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Dimensions of Accessibility and Interoperability for Electronic Health Records in the Nordic Countries: A Qualitative Evidence Synthesis of Facilitators and Barriers

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Abstract

This paper presents a qualitative evidence synthesis of facilitators and barriers of accessibility and interoperability of electronic health records in the Nordic Countries, i.e. Sweden, Norway, Denmark, Finland and Iceland. The findings are based on a thematic analysis of 19 papers selected through a systematic search strategy from databases covering research on medicine and information systems. We recognise three dimensions in accessibility facilitators, five dimensions in accessibility barriers, two dimensions in interoperability facilitators, and three in interoperability barriers. Our findings indicate that there is an imbalance in research addressing different stakeholders, and there are differences on how stakeholders affect or are affected by the accessibility and interoperability barriers and facilitators. The findings can help in designing policies and solutions for creating health record platforms which support all relevant stakeholders in healthcare delivery.

Keywords: Accessibility, interoperability, electronic health records, qualitative evidence synthesis

Introduction

In the healthcare sector, the use of technology in the form of an Electronic Health Record (EHR) is slated to transform the industry using technical tools and systems in three beneficial areas as: 1) clinical decision support, 2) computerized physician order entry, and 3) health information exchange (Menachemi and Collum 2011). Overall, these tools and systems are geared towards supporting health related decisions, processes, and outcomes for relevant stakeholders such as clinicians and patients. Auxiliary to this is the fundamental need to facilitate the sharing of patient information through EHRs to improve, for example, clinical outcomes, quality of care, patient safety, reduce medical errors, empower patients and individuals, and facilitate adherence to legal and ethical requirements (King et al. 2014; Menachemi and Collum 2011). However, the EHR is not without its caveats, such as barriers for EHR adoption in clinical practices, concerns for patient privacy, and most profoundly - the financial

burden for countries to build, maintain, and support interoperable EHR systems in public and private healthcare contexts (Beard et al. 2012; Hillestad et al. 2005; Simon et al. 2007).

The International Organization for Standardization (ISO) defines EHR in its most basic and broad form to be a repository of longitudinal patient (subject of care) information and data that is stored in digital or electronic form to be accessed or controlled securely by multiple authorized stakeholders (ISO/TR 20514 2005). The information which might be included within an EHR ranges from doctor notations to medical imagery, historical medical data, allergies, and even lifestyle habits (Ammenwerth et al. 2017). Despite the popularity and universal usage of the term EHR there is a variety of terms which are frequently used to describe different types of health records found in digital format. The Electronic Medical Record (EMR) focuses on the medical domain, the Electronic Patient Record (EPR) contains instances of patient information to specific hospital(s), and the Personal Health Record (PHR) is managed by the patient or individual (Häyrynen et al. 2008; ISO/TR 20514 2005). Of notable interest is the PHR, which could include pertinent information such as self-collected blood sugar levels, or a mental health diary which is of primary accessibility to the individual. How the patient accesses and controls their health data is of crucial importance for empowering the patient (Tang et al. 2006).

Several challenges are outlined by the European Union (EU) in their eHealth Action Plan which acts as motivating pressures placed on society and healthcare systems for change. Examples are the increased demand for equal access to health services for a variety of contexts (e.g., occupational healthcare), an aging population, expectations of high quality of healthcare with strict economical regulations, and smart spending in technology investments (Commission of the European Communities 2004). A key challenge however, is that within the vast amount of health data there is a need for it to be *accessible to the right stakeholder at the right time* and done so securely and efficiently (Commission of the European Communities 2004). Essén et al. (2017) argue that there is a definitive need to better understand how stakeholders across countries have tackled issues of hard legislation and soft policy for interoperability of EHRs where “the long-term goal is an international interchange between national health information exchange infrastructures on all levels of interoperability.” Also, the need for international interoperability around patient access to EHRs (PAEHRs) has been identified. Thus, there is a clear research gap concerning stakeholders’ access across EHRs to show the dimensions of accessibility across different countries. In regard to EHR accessibility and interoperability, the Nordic countries have been pioneers (Kierkegaard 2015) and there certainly is a lot that other countries within and outside the EU that stand to learn from research on EHRs in the Nordic countries. With this paper, we take a step towards closing this gap and ask the research question: *What are the dimensions of accessibility and interoperability to electronic health records for relevant stakeholders in the Nordic countries?*

Our goal is to provide insight into the existing dimensions of accessibility and interoperability around EHRs within the Nordic countries that encompass health data making. The remainder of the paper is structured as follows. First, we will describe the context of our study and justify our choice to focus on EHRs in the Nordic countries, as well as label the stakeholders. Then, we describe the research methodology of a qualitative evidence synthesis, followed by the results of the synthesis. Finally, we discuss our findings and conclude the paper.

