

VIRTUAL HOSPITAL AT HOME – CO-CREATION AND IMPLEMENTATION OF A DIGITAL SOLUTION

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ABSTRACT

In this project, the hospital and the patients at home have piloted an app developed for follow up and communication with patients that receive dialysis treatment in their own home. The purpose of the implementation has been to improve the knowledge of both the hospital's and the patients' needs, and to better understand how a digital application may be useful for the patients receiving treatment at home, and for the renal (kidney) nurses at the hospital outpatient clinic who are responsible for following up the patients.

The particular contribution of the project to research has been the work method. The development of the app and the implementation has taken place in a co-creation process between the technology developer, the hospital and two research institutions, all in Norway.

This longitudinal study used a qualitative and explorative approach, where data was collected over time during observation, interviews and participation in meetings and informal conversations. The focus was on the work method and how the implementation evolved and contributed to develop both services and the technology. The results show that co-creation as a strategy for implementation has several processes within, and requires longitudinal and iterative interaction between the different actors. The challenges pertain to merging different epistemic communities and to the integration of this system with other systems in the hospital.

The knowledge from this project contributes to theory on implementation of technology in complex fields, like the healthcare field, and to the current discourse on successful implementation of light-weight technology using co-creation.

1. INTRODUCTION

The «patient's own healthcare service» is introduced as the objective for the health care service of the future. One of the most salient tools in reaching this goal is increased use of technology and digitalization in general. A number of Norwegian hospitals have initiated innovation projects in order to map how the hospital may track and follow up patients at home, for example in order to dispatch the patient earlier from the hospital and increase the patient's quality of life. Parallel to this, the Norwegian Directorate of Health has established a national project on remote patient monitoring of patients with chronic diseases that receive treatment in their own home. The goal was to develop a digital solution that makes it possible for patients treated at home to perceive the health care service as a seamless and comprehensive service, a solution that does not exist to date. This will improve self-efficacy and prevent both increase and aggravation of chronic and other diseases.

Over time, there has been an articulated need for increased use of technology in order to support the communication between the hospital and the patient (Rygh, Arild, Johnsen, & Rumpsfeld, 2012). Studies that focus on chronic patients being treated in their own homes frequently have a patient perspective and a patient focus.; see for example (Bryant & Katz, 2018; Jepsen, Høybye, Hansen, Marcher, & Friis, 2016; Raphael, Nadeau-Fredette, Tennankore, & Chan, 2015), while Das et al (2018)

describe the need for a clear distribution of roles and responsibilities between the actors involved in follow-up and treatment of chronically ill persons at home. This treatment is either managed by the patient him/her self, by the homecare unit in the hospital or by next of kin. Little attention has however been paid to the work situation for the healthcare workers and the hospital's role in home treatments.

In general, projects that aim to implement technology in general often fail or end up with less than optimal solutions (Andreassen, Kjekshus, & Tjora, 2015; Stroetmann, 2014). The introduction and use of information and communication technology in the healthcare domain has shown to represent challenges, despite the fact that the technology often has been used over time in other industries. These challenges pertain to the several conditions, but in particular the nature of the operations. The healthcare domain is special in that the patient is vulnerable and issues at stake can be about life and death, and this highly influences the way the employees consider use of communication technology. This is an argument for high level of cooperation and co-creation in the development and implementation of technology. This study focuses on the hospital's role and on the healthcare workers, and includes the patients' experiences as a part of the frame for co-creation in eHealth implementation, as called for by Papoutsi et al. (2020, p.1), who state that «A shift is needed from co-designing with technology users to co-designing with patients as service users, and with healthcare staff as professionals». In underscoring the latter, in this study we ask: In what way can co-creation as implementation strategy for eHealth contribute to improve communication between hospitals and home based patients? Co-design can be seen as part of the co-creation process (Oertzen, Odekerken-Schröder, Brax, & Mager, 2018).

