Comparing the Implementation of Electronic Patient Record (EPR) Systems in Germany and Norway

What are the key factors explaining differences in implementation of Electronic Patient Record systems in Germany compared to Norway?

Stefan J. Mitterer

Department of Health Management
and Health Economics

Institute of Health and Society

UNIVERSITETET I OSLO

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Supervisor: Professor Frode Veggeland

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Abstract

BACKGROUND: Differences in the pace of implementation and degree of diffusion of Electronic Patient Record (EPR) systems can be observed between Germany and Norway. Whereas EPR systems are implemented nationwide in Norway, EPR implementations in Germany remain scattered at the regional level. A nationwide implementation has not yet been achieved. Considering that these differences exist, it is highly interesting to explore why this phenomenon occurs.

OBJECTIVE: The aim of this study is to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. The study aims to provide a starting point for further research on how to ensure success in EPR implementations.

METHOD: By combining three research methods; a scoping review, an implementation evaluation and a descriptive comparison, this qualitative comparative study examined two cases in a cross-country comparison. A scoping review was performed in order to identify relevant literature and variables. An implementation evaluation was developed to obtain country-specific observations. Subsequently, these observations were compared by performing a descriptive comparison. The descriptive comparison was anticipated to result in one or more key factors.

RESULTS: According to the assessed literature, differences in the pace of implementation and the degree of diffusion are a result of five key factors. These key factors are: (1) the degree of reservation towards EPRs from both society and from patients; (2) the efficiency and pace in political decision-making; (3) the presence of a clear national strategy, including strategy plans; (4) the presence of clear governance structures, including a clear allocation of responsibilities; and (5) the complexity and diversity of laws and regulations.

CONCLUSION: The extracted key factors suggest that the government, including its regulatory power, has a relatively strong influence on EPR implementations. This study found that dissenting government measures are the main source of factors that explain differences in the implementation of EPR systems in Germany compared to Norway. Additionally, societal and patients' reservations, at least in the past, seemed stronger in Germany than in Norway.

Zusammenfassung

HINTERGRUND: Ein Vergleich der Implementierung von elektronischen Patientenakten (ePA) zwischen Deutschland und Norwegen legt zum Teil erhebliche Unterschiede offen. Während ePAs in Norwegen flächendeckend eingeführt wurden, finden solche Systeme in Deutschland nur regional Verwendung. Eine flächendeckende Einführung steht noch aus. Diesen Unterschied genauer zu untersuchen leitet diese Studie.

ZIELSETZUNG: Ziel dieser Forschungsarbeit ist die Bestimmung von Schlüsselfaktoren, die die Unterschiede in der Einführung von ePA Systemen zwischen Deutschland und Norwegen erklären. Dadurch soll ein Ausgangspunkt für weiterführende Forschungstätigkeiten geschaffen werden.

METHODIK: Die vorliegende Arbeit ist eine qualitative Vergleichsstudie, die die Einführung von ePA Systemen in Deutschland und Norwegen untersucht. Relevante Literatur konnte durch eine systematische Recherche der existierenden Literatur gewonnen werden. Ein Modell zur Evaluierung von Implementierungen wurde benutzt um landesspezifische Beobachtungen zu gewinnen. Die landesspezifischen Beobachtungen wurden anschließend verglichen, um die gesuchten Schlüsselfaktoren zu bestimmen.

ERGEBNISSE: Entsprechend der ausgewerteten Literatur lassen sich Unterschiede in der Einführung von ePAs zwischen Deutschland und Norwegen auf Grund von fünf Schlüsselfaktoren erklären. Diese Schlüsselfaktoren umfassen: (1) gesellschaftliche Vorbehalte gegenüber ePAs; (2) zielführende und effektive politische Entscheidungsprozesse; (3) umfassende und hinreichende nationale Strategien und Strategiepläne; (4) klare und deutliche Governance-Strukturen, darunter eine klare Verteilung von Zuständigkeiten; und (5) die Komplexität und Vielfältigkeit von Gesetzen und Vorschriften.

SCHLUSSFOLGERUNG: Die gewonnenen Schlüsselfaktoren deuten darauf hin, dass die öffentliche Hand, eingeschlossen ihrer Gesetzgebungsgewalt, einen relativ starken Einfluss auf die Einführung von ePAs hat. Unterschiede zwischen Deutschland und Norwegen lassen sich durch abweichende staatliche Maßnahmen begründen. Zusätzlich lassen sich Unterschiede, zumindest historisch, durch eine Diskrepanz gesellschaftlicher Vorbehalte gegenüber ePAs erklären.

Sammendrag

BAKGRUNN: Sammenligningen av Norges og Tysklands implementering av elektroniske pasientjournaler (EPJ) viser til dels store forskjeller. Norge har hatt en omfattende implementering av EPJ systemer over hele landet, mens situasjonen i Tyskland viser store lokale variasjoner mht. hvorvidt slik iverksetting er gjennomført. Fokus for denne studien har vært å analysere nærmere mulige årsaker til ulik implementering i Norge og Tyskland.

MÅLSETTING: Målet for studien er å identifisere faktorer som kan forklare forskjeller mellom Norge og Tyskland når det gjelder etablering av EPJ systemer. Denne kunnskapen kan igjen skape et grunnlag for videre forskning på implementering generelt og implementering av EPJ systemer spesielt.

METODE: Studien er en kvalitativ komparativ case-studie av etableringen av EPJ systemer i Tyskland og Norge. Data er litteratur som er identifisert gjennom systematiske litteratursøk og deretter systematisert og analysert med utgangspunktet i problemstillingen. På dette grunnlag er det identifisert faktorer som kan forklare implementering av EPJ systemer i Norge og Tyskland. Studien anvender en etablert modell for evaluering av implementeringsprosesser. Modellen bidrar til å få identifisert og systematisert landsspesifikke observasjoner. De landsspesifikke observasjoner ble deretter sammenlignet i en deskriptiv komparativ studie. På dette samlede grunnlag ble de mest framtredende forklaringsfaktorer identifiserte.

RESULTATER: Analysen av data som framkom gjennom det systematiske søket, viser at fem sett av faktorer står sentralt når det gjelder å forklare forskjellene mellom Norge og Tyskland: (1) motstand mot EPJ systemer i samfunnet, (2) politiske beslutningers effektivitet, (3) detaljgraden i og hensiktsmessigheten ved nasjonale strategier og planer, (4) klare og tydelige governance-strukturer, herunder en klar fordeling av ansvar, og (5) kompleksiteten og mangfoldigheten i lover og reguleringer.

KONKLUSJON: De overnevnte forklaringsfaktorene viser at statlige tiltak og reguleringer har hatt en relativt sterk innflytelse på etableringen av EPJ systemer. Ulikheter mellom Norge og Tyskland når det gjelder etablering av EPJ systemer, kan forklares med både ulikheter i politikk og strategier nasjonalt og historiske forskjeller når det gjelder skepsis til, EPJ systemer blant ulike aktører i samfunnet.

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Stefan J. Mitterer

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Abbreviations and Acronyms

C	
CIM	Contextual Implementation Model
E	
EHR	Electronic Health Record
ePA	elektronische Patientenakte
EPJ	elektronisk pasientjournal
EPR	Electronic Patient Record
e.g.	exempli gratia
e-health	electronic-health
F	
FHI	Folkehelseinstituttet
G	
gematik	Gesellschaft für Telematikanwendungen der Gesundheitskarte
GKV	Gesetzliche Krankenversicherungen
GmbH	Gesellschaft mit beschränkter Haftung
GPs	General Practitioners
H	
HC	health care
I	
IOM	American Institute of Medicine
IT	Information Technology
K	
KITH	Kompetansesenter for IT i helse- og sosialsektoren
N	
NTNU	Norges teknisk-naturvitenskapelige universitet
P	
PEM	Process Evaluation Model
PubMed	Public/Publisher MEDLINE
R	
RE-AIM	Reach, Effectiveness, Adoption, Implementation and Maintenance
S	
SGB	Sozialgesetzbuch
U	
UiO	Universitetet i Oslo
W	
WHO	World Health Organization

1 Introduction

"E-health is the single-most important revolution in healthcare since the advent of modern medicine, vaccines, or even public health measures like sanitation and clean water."

European Commission's first high-level conference on e-health (Silber, 2003, p. 1)

In recent years remarkable progress in sophisticated medical technology and digitalization has drawn growing attention to the field of e-health. The field of e-health originated during the early 2000s and conceptualizes an ongoing trend towards increased utilization of advanced information and communication technologies in health care (Eysenbach, 2001). Part of this trend, and the main focus of this study, is the implementation of Electronic Patient Records (EPRs). The digitalization of patient records, the most important documentation tools in clinical practice, is widely recognized as being the key to transforming health care services into the future (Schmucker et al., 1998).

To counter future challenges in health care, such as demographic changes and resource constraints (Stone, 2014), health care authorities worldwide actively promote the implementation of EPR systems. Admittedly, the pace at which EPRs are implemented differs between individual countries (WHO, 2008). As this study will illustrate, two countries where differences can be observed are Germany and Norway.

In Germany, EPR systems are a controversial subject. Despite ongoing discussions about their implementation, notable changes have failed to occur. In fact, EPR implementations remain scattered at the regional level, and a nationwide implementation has not yet been achieved (Haas, 2017). In Norway, on the contrary, EPR systems have been successfully implemented nationwide, allowing for a cross-institutional exchange of information (Norsk senter for elektronisk pasientjournal, 2008).

Observing these differences, it is highly interesting to explore why this phenomenon occurs. Why can we observe differences in the pace of implementation and the degree of diffusion of EPRs between Germany and Norway? Exploring this question not only provides important information about the specific factors that need to be addressed to increase efficiency in EPR implementations, but also contributes to broader knowledge about implementation research.

Implementation research aims to enhance the understanding of implementation processes and outcomes, and provides a framework to detect strengths and weaknesses of implementations (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Nilsen, 2015). Considering the technological progress in health care, it can be expected that implementations of electronic services gain in importance in the future. By providing a structure for the assessment of such implementations, this research study aims to contribute to the broader implementation research.

Even though extensive research on the implementation of EPR systems has been conducted in both Germany and Norway respectively (Boulus, 2004; Ellingsen, 2003; Haas, 2017; Rauer, 2012), the literature provides no indication for the existence of any studies assessing the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. Being aware of this research gap, this study argues that, by enhancing the understanding of the factors explaining differences in implementation of EPR systems, important conclusions can be drawn. These conclusions can help to improve and accelerate EPR implementations and prevent related barriers and interruptions. This is not only essential for the implementation of EPRs in Germany and Norway, but also highly relevant for all other countries planning or conducting such endeavors.

The aim of this study is to provide a starting point to conduct further research on how to ensure success in implementing EPRs. This study argues that knowing the decisive factors that explain differences between Germany and Norway can provide this starting point. The two countries were chosen for three main reasons: the observable differences in EPR implementations; the availability of relevant literature; and the high relevance of EPR research in both countries. The following research question is addressed in this study:

What are the key factors explaining differences in implementation of Electronic Patient Record systems in Germany compared to Norway?

To extract the key factors, it is important to attain an enhanced understanding of both real-world context and theoretical underpinnings that characterize the implementation of EPR systems. Chapter 2 therefore not only closer defines EPR systems, but also outlines related historical aspects and today's situation in Germany and Norway. Furthermore, the chapter looks briefly at the country-specific health care systems. Subsequently, chapter 3 outlines the theoretical underpinnings of EPR implementations. The chapter presents both implementation theories and

frameworks as well as a range of classic theories connected to EPR research. A presentation of the analytical framework concludes chapter 3.

Chapter 4 encompasses a broad explanation of the methods used to extract the key factors. The three methods used are: a scoping review; an implementation evaluation; and a descriptive comparison. Thus, relevant literature can be identified, its content assessed and the key factors extracted.

The results of applying the three research methods are presented in chapter 5. Following the same structure as chapter 4, the chapter presents the results of the scoping review, the implementation evaluation and the descriptive comparison. By discussing the main findings and outlining the final conclusion, chapters 6 and 7 complete this research study.

2 Background

In the beginning of the 1990s the American Institute of Medicine (IOM) began to publish reports and conduct studies on the electronic storage of patient information. Leading the way away from paper based records towards modern electronic record systems as clinicians use them today (Gartee, 2012).

In its research on computer-based patient records the IOM identified eight core functions that characterize modern EPR systems (Gartee, 2012; Institute of Medicine, 2003). These core functions are as follows: (1) functions to store and provide information and data; (2) universal accessibility without time and geographical constraints; (3) functions to support clinical workflows and routines; (4) decision support tools; (5) communication and connectivity tools; (6) functions to support patients during their treatments; (7) functions to support administrative processes; and (8) functions to contribute to population health measurements.

Internationally, a wide range of terms circulate describing seemingly similar computer-based patient record systems. Terms such as “Electronic Medical Record”, “Electronic Patient Record” or “Electronic Health Record” are often used interchangeably without recognizing a clear distinction (Häyrinen, Saranto, & Nykänen, 2008). Adding the various terms that are being used in Germany, “Elektronische Krankenakte”, “Elektronische Patientenakte” or “Elektronische Gesundheitsakte” (Prokosch, 2001), and Norway, “pasientjournal”, “pasientregistre”, “helseregistre” or “medisinske kvalitets- og forskningsregistre” (Ørstavik, Cappelen, & Stoltenberg, 2005), the situation becomes even more complex.

To find common ground between all these terms, the English term “Electronic Patient Record” (EPR) is used throughout the whole study. The above stated eight core functions and the below outlined country-specific definitions define the term EPR as used in this study.

In Germany EPR systems, or the German equivalent “Elektronische Patientenakte”, are defined as systems created to store important information and documents regarding the treatment of patients (Arbeitskreises EPA/EFA, 2011). The information and documents are accessible cross-institutional and managed by health care providers. Information provided by patients can be included and communication between clinicians and patients is possible.

In Norway EPR systems, or the Norwegian equivalent “elektronisk pasientjournal”, are defined as an electronic collection of health-related information of a patient, encompassing information about past and current treatments (Helsedirektoratet, 2015). The system provides tools for cross-institutional communication as well as for clinician-patient communication. In addition, the system operates as a source for secondary record systems, called “helseregistre”.

To understand EPR implementations it is not only important to be aware of terminology and definitions but also to have a comprehensive understanding of the health care system in which a specific EPR system is implemented.

2.1 Health Care Systems

Health care systems around the world differ from each other, reflecting differences in core characteristics such as funding, organization, regulations and behavior (Sloan & Hsieh, 2012). These differences are crucial to consider when comparing health related phenomena in cross-country comparisons (Papanicolas & Jha, 2017). The next two subchapters provide an overview over the main characteristics of health care systems, both for Germany and Norway respectively.

2.1.1 Health Care System of Germany

The health care system of Germany, a Bismarck model health care system conceived by the German statesman Otto von Bismarck (Bhattacharya, Hyde, & Tu, 2014), is characterized by universal insurance coverage, community ratings and regulated provision of private health care services.

The organizational structure of the German health care system is headed, in legislative terms, by both the federal government and the 16 state governments. In executive terms, the health care system is headed by the Federal Joint Committee (Gemeinsamer Bundesausschuss) (Stroetmann, Artmann, & Giest, 2010). Legislations are enacted either by the federal ministry of health (Bundesministerium für Gesundheit) or by the state ministries of health. The Federal Joint Committee, composed of members of physician, dentist, hospital, insurance and patient associations, is the highest entity within Germany’s self-governing health care system. The

committee is responsible for the organization and administration of the statutory health insurance system.

