Postprint

Exploring the effects of eHealth service innovation

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Abstract

To analyse the impact of implementation and use of eHealth services is fraught with difficulty, and there is often a gap between expected and identified outcomes. In this paper, we identify innovation effects of an eHealth service by applying a framework that focusses on the expected coherent impacts of implementing an IT innovation and contributes to the body of knowledge on tracking innovation effects of services in eHealth. A case study examines four different care units in a government-funded health-care setting. The results show that the effects in the first two contexts of the framework, the micro level and intra-/interorganisational level, could be clearly identified with regard to the physicians and the organisation. However, effects were lacking in the virtual context when looking beyond the involvement of the stakeholders in the eHealth service. The connections between effects for societal groups and larger societal systems simply could not be made in a satisfactory manner.

Introduction

This paper aims to explore the effects of eHealth service innovation. The eHealth service was developed and introduced to improve work routines, decision making, and patient safety first and foremost. The study was performed in a Swedish government-funded health-care setting, where a specific framework (Vimarlund & Koch, 2012) was adopted and applied. The adopted framework focused on three different context levels, the micro level, the intra-/interorganisational and the virtual network context, when capturing the effects of information technology (IT) investments. The contribution of the paper is therefore twofold. First, we develop knowledge regarding how to capture innovation effects of IT investments within a government-funded health-care setting by applying a framework. Second, we increase the knowledge of which benefits can be traced to which level of enquiry concerning an eHealth service implemented to fulfil specific goals.

The health-care sector is one of the largest service sectors in the modern world, and it is undergoing changes all over the Western world. Health-care organisations are facing the challenge of handling a growing number of patients as well as strained budgets and lack of personnel (European Commission, 2012). At the same time, citizens have an increasing demand for better service quality, and patients wish to be more involved in their own health care (European Commission, 2012). According to Parasuraman et al (1985), the characteristics of services are intangibility, heterogeneity, perishability, and the simultaneous production and consumption. These characteristics have an effect on how to manage and maintain the services implemented, one part being the enhanced involvement of the recipient of the service.

Many countries invest effort into developing innovative eHealth services as a way of managing the challenge of a growing population. In this paper, we adopt a definition of eHealth as being … an emerging field of medical informatics, referring to the organization and delivery of health services and information using the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a new way of working, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology (Pagliari et al, 2005). The European Union, and many other countries, has developed strategies to foster the use of eHealth services (European Commission, 2012). One of the leading countries in the development and investment of eHealth services seems to be Denmark (Kierkegaard, 2013), which has launched several

initiatives such as a national service platform where numerous health services can be accessed, a shared medical record and a health summary where citizens can get an overview of their health status (National-Sundheds-it, 2012).

In examining investments and innovations in eHealth services, it is also interesting to discuss the effects and contribution of these services. Investments are often made in finding new means of interaction between individuals, achieving organisational flexibility, and optimizing resource flows (Vimarlund et al, 2008). As eHealth services seem to affect the organisation and the setting within which they are implemented, it is important to identify their effects on the organisation and its members. Involved stakeholders and leaders are also concerned about the contributions that eHealth services might bring to the organisation as they strive to make qualified decision about IT investments.

The concept of innovation has engaged scholars from several different disciplines and has traditionally been associated with technological improvements and products (Evangelista, 2000; Miles, 2000). When Schumpeter (1996) described the concept of innovation, it was broader and included not only the introduction of new products or qualitative changes of services but also the introduction of new methods, new markets, new materials, and changes in organisations. He saw innovation as a driver for change and economic development and acknowledged the significance of entrepreneurs to establish change.

Innovation can be defined as the intentional introduction and application within a role, group, or organisation, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, or wider society (West & Farr, 1990, s. 8). The definition includes the characteristics of novelty, an application component, and an intended benefit and could, in the healthcare context, be seen as new services, new products, and new ways of working (Länsisalmi et al, 2006). Currently, there is an interest in different types of innovations such as service innovation, disruptive innovation, and social innovation.

