JÖNKÖPING UNIVERSITY
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Doctoral Thesis

The Importance of eHealth Innovations

Lessons About Patient Accessible Information

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Acknowledgements

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Abstract

Access to digital information and communication has an increasing importance in both the work of healthcare professionals and in patients' everyday life and has transformed what we do and how we carry out activities. It changes the way in which healthcare is delivered, how information is exchanged within and between organizations and how patients and other actors access and manage information. Currently, innovation is imperative in the healthcare sector and today there is a focus on how different eHealth services can improve healthcare. With increased access to various eHealth services, there is a need to know more about the impact of eHealth innovations on healthcare.

The aim of this thesis is to acquire more knowledge about eHealth innovations in healthcare. The focus is on prerequisites to realize innovative eHealth services and eHealth services that provide patients with access to health information. The theoretical background addresses innovation, services and business models. This thesis is a compilatory work and includes five qualitative research papers. The first study is an interview study, the second is a literature review and the remaining three are case studies. The data collection consisted of interviews, surveys, workshops and secondary data collected from documents. The interview study and the case studies were performed in the Swedish eHealth setting.

The research contributes to our understanding of eHealth innovations with insights on prerequisites to realize eHealth innovations and knowledge on patient accessible information. The first study provides a classification of prerequisites that need to be considered to realize innovative eHealth services. When dealing with eHealth services, organizational and sematic interoperability are still a challenge, and they transcend organizational boundaries. This thesis provides knowledge on the recent trend of opening up electronic health records to patients. The knowledge derived from the studies on patient accessible electronic health records show that there is a discrepancy between the perceptions of patients and healthcare professionals. The thesis concludes that patients feel more involved and that the patient-professional relationship improves with patient access to electronic health records, whereas healthcare professionals have concerns about how patients will manage access to health information. This thesis also provides empirical insights on how business models can be represented in a public eHealth setting. By viewing public eHealth services as social innovations, the thesis contributes to the research on business models in a public healthcare setting by incorporating societal value into the representation of the business model.

The research in this thesis contributes to research in health informatics by discussing issues related to eHealth innovations and patient accessible information. Its practical importance lies in identifying issues that are important when discussing eHealth initiatives and the implications of giving patients online access to their electronic health record.

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1   Introduction

Access to digital information and communication has increasing importance in both work and everyday life. Digital services transform what we do and how we carry out activities. Digitalization of healthcare and what has been referred to as eHealth since the 2000s, involves the introduction and use of information and communication technology in healthcare (Eysenbach, 2001; Moen et al., 2012; Pagliari et al., 2005), which impacts different aspects of healthcare. It changes the way in which healthcare is delivered (Ramanathan, Swendeman, Comulada, Estrin, & Rotheram-Borus, 2013; Warmerdam, van Straten, Twisk, Riper, & Cuijpers, 2008), how information is exchanged within and between organizations (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Vimarlund, Olve, Scandurra, & Koch, 2008) and how patients and other actors access and manage information (Househ, Borycki, Rohrer, & Kushniruk, 2014; Rexhepi, Åhlfeldt, Cajander, & Huvila, 2016).

The digitalization of healthcare has further radically expanded since the introduction of computers in the 1960s (Haux, 2006). The 1970s is described as a time of exponential development in the area due to less expensive hardware, more powerful software and the introduction of personal computers (Cesnik, 2010). During this time, systems were mostly developed for healthcare professionals and specific departments, such as radiology or administration (Haux, 2006). In the 1980s, the first electronic health records (EHRs) were implemented in various forms, starting with different kinds of departmental EHRs that served different areas, such as intensive care, emergency departments or ambulatory care. These systems later transformed into broader systems that included entire hospitals, primary care and personal health records (Häyrinen, Saranto, & Nykänen, 2008). With the progress in information and communication technology, medicine and healthcare, along with changes in the needs and expectations of societies, digitalization continues to progress (Haux, 2010). Today, there is a strong focus on the development and use of innovative eHealth services (Nøhr, Villmusen, Bernth Ahrenkiel, & Hulbæk, 2015; Vimarlund & Koch, 2017).

Currently, digitalization and innovation are imperative in several industries (Nambisan, Lyytinen, Majchrzak, & Song, 2014) and in the healthcare sector (Hübner, 2015; Länsisalmi, Kivimäki, Aalto, & Ruoranen, 2006; Varkey, Horne, & Bennet, 2008). The digitalization of healthcare is an opportunity to transfer previously paper-based processes to digitally supported processes. This access to digital information can support innovation and new ways of working in addition to innovative products and services (de Lusignan, 2015). The European Union, the Organisation for Economic Co-operation and Development (OECD) and the American Medical Informatics Association (AMIA) have all stressed the importance of innovation to handle the challenge of providing value-based care in which better healthcare services are delivered using less resources, often by the use of eHealth (Adler-Milstein, Embi, Middleton, Sarkar, & Smith, 2017; European Commission, 2012a; OECD, 2013).

Traditionally, innovation studies have focused on the manufacturing industry and more high-tech areas, such as the aerospace, automotive and pharmaceutical industries (Djellal, Gallouj, & Miles, 2013). Less research in this area has been focused on the public sector (Djellal et al., 2013). In the healthcare setting, studies have often focused on adoption (Cresswell & Sheikh, 2013; Länsisalmi et al., 2006) and diffusion of innovation or implementation issues (Berwick, 2003; Greenhalgh et al., 2004). Today, there is a shifting focus from adoption of technology to how different eHealth services and innovations can improve healthcare and outcomes (Roberts et al., 2017). With increased access to various eHealth services, there is a need to know more about the impact of eHealth on healthcare (de Lusignan, 2015; Dixon-Woods, Amalberti, Goodman, Bergman, & Glasziou, 2011; Nøhr et al., 2016; Spooner, Salemi, Salihu, & Zoorob, 2017).

1.1 Aim and Research Questions

The aim of this thesis is to acquire more knowledge about eHealth innovations in healthcare. To elucidate the purpose of the thesis, three research questions were formulated to support the aim of the thesis.

What are the prerequisites to realize innovative eHealth services?
- Wass, S., & Vimarlund, V. (2017). *I got 99 problems, and eHealth is one*. Proceedings of the 16th World Congress on Medical and Health Informatics (MedInfo), Hangzhou, China.
- Wass, S., & Vimarlund, V. (2016). Healthcare in the age of open innovation – A literature review. *Health Information Management Journal*, 1-13.

How do healthcare professionals and patients perceive the initiative to give patients online access to electronic health records?

- Wass, S., & Vimarlund, V. (2017). The role of PAEHRs in patient involvement. *Submitted manuscript*.
- Wass, S., & Vimarlund, V. (2017). Same, Same but Different: Perceptions of Patients' Online Access to EHRs among Healthcare Professionals. *Submitted manuscript*.

How can a business model framework be used to describe eHealth services in a public healthcare setting?

- Wass, S., & Vimarlund, V. (2016). *Business models in public eHealth*. Proceedings of the 24th European Conference on Information Systems (ECIS), Istanbul, Turkey.

This thesis is a compilation of five research papers that answer the issues listed above and contributes to research on innovation and business models in healthcare. This research has followed the traditional steps of acquiring empirical material and analyzing and validating the findings.

1.1.1   Contribution

The work in this thesis contributes to the area of health informatics by discussing issues related to innovative eHealth services and the recent research trend of opening up EHRs to patients. It provides a classification of prerequisites that need to be considered when eHealth initiatives are discussed and provides knowledge on how patient accessible health information impacts patients and healthcare professionals. This thesis also discusses how business model frameworks can be used in the field of health informatics. Theoretically, the thesis contributes to work on innovation and business models by expanding theory from one area to the public healthcare context. Previously, innovation theory has typically been applied to fields like economics, business and other applied fields within information systems research. The contribution for practitioners is mainly the identification of issues that are important when discussing eHealth initiatives. Healthcare organizations can also benefit from the knowledge on patient accessible EHRs (PAEHRs).

The theoretical concept and framing of this thesis focuses on innovation. However, it does not discuss the actual innovation process in which different actors collaborate to design and develop an innovation.

1.2   Definitions

Within the healthcare context, information and communication technology and electronic services are often referred to as eHealth services. In this thesis, e-services, digital services and eHealth services will be used interchangeably. eHealth is defined as:

> *"...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, p. 17).

Interoperability is discussed in the first paper and defined according to the European Interoperability Framework:

> *"Interoperability is the ability of organisations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organisations, through the business processes they support, by means of the exchange of data between their ICT systems"* (European Commission, 2017, pp. 4-5).

2   An Overview of eHealth in Sweden

In the following section, a brief history of the progress of eHealth in Sweden is provided by mentioning different strategies, organizations and e-services. Official strategic work on eHealth in Sweden started in 2002 when the Ministry of Health and Social Affairs published the report "VårdITiden" to increase the use of eHealth (Olsson & Jarlman, 2004). Four years later, the first national IT strategy for health and social care was formed. The report stated that several different information systems existed in the Swedish healthcare system, but they were unable to share information with each other. To solve this problem, the strategy focused on initiatives to renew laws and regulations, build a common information infrastructure, develop the technical infrastructure and improve usability, availability and accessibility (Ministry of Health and Social Affairs, 2006). This IT strategy was followed by the first strategy for eHealth in 2010. Compared to the previous IT strategy, which focused on technical development, the eHealth strategy had a stronger focus on the implementation, use and value of information technology (Government Offices of Sweden, 2015; Ministry of Health and Social Affairs, 2010). In 2016, the eHealth strategy was replaced by a vision for eHealth until 2025. The vision notes the following areas as the most important: (i) regulations that support personal integrity, (ii) quality, safety and efficiency, (iii) the unified use of concepts and (iv) standards that ensure interoperability (Ministry of Health and Social Affairs & Swedish Association of Local Authorities and Regions, 2016).

The implementation of eHealth strategies and the coordination of eHealth in Sweden have been managed by different organizations throughout the years. The first official and national organization for eHealth, Carelink, was established in 2000 and organized by the county councils of Sweden, the Swedish Association of Local Authorities and Regions, the Swedish Pharmacy and the Association of Private Care Providers (Olsson & Jarlman, 2004). Between 2009 and 2013, the development and coordination of eHealth was managed by the Center for eHealth, CeHis, but in 2014, the responsibilities were transferred to Inera. During the same year, a new national agency, the eHealth Agency, was established with the aim of driving the development of eHealth in Sweden, develop infrastructures that support healthcare and citizens and provide eHealth services (The Swedish eHealth Agency, 2016).

The expansion of eHealth has required and has been possible due to the development of different digital infrastructures. One of the first infrastructures was Sjunet, a network that was launched in 1997 with the aim of enabling information exchange of patient data, pictures and medical applications between healthcare providers (Wadmann, Strandberg-Larsen, & Vrangbæk, 2009). Today, Sjunet is a communication network that connects all healthcare providers in Sweden and supports the secure exchange of patient data (Inera, 2015c). During the same period in which Sjunet was launched, EHRs were introduced in the Swedish primary care system; however, they did not reach full coverage across the entire country, including

primary care, psychiatric care and hospitals, until 2012 (Jerlvall & Pehrsson, 2016). With the expansion of EHRs, a discussion started about issues related to terminology and semantic interoperability. The importance of a common information structure and terminology resource was recognized in the national IT strategy in 2006, and since 2007, the National Board of Health and Welfare has been responsible for the national interdisciplinary terminology for health and social care. This work includes, the development and translation of SNOMED CT, an international clinical terminology resource (The National Board of Health and Welfare, 2011).

During the 1990s, initiatives were taken to develop not only information systems for healthcare professionals but also eHealth service for Swedish patients (Inera, 2014). In 2002, the first national website with health information was launched. InfoMedica gave patients access to information on different diseases and treatments, drugs and patient rights. The website was a joint project between all county councils and the Swedish Pharmacy. At its start, it contained information on 20 different areas, such as diabetes, cancer and hip treatment (Läkemedelsvärlden, 2002). This was followed by a parallel service via phone in 2003, which allowed patients to call for advice concerning health issues (Inera, 2015a). Today, the website has been transformed into a patient portal called "Healthcare Guide 1177". At the portal, patients can access quality assured information on diseases and treatments, ask anonymous questions, compare healthcare clinics and use several eHealth services. The eHealth services include requesting, canceling and rescheduling appointments, refilling prescriptions, online contact with clinics and care units and access to the EHR (Healthcare Guide 1177, 2015). The amount of information that is shown in the patient accessible EHR (PAEHR) varies across the different regions of Sweden. In the region of Uppsala, which was the first region to provide patient access to the EHR, the patient can access more information than for instance the region of Jönköping. Table 1 presents the information that is shown in the regions of Jönköping and Uppsala.