Context of the Paper

The Nordic Countries

A recent study has catalogued and compared the variability of the patient experience in using health system systems across 10 countries for their accessibility (Essén et al. 2017). Where it was determined that there are variances in world-wide security procedures for login, user rights to access data, and medically available data sets. For the present paper, the focus will be on four of the ten countries detailed in the Essén et al. (2017) study: Sweden and Norway (both of which have access procedures using the same login for multiple systems), and Denmark and Finland (both of which have the same login procedures for a single system). Additionally, Iceland will be included in the review in order to focus on a group of countries that have existing policies and agreements in many areas.

The Nordic Council of Ministers (Nordic Co-Operation 2018a) are active in maintaining and negotiating Nordic agreements and treaties aimed at increasing innovation and global competitiveness of Nordic countries. Examples of such agreements are the Agreement concerning a common Nordic labour market supporting labour mobility of Nordic citizens within Nordic countries, the Nordic language convention for a right of Nordic citizens to use their mother tongue in other Nordic countries, and Nordic public health preparedness agreement for collaboration between health and medical authorities (Nordic Co-Operation 2018b). Nordic countries have been successful in creating collaboration networks for using combined data, for example, for studies on prenatal exposure to antidepressants or risk factors and outcome of primary hip and knee replacements (Ehrenstein et al. 2017). This collaboration has been possible because of the long history of health registries in Nordic countries, and informal and formal political and professional collaboration structures. For example, common metadata standards are used for coding medical data (Ehrenstein et al. 2017). The Nordic Council of Ministers for Health and Social Affairs is active in establishing co-operation within the social and health care sector based on common values. This is based on the Nordic welfare model (Nordic Co-Operation 2018a), for example, with setting up Nordic eHealth Research network to develop common Nordic indicators for eHealth functionalities services to be used by national and international policy makers and research (Nordic eHealth Research Network (NeRN) 2018).

The Stakeholders

The classification and definition of key stakeholders who play a role in healthcare are critical for understanding the whole picture of healthcare systems. Table 1. is constructed based on the categorizations of key stakeholders in the EHR context which classifies and describes stakeholders based on their role in healthcare (Singleton et al. 2009). These will be used for organizing the findings.

Table 1. Stakeholder Classifications and Descriptions

| Stakeholder Classification | Description |
|---------------------------------|--|
| The Patients (Patients) | Patients, or immediate supporters such as informal caregivers |
| The Public (Public) | Residents/ citizens, media channels, and public representatives |
| Healthcare Professionals (HCPs) | Clinicians, practitioners, or researchers |
| Administrators (Admins) | Administrators, regulators, managers, and private organizations |
| Suppliers (Supp) | Suppliers, application vendors, consultants, support technicians, and system integrators |

Research Methodology

Qualitative Evidence Synthesis

There are several different methodologies available to approach the literature review process. These range from the more qualitative (narrative and descriptive) to the more quantitative (vote counting and meta-analysis) (King and He 2005). A ‘qualitative evidence synthesis’ or QES method was employed for its ability to bring together a broader phenomenon for interpretation (Grant and Booth 2009). The term QES has been synonymously used and confused with a qualitative systematic review as an inherited consequence to the popular movement of systematic literature reviews in research, but for want of clarity, ‘qualitative evidence synthesis’ will be used in this paper. For this method, selective sampling is applied to search for and appraise qualitative studies for integration. The purpose of this method is best described by Grant and Booth (2009), who say that QES can be used to:

“explore barriers and facilitators to the delivery and uptake of services; for an exploration of user views; to investigate perceptions of new roles, from the point of view of either those filling the roles or

those with whom the post holder interacts; and to inform the prioritization of services where evidence on effectiveness is equivocal and preferences and attitudes thus become the determining factors.”

