information infrastructures and is more helpful when studying such complex systems.

Latour argues that the science and technology has to be studied in action and that the focus should be on the dynamics of their interaction, rather than stability of their relationship (Latour 1987). Actor network theory is providing the necessary analytical framework for this approach.

2.2. Actor network theory

When analyzing implementation of technologies in organisations, different approaches can be used. From a Science and Technology Studies (STS) perspective there are two extreme end points of those approaches. On one side, technological determinism which suggests that technology determines its use. This stand point often is observed between computer

engineers, vendors and others closer to technology standing people. On the other side there is social constructionism which says that only society develops technology and technology itself plays no role (Monteiro 2000). Both schools underestimate the interaction between technology and organisation and the process that mutually shapes both. It can be seen as a dynamic interaction between the two that shapes the ongoing configuration of technology and organisation (Cordella and Shaikh 2006). Actor network theory takes this interaction perspective and looks at the relationship between technology and organisation. This is a theory that was developed from Science and Technology Studies (STS) in early 1980s in France by Michael Callon and Bruno Latour with participation of British sociologist John Law.

Actor network theory is a social science approach for describing and explaining social, organizational, scientific and technological structures, processes and events. It assumes that all the components of such structure both humans and non-humans form a network of relations that can be mapped and described in the same terms or vocabulary.

It has been hard to define all the parts involved in the network because of its heterogeneity, they can be not only humans. Almost a revolutionary part of the actor network theory was use of the notion of "actant" or "actor" that can be both human and non-human (organization, technology, nature etc). This to some extent assigned equal roles to humans and technology.

Actors that are part of the network are seen also as essential elements of this network. This means that actors and network are closely interlocked and can not be defined without each other. Every network can be seen as an actor in some other, bigger network, thus changing from network to an actor.

> *"The actor network is reducible neither to an actor alone nor to a network…An actor network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of." (Callon, Bijker et al. 1989)*

The idea that all the actants are connected in a large network of relations and are interdependent is also the weakness of this theory. In this case every actant could be linked

to one global network. This causes problems when analyzing a network because it becomes hard to distinguish where to stop pointing out important actors of particular network. It is important to keep focus on what is actually influential. Monteiro suggests viewing the actor-network as a context (Monteiro 2000).

There are several important concepts in actor-network theory, one of them is *translation.* Translation is done by an actor with some particular interests with a purpose of making others interested in reaching some particular goals. It is important to make the idea attractive to others, explain it in various acceptable ways, enrol and mobilize different actors with different interests for reaching the same goal.

> *"Interests are what lie in between actors and their goals, thus creating a tension that will make actors select only what, in their own eyes, helps them reach these goals amongst many possibilities" (Latour 1987)*

The system design can be seen as this kind of translation of interests. Callon suggests four "moments" of translation:

- Problematisation – in this phase the actor defines the problem in a way that makes this actor indispensable for other actors in this network. During this phase some *"obligatory passage points"* and actors are defined.

- Interessement – is the group of actions by which some actor is attempting to impose and stabilize the identity of the other actors that were defined through problematisation phase.

- Enrolment – successful interessement continues with enrolment, a set of interrelated roles is defined and ascribed to actors who accept them.

- Mobilisation – it is often done by spokesman who is representing a particular network and its intentions (Callon 1986).

All these four moments of translation can overlap in the real life situation. Translation can be seen as a process of *aligning interests*, negotiating the social order and providing stability to

the network. As added by Callon *"translation is a process, never a completed accomplishment and it may fail"*.

If the translating was successful, the next big step is to keep the aligned group in line, to control it. To make networks durable special programs of action are created – *inscriptions.* This is another important concept of the actor network theory. Inscriptions are different manuals, descriptions of work routines, training, legal documents etc. These inscriptions are also deeply involved in the control over the distance (Law 1986). Inscriptions are defining the roles to be played by users and the system. By inscribing a program of action to technology, it becomes a part of a network – an actor. To some extent inscriptions are standardizing the action of actors and helping to predict their behaviour. But it is almost impossible already in the design process completely define exact roles of the actors. Often these roles are re-written and negotiated while implementing and using the system.

Such concept as *"obligatory passage point"* can be used. Every network has some obligatory passage points. With defining obligatory passage points that must be passed through, particular actors in the network gain more importance and power; they can't be left out of the network and these passage points are keeping the network aligned and working.

Irreversibility is the difficulty of making changes which appears when aligned network has gained some inertia. Information infrastructure becomes irreversible as it grows due to relations between the actors, organizations and institutions involved. It can be seen also in connection with institutionalizing: an increased degree of irreversibility is signalled by a firmer institutionalization or opposite, the construction of institutions functions as a way to align the network and make it increasingly irreversible (Monteiro 2000). Hughes suggests that in longer run infrastructure is gaining a momentum (Hughes 1994). ANT is using a notion of *"black box"* to explain the state after the network has gained irreversibility and become relatively stabile. It is hard to see the network after it has been black boxed and it becomes visible only when something breaks down in the network and the black box has to be "opened". Latour suggests that all the actors are contributing to the black box and it changes over the time.

> *"..in this technoscience game we are watching, the object is modified as it goes along from had to hand. It is not only collectively transmitted from one actor to the next, it is collectively composed by actors." (Latour 1987)*

According to this, even though some actors can seem more important and more visible in the network, by being the initiators of action or spokesman for others in the network, the importance of invisible ones can not be doubted. Every single part of the network is essential to its existence. This collective work of creating and maintaining the network might complicate the assigning of responsibility.

In the classical understanding of actor network theory stability should be reached, for example Latour's "durable immobile". There are several ways how to see objects in actor network theory; a more classical view would be regions and networks, when expanding the theory objects as fluids and fires where suggested. This later variation was introduced because it was impossible to reach constant stability and continues changes were observed. Nothing seems to be fixed and forever in actor network theory, just some things are fixed and only for a time (de Laet and Mol 2000; Law and Singleton 2005).

Danger to the actor network or an information infrastructure is when the involved actors are too tightly coupled. Some robustness is needed to be able to keep working in the world that is in never ending change and development. Partially connected, multiply ordered, ambiguous and not very coherent systems usually are more robust (Law 2000).

In this case actor network theory is used to analyze development of the common medication card and see how the relationships are evolving in this network. Analysis mainly will focus on translation and alignment processes, point out some obligatory passage points and touch upon concept of stability and irreversibility of network.

4. Methods

4.1. Research approach

The data collection for this study was done from spring 2006 to winter 2007. During this period the common medication card service was still in the development phase and has not been in the real life use yet. This to great extent has influenced the data I collected, methods of data collection and the research questions of my study. Initially the research questions were rather vague but after further data collection the findings gained more validity and clearer questions were identified.

4.1.1. Research design

Traditionally there have been two ways of conducting the research: qualitative and quantitative methodology. In some literature sources it is preferred to use terms of “flexible” and “fixed” design (Robson 2002). Both these directions are grounded in different philosophical approaches (backgrounds) and they have developed a quite diametrically different way of conducting the research. Sometimes it is viewed as quantitative approach is the scientific approach but qualitative is rather anecdotic and not so reliable.

Quantitative methodology is traditionally associated with the data that is represented by numbers – “hard data”. Such research is done in rather closed environment. Quantitative approach has been widely used also in real world settings in psychology, social sciences, just as well as information system research. It is commonly done by using experiments and surveys, and statistical measurements are important part of this methodology. A well developed conceptual framework or theory is needed to know in advance what to look for; clear borders and standards are defined. Furthermore to achieve success, a particular degree

of control by the researcher is necessary to have, which sometimes can be problematic, especially in the real life settings (Robson 2002). A typical example of the quantitative methodology is randomised control trial, which is viewed by many as the “gold standard” in the research and also in evaluating the information systems (Stoop and Berg 2003). Another important characteristic of quantitative research is that it tends to attain results that can be generalised from the sample to the population.

Quantitative research can be strongly linked to the positivism. Positivism is a philosophical approach that for long has been used in science and considered to be major philosophical basis both in natural and social sciences. It can be seen as a “standard view” of science. This approach suggests that researcher should have a neutral stand point and investigate the facts. Positivism positions that facts and values are distinct and scientific knowledge consists only of facts. It is typically based on quantitative data (Walsham 1995; Robson 2002). Even though positivist approach is rather connected with quantitative methodology, it can also be used in qualitative research.

In 1960s the qualitative research had sunk to a very low status among social scientists because it was not believed to be capable of adequate verification. With the introduction of grounded theory in 1967 by Glaser and Straus, the qualitative research was brought back as a reliable research methodology. Besides legitimating the qualitative research, one of the main purposes of introducing the grounded theory was to bridge the gap between theory and empirical research. This approach suggested that theory can be generated and developed through interplay with data collected during research projects (Denzin 1994). The main emphasis of the grounded theory is that the theory should be constructed directly from the field data. Even though the usefulness of existing theories is recognised, the first use of theory is not suggested. This aspect which tends towards the ignoring of existing work is seen as one of the major disadvantages and critiques of the grounded theory (Walsham 1995).

Traditionally in the evaluation of the telemedicine interventions and systems the randomized control trial has been considered and used as the gold standard that should prove or deny the success of particular intervention. Unfortunately it has proven to be unsuccessful method for evaluating telemedicine solutions. This method to some extent ignores the context of the study and often the study couldn’t prove benefit of particular solution. In some occasions

even if the study proved the benefit of some telemedicine solution, this solution was not very well accepted by ordinary users and failed to be in use after the study was over.
It is said that many evaluation projects fail because they select evaluation techniques that can't properly answer the questions asked. To provide reliable results, social surroundings can't be ignored and it is suggested to combine both quantitative and qualitative approach when evaluating telemedicine solutions or information systems. Grønmo (1980) has stated that the distinction between qualitative and quantitative research is to be treated as two polar opposites on a continuous scale, rather than separate research disciplines. The importance of the interplay between those two disciplines shouldn't be forgotten (Grønmo 1980).

There are three phases of evaluation that can be done: pre-implementation, implementation, post-implementation phase. These three phases concentrate on different evaluation questions and the overall aim of each of them can be very different (Stoop and Berg 2003). According to the evaluation phase and the questions that have to be answered qualitative or quantitative methodology could be used. The data collected by using one of the methodologies could be used as an input for the data collection of the other methodology.

Research in telemedicine and information systems is more of a real life research. Typically to this setting is to have open systems that are relatively poorly controlled and situation is generally seen as "messy", there is asocial network around the system and it's has some influence on it. It has been discussed that qualitative approach is better suited for such settings (Robson 2002).

In the last decades some shifts have been observed in the social research methodology, predominance of quantitative methodology step by step have been replaced by putting an emphasis on qualitative methodology (Goulding 2002). Quantitative approach tends to ignore social aspects that could have an influence to the data and by doing so, the results delivered might be found insufficient or inappropriate for proper understanding of social phenomenon.

The data in qualitative research usually is in the form of words, but it can also be presented in quantitative form. The data collection has much less pre-specifications comparing to quantitative research. Usually the design evolves and develops as research proceeds; it is

flexible. Typical methods of qualitative research are interviews, observations, document analysis (Robson 2002; Stoop and Berg 2003).

Qualitative research just as quantitative research is based in various philosophical backgrounds or approaches. Qualitative research can be done through the positivist, interpretive or critical lens (Klein 1999). As mentioned above positivist approach is rather "standard view" of science, it deals with quantifiable measures of variables and hypothesis testing. Positivists are looking for one truth and the objective reality. Positivists tend to ignore the fact that people think and act, that they are active makers of their physical and social reality. This is one of the major critiques to this approach, especially in the studies, that involve people and organisations. It is hard to use positivist approach in such open and changing settings (Klein 1999; Robson 2002).

On the opposite, interpretivists argue that organizations are not static and that the relationships between people, organizations, and technology are not fixed but constantly changing. Interpretive approach suggests that the knowledge of reality is gained through social constructions like language, consciousness, shared meanings, documents, tools and other artifacts. Understanding of context is essential, a lot of attention is paid to peculiarities of the work practice – routines, procedures, preferences, things that usually are taken for granted are enlightened and various realities are accessed. Discovering the details of the work that individuals are doing is the key to gaining proper understanding of the field. Typically in the interpretive studies the researcher tries to get the grasp of the practical realities which confront the individuals in organisational life (Klein 1999; Harper 2000; Stoop and Berg 2003). Although the theory is no doubt an important part of interpretive methodology, it suggested that the researcher should have a considerable degree of openness to the field data, and willingness to modify initial assumptions and theories (Walsham 1995). In the interpretive studies the researcher himself is seen as the research instrument because all the collected data is seen and interpreted through the perspective of the researcher.