2. THEORY

Research on digitalization of communication between specialist health services (hospital) and the patient being treated at home, spans several fields such as eHealth, implementation of technology, technology acceptance (TAM), client participation, innovation through co-creation, quality of life, beneficent realization etc. Hence, the research field is complex, and furthermore there is no precise definition, or even description, of what 'hospital at home' actually means, and where the boundaries for patient and treatment responsibilities are drawn. Despite this vagueness, 'hospital at home' is gaining ground in both in Norway and internationally, as is home dialysis treatment. It has been a need for an increased use of ICT (information communication technology) to support the contact between the hospital and the patient (Rygh et al., 2012), and some studies have examined this issue (Walker et al., 2016). Research on technology implementation in the field of healthcare shows that there are challenges connected to organizing and leadership, see for instance (Åkerlind, Martin, & Gustafsson, 2019) and (Nilsen, Dugstad, Eide, Gullslett, & Eide, 2016).

Implementation of technology is part of a change process and has the potential to alter the way we work and how we organize work. However, a large number of change initiatives are slow to be implemented (referanse). The implementation phase is increasingly becoming a phase where the technology developers and the customers cooperate closely, and this process bears similarities to what is described in the marketing literature as co-creation of products, services or adventures (for example in tourism) (Neale & Corkindale, 1998; Prahalad & Ramaswamy, 2004; Sørensen & Torfing, 2011).

The concept of co-creation implies close and continuous interaction in the implementation phase between developers/vendors of the technology and the customers/users. The technology developers may lack knowledge about the market and the users, while customers often lack technology proficiency and vocabulary.

Co-creation can be seen as an implementation strategy (Dugstad, Eide, Nilsen, & Eide, 2019; Granja, Janssen, & Johansen, 2018; Hartley & Rashman, 2018; van Gemert-Pijnen et al., 2011). Oertzen et al. (Oertzen et al., 2018) defined co-creation of services as service providers and customers integrate their resources collaboratively when and if they are involved, engaged and participate in the co-creation of services» (p. 27). Based on this definition and a literature review Oertzen et al. (2018) developed a framework for co-creation of services. The framework consists of seven service processes; co-ideation, co-valuation, co-test, co-launch, co-production and co-consumption. These

processes are iterative and based on involvement, engagement and participation, and they are seen within the frame of contextual multi-actor network. In the study at hand, co-creation is used as a strategy for implementation of IT, as a strategy for developing the services, and, in addition, a strategy for developing the technology itself. This is often the case in innovative projects where not-fully developed technology is implemented in a “new” context (Nilsen et al., 2016), as in the study at hand.

3. THE CASE AND THE TECHNOLOGY

The project is organized as a classical Triple Helix project (Leydesdorff & Etzkowitz, 1996), including public sector represented by a regional hospital, private sector represented by the technology developer/vendor and research institutions, represented by an independent research institution and a public university. The project is at the same time a development and implementation project *and* a research project, and the development project is examined longitudinally real time by the researchers, including involving the researchers.

Dialysis is a vital treatment for severe renal impairment. Most patients with home dialysis manage to carry out the treatment themselves, but some receive assistance from relatives or from the municipality's home nursing service. The Kidney and PD Outpatient Clinic at the Hospital in Telemark offers training and follow-up of patients with PD as well as training and collaboration with home care in municipalities regarding PD patients. Most patients manage to carry out the treatment themselves, but some receive assistance from relatives or from the municipality's home nursing service. When dialysis treatment is moved to the home, this saves patients from traveling and staying in the hospital. They get a greater degree of freedom in life, they can travel and it makes it possible for more patients to continue working.

Dialysis requires large amount of equipment such as dialysis fluids, tubes, and bandages which requires storage space. Frequent deliveries are therefore necessary. Without the communication platform from Imatis, a nurse at the kidney outpatient clinic calls the patient either weekly or every other week have the latest status on the patient's health and equipment stock before ordering equipment for the next period. The renal nurses experience that they have spent a disproportionate amount of time getting hold of the patients and they are also dependent on the patient having counted their stock before the interview takes place. All though health issues are also discussed during these periodic calls, patients can also call the renal nurses at any time during daytime if they have questions, need help with treatment or see signs of incipient infections.