It is important to note that the credibility of synthesizing qualitative research as a research branch is heavily situated within the context of the study, ultimately limiting its generalizability. However, qualitative research is a powerful approach in answering questions oriented around the ‘how’ or the ‘what’ of the intended phenomena of study. Campbell et al. (2003) advocate that the qualitative perspective for health research has particular proclivity for policy and practice, both of which are important considerations for accessibility and interoperability. In summary, since the purpose of this paper is to literally ‘synthesize’ a holistic picture on existing literature on data interoperability and access for healthcare stakeholders in the context of EHRs, using the QES method to explore this phenomenon is suitable. As a result of applying this method, dimensions of barriers and facilitators are identified in regard to both accessibility and interoperability in the context of EHRs.

A limitation of the QES is that it is a relatively new research method – therefore, there is a lack of clear guidelines on how the literature search should be conducted. Up for debate is how the scope of methodical searches can be strategized, how to identify as many relevant studies as possible, and if the purpose is relevant to a defined phenomenon (Grant and Booth 2009). In the present study we attempt to minimize these identified weaknesses of the QES by using systematic tendencies where no explicitly prescribed systematic procedure is described by QES. During the data gathering procedure, we applied a set of honed search terms across relevant search engines (Boell et al. 2015) as opposed to the ‘quality assessment’ used to appraise suitability in the QES method (Grant and Booth 2009). Thus, we employed standard and appropriate inclusion and exclusion criteria used in systematic literature reviews (detailed in the section below) in order to increase validity and reliability of our results, and to comprehensively identify a high number of relevant studies to generate a holistic understanding of the phenomenon.

Phase 1: Literature Review Scope

In the first phase of the literature review process, relevant literature was searched using digital search engines. Three online databases were used to cover various search engine scopes such as medicine and information systems: Scopus (Elsevier), PubMed, and EBSCOhost (Academic Search Premier). The search criteria were polled within the abstract, title, and keywords to ensure the focus of the paper was as closely aligned to the search purpose as possible, additionally, terms such as “access” in full-text search reveal millions of results due to the use of [accessed] in bibliographic references. The first terms used overall were for “EHR” OR “electronic health record” as well as “access*” OR “interop*”. The * operator was used for variation in term names such as accessibility, accessing, or accessible. Search operators such as ‘AND’ and ‘OR’ were used. To further narrow down the location to the Nordic countries, the following Boolean phrase was also used with an AND operator for geographic terms: “Nordic” OR “nord*” OR “Denmark” OR “Danish” Or “Sweden” OR “Swedish” OR “Iceland” OR “Icelandic” OR “Norway” OR “Norwegian” OR “Finland” Or “Finnish”. The capital variation of “Nordic” and “nord*” was used to encompass variances in phrasing for the Nordic countries.

An initial filtering process was performed with the search engine functionality to restrict results to be in English, which is considered to be a limitation of the study as many Nordic countries publish in both English and their native language consequently leading to overlooking of publications related to the focus of this paper. Additionally, only published articles or conference proceedings were used to ensure quality, peer reviewed findings. Table 2 summarizes the database search findings.

Table 2. Literature Review Search Finding Overview

| Database | Initial Results | Results after Filtering |
|-------------------------------------|-----------------|-------------------------|
| Scopus (Elsevier) | N = 143 | N =129 |
| PubMed | N = 9 | N =9 |
| EBSCOhost (Academic Search Premier) | N = 6 | N =5 |
| Total Overall Papers | N =158 | N =143 |

Phase 2: Inclusion and Exclusion Criteria

The second phase consisted of compiling all the articles into an Excel spreadsheet, with a numbered list of authors, titles, and publication dates. All articles were downloaded through academic access points in search databases or requested through online resources such as Research Gate. Once all articles were downloaded and collected, all abstracts were read where an inclusion and exclusion process were applied based on the following criteria in Table 3.