An important type of interpretive studies is a field study, this include in depth case studies and ethnographies. Ethnographies usually are associated with long period of time which is spent in the field. Case studies in contrast don't depend only on ethnographic or participant-observer data. Ethnography is one of the key approaches used within the CSCW community

to specify the role of computer based systems in work practice. Ethnographies are seen as a very helpful tool in system design and evaluation (Forsythe 1999; Klein 1999; Harper 2000). Classical critique of interpretive research finds the data subjective and intuitive; it doubts the possibility to generalize the data. Often the methods of data collection and samples are not always identified in advance (Goulding 2002). However numerous articles explain how trustworthy interpretive research can be conducted and reliable data can be collected. These authors give the insight in philosophical basis that can be used for interpretive research and suggests how the research can be organised. Hermeneutics is one of the suggested philosophical approaches that can be used in the interpretive research.

One of the principles that are based in hermeneutics advocates the generalizability of the interpretive data. Use of abstractions and theory is what makes the obtained data generalizable, for example a use of actor network theory in the information system interpretive research (Klein 1999). There are other four types of generalizations that can be mentioned and they are as follows: the development of concepts, the generation of theory, the drawing of specific implications and the contribution of rich insights (Walsham 1995).

Another way of obtaining the reliable data is to use “thick” descriptions. As said by Ulrika Schulze, the difficulty in information and knowledge creation lies in convincing others of the reliability and validity of a knowledge worker’s knowledge claims. Using “thick” descriptions, well described perception of the world by those within the world is essential for better understanding of the field work and seeing the connections between the actors in a complex network. This is especially important for those who were not in the field (Walsham 1995; Harper 2000).

The interpretive studies to great extent deals with reflections and interpretations but those have to be scientific. Walsham (1995) explains that in ethnographies interviewee’s constructions are called first-order data, but the constructions of the researcher second-order data. These second-order concepts rely on the good theory and insightful analysis. Accordingly, mere collection data does not provide these concepts in itself. Suggested by Schulze some level of criticality to the data has to be reached (Schultze 2000).

This study of the common medication card project is conducted in a heterogeneous setting in different organisations, and various health care providers and developers of the system are involved. Both this situation and the stage of development of the common medication card project have influenced the choice of interpretive methods. Also the interpretive approach is potentially better suited for identifying potential research problems and developing the research questions for this study (Stoop and Berg 2003).

4.1.2. Research setting

This study will explore the development of the common medication card project. It will also try to find potential challenges in implementing a new service that, to some extent, can improve the communication between the various health care providers in the Norwegian health care system. Accordingly, this study will look upon the development and integration of the common medication card.

The common medication card project was initiated in 2004 in Trondheim municipality as a part of five national Lighthouse projects that are dealing with use of information technologies and electronic communication as a tool for improving the information flow between different healthcare sectors. The National Centre for Telemedicine in 2005 started working on similar project with similar intentions. Both of the projects are three year projects. There is collaboration between the two teams but the project is conducted in a slightly different way.

In Tromsø, the common medication card project pilot is planned to be started in autumn of 2007. It will involve half of the home care services in the Tromsø municipality. It is expected that around 200 patients will be involved in the study. There are 12 general practitioner offices with around 52 general practitioners in the municipality. It is expected that around 1/3 of the general practitioner will participate in the pilot study. Also the University hospital of North Norway and the causality clinic in Tromsø will be linked to the common medication database during the pilot study. After the study is finished, the service will be evaluated, but there are no particular plans for the common medication card service use in the future.

In Trondheim it is planned to start the first pilot in late spring of 2007. The first common medication card project pilot will be arranged in four zones, it will include four general practitioner offices, the causality clinic and one home care service. The project team in Trondheim and Trondheim municipality has an intention to have the common medication card in use after the project is finished. This gives some level of security to those who are working with development of this service.

There is another difference between those two projects and it deals with responsibility. According to Norwegian legislation there should be a person who is an owner of the common medication card and is responsible for its proper use and information that it is containing. The Trondheim project team has solved this problem with assigning the patient's general practitioner as an over all responsible person. The Tromsø team has found another solution that won't put more responsibility on the shoulders of general practitioners; during the pilot project they will have a person from the municipality and a hospital's head as responsible persons for the common medication card. However this solution might not be possible in the real life setting and it might meet some legal constrains.

The above information shows that this is a very complex and heterogeneous research setting, which might take a lot of effort and time to investigate it properly and map out the information flow between all those involved in providing patient's health care.

4.2. Data collection

Interviews are being used as a main tool for data collection in this study. The medication card is planned to be implemented in rather heterogeneous setting and it is expected that it will improve the information flow between various health care levels. It is important to map out the information flow. To get a better understanding of all the various parts involved, and also to get the grip on their expectations and concerns, interviews with different healthcare providers and project team members were conducted. Data collection process also involved travelling to Trondheim and conducting some interviews there, but most of the interviews have taken place in Tromsø.

The interviews have been conducted in three periods:

1. The first period took place in the spring of 2006. At this period two approximately one hour long interviews were recorded and three rather informal conversations concerning the project were held.

2. The second period was initiated in October in 2006. During October and November five interviews took place both in Tromsø and Trondheim.

3. The third period took place in winter/spring 2007. During this period there were conducted more interviews with different health care workers - potential users of the common medication card and people form the project teams.

In total 15 interviews were conducted with 13 different informants, two of the informants were interviewed twice. Among informants there were people from both project groups in Tromsø and Trondheim, hospital physicians, general practitioners, nurses from home care service and nursing home and a pharmacist.

The interviews are semi-structured and open ended. This way of conducting interviews has been chosen, to help identifying interesting and important issues concerning the implementation and use of the common medication card. Accordingly, some major points of interest were chosen and the interviews developed around these topics. Further interviews developed on the basis of first interviews and some new topics of interest were added to the next interviews. Recorder was used during the interviews and some notes were taken. Recorded interviews were transcribed.

Some other activities were done during the data collection period. On 25th and 26th of September I was attending the Sesam conference in Tromsø. At this conference the common medication card project from Trondheim was presented. This conference provided an opportunity to meet people involved in the common medication card project in Trondheim and get better understanding of the present telemedicine activities in Norwegian health care.
On the regular basis the collected data and study development was discussed with the supervisor and the colleagues from telemedicine studies. These discussions had a great

importance and influence the further development of data collection and issues that should be observed in this study.

4.3. Reflections on the method

The information I have collected contributes to understanding how the project is evolving and what kinds of expectations the involved actors are having – the project team and potential users, health care providers in both municipalities.

The study was started by mapping out the main actors of the common medication card project; it included project team, vendors and potential users of this service. To better understand the connections between various parts involved in such quite large project, it is important to define the actors in this network and define the borders of this network. According to Harper in the field study it is necessary to follow the life cycle of the information through the organisation. This information serves as the basis for the study; it gives an overview of the organisational processes and helps to recognise the key issues in the study (Harper 2000). This will also help to see how different sets of information depend on each other and where in the information life cycle some problems could be met.

Some issues have appeared here, for example if delayed laboratory results or late discharge letter will not influence the quality of information that will be found in the common medication card. Another issue in this case is if the information in the common medication card will be satisfactory for nurses, will it provide them with all the necessary information concerning the patient's treatment. Will the information in the medication card be reliable, will physicians update their patient records when new medication will be prescribed? These are questions that can't be answered yet, but they have to be taken into consideration and we should look for possible solutions.

The present stage of the common medication card project has greatly influenced the choice of the methods and the way this study is done. I see my study somewhere between the pre-implementation and implementation stage. Stoop and Berg explains that pre-implementation

stage deals with questions that are trying to find knockout arguments in favour or against the system and with questions about potential effects and expectations. The development of this project is in that phase when a lot of those questions already have been answered. But I still think that there are some issues I can look upon because undeniably project like this to some extent is driven by political and financial matters and some success is expected. Such driving forces could be a cause of ignoring some important issues of implementing the common medication card service.

Interpretive researcher has a difficult task of accessing other people's interpretations and giving his own interpretation of these interpretations. Walsham stresses that in this case it is important that the researcher of interpretive study has a view of his/her own role in the study that is conducted (Walsham 1995). Initially I have been struggling with defining my role in this study. I have had concerns if I have managed to approach the field of my studies close enough. Even though my previous education is connected with medicine and now I am involved in the telemedicine field, I did not feel a great help of this previous experience and my background, I still have had a feeling of being a stranger in the field. Also the fifth principle of hermeneutics, the principle of dialogic reasoning suggests that the researcher has to identify his prejudice, prejudgments and previous knowledge, because it plays an important part of our understanding (Klein 1999).

I have recognised myself as an outside observer in this study because I am rather distant from the personnel in the field organisations. This situation has some positive and negative aspects according to Walsham. Positive is that researcher is seen as not having a direct interest in some interpretations and outcomes, this is rather followed with more open views from interviewees, but it also brings with harder access to some data and less opportunities to get a direct sense of the field organisation from the inside (Walsham 1995).

Both Harper and Forsythe talks about the complexities of conducting good ethnography studies. The complexity of this process, importance of education in the field and training has been underestimated by many scientists without anthropology background. I have experienced myself the feeling of lack of competence, especially when conducting interviews. Harper says that a well-organised ethnographer has very particular purposes when undertaking the interviews, but I have to admit having experienced some struggles

with this issue. Not only the experience counts, also good social skills and personal sensitivity are of great importance when conducting the interviews. I have experienced that some of my interviewees are much harder to communicate with and some of them really expect me to be rather clear and concrete while I am having conversation with them.
Some of these struggles I have associated with the language barrier we have. As I come from Latvia, but my research setting is Norway and for collecting my data I use English, I think some misunderstandings and miscommunications might appear there. I presume that some meanings might be lost in translations. The principles of hermeneutic circle suggest that for understanding of complex whole, we should understand shared meanings and know the context where they are used (Klein 1999). I especially experienced this when I was having an informal conversation with one Russian nurse working in the nursing home. Even though I thought that I am capable of communicating in Russian, the feeling of not being understood or being kind of misunderstood didn't leave me through all the conversation.

The situation of double hermeneutics that means a subjective interpretation of subjective interpretations has been one of the critiques of interpretive research. Use of recorded interviews that are transcribed complicates the interpretation. Adding a use of third language in this situation complicates the interpretations even more. There are more links than usually between person's subjective reality and my interpretation of that, which means even more potential misunderstandings on the way. This situation might occur to less extent when using the quantitative methods, because those are based on the idea that there is one objective reality. My unfamiliarity with Norwegian also has caused some problems with access to the project documentation and even with conducting interviews, because some of potential users were not able to communicate in English.

This study has been using the elements of ethnographies and case studies but I feel that some elements of grounded theory could also be used when developing this research, because this is not pure ethnography or in-depth case study. Typically for grounded theory is to collect the data, analyze it and then go back in the field and collect more data. It can be done as long as the researcher is sure, that he has discovered all the sensitive topics (Denzin 1994). I have experienced similar situation when after the interview some new topics shoved up and more attention to that had to be paid in further interviews.

After implementing of the common medical card, this study could be developed further by combining the interpretive and quantitative methods. It might be helpful to combine these two methods. Such combination of both methods could contribute to validity of obtained data. Quantitative data in some cases can be more helpful in predicting some of the outcomes of study. But as stated by Grønmo (1980) qualitative and quantitative research should be treated as two polar opposites on a continuous scale, rather than separate research disciplines. There is a great value in using both methods and importance of the interplay between those two disciplines shouldn’t be forgotten (Grønmo 1980).

5. The case study

5.1. The context

This study was conducted in two municipalities in Norway – Tromsø and Trondheim where both project teams are located. The main goal of common medication project was to reduce the medication errors and improve the medication related information flow between different health care providers especially putting emphasis on health care providers in home care service and causality clinic, because problems have been reported especially in these fields.

> *"We did a survey last year that absolutely underlined this, that communication is not good. They just don't follow exact rules, especially the home care service, they don't get the information they need. The information is by law sent to general practitioners but they don't treat patients." – project leader in Tromsø*

This project has a broad scope and involves many different organisations, such as potential users, vendors, national research centres. Some of the participants are as follows.

5.1.1. The Norwegian EHR Research Centre - NSEP

The Norwegian EHR (electronic health record) Research Centre – NSEP. The centre is involved in different research project regarding development, use and usefulness of EHR. The centre was established by the Norwegian University of Science and Technology in 2003 (www.nsep.no 2007). It is located in Trondheim. The centre participated in the common medical card project during the phase of requirement development.