Table 1: Information in the EHR that is accessible by the patient (information marked in grey was made accessible after finalizing papers 3 and 4).

Accessible Information	Region of Jönköping	Region of Uppsala
Medical notes	■ (accessible)	■ (accessible)
Diagnosis	■ (accessible)	■ (accessible)
Forms		■ (accessible)
Log reports		■ (accessible)
Drugs		■ (accessible)
Maternal health		
Test results	▨ (grey)	■ (accessible)
Referrals		■ (accessible)
Growth curve		■ (accessible)
Warning signals		■ (accessible)
Vaccinations	■ (accessible)	
Healthcare contacts		
Psychiatry	▨ (grey)	

The use of eHealth strategies is not limited to Sweden. A recent report by the World Health Organization (WHO) shows that 70% of the member states in the European

region have a strategy that specifically refers to eHealth (World Health Organization, 2016). An analysis of the Nordic eHealth policies conducted in 2012 describes several similarities between the different policies. All policies contained statements about quality improvement, effectiveness, patient empowerment, information security, privacy and improved access to healthcare information. In comparison to other Nordic countries, Sweden has emphasized the use of information and communication technologies to enable change, usability issues and standardization (Nordic Council of Ministers, 2013). Today, a similar analysis illustrates that extensive progress has been made in improving eHealth in the Nordic countries (Vimarlund & Koch, 2017). Several applications and services have been implemented (Gilstad et al., 2016), and the strategies reflect an increased awareness of the possibilities that eHealth provides. The most important strategic decisions focus on engaging patients and making them more active in healthcare by providing different services that give access to healthcare information in different ways. Common to all strategies is a transformation from focusing on technical issues to focusing on issues related to governance, involvement and business models (Vimarlund & Koch, 2017).

Figure 1 summarizes and presents a brief overview of different strategies, organizations and e-services that have influenced the progress of eHealth in Sweden.
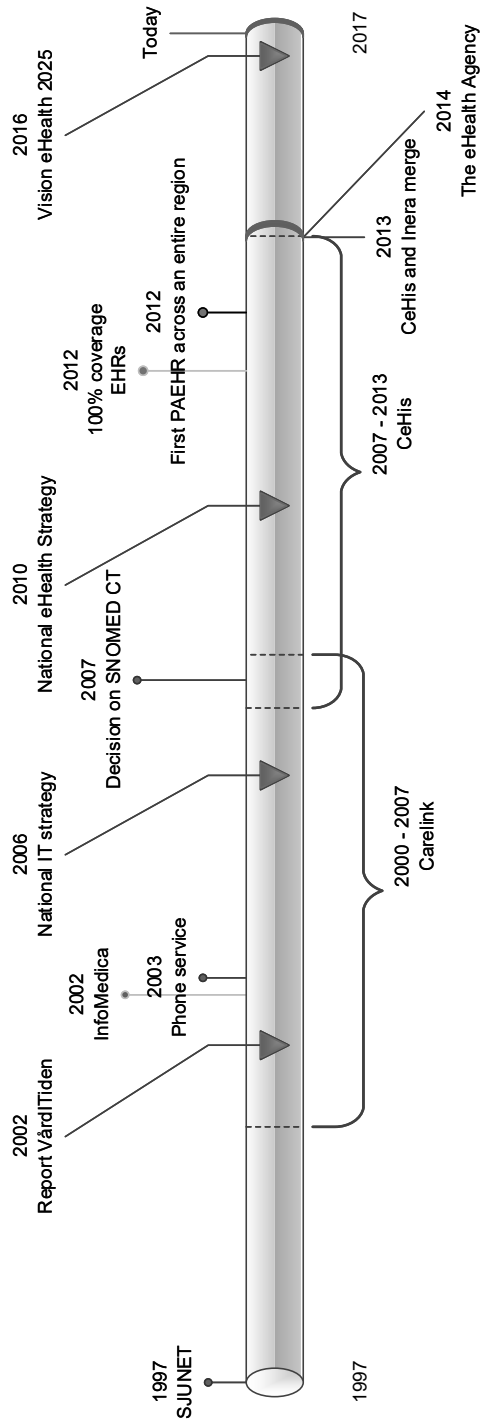
Figure 1: An overview of strategies, organizations and e-services in Swedish eHealth. Strategies are marked by arrows, organizations by brackets and services by dots

3 Frame of Reference

This chapter presents the frame of reference that supports and complements the research performed in the papers. First, an introduction is given on innovation and service innovation. Thereafter, services and e-services are presented, and finally, the concept of business models is introduced.

3.1 From Innovation to Service Innovation

Innovation has been studied in various disciplines and defined in numerous ways (Baregheh, Rowley, & Sambrook, 2009). Early contributions can be found in the field of economics, especially in the work of Schumpeter and the book *Theory of Economic Development* (1934). Schumpeter (1934) describes innovation as novel combinations of new and existing resources. They are often created by entrepreneurs and should be separated from inventions. While an invention can be a new product, service, process or idea, it has to be introduced on the market and make profit to become an innovation (Schumpeter, 1934). An invention can therefore be described as a scientific breakthrough and an innovation as a commercialization of the invention (West & Gallagher, 2006). The invention itself has less value to organizations and society (Gummesson, 2014) since it cannot redefine a market or create change. It is the implementation, diffusion and commercialization of an invention within a context that makes it useful (Gummesson, 2014; Weberg, 2009).

Newness and novelty are central to the innovation concept. However, it does not mean that everything that is new is an innovation. According to Schumpeter (1934), the notion of new entails that value is created for the firm and that other firms also follow such that the entire market changes as a whole. This definition is rather strict, and lately, different degrees of newness or novelty have been presented in service innovation research (Toivonen & Tuominen, 2009). Instead, innovations tend to be divided into radical and incremental, where radical innovations are new to the world and incremental innovations are new to the market (Sundbo, 1997), or to a sector or geographical contexts, such as regions or nations (Toivonen & Tuominen, 2009). It is important to emphasize the meaning of new, otherwise all organizations are innovators and that explanation would not contribute to understanding the meaning of innovation (Witell, Snyder, Gustafsson, Fombelle, & Kristensson, 2016). For instance, it is important to separate organizational learning and innovation. Both are evolutionary; however, organizational learning is smoother and requires continuous development, whereas innovation creates jumps in evolution (Sundbo, 1997). Services that are merely new to a firm should therefore be studied as the diffusion of innovation and the learning that is connected to that diffusion (Toivonen & Tuominen, 2009).

Products are typically associated with innovation (Weberg, 2009), but innovation tends to be described in terms of four types of novel outcomes: products (including

services), processes, marketing methods or organizational methods that are put into practice (OECD, 2005, p. 46):

> *"An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."*

Innovation that focuses on services is captured by the stream of research on service innovation that spans across several disciplines, including marketing, management, social sciences and healthcare (Witell et al., 2016). With an increased interest in service innovation, the concept has also become broader (Ostrom et al., 2010) and has been handled in different ways (Toivonen & Tuominen, 2009; Witell et al., 2016). However, definitions across different perspectives share the view of service innovation as "a new service" (Witell et al., 2016). Service innovation is defined according to the definition by Toivonen and Tuominen (2009, p. 893):

> *"... a new service or such a renewal of an existing service which is put into practice and which provides benefit to the organisation that has developed it; the benefit usually derives from the added value that the renewal provides the customers. In addition, to be an innovation the renewal must be new not only to its developer, but in a broader context, and it must involve some element that can be repeated in new situations, i.e. it must show some generalisable feature(s). A service innovation process is the process through which the renewals described are achieved."*

Service innovations can be described by four dualities: incremental versus radical (degree of change), product versus process (type of change), new to the firm versus new to the market (newness) and technology versus organization (means of provision). The table below explains the different dualities (Snyder, Witell, Gustafsson, Fombelle, & Kristensson, 2016).

Table 2: The dualities of service innovation according to Snyder et al., 2016.

	Degree of change	Type of change	Newness	Means of provision
Categories	Radical, incremental	Product, process	New to the market, new to the firm	Technology, organization
Explanations	A service innovation is based on new core characteristics or improvements to existing core characteristics.	A service innovation is based on changes in the core characteristics related to the output or service provision.	A service innovation that has not been provided by competitors or is a new service for the specific service provider.	A service innovation is provided in a new way through technology or new organizational arrangements.

The characteristics related to the outcome or the type of change, i.e., product versus process change, are challenging to apply to service innovations. Since a service tends to be both products and processes, differentiation becomes problematic (Michel, Brown, & Gallan, 2008). It is also easier to distinguish an industrial product as a new one compared to identifying a change or improvement in a service (Gallouj & Weinstein, 1997). The consequences or impacts of innovations are hard to foresee. The impact of innovations has traditionally been identified as the economic value of the firm. In some contexts, it can be discussed if this impact provides the entire story of an innovation. As an example, healthcare services might not generate revenue for the developer but can improve well-being and other health related benefits for the individual and society (Witell et al., 2016). In a healthcare context, the benefits could for instance be new processes, new policies and new ways of organizing that in turn change the outcomes of healthcare (Weberg, 2009). The consequences or impact of innovations in healthcare has been described as follows:

> *"… the introduction of a new concept, idea, service, process, or product aimed at improving treatment, diagnosis, education, outreach, prevention and research, and with the long term goals of improving quality, safety, outcomes, efficiency and costs"* (Omachonu & Einspruch, 2010, p. 5).

Another view on innovations is social innovation. Much of what we take for granted today in our society began as a social innovation, including the rise and spread of trade unions, collective insurance against sickness and the development of universities and kindergartens. These innovations were led by social movements, such as the antislavery movement in the United States and the feminist movement, and also by governments in the establishment of welfare states, schooling systems and banks (Mulgan, Simon, Ali, & Sanders, 2007). Social innovations have a social mission, aim to offer a shared value (European Commission, 2013) and find new solutions to social problems (OECD, 2011). Social innovation can be defined as follows:

> *"A novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value benefit primarily society as a whole rather than private individuals"* (Phills, Deiglmeier, & Miller, 2008, p. 36).

Given this background, service innovation (i) is something novel that provides change and is put into practice, (ii) offers value on several levels and (iii) has an innovation process that can be separated from the actual service innovation. In addition, social innovation acknowledges the importance of finding new solutions to social problems and benefiting society, not merely private individuals or organizations.

3.1.1   From Services to e-services

Traditionally, services have been defined by comparing them to goods, and they have been described by four intrinsic characteristics: intangibility, heterogeneity, inseparability and perishability (Parasuraman, Zeithaml, & Berry, 1985). Intangibility refers to the view of services as performances instead of objects. Due to this characteristic, it is argued that it is impossible to evaluate, test or measure services in

the same way as goods. Heterogeneity of service refers to the unstandardized nature of services as they frequently involve employees and customers whose performances differ from day-to-day. Moreover, services tend to include human interaction with unique demands and experiences: two services will therefore not be identical but will vary between different suppliers and customers. The characteristic of inseparability denotes that production and consumption often occurs simultaneously and that the customer interacts with the service provider or other customers as the service is delivered (Parasuraman et al., 1985). The final characteristic, perishability, refers to the inability to produce or store services in advance (Edgett & Parkinson, 1993).

This way of describing services has been criticized for two main reasons: the customer is seen as a passive actor and the focus is on the provider (Tronvoll, Brown, Gremler, & Edvardsson, 2011). Moreover, the characteristics attributed to services (intangibility, heterogeneity, inseparability and perishability) can also be applied to goods (Lovelock & Gummesson, 2004; Vargo & Lusch, 2004). There is therefore no need to differentiate services from products since services are as unlike each other as products are from other products (Edvardsson, Gustafsson, & Roos, 2005). Another way to describe services is to view services as dynamic processes that focus on the co-creation of value (Edvardsson et al., 2005; Grönroos, 2008; Vargo & Lusch, 2004). According to this view, resources do not 'have value' (Tronvoll et al., 2011), and value is not produced or delivered by an organization but is co-created with the customer and others (Vargo, Lusch, & Akaka, 2010). Today, most scholars consider services to be activities, deeds or processes and interactions (Edvardsson et al., 2005) that center around the customer and are solutions to needs of the customer (Grönroos, 2007). Consequently, the overall view of services has gone from separating services from goods and discussing the characteristics of services to a process-view focusing on the co-creation of value with the customer. In this thesis, the process-view of services is adopted.