Table 3. Inclusion and Exclusion Criteria for Filtering Relevant Papers

| Criteria | Description | Conditions If Applicable |
|----------|---|--|
| 1 | Is the paper a duplicate of another listed paper? | Papers were excluded if duplicated across databases or within search results of an individual database. |
| 2 | Is the paper situated in a Nordic context? | If the paper included countries asides from the Nordic countries, they were included unless the extractions or results for the Nordic countries were indiscernible from the other countries. |
| 3 | Does the paper include at least 1 of the 5 stakeholders from the groups listed in table X.0 above? | Papers were excluded automatically if no stakeholders were explicitly discussed in the context of the results. |
| 4 | Does the paper discuss electronic health records (EHRs) as their primary subject manner? | Papers could also include other terminology and record types used within the EHR scope such as electronic medical records (EMRs) or personal health records (PHRs). However, the paper was required to be primarily in the context of EHRs, otherwise it was excluded. Patient Access to Electronic Health Records (PAEHR) and National Electronic Health Records (NEHR) were considered to be primarily in the context of EHRs. |
| 5 | Does the paper use at least 1 qualitative methodology to conduct the study, such as case study, interviews, qualitative survey, or literature review? | The QES methodology requires papers to be qualitative in nature. In the case of multiple or mixed methodology, the paper was considered excluded if the results did not clearly delineate the qualitative component(s). |

After applying the inclusion and exclusion criteria, a total of 19 papers were found to be relevant and used in this paper. Table 4 iterates how each step of the exclusion criteria removed papers from the corresponding database until the final 19 papers remained. Criteria 5 excluded a large number of papers (61 papers) as the papers were either quantitative or did not differentiate qualitative results from the quantitative ones. Future research should aim to include both quantitative and qualitative papers for synthesizing to broaden insights into EHR facilitators and barriers to accessibility and interoperability.

Table 4. Literature Count After Application of Inclusion and Exclusion Criteria

| Database | Excluded Paper Amounts Based on Prescribed Criteria | | | | | | Total Included Papers |
|----------|---|------------|------------|------------|------------|------------|-----------------------|
| | Starting Total | Criteria 1 | Criteria 2 | Criteria 3 | Criteria 4 | Criteria 5 | |
| Scopus | N = 129 | N = 4 | N = 5 | N = 1 | N = 39 | N = 61 | N = 19 |

| | | | | | | | |
|-----------|---------|--------|-------|-------|--------|--------|---------------|
| PubMED | N = 9 | N = 8 | N = 0 | N = 0 | N = 1 | N = 0 | N = 0 |
| EBSCOhost | N = 5 | N = 5 | N = 0 | N = 0 | N = 0 | N = 0 | N = 0 |
| Total | N = 143 | N = 17 | N = 5 | N = 1 | N = 40 | N = 61 | N = 19 |

Phase 3: Thematic Analysis of Relevant Papers

For the final phase, a thematic analysis of the 19 papers was conducted to focus on the key sections of the included papers in order to extract meaningful and key qualitative data. Since the paramount purpose of the present paper is to provide a holistic picture, thematically analyzing the 19 identified papers underpins a developed understanding of Nordic country accessibility and interoperability dimensions. The thematic analysis method helps us answer the research question, as well as clearly delineates what is being included as thematically analyzable data for this synthesis, which is a difficult task to perform (Thomas and Harden 2008). In order to collect the data to be thematically analyzed, the ‘results’ or ‘analysis’ or ‘findings’ sections of the 19 papers were gathered together and assigned a number of 1 through 19 based on descending dates of publication and kept in a PDF document form including quotes from interviews, diagrams, or policy catalogues. Additionally, excerpts from the abstract that states ‘results’ or ‘analysis’ or ‘findings’ were also included. Any paper that had mixed methodology was required to clearly state or outline the boundary between the quantitative and qualitative findings, such as with paper 9 where they declare in the results the initiation of qualitative results starting by stating “In the open-ended questions...” (Kivekäs et al. 2016). The collection of data from the 19 papers was read through for further familiarization and context building, before a coding process was applied. The coding process considered groups of text from the 19 papers before assigning a code for whether it was accessibility or interoperability, then which stakeholder or stakeholders it was contextualized for, and finally what theme or themes were identified within the text. The codes were then synthesized together to inductively reveal dimensions of accessibility and interoperability. As a result, we identified thirteen relevant dimensions within these themes. We will present them in more detail next.