The health care system of Germany is funded by mandatory social health insurance contributions, split in three co-existing insurance schemes (Stroetmann et al., 2010). Contributions are either paid to a statutory health insurer, to a private health insurer or within governmental schemes. Statutory health insurance schemes account for the majority of insurances. Contributions are based on the level of income and are equally paid by employer and employee.

According to Stroetmann et al. (2010), hospitals are under the jurisdiction of the state health authorities, and are either run by public, private or independent non-profit actors. Ambulatory health care services are provided by both general practitioners and specialists. Patients are free in their choice of a physician, dentist, pharmacy or emergency care provider.

2.1.2 Health Care System of Norway

The health care system of Norway, a Beveridge model health care system conceptualized by the British economist William Beveridge (Bhattacharya et al., 2014), is characterized by universal health care coverage, a single-payer insurance, public provision of health care services and free care.

Organizationally, a three-level division characterizes the Norwegian health care system. (Bergmo & Johannessen, 2006; Doupi, Renko, & Giest, 2010). The organizational structure is headed by the national government, followed by the four regional health authorities and the present 422 municipalities. The responsibility for policy making, national budgeting and approval of institutions rests with the Norwegian parliament (Stortinget) and the Ministry of Health and Care Services (Helse- og omsorgsdepartementet). The four regional health authorities are responsible for planning and provision of secondary care services as well as specialized care. Responsibility for funding and provision of primary care services, public health initiatives and social care services rests with the local municipalities.

The health care system is based on the principle of universal coverage and access. The aim is to provide all citizens with the equal opportunity to access health care services, independent of their socio-economic statuses or geographic locations (Bergmo & Johannessen, 2006; Doupi et al., 2010).

The large majority of costs within the health care system are covered by general taxation. In some situations, e.g. for outpatient consultations and certain laboratory tests and medicines, user-fees and co-payments apply. Membership in the national health insurance scheme is mandatory (Bergmo & Johannessen, 2006).

2.2 EPRs in Germany

2.2.1 History

As outlined in subchapter 2.1.2, legislative jurisdiction within the German health care system is shared among the federal ministry of health and the state ministries of health. Due to this dichotomy, issues of EPR implementations were discussed on both federal and state levels.

On the federal level, discussions on methods and measurements to promote digitalization within health care originated during the mid-1990s (Schweim, 2007). During these years, the federal ministry of health established the "INFO 2000" task force that, besides others, explored how patient health data can be stored online (Haas, 2017).

In the early 2000s the idea to use chip-based health insurance cards as data carrier and key to various computer applications, including EPR systems, emerged. A pre-requirement to transfer this idea into practice was the establishment of a nationwide standardized IT-infrastructure. To frame guidelines for the needed infrastructure the federal ministry of health launched the "bit4Health" task force. The task force recommended to found a specialized organization to administrate the creation of a nationwide health net. Thereupon, the federal health ministry and the Federal Joint Committee agreed to establish the "protego" project, which was later merged into the gematik GmbH (Gesellschaft für Telematikanwendungen der Gesundheitskarte mbH) (Schweim, 2007).

During the creation of the nationwide health net, little attention was given to the implementation of EPRs. It was not until 2016, when the new e-health law (Gesetz für sichere digitale Kommunikation und Anwendungen im Gesundheitswesen) passed, that EPRs were discussed in-depth again (Haas, 2017).

On the state level, several limited projects (Alnawaiseh et al., 2015; Grüner, Ljutow, Schleinzer, & Bosancic, 2008; Krüger-Brand & Osterloh, 2017; Kuchenbecker & Behrens-Baumann, 2004) on EPR implementations were carried out, often supported by the responsible state government.

2.2.2 Situation Today

Today, several EPR systems are implemented locally (Alnawaiseh et al., 2015; Grüner et al., 2008), a nationwide dissemination however has not yet been achieved.

In implementing EPR systems, health care providers in Germany rely on systems developed in the private market (Haas, 2017). Some vendors tried to implement EPR systems directly into the health care system, but difficulties arose from deficiencies in system integration and interoperability.

To counter the insufficient dissemination of EPR systems, the federal ministry of health initiated the e-health law that, besides others, obligates the gematik to create the necessary conditions to implement EPR systems nationwide. By the end of 2018, these pre-conditions need to be established (E-Health-Gesetz, 2015).

2.3 EPRs in Norway

2.3.1 History

During the 1990s a growing number of hospitals, GPs and municipalities implemented early versions of EPR systems. In the beginning, these early versions were used to fulfill administrative purposes but more features were added over time (Ellingsen & Monteiro, 2012; Larsen & Mydske, 2013). Within the same period, in 1997, the Norwegian government outlined the first national strategy plan ("mer helse i hver bIT") to address the implementation of electronic communication channels in the health care sector (Helse- og omsorgsdepartementet, 2012).

The health care reform of 2002, which included a restructuration of the previous five health regions into four, called for a revision of the national health IT-infrastructure (Ellingsen & Monteiro, 2012). Building on both the health reform and the "mer helse i hver bIT" strategy plan, a new strategy plan called "Si@!" was launched (Helse- og omsorgsdepartementet, 2012).

Part of the plan was the creation of a nationwide health net (Norsk Helsenett), a pre-condition to implement EPR systems nationwide. In 2004 the health net was realized, giving the four health regions a common IT-infrastructure (Hygen, 2005). To consolidate the development further, and to improve system interoperability, the Norwegian Ministry of Health and Care Services launched the "S@mspill" strategy plan in 2007. Later, in 2011, this plan was revised and relaunched as "Samspill 2.0" (Helse- og omsorgsdepartementet, 2012). By 2009 almost 80% of doctor offices, hospitals and other health service providers had implemented EPR systems. In addition, the remaining 20% had already made plans to implement such systems (Norsk senter for elektronisk pasientjournal, 2008).

To accompany the process of developing a standardized IT-infrastructure and implementing EPR systems nationwide, the Norwegian government established the Norwegian Center for Health Informatics (KITH). The center was founded in 1990 and was responsible for setting standards and securing information exchange with regards to IT-systems, such as EPRs (Hygen, 2005). Later, in 2016, the newly-established Norwegian Directorate of eHealth (Direktoratet for e-helse) took over the responsibility of administrating the implementation and use of EPR systems.

In addition, a temporary research unit (Norsk senter for elektronisk pasientjournal) for EPR research was established at the Norwegian university of science and technology (NTNU) in Trondheim. The research unit had the task of conducting multidisciplinary research on EPR systems (Norsk senter for elektronisk pasientjournal, 2008).

2.3.2 Situation Today

Today, EPR systems are widely-used within the Norwegian health care system. All hospitals are connected by interoperable EPR systems (Fragidis & Chatzoglou, 2017; Østensen & Moen, 2015), enabling the cross-institutional transfer of standardized information. The responsibility of EPR system development rests with private vendors.

EPR systems are used nationwide but full system interoperability is, due to lacks in standardization, still a challenge (Fragidis & Chatzoglou, 2017). Improving interoperability by means of standard setting and greater digitalization is therefore a main priority in developing EPR systems further. To address this issue, the Norwegian Directorate of eHealth launched a strategy

plan ("Nasjonal handlingsplan for e-helse 2017-2022") to, besides others, promote the digitalization of work-processes and the standardization of coding and terminology (Direktorate for e-helse, 2017).

In addition, the Norwegian government launched the project "Èn innbygger – èn journal". The aim is to combine a patients' several records within one central patient record, called "kjernejournal" (Helse- og omsorgsdepartementet, 2012).

By defining and explaining the term "Electronic Patient Record" chapter 2 provided the necessary background information needed to perform this research study. Having outlined both health care system characteristics and country-specific situations regarding EPRs, the chapter provided the starting point for a detailed assessment of EPR implementations. In addition to the real-world underpinnings, the next chapter presents the theoretical underpinnings of EPR implementations. The aim is to further enhance the understanding of the complex relationship between implementation research and EPR systems. Understanding this relationship is important to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway.

3 Theory and Framework

The aim of this study is to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. These key factors can be extracted by understanding the complex relationship between implementation research and EPR systems. Additionally, as subchapter 3.2 outlines, classic theories in EPR research provide guidance in assessing EPR implementations. As chapter 3 shows, a clear distinction between theory and methodology is not always possible. Implementation frameworks often act as both underpinning theories and methodological approaches.

3.1 Implementation Research

As Nilsen (2015) notes, implementation research aims to enhance the understanding of implementations and to explain related processes and outcomes. An implementation can be defined as "*a specified set of activities designed to put into practice an activity or program of known dimensions*" (Fixsen et al., 2005, p. 5). "Set of activities" refers, in this context, to a purposeful implementation process, being important for detecting the strengths and weaknesses of an implementation.

From a historical perspective, theories and theoretical frameworks have not always been adequately acknowledged in implementation research. Early research was mostly driven by empirical findings, and little attention was given to the theoretical underpinnings (Nilsen, 2015). Over time, practices in implementation research changed and the importance of theoretical frameworks became increasingly recognized. Today, as this chapter shows, many models, theories and frameworks exist that can be used to enhance the understanding of specific aspects of implementations.

An implementation should never be seen as a single action, rather as a complex process that can be divided into different stages (Nilsen, 2015). These stages range from planning and strategy setting, via the implementation of interventions, to the determination of success. To illustrate which models, theories or frameworks to use during a certain implementation stage, Nilsen (2015) grouped a wide range of models, frameworks and theories into five categories. The five

categories are: (1) process models; (2) determinant frameworks; (3) classic theories; (4) implementation theories; and (5) evaluation frameworks.

In implementing EPR systems into practice, both process models and determinant frameworks provide underpinning theoretical frameworks for strategy setting. Frameworks such as the Knowledge-to-Action Model (Graham et al., 2006), the Quality Implementation Framework (Meyers, Durlak, & Wandersman, 2012), the Consolidated Framework for Implementation Research (Damschroder et al., 2009) or the Understanding-User-Context Framework (Jacobson, Butterill, & Goering, 2003) provide guidance in planning implementations.

Since the aim of this study is to extract the key factors influencing EPR system implementations and not the creation of an EPR implementation strategy, less attention will be paid to process models and determinant frameworks. More attention will be paid to classic theories, implementation theories and evaluation frameworks.

Both implementation theories and evaluation frameworks guide the extraction of the key factors. Classic theories are crucial for the whole research process. They enhance the understanding of the complex relationship between implementations and EPR systems. Considering the three categories, the following theoretical framework forms.

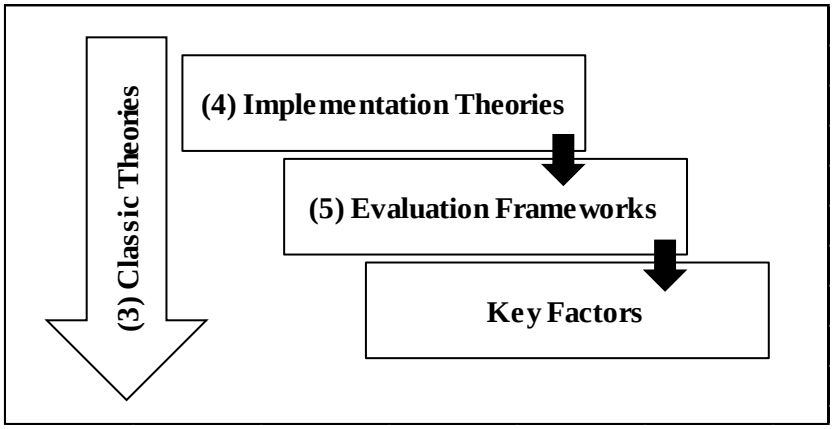


Figure 1: Theoretical Framework

Classic theories emerge from research traditions external to implementation research, for instance from management, economic, or information technology research. The large number of classic theories that can be found in EPR research reflects the complexity of EPR systems. To

account for the high complexity, a separate subchapter, chapter 3.2, is dedicated to classic theories. Thus, a more comprehensive overview over the interaction of implementation research and EPR research can be given.

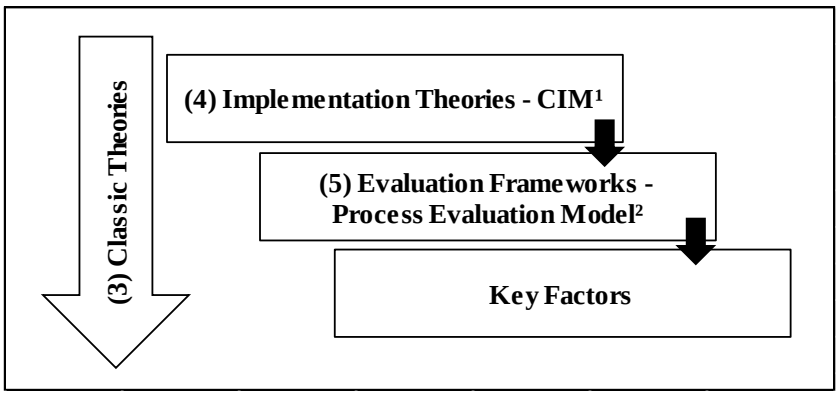
In contrast to classic theories, implementation theories, frameworks and models have their origin within implementation research. By acknowledging the complexity of implementations, they offer an enhanced understanding of the factors characterizing implementations. In the context of this study, theories, frameworks and models worth mentioning are: the Implementation Climate Framework (Klein & Sorra, 1996); the Normalization Process Theory (May & Finch, 2009); and the Contextual Implementation Model CIM (Callen, Braithwaite, & Westbrook, 2008).

By providing a framework for clinical information system implementations, such as EPR implementations, the CIM aims to fill a gap in implementation research (Callen et al., 2008). The model contributes to an enhanced understanding of implementations by stressing the importance of diversity and differentiation factors. Chapters 4.2 provides a detailed explanation of how the model contributes to the extraction of the key factors explaining differences in the implementation of EPR systems in Germany compared to Norway.

Research on evaluation frameworks is characterized by the necessity to determine whether a certain implementation was successful or not. Frameworks such as RE-AIM (Reach, Effectiveness, Adoption, Implementation and Maintenance) evaluate implementations by assessing associated changes for individuals, organizations and communities (Glasgow, Vogt, & Boles, 1999). Similarly, the Process Evaluation Model (PEM) developed by Hulscher et al. (2003) provides a framework to assess implementation success. Originally designed to determine the success of clinical quality improvement interventions, the model provides a framework to enhance the understanding of an intervention by assessing both exposure and experiences. Chapter 4.3 explains in detail how the PEM can be used to assess EPR implementations.

As this chapter showed, both implementation theory and evaluation frameworks contribute to an enhanced understanding of the complex relationship between implementation research and EPR implementations. The exemplified theories, frameworks and models not only enrich the theoretical framework but also provide the research methods needed to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. Adding both the CIM and the PEM to the theoretical framework, the research framework

guiding this study forms. The analytical framework outlined in chapter 3.3 reflects on the research framework presented in Figure 2.



[1](Callen et al., 2008), [2](Hulscher, Laurant, & Grol, 2003)

Figure 2: Research Framework

3.2 Classic Theories in EPR Research

As noted in the previous chapter, classic theories can enhance the understanding of the complex relationship between implementation research and EPR systems. EPR systems, with their high complexity, prove to be applicable to a wide range of underlying theories. This chapter shows that, depending on a particular EPR characteristic, classic theories provide orientation in assessing EPR system implementations.