Service innovation can be divided into four different approaches, namely, technology, assimilation, demarcation, and synthesis. The technologist perspective sees innovation in services as being related to progress in IT and technological competence gains. Scholars focusing on the assimilation approach argue that theories and concepts in the manufacturing context can be transferred to service innovations, while the perspective of demarcation focusses on features of services. The final approach, synthesis, focusses on bringing together service innovation and innovation in manufacturing and stresses the importance of including elements such as customer involvement (Droege et al, 2009).

The concept of disruptive innovation was introduced by Christensen (1997) in a number of articles and later published in The Innovator's Dilemma, where he presented innovations as either sustaining or disruptive. Sustaining innovations are characterised by adding value or enhancing the value the customers already have. Value can be added or enhanced in an evolutionary or revolutionary way by adding either expected or unexpected value. Disruptive innovations tend to perform worse in traditional markets while adding new attributes and performing better in new and often smaller markets.

Christensen & Raynor (2003) later divided disruptive innovations into two different types that focus either on a new market or on the low-end market. Innovations in the new market are considered to be easy to use and present new features that have not been used before. Innovations in the low-end market are, in contrast, often low-priced and offered to customers with less purchasing power. Hwang & Christensen (2008) have argued that disruptive innovations in health care are needed and that transforming complicated and expensive services into simpler, more convenient, and more affordable services is important.

Much of what we today take for granted in our society began as social innovations, including the rise and spread of trade unions, collective insurance against sickness, and the development of universities and kindergartens. These innovations have been led by social movements such as the antislavery movement in the United States and the feminist movement but also by governments in the establishment of welfare states, schooling systems, and banks (Mulgan et al, 2007). More recent examples of social innovations are Fair Trade, microfinance, and emissions trading (Phills et al, 2008).

Social innovation can be defined as a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which value created accrues primarily society as a whole rather than private individuals (Phills et al, 2008, s. 36). Consequently, the social value of the innovation is given mainly to the society as a whole instead of to an individual or an organisation. Compared with other

innovations, social innovations have a social mission and aim to create a shared value (European Commission, 2013) and find new solutions to social problems (OECD, 2011).

The area of social innovation includes some of today's most profitable markets: insuring the uninsured, alternative sources of energy, lowering poverty, and improving health care (Saul, 2011). Social innovation can take place in the public sector as well as the private and non-profit sectors (OECD, 2011). Social innovation can provide an opportunity for both the private and public sector and is in line with the Europe 2020 Strategy that aims to stimulate innovation, entrepreneurship, and the knowledge-based society (European Commission, 2013).

Presentation of a framework for identifying the contributions of IT innovations

In the following sections, the framework that has been used to identify the innovation effects of the studied eHealth service is presented. The framework has been developed by researchers in the Swedish eHealth network with support from the National Board of Health and Welfare, Center for eHealth in Sweden, and the Swedish Association of Local Authorities and Regions. The framework has previously been used to identify the contributions of a number of eHealth services such as electronic medical prescriptions, electronic registration of newborns, and guidance information for young people (Socialstyrelsen, 2011).

The description of the framework is based on Vimarlund and Koch (2012). The framework is used to identify and classify the innovation effects of IT innovations in three different contexts with the aim of supporting decision making on IT investments in health and social care (Socialstyrelsen, 2011). The different contexts (the micro level, the intra-/interorganisational, and the context of the virtual networks) are defined by the degree of patient involvement and the degree of integration between technology and actors. Each context consists of a number of outcomes that can be used to identify innovation effects of an implemented IT innovation (see Tables 1–3).

IT investments in the micro-level context are made mainly to support communication and information management at a local care unit and usually do not support real-time interaction with patients. The aim of the innovation is primarily to reduce errors in manual data entry and to increase the usability of the system. The outcome of the innovation is often short-term returns such as sharing of information, reduced use of resources, reduced work overload, and improved decision making. Possible effects and outcomes in the micro-level context are presented in Table 1.