Results

With help of the QES method, we identified thirteen dimensions of accessibility and interoperability across the 19 studies we analyzed. Table 5 in the section below includes information about the 19 papers we analyzed. For each paper, we present the reference with the year of publication, and the country the paper’s findings are based on. In addition, each paper is assigned a paper identifier number that we will use in the remainder of the present study to refer to these papers.

Table 5. Summary of Studies Identified for Inclusion with the QES Methodology

| Paper Identifier Number | Authors | Country | Paper Identifier Number | Authors | Country |
|-------------------------|--------------------------------|------------|-------------------------|------------------------------|---------|
| 1 | (Bergevi et al. 2018) | SE | 11 | (Pinto et al. 2016) | DK |
| 2 | (Kautsch et al. 2017) | DK | 12 | (Adler-Milstein et al. 2014) | DK |
| 3 | (Fragidis and Chatzoglou 2017) | DK, NO, SE | 13 | (Hammar et al. 2014) | SE |
| 4 | (Hägglund and Scandurra 2017) | SE | 14 | (Lehnbom et al. 2013) | SE |
| 5 | (Scandurra and Hägglund 2017) | SE | 15 | (Rahmner et al. 2012) | SE |

| | | | | | |
|----|--------------------------------------|----|---|---------------------------|----|
| 6 | (Scandurra, Pettersson, et al. 2017) | SE | 16 | (Pluut and Zuurmond 2009) | DK |
| 7 | (Scandurra, Lyttkens, et al. 2017) | SE | 17 | (Maass et al. 2008) | FI |
| 8 | (Olesen et al. 2016) | DK | 18 | (Øie et al. 2007) | NO |
| 9 | (Kivekäs et al. 2016) | FI | 19 | (Zurita and Nøhr 2004) | DK |
| 10 | (Skyttberg et al. 2016) | SE | Denmark = DK, Sweden = SE, Norway = NO, Finland = FI (Note: No Icelandic papers were found to be suitable) | | |

We will present the main results of our study next. The results are separated into findings regarding accessibility and findings regarding interoperability. First, we describe how accessibility works as a facilitator for EHR use on the one hand, followed by the barriers encountered when providing EHR accessibility to different stakeholders. Then, we will describe how EHR system interoperability acts as a facilitator for EHR use, and finally describe the barriers to implementing and using interoperable EHR systems we identified. Each section contains a table showing the dimensions and their relevant stakeholder sections. Due to length limitations, we only present the most important results in detail.

Accessibility as a Facilitator

In this section, we first describe the three dimensions of EHR accessibility as facilitators, followed by the five dimensions of barriers that were found to exist when providing stakeholders with EHR access. Table 6 summarizes the three dimensions of accessibility as facilitators. Accessibility was determined to be predominantly around two main stakeholders; the majority either the patients' access or the healthcare professional's access to EHRs. The same was reflected for interoperability stakeholders.

Table 6. Accessibility Facilitators – Dimensions and Corresponding Papers

| Dimensions | Patients | Public | HCP | Admins | Supp |
|---|------------------------------------|--------|--------------------------|--------|------|
| Benefits of accessibility as a facilitator for: transparency (1, 12, 14), or engagement (1, 4), or education (1, 16), or empowerment (1, 5, 12, 16), or access control (4, 13, 14, 18), consent (2, 14), or accountability (2, 4, 18), or risk dissonance (1, 14, 18) | 1, 2, 4, 5, 12, 13, 14, 16, 18, 19 | 14, 16 | 2, 8, 10, 13, 14, 16 | | |
| Supportive tool for: work practices (10, 14), or patient safety (8, 9, 13, 14), or quality of care (14, 16, 17) | | | 8, 9, 10, 13, 14, 16, 17 | | |
| Accessibility opportunity for: personalization (1, 15) | 1 | | 15 | | |