EPR system research includes a broad range of different research traditions. In their article "Tensions and Paradoxes in Electronic Patient Record Research: A Systematic Literature Review Using the Meta-narrative Method" Greenhalgh et al. (2009) identified several research traditions that are part of EPR research. These range from information system and health informatics research, via change management, computer-supported cooperative work, critical sociology and empirical philosophy research, to system approaches to risk and integration. Each research tradition is characterized by corresponding theories, which all can be applied to different aspects of EPR implementations. Areas of application are, for instance, the analysis of effects of EPR implementations on clinical relationships or an assessment of the intersection of EPR implementations and clinical workflows. The following table, Table 1, assigns corresponding classic theories to the research traditions outlined by Greenhalgh et al. (2009).

Table 1: Classic Theories in EPR Research

Research Traditions	Related Theories
Information Systems & Health Informatics	System Theory, Institutional Theory, Diffusion of Innovation Theory, Structuration Theory
Change Management	Change Management Theory
Computer-Supported Cooperative Work	Coordination Theory, Acceptance of Technology Theory, Unified Theory of Acceptance and Use of Technology
Critical Sociology	Critical Theory
Empirical Philosophy	Actor-Network Theory, Theories of Privacy
System Approaches to Risk and Integration	Complexity Theory

Research Traditions: (Greenhalgh, Potts, Wong, Bark, & Swinglehurst, 2009)

Both information system and health informatics research aim to enhance the structured development and implementation of well-designed EPR systems (Greenhalgh et al., 2009). By enhancing the understanding of innovation and diffusion of technology in the highly institutionalized health care sector, corresponding theories not only assess the influence of EPRs on institutional values but also illustrate their effects on clinical work processes and practices.

Whereas System Theory (Regan & Wang, 2015), by providing a framework that recognizes the complex interactions among people, processes and technology, contributes to successful EPR implementations, Structuration Theory (Greenhalgh & Stones, 2010) goes a step further and provides understanding of how EPR implementations affect balance and structures among clinical actors. In addition, Diffusion of Innovation Theory (Rogers, 2003) provides insight in EPR adoption processes and, by doing so, gives an understanding of how such systems spread (Zhang, Yu, Yan, & Spil, 2015). Moreover, an institutions environmental factors, such as cultural beliefs, normative frameworks, regulatory systems, governance systems or rules of social actions, can be influential in implementing and adopting EPR systems. In this context, Institutional Theory exemplifies the connections between EPR systems and an institutions environmental factors (Sherer, Meyerhoefer, & Peng, 2016).

The introduction of EPR systems is a complex, system changing task that requires structured planning, a clear strategy, strong leadership and good project management (Greenhalgh et al., 2009). In this regard Change Management Theory (Kotter, 2010; Lewin, 1947; Schein, 1999) gives important implications. By providing a safe environment for change and preparing individuals with necessary skills and knowledge to manage change (Bradley, Burns, & Weiner,

2012), the theory provides a framework to reduce organizational reluctance towards EPR related changes.

Computer-supported cooperative work research is instrumental in enhancing clinical work processes (Greenhalgh et al., 2009). Clinical work processes are characterized by collaborations among various clinical actors, such as doctors, nurses, the management and the IT-administration. In this complex environment, EPR systems can contribute to a firmer coordination of work processes. Coordination Theory, for instance, provides important insight in the coordination of clinical activities. The aim is to coordinate clinical activities in a beneficial way that allows all actors to work together harmoniously (Malone & Crowston, 1990).

EPR systems are often developed under coordination constraints, involving software engineers and clinicians (Walker, Bieber, & Richards, 2005). As a result, EPR system usability, at times, diverges from clinical needs. Weaknesses in system usability might lead to interruptions of clinical workflows, and consequently to growing information technology reluctance amongst clinicians. To account for aversions in technology acceptance, theories addressing the acceptance and use of technology, such as the Technology Acceptance Model (Holden & Karsh, 2010) or The Unified Theory of Acceptance and Use of Technology (Benmessaoud, Kharrazi, & MacDorman, 2011), contribute to an enhanced understanding of the interactions of technology and individuals.

In the context of EPR system implementations, research on critical sociology aims to assess changes in hierarchy provoked by EPR related modifications of work processes (Greenhalgh et al., 2009). It can be assumed that EPR implementations render the relationships among clinical actors, such as doctors and nurses. In this regard, Critical Theory provides a framework to analyze both the impact of EPR implementation on dominant organizational structures and the effects of EPRs on traditional power relations (Stahl, Doherty, Shaw, & Janicke, 2014).

Within the research tradition of empirical philosophy, the Actor-Network Theory provides interesting insight in EPR implementation processes (Greenhalgh et al., 2009). The theory argues that technologies are actors in networks, equal to individuals. The relationships between individuals and technologies are seen as a dynamic network that evolves over time (Cresswell, Worth, & Sheikh, 2010). Thus, EPR systems should be understood as part of clinical systems, and not as an external force. Empirical philosophy furthermore encompasses philosophical and legal theories of privacy (Tavani, 2007). These theories provide important implications with

regard to security concerns of storing private patient data in EPR systems. The theories argue that sensitive patient data need to be secured under the frame of an adequate online privacy policy that addresses security concerns regarding information technology systems.

System approaches to risk and integration are important to consider to minimize risk of errors, flaws in technology and incidences of damage (Greenhalgh et al., 2009). Here, Complexity Theory offers a framework to study the complexity of EPR systems. An enhanced understanding of interactions within these systems, their self-organizing nature, and interactions with their environment can be instrumental in risk reduction (Thompson, Fazio, Kustra, Patrick, & Stanley, 2016). In addition, high levels of standardization and integration might affect risk reduction positively. However, as the size of an EPR system increases, increases its complexity (Greenhalgh et al., 2009). It can be argued that increased complexity leads to a higher risk of tensions and errors.

It has to be noted that the research traditions outlined by Greenhalgh et al. (2009) are not all-encompassing. Further research traditions, such as economics and ethics, are influential in implementation research (Grol, 2013). Similarly, the stated theories represent only a fraction of applicable theories, additional theories might prove to be useful in assessing EPR implementations.

The outlined research traditions and the corresponding classic theories illustrate how complex and multilayered EPR research is. As chapters 3.1 and 3.2 showed, implementation theories and frameworks as well as classic theories are instrumental in evaluating EPR implementations. In order to provide a structure for conducting this research study, an analytical framework was developed. The analytical framework presented in chapter 3.3 provides the needed structure to navigate through the complex research field of EPR research.

3.3 Analytical Framework

The following three-stage analytical framework was developed to structurally guide this research project. The framework is a composition of three underlying modus operandi. It starts with a (1) scoping review to extract variables, proceeds with an (2) implementation evaluation to obtain corresponding observations, and ends with a (3) descriptive comparison to obtain the

key factors that explain differences in the implementation of EPRs between Germany and Norway.

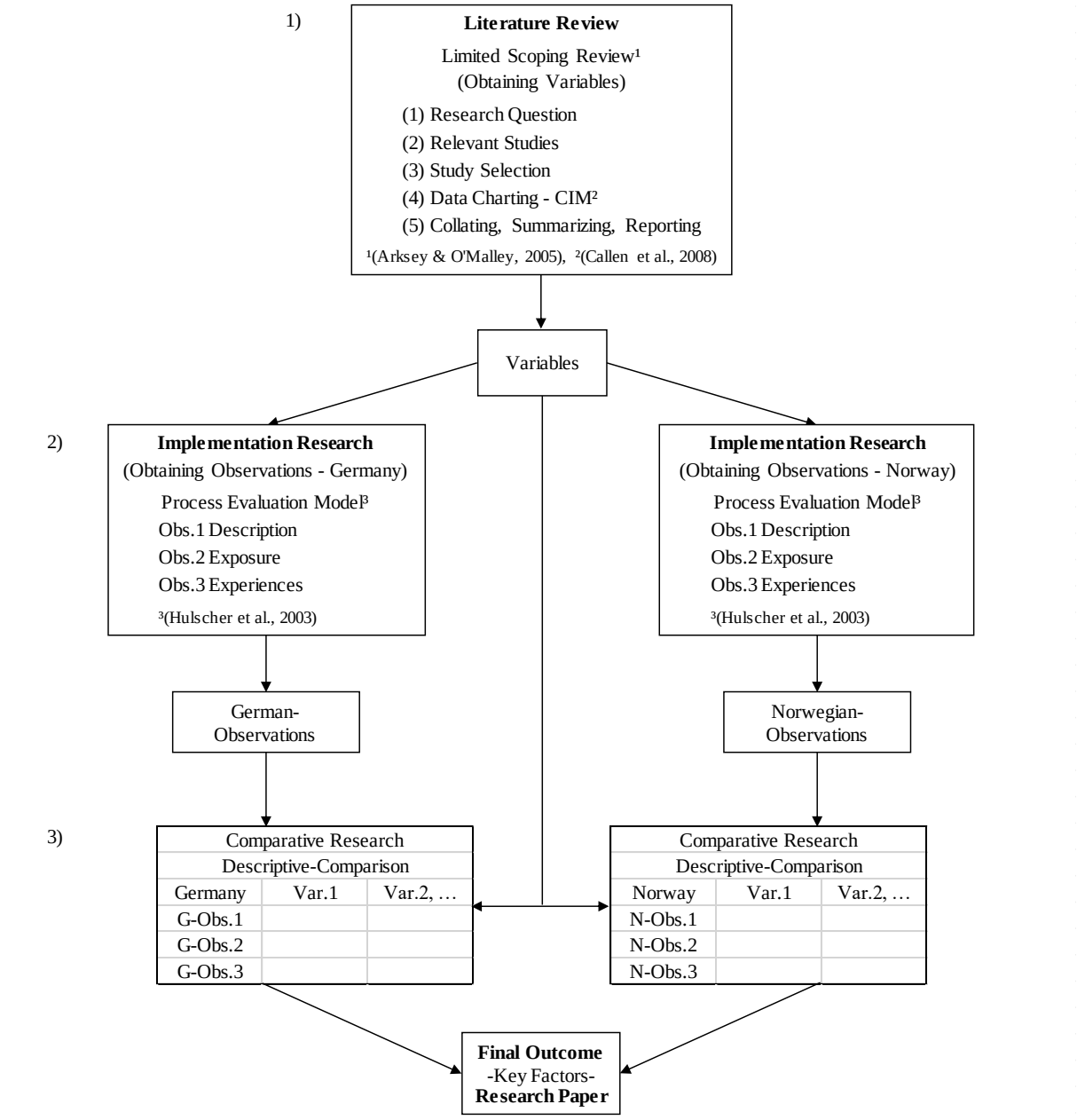


Figure 3: Analytical Framework

The theories, frameworks and models outlined in chapters 3.1 and 3.2 guide the analytical framework. Especially the models developed by Callen et al. (2008) and Hulscher et al. (2003) proved to enrich the analytical framework. To extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway, the next chapter detailed outlines the research methods included in the analytical framework.

4 Methodology and Data

4.1 Study Design and Data

The aim of this qualitative comparative study is to identify the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. By combining three research methods; a scoping review, an implementation evaluation and a descriptive comparison, this study examines two cases in a cross-country comparison.

To extract the key factors, this study begins with a systematic review of the literature. A scoping review is performed in order to identify relevant literature on the implementation of EPR systems in Germany and Norway. As chapter 4.2 outlines, the scoping review follows a five-step framework, as conceptualized by Arksey and O'Malley (2005). Besides identifying relevant literature, the scoping review also has the purpose of identifying the variables needed for both the implementation evaluation and the descriptive comparison. To obtain these variables, a categorization-framework was designed which incorporates both primary literature and the Contextual Implementation Model developed by Callen et al. (2008). This categorization-framework is used to chart the identified literature. By charting the scoping review records, variables are extracted by means of measuring frequencies. The most frequently discussed variables are further assessed during an implementation evaluation.

In order to obtain country-specific observations, an implementation evaluation model was derived from the Process Evaluation Model developed by Hulscher et al. (2003). As chapter 4.3 outlines, this derived implementation evaluation model is used to assess the content of the identified scoping review records. In this way, the country-specific observations needed for the descriptive comparison are obtained. Observations are provided for both Germany and Norway separately, thus a comparison of the results is feasible.

Lastly, this study performs a descriptive comparison designed to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. The obtained variables and country-specific observations are placed in a comparison matrix. Thus, potential differences in the implementation of EPR systems between the two countries are visible. Chapter 4.4 outlines this final step.

4.2 Scoping Review

In their seminal work on literature reviews, Arksey and O'Malley (2005) designed an enhanced framework for performing scoping reviews. This enhanced framework not only allows researchers to address relative precise research questions but also helps them to improve the understanding of the main concepts underpinning a particular field of research. Considering the research question at hand, this is especially important because the literature review aims to enhance the understanding of the underpinning factors of EPR system implementations.

In researching a certain topic, scoping reviews have the advantage that studies of different design, gathered from both published and grey literature, can be included (Levac, Colquhoun, & O'Brien, 2010). This is especially important in EPR research because the research field is fairly complex and includes a wide range of concepts, research traditions and theories. However, the high complexity of EPR research and the nature of this study call for certain limitations. As chapter 4.5 clarifies, some limitations concerning the use of search terms and the method of data charting apply.

The scoping review is conducted by following the five-step scoping review framework proposed by Arksey and O'Malley (2005). The five steps are: (1) identifying the research question; (2) identifying relevant studies; (3) study selection; (4) charting the data; and (5) collating, summarizing and reporting the results. The below presented scoping review protocol outlines all five steps.

In addition to the five-step scoping review framework (Arksey & O'Malley, 2005), several other studies discussing or performing scoping reviews were reviewed in order to attain a deeper understanding of the scoping review method (Grant & Booth, 2009; Halas et al., 2015; Peters et al., 2015; Symon, Williams, Adelasoye, & Cheyne, 2015; Weeks & Strudsholm, 2008).

Scoping Review Protocol:

(1) Identifying the research question

As outlined in the introduction, differences in the pace of implementation and the degree of diffusion of EPR systems are observable between Germany and Norway. By comparing EPR implementations between both countries, this study explores the underlying factors that can

explain these differences. Hence, the following research question is addressed in this study: *What are the key factors explaining differences in the implementation of Electronic Patient Record systems in Germany compared to Norway?* To answer this question, this study begins with a systematic review of the literature. A scoping review is performed in order to identify relevant literature on the implementation of EPR systems in Germany and Norway.

(2) Identifying relevant studies

The aim of the scoping review is to identify relevant literature in order to answer the research question of this study. To guide the scoping review and provide an accurate overview over both published and grey literature, certain search terms and eligibility criteria were prior determined. The eligibility criteria and search terms outlined in Tables 2 and 3 were formulated to provide guidance in systematically reviewing the literature on EPR implementations. Consideration to the eligibility criteria is given throughout the whole literature review process.

Table 2: Eligibility Criteria

Eligibility Criteria
• Literature published in the languages Norwegian, German and English
• No time horizon (research on EPRs originated in the 1990s)
• Grey literature from government, public institutions, professional associations and associated publishers' websites
• Literature on EPR implementations (EPRs as defined in chapter 2)
• Studies of different design (qualitative, quantitative, mixed-methods)
• The review is limited to Norway and Germany
• Printed books are excluded from the search (used as primary literature)
• Printed magazines, conference presentations and patents are excluded

Regarding the search modalities, the following homepages and electronic databases are included in the search for relevant literature. The electronic databases UiO-Oria, PubMed and google.scholar are searched to identify relevant published literature. Grey literature regarding Germany is taken from the webpages aerztezeitung.de, aerzteblatt.de, bundestag.de, gematik.de, bundesaerztekammer.de, gkv-spitzenverband.de (GKV-Spitzenverband deutscher Krankenversicherungen), bundesgesundheitsministerium.de and Forschungs- und Entwicklungsprojekt Elektronische Patientenakte (https://www.epa291a.de/doku.html). Literature and grey lit-

erature regarding Norway is taken from the FHI-Oria-Library, as well as the webpages riksrevisonen.no, fhi.no (Folkehelseinstituttet), helseregistre.no, regjering.no, helse-midt.no and ehelse.no (Direktroratet for e-helse).