The micro level context		
IT innovation	**Effects**	**Outcomes**
Electronic decision support systems (EHR, EPR)	Electronic scheduling of appointments and registration of tasks	• Reduced number of missed contacts • Reallocation of time and resources • Reduce numbers of double referrals and/or errors due to manual registration
	Organisational learning	• Increase and stimulate information and knowledge exchange between different care givers at the same unit. • Support awareness of patient safety
Virtual logistic systems	Effective and fast access to information for joint planning and distribution of resources	• Shorter lead time for communication • Integration of the activities along the logistics value chain. • Proactive planning of resources • Shorter time for delivery of results, analysis, etc. • Reduce transaction costs due to effective and fast access to information for joint planning
E-basic services, i.e., booking systems, birth registration, renewal of prescriptions	Customisation of services	• Flexibility and new options for booking/outbookning of appointments • Reduction of waiting time for accessibility of services (i.e., renewal of prescriptions, electronic birth registration)

Table 1: Overview of possible effects and outcomes in the micro-level context (Vimarlund & Koch, 2012).

The aim of IT innovations in the intra-/interorganisational context is to improve information exchange throughout the entire care process within and across organisations (see Table 2). The effects of the IT innovations can be improved integration between actors with the possibility of collaborating with other

organisations. One important aspect of innovations in this context is that the benefits of the innovation might not always return to the financier of the innovation.

The intra-/interoganisational context		
IT innovation	**Effects**	**Outcomes**
Organisational intelligent systems	Integration of electronic healthcare records and laboratory report systems	• Tests can be taken within all healthcare organisations (HC, hospital,) and results are accessible in the system • Reduced waiting time for registration and follow-up of information on results from different tests • Particular prescription of drugs and its motivation are accessible for all actors in EHR • Strategies for prevention and control with the possibility of simulating for prognosis and redistribution of resources in real time • Pictures and opinions from different experts are presented and visualised in the system
	Integration and coordination of vertical and horizontal administrative and clinical information	• Reduced transaction costs for making information accessible for all healthcare providers • Embedded solutions for control and reduction of incorrect prescription of drugs, laboratory results and diagnoses • Electronic support for documentation of deviation handling systems improves service quality and patient safety • Prioritisation and reduction of time for the selection of treatment efforts and routines • Information about private actors for follow-up on controls of costs and quality of efforts in real time • IT-based collaboration and development of e-based warning systems
	Best practices at inter-/intra organisational level	• Diminution of information asymmetry leads to fewer mistakes and more secure routines • Fast and effective access to key information in acute situations (i.e., epidemic, pandemic) • Better routines for follow-up of acute situations
E-business models	Outsourcing of specialised services, i.e., X-ray, tomography, screenings, etc.	• Rationalisation and specialisation of services • Alternative forms of resource use
	IT-based economical information systems	• Individual health budget with possibility for follow-up

Table 2: Overview of possible effects and outcomes in the intra-/interorganisational context (Vimarlund & Koch, 2012).

IT innovations in the context of virtual networks include previously mentioned contexts and an active patient who takes part in the production and delivery of the e-service. The patient is believed to be updated on his/her own needs and assumed to be aware of which kind of e-service would be useful. The aim is to have an active patient who takes part in his/her own care and the demands of e-services. Examples of IT innovations include blogs, networks, and social media, among others.

The value of these IT innovations has to be analysed on several levels because the IT innovations are more complex and embedded in organisations. The effects in the context of virtual networks consist of an increased patient involvement as well as an improved awareness and an empowered patient. Possible effects and outcomes in this context are presented in Table 3.