Benefits of Accessibility as a Facilitator. Facilitating accessibility emphasizes patient access to EHRs as a supportive tool. The patients highlight that accessibility to EHRs was thought to be a supportive where the access itself supports *transparency* (1, 12, 14). The patient was also found to be *empowered* by having access to their health information to encourage active participation in the process (1, 5, 12, 16). Activities to exercise *access control* (4, 13, 14, 18) was shown to be facilitated by access to EHRs for purposes such as giving or withdrawing *consent* (2, 14). A patient may wish to limit a specific healthcare professional from accessing their EHR (18) and if the healthcare professional who was requested not to access the patient's EHR did, a record was kept of the access taking place; which also was reflected as an act of *accountability* (2, 4, 18). *Risk dissonance* is illustrated as a facilitator as there

was shown to be a disconnect between the perception of risk and how it applied to their person. Exemplifying that despite risk for breaches in privacy (14), confidentiality (1, 14, 18), or security (1) which were acknowledged as a potential outcome from both technical (data breaches) or clinical (code of conduct) aspects, where dissonance was favoured for personal access or for HCPs.

Supportive Tool. Supporting HCPs with access to the EHRs was important for *work practices* to be carried out (10, 14). HCPs reflected this provided support for them to perform their everyday tasks as access to the EHRs is paramount to conduct *work practices* (14). Some of the healthcare professional’s attitudes for accessibility to EHRs was revealed to facilitate benefits for the patients in terms of: *patient safety* (8, 9, 13, 14) – such as reducing medication abuse or reducing errors due to handwriting (9) or preventing the spread of diseases (8). Moreover, improved *quality of care* (14, 16, 17) which is provided by access to holistic or comprehensive medical histories of patients (17) when caring for a patient.

Accessibility Opportunity. Accessibility to EHRs were reflected as opportunities to facilitate how patients considered to use accessibility for personal purposes. This activity was identified as, *personalization* (1) where the patient could tailor access to their personal needs at any given time; for instance, comparing current and past personal health experiences during different pregnancies (1). For HCPs, personalization was suggested for conducting work practices, where additional features for functionality such as prescription calculators, or images to show patients were suggested to meet the specific needs of the physicians (15).

In summary, looking at Table 6, we found that EHR accessibility acts as facilitator specifically for the patient, public, and HCP stakeholder groups. EHRs have been found to be a tool that supports the work of and services provided by HCPs. For patients, the public, and HCPs, EHRs accessibility has been found to provide benefits in the form of transparency, engagement, empowerment, and accountability.

Barriers Encountered when Providing EHR Accessibility to Stakeholders

Table 7 summarizes the five dimensions of barriers that were encountered when providing EHR accessibility to different stakeholders. We present our findings in more detail next.

Table 7. Accessibility Barriers – Dimensions and Corresponding Papers

| Dimensions | Patients | Public | HCP | Admins | Supp |
|---|------------------------|---------------|-----------------------|--------|--------------|
| Finding a balance of: power (2, 5, 7, 14), or expectations (4,19), or access control (6, 14), or authorization (2, 14,18), or responsibility (7, 13, 14) | 2, 4, 5, 7, 14, 18, 19 | | 2, 6, 7, 13, 14 | | |
| Accessibility challenges: cost (4, 5), technical demands (4, 5, 6, 13, 19), vendor involvement (3, 12), or pressure for responsibility (3, 4, 7), or change management (4, 5, 10, 13) | 5, 13, 19 | 3, 4, 5, 6 | 3, 4, 5, 6, 10, 13 | 10 | 3, 7, 12, 13 |
| Negative attitudes towards accessibility as a risk factor for: validity of content (1, 4, 5), or safety (1) and security (14) and privacy (13, 14) | 1, 5, 14 | 14 | 4, 13 | | |
| Policy: pressure (4), or balancing act (4, 5, 6, 7, 12), or fragmentation (2, 4, 5, 7, 13) | 2, 4, 5, 6, 7 | 2, 4, 5, 6, 7 | 2, 4, 5, 6, 7, 12, 13 | 2, 18 | 2 |
| Usability (4, 10, 13, 14, 15) | 4 | 4, 15 | 10, 13, 14, 15 | | 4, 15 |

Finding a Balance. A key barrier was *finding a balance* where on one hand, a *balance of power* needs to be struck between empowering patients with immediate or ‘real-time’ accessibility to EHRs in order to encourage patients to be more active and involved in their healthcare (2, 5). On the other hand, it should allow HCPs to use the EHR as their intended tool. However, balancing the desire of the patient for immediate access to their EHR is juxtaposed against HCPs who have expressed a desire to set a number of respite days before releasing the information in the EHR. This is understood as both a limitation of accessibility as well as a procedure to protect the patient from accessing incorrect or disjointed information (5, 7, 14). Another challenge is *access control* within the EHR, which requires harmonization between enabling adherence of access due to legal rights for patient consent (6, 14) before a healthcare professional can or should access health information (14), whilst also having granular controls (2, 18) for authorizing access across different healthcare professional levels.