The notion of e-service was introduced as a consequence of the expansion of electronic networks (Hassan, Shehab, & Peppard, 2011). The *e* in e-services refers to electronic and the electronic mediation of a service through the use of information technology (Scupola, Henten, & Westh Nicolajsen, 2009). e-services can be seen as technical artifacts that are usually Internet-based, include interaction and are connected to other information systems (Lindgren & Jansson, 2013). In a broad sense, e-services have been defined as a provision of services using electronic networks (Rust & Kannan, 2003). The definition by Rowley (2006) is in line with the process-view of services and emphasizes the action delivered via information technology:

> *"e-service is deeds, efforts or performances whose delivery is mediated by information technology…"* (Rowley, 2006, p. 341).

Compared to e-services in firms, e-services in public organizations, such as eHealth services, have dissimilarities. Characteristics that are unique to service delivery in public organizations include the large and heterogeneous group of users (all citizens) and the need to provide services for all citizens with the aim ensuring public and collective interests (Lindgren & Jansson, 2013; Sundgren, 2005). This description includes the non-commercial nature of e-services (Scupola et al., 2009) and a rationalization of its use as a key incentive and tool for saving public money (Ilshammar, Bjurström, & Grönlund, 2005). Public organizations should therefore

serve the common good, aim for social justice and consider both economic and democratic values. Welfare services, such as healthcare, are for instance expected to be provided to all citizens and on equal terms (Lindgren & Jansson, 2013). It can be a challenge for public organizations to provide services to a limited group of citizens. The public actor must then establish a process to determine which group of citizens to include and which ones to exclude from the offering (Chesbrough & Di Minin, 2014).

In addition, the market of public services is different. Today, various public services are monopolized or provided in cooperation with private actors. If that is the case, the service is often selected through public procurement. Therefore, the customer has limited power and is generally unable to choose whatever service he or she wants. When private alternatives do exist, they are sometimes too expensive for certain groups of citizens (Lindgren & Jansson, 2013). Other distinctions that have been reported include the need for several different channels to support all citizens, the use of both public and private data and the sometimes contradictory needs of the user and the producer/authority (Sundgren, 2005). However, the difference between public and private services is more difficult to define today, as private actors have increased their part in public service delivery (Lindgren & Jansson, 2013).

3.2 Business Models and eHealth Business Models

The use of the business model concept expanded during the 1990s as the Internet progressed, and since then, it has been the focus of both practitioners and academics (Zott, Amit, & Massa, 2011). On a general level, a business model describes an organization and how that organization achieves its goals (Massa, Tucci, & Afuah, 2017). However, several scholars have published extensive literature reviews stating that it is a diverse area (Al-Debei & Avison, 2010; Massa et al., 2017; Osterwalder, Pigneur, & Tucci, 2005; Pateli & Giaglis, 2004; Zott et al., 2011) and a concept that is defined in different ways to suit the purpose of each study (Zott et al., 2011). This discrepancy is explained by the newness of the concept (Osterwalder et al., 2005), its multi-disciplinary background (Chesbrough & Rosenbloom, 2002; Pateli & Giaglis, 2004) and the innovative areas in which the concept is explored (Al-Debei & Avison, 2010). In order classify the area, prior studies have defined the concept (Rappa, 2001; Shafer, Smith, & Linder, 2005; Timmers, 1998), described what constitutes a business model (Dubosson-Torbay, Osterwalder, & Pigneur, 2002; Hedman & Kalling, 2003; Osterwalder & Pigneur, 2010; Shafer et al., 2005), the relation to strategy (Shafer et al., 2005) and innovation (Chesbrough, 2010; Teece, 2010) and provided frameworks (Al-Debei & Avison, 2010; Pateli & Giaglis, 2004; Zott et al., 2011).

In an extensive review, Zott et al. (2011) found that most contributions to the business model literature highlight the notion of value, financial aspects and the network between the firm and other actors. The authors also state that a business model is the combination of three elements or components and not merely a revenue model, value proposition or network of actors. In this thesis, a business model is defined as follows:

> *"...a new unit of analysis, offering a systemic perspective on how to "do business," encompassing boundary-spanning activities (performed by a focal firm or others), and focusing on value creation as well as on value capture"* (Zott et al., 2011, p. 1038).

Thus, the concept is a number of related components or activities that aim to offer a perspective on how to create and capture value within a network. While value in this definition is described as the capability of providing a commercial offering (Kowalkowski, 2011), in service research, it is stressed that value is not something that can be created or produced (Tronvoll et al., 2011). It is therefore important to acknowledge that value is co-created with the customer and others (Vargo & Lusch, 2016).

In a recent review, Massa et al. (2017) proposed three interpretations that have emerged from management literature on the business model concept. Business models are interpreted (1) as attributes of real firms, (2) as cognitive or linguistic schemas and (3) as formal conceptual representations of business functions. The first interpretation focuses on how firms do business and includes business model archetypes such as advertising, freemium, brokerage and crowdsourcing. The second interpretation focuses on how the business model is viewed by organizational members based on the dominant thinking-pattern of the organization. The third interpretation focuses on how business models can be represented by formal conceptualizations (symbolic, mathematical or graphical descriptions). This interpretation includes research that focuses on different components of the business model (Massa et al., 2017) and frameworks like the Business Model Canvas (Osterwalder & Pigneur, 2010).

Research on eHealth business models is inspired by overall research on business models, and the concept seems to be interpreted as either attributes of different services (e.g., Mettler & Eurich, 2012; Parente, 2000) or formal conceptual representations of different services (e.g., Kijl & Nieuwenhuis, 2011; Valeri, Giesen, Jansen, & Klokgieters, 2010). In line with overall research on business models, eHealth business models that are interpreted as attributes focus on revenue models, such as freemium, crowdsourcing and 'inverted razors and blades' (Mettler & Eurich, 2012). Studies that interpret eHealth business models as formal conceptual representations employ frameworks such as the Business Model Canvas (e.g., S. Chen, Cheng, & Mehta, 2013; Valeri et al., 2010), the framework by Al-Debei and Avison (2010) (e.g., Ranerup, Henriksen, & Hedman, 2016) and the Service, Technology, Organization and Finance (STOF) model (Fredriksson, Mazzocato, Muhammed, & Savage, 2017). The research in this thesis and what is presented in paper 5 can be positioned in the stream of research that interprets business models as formal conceptual representations. A formal conceptual representation is an abstraction or simplification of a complex phenomenon (Massa et al., 2017).

In this thesis, the 'STOF business model framework' was used to conceptualize the business model for a public eHealth service. The STOF model is comprised of four main components: service, technology, organization and finance. The framework also includes the influences of external forces and considers market drivers (influence of suppliers/customers/competitors), technology drivers (changes and innovations) and regulation drivers (privacy, intellectual property, regulations) (Bouwman, Faber, Haaker, Kijl, & Reuver, 2008). The framework is presented in Figure 2.
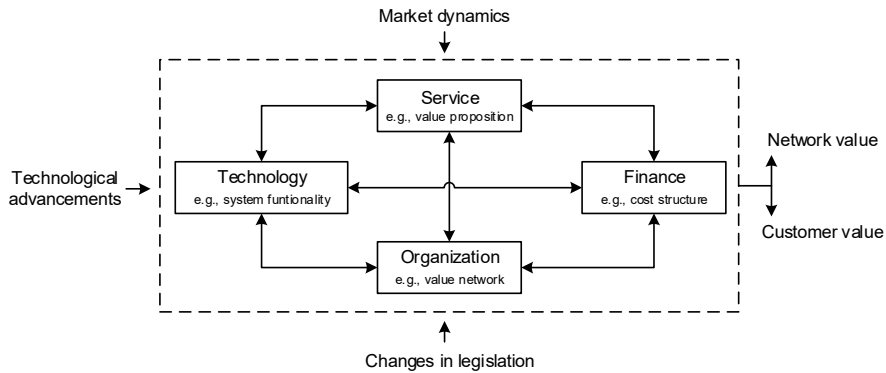
Figure 2: The STOF business model framework, based on Bouwman et al. (2008) and Spil and Kijl (2009).

It is also stressed that since no organization is static, neither are the business models, which therefore need to be continually developed (Bouwman et al., 2008; Chesbrough & Rosenbloom, 2002; Spil & Kijl, 2009). This development is described as a process in which the initial stages are more of a pre-strategy or hypothesis on how to offer value to the customer (Chesbrough & Rosenbloom, 2002). These stages are later followed by different phases and loops as the business model develops over time (Bouwman et al., 2008). In some cases, the current business model fits new and innovative solutions, and in other cases, there is a need to employ a new business model, which is often the situation of innovative solutions that lack a clear path to market (Chesbrough & Rosenbloom, 2002).

The STOF business model framework was chosen for its emphasis on services, which is relevant to our study, and because of its inclusion of components that are common in other frameworks i.e., value proposition, customers, network activities, resource and actors and financial issues. The inclusion of external factors in the framework is also believed to be relevant in the healthcare context due to issues related to regulations on patient data.

4 The Academic Context of the Thesis

In this section, a brief overview is presented on health informatics research and eHealth in order to frame this thesis in an academic context.

4.1 An Overview of Health Informatics

Informatics has been around for several decades and is not limited to the field of healthcare (Hersh, 2009). Friedman (2013) has described informatics as the discipline in which basic sciences and informatics meet and interact with an application domain. Examples of basic sciences can be information science, computer science, cognitive science and organizational science. Based on the application domain, different branches of informatics have been created. The information systems or informatics community typically uses the term health informatics to refer to applied research on informatics in the clinical and public health area (AMIA, 2017). The field of health informatics emerged as healthcare professionals started to use computers to meet the complex information needs of healthcare (Collen & Shortliffe, 2015). The first research articles in the area appeared in the 1950s when computers were used for processing signals, images and laboratory tests. In the 1960s, studies included applications that were developed for patient care, and in the 1970s, the field matured to include the study of applications, such as clinical information systems and clinical decision support. As the field evolved, it came to include issues related to computers, communication, information science, engineering and technology (Collen & Shortliffe, 2015).

The term health informatics developed out of medical informatics (Cesnik, 2010; Haux, 2010; Shortliffe & Blois, 2014; Vimarlund, Ljunggren, & Timpka, 1996), which was introduced in Europe in the 1970s, and was inspired by the French term for computer science (*informatique*) (Collen, 1986; Shortliffe & Blois, 2014). In the late 1980s, the term informatics was also widely accepted in the United States and medical informatics became the preferred name of the field. However, there were concerns that *medical* denotes a focus on physicians and excludes the importance of other healthcare professionals. Thus, the term health informatics gained popularity (Shortliffe & Blois, 2014). Today, health informatics is viewed as embracing medical informatics along with nursing and dental informatics (Hovenga, 2010). The U.S. National Library of Medicine (2016) defines health informatics as follows:

> *"...the interdisciplinary study of the design, development, adoption and application of IT-based innovations in healthcare services delivery, management and planning."*

Broadly described, health informatics research explores information and communication processes and systems for better provision of healthcare (Cesnik, 2010; Coiera, 2015). Research within the field tends to focus on (i) health information systems and their application, evaluation and organization, (ii) knowledge representation, such as decision support, ontologies and databases, and (iii) data analysis, including classification techniques and signal analysis (Kulikowski, 2007; Schuemie, Talmon, Moorman, & Kors, 2009). Consequently, health informatics research can be understood as the field that concerns different aspects related to information systems applied to healthcare.

4.2   eHealth and eHealth Services

Beginning in the 2000s, the area of eHealth and the application of technology in healthcare (Hovenga, 2010) received plenty of attention within health informatics (AMIA, 2017). eHealth is often mentioned as a manner to innovate healthcare and as a solution to or a way to mitigate the impact of the challenges that healthcare faces (Alvarez, 2002; Oh, Rizo, Enkin, & Jadad, 2005; Pagliari et al., 2005). For instance, eHealth is argued to be a way to increase patient-centeredness by shifting the power and responsibility from healthcare professionals to patients and changing the role of patients from passive to active participants in their own care (Calvillo, Román, & Roa, 2015; Koch, 2012). eHealth is also expected to improve healthcare quality and efficiency (Stroetmann, Jones, Dobrev, & Stroetmann, 2006; World Health Organization, 2005), increase access to healthcare information and foster collaboration within and between organizations (Neuhauser & Kreps, 2010). Additional benefits include streamlined healthcare processes and increased safety and effectiveness (Stroetmann et al., 2006).

The term eHealth appeared along with several other e-words, such as e-commerce and e-business, in order to highlight the opportunities that the Internet and information and communication technologies bring to healthcare (Alvarez, 2002). One of the first academic definitions was provided in 2001 by Eysenbach, who stressed the importance of digital services:

> *"...an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies"* (Eysenbach, 2001, p. 1).