5.1.2. KITH

KITH – Norwegian Centre for Informatics in Health and Social Care is located in Trondheim. A great deal of KITH activities is related to standardisation and coordination that deals with codes and terminology, electronic information exchange, information security, electronic health record systems and digital imaging systems (www.kith.no). KITH is very important actor of the common medication card project because it has close collaboration with EPR system vendors.

5.1.3. Trondheim municipality

Trondheim municipality is a municipality in Sør-Trondelag, it is centre of health region Central Norway. Trondheim is the third largest city in Norway with approximately 160 000 inhabitants. Approximately 1,5% of inhabitants in Trondheim are potential users of the common medication card service. Therefore Trondheim municipality is partly financing the common medication card project in Trondheim and is showing interest in having this system after the project is terminated.

> *"It's very seldom when you get the municipality or the hospital to use so much money in one project. We have never seen anyone with such willingness to invest in a project." - TN*

5.1.4. Health care providers/institutions in Trondheim

St. Olav's hospital is a university hospital in Trondheim and a central hospital in the health region Central Norway. This health region has a total of 630 000 inhabitants. According to data from 2004, the hospital has 1350 beds and every year there are approximately 50 000 patients referred to the hospital (www.stolav.no 2004). Even though the hospital is potentially a very important actor in the common medication card service, due to serious reforms in the hospital, it is not taking part in the first stages of the common medication card pilot in Trondheim.

Søbstad nursing home is one of the biggest nursing homes in Trondheim it has 128 beds and is organised in four big departments. One of the departments in this nursing home will take a part in pilot testing of common medication card service in Trondheim.

5.1.5. Norwegian Centre for Telemedicine

Norwegian Centre for Telemedicine (NST) is located in Tromsø in North Norway. For more than 10 years the Norwegian Centre for Telemedicine has been working with developing various telemedicine solutions and to great extent also contributing to use of ICT in health care in Norway. In 2005 NST initiated the common medication card project which is financed by HealthNorth (NST).

5.1.6. Health care providers/institutions in Tromsø

University hospital in North Norway (UNN) is the central hospital in the health region North Norway. It is located in Tromsø municipality. There are 619 beds in the hospital and since 1st of January 2007 hospitals in Narvik and Harstad have become a part of UNN (www.unn.no). UNN is going to be one of the users of the common medication card in Tromsø during the pilot testing in summer 2007. Causality clinic in Tromsø will take a part in the pilot study.

Home care service “Fastlandet” is located in Tromsdalen. It takes care of approximately 340 patients and is divided in three departments (www.tormso.kommune.no).

5.1.7. General practitioners

Since the reform in healthcare sector in 2001 when patients are signing up for a regular general practitioner, the role of general practitioner has changed and it is expected that general practitioners are having better overview of patient’s health. There are 123 general practitioners in Trondheim municipality and around 52 in Tromsø. General practitioners will be informed about all the changes that will be made in medication list. Besides the general

practitioners in Trondheim will be overall responsible for the medication list and the changes in it, but this is not the case in Tromsø.

5.1.8. Electronic patient record vendors/suppliers

Profdoc Norge AS (Winmed, Vision) is a company that is providing healthcare information technologies. It was founded in 1985 in Norway but over the time company has extended its activities also to other Scandinavian countries and is expanding even wider. Profdoc is one of the leading EPR system vendor both for hospitals and general practitioners in Norway (www.profdoc.com).

DIPS ASA (DIPS EPJ/PAS) is a company that is located in Northern part of Norway and is working with EPR systems for hospitals, especially stressing the effectiveness of paperless EPR concept. Last year the company was named among 50 fastest growing technology enterprises in Norway (www.dips.no).

Visma Unique AS (Unique Profil) is developing and implementing IT solutions both in private and public sector with the main focus to public sector. Unique Profil is a system for community care nursing-, rehabilitation- and home care services used in different municipalities in Norway (www.visma.no).

Acos AS (Cosdoc) among other systems have developed systems for community care – nursing homes, rehabilitation and home care services (www.acos.no).

Hove Medical System AS was founded in 1999 and was a pioneer in the field of EPR systems. Company is offering electronic patient record systems both for primary and secondary care (www.systemx.no).

Infodoc AS (Infodoc) is a computer-system vendor for healthcare sector in Norway both for private practices and large organisations (www.infodoc.no).

TietoEnator AS (Infomedix, Gerica) is a large international software company that has wide spectrum of products and offers products also for healthcare and welfare sector (www.tietoenator.com).

These vendors represent nearly 100% of the Norwegian EHR market when it comes to general hospital systems, community health service systems and general practitioner systems. Having so many of patient record vendors involved is very positive for project's success.

5.2. Introduction to the project

The common medication card project is collaboration between two independent project groups, one in National Centre for Telemedicine in Tromsø and the other is a project group in Trondheim municipality. The project team in Trondheim have established some collaboration with municipality in Stavanger which is one of the Lighthouse teams and have been working on similar solution that is mainly about using electronic messaging for exchanging medication information. Some of the information that is planed to be exchanged is information from the hospital to the community health care, general practitioner's medication list and the medication list to and from the multidose suppliers.

The intention of the medication card project is to reduce the medication errors in the health care. Especially those which appear because of the lack of information about prescribed medication in different healthcare levels. Electronic patient record is an important tool for carrying out this project.

> *"The patient record is the core in the flow of information in the health service. It is here that all information is gathered from those who have an obligation to provide documentation….this core will need to be well integrated" – Teamwork 2007*

As a part of national lighthouse project Trondheim municipality initiated common medication card project in 2004 and it is planned to terminate this project in the end of 2007. Parallel in 2005 NST started similar three year project.

5.3. Some background on this project

As health care is provided in different levels and by various health care providers, the lack of common information about the patient has been experienced. In national health care strategy 2004 – 2007 for Norway – Teamwork 2007, two main priorities are named. The first one involves improving of information flow in health care sector stressing that:

> *"electronic interaction between different actors and applications is essential" (SHdir 2004)*

Similar initiatives have been discussed among health care providers in western countries and various solutions have been proposed (www.scotland.gov.uk 2006). There are several potential solutions in Europe like European Patient Summary, Emergency Care Summary and Summary Care Record. The main goal of these projects is to provide health care personnel with up to date information about patient's health state and his/her medications and it is planned to be done by using electronic patient record systems and insuring electronic interaction between various health care providers.

The other priority mentioned in Teamwork 2007 deals with including more actors in electronic interaction that is taking place in healthcare sector. Up till now the electronic interaction has involved health enterprises, general practitioners and the National Insurance Service. The national strategy suggests that patients, relatives, pharmacies and municipal health and social services are actors that must be included more closely in this interaction (SHdir 2004). This is in tune with western trends of empowering the patients and can be related to the studies in Europe that suggest exploring more the potential of nurses role in health care.

One of the consequences of poor information flow in healthcare sector is medication errors. It is stated by KITH that wrong use and wrong handling of medications is a great problem in primary healthcare. Previous studies have shown that around 50 – 90 % of patients in home care have had some differences in medication information in medication card in the home care service and in general practitioners office. It is estimated that in Norway there are

approximately 160 000 of medication related errors per year that occur to non hospitalized patients. Approximately one third (50 000) of these errors could have been avoided (www.kith.no). There is an assumption that considerable amount of these errors is caused by lack of information. Reducing these errors is one of the main intentions of both common medication card project groups.

In Trondheim municipality a medication survey was conducted to gain some insight in the situation with medications for people using home care service and this survey showed some problems. For a period of time a group of people that receive community health services participated in this study that was dealing with the medication that participants are taking and what actually was prescribed. The results were rather surprising, almost one third of the drugs "disappeared" and patients received 82 drugs from some other sources.

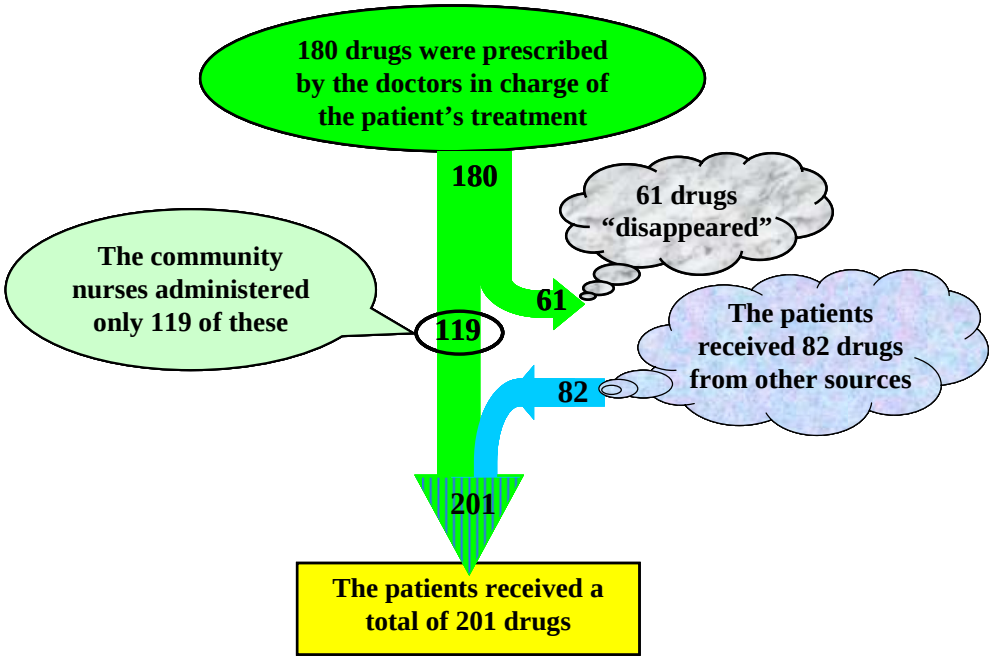

Figure 1 Medication survey from Trondheim

Documentation is different for every health care provider, there are several health care providers that are involved in taking care of one patient and all of them have slightly different information that is documented in their own patient records.

The figure bellow shows the patient and information flow in the Norwegian healthcare sector.

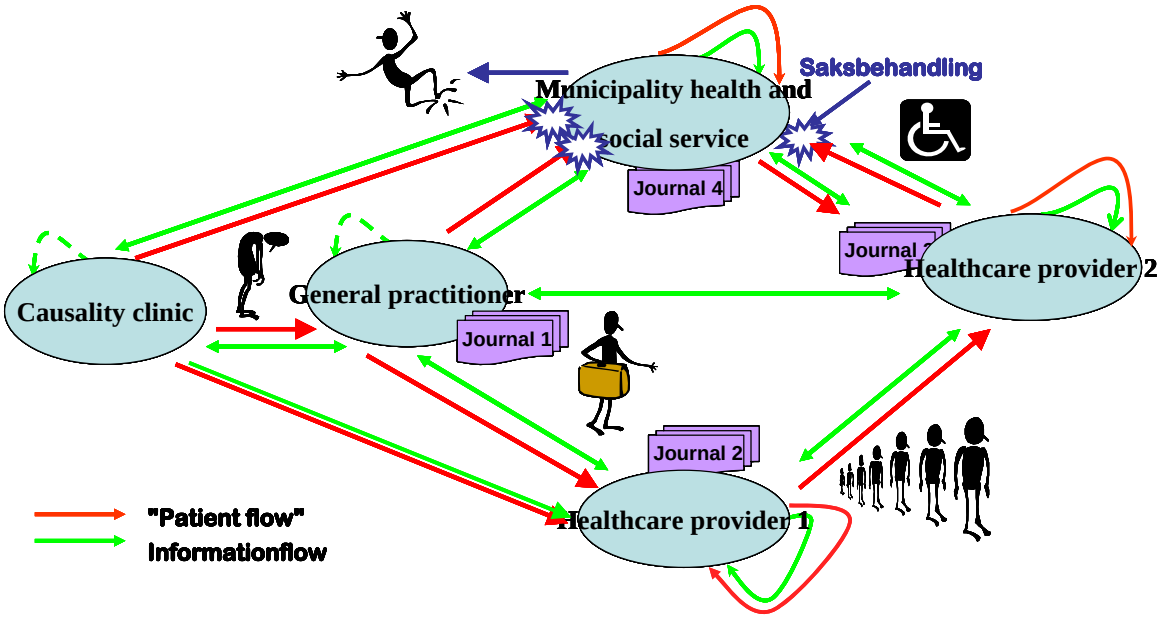

Figure 2. Present information flow between different healthcare providers

In contemporary western health care a patient often is getting care in various institutions. As seen in the figure above there is one patient and several health care providers. Every health care provider has their own patient record whether it's electronic or paper. This leads to a situation when there is rather fragmented information about the patient and often this information might not be up to date. Even though the patient is travelling between several health care providers and health related information should be following the patient, in reality the information about present health state of the patient is not following the patient simultaneously, it's often delayed and incomplete.