In addition to conversations related to ordering equipment, the patient has contact with the hospital during physical consultations. These can vary in frequency depending on the course of the disease. At these consultations, various samples are taken, and patients who have machine-based dialysis must bring a memory card that contains information about how much fluid has been inserted and drawn since the previous consultation. This information will thus only be available to the renal nurse / doctor when the patient comes for a consultation. Patients using CAPD should keep this fluid record on paper, but more often they do not.

The objective of the project was to pilot a «dialyses app» for follow-up of patients at the regional hospital that receive dialyses at home. The project's purpose has been to increase the knowledge of the employees' and patients' needs, and to better understand how the technological solution can be useful for the employees in the renal (kidney) out-patient clinic with particular responsibility for the patients at home. The hospital had a need to map the effects of the potential benefits of the technological solution, both concerning benefits for patients, economic benefits and organizational benefits. The project additionally aimed to increase the technology developer/vendor's insight in functional and technical requirements for a technological solution that can be taken to the open market.

The application piloted in this project is a «minimum solution» based on the vendor's existing technology platform, and is set up as a «stand alone»-solution lacking integration with other systems and with several technical and functional limitations. The application offers «basic functionality», and forms a useful starting point for knowledge building. Figure 1 illustrates the communication flow in

the project, with the patients in one end and the employees in the hospital in the other end. The application has not been optimized for mobile phone, but the patients have access to iPad (either privately owned or issued from the hospital). The application can also be use on a PC.

The application is set up without integration with other systems in the hospital, like the EPJ (electronic patient journal) and booking system for equipment/commodities. Since the system has not implemented solutions for health logistics, the system is totally “isolated”. The pilot was initiated on this condition, since it was an objective to evaluate whether the application, in spite of the lack of integration, could offer a better overview and support for the renal nurses, and make structuration of tasks and communication possible. Another weakness is that the solution has not been adapted for use on cell phone, since most patients have a cellphone, even if they do not have an iPad or a PC.

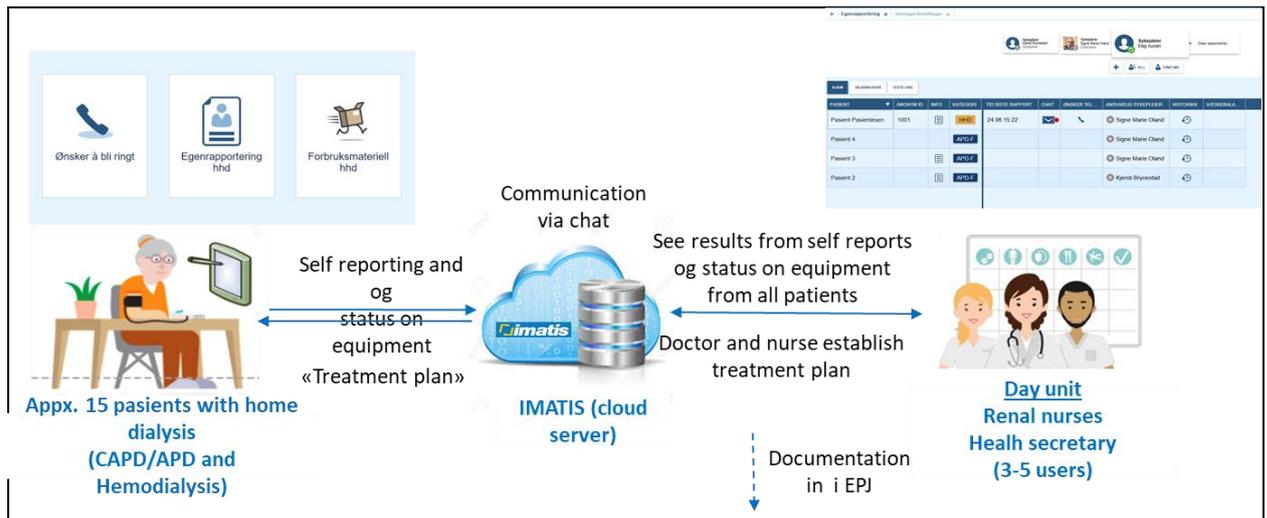


Figure 1: *Virtual hospital at home – the communication platform.*

The methodological approach in the development project were a team of two horses with the research method. The research approach is explorative and both follows and is involved in how the implementation and the technology itself develops through practical use of the app in a co-creation process between the hospital employees and the technology developer/vendor.