The concept also embraces information and data sharing between a number of different actors, such as patients, healthcare providers and health information networks (European Commission, 2016). It is important to recognize that eHealth is not a substitute for previous healthcare activities but a way to expand, assist or enhance activities performed in healthcare (Oh et al., 2005). The term is also adopted in policy work and is defined by the EU as follows:

> *"...tools and services using information and communication technologies (ICTs) that can improve prevention, diagnosis, treatment, monitoring and management."* Regarding outcomes, eHealth can *"benefit the entire*

community by improving access to care and quality of care and by making the health sector more efficient" (European Commission, 2016).

In this thesis, eHealth is defined using the definition of Pagliari et al. (2005). Their definition includes not only the importance of digital services but also a new way of working:

"e-health is 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, p. 17).

5   Research Methodology

In this chapter, the research approach is addressed by first presenting qualitative research and case study research in section 5.1. This presentation is followed by section 5.2 which provides a description of the research process of the included research papers. The research setting, data collection and data analysis are presented for each research paper. Finally, ethical considerations and methodological limitations are presented.

5.1   Qualitative Research

Based on the aim of the research study, either quantitative or qualitative research methods are suitable. Quantitative research methods are common in the natural sciences (Myers, 1997) and are associated with objective data collection, clear procedures and replicable findings (Daft, 1983). In quantitative research, a phenomenon is understood by numerical measurements and relationships between different variables in large data samples (Silverman, 2015). The researcher tends to be in favor of a positivist stance in which reality or the social world is assumed to exist independently of humans (W. Chen & Hirschheim, 2004) and is best described by measurable properties (Myers, 2013). The researcher therefore needs to be detached from the investigated phenomenon and departs from theory or models that are tested in an empirical setting. Examples of quantitative research methods are survey methods, laboratory experiments, econometrics and numerical methods (Myers, 1997).

    Qualitative research, on the other hand, provides scholars with an opportunity to study verbal and written descriptions of real-life situations and to gain a deeper understanding of a social phenomenon (Myers, 1997; Silverman, 2015). Researchers tend to have a hermeneutic stance and stress the importance of interpretation in understanding a social phenomenon (Butler, 1998). In qualitative research, people and their perceptions, understandings and practices are the primary source of data (Mason, 2002), and the researcher aims to understand the meaning of a phenomenon in a social context (Myers, 2013). It implies that the researcher cannot be detached from the phenomenon and that the researcher's prior assumptions, beliefs, values and interests will shape the investigation (Orlikowski & Baroudi, 1991). Qualitative research often departs from empirics, and an analysis of the findings is used to form a theory, model or explanation. It is characterized by a focus on a case or a few individuals and involves understanding and interpretation rather than testing hypotheses (Bryman & Bell, 2007). When numbers are used, they are often in simple tabulations and do not discuss statistical correlations or tests (Silverman, 2015). Common data sources in qualitative research include interviews, observations, questionnaires and documents (Myers, 1997).

The research in this thesis can be characterized as qualitative and consists of one interview study, a literature review and three case studies. This approach was perceived as suitable for studying the complex phenomena of innovative eHealth services and rather new phenomena in health informatics, such as patient accessible EHRs and business models for eHealth. The qualitative approach provided the opportunity to focus on these specific cases in more detail. In addition, qualitative research provides an opportunity to understand a context-specific phenomenon (Silverman, 2015) and acknowledges the importance of the involved people and their perceptions (Mason, 2002). Previous studies have shown that eHealth services and implementation of information systems in healthcare are context-dependent, and therefore, the qualitative approach provided an opportunity to study innovative eHealth services in their specific contexts. Even when numerical measurements have been used, they have focused on the perceptions of people and do not include any statistical measurements.

5.1.1 Case Study Research

One qualitative research approach is case study research (Myers, 1997), which has been employed in three of the included papers (papers 3, 4 and 5). In this section, an introduction is given to case study research, and in section 5.2, the case study approach employed in the papers 3, 4 and 5 is described.

Case study research can be defined as the in-depth investigation of a contemporary phenomenon in a real-life context. It is often applied when the boundaries between the phenomenon and context are fuzzy (Yin, 2014). The study of innovative eHealth services includes boundary-spanning activities and services that influence healthcare organizations on different levels in addition to patients and society. Consequently, it was judged that it was important to study innovative eHealth services in a real-life context with its specific conditions. Case study research was therefore seen as a suitable approach for the main part of this thesis. Case study research is also appropriate when the aim is to answer "how" and "why" questions about a contemporary phenomenon (Yin, 2014). This thesis addresses two "how" questions: *How do healthcare professionals and patients perceive the initiative to give patients online access to electronic health records?, How can a business model framework be used to describe eHealth services in a public healthcare setting?*

5.1.1.1   Data Collection in Case Studies

Case studies do not suggest the use of a specific type of evidence and can include qualitative and/or quantitative evidence. Most importantly, case studies give the researcher an opportunity to collect data using different sources and techniques. Access to multiple sources allows the researcher to address a wider range of issues and present more accurate results and conclusions (Yin, 2014). Examples of data collection techniques and data sources in case studies include interviews, documents, physical artifacts and surveys.

A common source for data in case studies is interviews, which can give useful descriptions of phenomena that people encounter (Kvale, 1997) and they can also be a way to identify other relevant sources of data. Interviews are often described in

relation to how structured they are (Kvale, 1997). The interviews in this thesis were 'semi-structured', referring to an interview format in which the researcher is guided by some main questions that allow the researcher to follow-up with other questions depending on the interviewees' answers (Kvale, 1997; Silverman, 2013). The strength of this format is that it is flexible and can generate in-depth descriptions of a phenomenon (Kvale, 1997; Silverman, 2013). During an interview, it is important that the researcher follows his or her line of inquiry while simultaneously asking the respondent conversational questions (Yin, 2014).

Yin (2014) also mentions *survey interviews*. In these interviews, a structured questionnaire is used to collect data that are later used as a component of the entire case study. Survey questions that seek categorical answers, rather than numerical ones, or studies of perceptions tend to be more qualitative in nature. Another source of evidence is documented information, such as e-mail correspondence, agendas, minutes from meetings and written reports. Since documents have often been edited, they should be used carefully and mainly to corroborate evidence from other data sources. It is therefore important to identify the purpose of the written document and its intended audience to correctly interpret the information (Yin, 2014). Physical artifacts, including tools, instruments and technical devices, can be an important part of a whole case and a source of wider perspectives (Yin, 2014). In informatics and information systems research, digital services are often the focus of the studied case.

5.1.1.2   Data Analysis in Case Studies

It is important to not only collect data from several sources but also analyze the data in combination in order to validate the studied phenomena (Yin, 2014). According to Yin (2014, p. 150) case study data analysis includes the following:

> *"...examining, categorizing, tabulating, testing, or otherwise recombining evidence, to draw empirically based conclusions."*

Yin (2011) presents a procedure that is described by three phases: compiling, disassembling and reassembling. Compiling is the process of sorting the collected data in a systematic order. This process includes transcribing interviews, rereading the collected material and 'getting to know the data'. This phase also includes ensuring that the terminology is not used in contradictory ways and that the vocabulary is consistent. The second phase, disassembling, concerns the act of coding data or parts of the data. The aim of the coding is to reach a high conceptual level in which similar items are given the same code. The third phase, reassembling, focuses on finding patterns that can be expressed in different themes and theoretical concepts. This procedure is similar to content analysis, which includes reading the material, extracting the text that focuses on the aim of the study and grouping the text into different themes (Graneheim & Lundman, 2004). Even if the analysis is described as a linear process, the process is iterative and involves going back and forth during the analysis.

5.1.1.3   Rigor and Quality in Case Studies

The quality of qualitative studies can be improved using rigorous techniques to gather and analyze the data (Patton, 1999). Rigor and quality in qualitative studies can be

addressed in relation to four criteria: constructs validity, internal validity (mainly a concern for explanatory studies and not further discussed here), external validity and reliability. Constructs validity refers to the following:

> *"identifying correct operational measures for the concepts being studied"* (Yin, 2014, p. 71).

The researcher can increase constructs validity in a case study in three ways: (i) using multiple sources of evidence, e.g., data triangulation, (ii) maintaining a chain of evidence and (iii) allowing informants to review the material (Yin, 2014). Data triangulation is characterized by the combination of multiple data sources in the search for evidence. The use of multiple source of evidence allows the researcher to address a broader range of issues and reach more accurate conclusions if several sources follow a similar convergence (Yin, 2014). Constructs validity can also be increased by establishing and maintaining a chain of evidence. This chain of evidence includes a formal assembly of the evidence and explicit connections between the questions asked, collected data and conclusions (Yin, 2014). This connection increases by using systematic techniques to analyze the data.

One such technique is content analysis (Krippendorff, 2004). The quality and trustworthiness of content analysis can be described in terms of credibility and transferability (Graneheim & Lundman, 2004). Credibility can be strengthened by not using too broad or too narrow meaning in the units of analysis or excluding data because it does not fit into the themes or categories. It is also important to allow others to judge the result; therefore, quotations from the transcribed material should be added. Constructs validity can increase if the participants and/or informants in the study review the result (Yin, 2014). It is also recommended to seek agreement with for instance co-researchers (Graneheim & Lundman, 2004).

External validity addresses the task of defining the domain to which the findings can be generalized (Yin, 2014) or transferred (Graneheim & Lundman, 2004). It is therefore important to provide a rich description of the research process and analysis (Graneheim & Lundman, 2004). The goal of case studies is not to generalize to populations (statistical generalization) but rather to generalize a specific set of results to a broader theory or concept (analytical generalization). In case studies, statistical generalization is not possible since the case is not a 'sampling unit' and the number of respondents would most likely not be enough to represent any larger population. Analytical generalization, on the other hand, sheds light on theoretical concepts or principles and can result in a working hypothesis that can be further investigated (Yin, 2014). External validity is increased by the use of theoretical concepts:

> *"In other words, the analytic generalization may be based on either (a) corroborating, modifying, rejecting, or otherwise advancing theoretical concepts that you referenced in designing your case study or (b) new concepts that arose upon the completion of your case study"* (Yin, 2014, p. 67).

The final criteria of quality, reliability, is the task of demonstrating that the procedures of the study can be repeated and provide the same results. The goal of reliability is to avoid biases and errors and can be achieved through the use of a case study protocol and a case study database (Yin, 2014). A case study protocol aims to guide data

collection, whereas a case study database is a formal assembly of the collected data (Yin, 2014).

5.2   Methods Used to Perform the Studies

Out of the five research papers, one is an interview study, one is a literature review and three are case studies. The empirical research setting of the case studies focuses on two areas, patients' online access to EHRs and an eHealth service called 'My Referrals'. The following sections describe the methods used in each research paper, including those for data collection and data analysis, and address the issue of quality in the empirical papers.

5.2.1   Methods Used in Paper 1

The first paper focuses on the current and future challenges of Swedish eHealth. The collected data consisted of interviews that were performed with seven decision-makers and experts in eHealth. The interviewees represented administrative authorities, ministry, employees' organizations and trade organizations that were all involved in the development of a future eHealth strategy. The questions asked focused on the primary challenges and trends of Swedish eHealth. The interviews lasted between 40 to 65 minutes each and were recorded and later transcribed verbatim.

Analysis of the interviews was done by means of inductive content analysis (Graneheim & Lundman, 2004). First, the transcripts of the interviews were read several times to gain an understanding of the collected data. Then, the text pertaining to challenges was extracted and gathered into a section that constituted the unit of analysis. The actual analysis consisted of a number of steps. First, the text was divided into shorter sentences that were labeled with a code. These sentences were compared and grouped into mutually exclusive sub-themes that focused on challenges. Finally, we reflected on the sub-themes and read literature pertaining to these sub-themes and the state of eHealth (European Commission, 2010, 2012b). This reflection resulted in headings that seemed to unify the sub-themes into six themes. The sentences were read again and nothing that contradicted the themes could be found. Even if the analysis is described as a linear process, the process was iterative and involved going back and forth during the analysis.

To achieve credibility, the paper illustrated how the sub-themes and themes were related and included representative quotations from the interviewees that supported the opinions expressed during the interviews. Transferability was facilitated by describing the data collection and analysis process and providing a rich description of the findings. In addition, the results of the analysis were discussed by the first and second author to ensure agreement.