In the project description of Trondheim project it is stressed that the target group of this service is mainly the patients, who now will receive safer care, but it also emphasised the home care service personnel as main users of this service. They will receive more information for providing better care (www.trondheim.kommune.no).

The main goal is to reach: correct diagnose – correct prescribing – correct use of medications. Even though it is not stressed in the project descriptions, but saving of time is another burning issue often mentioned by physicians. Particular amount of time is invested in finding out this very important information.

> *"..drugs and allergies are two most important things for a doctor to know when the patient comes to the hospital." – physician (SB)*

Though this information is so important, because of the time pressure, physicians often do not have enough time to find out all the medication information if it is not presented already. In hospitals it often results in cancelling all of the previous medication.

> *"In the hospital when I get tired of finding the medications, I just tell nurse to find it, and if we don't have it, I don't bother to waist my time asking the patient what is he taking." – physician (SB)*

This service might have a potential of saving time for health personnel. This could be a good motivation when promoting the common medication card service.

5.4. The national medical card project

Electronic medication card project is seen as a potential solution for reducing medication errors and improving medication related information flow in various healthcare sectors. This project was initiated in 2004 in Trondheim municipality as a part of the national Lighthouse project (www.trondheim.kommune.no). The main intention of this project is dealing with improving the routines of care for patients that are using home care service. By introducing information technology solutions it is planed to ensure that the medication related information is up to date, thus reducing the medication errors that appear because of the lack of information. Main purpose of this service is to achieve more secure handling of medication in primary care and in addition to decreasing wrong medication and gain economically.

Goals of this project is that all 1500 patients whose medication is administered by home care service in Trondheim municipality, should have right medication in right amount at the right time. Through the continuously updated medication card the quality of administering the medications should improve. The overall goal is to conduct the project in accordance with the national standards.

In the table below the expected progress of the project is shown.

Table 1 Project timeline (plan of progress)

Project year		**2005**				**2006**				**2007**			
Project groups	**Main activities**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1) Evaluation and research	Mapping and studies of routines			X									
	Requirement specifications and routine evaluation			X	X								
	Evaluation											X	X
	Distribution of information and knowledge		X	X	X	X	X	X	X	X	X	X	X
2) OFU- project	Preproject			X	X	X							
	Main project						X	X	X	X			
3) Technological development	Requirement specification			X	X	X							
	Preparing technical infrastructure							X	X				
	Pilot test								X	X			
	Prepare pilot test		X	X	X	X							
4) Carrying out the project	Exchange of messages						X	X	X				
	Pilot of core medical record									X	X	X	X
	Requirements of organisation development/routines			X	X	X							
	Security related tasks			X	X	X	X	X	X	X	X	X	X
5) Standardizing, risk analysis	Lighthouse projects		X	X	X	X	X	X	X	X	X	X	X
	E-prescription, ELIN, NST/Stavanger		X	X	X	X	X	X	X	X	X	X	X
6) Collaboration with other projects			X	X	X	X	X	X	X	X	X	X	X

5.4.1. Trondheim project

Trondheim municipality is a central municipality in health region Central Norway it has around 160 000 inhabitants and there are 123 general practitioners in the municipality. In Trondheim municipality the EPR systems are used already for more than 10 years, not only

by general practitioners but also both by all nursing homes and home care services. KITH has an important role in this project because it is involved with all the electronic patient record vendors in Norway and has a particular influence in this relationship.

> *"KITH has an involvement with all the vendors and they do as we say them to do." – Project member from KITH*

The electronic medication card will be a part of a consent based core medical record. This is a three year project, that started in 2004, during the year 2007 Trondheim municipality will try out a service of electronic sharing of medical information through the consent based electronic core medical record (www.trondheim.kommune.no). The first common medication card pilot will be arranged in four zones, it will include four general practitioner offices, the causality clinic and one home care service. In the first round of the pilot St. Olav's hospital in Trondheim, the central hospital of health region Central Norway, will not participate because of some changes in the hospital's EPR system, but it is expected that the hospital will join the pilot in the last phase of the project. Project team in Trondheim stresses that pharmacy is potentially a very important actor, but it's not joining the project before the e-prescription project is finished and electronic prescription database is implemented.

5.4.2. Tromsø project

In year 2000 Norwegian Centre for Telemedicine conducted a study that was investigating the possibilities of using net-based common medication card. The conclusion of this study was not positive. At that time due to lack of infrastructure and some legal and security issues it was impossible to use such net-based service. Electronic patient records were not used by all health care providers and it was not common to communicate health related information electronically. Not only the privacy and security issues were of concern, but in this case of such common information database when many users are contributing to it and using this information, the ownership of information became a serious concern.

Five years later in 2005, some of the initial problems were solved. The use of an electronic patient record had grown and it had become common in most of the health care sector.

Health related information increasingly was shared electronically through the secure network – HelseNet. There was a growing need to improve the communication between different health care levels. Some legal and privacy issues are still unclear, but for the most part, it seemed to be possible to create and implement a common database of the medication information. It was expected that this service will link hospital, causality clinic, general practitioner's office, nursing home, home care service and pharmacy to one common medication database. Accordingly the potential users of the common medication database are general practitioners, hospital specialists and nurses, causality clinics, nursing homes, home care service nurses and pharmacists.

Tromsø municipality is the central municipality in the health region Northern Norway. There are 12 general practitioner offices with approximately 52 general practitioners in the municipality. It is planned to test the medical card in real life setting in autumn of 2007. This pilot study will involve half of the all home care services in the Tromsø municipality. It is expected that there will be around 200 patients that will use this service. Around one third of all the general practitioners are potential participants of this pilot study. Furthermore the University hospital of North Norway and the causality clinic in Tromsø will also be linked to the common medication database during the pilot study.

5.4.3. Merging of both projects (collaboration)

After working separately in the beginning, both projects began to collaborate in 2006. One of the possible reasons of this collaboration was Tromsø project team's interest in working closer with KITH, which was part of the Trondheim team.

> "*The project in Trondheim has involved KITH. KITH is the most important project part in Trondheim, actually it is KITH we are cooperating via Trondheim*" *– project leader in Tromsø.*

Another argument for collaboration is gaining more influence in discussions with electronic patient record vendors admits the leader of the project team in Tromsø.

"Because of this cooperation we are much stronger and we can in another way demand these integrations from vendors. After we have agreed to cooperate we really see that they are taking us more serious."

After agreeing on collaboration both teams started working on different task in developing the common medication card service. Tromsø project team cancelled development of its own medication database and started working with development of web based solution (application) for accessing the common medication database without being a user of EPR. Trondheim project team took responsibility for development of database.

Even though both project teams are collaborating, the pilots will be conducted slightly different. Trondheim project team has no need in using the web-based solution that is developed in Tromsø, because all the EPR systems used in the nursing homes or home care services in Trondheim will be upgraded with necessary functionalities. In the first phase of testing in Trondheim users of electronic medication card will be general practitioners, causality clinic, home care service and nursing home. The regional hospital is expected to join the last phase of testing. On the other hand in Tromsø, the users will be hospital, general practitioners, home care service, nursing home and causality clinic. Some of the users will have to use web-based solution because they do not use EPR systems yet. Another difference is dealing with legal issues. The functionalities of the service are going to be the same, but in Trondheim each of the patient's GPs will be responsible for information in common medication card, instead in Tromsø during the pilot it will be cooperation between the head of the municipality and the head of the University hospital of North Norway.
The future expectations of the project in Tromsø are unclear:

"The project closes in December 2008, after that I think it is not working in Tromsø. In Trondheim they are buying this application, so they plan to have it after the project period. They are sure that this system is ok with data inspectorate, but I know that it is not so." –project leader in Tromsø

Trondheim project team is expecting to use this solution in the real life after the project is finished as already mentioned above.

"That's what is very good with Trondheim project, the municipality of Trondheim they are not in to test something, they are in to get a solution. So this is going to be used, it's not a question if it should be used or no." – project member from KITH

5.5. The technology and its intentional use – "the evolution, not a revolution"

"This solution is based on the experience with structuring health information and what possibilities the technology provides, what you can do without having to make a revolution. What can be an evolution, not a revolution." – project member from KITH

The main idea of common medication card is to share the medication information on the secure network between various health care providers. Some users of this service will be able to contribute with information, add medication information but others will be able just to access the information. Users that will be able to contribute with information will be medical doctors (physicians) because these healthcare professionals have a right to prescribe the medication and writing an (electronic) prescription will update the medication card with the necessary medication information.

Common medication card or core medical record database is planned to be a part of a general practitioner's electronic patient record that is placed on a separate server. Such functionality allows sharing different kinds of information from the electronic patient record, but by now it is planned to share only medication information and information about allergies. But as it has possibilities for sharing more information, it can be seen as an open-ended system.

"The possibilities of this service are much wider then the medication card that is going to be tested. It is more like a patient summary." – project membert from KITH)

Openness of this system can be seen also in the future plans of the Trondheim project team, which is to add more actors to medication card. During the project it is not planned to include pharmacies, but pharmacy is seen as a potentially very important actor in this

network. The information provided by pharmacy will actually show the real medication situation. In future also the patient him/herself or his/her relatives are seen as potential users of the medication card. Figure3 shows the information flow after the medication card service will be introduced.

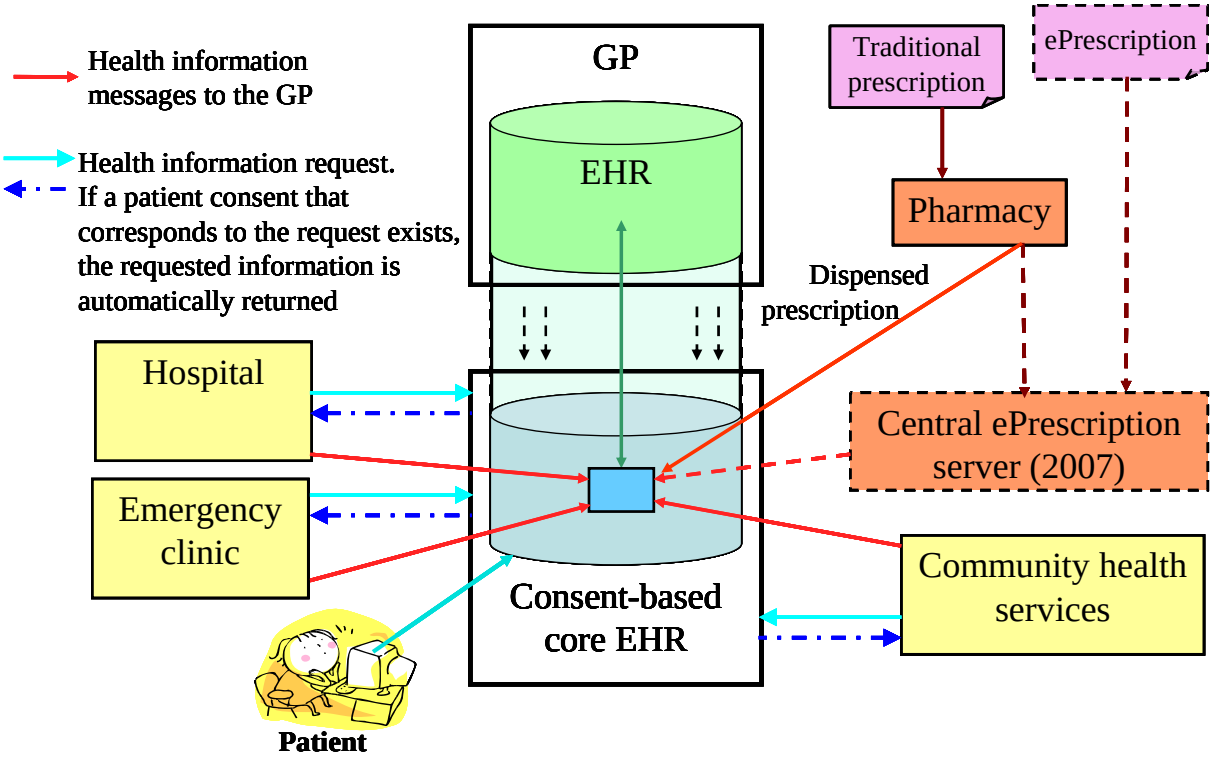

Figure 3 Expected information flow when using common medication card

It is planned to access the information in the medication card via the electronic patient record, in case if the health care providers do not yet use the electronic patient record, a web application for accessing the database will be offered.