Concerning the search strategy, the search is kept limited but comprehensive enough to identify a satisfying amount of literature. Due to time and resource limitations the search is limited to 8 search terms, as presented in Table 3. As outlined in chapter 2, terms describing seemingly similar electronic data storage systems are often used without recognizing a clear distinction. Thus, a decision was made to use both the "health" and "patient" terms to review the literature. Admittedly, it has to be noted that the Norwegian term "helseregistre" refers to secondary record systems that are used for surveillance and research purposes. This is not necessarily the case for the German and English equivalents.

Table 3: Scoping Review Search Terms

Norwegian:
helseregistre
pasientjournal
German:
elektronische Gesundheitsakte
elektronische Patientenakte
English:
implementing electronic health records Norway
implementing electronic patient records Norway
implementing electronic health records Germany
implementing electronic patient records Germany

As chapter 2 showed, Norway has a long history of implementing and using EPR systems. For this reason, the terms "helseregistre" and "pasientjournal" were not specified further. The German search terms "Patientenakte" and "Gesundheitsakte" were complemented by the term "elektronische" in order to identify literature that is truly relevant. The English search terms were specified even narrower, including the terms "implementing", "electronic" and the country names "Norway" or "Germany", in order to identify relevant literature.

In performing the online search, the Boolean term 'AND' is used between the individual terms. The terms "electronic patient record" or "electronic health record" are used as one term. At all search stages, consideration is given to the above stated eligibility criteria.

The international databases are searched using all 8 search terms. Grey literature from country-specific webpages is identified by using the national-language search terms. The webpages are searched by using website-specific search engines or, in cases where no such engine is available, by screening the webpages for relevant literature on EPRs.

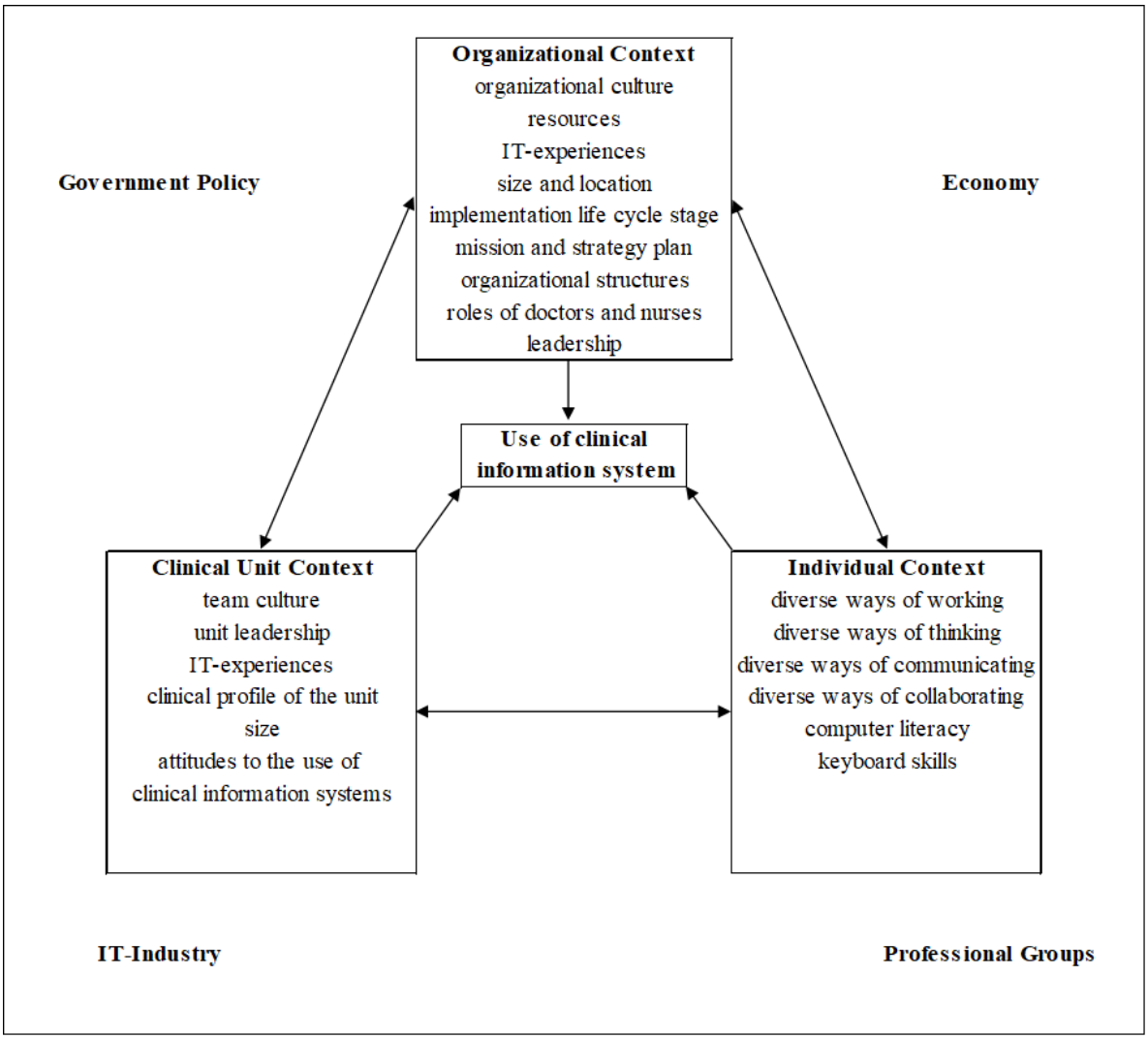
(3) Study selection

A four-stage selection process is used to select relevant literature. In a first step, upon the titles of the search results, relevant studies are identified. In a second step, studies that appear more than once, are only kept once. In other words, double search results are rejected so that each and every article is included only once. In a third step, the remaining studies are screened by reading the abstracts. Only relevant studies are considered further. The fourth and last step includes a full-text assessment of the identified literature. The studies are read and a decision is made about which articles are truly relevant with regards to the eligibility criteria.

(4) Charting the data

The data obtained from the scoping review records are charted along a categorization-framework. This categorization-framework was derived from the Contextual Implementation Model (CIM), developed by Callen et al. (2008). Figure 4 and Table 4, presented on the next page, illustrate the creation of this categorization-framework.

In order to enhance the understanding of the factors influencing clinical information system implementations, the CIM classifies seven internal and external dimensions. The three internal dimensions are: organizational context; clinical unit context; and individual context. The four external dimensions are: government policy; economy; IT-industry; and professional groups. By defining these dimensions, the CIM offers a framework that supports the extraction of the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway.



(Callen et al., 2008)

Figure 4: Original Contextual Implementation Model

Table 4: Preliminary Categorization-Framework

Categorization-Framework:
Internal:
Organizational Dimension
Organizational categories will be determined by assessing primary literature.
Clinical Unit Dimension
Clinical categories will be determined by assessing primary literature.
Individual Dimension
Individual categories will be determined by assessing primary literature.
External:
The categories within the dimensions of Government Policy, IT-Industry, Economy and Professional Groups will be determined by assessing primary literature.

As Table 4 states, the derived categorization-framework will be filled with categories obtained from primary literature (Daim & Behkami, 2016; Fixsen et al., 2005; Grol, 2013; Peters et al., 2013; Walker et al., 2005). The primary literature includes both literature on EPR systems and literature on implementation research. The categorization-framework guides the identification of the variables needed for both the implementation evaluation and the descriptive comparison.

The studies identified during the scoping review are assessed along the derived categorization-framework. By measuring the frequencies of how often certain categories are discussed in the literature, the scoping review records are charted. Thereafter, the measured frequencies are converted into country-specific percentage rates. By measuring the differences between these percentage rates, differences in frequencies of discussions are visible. The categories accounting for the highest differences (over a threshold of 10%) represent the variables that are evaluated during the implementation evaluation.

(5) Collating, summarizing and reporting the results

The aim of the scoping review is to identify relevant literature on the implementation of EPR systems in Germany and Norway. In addition, the scoping review also has the purpose of identifying the variables needed for both the implementation evaluation and the descriptive comparison. Chapter 5.1 comprehensively presents the results.

4.3 Implementation Evaluation

An implementation evaluation is performed to obtain country-specific observations, for both Germany and Norway respectively. To obtain these observations, an implementation evaluation model was developed based on the Process Evaluation Model conceptualized by Hulscher et al. (2003). The implementation evaluation model is used to assess the literature identified during the scoping review. Tables 5 and 6 illustrate both models.

The derived implementation evaluation model has a similar purpose as the original Process Evolution Model. The aim is to formulate descriptions, assess exposures and evaluate experiences. Thus, the model not only provides important information on the success or lack of success of EPR implementations but also enhances the understanding of the variables characterizing EPR implementations.

Table 5: Original Process Evaluation Model

1. Describe the Implementation/Intervention	What is the exact nature of the intervention? What is required to fulfill the implementation?
2. Check the actual exposure to the implementation/intervention	Was the intervention implemented according to plan? Was the target population exposed to the interventions as planned?
3. Describe the experience of those exposed to the intervention	How was the implementation experienced? What problems arose while implementing the intervention? What requirements for changes were experienced?

(Hulscher et al., 2003)

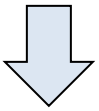


Table 6: Derived Implementation Evaluation Model

1. Description	What is the exact nature of the variable that influences EPR system implementations?
2. Exposure	How were EPR implementations exposed to this variable?
3. Experiences	What issues were experienced during the implementation with regards to this variable?

As Tables 5 and 6 show, the original PEM was adjusted in order to match the setting of this study. As with the original PEM, the derived implementation evaluation model also follows a description-exposure-experience structure. In contrast to the original model, the derived model analyzes the influence of individual variables on the implementation of EPR systems. Thus, country-specific observations are obtained. By describing the exact nature of the variables, a deeper understanding of EPR implementations is gained. Analyzing exposure illustrates the influence these variables have on EPR system implementations. This provides the basis for assessing whether or not problems in implementations arose. Furthermore, by assessing experiences potential implementation barriers are visible.

Having obtained data for the three observational stages, a descriptive comparison is feasible. The country-specific observations are obtained for each country separately. The results of the implementation evaluation are presented in chapter 5.2.

4.4 Descriptive Comparison

Conducting a descriptive comparison is the final part of this study. A descriptive comparison is advisable in the context of this study because the aim is to extract and describe certain key factors, and not to make suggestions for improvements. If the aim would be to make recommendations for improvements, a normative comparison would be advisable (Behdad, Berg, Thurston, & Vance, 2013).

The descriptive comparison is conducted in a cross-country setting, comparing aspects of EPR implementations between Germany and Norway. The aim is to find and clarify the key factors that explain differences in the implementation of EPR systems. Comparing Germany and Norway, these key factors can be found by outlining differences in observations. In this regard, the comparative research method not only allows the analysis of a small number of cases (Lijphart, 1971; Sartori, 1991) but also illustrates similarities and differences (Blank & Burau, 2014). Consequently, a comparison was chosen to extract the sought key factors. The descriptive comparison is anticipated to result in one or more key factors.

To determine whether the comparison follows a Most Similar or Most Different System Design, consideration must be given to the phenomenon under investigation (EPR systems) and the system the phenomenon occurs in (health care systems) (Przeworski & Teune, 1970). According to Anckar (2008), when applying a Most Similar System Design, researchers choose research systems that are as similar as possible. Thus, extraneous variables can be kept constant and research questions exploring "effects of X on Y" can be answered. If the aim of a study is to answer questions such as "what explains Y", as it is the case in this study, a Most Different System Design applies (Anckar, 2008). Here, researchers choose research systems that are different with regards to extraneous variables. In studies using a Most Different System Design, researchers analyze and compare variable interactions within research systems that are as different as possible.

Considering the research question at hand, a Most Different System Design applies because both health care systems differ by means of certain core characteristics, as illustrated in subchapters 2.1.1 and 2.1.2. The German and Norwegian health care systems differ in organization and funding, and can be classified as Bismarck model and Beveridge model health care systems, respectively. The systems differ on a sub-systemic level. EPR systems, on the other hand, can be assumed to be similar because, independently of their geographical implementation, they

have to fulfill the same requirements. In addition, as subchapters 2.2.2 and 2.3.2 noted, private vendors are responsible for the development of EPR systems in both countries.

The previously outlined research methods (scoping review and implementation evaluation) provide the necessary variables and observations to compare the implementation of EPR systems between Germany and Norway. During the descriptive comparison, these variables and country-specific observations are compared by placing the obtained data in a comparison matrix, as presented in Figure 5.

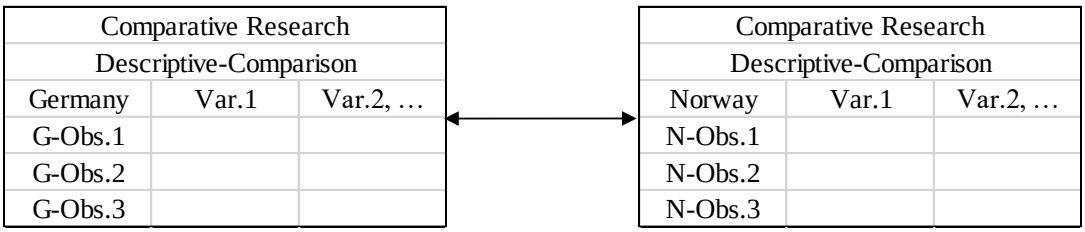


Figure 5: Comparative Research Matrix

By generating a matrix that places country-specific observations in contrast to each other, key factors explaining differences in the implementation of EPR systems in Germany compared to Norway can be extracted. The descriptive comparison results, outlined in chapter 5.3, complete the research part of this study.

4.5 Limits in Methodology

In conducting this research study, certain time and resource constraints are inevitable. Thus, some limitations regarding the methodological approach need to be addressed. Following the structure of chapter 4, this subchapter outlines limitations with regards to the scoping review, the implementation evaluation and the descriptive comparison.

As explained in chapter 4.2, the limited number of search terms limit the scoping review. In addition to the search terms outlined in Table 3, further search terms can be used, including acronyms such as EPR and EHR. Despite the eligibility criteria being kept broad enough to make up for the limited number of search terms, the search results may differ when performing

the review with a wider range of search terms. However, the scoping review outlined in chapter 4.2 aims to review the existing literature in-depth, and obtain meaningful results.

The data obtained from the identified scoping review records are charted by counting frequencies of discussions. This does not say anything about the detail or quality of the assessed discussions. If a research study was to measure the quality and detail, in addition to frequencies, the variables obtained for the implementation evaluation might differ. To minimize this issue and to only extract the most influential variables, a 10 % threshold was set.

Originally, the scoping review framework conceptualized by Arksey & O'Malley (2005) includes a sixth stage, called consultation. This sixth stage is an optional stage that aims to supplement the literature review. By consulting stakeholders with regard to the research question, additional literature can be identified (Levac et al., 2010). Due to time constraints, this study will not give consideration to this optional sixth stage.