5.2.2   Methods Used in Paper 2

The second paper is a literature review of the healthcare sectors' engagement in open innovation. The review followed the PRISMA checklist, and the flow diagram is

presented in the paper. Systematic searches were conducted in ABI/Inform, PubMed/MedLine, Academic Search Elite, SAGE Journals, JSTOR, Business Source Premier, Emerald, ScienceDirect and Google Scholar databases. We searched for articles that contained the terms 'open innovation' AND 'health' in the title, abstract or keywords and were published between 2003 (when open innovation was coined) and 2014. The review resulted in 43 articles after removing duplicates. Both empirical and conceptual full-length articles published in English and book chapters focusing on open innovation and healthcare were included.

The initial selections of studies were made by reviewing the title and abstract of the articles to ensure that they dealt with open innovation in the context of healthcare. If a decision on inclusion could not be made merely on the title and abstract, the full article was read. After removing the articles that did not focus on healthcare, 14 articles were included in the review. The search was then extended to other terms that denote collaboration across the boundaries of an organization and with other actors to accelerate innovation. An additional search was made with the keywords 'innovation network' AND 'health'. This search resulted in 11 articles (after removing duplicates), which after the same procedures previously described, resulted in four articles that were added to the previous sample. In total, 18 articles were included in the review.

A classification scheme was outlined to code the different studies according to a number of characteristics based on previous research on innovation and open innovation: type of open innovation process, stage of the open innovation process, social context and innovation outcome. This scheme helped us identify how open innovation principles had been applied in healthcare. To highlight the challenges and benefits of open innovation in the healthcare context, stated factors that constrained open innovation and positive outcomes of open innovation were identified, in the reviewed articles. Initially, the articles were classified based on the alternatives of the first four characteristics. These classifications were identified through a bottom-up approach by reading and gaining a comprehensive understanding of the articles and coding them according to the classification scheme. Then, the factors that constrained open innovation and positive outcomes of open innovation were identified through content analysis. The procedure for data analysis involved three phases, compiling, disassembling and reassembling, with the aim of identifying different themes (Yin, 2011).

5.2.3   Methods Used in Papers 3 and 4

Two of the papers are case studies that focus patients' online access to their EHRs (PAEHRs).

5.2.3.1   Case Description

Since the 1980s, patients have had the right to request a printed copy of parts of their health record (SFS, 1985:562). In 2012, Uppsala County Council was the first healthcare provider in Sweden to implement PAEHRs for all its patients (Erlingsdóttir & Lindholm, 2015). In February 2015, the region of Jönköping County followed and gave all patients aged 18 years or older online access to their EHRs (Region Jönköping county, 2013). The PAEHR is accessible via a national platform for eHealth that

enables integration between different information systems and healthcare actors (Inera, 2015b). Patients can access the information through a secure log-in using the same electronic ID that they use for banking and other government e-services.

During the time of the study, the accessible information in the PAEHR included medical notes, diagnoses and vaccinations. The medical notes are dated back to July 1, 2014, whereas older medical notes can be requested and received on paper. The decision to make the information available in this manner was made to give healthcare professionals the opportunity and time necessary to modify the language that they used in medical notes before patients accessed the records online. Healthcare professionals have 14 days after documentation of the event to confirm and if necessary, correct, the medical notes before they become accessible to the patient. After 14 days, all notes are accessible, whether they have been confirmed or not. Healthcare professionals can use two keywords to keep information inaccessible to the patient. These keywords can be used to withhold suspected diagnoses that need further investigation before the final diagnosis is given to the patient and notes about sensitive life-situations, such as violence against women. Patients can decide whether to share their EHR with other persons, and parents can access their children's EHR until they turn thirteen. During the time of the study, the PAEHR had been implemented for 14 months.

Patients' online access to the EHR was chosen as a case due to the more widespread implementation of this service. The rational for choosing this type of *common* case is the possibility of capturing the circumstances of an everyday situation (Yin, 2014). Today, PAEHRs are implemented all over Sweden, and in the future, PAEHRs will be a common situation for Swedish patients and healthcare professionals.

5.2.3.2 Data Collection and Data Analysis

The data collection in papers 3 and 4 consisted of a workshop, fifteen interviews and two surveys. The first data collection activity was a workshop that aimed to identify the expected benefits and drawbacks of providing patients with online access to their EHRs. The workshop included the project manager of the system implementation, an eHealth strategist, a director of communication, two physicians and the system owner. During the workshop, we used a technique called "Pains and Gains" to structure the workshop and identify the benefits and drawbacks of the initiative for both patients and healthcare professionals. The workshop started with the development of two 'personas'. The participants were asked to develop a persona who represented a healthcare professional whose patients could access the EHR and a persona who represented a patient. The personas were then used as representations, and each participant was asked to indicate the expected benefits and drawbacks that the persona would face due to the PAEHR. The benefits and drawbacks were written on post-it notes and presented to the group by each participant. These remarks were written down on a whiteboard. Finally, the group discussed the benefits and drawbacks that were identified, agreed on the most important outcomes and illustrated them by means of practical examples.

As a second step in the research procedure, nine patients and six healthcare professionals were interviewed about the perceived benefits and drawbacks of patients' online access to the EHR. All interviews were recorded and later transcribed.

The interviews were analyzed by means of inductive content analysis as presented by Graneheim and Lundman (2004). We reviewed the transcripts of the interviews and identified sentences and paragraphs that focused on the benefits and drawbacks of patients' online access to the EHR. These different sentences and paragraphs were then labeled with a code. By organizing the codes that were related to each other in terms of their content, different themes were derived from the interviews.

As a third step, we distributed a survey to patients at one primary care unit and two outpatient clinics. The survey was paper-based and was given to patients by a medical secretary upon registration for their visit along with an accompanying letter that stated that participation was voluntary and anonymous. The patients were eligible for the study if they had accessed their EHR via the patient portal. The completed survey could be returned in a box at the check-in desk or sent by mail to the researchers if the patients preferred to complete it at home. In total, 56 patients completed the survey with a response rate of 61% (12 patients declined to take part in the study and 24 did not return the survey). The other survey was sent to healthcare professionals at six different sites in the region of Jönköping: three primary care units and three outpatient clinics. The respondents included healthcare professionals who were responsible for documenting information such as medical notes, diagnoses and test results in the health record, i.e., physicians, nurses, assistant nurses and occupational therapists. The survey was conducted online, using a web survey tool called 'Qualtrics'. The survey was sent to 324 healthcare professionals with a total response rate was 45% (n=146). We excluded 20 surveys that did not answer all of the questions.

We examined the survey results across a 5-level grade including "agree", "somewhat agree", "neither agree nor disagree", "somewhat disagree" and "disagree". The percentage of the patients and healthcare professionals who agreed or disagreed with the statements was calculated for each question. For professionals, comparisons between the respondents at primary care units and outpatient clinics were also made.

To increase the constructs validity in papers 3 and 4, the data collection consisted of different techniques and data sources, including a workshop, interviews and survey data. During the research process, emphasis was put on providing a thorough description of the methods to provide the reader with a full view of how the research progressed from research questions, data collection, results and conclusions. To increase the accuracy of papers 3 and 4, the project team of the region of Jönköping County was asked to review and comment on the paper to clarify parts that seemed unclear or could be misinterpreted. External validity can be increased through the use of theory. In papers 3 and 4, previous research on patients' online access to EHR guided the study design and conclusions. During the case study, we drafted a description of the case study, including objectives of the study, possible readings, data collection strategies and questions and the structure of the future paper. The collected material was organized in a structured way. Notes from the workshop were written out on the computer directly after the workshop, and transcripts from the interviews and the survey results were stored electronically.

5.2.4   Methods Used in Paper 5

The fifth paper is a case study based on an industry-academia collaborative project called "My Care Pathways" and focuses on a service called My referrals.

5.2.4.1   Case Description

The project aimed to enable patients to track their past and future healthcare events through the development and design of new services. Among other activities, it resulted in an open service platform and a Software Development Kit (SDK) that was integrated with the national healthcare platform and patient portal 'Healthcare Guide 1177'. In addition, a number of eHealth services were developed, including 'My referrals', which was the focus of our study. My referrals allows the patient to keep track of referrals as they are managed by different healthcare providers and professionals. The patient can access the service through the patient portal 'Healthcare Guide 1177' with their electronic ID to see when and by whom the referral was sent and the status of the referral. The eHealth service was developed as part of the project, but it was intended to be provided to patients by local healthcare providers.

One rationale for a single-case study design is the *unusual* case in which unusual circumstances can reveal new insights (Yin, 2014). In contrast to previous research on business models, which has mostly focused on a multi-payer or market-based healthcare system (Acheampong & Vimarlund, 2014), this case provided the opportunity to study business models in a public healthcare setting.

5.2.4.2   Data Collection and Data Analysis

The data collection in this study consisted of a number of interviews and secondary sources, such as project meeting notes, presentations and marketing material. To provide a background, we interviewed an IT strategist at the Center for eHealth (CeHis) about the current state of eHealth and the use of business models in Swedish eHealth. This interview was followed by an informal interview with the service developer over Skype in which the demo version of the service was tested.

With the aim of capturing the future service providers' view of the business model, we interviewed five representatives of a healthcare provider that considered implementing My referrals. The representatives included two improvement managers, a public health analyst, a section manager of public health and a specialist physician. The interviews focused on the potential value of the eHealth service and its impact on patients and the organization along with possible revenue streams. All interviews were recorded and transcribed. At the same time, the project management answered a couple of questions in writing that were followed up with informal talks. The questions focused on the service offerings, technical infrastructure, involved actors and financial issues. The study also drew on secondary sources, which included project meeting notes, presentations and marketing material. A complementary interview was done with an entrepreneurial physician. The interview focused on payment alternatives for eHealth services in a public healthcare context.

The theoretical framework of the business model was used as a basis to code the transcribed interviews and included documents. The different components of the business models (service, technology, organization, finance and external factors)

served as codes that were used to classify different quotations from the interviews and transcripts from the documents. Similar quotations and transcripts were divided into sub-categories to describe the business model. Based on the interviews with the future service provider, a process chart was made to visualize the patient process before and after the implementation of My referrals. The process chart allowed us to compare the current patient process of referrals with the expected one after implementation and to corroborate data about service offerings.

To increase the constructs validity of the case study, we used multiple sources of evidence. The data primarily relied on interviews but also included documents and the studied e-service, which were used to corroborate the evidence collected from the interviews. To maintain a chain of evidence, detailed descriptions of the methods and references to specific quotations and excerpts from documents were provided to describe the collected evidence. Informants were also asked to review the material. Two informants reviewed the process chart to avoid misunderstandings and enhance the accuracy of the study. The result was also presented in a report and at a meeting at which the project members could ask questions and provide comments. The theoretical concepts of the business model were used to enhance the external validity. To increase the reliability of the case study, a description of the case study was drafted, and the collected data was organized in a structured way. Notes from interviews and meetings were handwritten, whereas transcripts from interviews and documents were stored electronically.

5.3   Ethical Considerations and Limitations

There are ethical considerations to take into account in qualitative research (Kvale, 1997). It is important to clarify the aim and goal of the study, research procedures and data storage to the participants and to emphasize the anonymity of the participants and their right to terminate their involvement in the study. With this information, the participants can consent to participate in a study or not. In all empirical studies, the respondents were informed about the research project, the aim of the study and how the anonymity of the participants would be handled. All participants were informed that the interview was voluntary and that they could withdraw from the interview at any time without reason. We also asked about permission to record the interviews and later transcribe them. The interviews with patients focused on questions related to their perceptions of accessing their EHR online. While we did not ask questions about illness or health status, we were aware that the responses could include references to their health. It was therefore stressed that the information in the interview was confidential and that the respondent should indicate if they did not wish to continue.

Due to the choice of studying single cases, it is important to clarify the type of conclusions that can be made from this research. The research design does not allow for statistical generalization. Instead, the findings should be discussed in relation to broader theoretical concepts, which is known as analytical generalization. Thus, the conclusions should be viewed in relation to previous studies on innovative eHealth services, patient accessible EHRs and business models. In addition, the findings of this thesis are based on studies in Sweden and hence limited to the context of the studies. For different types of eHealth services outside a Scandinavian healthcare

context, the results might have been different. Detailed descriptions of the cases have therefore been provided to clarify the setting and its contribution to the results.

The studies have focused on the perceptions of eHealth experts, healthcare professionals and patients and mostly discussed individual and organizational aspects of innovative eHealth services. The focus therefore did not include issues related to medical and health economic impacts of eHealth services. A more interdisciplinary approach, including mixed-methods, would have added other aspects of innovative eHealth services.

6   Results

This section summarizes the key contributions of the appended research papers. This section is based on excerpts from the individual papers and on text written for only this purpose.

6.1   What are the Prerequisites to Realize Innovative eHealth Services?

Many eHealth initiatives are never implemented or merely end as pilot projects. In papers 1 and 2, we present a number of prerequisites that need to be considered to realize innovative eHealth services.