Any new information that appears in the health care provider's electronic patient record concerning the medications will automatically be sent to the common medication card database and the general practitioner will be notified about these changes. It is expected that via the medication card home care service nurses will be able to order new prescriptions from general practitioners.

The information about medications that can be obtained from electronic patient record today is seen in the figure below. The layout of information can vary in different EPR systems, but mainly it contains information about the name of the patient, name of the medication, dosage, and some indications, just as special notes for example information about allergies.

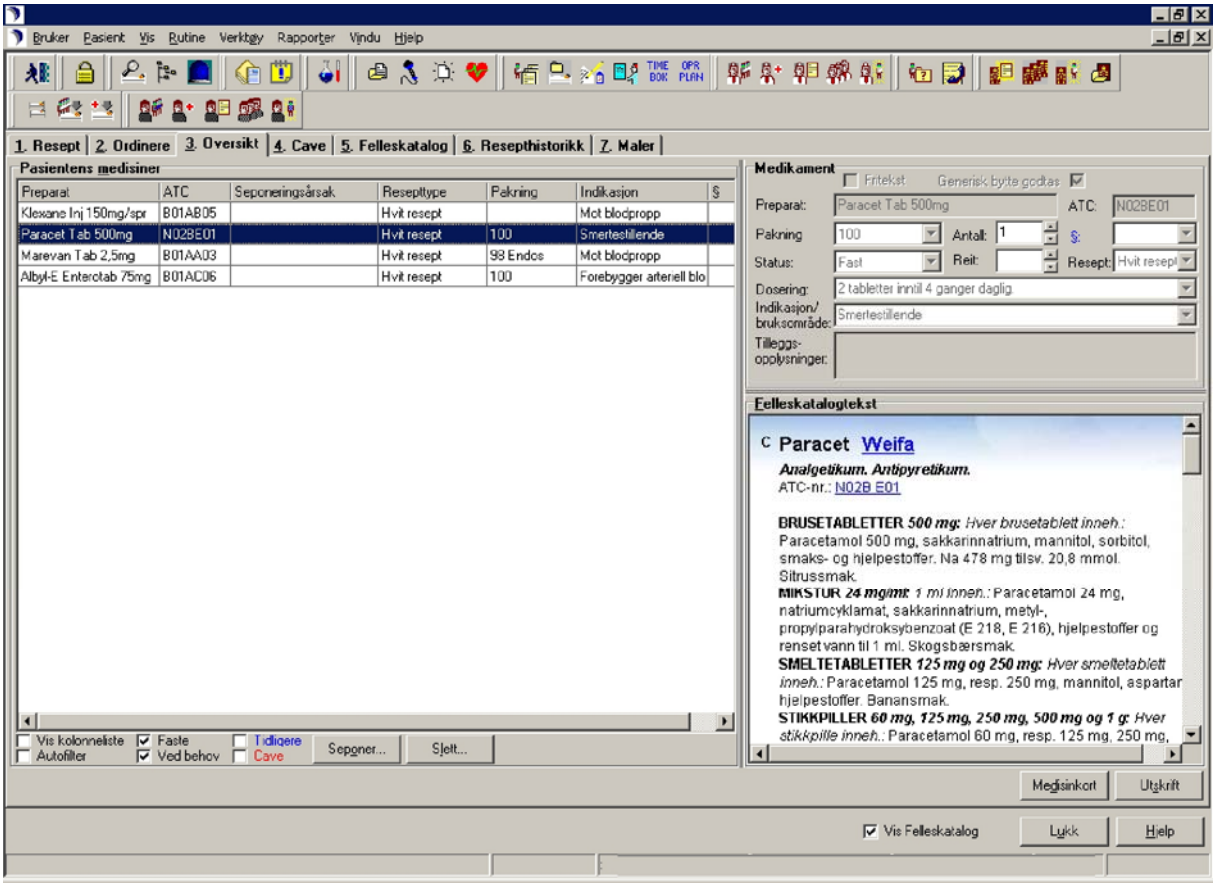

Figure 4 Screenshot from medication overview in DIPS EPR system used in the UNN

The common medication card will contain similar information about medications, but this information will be more expanded and some additional will be added. Figure5 shows the layout of web accessed common medication card. The common medication card will offer following information:

- Patient information – patient's name, surname, personal ID number, gender, allergies, medication administrator (person who is administering the medication while the patient is at home), some relatives

- Medication information - medication code, name and form, strength of medications, doses, way of administering, date of initiating and terminating the medication, indications, reason of cancelling, date of last prescription, date of receiving the medication in pharmacy (only after pharmacies will be included in the service), unique ID of person who prescribed/cancelled the medication

- Date of last changes

- Login – time and date, unique ID of user (health personnel), activity type (read, update)

- Consent information – unique ID for institutions that have access to the medication information, unique ID for health personnel that do not have access to the information, unique ID for the person that has received the consent (GP)

- Medication administrator (for each patient it should be one unit that administer the medications to the patient) – ID, name, address, phone number and email address

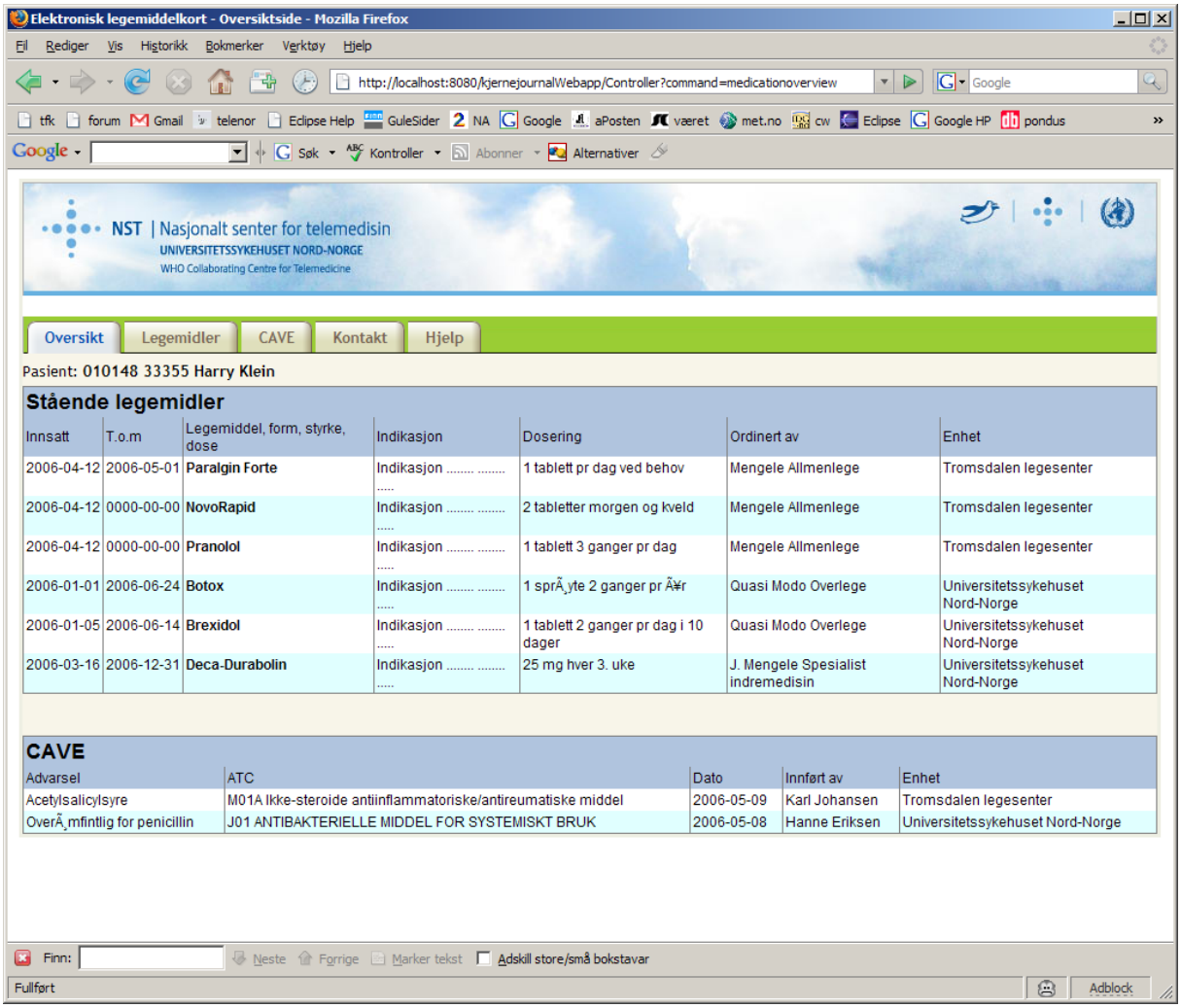

Figure 5 Screenshot from medication overview in the web solution developed by NST

5.6. Current practice

Common medication card developers have defined a clear group of patients who could benefit from this solution. It is expected that medication card is service that will be used for patients who have home care service to administer their medications, these patients often have to use a lot of drugs, and often they are elderly people. All of these patients have regular general practitioner, but the main communication they have with home care nurses. If patient has been in hospital or causality clinic or has had a visit to some private specialist there might appear some medication errors related to insufficient information about medications in other healthcare institutions.

5.6.1. Home care service

When the home care service takes the responsibility of administering patient's medication, some administrative procedures have to be done and the necessary information has to be obtained. It is initiated with a patient signing a consent that delivers the responsibility of administering the medication to home care service. After this consent is signed the home care contacts patient's general practitioner and informs him/her about these changes and obtains the necessary information about the patient's care and medications. These routines can be slightly different in different municipalities.

Depending on the patient's situation these formalities can be done differently. If the patient is discharged from the hospital and there is a need for special care that can be provided by home care service, then the hospital contacts the home care service and the necessary information about patient and patient's medication is delivered by hospital with discharge letter and nursing notes. In this case patient's general practitioner even might not have the latest information about patient's health state and the medication changes in the hospital.

> *"The general practitioner doesn't necessarily know what happened in the hospital. He is supposed to get that information, but if the patient comes out of the hospital on Thursday afternoon and he needs the care on Thursday evening…" – general practitioner (P)*

If the patient has been in the hospital and after discharge the home care service has received all the necessary information about patient care and medication from the hospital, the general practitioner is almost not involved in the patient's care at all. General practitioners are contacted only when some unexpected complexities appear.

> *"If everything is like planed doctors are not very much involved in the home care. If patient's recovery after he/she left the hospital is according to plan, patient don't see the doctor at all." – general practitioner (P)*

5.6.2. General practitioner

According to legislation the physician is responsible for patient's medication and informing the home care service about changes in the medication information, if the patient's medications are administered by home care service. There are two ways how the general practitioner can inform the home care service about changes in the medication. One way is to make a phone call to the home care and the other is to fill out a special paper form for home care service about changes in medication. This form is later delivered to the corresponding home care service. However the real life situation is slightly different general practitioners might forget to make a phone call or fill out the form. Consequently the home care nurses have to take a lot of initiative to get the information that is necessary for providing adequate care.

> *"We often say that we take more responsibility for patient's medication than we have to, because it is a doctor's responsibility. But doctors know when we have the responsibility for patient's medication we do what we have to do and they just sit back" –home care nurse (B)*

This is confirmed also by general practitioner, who admits that home care nurses are actively involved in acquiring the medication information and managing the administrative part of patient care.

> *"If the patient has been in the hospital, they (home nurses) are usually very clever to come to us very quickly and ask to resign the medication." – GP*

The medication list that is used by home care service can be seen as the only up to date medication list while the patient is at home.

> *"The medication list that the home care service has is the only medication list that is updated for sure, because it is the home care service that physically gets the tablet and gives them to patient." – general practitioner (P)*

It is similar when the patient is in the hospital or nursing home, then the actual list of medications is most likely supervised by nurses who administer the medication. In some cases when general practitioners are referring the patients to the hospital, they might ask patient about the medication patient is taking or in case, the patient doesn't remember that, general practitioner has to check this information in the patient record. Another possibility if the patient is having home care is that in the referral they suggest to check the medications from the list provided by home care service.

> *"I usually ask patient, and if the patient doesn't remember then I have to check. Home care usually has updated lists and they send those (lists) with the patient to the hospital. Or if it is a home care patient, then what I usually do is in the medication part (of referral) I say - see the home care list. It is the only list that is updated for sure." – general practitioner (P)*

If the patient has not had home care before referring to the hospital, there might be incomplete medication information provided by the patient's regular general practitioner, because it is not uncommon that the medication list in the electronic patient record is poorly updated. If the referral is electronic, then patient's medication information is added automatically, and the missing medication information has to be added manually, which is a case in situation with poorly updated medication lists in electronic patient records.