Accessibility Challenges. Intrinsic to the barrier theme were *accessibility challenges* – which were responses or actionable ways to address a particular part of a barrier. They were shown to be mainly concentrated for the patient, public, and HCPs. The *cost* barrier, i.e., the financial burden of providing and supporting accessibility for patients with complex and demanding healthcare systems (5) from the healthcare providers, or smaller satellite clinics, is challenging due to the required financial supplementation. Furthermore, researchers, who are considered as part of the HCPs stakeholder group, are limited by funding to explore long-term effects of accessibility to EHRs (4) as “financial support is scarce” (Scandurra and Hägglund 2017b). *Technical demands* include an expected up-time where there is a very severe threshold for down-time due to the healthcare context; this burdens HCPs and especially suppliers (13). *Pressure for responsibility* falls to the suppliers or vendors, public bodies, and HCPs who are responsible for being able to provide or have access to systems without failure (3, 7). Lastly, *change management* is an organizational challenge for adopting accessibility to EHRs into HCP and administrator contexts. Unwillingness to adopt comes from sources of concern for the patient’s safety (4, 5, 13) or technical systems being unfit to support workflow for both HCPs and administrators (10).

Negative Attitudes as a Risk Factor. There were also negative attitudes towards accessibility which are considered challenges for the implicated stakeholders. One such factor were concerns for the *validity of the content* in the EHRs. These EHRs are available for patients, but burden HCPs if the patient misunderstands the content either due to medical language or miscommunication (1, 4, 5). The factors of *privacy* (13, 14), *security* (14), and *safety* (1) were considered equally among individuals and patients, as well as HCPs who viewed access to EHRs as a general risk.

Policy. Using policy for a ‘top-down approach’ is an accessibility challenge which illustrates the complexities that involve policy, standards, regulations, and/or legislations. There is *pressure* placed on providers to facilitate accessibility of EHRs (4). This pressure requires a *balancing act* between protecting patients or citizens whilst also providing them equal access to EHRs (2, 4, 5, 6, 7). This policy is not uniformly applied but is also flexible in adherence for interpretation and implementation for EHR systems (4, 5, 6, 7, 12). Conversely, this flexibility informs one of the main challenges within policy in the form of *fragmentation*. This occurs when policy has put pressures on healthcare systems to maintain both centralized (country-wide system) and de-centralized (a more regional system) requirements. This results in the disconnectedness of uniformity for providing holistic information to patients (2, 4, 7), individuals (5), HCPs including researchers (2, 4, 5, 7, 13), and even administrators (2) and vendors (2). Systems are forced to connect to a centralized system but are also controlled by policy to be de-centralized across municipalities, counties, and the Nordic countries.

Usability. Usability as a challenge dimension for accessibility explicates the experiences of patients, HCPs, and suppliers when it comes to accessing and using EHR systems. In the context of physicians accessing EHRs, the perceived value found in the experience is relatively low as the functionality and interaction has shown to be lacking (10, 13, 14, 15). Want of functionality and engagement with EHRs is also reflected by patients and individuals (public) (4, 15) but (4) further suggests that usability studies are severely lacking in this area.

In summary, we can see from Table 7 that all stakeholder groups are at least to some extent considered to have a role in accessibility barriers that were encountered. However, we want to draw the reader’s attention to a couple of interesting findings. We found that foremost patients and HCPs are affected by

or responsible for finding balance in the areas of power, expectations, access control, authorization, and responsibility. Interestingly, neither the suppliers, nor the public or administrators needs were identified. Negative attitudes towards accessibility as a risk factor have been found to concern the patient, public and HCP stakeholders, but not the administrators or suppliers.

Interoperability as a Facilitator for EHR Use

This section discusses how interoperability acts as a facilitator for EHR use, as well as the barriers to implementing and using interoperable EHR systems. Table 8 summarizes the two dimensions of how interoperability acts as a facilitator for EHR use.