4. RESEARCH METHOD

The research method has been longitudinal, exploratory and inductive, and the implementation to the mentioned patient group constitutes a case study. The actors' voice is important and it is a goal for the research to see the project as the actors experience it. Telemark Hospital normally has 20-25 patients with home dialysis who are followed up by the PD outpatient clinic over a few months or several years. During the project period, 15 patients were recruited an a technical solution was set up for each, but due to limitations due to the Covid-19 epidemic, not all of them have had time to gain experience with practical use before the project had to be concluded and experiences summarized. For the period reported, 10 patients have used the solution, which makes up about 50% of the patients in the same period. Qualitative findings are emphasized due to the total number of patients at the PD outpatient clinic and the form of the project, as an exploratory project with the aim of gaining detailed insight into needs, opportunities and limitations. Researchers have followed employees and users since before the solution was introduced in the outpatient clinic.

Table 1 shows an overview of the data collected in the project. Interview guides have been prepared adapted to each of the informant groups, and these have been adapted to the relevant stage of implementation. Interviews have been semi-structured according to interview guides, with the opportunity to follow up on topics the informants have emphasized. Interviews with patients and focus

group interviews with nurses were recorded and transcribed 'ad verbatim'. Field notes were taken during observations.

Table 1: *Data collection and data sources*

Point in time	Data collection	Datasource
August 2019	Participation in meeting	Kickoff with technology developer
August 2019	Participation in meeting	Start-up meeting with the hospital
September 2019	Participant observation	Workshop: Mapping of potential gains from the project
October 2019	Observation and informal conversations, total of 12 hours	Renal (kidney) nurses in the renal out-patient clinic
November 2019	Individual interviews	Patients (4)
November 2019	2 group interviews	Renal (kidney) nurses
February 2020	Individual interview	Technology developer
March 2020	Participation in meeting	Mid-term evaluation
May 2020	Individual interviews	Renal (kidney) nurses and department manager (4)
June 2020	Individual interviews	Patients (4)
June 2020	Individual interview	Community care nurse (municipality)
June 2020	Participation and presentations	Summary and exchange of experience. Evaluation.
October 2019 - June 2020	Miscellaneous shorter meetings and observations	Renal (kidney) out-patient clinic

Patients that receive dialyses treatment at home and are followed-up by the regional hospital were asked to participate in the pilot project. Some of these were asked to take parts as informants in the research. The study was approved by the Norwegian Social Science Data Service (ethical approval no. 539488). Participants gave their informed consent and had the opportunity to withdraw from the study without penalty. Care was taken to ensure participants' anonymity throughout the study.

5. FINDINGS

In general, the experiences with the use of the app are good, since it simplifies the dialogue between the nurses and the patients, and increases the autonomy of both the patient and the hospital employees. The technology and the practical use of the app is developed in a process between the parties involved, through intensive contact via telephone, mail and face to face contact during all phases of the project. This has contributed to translation between professional fields and development of a common set of concepts, which has great implications for the result. This «conversation» continued in meetings during the implementation, including in the midway evaluation and the final evaluation, where also the researchers' preliminary findings were discussed.

The cooperation and co-creation has taken place in close contact by phone, e-mail and informal meetings where the technology developer(s) from the vendor has been present in the renal out-patient clinic on several occasions. These have been arenas for interaction, exchange of experiences, Q and A's, including detection of misunderstandings and obscurities. This contributed to translation of «tribal» language and concepts and development of common vocabulary. These «conversations» continued in meetings en route in the project, including touchdowns like mid-term and final evaluations. At these points in the project, the researchers' preliminary findings were presented, both from the employees' and the patients' perspective.