One of the possible reasons for not updating the medication lists is that updating of this list is rather time consuming process and has to be done in inefficient way – more than one click to make changes. Medication information from discharge letters has to be put in the medication list manually and often it is not done before the next visit of the patient.

> *"What you do is, you see he (patient) has Zelock 50mg once a day, you go first to prescription, then edit medications, you write down Zelock to the search, get the list, find the right one, click on that, write it down, fix the doses so they are right, press the button and then it (the EPR program) asks "do you want to edit the medications". You say "yes" and then it goes there (in the medication list). And then you have to delete previous medication or dosage before you go to another. The amount of information*

you can get from this medication list is very small in the relation to work that you need to put there to keep the list updated." – general practitioner (P)

5.6.3. Hospital, causality clinic

If patient has not been in the causality clinic before there is no information available about the patient and the only actual source of information is patient. Sometimes physician in causality clinic has to call some of the previous healthcare providers, but this always takes time.

"That is the heart of working as a doctor, that what you do is you manage with insufficient information and you have to make decisions. Always as a doctor you base your decisions on insufficient information. You never have sufficient information, you play with probabilities." – general practitoner (P)

If the patient is referred to the hospital, then the medication should be included in the referral as already mentioned above. But as referral might not contain all of the medication information, often the actual medication list has to be combined from different information sources.

"… the situation now is that we have to combine the medication list based on pills the patient brings with himself to the consultation and a list of medications from a referral letter." – physician (A)

During patient's stay in hospital, while the medication is prescribed by hospital physicians and administered by nurses, there is a small chance that patient might be taking medication that is obtained from some other source. The main problem so far has been delayed information from hospital to patient's general practitioner. Discharge letters containing the medication information are sent some days or even few weeks later

6. Discussion

Common medication card is potentially a very valuable service that might bring important improvements in providing healthcare services. This service might even add some unplanned value to routines of healthcare providers. Today healthcare personnel in both specialist and primary healthcare are complaining that medical information they are receiving from some other healthcare institution can not be automatically added to their EPRs, it has to be done manually. Common medication card may be a solution for this problem because it may provide structured information as well as it is easier to operate with this kind of information in electronic systems. Especially it should be possible when using well integrated open electronic systems, but up to date there have been problems because these systems are still used in ways that is better suited to paper-based work practice. This can as well be explained by the complex nature of healthcare and the specificity of the information which is hard to structurise. To great extent success of common medication card service will depend on how well the implementation of this service will be executed and how well the designers of this system have considered the present work routines. Not to mention the training of potential users of the service, which is necessary if this service should be used in the best possible way.

In this section some of the potential challenges that might occur in the common medication card project will be described and analysed. Common medication card is a complex network that involves healthcare providers both in primary and secondary level and will try to insure better information flow between those levels. To analyse such network I use actor network theory to pinpoint the connections and interdependencies in infrastructures as large and complex as this one. The research questions were as follows:

- What are the potential challenges while implementing the common medication card service?
- How to achieve the sustainable use of this service?
- How different driving forces influence the development of the common medication card projects in Tromsø and Trondheim?
- How can common medication card improve the collaboration between different health care providers?

- How use of the common medication card service could change the work practice in healthcare sector?

6.1. Obtaining sustainable use

As mentioned in chapter two, for more than 20 years different kinds of telemedicine solutions have been proposed and seen as promising improvements for delivering better healthcare.
Consequently in these two decades there have been many solutions that have received very good evaluation and seem to be potentially very promising for use in healthcare sector. However too many of them fail to be integrated in work practice (Cornford and Klecun-Dabrowska 2001; May 2001; May and Ellis 2001). And this is not because of the lack of functionality or bad design. One assumption is that such failures often happen because of lack of awareness about established practices in settings where the solution is supposed to be used. Systems are badly integrated in the organisational structure. This has been explained by the often technology-orientated nature of health information systems and a need to more social- and communication-oriented approach has been suggested (Giuse and Kuhn 2003).

The value delivered by an information infrastructure depends on who is seen as a user. The effects of IT integration vary across the organisation. Therefore it is challenging to find a balance between value for users and continuity of production and compatibility (Rönnbäck, Holmström et al. 2006).

Actor network theory suggests that stability, technological and social order in the network is constantly negotiated. This is done through a process of translation, an important part of this process is mobilisation. As suggested by Callon mobilisation is done by representatives of some group with the intention to coordinate the actions and direction of this group.

"To speak for others is first silence those in whose name we speak." – (Callon 1986)

Mobilisation results in forming alliances and acting as a unit of force. Successful translation and mobilisation often lead to alignment of the network. Alignment is rather a fragile state of the network and it has to be constantly negotiated and even if network has reached some kind of equilibrium, it is likely that it is temporary (Aanestad and Hanseth 2000).

One of the common medication card challenges is to obtain sustainable use and ensure that this service is adding value to all the involved users, because this solution seems to be very dependent on well established routines of updating the common medication card by all its users. Adding value to all the involved users of medication card is one way how to manage one of the main challenges - obtaining the sustainability of this service. There are threats to sustainable use in both projects. The Trondheim project has a pressure from potential purchaser of the newly developed service – Trondheim municipality, who is also partly financing the project, while the NST project tends to be more of an experimental initiative, this study very much depends on the funding the project team is receiving from HealthNorth.

The national common medication card project is a large scale project, estimated costs of this project is more than 25 million NOK. The project is of a large scale not only from financial perspective but also as a result of different actors that are involved thus creating a wide network. The common medication card project is partly collaborating and to some extent has some interest in the successful development of two other big projects in Norway – e-prescription and ELIN-K. Both of these projects might be linked to the common medication card project later in the future. The amplitude of this project naturally raises a lot of expectations from this service and success to some extent is expected. But there are considerable differences in future expectation of both projects.

The Tromsø project is run by the National Centre for Telemedicine (NST), which is a research organisation in northern Norway. NST is developing and testing various telemedicine solutions, often funded on a pre project basis where the services do not run after the project period:

> *"The project closes in December 2008, after that I think it is not working in Tromsø."*
> *– project leader in Tromsø*

A major challenge in this case is therefore to create a robust solution after the project is terminated. One explanation may be that nobody will be working on promoting and selling the new solutions. A closer collaboration with potential users or purchasers might be a way of ensuring the long term use of it in the future.

In addition it is rather surprising how differently the legislation issues are interpreted in the two projects. One team doesn't see this project working in today's practice, while the other team is sure that their solution can be used without a doubt, after the project is terminated. The project leader thinks that service like this is not possible to use in the real life setting in accordance with today's legislation in Norway. Interestingly there are only small differences between both projects and these differences are dealing with responsibility issues, but they result in quite different future expectations from both project teams. The project team in Tromsø has defined why there is a need for this solution but has not worked out a long-term strategy for making it a sustainable solution after the project period.

> *" A. Who should buy (owe) this service?*
> *B. It is a difficult question and I don't have an answer. It will be something we will have to write in the end of the project. What does it cost and should each hospital buy it, each GP office or municipality should buy it and so on. Personally I don't believe in the system that each one has to buy. But we have to document that it is really good, then it is easier to argue on its value" – project leader in Tromsø*

This constitutes a real challenge as potential success in the project is not pursued.
The collaboration between both project teams could be closer thus making both projects stronger. As Trondheim team has some important actors involved in their team, the Tromsø team needed to be flexible and accept some of the directions Trondheim team had set up.

> *"I have wanted vendors to be more integrated in specifications, but Trondheim does not have the same idea how this specification part should be written down. They kind of want to chew it together and then give it to vendors. …I haven't been that happy about that part." – project leader in Tromsø*

The Trondheim project is conducted in close collaboration with municipality which is partly financing the project and is expecting to use this service after the project period is over. This has provided a lot of confidence to project team.

> *"That is what is very good with this project, the municipality they are not in to test something. They are in to get a solution. So this is going to be used, it is not a question if it should be used or not. Therefore this is going to be implemented in the system in a way that it can be used after the project and nothing has to be done when the project is finished." – project member from KITH*

It seems that the main actors are successfully aligned to reach the project goals – GPs have agreed to be overall responsible for information in common medication card *"they (GPs) have accepted and agreed to it, all of them"*, municipality is closely involved *"the one who has control of this project (in Trondheim) has no one above him; he takes the decisions on behalf of Trondheim"* and even all the EPR system vendors have agreed to make necessary adjustments in their systems. All of the healthcare providers in Trondheim are using electronic patient record systems, this is rather positive aspect when it comes to use of this new common medication card service. If well integrated in EPR systems the common medication card might have a very good functionality, because EPR is one of the most important tools of healthcare providers. Most of the healthcare providers are used to using EPR systems and it might make it easier to start using this new service, especially if it is successfully integrated in the record system as just another new functionality. The project team in Trondheim seems to be very confident about the end result of their product. But is the success really so close?

> *"It is much easier to get health personnel to use it. They get new functionalities in their systems at least once a year, so this will just be another new functionality." – project member from KITH*

In contrast the web-based service in the Tromsø project is created for those who are not using the EPR systems, typically the home care service. This means that it is not necessary to have any agreements with EPR vendors about changes in their systems.

One of potentially very important actor in common medication card network regional hospital in Trondheim – St.Olav's hospital, is not taking part in the first pilot testing of this service. This is rather important actor and absence in project by such figure might decrease the strength of the obtained results and some potential weakness of the service might be missed out. This underscores the potential benefits of having a closer collaboration with the Tromsø project because here the hospital is included. It could be very useful for Trondheim team to strengthen the results they have obtained and see if the medication error related visits to hospital has decreased.

> *"The pilot in Trondheim will not include the hospital, so for hospital patients we will have only these numbers in Tromsø." – project leader in Tromsø*

Neither of project teams will have pharmacy included during the pilot testing, even though it is repeatedly stressed that pharmacy is an essential actor to get better overview of medications that have been prescribed by some external sources – like private specialists or family members.

> *"The medication information from other sources, that is what is really the most important to get full control of" – project member from KITH*

Pharmacy is seen as a possible member of this network only after the e-prescription reform has taken the place. Before that only part of the common medication card intentions (promises) could be fulfilled and the information provided in the common medication card still might be insufficient. The e-prescription project is scheduled to be tested in 2008 but it is expected that only during the year 2011 approximately 80% of all prescriptions will be electronic (SHdir). Consequently, the success of common medication card project is strongly dependant and linked to progress of another project – e-prescription project. This can be seen as a threat to the reaching of the main goals of common medication card project, at least before pharmacy is capable to join this network.

> *"Pharmacy is the most important part, because the only medication that patient might get that is not coming from pharmacy is the day or two day dosage that patient*

receives form the hospital when they are leaving it. …but the e-prescription project has to provide the basic input to this system." – project member from KITH

6.2. Expanding the scope

The common medication card clearly can be seen as an information infrastructure that is embedded in healthcare sector through an electronic patient record system and is linked to different working practices in this field.

The intention of this service is to reduce medication errors by collecting the medication information in one place – in common medication card and providing all the parties involved in health care with the same information about patient's medications. To be able to do that medication information sources should be defined, just as well as possible points where the mistakes appear. Common medication card developers have mapped the information flow and pointed out medication sources. Medication survey from Trondheim mentioned in 5th chapter has shown several inconsistencies in medication information in different healthcare providers' medication lists.
Such inconsistencies about medication information might appear because the communication between healthcare personnel is not so smooth and well organised. Bad routines have been blamed.

"..there must be something wrong with the routines if 61 of prescribed drugs disappear" – project member from KITH

Home care nurses often are the ones that are calling general practitioner and finding out the necessary information about changes in medications. One of nurses admits that there could be a situation when the medication list is different in home care and in general practitioner's record. Home care nurses to great extent are dependant on the information they get from other healthcare professionals, especially general practitioners and hospital physicians. If the information exchange routines are not satisfactory, some healthcare professionals often have to take more initiative to get necessary information to avoid some failures. In this case as

home care nurses are responsible for administering the medication to patient, they seem to take more initiative for getting the necessary information about medications.

> *"It could happen (medication information mismatch). It is because the doctors are not aware of giving us the message when they have changed something. We are very dependant on that […]. It could happen that for a week or few days we are not aware that their (patients') medication has changed. But when we are responsible for medication, normally it shouldn't happen." – nurse (B)*

Some emergency situation might appear and the patient unexpectedly had to go to causality clinic or hospital. Such situation might have some influence in the case of incorrect medication information or at least for some period of time leave the healthcare personnel in the municipality without adequate medication information.