As Callen et al (2008) note, the CIM is, like others models, a simplification of reality. The model simplifies a complex situation in order to provide explanations. Thus, the variables obtained using this model might not include all the variables that determine EPR implementations. Additional variables might exist. The aim of this study, however, is to identify the most influential variables. Thus, even if additional variables exist, their influence can be expected to be limited.

Similar to the CIM the PEM, developed by Hulscher et al. (2003), is only a simplification. Additional aspects that influence implementations, but are not observable by applying the model, might exist. However, as stated, the aim of this study is to extract the most influential factors. Thus, even if additional aspects influencing EPR implementations exist, their influence on the final outcome can be expected to be limited.

In terms of the descriptive comparison, limitations concern the Most Different System Design. Comparative studies are confronted with the problem of causal complexity (Anckar, 2008). Causal complexity refers to how it is usually impossible to consider all possible variables and variable combinations that could explain differences. In the context of this study, uncovered underlying factors might influence the implementation of EPR systems.

In putting the methodological approaches into practice, this study aims to be as objective as possible at all times. Despite the fact that it would be advisable to have a second researcher

monitoring and verifying the research process, this study abstains from this due to limited resources. Thus, a certain subjectivity might influence the research.

Similarly, due to time constraints, the study abstains from a triangulation. By obtaining results via additional sources and research methods, e.g. interviews, surveys or real-world observations, triangulations aim to increase the validity of a research study. By abstaining from applying other research methods, this study relies on data obtained from the literature.

By outlining potential limitations, the aim of chapter 4.5 was to enhance reliability and validity. Validity describes the appropriateness of the methods used to obtain meaningful research results (Leung, 2015). In the context of this study, all three methods; the scoping review, the implementation evaluation model and the descriptive comparison, are essential to extract the sought key factors. Combining the three research methods provides important insight into the implementation of EPR systems and thus leads to meaningful research results.

The reliability of a study depends on the consistency and repeatability of the performed research (Leung, 2015). In other words, a study should obtain the same results when applying the same research methods on the same data again. By being transparent in obtaining results, and precisely following the outlined analytical framework, this study aims for a high level of reliability.

The aim of the methodology chapter was to provide the foundation for performing this research study. By outlining three modus operandi; a scoping review, an implementation evaluation and a descriptive comparison, the chapter provided the necessary methods for extracting the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. The results of applying the three outlined research methods are presented in the next chapter. Chapter 5 follows the same structure as the methodology chapter. First, the results of the scoping review are presented followed by an illustration of the implementation evaluation findings. Lastly, the chapter presents the key factors obtained by performing a descriptive comparison.

5 Results

5.1 Scoping Review Results

5.1.1 Identified Literature

The scoping review results were obtained by following the scoping review protocol outlined in chapter 4.2. Relevant studies on the implementation of EPR systems in Germany and Norway were identified by applying the four-stage selection process presented on page 23 (*(3) study selection)*. The eligibility criteria were taken into account at all times. The scoping review was conducted throughout December and January 2017/18. Figure 6 illustrates both process and findings of the scoping review.

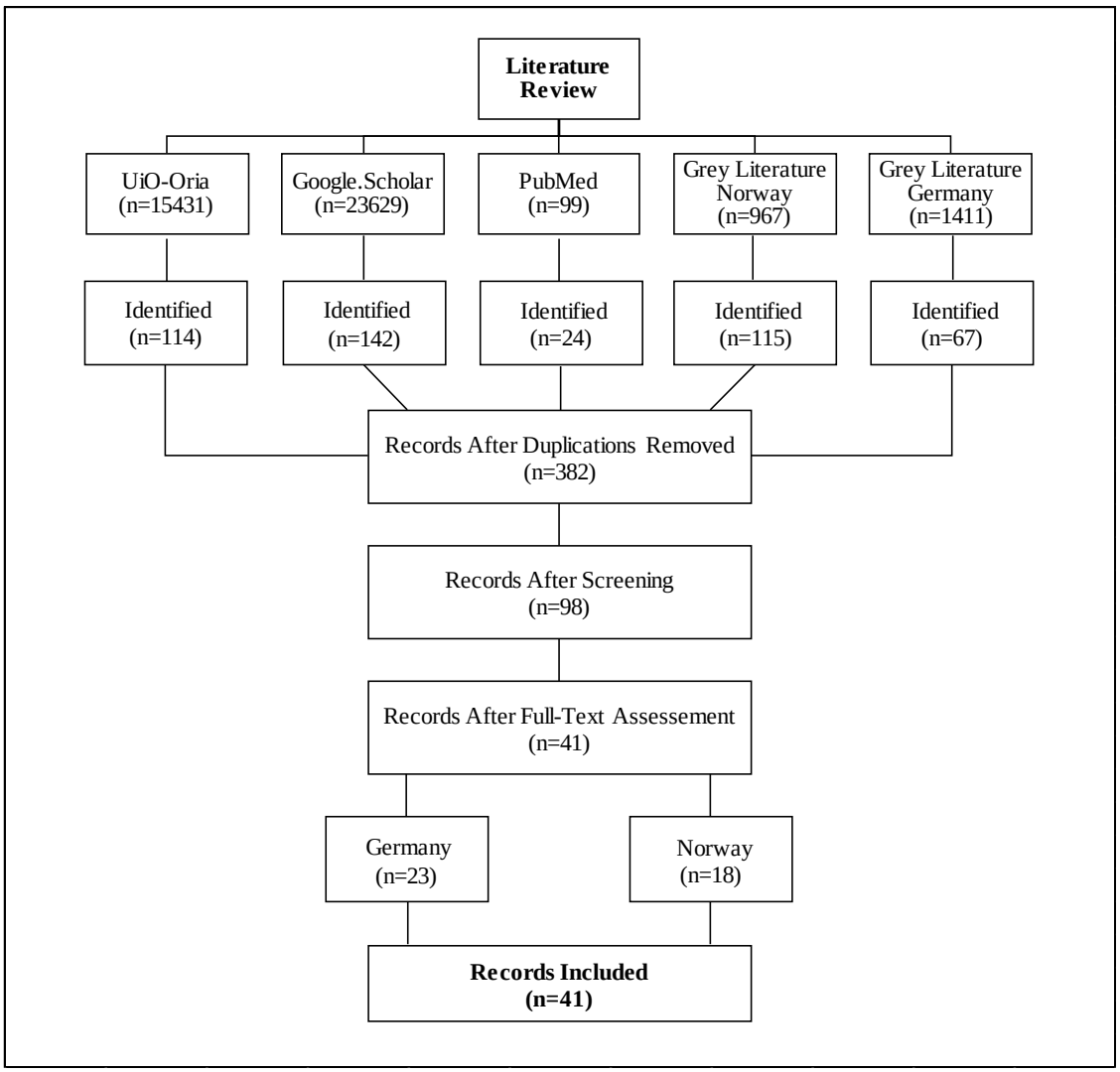


Figure 6: Scoping Review Records

By searching the databases and websites listed on pages 21 and 22 (*(2) Identifying relevant studies*), a large number of search results was obtained. After checking the search result titles and removing duplications, a total of 382 records were extracted. The ensuing screening of abstracts resulted in the exclusion of 284 records. The remaining 98 records were subject to a full-text assessment, after which another 57 records were excluded. Thus, meeting the pre-determined eligibility criteria, a total of 41 records were identified. Of these 41 records, 23 are accounted for by Germany and 18 by Norway. A detailed classification of the further assessed records is outlined in chapter 5.2.

5.1.2 Identified Categories

The content of five primary sources (Daim & Behkami, 2016; Fixsen et al., 2005; Grol, 2013; Peters et al., 2013; Walker et al., 2005) was analyzed in order to extract the categories needed to assess the identified scoping review records. The content assessment of the five primary sources is illustrated in Table 7.

Thereafter, the obtained categories were merged into the categorization-framework outlined on pages 23-25 (*(4) charting the data*). Thus, grouped into internal and external dimensions, a total of 10 final categories could be generated. The final categorization-framework, including a detailed definition of each category, is presented in Table 8.

It has to be noted that the generated categories should not be assumed to be independent from each other. Interdependencies among the categories might exist, for instance between “usability and workflows” and “acceptance/reluctance by clinicians”.

Table 7: Content Assessment of Primary Literature

Primary Literature and Categories	Page No.
Implementing an Electronic Health Record System (Walker et al., 2005)	
Organizational climate, culture, resources	3
Vendor selection, software selection, contract negotiation	15
IT-infrastructure	21
Understanding of current workflows	36
Staff and skill sets	40
Usability of the system	47
Acceptance/reluctance by clinicians	60
System integration (compatibility, standards)	89
Acceptance/reluctance by patients	153

Improving Patient Care: The implementation of change in HC (Grol, 2013)	
Complexity of changing routines and workflows	41
Organizational and practical aspects (infrastructure and funding)	41
Acceptance of change within the organization	41
Innovation (vendors, contracts, functionality)	41
Performance of the innovation, usability	42
Innovation acceptance by target groups (clinical staff and patients)	42-43
System integration (infrastructure, compatibility, standard setting)	44
Healthcare Technology Innovation Adoption: Electronic Health Records and Other Emerging Health Information Technology Innovations (Daim & Behkami, 2016)	
Acceptance/reluctance by clinicians	11
Acceptance/reluctance by patients	13
Role of the government	12
Role of other stakeholders (insurance companies/payers), vendors	13-14
Standards, regulations, IT-infrastructure	15
Routines and workflows	17
Organizational decision making and planning	17
Costs and funding	18
Cyber-security and privacy policy	18
Implementation Research in Health: A Practical Guide (Peters et al., 2013)	
Role of the government (funding, regulations, policy making)	29
Organizational aspects (funding, decision making, integration)	29
Clinical staff (training, acceptance/reluctance)	29
Patients, communities, households (acceptance/reluctance)	29
Other actors (vendors, interest groups)	29
Appropriateness of the innovation, usability	30
Costs and funding	30
Implementation Research: A Synthesis of the Literature (Fixsen et al., 2005)	
Decision making processes	60-62
Skills of the implementation team	60-62
Acceptance/reluctance by clinicians	60-62
Training of staff	60-62
Workflows and changes in routines	60-62
Funding	60-62
Acceptance/reluctance by patients	60-62
Infrastructure	60-62
Stakeholders (government, insurances, vendors, etc.)	60-62

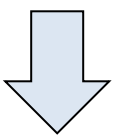


Table 8: Final Categorization-Framework

Categories	Definitions
Internal	
Organizational Dimension	
1. Sufficient Funds and Resources	The availability of sufficient funds and resources to finance an EPR implementation.
2. System Integration	Integration of an EPR system within an organization and its IT-infrastructure, including standardization and compatibility.
3. Decision-Making and Planning	Efficient organizational decision-making and the strategic planning of EPR implementations.
Clinical Unit Dimension	
4. Usability and Workflows	Does the EPR system meet the clinical needs? Does the implementation interrupt workflows and routines?
5. Skills and Training	Is the staff adequately prepared to handle the implementation of an EPR system?
Individual Dimension	
6. Acceptance/Reluctance by Clinicians	Clinicians' acceptance or reluctance towards change, innovations and technological progress.
7. Acceptance/Reluctance by Patients	Patients' acceptance or reluctance towards change, innovations and technological progress.
External	
8. Vendors/IT-Industry/Contracts	System development and implementation by vendors. Negotiations of contracts. Understanding of clinical work processes by software developers and IT-industry.
9. Government and Data Protection	Role of the government in making legislations and building up government institutions for the implementation of EPRs. Data Protection regulations and laws.
10. Other Stakeholders	The influence of other stakeholders, e.g. insurance companies and associations.

The final categorization-framework provided the necessary tool to assess and chart the content of the 41 identified records outlined in subchapter 5.1.1. By measuring how often the 10 categories were discussed in the literature, the study extracted the variables needed for both the implementation evaluation and the descriptive comparison. The data charting outcome and the obtained variables are presented in the next subchapter.

5.1.3 Obtained Variables

The 41 identified scoping review records were charted by measuring the frequencies of how often the 10 categories were discussed. A list of the 41 records and the corresponding categorization, indicated by category numbers, can be found in the appendix on page 65. The variables needed for both the implementation evaluation and the descriptive comparison were obtained by following the methods outlined on pages 23-25 (*(4) charting the data*).

In a first step, the frequencies of how often certain categories were discussed in the literature were measured for both Germany and Norway separately. To account for differences in the number of frequencies and records, the frequencies were converted into percentage rates. The results are presented in Tables 9 and 10, for Germany and Norway respectively.

In a second step, the differences in percentages were measured in order to visualize where differences in frequencies of discussions are biggest. The categories containing the biggest differences were found to be the variables that are analyzed in the implementation evaluation. Table 11 illustrates the findings. To extract the variables from the categorization-framework, a 10% threshold was set.

Table 9: Frequencies of Discussions – Germany

Germany	Frequency	Percent
Internal		
Organizational Dimension		
1. Sufficient Funds and Resources	6	**10.7%**
2. System Integration	13	**23.2%**
3. Decision-Making and Planning	1	1.8%
Clinical Unit Dimension		
4. Usability and Workflows	2	3.6%
5. Skills and Training	1	1.8%
Individual Dimension		
6. Acceptance/Reluctance by Clinicians	10	**17.9%**
7. Acceptance/Reluctance by Patients	7	**12.5%**
External		
8. Vendors/IT-Industry/Contracts	3	5.4%
9. Government and Data Protection	9	**16.1%**
10. Other Stakeholders	4	7.1%

Regarding the 23 records referring to EPR implementations in Germany, the assessment found that the five most frequently discussed categories are: (1) Sufficient Funds and Resources; (2) System Integration; (6) Acceptance/Reluctance by Clinicians; (7) Acceptance/Reluctance by Patients; and (9) Government and Data Protection.

Table 10: Frequencies of Discussions – Norway

Norway	Frequency	Percent
Internal		
Organizational Dimension		
1. Sufficient Funds and Resources	2	5.0%
2. System Integration	9	**22.5%**
3. Decision-Making and Planning	1	2.5%
Clinical Unit Dimension		
4. Usability and Workflows	13	**32.5%**
5. Skills and Training	0	0.0%
Individual Dimension		
6. Acceptance/Reluctance by Clinicians	9	**22.5%**
7. Acceptance/Reluctance by Patients	1	2.5%
External		
8. Vendors/IT-Industry/Contracts	4	**10.0%**
9. Government and Data Protection	1	2.5%
10. Other Stakeholders	0	0.0%

Regarding Norway, the assessment of the 18 identified records found that the four most frequently discussed categories are: (2) System Integration; (4) Usability and Workflows; (6) Acceptance/Reluctance by Clinicians; and (8) Vendors/IT-Industry/Contracts.

Having assessed the identified records, it appears that the literature on EPR implementation emphasis different aspects in Germany compared to Norway. Whereas both (2) System Integration and (6) Acceptance/Reluctance by Clinicians are frequently discussed in both countries, frequencies of discussions regarding (1) Sufficient Funds and Resources, (4) Usability and Workflows, (7) Acceptance/Reluctance by Patients, (8) Vendors/IT-Industry/Contracts, and (9) Government and Data Protection are dissenting. But which of these categories account for the biggest differences? By measuring the exact differences, Table 11 presents the variables that are further assessed during the implementation evaluation.