6.1.1   Paper I - I Got 99 Problems, and eHealth is One

In the first paper, we explored whether previously identified challenges in the eHealth area have remained in the Swedish setting or whether they have changed. After interviewing experts in eHealth, we presented a classification of areas of concern (Table 3). The results showed that there is a need to consider issues related to different levels of interoperability, more resources and placing the patient at the center.

Table 3: Areas of concern identified from the interviews.

Area of concern	Sub-theme	Respondent
Organizational interoperability	Organizational change	a, b, c, d, e, f, g
	Collaboration between organizations	a, b, c, d, e, f, g
	Common goals	a, b, e, f, g
Technical interoperability	HIS data exchange	a, c, d, f, g
	Redundancy	a, d
	High usability	a, d, e
Legal interoperability	Legislation	a, b, d, f
	Integrity	a, d, g
Semantic interoperability	Semantics	a, b, c, e
	Information structure	a, b, c, d, e, f, g
Additional resources	Increased finances	a, d, f
	Digital literacy	b, c
	Health informatics education	a, d, e, g
The patient at the center	Patient perspective	a, c, d, e, f
	New patient expectations	a, d, f

6.1.1.1   Organizational Interoperability

The importance of organizational interoperability involves managing organizational change and development, collaborating over organizational boundaries and finding common goals. The respondents described the importance of not managing eHealth initiatives as IT projects but rather as changes in business processes, structures and cultures. IT was not described as the challenging part of eHealth in comparison to the organizational change that it entails. The respondents also talked about the need to collaborate across organizational boundaries and the necessity to coordinate this collaboration and establish spaces where actors can meet and collaborate for innovation. The respondents particularly stressed the importance of having common goals. They mentioned that a unified picture of the future is needed, that local ideas and goals can hamper the development of eHealth and that everyone needs to move in the same direction.

6.1.1.2   Technical Interoperability

Another matter that was mentioned during the interviews was a number of technical challenges, including communication between different information systems and usability issues. The lack of communication between information systems was described as a problem that results in data redundancy. In addition, the respondents talked about achieving standards of 'high usability' in eHealth services and the importance of services that are supportive of work processes instead of interfering with them. However, technical interoperability was no longer viewed as a main barrier in comparison to organizational, semantic and legal interoperability.

6.1.1.3   Legal Interoperability

The respondents mentioned the importance of legal interoperability and that laws and regulations need to adjust to accommodate the digital evolution. This adjustment also involved balancing the fine line between integrity and service innovation.

6.1.1.4   Semantic Interoperability

All respondents stressed the importance of achieving semantic interoperability. This area involves regulation of the exchange of information between primary care units and hospitals through a set of principles that includes common terms, concepts and a national information structure. Several respondents claimed that a unified information structure is the necessary foundation for information sharing, the development of innovative services and new ways of working.

6.1.1.5   The Need for Additional Resources

The Swedish eHealth area was described as being in need of more resources, not only in terms of financial needs but also in terms of knowledge of how informatics and organizational healthcare issues will be solved. Today, the various Swedish regions invest 3% of their budget on IT/IS and eHealth (Jerlvall & Pehrsson, 2016). The respondents reported that they found it remarkable that a knowledge-intense industry, such as healthcare, does not spend more resources on eHealth.

6.1.1.6   The Patient at the Center

The respondents also spoke of the importance of acknowledging the patient and dealing with new expectations from citizens and patients. The healthcare sector was described as 'paternalistic' and pushing the patient into the organizational structures of healthcare. Ownership of information and patient involvement was also mentioned as an area of concern.

6.1.2   *Paper 2 - Healthcare in the Age of Open Innovation – A Literature Review*

The second paper is a literature review and gives an overview of the healthcare sector's engagement in open innovation and the constraining factors and positive outcomes of open innovation in healthcare. The review revealed that most research articles studied an inbound open innovation process in which innovation is created by including knowledge from actors outside the boundaries of the organization (Gassmann & Enkel, 2004). The results also showed that all articles studied the ideation phase or pilot phase of an open innovation phenomenon. The collaboration was either between public and private organizations, hospitals and patients or via online platforms that served as a tool and an arena for innovation. Almost all articles studied an innovation process that focused on providing products or eHealth services. Outcomes, such as novel marketing methods or organizational methods, were not part of the included articles.

The results revealed four main barriers of open innovation. First, the organizational context of healthcare organizations seemed to be a constraining factor. For instance, it was difficult to introduce process and service innovations in healthcare because of strong local variations. Second, laws and regulations that are specific to the healthcare sector were found to hinder innovation. For instance, the lack of access to patients' private and clinical data was considered a hindrance. The third constraint was connected to business model, such as finding key actors, difficulties in maintaining ties between several actors and costs of searching for outside knowledge. Fourth, access to and capturing of patients' knowledge and clinical knowledge were identified as being restricted by a lack of arenas in which patients and healthcare actors can communicate and interact. Open innovation was found to have three main, positive outcomes including a changed role of the patient, who became an active actor and contributed with valuable knowledge to the development of products and services. Moreover, open innovation appeared to enable collaboration between several knowledgeable actors and provide access to new markets.

6.2   How do Healthcare Professionals and Patients Perceive the Initiative to Give Patients Online Access to the EHR?

Papers 3 and 4 are based on a case about patients' online access to EHRs (PAEHRs) and focuses on the perceptions of patients and healthcare professionals.

6.2.1   *Paper 3 - The Role of PAEHRs in Patient Involvement*

The study in paper 3 was performed as a case study and included nine interviews with patients and a survey that received responses from 56 patients. Almost all of the patients who answered the survey viewed PAEHRs as a good or very good initiative (94%, n=56). None of the patients considered it to be a negative initiative. The respondents were asked to choose the words they considered most suitable to describe the service. Out of a list of 23 'positive' and 'negative' expressions, the most common terms were: trustworthy service, time saving, a citizen's right and easily accessible information (Table 4).

Table 4: Expressions that the respondents would use to describe the service (n=45).

Rank	Top ten expressions	% (n)
1	Trustworthy service	70% (31)
2	Time saving	64% (29)
3	A citizen's right	62% (28)
4	Easily accessible information	60% (27)
5	Easy to navigate	51% (23)
6	Secure information management	49% (22)
7	Rich with information	47% (21)
8	Openness towards citizens	44% (20)
9	Enables participation	44% (20)
10	Enables responsibility	42% (19)

Similar patterns were found in the interviews, where the patients described the different benefits of PAEHRs (Table 5)

Table 5: Themes focusing on the benefits of PAEHRs, as identified from the interviews.

The service…	Respondents
helps me ensure that we have reached a mutual understanding	a, b, c, d, e, h, i
helps me ensure that I understand what the healthcare professional said	d, e, f, g, h, i
improves access to health information	c, e, f, g, h, i
makes it possible to assist relatives	a, b, c, f, h, i
increases patient involvement	b, i, e, f, h
is a more secure way to send private information	b, c

For instance, the patients described the online information as more accessible compared to other sources. *"It helps a lot, it is easily accessible, the communication is faster, and you get a quicker response to how you experienced the care this time, and what they said."* Another respondent appreciated the ability to access the EHR whenever he or she preferred. *"It is more easily accessible; previously you had to write to the healthcare provider and ask them to send…now I can log in and read whenever I want to."* The improved access to information was confirmed by the

survey, in which almost all patients agreed or somewhat agreed that it was easier to access information (96%, Table 6).

Table 6: Patients' perceptions of patient involvement.

The service makes it easier to… /for me…	Agree or somewhat agree	Neither agree nor disagree	Disagree or somewhat disagree
access information from the appointment/phone call (n=55)	96% (53)	4% (2)	-
be more involved in my treatment and/or rehabilitation (n=55)	81% (45)	16% (9)	2% (1)
understand what was said during the appointment/phone call (n=55)	89% (49)	11% (6)	-
talk to physicians, nurses, or another person about my situation (n=55)	82% (45)	16% (9)	2% (1)
discuss what is documented about me (n=56)	72% (40)	27% (15)	2% (1)
ensure that what was discussed was actually documented (n=56)	80% (45)	18% (10)	2% (1)
take more responsibility for my care (n=55)	76% (42)	22% (12)	2% (1)
affect my care more actively (n=55)	62% (34)	36% (20)	2% (1)

The results of the interviews and the survey indicated that patients feel more involved when they can access their EHRs online. The survey results showed that 81% of the respondents agreed or somewhat agreed that the service has made them more involved in their treatment (Table 6). One interview respondent felt more involved due to being provided the opportunity to obtain a proper understanding of the treatment process: *"I can follow the process, what has happened and everything, so of course I feel more involved in the work that they have done with me".* Another theme that emerged from the interviews dealt with the patients' understanding of the information that the healthcare professional gave them. *"The confirmation, that is important to me, because it can be difficult to follow the information, and then, it goes so fast… It was a strength to be able to read in peace and quiet."*

This reported increase in understanding was confirmed in the survey, in which 89% of the respondents agreed or somewhat agreed with the statement about understanding what was said. Several interview respondents also mentioned the fact that they could now ensure that they had reached a mutual understanding with the healthcare professional: *"…it is really our joint description; the information is given from me also. Of course, you have to see how they have interpreted it and how they have valued it to be able to ask them if we do not agree".* One respondent used the PAEHR to check whether a topic needed to be discussed during the next meeting. *"I log in after each visit to read and to clarify and to see if there is something specific that I need to talk to the doctor about the next time."* An improvement in the quality of communication was also indicated by the survey results; 82% of the patients agreed or somewhat agreed that the service made it easier to talk to healthcare professionals about their situation. In addition, 72% agreed or somewhat agreed that it was easier to discuss what was documented about them. Approximately 80% of the respondents

claimed that it was easier to check whether what was discussed was actually documented (Table 6).

During the interviews, the respondents stated that they were eager to get access to *more* information in the PAEHR and that this access would increase patient involvement. One respondent stated the following: *"When I log in, then I cannot find referrals; for instance, I cannot find the test results, the diagnoses are there if you access them and read them, but there is still a lot that is missing…When you know that the possibility exists, it will most likely make you even more involved."* The desire for more information was confirmed in the survey, in which the respondents were asked to judge between different types of information that could be added to the PAEHR. The top three additional pieces of information that were requested included test results (85%), access to referrals (61%) and information on the interactions between different drugs (46%).

6.2.2   Paper 4 - Same, Same but Different: Perceptions of Patients' Online Access to EHRs among Healthcare Professionals

The fourth paper explored and compared how healthcare professionals in primary care and outpatient clinics perceive the outcomes of giving patients online access to their EHRs. The study was carried out as a case study, and data collection consisted of a workshop, six interviews and a survey that was distributed to three primary care units and three outpatient clinics.

The results from the workshop indicated that the participants expected the following benefits: enhanced information-sharing, the possibility of establishing a mutual understanding between the patient and the care provider, increased patient involvement and a better prepared patient. The expected drawbacks included healthcare professionals being expected to be more up-to-date about their patients' situations and healthcare professionals being unable to document desired information in the EHR. The participants of the workshop also mentioned the risk of patients misinterpreting and getting upset about the information that is recorded in the EHR. From the interviews, similar benefits and drawbacks were identified. The key themes that emerged from the interviews are presented in Table 7.

Table 7: Benefits and drawbacks identified from the interviews. 'P' represents physicians P1, P2, and so on. 'N' represents the nurse, and 'T' represents the therapist.

Expected benefits	Respondent	Expected drawbacks	Respondent
Enhanced access to information	P1, P3, N	Exposed and vulnerable patients	P1, T
Improved understanding	P1, P2, P4, T	Negative impact on work processes	P3, P4
Increased patient involvement	P1, P2, T, N	Worries and misunderstandings	P2, P3, P4
Positive impact on work processes	P1, P2, N		

More than 50% of the survey respondents reported that the PAEHR was a 'good' or 'very good' initiative. When we compared the answers from respondents working in primary care units and outpatient clinics, the data showed that there were small differences between these two groups (55% versus 53%). However, more detailed questions showed that the respondents working in primary care were more positive towards the use of the PAEHR in comparison to the respondents working in outpatient clinics (Table 8).

Table 8: Healthcare professionals' perceptions about the PAEHR.