The virtual networks context		
IT-innovation	**Effects**	**Outcomes**
Patient portals	Digitally integrated information tools for follow-up and interaction with health-and social care	• Electronic follow up or control of the state of services • Information on actual current questions for different target groups • Possibility for follow up and support healthcare receivers in different clusters • Services adapted to the individual preferences • Reduced number of steps for access to information • Rationalisation of information supply for healthcare units • Visualisation of treatment strategies, efforts, interventions, e.g., individual care plan
	Innovative work-routines	• Re-design of work routines and processes and electronic access to individual information • Possibilities to control number of visits and reallocate resources • Reduced number of steps for distribution of information • Control of consumption of services • Automatic reminders or follow-up on care plans or healthcare efforts and their effects • Post information or questions before an appointment or follow-up of information during a care-process
Online communities	Health "Facebook" or such including tools for simulation and visualisation for preventive efforts	• eHealthcare teams for virtual care and to particularly support chronically ill individuals • The healthcare receiver is offered possibilities to participate in specialised "communities" with chat rooms and interaction opportunities • Faster and more effective decision making that favours the healthcare receiver and makes administration for certain matters more cost-effectives • Telemedicine and distance healthcare within all areas: elderly, children, chronically ill, palliative healthcare, cardiovascular, etc. • Follow-up in areas and of healthcare receivers with special healthcare needs, with the possibility for cooperation between external actors
Virtual Systems for Control and Accounting	Automatic decisions for third party (i.e., health insurance office or insurance company).	• Faster and more effective decision making that favours the healthcare receiver and makes administration for certain matters more cost-effective • Information/answers for costs/ support of different efforts between and within different healthcare providers, including both private and public healthcare providers • Real-time interaction with external organisation such as social security offices • Cost-control and effective management of demand of services both at the individual and group level
	Standardisation with the healthcare receiver in focus	• Standardisation of health and social care information about treatments and interventions, IT consequences and costs at a national level • Standardisation of answers related to private life issues offers possibility to keep anonymity if it is desirable and reduce personal visits to primary healthcare • Facilitate search services and comparison of providers for the health care receiver

Table 3: Table 4: Overview of possible effects and outcomes in the context of virtual networks (Vimarlund & Koch, 2012).

Description of the e-service in the study – NjuRen

Stockholm County Council (SLL) developed an eHealth service named NjuRen. The service has two main purposes: to help physicians to calculate renal function of patients and to provide support for selecting the appropriate drug and dosage for patients with renal failure. NjuRen is designed to increase the physicians' awareness of renal function during drug dosing because 10–15% of all registrations at emergency wards are due to drug side effects and other problems related to drug prescription (Odar-Cederlöf et al, 2008). At the

time of this study, NjuRen had been used as a pilot for 3 months, and a second version had been implemented.

NjuRen is considered an eHealth service that offers two main functionalities, calculation of renal function of patients and evidence-based drug dosage recommendations relative to patient renal function. The eHealth service is presented as a part of 'Janusfönstret', which is an integrated system of the medical record system TakeCare. Information on drugs is collected from the Swedish Information database for drugs (SIL), and recommendations on drug dosage are based on the 'Renbase' database that is provided by Medbase AB. However, the information is manually adjusted by SLL before it is presented in NjuRen.

NjuRen provides a relative estimated glomerular filtration rate value based on the Chronic Kidney Disease Epidemiology Collaboration (CKD-Epi) formula. Information on P/S-creatinine, date of creatinine measurement, age, and gender is then gathered from the medical record system. NjuRen is expected to be used by physicians and on laptops on trolleys. When the physician clicks on the NjuRen button, the drugs the patient is taking are shown with a classification based on renal impact. The physician also receives drug recommendations and further drug information based on the renal function of the patient (see Figure 1). NjuRen has undergone evaluations before this study. However, these studies focused on the use and usability of the tool itself and not on the innovation effects, which is the focus of this study.