In this project, co-creation prioritized both the employees' and patient-facing features, and focused closely around a specific clinic. Both the patients and the nurses perceived that their day has become simpler. The chat function, the digitalized ordering service and reporting on health measures are underscored as having particularly positive influence on the daily routine, both for the nurses and the

patients. The nurses perceive that they have more control; that they use less time on the phone with the patients, and are less interrupted. The patient do not have to call in and still feel looked after.

Even though there are positive experiences, there is still potential for improvement. This is particularly related to user friendliness and security. Some of these issues were addressed in the process, but some issues need more handling. The weaknesses were detected through experimenting and frequent feedback. Sometimes the technology developers have had to come to the ward in order to actually see for themselves what has happened when the nurses have referred to weaknesses in the system, for example when the ‘chat-window started wandering around on the screen’. The identification of such incidents is one of the purposes of the pilot, and interaction in person on site has made it simpler to make adjustments to fit the actual needs of the users. The patients’ perspective was mediated through the nurses and through the interviews with the researchers – and as such played a role in the co-creation merely indirectly. The technical solution offered the patients a chat /message function with a renal nurse, a form for reporting equipment stock, a form for keeping fluid record, a «Call me»-button that the patient could use if s/he wanted to be called by a renal nurse as soon as possible.

The content in the forms for ordering equipment and reporting measures were individually tailored to each patient's needs. They had a form adapted to their treatment plan, and in reporting inventory, they were only asked about goods that were relevant to them. It was possible to change the layout per patient continuously if the treatment plan was altered. This job, per patient, was performed by the technology developers during the pilot period.

As the renal nurses had regular contact with the patients during the project, the nurses acted as the patients' voice when discussing functionality and technical issues and concerns with the vendor during the project. In individual interviews with patients towards the end of the project, informants had the opportunity to be more specific about their overall experiences.

In addition to the end-user, the renal nurses were users of the new app. They had access to the data (equipment stock and the fluid record) registered by the patients. This enabled them to follow trends and development in the patients’ treatment, and this could subsequently enable them to discover warning signals at an early stage and initiate necessary changes in the treatment early. They also had the chance to chat with the patient, get a message when the patient wanted to be contacted (‘call me’), and to follow the patients’ treatment in “real time”, and not solely during consultations. The nurses also had an overview of inventory or measurements that were missing, and the system would remind them when data were missing.

Short meetings, when the need emerged, between the technology developer and the nurses at the hospital have contributed to iterative interactions with subsequent changes in the technology – and in the service. And in addition they have kept in contact by phone and e-mail.

The use of the app for communication with the patients increases the pressure on innovation also for the hospital ward. The technology contributes to standardize the work tasks, the forms and the contact with the patients. This is discussed in the interaction with the hospital employees and the technology vendors, as these to quotes illustrate:

“I am thinking that we could standardize the dialysis prescription. We are still not totally clear about how we are going to do this.” (hospital nurse)

“That’s how it is with technology – it demands structure in order to make sense – and to function” (technology vendor).

5.1 What were the challenges?

When there was a need for larger alterations, like adding products and adding patients (users) the technology developer has been the bottleneck. This has been particularly salient when the issue was urgent and the particular technology developer was busy doing something else. There was a lack of calibrated expectations on both sides, and an oversized dependency on the technology developers to make the necessary alterations when the hospital saw it fit.

There have been some communication challenges between the technology developers and the nurses. In particular in the early phases of the pilot. One example is that a product has been referred to by various names. This has resulted in the same product being listed several times under various names. This has been the case for the various fluid forms, and has created confusion. The subsequent standardization of both products and fluid forms made it easier. This could have been avoided if the hospital administered the system by themselves, and were less dependent on the technology developer.

Another challenge in the project was that the technological application has been isolated from the rest of the systems in the hospital.

6. DISCUSSION

Our empirical findings illustrate that both the healthcare employees and the patients perceived that the technology contributed to increased patient satisfaction and quality of life (Røhne, Boysen, & Ausen, 2017). The co-creation process is necessary, but not necessarily sufficient for successful implementation (Papoutsi et al., 2020).