> *"It could happen that doctors did not write discharge letter immediately, because sometimes they do that next day or the day after. It is not a big problem, I would say, but sometimes it happens." – nurse (B)*

According to Monteiro (2000) in the network like this where many parties are involved in providing necessary health care, stability and social order are continually negotiated, and the interests are aligned. In this case the main interest is to provide health care to the patient and administer the right medication in the right time. As this is the actual obligation of home care nurse to administer patient's medications, nurses have taken more initiative to obtain the necessary information about patient's medications and their actions are keeping the network stabile.

There are some other possible reasons for having incorrect medication lists for various healthcare providers. It is possible that patients might have visited some private specialists and the patient's general practitioner not necessarily receives the information about changes in the patient's medication. Some patients have relatives that are practicing medicine and can prescribe the medications; this information often is not communicated further to patient's general practitioner. Today it is not possible to get hold of this information, but this is seen

as a very important issue that could be solved by incorporation the information from the pharmacies in the common medication card service.

> *"The medication information from other sources, that is what is really the most important to get full control of. …you can not get full control of that unless you get the information about those prescriptions you don't know who prescribed them…" – project member from KITH*

To cover everybody who is prescribing the medications, the network needs an important actor that could take a role of obligatory passage point, actor that could collect the necessary information and bring the entire network together. In this case pharmacy is seen as potential obligatory passage point, because it is the place where the patient actually gets his/her medications and from here comes the most correct information about patient's medications. Even though some of the prescribers, like private specialists or family members might not have joined the common medication card network, but with pharmacy in this network the information about dispensed medication will be added to the common medication database.

> *"To have a control of the information from pharmacy is the key to success" – project member from KITH*

Adding a new actor to aligned network often opens the network inducing the need for new aligning and new negotiations. It is seen that ANT leans heavily towards a bottom-up concept of alignment and strategy formation. Alignment according to ANT is not the result of any top-down plan or decision. It is the achievement of a process of bottom-up mobilisation of heterogeneous actors (Monteiro 2000). In the case of common medication card a lot of mobilisation is partly done with top down approach. Even the potentially so important actor as pharmacy might be put in the situation when they have to join this service.

> *"… Trondheim has a power to insure that their pharmacies provide such service, if not they change the pharmacy and then they (pharmacies) are having millions they loose each year. So they have the power they need to insure that they get that information. But again the e-prescription project has to provide the basic input (..) to the systems." – project member from KITH*

The importance of getting hold of the information about medications that are prescribed by healthcare providers other than patient's general practitioner, hospital specialists or causality clinic is undeniable but there are some other medication sources that shouldn't be forgotten. Patients might have experimented with some medication that they have borrowed from their neighbours or relatives. This could be the case with some sleeping pills or painkillers.

> *"When I open the cabinet, I can see a lot of drugs that have never been used or that a daughter has taken because she has a condition where the mother's pills can be of use. That is the case with sleeping pills and painkillers. You see a lot of experiments going on in the real life in homes and even though the target group of patients is defined, there are all those borderline patients. Patients who are in need of assistance but don't get it and those where for example there is a daughter that assists the mother and helps with taking the drugs and making a dosete." – physician (A)*

It seems that it is very hard to get full control of patient's medication situation, too many sources are involved and the hardest to control are the unofficial ones – relatives, neighbours etc. Because of this rather distributed character of medication information, it becomes hard to predict where the common medication card service should stop, which actors should be included as information sources and which not.

The same applies to information in the medication card. Providing more information often results in need for even more information. This could be a case when it comes to use of the common medication card service.

> *"As soon as you'll have a medication list, you will see a need to share more; you will see that you need to share the entire plan. And then you have a problem with plan systems and the planning in EPR, because the problem with plans is that it takes time to write them down, therefore plans very often are implicit." – physician (A)*

6.3. The distributed character of deciding on prescriptions

According to information infrastructure theory, information infrastructures consist of heterogeneous elements that are added to infrastructure over the time, thus creating layers. Often different infrastructures meet each other and overlap creating an even bigger infrastructure. The infrastructure is never static, it is changing and expanding over the time and has a particular degree of dynamics.

In the healthcare there is a network building around prescription and prescription can be seen as a dynamic actor in this network. The prescription is an element that is connecting several networks. It is moving in this network and in different places it has slightly different role. According to Berg a chain of heterogeneous entities that are distributed around patient care can be organized and linked with the help of mediating artefact. In this case the prescription can be seen as such mediating artefact (Berg 1999). This network seems to be rather open, it involves patient, physician, other healthcare personnel, pharmacist and possibly other actors – sometimes relatives or even neighbours. Medication errors can occur in every link of this network – while ordering, transcribing, dispensing, administering or monitoring. Some studies show that use of computerized prescribing reduces some of these mistakes, but there are still mistakes that could be avoided with better designed systems (Gandhi, Weingart et al. 2005). One of the problems with computerized prescribing is that the models used for developing CPOE might be too focused on the individual cognition and behaviour of clinicians, instead it should be accessed as distributed knowledge about patient's problems (Aarts, Ash et al. 2007). Such collective, distributed activities as patient care or ordering, dispensing or administering of medications are often characterised by merging activities and blurring of boundaries between these collective tasks (Berg 1999). Healthcare is an environment where all the elements are closely interrelated and introducing of new tool, element or new routines has an impact to whole network.

> *"Because of this tight interrelation between elements in a network, the introduction of a new element, or the disappearance of an element often reverberates throughout the health care practice." (Berg 1999)*

It is common to believe that physician is the only one that is responsible for prescriptions. Medications are directly linked to the physicians but in the real life setting this responsibility has rather distributed character. When the patient is having the home care service for administering his/her medications, home care is officially taking the responsibility for correct administering of medications. But the participation of home care does not end with administering medication. Home care nurses are having regular contact with patient and communicate with physicians when they are observing some adverse effects of medications or patient's health state has changed.

> *"..we have to observe the patient and sometimes blood pressure medication if we see is too much, we have to call the doctor and have to suggest something. Or suggest some other medications – pain-killers or so. It is quite a lot of communication going on between the nurses and the doctors." – home care nurse*

Some medications need a special attention and additional care. One of such medication is Marevan (Warfarin Sodium) which is an oral anticoagulant used to stop forming of blood clots in blood vessels. This medication has very serious side effects that can even lead to lethal bleeding. While taking Marevan patients have to have regular blood tests and the dose of medication is adjusted according to test results. In addition before every minor or major surgical invasion even in dentistry, the health care providers have to be warned that patient is using this medication. Use of medication like this always is creating the need for additional communication among healthcare professionals.

> *"We have quite many patients that take Marevan and we have to know if there is a change in blood tests. We have to be aware that we ask the doctor, because some of them in a worst case perhaps forget to remind us that we have to change the doses. And that is the worst, Marevan is very important to take correctly." – home care nurse (B)*

Pharmacists also have to be aware of what medication patient is on to be able to provide best advices for taking the medication or avoid some side-effects or unwanted drug interaction. Work in pharmacy includes communication with physicians who are prescribing the medication, this communication is quite regular.

"I have to call doctors at least once a day. We call when doctor has prescribed strange doses, strange strength of medication or there are some serious interactions with some other medication the patient is taking. We call also when the prescribed medication doesn't exist anymore, or it is not available now or some other medication related issues." - pharmacist

In some cases when patient gets prescription from different physicians, some mismatch or serious adverse medication interactions can appear. In these case pharmacists have to contact physician and do the necessary adjustments to avoid these potential medication errors.

"For example, patients regular GP has prescribed patient a high dose of Simvastatin and also Metoprolol and Tiazid, and patient is taking these medications regularly. For some reason patient has been to dentist or causality clinic and there he has received a prescription for Erythromycin – antibiotic medication. It is recommended not to use Simavastatin together with Erythromycin because of some adverse effects. So we have to call the physician who prescribed Erythromycin and find out with what to replace this medication. But this we can do only if the patient has bought his/her regular medication in our pharmacy before and we have this information in our database." – pharmacist

Obviously it is just as important for pharmacists to be able to access patient's medication as for other healthcare personnel to be sure that the best is done to avoid medication errors. To reduce medication errors, the double check in every link dealing with medications would be beneficial. Unfortunately members of the project team in Trondheim are not that sure that pharmacists need additional information about patient medications, they rely on physicians to do their job well enough with information provided by the common medication card.

"Information about prescription will be on the prescription server only for some month, so pharmacists can't say just by looking at prescription server that these are the only drugs the patient is taking. The pharmacy association would like to have this role, of course if they get paid for that. Then they should use the information form the common medication card, because there is also information about allergies. But if

doctors do their job well enough, there should be no need for that." – project member from KITH

There is another aspect that reveals the distributed character of the prescription responsibility, since pharmacists are obliged to dispense the cheapest drugs if they are prescribe on the blue prescription. This often means that people get generic medication or in case if person wants to have exact product physician has prescribed, they have to pay the difference in price themselves. If the medication is prescribed on the white prescription the pharmacists again can offer a cheaper generic medication but in this case it is just a choice of patient. This case with generic medications has caused some dissatisfaction among physicians and patients.

A generic drug is identical, or bioequivalent to a brand name drug in dosage form, safety, strength, route of administration, quality, performance characteristics and intended use. Although generic drugs are chemically identical to their branded counterparts, they are typically sold at substantial discounts from the branded price. According to the Congressional Budget Office, generic drugs save consumers an estimated $8 to $10 billion a year at retail pharmacies substantial discounts. Today, almost half of all prescriptions are filled with generic drugs (FDA).

"Now when they can freely change the medication in pharmacy, give some generic product, we have no bloody idea. There are so many names …even though you have a correct medication list, you don't really know what they are taking. Even they (patients) don't know what exactly they are taking, they can get confused." – general practitioner

Also home care nurses have experienced some frustration when it comes to generic medications, some times it even causes some additional work, that has to be done.

"Oh, now we have got another medication, but it doesn't look like the previous one, maybe another colour or shape. We always control the medications – one puts all the medication in dosets and another controls. Then there is a bit of frustration, we have to check if it is the right medication. Also the patients get used to the look of their medications." - home care nurse

As a result we have confused healthcare providers both in home care service and general practitioners that might have problems with getting the overview of patient's present medication situation. If before general practitioner could try to find out the medication information from patients, then now when prescribed medication can be changed to generic medications, patients are having hard time remembering the names of their medication.

> *"The problem is the name of the medication. The patients have no clue anymore. If for 10 years you used the medication called Renitec, you will learn that. Now one day your Renitec is changed to a medication that has completely different name, after six month it is changed again and possibly after three months again. You use eight different medications and three or four are changed constantly. It is no chance to remember especially if the names have no context to the patient." – general practitioner (P)*

This seems to be a problem not only for patients but also for physicians themselves. Often physicians are used to work with some particular products and they are not eager on spending their time in consultation to find out what are the generic names of some particular product.

> *"In every medication class there are several subdivisions. If there are there are six groups and every group has subdivisions and every subdivision has three medications plus all the generics. That creates a huge amount of medications. I have to admit that there are a lot of heart and blood medications I use by product names and I don't think of them as active component. If I start thinking of active components than again I have to remember the product names." – general practitioner (P)*

It seems important for physicians to get the information about generic medication that has been delivered to the patient in the pharmacy.

> *"Giving of generic should be updated in the common medication card. And they (pharmacists) should also say why – cheaper, didn't have etc" – physician (SB)*

This shows a rather complex network with distributed responsibilities and shared decision making. Allowing only physicians and pharmacy to update medication card, might exclude a very important but to some extent underestimated actor – nurse, from providing some important information to common medication card and sharing some responsibility. It seems that some of the work nurses are doing has become invisible. It also should not be forgotten that pharmacists are not only dispensing the medication, but are controlling the accuracy of prescribed doses and follow up the potential interaction between different medications. Providing pharmacists with enough information about patient's medications some of the possible medication errors could be avoided.

6.4 The interdependency of medical information

One of the characteristic of information infrastructure is openness and according to actor network theory actors are not isolated artefacts. Medication information just as previously mentioned prescription responsibility is one of such cases, it is not isolated but to great extent interdependent with other medication related information. Every prescription is prescribed based on the information about patient's health status, diagnosis. Diagnose is based on the laboratory test results, all kinds of examinations and observations, as well as patient's medical history and his/her family's medical history. Often medication can be changed because of patient's intolerance to some of the component in the medication or because of unsatisfactory effect. Finding the best medication can take some time and testing of different medications. Often in this process we can see more than one healthcare personnel involved.