Renal function and recommendation					
Value of renal function of the patient				Formula: CKD-EPI	
				GFR 50-80 mL/min (weak renal failure)	
				GFR 30-49 mL/min (moderate renal failure)	
P/S-creatinine:200 μmol/L (2013-11-11) eGFR: 29 mL/min/1.73 m^2				GFR 10-29 mL/min (strong renal failure)	
				GFR < 10 mL/min (terminal renal failure)	
Drug	**Substance**	**Class**	**Recommendation**		**Toxic**
Voltaren T	Diclofenac	D	Drug should be avoided	Read more >>	Yes
Glucophage	Metformin	D	Drug should be avoided	Read more >>	
Ciprofloxacin	Ciprofloxacin	C	See additional information	Read more >>	
Alvedon	Paracetamol	A	No need for drug dosage adjustment	Read more >>	

Figure 1: Figure 1 Illustration of the eHealth service NjuRen, after the button is pressed in Janusfönstret.

Method

A single descriptive case study (Yin, 2009) was performed that looked at the perceived innovation effects of the eHealth service innovation NjuRen at four different care units in SLL: one geriatrics ward, one emergency ward, and two district health-care centres. The choice of units for the study was based on their prior use of the e-service and their expected ability to comment on the innovation effects of NjuRen.

Data were gathered using a questionnaire and a followup semi-structured interview with two physicians. The framework, which seeks to capture innovation effects of IT innovations (presented on pages 5–8), was used as a basis for the development of the questionnaire. The questionnaire was organised in such a way that it represented the different contexts in the framework by incorporating questions on innovative functionalities that the eHealth service offered and the effects they have at the micro level, the intra- and interorganisational levels, and a virtual network context of enquiry. The questions were both closed and open and adapted to the setting and aim of NjuRen and could later be derived back to the framework. Examples of questions included in the questionnaire can be viewed in Appendix B.

All physicians at the care units received the questionnaire. Seven of the physicians were excluded from the study due to their limited use of the eHealth service. Out of the 52 physicians, 30 answered the

questionnaire. To gain a deeper understanding of the answers and to validate the result of the questionnaire, two follow-up interviews were performed. On the basis of the results of the questionnaire, questions were generated and used in follow-up interviews with two randomly selected participants.

Application and conceptualisation and of the framework

First, the framework and the different outcomes that could be used to identify the innovation effects of NjuRen were investigated (see Tables 1–3). On the basis of the outcomes in the three different contexts of the framework, we constructed a number of questions for the survey. The data from the questionnaire were later analysed and categorised in relation to the different innovation effects in the framework. On the basis of the answers about the outcomes, we were able to determine whether the different innovation effects could be identified. The outcomes and innovation effects were then grouped and are presented in Table 4 according to the different contexts of the framework. The different steps taken are summarised in Figure 2.
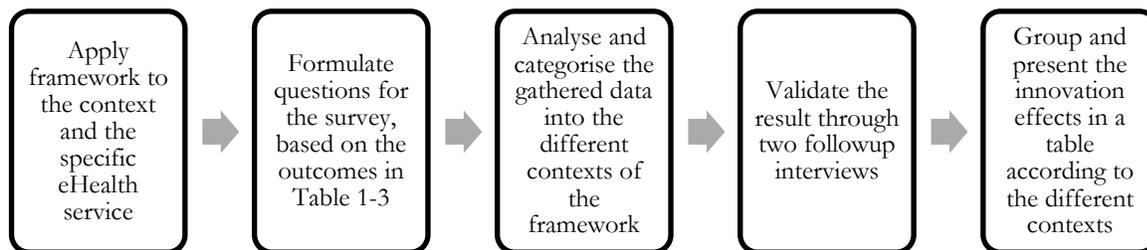

Figure 2: Process describing how the study was conducted.

Results

The main results of the questionnaire and the interviews show that the identification of patients with renal failure has improved due to the implementation of the eHealth service NjuRen because it has provided physicians an increased awareness of their patients' renal function. The results show that sometimes the calculated renal value is controlled by a manual calculation due to a disbelief in the calculation method. Those who trust the calculation method do, however, perceive that the eHealth service helps them to save time, but nevertheless, this study cannot define the exact amount of time saved for the entire organisation.