Table 11: Differences in Frequencies of Discussions

Germany and Norway	Differences
Internal	
Organizational Dimension	
1. Sufficient Funds and Resources	5.7%
2. System Integration	0.7%
3. Decision-Making and Planning	0.7%
Clinical Unit Dimension	
4. Usability and Workflows	**28.9%**
5. Skills and Training	1.8%
Individual Dimension	
6. Acceptance/Reluctance by Clinicians	4.6%
7. Acceptance/Reluctance by Patients	**10.0%**
External	
8. Vendors/IT-Industry/Contracts	4.6%
9. Government and Data Protection	**13.6%**
10. Other Stakeholders	7.1%

As Table 11 shows, differences in frequencies are biggest for the categories (4) Usability and Workflows, (7) Acceptance/Reluctance by Patients, and (9) Government and Data Protection. All three are above the 10% threshold and thus represent the variables that are evaluated during the implementation evaluation.

Having obtained the variables needed for both the implementation evaluation and the descriptive comparison, the first step in finding the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway was completed. The next step was to obtain country-specific observations.

5.2 Implementation Evaluation Results

The results of the implementation evaluation were obtained by assessing the content of the 41 identified studies along the three extracted variables. The assessment was performed by applying the implementation evaluation model outlined in chapter 4.3. The aim was to extract country-specific observations for each variable.

The implementation evaluation result chapter is divided into three subchapters, reflecting on the three obtained variables (Usability and Workflows, Acceptance/Reluctance by Patients, and

Government and Data Protection). Each subchapter has the same structure, opening with a brief presentation of the assessed scoping review records. Thereafter, country-specific observations were extracted by means of an assessment of the variables with regard to EPR implementations. As outlined in chapter 4.3, this assessment is structured into three stages: describing the nature of a variable; assessing exposure; and evaluating experiences.

5.2.1 Usability and Workflows

A total of 15 out of the 41 identified scoping review records discussed the interplay of the "usability and workflows" variable and EPR implementations. Of the 15 records, two refer to Germany and 13 to Norway. Table 12 outlines all 15 records, sorted by research types.

Table 12: Identified Records – Usability and Workflows

Research Type	Quantity	Sources
Germany		
Qualitative	1	(Grüner et al., 2008)
Quantitative	1	(Alnawaiseh et al., 2015)
Norway		
Qualitative	7	(Boulus, 2004; Boulus & Bjorn, 2010; Ellingsen, 2003; Ellingsen, Christensen, & Silsand, 2014; Ellingsen & Monteiro, 2008; Grisot & Vassilakopoulou, 2013; Mikkelsen & Aasly, 2001)
Quantitative	3	(Christensen, Faxvaag, Lærum, & Grimsmo, 2009; Heimly, Grimsmo, & Faxvaag, 2011; Lium & Faxvaag, 2006)
Mixed-methods	2	(Christensen & Grimsmo, 2008a, 2008b)
Report	1	(Bergland & Andresen, 2014)

The 13 studies referring to Norway evaluated EPR system implementations in all three settings, hospitals, doctor offices and nursing homes, whereby hospitals accounted for the majority of evaluations. The two studies referring to Germany, analyzed EPR implementations in hospitals. Theoretically, the studies were embedded in the classic theories on computer-supported cooperative work and information systems outlined in chapter 3.2.

Having obtained an overview over the relevant literature, country-specific observations regarding the "usability and workflow" variable could be extracted. The observations were obtained by following the description-exposure-experience structure outlined in chapter 4.3.

(1) Description

The "usability and workflows" variable can be divided into two aspects. Whereby usability refers to an EPR systems well-arranged and self-explanatory software design, workflows refer to EPR system related changes in routines and work processes (Walker et al., 2005). Having assessed the literature with regard to these two aspects, the following observations were obtained.

Table 13: Variable Description – Usability and Workflows

Country	Description	Sources
Germany and Norway	Usability: health service providers deploy EPR systems developed by private vendors in the free market Workflows: clinical workflows evolve around the diagnoses, treatment, care and cure of patients and are often highly specialized	(Alnawaiseh et al., 2015; Boulus, 2004; Ellingsen, 2003; Grüner et al., 2008)

(2) Exposure and (3) Experiences

The obtained observations regarding exposure and experiences are presented in Tables 14 and 15 for Germany and Norway respectively.

Table 14: Exposure and Experiences – Usability and Workflows in Germany

Exposure	Experiences	Sources
• sufficient time and guidance to adopt to a new EPR system	To minimize the disturbance of workflows, clinicians had to take part in training and preparation sessions. This was seen positively by clinicians but claimed certain resources and time. During the adoption phase disturbances in workflows were experienced, time and guidance were required in adopting to the new system.	(Alnawaiseh et al., 2015; Grüner et al., 2008)
• usability, system complexity and operability	To ensure usability, EPR systems need to meet the needs of its users, reflecting specific processes and work patterns. To arrange for high usability was cost and time intensive.	(Alnawaiseh et al., 2015; Grüner et al., 2008)
• software updates and lack in system features	Clinicians noted that certain clinic-specific features were missing. When a new software update was installed, information got lost and the system slowed down. Before the reinstallation of the old version, workflows were affected negatively.	(Alnawaiseh et al., 2015; Grüner et al., 2008)
• parallel use of more than one record system	To work in parallel systems was found to be critical and to complicate work-processes. Clinicians experienced using two systems simultaneously challenging.	(Alnawaiseh et al., 2015; Grüner et al., 2008)

Table 15: Exposure and Experiences – Usability and Workflows in Norway

Exposure	Experiences	Sources
• sufficient time and guidance to adopt to a new EPR system	Sufficient time and training to adopt to a new systems was found to be important.	(Boulus & Bjorn, 2010; Grisot & Vassilakopoulou, 2013)
• usability, system complexity and operability	Clinicians were concerned about the operability and complexity of EPR systems. Inadequate usability led to dissatisfaction with vendors. Systems were found to be challenging to use (many klicks necessary to get information, data stored in different places, danger to overlook information). Systems did not equally meet the needs of all involved professions. Complexity led to additional paper use, which is counterproductive to a digitalization of work-processes.	(Bergland & Andresen, 2014; Christensen et al., 2009; Christensen & Grimsmo, 2008a, 2008b; Ellingsen et al., 2014; Heimly et al., 2011; Lium & Faxvaag, 2006)
• software updates and lack in system features	Clinicians missed certain functions and features. For example, clear structured overviews over patient health histories, features to support work coordination and tools to discuss patient issues with other professionals. In addition, clinicians requested decision support features to enhance workflows.	(Christensen & Grimsmo, 2008a; Lium & Faxvaag, 2006; Boulus, 2004; Ellingsen et al., 2014)
• parallel use of more than one record system	Using parallel systems is not desirable. Clinicians spent valuable time operating in parallel systems. Work processes became more complicated and led to disturbances in workflows. Clinicians were, for instance, confronted with several versions of the same record and had to use several passwords. The use of both paper and electronic patient records complicated the adoption of EPR systems. But ad hoc transitions are seen critical as well, they can lead to severe disturbances in workflows.	(Boulus, 2004; Ellingsen & Monteiro, 2008; Lium & Faxvaag, 2006; Mikkelsen & Aasly, 2001)
• effects on traditional hierarchies and clinical relationships	EPR system implementations were found to blur traditional boundaries between clinical workforce groups. EPR system implementations postulate a certain willingness to cooperate and change previous work routines, including shifts in tasks among physicians, nurses and secretaries. Administrative work was shifted from secretaries to physicians. Thus, physicians were less dependent on others, but concerns about too much administrative work arose. In addition, concerns might arise when EPR systems are used by clinical leaders to control and influence the behavior of physicians.	(Boulus, 2004; Boulus & Bjorn, 2010; Christensen & Grimsmo, 2008b; Ellingsen, 2003)

5.2.2 Acceptance/Reluctance by Patients

Seven studies and one expertise discussed issues regarding the "acceptance/reluctance by patients" variable. Table 16 illustrates the identified records, grouped into research types.

Table 16: Identified Records – Acceptance/Reluctance by Patients

Research Type	Quantity	Sources
Germany		
Qualitative	4	(Deutsch, Duftschmid, & Dorda, 2010; Eckrich, Baudendistel, Ose, & Winkler, 2016; Hoerbst, Kohl, Knaup, & Ammenwerth, 2010; Richter et al., 2010)
Quantitative	1	(Duennebeil, Sunyaev, Leimeister, & Kremar, 2010)
Mixed-methods	1	(Rauer, 2012)
Expertise	1	(Haas, 2017)
Norway		
Mixed-methods	1	(Sørensen & Johansen, 2016)

Methodological the majority of the identified studies is based on interviews and surveys, except three records (Deutsch et al., 2010; Eckrich et al., 2016; Haas, 2017), which are based on document analyses.

(1) Description

The variable "acceptance/reluctance by patients" includes both patients' attitudes towards EPR implementations (Hoerbst et al., 2010; Richter et al., 2010) and patients' behavior in using and operating EPR systems (Duennebeil et al., 2010; Sørensen & Johansen, 2016).

Table 17: Variable Description – Acceptance/Reluctance by Patients

Country	Description	Sources
Germany	Project specific access to EPRs Attitudes: positive attitude but concerns about reliability and privacy of digital information are common Behavior: concerns about digital divide in society, degree of use of EPRs depends on age and education	(Hoerbst et al., 2010; Richter et al., 2010)
Norway	Widespread access to EPRs Attitudes: positive attitude, high willingness to use e-health services Behavior: good understanding of the content, some challenges with operating the systems	(Sørensen & Johansen, 2016)

(2) Exposure and (3) Experiences

Table 18: Exposure and Experiences – Acceptance/Reluctance by Patients in Germany

Exposure	Experiences	Sources
• knowledge about and familiarity with EPR systems	Patient education and the communication of knowledge and skills to operate EPR systems can improve patients' attitudes. Important to address the question of responsibility for patient education. Are health insurances, physicians, patient associations, public health authorities responsible?	(Duennebeil et al., 2010; Hoerbst et al., 2010; Rauer, 2012)
• trust in the system, societal acceptance of EPRs	Trust in EPR systems is important for patients' acceptance. Trust can be improved by involving patients early on in use and storage of information, by establishing an independent control organization that regulates use and storage of health data and by illustrating benefits and advantages of EPR systems. Concerns about privacy and cyber security as well as confidence in the internet use should be addressed when implementing EPR systems.	(Deutsch et al., 2010; Duennebeil et al., 2010; Haas, 2017; Hoerbst et al., 2010; Rauer, 2012; Richter et al., 2010)
• EPRs influence on patient-clinican relationships	EPRs can improve patients' understanding of their health situations and thus improve compliance during treatments and utilizations of doctor visits. Effects on patient-clinician relationships can be positive but confusion in regard to medical terms stated in EPR systems can lead to additional questions of patients to clinicians. Patients might not want clinicians to see their whole health history.	(Eckrich et al., 2016; Rauer, 2012)
• ownership of data, principals of self-determination and patient autonomy	Weighing the benefits of information storage against autonomy over own data. Principles of self-determination and right to information in regard to what information is stored and who is allowed to access it influences acceptance.	(Haas, 2017)

Table 19: Exposure and Experiences – Acceptance/Reluctance by Patients in Norway

Exposure	Experiences	Sources
• knowledge about and trust in EPR systems	Positive attitude towards the system, but some problems with understanding medical terms. The system interface should be based on patients' requirements and needs. Secure IT-infrastructure is a precondition for high acceptance.	(Sørensen & Johansen, 2016)
• timing and pace of EPR implementation	Consideration should be given to a step-by-step approach in implementing patient access to EPR systems. Timing is important to give patients enough time to adopt to the system.	(Sørensen & Johansen, 2016)

5.2.3 Government and Data Protection

A total of 10 out of the 41 identified records discussed EPR implementation issues with regard to the "government and data protection" variable. Table 20 illustrates the identified records, sorted by research types.

Table 20: Identified Records – Government and Data Protection

Research Type	Quantity	Sources
Germany		
Qualitative	2	(Deutsch et al., 2010; van der Haak et al., 2003)
Quantitative	1	(Gand, Richter, & Esswein, 2015)
Mixed-methods	1	(Bergmann, Bott, Pretschner, & Haux, 2007)
Discussion-Papers	4	(Berhanu & Mühlbacher, 2003; Caumanns, 2013; Hornung, Goetz, & Goldschmidt, 2005; Krüger-Brand & Osterloh, 2017)
Expertise	1	(Haas, 2017)
Norway		
Qualitative	1	(Ellingsen et al., 2014)

(1) Description:

The variable "government and data protection" can be divided into two parts. The government part refers to the role of the government in organizing and administrating the implementation of EPR systems. The data protection part refers to the complexity and diversity of data protection laws.

Table 21: Variable Description – Government and Data Protection

Country	Description	Sources
Germany	Government: The gematik was established to create a nationwide IT-infrastructure for the health care sector. Data protection: Several laws regulate e-health services, including confidentiality laws (§ 203 StGB and BVerfG 32, 373), diverse federal and local data protection laws, Telemediengesetz, Telekommunikationsgesetz, GKV-Modernisierungsgesetz, E-Health-Gesetz and several laws within the Sozialgesetzbuch (SGB V).	(Haas, 2017)
Norway	Government: Early establishment of government structures, including KITH, Norsk Helsenett and Direktoratet for e-helse. Several national strategy-plans to create the precondition for implementing EPRs. Data protection: Separate laws to regulate e-health services, including Pasientjournalloven, Helseregisterloven, Helsepersonelloven and Pasient- og Brukerrettighetsloven.	(Ellingsen et al., 2014; Helse- og omsorgsdepartementet, 2001a, 2001b, 2015a, 2015b)

(2) Exposure and (3) Experiences

Table 22: Exposure and Experiences – Government and Data Protection in Germany

Exposure	Experiences	Sources
• complexity and diversity of laws regulating EPRs	High complexity and diversity within the legal framework regulating EPR implementations. Several laws and regulations are of relevance (Table 20). Germany has strong data protection laws, including regulations on e-consent, authentication and cross-institutional data transfers. The high complexity and diversity of laws interfered with EPR system implementations, it led to uncertainties about legal implications of certain EPR features, hampered cross-institutional data transfers and complicated vendors' development of EPR systems.	(Bergmann et al., 2007; Berhanu & Mühlbacher, 2003; Caumanns, 2013; Hornung et al., 2005; van der Haak et al., 2003)
• smooth political decision-making, clear national strategy, clear schedule and framework	Political decision-making in regard to EPR implementations claimed a lot of time. The complexity was underestimated and difficulties in creating an efficient decision-making structure and assigning responsibilities arose. Certain uncertainties about whether the timeline regarding the e-health law schedule can be kept exist, including implementation problems with the health chip cards.	(Deutsch et al., 2010; Krüger-Brand & Osterloh, 2017)
• predefined governance structures, clear allocation of responsibilities	The large population, diverse stakeholders within the health care sector and certain difficulties in organizing national e-health developments interfered with smooth EPR system implementations. A special organization with clear defined responsibilities to implement EPRs is missing.	(Gand et al., 2015; Haas, 2017)

Table 23: Exposure and Experiences – Government and Data Protection in Norway

Exposure	Experiences	Sources
• predefined governance structures, clear allocation of responsibilities	Clear defined responsibilities and an overall strategy in standard setting, coding and design of terminology are supporting EPR implementations. Large consensus among the involved stakeholders is necessary.	(Ellingsen et al., 2014)

After having obtained country-specific observations for all three variables, the next step in answering the research question was to perform a descriptive comparison. The results are presented in the next subchapter.

5.3 Descriptive Comparison Results

The descriptive comparison was performed after filling in the comparative research matrix (Figure 5) with the variables and observations outlined in chapters 5.1 and 5.2. By filling in the matrix with the country-specific observations, the key factors explaining differences in the implementation of EPR systems in Germany compared to Norway could be obtained. Figure 7 illustrates the comparison schema. The findings are outlined below.