In order to avoid ending up merely digitization (the pure analog-to-digital conversion), a high level of redundant or overlapping knowledge (Nilsen, 2010; Nonaka, 1994) about the practice of treating renal patients in particular and hospital management in general. This is challenging when several epistemic communities meet (Knorr-Cetina, 1999), as in a triple-helix projects (Etzkowitz & Leydesdorff, 1997) like the one under study, where technology developers, renal nurses, hospital managers, and researchers work together in a co-creation process.

As an analytic framework we have been inspired by the seven service processes developed by Oertzen et al. (2018); co-ideation, co-valuation, co-test, co-launch, co-production and co-consumption. These processes are iterative and based on involvement, engagement and participation, and they are seen within the frame of contextual multi-actor network. Oertzen et al. (2018) state that not all of these processes are found every co-creation project. In the project under study the co-ideation process emerged from a long business relationship and regional ties between the technology developers and the hospital. The hospital perceived that the contact with the group of chronic patients as a challenge and the vendors saw this as a promising market opportunity with great potential. The parties entered into a co-test process including facilitators like the research institutions. For technology developers in the emerging market of eHealth, particularly in Norway where the healthcare service is predominantly public, entering co-creation processes with products in the making is complicated by strict regulations on competitive bidding and restrictions of tender (Moe, Newman, & Sein, 2017). A research project is an opportunity to enter into a co-creation process and from the start, the co-ideation, be in interaction with the practice field.

As part of the co-ideation is the planning of the co-creation project, or the co-initiation phase (Sørensen & Torfing, 2016), mapping of stakeholders is useful (Nilsen, Stendal, & Gullsløtt, 2020). In this project, the stakeholders were perceived to be few. This number increased during data collection, when for instance the municipality (home care nurses) and next of kin emerged as stakeholders. This is an example of challenges in the co-creation project, when overlapping knowledge needs to be built not only iteratively but longitudinally (Dugstad et al., 2019).

At the outset of the project and in the planning phase, the innovative technology firm meets the hierarchy of the large hospital organization. The interaction in this phase is most intense with the hospital management, and the distance between the managers, and their focus, and the nurses in the clinic in contact with the patients became noticeable, since these groups necessarily have differing considerations, and there are challenges connected to management (Åkerlind et al., 2019). The support and the foundation with the management was crucial in order to develop the involvement, engagement and participation (Oertzen et al., 2018; Olafsen, 2018) from the nurses, necessary for successful implementation.

The co-testing process included the actual testing of the technology with two user groups; the patients and the nurses. A prototype was tested out before the product was introduced to the market. The co-creation process in this phase depend on tight contact between the developers and the users, in an iterative manner, as illustrated by Oertzen et al. (2018), and this evolves into the co-production process. Both the co-testing and the co-production processes are based on high degree of engagement from the nurses. This was aided by the immediate benefits they experienced with the system.

This contributes to theory on implementation of technology in complex fields, like the healthcare field (Bygstad, Hanseth, & Truong Le, 2015), and to the current discourse on successful implementation of light-weight technology through co-creation.

7. CONCLUSION

In this project co-creation was used as a strategy for implementation of an app with the objective to enhance the communication between patients that receive dialysis at home and the renal nurses in an out-patient clinic in a regional hospital. The project was a triple helix cooperation between a private technology developing company, a public hospital and two research institutions. The results show that co-creation as a strategy for implementation has several processes within, and requires longitudinal and iterative interaction between the different actors. Overall the patients and the nurses in particular found the app useful. It structured their daily tasks and pushed for innovation in their services. The co-creation method's success was dependent on longitudinal frequent interaction between the parties. The challenges pertain to merging different epistemic communities and to the integration of this system with other systems in the hospital.

The knowledge from this project contributes to theory on implementation of technology in complex fields, like the healthcare field, and to the current discourse on successful implementation of light-weight technology using co-creation.

8. IMPLICATIONS FOR PRACTICE

A patient portal for 'virtual hospital at home' will be of great use for a number of patient groups, for instance patient with epilepsy, with COPD, heart failure, cancer, diabetes, psychological health issues or obesity. Additionally, it can be used for a general dialogue with patients as a regular follow up in a treatment or rehabilitation course, and would be appropriate for home treatment of children.

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