Another effect of NjuRen is that it provides information that can be used during drug reviews. In theory, NjuRen has also decreased the steps needed to adjust drug dosage. The physicians can now use Swedish Physicians' desk reference (FASS) as a complement because NjuRen provides information on how the drug dosage should be changed in relation to the normal dosage provided in FASS. However, there is a limited use of some functions such as additional information and references, due to perceived lack of time. Concerning the involvement of the patients in their own care, there is no indication in the results that physicians involve patients to a greater extent than before. Some physicians state that it is unlikely that patients are even aware of the existence of NjuRen.

Classification of the outcomes and findings

The outcomes and findings have been classified according to the different contexts of the framework presented in Vimarlund & Koch (2012), namely, the micro level, the intra-/interorganisational level and the virtual network level, to identify the innovation effects of an IT investment in a government-funded setting.

The micro-level context

The innovation effects of NjuRen on the micro-level context can be related to an improved information access due to the automatic calculation of renal value and structured information. Previously, patients' renal function was calculated manually when perceived to be needed. However, with the implementation of NjuRen, efficient and faster access to information and a quick identification of patients' renal function became (with logistical improvement) a possibility. Some physicians also experience increased access to information for improved decision making that can be used to discuss with and learn from fellow colleagues. The

identification of patients with renal failure was perceived as an improvement in service delivery. Innovation effects within the micro-level context:

- electronic access to information;
- internal integration and coordination of administrative and clinical information;
- logistical improvements;
- potential of learning among staff;
- internal benchmarking and patient safety.

The intra-/interorganisational context

In the intra-/interorganisational context, IT-based organisation coordination can be identified because physicians, regardless of care unit, get access to the same information on patients' renal function, and drug information. Furthermore, NjuRen gives the organisation the opportunity to coordinate improvement of information through updates to the information provided by NjuRen. The physicians also perceive an increased awareness concerning renal failure that can further be connected to improved patient safety. Innovation effects in the intra-/interorganisational context:

- IT-based organisational coordination;
- organisational learning;
- possible effectiveness and improved patient safety.

The context of the virtual network

In the context of the virtual network, the focus is on the patient as the initiator of eHealth service use. To be able to identify innovation effects in this context, the patient has to be active and take part in dialogues with other caregivers and patients (Vimarlund & Koch, 2012). Currently, the users of NjuRen are physicians, and consequently, it is natural that the innovation effects are related primarily to the individual physician and the organisation. One possible innovation effect in the virtual network context could be a more involved patient because renal values and drug dosage recommendations can be visualised. However, the results do not indicate that the patient is more involved. From a long-term perspective, NjuRen could perhaps contribute to the Swedish national strategy of improving health through the use of eHealth. It is nevertheless clear that NjuRen does not have any direct innovation effects in the context of the virtual network.

The context of the virtual network	
Effects	**Outcomes**
No effects identified	No outcomes identified

Effects and Outcomes of NjuRen

The intra- and interorganisational context	
Effects	**Outcomes**
• IT-based organisational coordination • Organisational learning • Support possible effectiveness and improved patient safety	• Integrated decision support system and medical record system • Supports new work routines • Supports distribution of best practice • Increased awareness of patients renal function

The micro-level context	
Effects	**Outcomes**
• Electronic access to information • Internal integration and coordination of administrative and clinical information • Logistical improvements • Support learning among staff • Internal benchmarking • Patient safety	• Automatic calculation of renal value for decision making • Organised, structured, and evaluated information regarding drug dosage • Support coordination and control of clinical information • Fast and effective access to information during decision making • Informal knowledge exchange during drug reviews • Increased control and awareness of renal function

Table 5: Summary of the identified effects and outcomes of NjuRen.