Providing of healthcare is a very complex process and by its very nature is supported by collaborative work practices, decisions about patient care are not made by a single individual but are the result of negotiations among healthcare professionals. Sometimes these negotiations involve even patients and their families. Boundaries between tasks and roles of healthcare professionals are not so clearly defined (Aarts, Ash et al. 2007). The sharing of information and using open information systems for this sharing makes this work even more collaborative.

In their daily practice physicians are using various sources for obtaining the information they need. Medication information is obtained both from referral letters, home care and even patient.

> *"… the situation now is that we have to combine the medication list based on pills the patient brings with himself to the consultation and a list of medications from a referral letter." – physician (A)*

Common medication card is seen as a major improvement in healthcare and it is expected that this service might reduce medication mistakes and even improve the quality of prescriptions and healthcare.

> *"It is a dream come true for nurses," says on of the nurses but one of physicians has some great expectations: "I believe that the common medication card might be one of the most important technical solutions for healthcare system."*

There is also more grounded perspective of common medication card service that is shared among healthcare personnel. Some admit that there is more information than just medication information that is necessary for providing better and continuous healthcare to the patients. The need to know patient's medical history is stressed.

> *"Just medical card is never going to be enough information about patient. It says only a little bit about what kind of problems that person may have. …it doesn't say that the patient broke his hip two years ago... to give the right care you also have to know what happened to the patient in the past" – nurse B.*

Next statement supports the studies stressing that decision making and actions in healthcare are strongly interrelated with health related information that is obtained from different sources, different healthcare institutions. Actions of home care nurses are strongly related to information they are receiving from hospitals, patient's regular general practitioner and even patient himself. It has been stressed that nurses are the healthcare providers that has most contact with patient. In home care nurses are responsible for administering the medication and it is essential for them to know what medication patient is taking. The developers of

common medication card service have been concerned that nurses do not get the medication information on time in cases when there have been some changes made in the hospital or by general practitioner. Is common medication card big enough patch to cover and cure poor information flow? Home care nurse admits that medication information is not the only information they need. She sees this information as useful only in context with the rest of health related information.

> *"You will not work with the medication card isolated, I think. When I write in a patient's name it could be like that – I have all, diagnose, what kind of treatment he needs, name of the doctor and the medication card will be there too." – home care nurse.*

A hospital physician agrees that not only the medication list is needed, more than that is necessary for providing continuous healthcare if it is organised in various levels and in different organisations. In "perfect world" care plans should be shared.

> *"What you actually need is to share a plan, but the problem with writing prescriptions is that you don't have a field in prescription that says indications, it also doesn't have a field how to evaluate patient's situation. It just has a field for the name of the drug and how to take it." – hospital's physician (A)*

The need for more explicit information is characteristic to situations where already some information is available and one can recognise what information he/she is lacking. But what about situations where you have no information, where the tiny bit of information can be of great value? This seems to be a case with physicians in causality clinic. Situation when there is no information about patient is quite common there and the only source of information is maybe only the patient.

> *"In causality clinic we don't have any information about the patient. We don't receive discharge letters from hospital, we have no information. In the situation when the patient comes here, we just have to do the best we can. ….medication list doesn't say everything but it tells a lot more than nothing. Especially when I don't know the*

patient well, then it is important to have the medication list. The less information I have the more valuable is the little extra information I can get." - physician

Obviously the value of information provided in common medication card might vary from the situation and context where it is used. It might not be the one and only unique solution to information flow problems in health sector, but undeniably there can be situation when it will be of great value and might even live up to expectation of being *"the most important technical solution in healthcare"*. Even though some sceptics think that common medication card will not solve the quality problems and is not inventing more time.

"It is not only a list of medications that is needed, and the common medical card is not inventing more time for physicians. …it might not be an appropriate quality problem solution" - general practitioner (K)

6.5. The changes of routines and responsibility

As mentioned before boundaries between tasks and roles of healthcare professionals are not so clearly defined and tightly drawn. Because of the distributed character and collective nature of healthcare providing there is a lot of "invisible work", work that is taken for granted without even thinking who is responsible for managing this task. Positive aspect of collective work is that mistakes that appear during the work process might be corrected on the way.

"Many errors in group work are corrected through the interaction of the actors and group performance seems to protect against errors or failures of individual members." (Aarts, Ash et al. 2007)

Improvisation and ad hoc manner is common in healthcare setting, the tasks and responsibilities often are distributed unofficially. Nurse might be doing some of physician's tasks and physicians are accepting that and relying on that. This can become a problem, when new technological solution is implemented in such healthcare setting, especially if the

developers have not properly considered the complexity of delegating the tasks and responsibilities in healthcare. This might result in technology solutions that are trying to draw clear borders between those involved in providing healthcare. For example, only licensed physician can enter orders in CPOE, ignoring the aspect that nurses are also quite involved in this process (Aarts, Ash et al. 2007).

It has become more common to communicate health related information electronically, that has happened with referrals, discharge letters and laboratory test results. Medication information today is shared between different healthcare providers through referrals, discharge letters or nursing notes. For some of the people involved in the common medication card project introduction of this service seems to be an easy change. They argue that there have been well developed paper based routines in sharing medication information, so this will be just a change from paper to electronic sharing.

> *"This is just taking one existing solution and making it into an electronic solution" - project member form KITH*

This is one of common problems when implementing electronic solutions in work practices, belief that paper based routines can be directly translated to electronic ones. Often new technical solutions bring some changes in the work routines, especially the initial period of using the new tool might involve ongoing improvisations and tries to manage the work process and adapt to the new tool (Orlikowski 1996).

Even though the project team members believe that these changes will not be radical, they admit that some changes in work routines will take place after implementing the common medication card service. General practitioner might be one of the parties that will experience some changes. Firstly they will receive more information that before and secondly, at least in Trondheim project, general practitioner will be responsible for the information in the common medication card.

> *"They use 15 minutes with the patient and today they do the most when the patient is in the office. Later they will get much more messages when the patient is out of the office. They have to spend some time each day to read this kind of information. They*

spend some time already when handling discharge letters and laboratory results. With this they will get more information that they have to handle when the patient is not there. And we really don't know how much more, because the GPs get too little information today." – project member KITH

Knowing that general practitioners are quite sensitive to their time, the solution must be very well designed, so that there is not much extra time spent while managing medication information and it should add some value to physicians work.

"I don't want information that I don't need and I need the information only when I start working with the patient. I don't need it before" – general practitioner (P)

These changes in routines might as well be accompanied by some shift of responsibility. Some of the interviewees predict that this service could be potential benefit for nurse both in home care service and nursing homes, because it might reduce some of their responsibility delegating it to physicians.

"For nurses it must be easier. Today, I believe, they have more responsibility than they should have; they are really the ones that get all the information from everybody to everybody that is informed" – project member from KITH

"Another good thing is that it is doctor who will make the changes in the medication card, today in our system it's the nurse who makes the changes" – nurse from nursing home

On the other hand it seems that physicians are still quite interested in engaging the nurses in sharing their workload and responsibility. Nurses are having most contact with patients and in a way are communicating the information between physician and the patient. There are cases when patients have some unexpected reaction to prescribed medication and the doses should be changed. In such situation home care nurse most likely calls the patient's general practitioner and the dose is changed. There can be a situation that physician suggests to change the dose, but doesn't document that in his/her electronic patient record, because for some reason record is not available, for example the physician is out of office. Because of

this reason one of the physicians expressed the opinion that also nurses should be able to make some changes in the common medication card and these changes could later be accepted by physician

> *"But it would be very, very important that the nurses could also make changes in the medication card, because they are basically doing it, working with it every day, not the doctors" – general practitioner (P)*

Another physician sees potential benefit in ordering prescriptions through the medication card instead of nurse calling the physician like it is done today.

> *"The benefit of the system would be if they (nurse) could ask if they could increase some doses. It would be nice if the card could send a request to the doctor about this issue." - physician (SB)*

It is not only physicians who are looking for some way of sharing their workload and responsibility. Also nurses are looking for some ways to reduce their workload and responsibility. As one of the solutions multidose system is mentioned. This is service where pharmacy is packing the daily doses for home care service.

> *"Multidose could really save a lot of resources and nurses could do other things. Besides it is much more reliable and we could avoid some human mistakes. On packing the dosetes we spend around two days a week. If there are some changes in medication, then we have to do it again. We have a lot of work, that is why I whish we could have such system (multidose)." – home care nurse*

As mentioned before, it could be very valuable to allow pharmacies to access common medication card, and then pharmacy could be one more security check point in the chain of patient care. There have been discussions about role of pharmacists in healthcare and often pharmacists have felt underestimated. Lack of information has been one of the reasons why pharmacists have not been able to fully accomplish their role in healthcare. But providing the pharmacies with this medication information will also delegate more responsibility to pharmacists. Pharmacist will not be a person who is dispensing medication, he/she will be a

person who will have to process the medication information and make decisions according to this information.

7. Conclusion

There are a lot of expectations that use of IT will improve some of the weaknesses in healthcare system, especially the ones that are dealing with information flow. The common medication card developers have great expectations from this service. Furthermore, a common medication card service has the potential of successfully improving the healthcare. So far, the development of this service has been done quite successfully and in collaboration with potential users and EPR system vendors. Nevertheless, the project in Trondheim has experienced some delays in planned testing of the service. Partly it was because of experienced problems with obtaining the funding.

The common medication card project has some advantages. The project has a very well defined group of patients, it is expected that this solution is necessary only for a small part of the community, people that have home care and take a lot of medications. In Trondheim it is estimated that it will be around 1% of the inhabitants. Not trying to cover a too broad spectrum of different patients is clearly one of the advantages of the project. Another advantage of the project is that this service will be integrated in the EPR systems, thus making it easier for users to accept the new service, because the system will be the same, but only improved with new functionality. This can be seen as an evolution, not revolution and this approach has proven to be good tactics when implementing IT solutions in work practices.

Some potential challenging issues were highlighted during this study. One potential challenge is dealing with ensuring sustainability of this service. Sustainability is a common problem with telemedicine solutions. Also this solution at least initially might need some additional job and some changes in healthcare personnel routines to obtain sustainability. Closer collaboration with potential purchaser, the municipality might be one way how to secure the future use of the common medication card. To fully embrace the potential of common medication card service, pharmacy should be included in this network. This raises the question of dependency on other organisations and other projects. Including pharmacies would depend on another project called e-prescription. Before this project is finished and pharmacies have the right infrastructure, the information provided in the common

medication card still might be incomplete and not solve the medication information problem. Traditionally information infrastructures are characterised as always expanding with blurred boundaries and this could be the case with the common medication card. So far, the common medication card developers have included information from healthcare providers in the service, but this is not the only source of medications, often patients get some medication from other sources – for example, their families and neighbours. Consequently, the information in common medication card might not be complete. Undeniably it is rather impossible to avoid all possible medication errors and some borders of the network have to be set.

The complex nature of healthcare is characterised with collaborative work and close interrelation between healthcare workers and blurred boundaries between roles and tasks of healthcare personnel. This aspect of healthcare nature signals that the nurse's role in deciding on medication might be more important than it is common to think. This is not a one man's show and also other healthcare personnel have some influence to making decisions about prescriptions. This distributed character of healthcare has to be taken into consideration when designing systems like common medication card. Just as the decision making in healthcare, also medical information is closely interrelated. A common medication card provides only one part of this information, but it might be very valuable in cases when there is no information available about the patient. This seems to be the case with causality clinic, where a common medication card could be of great value.

Some changes in work routines and responsibility are likely to appear, but consequences of these changes and healthcare personnel's reaction are hard to predict before the common medication card service is in use in real life setting. The success of this service to some extent depends on the driving forces behind the project. Being aware that the common medication service will be in use after the project is terminated, gives a lot of confidence to its developers. But this sometimes might result in pushing too hard to get the solution in use and not considering some of potential pitfalls.

This study was conducted in the period when the common medication card project was in a rather premature stage and much of the potential challenges could not be addressed, simply because the service was not yet tested in the real life setting. It has influenced the empirical

data that has been collected. Consequently, by using this information it is hard to foresee the future development of the common medication card service. After implementation of this service, it might take some unexpected turns, be a very successful solution or maybe a big, expensive failure, a solution that does not live up to expectations of its developers and users. It is possible that patients, at least initially, could be reluctant to allowing their health information to be accessible to different healthcare providers. No matter if this solution will be a success or a failure, fragmented information flow will be seen as a problem in healthcare and more solutions that might solve this problem will be developed.

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