The service makes it easier to…	Primary/ Outpatient	Agree or somewhat agree	Neither agree nor disagree	Disagree or somewhat disagree
clarify what is important to the patient	Primary	50% (33)	26% (17)	24% (16)
	Outpatient	26% (21)	38% (30)	36% (29)
increase adherence to the advice that I provide the patient	Primary	50% (33)	35% (23)	15% (10)
	Outpatient	35% (28)	35% (28)	30% (24)
communicate with the patient	Primary	36% (24)	36% (24)	27% (18)
	Outpatient	20% (16)	39% (31)	41% (33)

Half of the respondents working in primary care 'agreed' or 'somewhat agreed' that the PAEHR made it easier to clarify what is important to the patient, whereas only 26% of the respondents from outpatient clinics perceived that the PAEHR contributes to the clarification of what is important to the patient. The same pattern can be observed with issues related to adherence; 50% of the respondents in primary care versus 35% of respondents in outpatient clinics 'agreed' or 'somewhat agreed' that patient access to the EHR contributed to increased adherence. Approximately 36% of the respondents in primary care perceived that it was easier to communicate with the patients, whereas 20% of the respondents in outpatient clinics 'agreed' or 'somewhat agreed'. In general, the results show that the respondents in the outpatient clinics were

less positive to the PAEHR and that they 'disagreed' or 'somewhat disagreed' to a larger extent on this point than respondents from primary care.

Table 9: Healthcare professionals' perceptions of the benefits for patients.

The service has made the patient…	Primary/ Outpatient	Agree or somewhat agree	Neither agree nor disagree	Disagree or somewhat disagree
more involved in his/her treatment and/or rehabilitation	Primary	35% (23)	44% (29)	21% (14)
	Outpatient	24% (19)	55% (44)	21% (17)
more prepared for an appointment	Primary	29% (19)	49% (32)	23% (15)
	Outpatient	23% (18)	44% (35)	34% (27)
able to quality-control what I document	Primary	46% (30)	38% (25)	17% (11)
	Outpatient	26% (21)	46% (37)	28% (22)

Slightly more respondents in primary care 'agreed' or 'somewhat agreed' that patient access had made the patient more involved in his or her treatment and more prepared. However, more respondents working in primary care units positively responded towards issues related to quality-control than the respondents working in outpatient units. Approximately 46% of respondents in primary care versus 26% of respondents in outpatient clinics 'agreed' or 'somewhat agreed' that patient access contributed to quality-control (Table 9).

Table 10: Healthcare professionals' perceptions of the drawbacks for patients.

The service has resulted in the patient...	Primary/ Outpatient	Agree or somewhat agree	Neither agree nor disagree	Disagree or somewhat disagree
becoming upset about the information that can be read	Primary	26% (17)	55% (36)	20% (13)
	Outpatient	45% (36)	39% (31)	16% (13)
becoming worried about the information that can be read	Primary	36% (24)	47% (31)	17% (11)
	Outpatient	53% (42)	35% (28)	13% (10)
misunderstanding the information in the health record	Primary	33% (22)	47% (31)	20% (13)
	Outpatient	49% (39)	38% (30)	14% (11)

The table above shows that respondents working in outpatient clinics are more concerned about patients becoming upset or worried or misunderstanding information in the EHR. For instance, 45% of the respondents working in outpatient clinics 'agreed' or 'somewhat agreed' that the patient becomes upset, whereas only 26% of the respondents from primary care perceived patients becoming upset. A similar difference exists with respect to issues related to worries and misunderstandings; 53% of the respondents in outpatient clinics 'agreed' or 'somewhat agreed' that the patient becomes worried versus 36% of the respondents working in primary care. Moreover,

49% of the respondents in outpatient clinics 'agreed' or 'somewhat agreed' that the patient misunderstands information in the health record compared to 33% in primary care (Table 10).

Table 11: Perceptions about the impact on their work due to the PAEHR.

The service has resulted in me...	Primary/ Outpatient	Agree or somewhat agree	Neither agree nor disagree	Disagree or somewhat disagree
using more time for the appointment/phone call	Primary	8% (5)	38% (25)	55% (36)
	Outpatient	10% (8)	45% (36)	45% (36)
using more time to dictate/write information	Primary	23% (15)	30% (20)	47% (31)
	Outpatient	24% (19)	38% (30)	39% (31)
being unable to document what I want in the medical notes	Primary	26% (17)	29% (19)	46% (30)
	Outpatient	31% (25)	24% (19)	45% (36)

The PAEHR seems to have little impact on healthcare professionals' work, and we observed only small differences between the respondents working in primary care units and those working in outpatient clinics. Approximately 8% of the respondents working in primary care reported that they spend more time on appointments versus 10% of the respondents working in outpatient clinics. Similarly, 23% (primary care) versus 24% (outpatient clinics) of the respondents 'agreed' or 'somewhat agreed' that they spend more time on writing or dictating notes. Approximately 26% of the respondents working in primary care units and 31% of those working in outpatient clinics 'agreed' or 'somewhat agreed' that they cannot document everything what they want in the medical notes (Table 11).

Table 12: Perceptions about the impact on documentation due to the PAEHR.

Questions	Primary/ Outpatient	Yes	No	No, I did not know that they existed
Have you changed the way that you document information?	Primary	21% (14)	79% (52)	-
	Outpatient	35% (28)	65% (52)	-
Have you ever used the keywords?	Primary	5% (3)	67% (44)	29% (19)
	Outpatient	5% (4)	48% (38)	48% (38)

Approximately three-fourths of the respondents had not changed the way they document information in the record, 79% of those working in primary care and 65% of those working at outpatient clinics. With respect to the professionals who had changed the way they document information, they reported that they had made changes in the way that they record specific symptoms related to mental illness, cancer, obesity, drug (ab-)use and changes in the language that they used, including less 'provocative' language, abbreviations, and Latin words. Only 5% of the respondents from both groups had used the special keywords to withhold information

from patients. Respondents in outpatient clinics seem to be less aware of the use of the keywords to withhold information from the patient; 48% did not know that the keywords existed, in comparison to 29% of the respondents in primary care (Table 12).

6.3   How can a Business Model Framework be Used to Describe eHealth Services in a Public Healthcare Setting?

The fifth paper focuses on business models for public eHealth services and was carried out as a case study. Data collection consisted of interviews and documents.

6.3.1   *Paper 5 - Business Models in Public eHealth*

The fifth paper studied an eHealth service called 'My referrals'. Using the theoretical framework of the STOF business model (service, technology, organization, finance and external factors), we identified and described each business model component of the service (Figure 3).
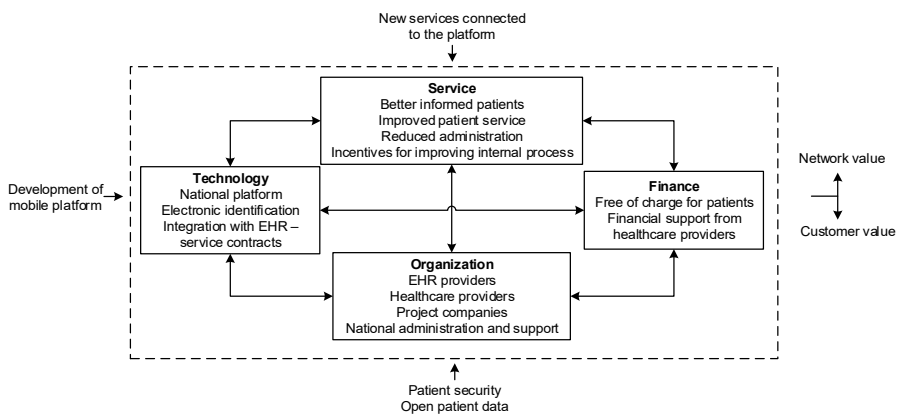

Figure 3: Description of the business model of My referrals.

6.3.1.1   Service

The main functionality of My referrals can briefly be described as collecting and visualizing health information for citizens. One value proposition that was identified from the presentations and interviews was better-informed patients. The respondents and documents also mentioned improved patient service, especially due to online access to information. Moreover, the service was described as a means of reducing anxiety due to better informed patients who do not have to depend on specific phone hours to obtain information about their referrals. From the healthcare providers and

project management, we learned that the service could reduce the number of phone calls concerning referrals and thereby also reduce administration. The incentive to improve the internal process within healthcare organizations was also reported in the interviews. If patients can see where the delays occur, the healthcare organization could be encouraged to improve the process.

6.3.1.2   Technology

The development of My referrals was part of a national project and was intended to be provided via the national platform and patient portal. Patients need an electronic identification (distributed by the patients' bank) or a temporary code to access the portal. In addition, project management reported that healthcare providers had to connect the EHR or referral system to the national platform and make patient data accessible via application programming interface (API) services. Security issues connected to patient data would then managed by the national secure service platform, and the individual healthcare provider would not have to engage in legislation and regulation requirements to provide My referrals to their patients. However, all county councils in Sweden have to sign a service contract to share patient-related information via the national platform.

6.3.1.3   Organization

The most important actors for the provision of My referrals were reported to be the providers of EHRs, healthcare providers and the private companies that took part in the project, including companies that were engaged in the development and design of My referrals. The providers of EHRs and private development companies were described as important actors in connection to the service contracts that were needed to make patient data accessible in the service. Healthcare providers were important as the service providers for the patients. Another actor that was stated as important due to the future national distribution of the service was the agency called Inera. The agency was intended to manage and administer My referrals on a national level. Neither service providers nor healthcare providers were aware of how the support would be provided, but a helpdesk for the end user was mentioned.

6.3.1.4   Finance

The project and development of My referrals was financed by Vinnova, Sweden's innovation agency. It was not yet decided how the service would be financed in the future, but it would be offered for free to patients due to its public healthcare context. Inera would most likely handle the responsibility for support, and it was likely that the healthcare provider would have to pay for the service. Project management reported that it was difficult to quantify the price of the service and the positive effects of implementing My referrals.

6.3.1.5   External Factors

When we looked at the external forces that influenced the business model (market, technology and regulation drivers), the market for the specific service seemed to be preserved for the studied project. As more data and APIs will be available via the

national platform, more actors will have the ability to enter the market, which might result in new services that can change the value proposition of My referrals. Concerning regulations, there are several laws regarding patient security and patient information and data. For instance, Swedish law states that there is also a need to inform the user about secure log-in, direct access to patient information and support (The Swedish Data Protection Authority, 2015). Hence, changes in regulation might affect the business model. During project meetings, public procurement was mentioned as a restriction for purchases in public organizations.

7   Discussion

This chapter discusses the findings of the five appended papers and is structured according to the three research questions of the thesis. It concludes by discussing how the studies are related to research on innovation and e-services.

7.1   Prerequisites to Realize eHealth Services

This thesis shows that interoperability issues need to be addressed to realize innovative eHealth services. The findings show that *organizational interoperability* is an important prerequisite and that there is a need for organizational change and re-engineering of organizational processes when eHealth services are introduced. This finding is in line with previous studies, which indicated the need for change management (Greenhalgh et al., 2004; Southon, Sauer, & Dampney, 1999) and to acknowledge issues related to individuals, tasks and technology (Ammenwerth, Iller, & Mahler, 2006; Tsiknakis & Kouroubali, 2009). Another prerequisite that emerged from the data was *semantic interoperability*. There is a need for a common information structure and shared concepts that enable organizations to share information and develop new services and new ways of working. Furthermore, *legal* and *technical interoperability* are remaining barriers for successful eHealth. However, technical interoperability seems less troublesome today, and this is reflect in policy work (Vimarlund & Koch, 2017). Apart from interoperability issues, there is a need for *additional resources*, including both financial and knowledge resources, and a need to place *the patient at the center*.

   It was revealed that the challenges seem to transcend the traditional boundaries of an organization and are thus not limited to the individual organization that develops and implements an eHealth service. For instance, the findings show a need for spaces in which different actors can meet to collaborate for innovation and to share common goals. It seems as if eHealth services are not solved by one single actor; instead, it includes collaboration between several parties. This challenge was also studied in paper 2, which indicated that open innovation (Chesbrough, 2003) in healthcare can be a way for patients to contribute valuable knowledge. However, this contribution seems to be constrained by a lack of routines on how to acquire knowledge from both clinicians and patients, laws and regulations on healthcare data and the complex organizational context of healthcare organizations.