Germany	**Var. 1[1]**	**Var. 2[2]**	**Var. 3[3]**		**Var. 3[3]**	**Var. 2[2]**	**Var. 1[1]**	**Norway**
Description	Table 13	Table 17	Table 21		Table 21	Table 17	Table 13	**Description**
Exposure & Experiences	Table 14	Table 18	Table 22		Table 23	Table 19	Table 15	**Exposure & Experiences**

[1]Usability and Workflows, [2]Acceptance/Reluctance by Patients, [3]Government and Data Protection

Figure 7: Final Comparison Matrix

As the obtained observations show, issues related to the "usability and workflow" variable were more extensively discussed in Norway than in Germany. Noted issues were the usability of EPR systems, missing system features, the parallel use of more than one record system, and changes in traditional hierarchies and clinical relationships. Ellingsen (2003) noted that *"it is obvious that the traditional hierarchy and the authoritative physician's role are challenged"* (p.50) when implementing EPR systems in hospitals. Boulus (2004) concluded that an exact customization of EPR systems is crucial in order to meet clinical operating conditions.

However, the comparison gave no indication that the "usability and workflow" variable explains any noticeable differences in the implementation of EPR systems in Germany compared to Norway. Differences in the assessed discussions might be a consequence of the more advanced diffusion of EPR systems in Norway. As outlined in chapters 2.2 and 2.3, Norway has a longer history of using EPRs nationwide. It can be argued that this provides a broader basis for research on usability and workflows. In comparison, Germany has not yet implemented EPR systems nationwide. Thus, the country has a smaller basis for related research on usability and workflows.

Comparing the observations obtained for the "acceptance/reluctance by patients" variable, it is noticeable that patients' concerns about EPRs are discussed in greater detail in Germany than

in Norway. In conducting 293 interviews to assess the attitude of German citizens towards EPR systems, Hoerbst et al. (2010) noted that many participants expressed data privacy concerns. Confidence in EPR systems is a second issue that was broadly discussed in the German related literature. After interviewing 153 German outpatients on their attitude towards EPR systems, Richter et al. (2010) concluded: *"Unchanged low confidence rates in the internet and in the reliability of medical information derived from the internet should sound a note of caution regarding the implementation of such services"* (p.261). In contrast, by surveying Norwegian patients to assess their attitude towards using the internet for health purposes, Sørensen and Johansen (2016) found that patients are familiar with using e-health services and that they have a positive attitude towards the introduction of more such services.

In assessing the attitude of patients towards EPRs, it is notable that research studies in Germany tend to connect the acceptance of EPR systems with societal reservations towards digitalization (Richter et al., 2010). Societal acceptance of information technology was portrayed as being key to successful implementation of EPR systems (Haas, 2017). Considering the difference in patients' attitudes towards EPR systems between Germany and Norway, and the discussion of societal reservations towards digitalization in Germany, the strength of societal and patient's reservations towards EPRs was found to be the first key factor in explaining differences in the implementation of EPRs.

In comparing the observations obtained for the "government and data protection" variable, country-specific differences in the nature of the variable became visible. As outlined in Table 21, as well as in chapter 2, the role of the government differs in Germany compared to Norway. Furthermore, due to country-specific legislations, differences in legal frameworks surrounding EPRs could be observed.

The obtained observations suggest that efficiency and pace in political decision-making are important factors to the successful implementation of EPR systems. Deutsch et al. (2010), for instance, concluded that excessive time taken in decision-making, and an underestimation of complexity, interfered with an earlier implementation of EPR systems in Germany. The difference in pace of EPR implementations between the two countries, outlined in chapter 2, supports these findings.

Similarly, when considering the historic developments in the implementation of EPR systems in both countries, it is noteworthy that the number of launched strategy plans differ. Historically,

as chapter 2 outlined, the responsible authorities in Norway developed such plans continuously. In contrast, no periodic launch of strategy plans was pursued in Germany. Being aware of today's situation of EPR implementations in Germany, Hass (2017) argues for the development of a comprehensive strategy to implement EPRs nationwide.

In their study on an EPR system in Norway, Ellingsen et al. (2014) note that a clearly defined governance structure can contribute to an efficient implementation of such systems. Comparing the existing governance structures in Germany with the ones in Norway, it appears that both countries have their own organization responsible for designing and administrating the respective nationwide health net (Norsk Helsenett and the German gematik). Moreover, an additional public organization (Direktoratet for e-helse) to administrate developments in e-health can be found in Norway. Such a separate organization does not exist in Germany. The obtained observations suggest that this is one reason why EPR systems are more widespread in Norway than in Germany.

A comparison of the observations showed that due to national legislations, differences in the country-specific legal frameworks surrounding EPRs exist. As listed in Table 21, laws that apply to EPR system implementations appear to be more diverse and spread over more legal texts in Germany compared to Norway. Caumanns (2013) supports this observation, concluding that a high diversity and complexity of laws and regulations surrounding EPRs interfered with the smooth implementation of EPR systems in Germany. Similarly, van der Haak et al. (2003) noted that Germany's *"complex legal framework […] has a considerable influence on the development and implementation of cross-institutional EPRs"* (p. 128).

The comparison of country-specific observations under the "government and data protection" variable revealed the far-reaching influence this variable has on EPR implementations. A total of four key factors could be derived: efficiency and pace in political decision-making; a clear national strategy and strategy plans; clear governance structures and allocation of responsibilities; and the complexity and diversity of laws and regulations.

The results, outlined in chapters 5.1 and 5.2, showed that the factors influencing EPR implementations in Germany and Norway are manifold. To find out which of these factors are the most influential, it was necessary to further narrow down the obtained results. For this reason, a comparison was performed, providing the final results of this research study. The obtained

key factors that explain differences in the implementation of EPR systems in Germany, compared to Norway, are presented in Table 24.

Table 24: Key Factors

Key factors to explain differences in the implementation of Electronic Patient Record systems in Germany compared to Norway:
(1) strength of societal and patients' reservations towards EPRs
(2) efficiency and pace in political decision-making
(3) clear national strategy, including strategy plans
(4) clear governance structures, including a clear allocation of responsibilities
(5) complexity and diversity of laws and regulations

Chapter 5 comprehensively outlined the results of this research study. The literature was systematically searched to identify relevant studies and articles on EPR implementations in Germany and Norway. A total of 41 records could be obtained. Thereafter, the identified records were charted according to the developed categorization-framework. Three variables then emerged: "usability and workflows"; "acceptance/reluctance by patients"; and "government and data protection". In the next step, these variables were more closely assessed using the derived implementation evaluation model. By assessing the content of the identified scoping review records, several country-specific observations could be obtained. Thereafter, the observations were compared using a comparison matrix. Thus, the outlined key factors explaining differences in the implementation of EPR systems in Germany compared to Norway could be obtained.

The next chapter, chapter 6, serves as a discussion chapter reflecting on the performed research. First, the chapter briefly recalls the objectives of this study. The aim was to identify the key factors explaining differences in the implementation of EPR systems in Germany compared to Norway. Thus, the study aimed to add to the existing knowledge of EPR system implementations in Germany and Norway, as well as contribute to implementation research in a broader perspective. This is followed by a discussion of the main findings. A discussion of the limitations of this study and recommendations for further research complete chapter 6.

6 Discussion

6.1 Study Objectives

This research study aimed to identify the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. As outlined in the introduction, this objective originated from observing differences in the pace of implementation and degree of diffusion of EPR systems. The main purpose of this study was to explore and explain this phenomenon.

To explore this phenomenon, the study started with a systematic review of the literature. The performed scoping review aimed to obtain relevant literature on EPR implementations. Furthermore, the scoping review had the purpose to identify the variables needed for both the implementation evaluation and the descriptive comparison. To obtain these variables, a categorization-framework was developed and then filled with categories obtained by means of assessing primary literature. The identified scoping review records were subsequently assessed along this framework. This was done for each country separately, providing the basis for measuring differences in discussions within the literature. The categories accounting for the biggest differences were found to be the variables containing the key factors.

In order to extract the key factors embedded in the identified variables, the research proceeded with an assessment of the scoping review records. The records were assessed by applying the developed implementation evaluation model. By structurally extracting data from the literature, several country-specific observations could be obtained.

The last step in extracting these key factors was to compare the country-specific observations with regards to the respective variables. The descriptive comparison was anticipated to result in one or more key factors, and the obtained key factors were anticipated to provide a starting point for further research. The obtained key factors, and the implications for implementation research, are discussed in the next subchapters.

6.2 Main Findings

6.2.1 Key Factors

The findings of this study indicate that differences in the implementation of EPR systems in Germany compared to Norway are mainly a result of five key factors. The literature suggests that these key factors are as follows: (1) the degree of reservation towards EPR systems from both society and from patients; (2) the efficiency and pace in political decision-making; (3) the presence of a clear national strategy; (4) the presence of clear governance structures; and (5) the complexity and diversity of laws and regulations.

Four out of five of the key factors are a part of the "government and data protection" variable. This indicates that both the role of the government and national legislations have a relatively strong influence on the implementation of EPR systems. The literature suggests that political and institutional settings matter in EPR system implementations. Political and institutional aspects should be evaluated critically before implementing EPR systems. The "acceptance/reluctance by patients" variable accounts for one key factor, whereas no key factor could be found for the "usability and workflow" variable. Table 25 lists the key factors, and indicates differences between the two countries.

Table 25: Key Factors – Country-Specific

	Germany		**Norway**
(1)	societal and patients' reservations	>	societal and patients' reservations
(2)	efficiency and pace in political decision-making	<	efficiency and pace in political decision-making
(3)	clear national strategy	<	clear national strategy
(4)	clear governance structures	<	clear governance structures
(5)	complexity and diversity of laws and regulations	>	complexity and diversity of laws and regulations
	A nationwide implementation of EPR systems has not yet been achieved.	*(explains differences)*[1]	EPR systems have been implemented nationwide.

[1](higher/stronger > lower)

As noted, the "acceptance/reluctance by patients" variable accounts for one key factor. The literature indicates that reservations from society and from patients towards EPRs are more

influential in Germany than in Norway. Literature in Germany more broadly discussed concerns about data privacy, lawful usage of private information and cyber-security (Hoerbst et al., 2010; Richter et al., 2010). This indicates that societal reservations were, at least in the past, stronger in Germany than in Norway. However, as a recent study on the attitudes of German citizens towards digitalization indicates (DIVSI, 2017), the influence of societal reservations towards EPR implementations might be less strong today. The study notes that fast-paced digital development in all areas of society continually influences societal attitudes towards digitalization. Thus, reservations towards EPR system implementations might further decrease in the future.

The identified literature on efficiency and pace of political decision-making suggests that both excessive time taken to make decisions, and an underestimation of complexity, interfered with the smooth implementation of EPRs in Germany (Deutsch et al., 2010). Differences in the pace of implementation and the degree of diffusion, as outlined in chapters 2.2 and 2.3, support this assessment. Reasons for a more cautious decision-making in Germany compared to Norway can be manifold. The literature mentioned insufficient political commitment as one reason (Deutsch et al., 2010). Other possible reasons are the influence of various stakeholders, missing governance structures, conflicting interests within a complex health care system, or resource constraints.

Besides political decision-making, the literature indicates that a clear national strategy is an additional key factor in the implementation of EPR systems. Historically, it is noticeable that there were more strategy plans initiated in Norway than compared to Germany. Subchapters 2.2.1 and 2.3.1 outlined the previously launched strategy plans for Germany and Norway respectively. As the literature indicates, a clear strategy with a precise formulation of implementation goals, schedules and interim stages can provide important orientation for stakeholders (Ellingsen et al., 2014; Haas, 2017). A clear strategy can give all stakeholders, including associations, insurance funds and vendors, a long-term planning horizon and thus safety in the development and implementation of EPR systems.

In its World Health Report of 2000, the World Health Organization broadly outlined the importance of well-designed governance structures in health care. The WHO argued that governments have the responsibility to provide stewardship in creating well-performing health care systems (WHO, 2000). Comparing EPR-related governance structures between Germany and Norway, the literature reveals significant differences (Ellingsen et al., 2014; Haas, 2017). The absence of a specialized organization responsible for e-health and EPR implementations is, as

Haas (2017) argues, a main barrier in the implementation of EPR systems in Germany. A specialized organization could set standards to promote system interoperability and cross-institutional communication, provide funding, and administrate EPR implementations. Haas thus recommends a revision of the existing governance structures in Germany.

The fourth key factor derived from the "government and data protection" variable is the complexity and diversity of laws and regulations. The literature indicates that laws and regulations concerning EPR systems are more diverse, and spread over more legal texts in Germany than in Norway (Caumanns, 2013; van der Haak et al., 2003). The observations indicated that a clearer legal framework could provide a higher degree of certainty for all actors having a stake in EPR system implementations. It can be argued that stakeholders profit from a clearer legal framework because precise legislations provide the necessary safety and legal protection in the development and implementation of EPR systems.

In addressing the delayed implementation of EPR systems in Germany compared to Norway, the findings of this study suggest that the nationwide implementation of EPR systems in Germany could particularly profit from re-thinking the role of government. Creating a clearer legal framework that supports the establishment of a comprehensive strategy, and clear governance structures, could noticeably influence and accelerate the implementation of EPR systems. High standards in decision-making, and societal and patients' concerns, should be addressed at all times in order to improve efficiency and to establish a positive attitude towards EPR systems. This study argues that addressing these issues could noticeably benefit EPR implementations in Germany, so that a nationwide implementation can soon be achieved.

6.2.2 Contribution to Implementation Research

As outlined in both the introduction and chapter 3, implementation research aims to enhance the understanding of implementation processes and outcomes and provides a framework to detect the strengths and weaknesses of implementations (Fixsen et al., 2005; Nilsen, 2015). By developing a research structure to extract the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway, this research study addressed these objectives. The developed analytical framework can be used to enhance the understanding of implementations. Strengths and weaknesses of EPR implementations can be explained by

means of the obtained key factors. The comparison showed that barriers to implementation include high reservations towards EPRs, inefficient decision-making, deficiencies in setting a strategy, unclear governance structures and a high complexity of laws and regulations.

This study proved that by applying the developed research structure, as outlined in the analytical framework, knowledge about implementations can be increased. Thus, this study argues that the presented analytical framework is a notable contribution to implementation research. As the study at hand showed, analyzing implementations with the outlined structure can generate meaningful results. Beyond EPR implementations, the analytical framework could be modified in order to be applicable for other implementations. The structure could be used to compare, and thus assess, the implementation of other communication and information technologies.

Considering the technological progress in health care, it can be expected that implementations of electronic services become even more important in the future. The developed analytical framework can be used to gain an understanding of the implied implementation processes. By providing a structure for the assessment of such implementations, potential weaknesses can be detected. Obtaining key factors to implementations can help to detect the main issues, and thus give a starting point for improving implementations.

It would be interesting to find out if the same key factors, as the ones obtained in this study, could explain differences in the implementation of EPR systems when comparing other countries. This can be assessed by setting the research findings in a broader perspective. If issues regarding the role of the government are a common factor, health care authorities worldwide could pay special attention to this aspect. Further research, as outlined in chapter 6.4, can contribute to a more general application of the obtained research findings.

6.3 Limitations

The research field of e-health, especially the digitalization of patient record systems, is of increasing importance in modernizing health care systems. Researching related aspects therefore give this study a high degree of relevance. By outlining all research steps and underpinnings in

detail, the study furthermore aimed to obtain a high level of credibility, repeatability and transferability. To strengthen the validity of this study further, this chapter will acknowledge important limitations.