Discussion

In this study, we applied a framework (Vimarlund & Koch, 2012) to identify the effects of eHealth service innovation. The results revealed that NjuRen has several innovation effects in the micro-level context and the intra-/interorganisational context. The effects can be assigned to the individual physician and the involved organisations that have the ability to access information on renal failure in a faster and more efficient way. NjuRen also provides physicians with structured and organised information that facilitates decision making and discussions with colleagues. In addition, the implementation of the eHealth service has given the organisation the ability to provide high-quality information and safer care. The innovation effects in the context of the virtual networks were, however, not identified due to the lack of involvement from and with the patient.

NjuRen was implemented to support and improve the process and decisions concerning patients with renal failure. The aim was, however, not to create virtual networks but to support the individual physician in his/her daily work; consequently, innovation effects could not be identified within the third context. If the eHealth service were to provide the opportunity to capture, store, manage, and analyse data that have previously been hidden in work routines, it would probably be possible to deliver more personalised health care as well as services for specific populations. To reach this goal, however, there is a need for a sustainable information flow in which the information needed can be transferred from all producers to all consumers in a structured way.

The identified effects can be related to the basic aim of the implementation of NjuRen, an improved support for decision making and a possible way to improve patient safety. However, it is difficult to determine the actual effects on the individual patient and society as a whole. This difficulty is attributable to the aim of the eHealth service, to support the individual physician, and not to gather big data. Nevertheless, it would be interesting to study the future societal effects of implementing NjuRen and whether it has improved patient safety in the long term. Within government-funded organisations, a direct return is not always necessary because benefits of the investments might be observed in other parts of the society, for instance in the interaction between citizens and the health-care sector.

From this perspective, NjuRen could be viewed as a social innovation as it seems to be more effective and efficient than previous solutions; it also has the potential to create value for society. However, the latter is yet to be proven.

Previous studies (Greenhalgh et al, 2004) have shown the importance of a good introduction to facilitate adoption and diffusion of eHealth services. The importance of a good introduction was also shown in our study, as the initial scepticism about the calculation method diminished when the physicians received further information about it and its benefits. This effect underscores the importance of involving the users of the eHealth service in the development process and the significance of providing information to the users.

We found the use of the framework for identifying contributions of IT investments to be useful and applicable to our study as it gave a structured approach to identify possible effects of IT investments. The three conceptual levels also helped to maintain a patient focus during the analysis as well as to bear in mind the societal aspects of the service that might be important in a government-funded setting. It may, however, be possible to improve the framework by providing further instruction regarding how to apply it and when or in which situations managers or researchers should apply it.

As with every framework, the applied framework will limit the user as he/she will search for effects that have been specified within it. Our opinion is that health-care providers, after small adjustments, can use the framework to identify expected benefits of possible IT investments and as a tool for identifying perceived outcomes of implemented IT innovations. Consequently, it will be possible to follow up decisions on IT investments and improve decision making in health-care settings. As is always the case, there are limitations to this study, particularly the length of time that the eHealth service had been in use when the study was conducted. The innovation effects of NjuRen were identified between two pilot testing phases. The first phase had just ended after a 3-month trial, and the second was to start after our study. This rather short time span has affected our results, but we do not believe that it diminishes their credibility; rather, the opposite is true. Our ability to obtain these results within the given time span bodes well for future studies. It might well be that the eHealth service needs to run for a longer period of time before societal effects can be identified. One restriction in the analysis is that the limitations of the studied eHealth service might have affected the result. However, given the conditions of the project, it is our opinion that the results accurately reflect reality. If the situation changes, so will the results.

The main contribution of this work is the application of the framework in a real-life health-care setting within a government-funded context: it creates an example of how to approach the capture of innovation effects of IT investments and highlights the areas where the framework should perhaps be further developed. In addition, the benefits of eHealth services such as NjuRen can have effects on an organisation and its work routines. However, no direct and visible effects were shown in the virtual network context within the conceptual framework.

Acknowledgements

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