7.2   Patients' Online Access to the EHR

The insights derived from the studies on PAEHRs (papers 3 and 4) show that there is a discrepancy between how patients and healthcare professionals perceive the service. This finding is in line with the study by Grünloh, Rexhepi, et al. (2016), which indicated that physicians' and patients' perceptions of the usefulness of PAEHRs differ. Our study showed that patients consider the PAEHR to be a secure and a time-

saving way of providing easily accessible and personal health information. The PAEHR complements meetings with the care provider by confirming the patient's understanding and reminding them of what was said during their medical appointments. These results are consistent with previous studies, which identified benefits such as a greater understanding of healthcare plans (Delbanco et al., 2012) and medical notes that confirm the patient's understanding of the information that has been provided (Esch et al., 2016; Rexhepi et al., 2016). Our results indicate that the PAEHR improves patient involvement and the patient-professional relationship as patients feel that it is easier (i) to reach a mutual understanding of what occurs during the consultation and (ii) to communicate with healthcare professionals about their medical condition and life situation. Even if patients feel more involved in their treatment, it was revealed that patients would like to access more information than just medical notes, vaccinations and diagnoses. This result is consistent with previous studies that indicated that patients would like to obtain online access to their healthcare information (Nazi, Hogan, McInnes, Woods, & Graham, 2013; Spooner et al., 2017; Woods et al., 2013).

In contrast to the perceptions of patients, healthcare professionals do not perceive patients to be more involved in their own care nor do they claim that their patients are more prepared for their appointments. Primary care professionals find benefits in increased adherence, clarification of important information and the possibility of patients controlling the information that is documented, whereas healthcare professionals at outpatient clinics are indifferent towards these benefits. In addition, only a few primary care professionals reported that communication with the patient was improved. The less positive perceptions seem to be connected to concerns about patients and not the impact on healthcare professionals' work processes. The majority of healthcare professionals reported that there was no impact on the time required to set up or attend appointments or document information. This finding is consistent with those of Delbanco et al. (2012), which also reported little impact on these matters. In line with previous studies (de Lusignan et al., 2014; Grünloh, Cajander, & Myreteg, 2016; Johnson, Frankel, Williams, Glover, & Easterling, 2010; Ross et al., 2005), the results reflect concerns about increased patient anxiety, misunderstanding of the information in the EHR and patients getting upset. Interestingly, these drawbacks were especially perceived by healthcare professionals in outpatient clinics. Although these concerns were identified, the majority of the healthcare professionals have not made changes to their documentation procedures. In cases in which changes were made, the items that were changed were specific symptoms and the use of abbreviations and Latin terms. It is also interesting to note that half of the professionals working in outpatient clinics were not aware that it is possible to withhold information from the patient with respect to on-going diagnoses.

7.3   Business Models in eHealth

Over the last two decades, there has been a growing interest in the business model concept (Massa et al., 2017). This thesis shows how business models can be represented in eHealth through the illustration of a case on a public eHealth service. In paper 5, the theoretical framework of the STOF business model framework

(Bouwman et al., 2008) was used as a basis to represent and discuss a business model of an eHealth service.

The representation of the business model showed that legislation and regulations are important components in the public setting as they impact the requirements of the eHealth service and the business model. On the other hand, the findings showed that the market forces were less notable. A key part of a business model is its value propositions (Zott et al., 2011). The empirical data revealed value propositions that were not only on an individual or an organizational level but also on a societal level. This finding is in line with the notion of public services and social innovations, which tend to benefit not only an individual or organization but also society at large (Lindgren & Jansson, 2013; Phills et al., 2008). Therefore, it was proposed that societal value needs to be incorporated into the business model framework to represent business models of public eHealth services. Moreover, it has been reported that business models can support the delivery of sustainable services (Stroetmann, 2013), successful deployment (Spil & Kijl, 2009) and reduced failure rates of eHealth services (Kijl, Nieuwenhuis, Huis in't Veld, Hermens, & Vollenbroek-Hutten, 2010; Spil & Kijl, 2009). During the project meetings, diffusion of the eHealth service was observed to be important to all actors. However, the business model did not provide clear answers on how to proceed to reach successful deployment or sustainable service in the future. Therefore, it was suggested to include the diffusion of the eHealth service in the representation (Figure 4).
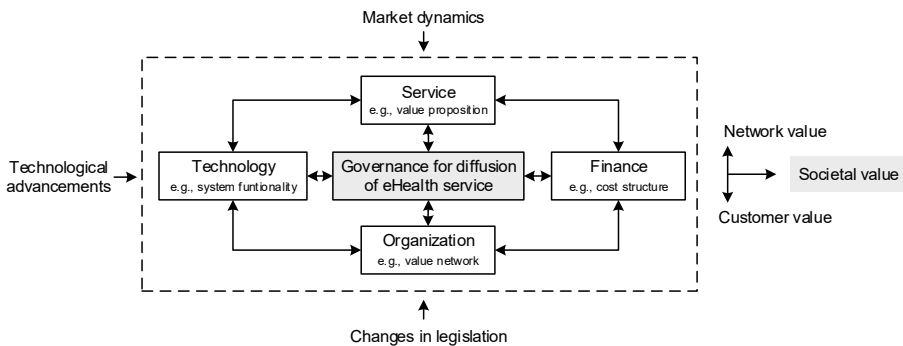

Figure 4: Suggestion on how to expand the STOF model to the public healthcare setting.

7.4   Correspondence between Frame of Reference and Results

As previously noted, it is important to highlight the meaning of new when studying service innovations (Sundbo, 1997; Toivonen & Tuominen, 2009; Witell et al., 2016). Patients' online access to health information presents a new situation in which existing characteristics (access to health information) are changed. The change gives patients the opportunity to access information in real-time without delay and without asking the healthcare provider for permission. The new service is not new to the world, but

it is new to the market and to the Swedish healthcare context and is therefore framed as an incremental innovation (Sundbo, 1997; Toivonen & Tuominen, 2009). The type of change provided by the innovations studied in this thesis are difficult to categorize as either a product or process change. The output of the service provision is different as the patient can access information that was previously inaccessible. However, the service process has also changed as it is carried out in a different way. As in other industries, it seems problematic to differentiate between a product and process change (Michel et al., 2008).

Similar difficulties arise for the means of provision to determine whether a service innovation is provided in a new way using technology or new organizational arrangements as suggested by Snyder et al. (2016). The PAEHR and My referrals are provided via the national patient portal; hence, they are delivered through technology. Our findings indicate that few healthcare professionals have changed their documentation procedures. However, the question is if it is sufficient to provide a 'new service' if for instance the process of documentation connected to the service offering is not adjusted. As noted by Pagliari et al. (2005), eHealth is not only a matter of using digital services to deliver healthcare but also a new way of working.

Apart from a novel service that is put into practice, service innovations also benefit actors on several levels (Toivonen & Tuominen, 2009). From a firm perspective, the benefits of innovation have often focused on the importance of a making profit (Snyder et al., 2016). If a firm fails to innovate, they might lose market shares and ultimately close down their business (Sørensen & Torfing, 2012). This view of innovation as an enabler for change has a connection to healthcare. As healthcare is a business, innovation influences the financial actions and operations. However, healthcare is also a social imperative (Weberg, 2009), and healthcare services and public services are also not always aimed at generating revenue for the developer (Scupola et al., 2009; Witell et al., 2016). The findings illustrated the benefits of patient accessible health information, such as patient understanding, patient involvement and improved patient-professional relationships. Therefore, patient accessible health information is framed as a social innovation as it aims to create a shared value (European Commission, 2013; Phills et al., 2008) and addresses a social need (OECD, 2011) to increase patient involvement. This framing is in line with the impact of eHealth innovations that for instance aim to improve healthcare by changing the role of the patient (Koch, 2012) and research on public e-services, emphasizing the need for public e-services to serve the common good and aim for social justice (Lindgren & Jansson, 2013; Sundgren, 2005). This shared value was also reflected in paper 5 in which the societal value was proposed into be incorporated to the conceptual representation of business models in public eHealth. Given this background and the focus of this thesis, innovative eHealth services in a public healthcare setting are viewed as social service innovations.

8 Concluding Remarks and Future Research

This chapter briefly discusses the key issues and outcomes of the performed research and suggestions for future research.

8.1 Concluding Remarks

The results and analysis of the studies contributes to research on innovation and eHealth services (Cresswell & Sheikh, 2013; Greenhalgh et al., 2004; Moen et al., 2012) by providing a classification of prerequisites that need to be considered when eHealth initiatives are discussed. When dealing with eHealth services, organizational and semantic issues are still a challenge. This thesis also provides new insights, arguing that these challenges are not limited to the organization that develops and implements eHealth services but are instead challenges that transcend organizational boundaries.

Second, this thesis contributes to the recent trend of opening up EHRs to patients and providing patient accessible information (e.g., Delbanco et al., 2012; Esch et al., 2016; Nøhr et al., 2017; Roberts et al., 2017; Ålander & Scandurra, 2015). The knowledge derived from the studies on PAEHRs show that there is discrepancy in how patients and healthcare professionals perceive the service. This thesis complements studies that find that patients prefer to obtain access to their EHR (Rexhepi et al., 2016), and it can be concluded that patients feel more involved and that the patient-professional relationship improves with patient access to EHRs. Our findings add to previous studies (Oster et al., 2015; Ålander & Scandurra, 2015) by comparing the perceptions of healthcare professionals' working in primary care units and outpatient clinics. While healthcare professionals in primary care find benefits in increased adherence, clarification of important information and the possibility of patients controlling information in the EHR, those working in primary care and outpatient clinics do not perceive patients to be more involved. The concerns among healthcare professionals mainly involve how patients will manage their access to the information, not how this access might impact healthcare professionals' work. This conclusion confirms findings from previous studies on patient accessible information (de Lusignan et al., 2014; Grünloh, Cajander, et al., 2016).

Third, this research adds to the discussion on business models as formal conceptual representations of business activities (Massa et al., 2017) in a public healthcare context. Previous studies on business models in healthcare have mostly focused on a multi-payer or market-based healthcare system (Acheampong & Vimarlund, 2014) and have focused on listing elements of business models, but not presenting them with data (Fredriksson et al., 2017). The study in this thesis adds to this work by providing empirical insights on how business models can be represented

in a public eHealth setting. By viewing public eHealth services as social innovations, this thesis also contributes to the content of business models in a public healthcare setting by incorporating societal value into the representation of the business model.

8.2   Implications for Practitioners

This research has shown the importance of paying attention to issues related to organizational change and semantics when discussing eHealth initiatives. These issues are central to the introduction of eHealth services and need to be discussed across organizational boundaries. Regarding PAEHRs, there seems to be a discrepancy between the perceptions of patients and healthcare professionals concerning the value of PAEHRs. An important issue for healthcare providers will be to disseminate research findings about the benefits for patients due to patient accessible information to engage practitioners in endorsing patient use. Another important issue will be to discuss the need to provide accessible health information on equal terms to all citizens. While the results show that several respondents view the PAEHR as a citizen's right, there is currently uneven access to information across different regions. Finally, when introducing eHealth services, the representation of the business model can be used to draw attention to the implications that a service can have on a public level and can incorporate important societal values into discussions.

8.3   Future Research

Previous studies on eHealth innovations have shown the importance of technical, social and organizational considerations and their interconnections when introducing innovations in healthcare (Cresswell & Sheikh, 2013). Today, public service delivery is increasingly influenced by private actors (Lindgren & Jansson, 2013), and our findings show that it will be important to include more actors to deliver eHealth innovations. Despite previous research, it seems as if these issues have not received enough attention in more complex settings that involve several actors, both private and public ones. It will also be interesting to study whether it is still relevant to discuss the inclusion of societal value in the business model framework as new and private actors take part in service delivery.

Second, the PAEHR seems to be a step towards realizing some of the expectations of eHealth. However, it will important to full share the EHR with patients and provide additional services to change the role of the patient from a passive actor to an active and engaged patient (Adler-Milstein et al., 2017). Several new services and apps give patients the possibility of registering their own health information. As more patients view and learn from their own data, known as patient generated health data, new opportunities arise (Lai, Hsueh, Choi, & Austin, 2017). However, it seems unclear how patients should handle the dichotomy of owning healthcare data while at the same time lacking medical knowledge. These aspects will be important to study, especially in patients with limited health literacy (Demiris, 2016).

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Collection of Papers

Paper 1
I got 99 Problems, and eHealth is One
Sofie Wass and Vivian Vimarlund

Paper 2
Healthcare in the Age of Open Innovation – A Literature Review
Sofie Wass and Vivian Vimarlund

Paper 3
The Role of PAEHRs in Patient Involvement
Sofie Wass and Vivian Vimarlund

Paper 4
Same, Same but Different: Perceptions of Patients' Online Access to
EHRs among Healthcare Professionals
Sofie Wass and Vivian Vimarlund

Paper 5
Business Models in Public eHealth
Sofie Wass and Vivian Vimarlund

Additional Publications

Additional publications, that were written during this time, are listed below.

Wass, S., & Vimarlund, V. (2017). *The role of ICT in home care - impact on information access and work processes*. Proceedings of the Context Sensitive Healthcare Informatics (CSHI) conference, Hong Kong, China.

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