As chapter 4.5 (limits in methodology) outlined, the literature review was limited by means of a limited number of search terms. However, considering the results obtained during the scoping review, this study argues that a satisfying amount of records could be obtained. The review identified a total of 41 studies that provided an ideal basis for the extraction of the key factors explaining differences in the implementation of EPR systems in Germany compared to Norway.

As noted in subchapter 5.1.2, the generated categories stated in the categorization-framework should not be assumed to be independent from each other. Inter-dependencies might exist. Similarly, the obtained variables, as well as the obtained key factors, might be linked to each other. These inter-correlations were not assessed in this study, but might reveal interesting implications for the implementation of EPR systems.

Neither in Germany nor in Norway did the obtained literature explicitly discuss the influence of international aspects. However, this issue cannot be ruled out completely. Health care systems might not be as independent as a research study assumes they are. In Europe, EU legislations might be an increasingly influential aspect in EPR system implementations.

Comparing the implementation of EPR systems between Germany and Norway was the main focus of this research study. As the eligibility criteria of the scoping review pointed out, the research was limited to these two countries. As illustrated in the next chapter, research on the key factors of EPR system implementations might profit from comparing other countries as well. A broader range of research findings could provide an interesting contribution to the research on EPR systems.

The limited number of cases restricts the ability to generalize the obtained research findings. The extracted key factors explain differences in the implementation of EPR systems in Germany compared to Norway. Differences between other countries might be the result of other key factors. However, chapter 3.3 outlined an analytical framework that can be applied in similar settings. Thus, this study provides a framework that can be used to assess implementations on a broader scale.

As noted in chapter 4.5, the validity of a study can be improved by means of a triangulation. Due to time and resource limitations, the study at hand abstained from applying additional research methods such as surveys or interviews. Similarly, a second researcher monitoring and verifying the research process would have increased reliability and validity. Nevertheless, by precisely following the outlined methodology, the study aimed for a high level of objectivity.

6.4 Further Research

As noted in the introduction, the aim of this study was to provide a starting point for further research on EPR implementations. Considering the five obtained key factors, and the developed analytical framework, further research could be performed on both a national and international level. Tables 26 and 27 outline potential applications of the results obtained in this study. It should be noted that these are only recommendations. The findings might be beneficial in other research settings as well.

Table 26: Further Research – National Level

National Level

Start:	Five key factors
↓	↓
Research:	Analysis of the key factors: (Potential questions) - Why were societal and patients' reservations stronger in Germany than in Norway? - Why was more time taken to make decisions in Germany than in Norway? - Why were more strategy plans implemented in Norway than in Germany?
↓	↓
Outcome:	Recommendations and indications

As Sartori (1991) notes: *"comparing is 'learning' from the experiences of others"* (p. 245). Having obtained the five key factors that explain differences in the implementation of EPR systems in Germany compared to Norway, further research could develop recommendations to improve EPR implementations. Considering the fact that EPRs are implemented nationwide in

Norway, but not in Germany, it would be highly interesting to find out what factors could accelerate EPR implementations in Germany.

A seminal research study could start with an analysis of the five key factors obtained in this study. By assessing what underpins these key factors, recommendations and indications for improvements could be obtained. Potential questions are outlined in Table 26. Thus, important knowledge to accelerate EPR implementations could be gained.

Table 27: Further Research – International Level

International Level

Start:	Modifying the analytical framework
↓	↓
Research:	Multinational comparison: Are differences in implementation observable when comparing multiple countries?
	↓
	What are the key factors explaining these differences?
	↓
	How do the key factors respond to the five key factors obtained in this study?
↓	↓
Outcome:	Providing health care authorities with evidence and recommendations on EPR system implementations

Internationally, the obtained research findings could be set in a broader perspective. By applying the analytical framework outlined in chapter 3.3 in a multi-national comparison, an enhanced understanding of the key factors influencing EPR implementations could be gained. The aim of such an international study could be to provide health care authorities with evidence and recommendations on what to consider when implementing EPR systems. A doctoral research study could give consideration to the outlined research recommendations.

By obtaining the key factors that explain the differences in the implementation of EPR systems, and providing the starting point for further research, this study filled a gap in the existing research. The two outlined recommendations for further research could further enhance an understanding of EPR implementations. The next chapter will conclude this research study by briefly summarizing the performed research.

7 Conclusion

The aim of this study was to obtain the key factors that explain differences in the implementation of EPR systems in Germany compared to Norway. The main objective was to find the factors that explain differences in the pace of implementation and the degree of diffusion of EPR systems. The study furthermore aimed to provide a starting point for further research.

After systematically searching the literature, the study identified several records evaluating and discussing the implementation of EPR systems in Germany and Norway. Thereafter, these records were assessed and charted. Thus, specific variables that characterize EPR implementations could be obtained. Three of these variables were analyzed in detail: “usability and workflows”; “acceptance/reluctance by patients”; and “government and data protection”. Country-specific observations were obtained for each of these variables.

After obtaining country-specific observations, the study proceeded with a comparative analysis of these observations. The comparison found that political and legislative aspects have a relatively strong influence on EPR implementations. Differences in implementation of EPR systems between Germany and Norway can be explained by differences in: political decision-making; national strategy setting; governance structures; and complexity and diversity of laws and regulations.

In addition, the study found that societal and patients’ reservations towards EPRs were an influential factor in the implementation of EPR systems. Societal and patients’ reservations, at least in the past, seemed stronger in Germany than in Norway. The literature suggests that differences in implementation of EPR systems can partly be explained by differences in attitudes towards EPRs.

Knowing the decisive factors that explain differences in the implementation of EPR systems serves as a starting point for further research. The obtained findings can be further analyzed in studies aiming to improve EPR implementations. In a broader perspective, the findings can be used as a starting point to assess the key factors influencing EPR system implementations in a multinational context. Thus, the study serves as a first step in making recommendations on how to ensure success in EPR system implementations.

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Appendix

Assessed Scoping Review Records – Germany

Identified Studies	Category No
Alnawaiseh, e. a. (2015). Implementierung einer elektronsichen Patientenakte an einer deutschen Augenklinik der Maximalversorgung. Der Ophthalmologe, 4, 337-345.	2,4,6,8
Bergmann, J., Bott, O. J., Pretschner, D. P., & Haux, R. (2007). An e-consent-based shared EHR system architecture for integrated healthcare networks. International Journal of Medical Informatics, 76(2), 130-136. doi:10.1016/j.ijmedinf.2006.07.013	2,6,9
Berhanu, S., & Mühlbacher, A. (2003). Die elektronische Patientenakte: Ein internetbasiertes Konzept für das Management von Patientenbeziehungen (Vol. 2003/8): Technische Universität Berlin, School of Economics and Management.	2,9,10
Caumanns, J. (2013). Datenschutz und Datennutz bei elektronischen Patientenakten. Datenschutz und Datensicherheit - DuD, 37(3), 137-142. doi:10.1007/s11623-013-0049-6	5,9
Deutsch, E., Duftschmid, G., & Dorda, W. (2010). Critical areas of national electronic health record programs—Is our focus correct? International Journal of Medical Informatics, 79(3), 211-222. doi:10.1016/j.ijmedinf.2009.12.002	1,3,6,7,9,10
Duennebeil, S., Sunyaev, A., Leimeister, J. M., & Kremar, H. (2010). Strategies for Development and Adoption of EHR in German Ambulatory Care. 4th International Conference on Pervasive Computing Technologies for Healthcare, München.	6,7
Eckrich, F., Baudendistel, I., Ose, D., & Winkler, E. (2016). Einfluss einer elektronischen Patientenakte (EPA) auf das Arzt-Patienten-Verhältnis: eine systematische Übersicht der medizinethischen Implikationen. Ethik in der Medizin, 28(4), 295-310. doi:10.1007/s00481-016-0386-8	7,8
Gnad, K., Richter, P., & Esswein, W. (2015). Applications of Lifetime Electronic Health Records: Are we ready yet? BLED 2015 Proceedings, 24.	2,6,9,10
Grüner, A., Ljutow, A., Schleinzer, W., & Bosancic, D. (2008). Implementierung einer elektronischen Krankenakte: Erfahrungen in einer interdisziplinären Schmerzklinik. Der Schmerz, 22(1), 24-33. doi:10.1007/s00482-007-0617-5	2,4,6
Haas, P. (2017). Elektronische Patientenakten: Einrichtungsübergreifende Elektronische Patientenakten als Basis für integrierte patientenzentrierte Behandlungsmanagement-Plattformen. Gütersloh, Deutschland: BertelsmannStiftung.	1,2,6,7,8,9,10
Hoerbst, A., Kohl, C. D., Knaup, P., & Ammenwerth, E. (2010). Attitudes and behaviors related to the introduction of electronic health records among Austrian and German citizens. International Journal of Medical Informatics, 79(2), 81-89. doi:10.1016/j.ijmedinf.2009.11.002	7
Hornung, G., Goetz, C. F.-J., & Goldschmidt, A. J. W. (2005). Die künftige Telematik-Rahmenarchitektur im Gesundheitswesen: Recht, Technologie, Infrastruktur und Ökonomie. WIRTSCHAFTSINFORMATIK, 47(3), 171-179.	1,2,9
Jähn, K., & Reiher, M. (2005). Informations- und Kommunikationstechnologie in bayerischen Krankenhäusern: Von Insellösungen zu Blended Healthcare. Telemedizinführer Deutschland, Ausgabe 2005, 101-105.	2
Krüger-Brand, H. E., & Osterloh, F. (2017). Elektronische Patientenakte: Viele Modelle - noch keine Strategie. Deutsches Ärzteblatt, Jg. 114(Heft 43), A1960-A1966.	2,6,9
Krämer, T., Rapp, R., & Krämer, K. L. (1999). Von der Planung zur Realisierung einer elektronischen Patientenakte. Der Orthopäde, 28(3), 218-226. doi:10.1007/PL00003601	1,2,6
Kuchenbecker, J., & Behrens-Baumann, W. (2004). Einsatz einer elektronischen Patientenakte (EPA) an der Universitätsaugenklinik Magdeburg. Der Ophthalmologe, 101(12), 1214-1219. doi:10.1007/s00347-004-1048-7	2,6
Neubauer, A. S., Priglinger, S., & Ehrt, O. (2001). Elektronische oder papiergebundene Patientenakte Ein Kosten-Nutzen-Vergleich. Der Ophthalmologe, 98(11), 1083-1088. doi:10.1007/s003470170030	1

Rauer, U. (2012). Patient Trust in Internet-based Health Records: An Analysis Across Operator Types and Levels of Patient Involvement in Germany. Policy & Internet, 4(2). doi:10.1515/1944-2866.1177	7
Richter, e. a. (2010). Changing attitudes towards online electronic health records and online patient documentation in rheumatology outpatients. Clinical and Experimental Rheumatology, 28, 261-264.	7
Stausberg, J., Uslu, A., & Schoch, B. (2004). Die Elektronische Patientenakte in der Intensivmedizin: Anforderungen - Konzepte - Nutzen. Telemedizinführer Deutschland, Ausgabe 2004, 136-140.	1
van Der Haak, M., Wolff, A. C., Brandner, R., Drings, P., Wannenmacher, M., & Wetter, T. (2003). Data security and protection in cross-institutional electronic patient records. International Journal of Medical Informatics, 70(2), 117-130. doi:10.1016/S1386-5056(03)00033-9	9
Veseli, H., Kopanitsa, G., & Demski, H. (2012). Standardized EHR Interoperability - Preliminary Results of a German Pilot Project using the Archetype Methodology. IOS Prss.	2
Warda, F. (2005). Die elektronische Gesundheitsakte in Deutschland. Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz, 48(7), 742-746. doi:10.1007/s00103-005-1084-8	2

Assessed Scoping Review Records – Norway

Identified Studies	Category No
Bergland, C., & Andresen, T. (2014). Electronisk pasientjournal i omsorgstjenesten. Oslo, Norway: Helsedirektorate.	2,4,6
Boulus, N. (2004). Managing the Gradual Transition from Paper to Electronic Patient Record (EPR).	2,4,6
Boulus, N., & Bjorn, P. (2010). A cross-case analysis of technology-in-use practices: EPR-adaptation in Canada and Norway. International Journal of Medical Informatics, 79(6), e97-e108. doi:10.1016/j.ijmedinf.2008.06.008	4,6
Christensen, T., Faxvaag, A., Lærum, H., & Grimsmo, A. (2009). Norwegians GPs' use of electronic patient record systems. International Journal of Medical Informatics, 78(12), 808-814. doi:10.1016/j.ijmedinf.2009.08.004	4,6
Christensen, T., & Grimsmo, A. (2008). Expectations for the next generation of electronic patient records in primary care: a triangulated study. Infromatics in Primary Care(16:8-21).	4,6
Christensen, T., & Grimsmo, A. (2008). Instant availability of patient records, but diminished availability of patient information: A multi-method study of GP's use of electronic patient records. BMC Med Inform Decis Mak, 8:12.	4,6
Ellingsen, G., Christensen, B., & Silsand, L. (2014). Developing large-scale Electronic Patient Records conforming to the openEHR architecture. Procedia Technology, 16, 1281-1286.	2,4,6,8,9
Ellingsen, G., & Monteiro, E. (2008). The organizing vision of integrated health information systems (Vol. 14, pp. 223-236).	1,2,4
Ellingsen, G., & Monteiro, E. (2012). Electronic patient record development in Norway: The case for an evolutionary strategy. Health Policy and Technology, 1(1), 16. doi:10.1016/j.hlpt.2012.01.007	8
Eysenbach, G., Aanestad, M., Larsen, E., & Mydske, P. K. (2013). Developing Electronic Cooperation Tools: A Case From Norwegian Health Care. Interactive Journal of Medical Research, 2(1). doi:10.2196/ijmr.2346	2,8
Grisot, M., & Vassilakopoulou, P. (2013). Infrastructures in healthcare: The interplay between generativity and standardization. International Journal of Medical Informatics, 82, 170-179.	2,4

Heimly, V., Grimsmo, A., & Faxvaag, A. (2011). Diffusion of Electronic Health Records and electronic communication in Norway. Appl. Clin. Inform., 2(3), 355-364. doi:10.4338/ACI-2011-01-IE-0008	1,2,4,8
Jacucci, E., Grisot, M., Aanestad, M., & Hanseth, O. (2003). Reflexive Standardization Interpreting Side-Effects and Escalation in Standard-Making. MISQ Special Issue Workshop.	2
Lium, J.-T., & Faxvaag, A. (2006). Removal of paper-based health records from Norwegian hospitals: Effects on clinical workflow. Stud Health Technol Inform, 124, 1031 - 1036.	4,6
Mikkelsen, G., & Aasly, J. (2001). Concordance of information in parallel electronic and paper based patient records. International Journal of Medical Informatics, 63(3), 123-131. doi:10.1016/S1386-5056(01)00152-6	3,4
Ellingsen, G. (2003). Coordinating work in hospitals through a global tool: Implications for the implementation of electronic patient records in hospitals. Scandinavian Journal of Information Systems. 15: 39-54	4
Sorensen, T., & Johansen, M. A. (2016). Developing and Implementing Patients' Full-Scale Electronic Access to Their Health Record. Stud Health Technol Inform, 228, 85-89.	7
Ulriksen, G.-H., Pedersen, R., Wynn, R., & Ellingsen, G. (2015). How to organize for a large-scale openEHR-based Electronic Patient Record. IOS Prss.	2,6