Table 8. Interoperability Facilitators – Dimensions and Corresponding Papers

| Dimensions | Patients | Public | HCP | Admins | Supp |
|---|----------|--------|-----------|--------|------|
| Supportive tool for: patient safety (13), or social comparison (12) | 12 | | 1 | | |
| Interoperability opportunities: sharing (4), or increase patient safety (9, 10, 13), or re-use (10) | 4 | | 9, 10, 13 | | |

Supportive Tool. Similar to the accessibility facilitator, supportive tools for interoperability highlighted how interoperability facilitates better *patient safety*. This was emphasized as a potential for increasing patients’ safety which could be dependent on the implementation of the technical solution being fully automated as part of existing healthcare systems (13). Denmark’s patient-to-patient communication networks that have been available for 10 years, facilitate *social comparison* for patients and/or individuals with chronic diseases (12).

Interoperability Opportunities. Opportunities were far less prevalent as an immediate benefit for interoperability and were mostly considered in a future context as an idealistic method for developing healthcare systems further. Patients can utilize interoperability across healthcare systems as an expediter for *sharing* EHRs (4) with chosen recipient(s) in order to exercise control or consent over their EHRs. HCPs were predominantly reflective on interoperability and how it could increase *patient safety* in clinical settings (9, 13). For HCPs, interoperability across EHRs could potentially facilitated *re-use* as a utility for later referencing for medical purposes such as medication checking (10).

In summary, from Table 8 we can see that interoperability as a facilitator is especially relevant for HCPs and patients. EHRs help HCPs to improve patient safety and social comparison.

Barriers to Implementing and Using Interoperable EHR Systems

Three dimensions of barriers to implementing as well as using interoperable EHR systems could be identified (see Table 7). The dimensions of interoperability touched on three of the same areas as the accessibility barriers, which are: *challenges, policy, and usability*; however, slightly less saturated.

Table 9. Interoperability Barriers – Dimensions and Corresponding Papers

| Dimensions | Patients | Public | HCP | Admins | Supp |
|--|----------|--------|---------------|--------|-------|
| Interoperability challenges: trusting technical systems (9, 10, 13), or workflow integration (9, 10, 13) | 9 | | 9, 10, 13 | | |
| Policy: standard adherence (3,10) | | | | | 3, 10 |
| Usability (9, 10, 13, 14) | | | 9, 10, 13, 14 | | 9, 10 |

Interoperability Challenge. Challenges to interoperability came from *trusting technical systems*, where patients had reservations about using technical systems and requested more familiar pathways of services (9). The HCP's trust considerations were oriented around the functionality, e.g., accuracy of information being provided to those accessing the EHRs (9, 10, 13). The second challenge, *workflow integration*, was concerned with execution of technical systems that support workflow across disciplines, regions, or systems for interoperability. This was expressed, for example, in paper 9, where HCPs characterized "the importance of having work processes that fit with patients' visits and the need to clarify the e-prescribing process. For example, GP's felt that prescription renewal times were insufficient at 13 months." This delineates that the existing systems are not meeting expectations or standards for healthcare workflows (9, 10, 13).

Policy. Developing standards to guide suppliers and vendors to enable or support interoperability is perceived as being complex due to policy challenges to acquiesce to *standard adherence*. For instance, Denmark, Norway, and Sweden were reported to not follow the widely accepted EHR system standard of HL7 to support interoperability (3). Furthermore, there was a lack of medically oriented standards for adherence which HCPs could use for providing vendors or designers with system requirements. These include templates or terminologies for reference models resulting in deficient support and design from suppliers to provide comprehensive workflow services (3, 10).

Usability. Usability for interoperability is a challenge for both HCPs and suppliers. On one hand, HCPs report challenges in usability ranging from software specific difficulties (9), want of usable medical keywords for functionality (10, 14), and a better overall user experience (9, 10, 13, 14, 15). For the suppliers, the challenge is oriented around working with HCPs to provide services that fit all the needs of the stakeholders (9) and to have techniques for feedback between the user and the supplier (9, 10).

Looking at Table 9, in summary, we found that specifically HCPs and suppliers are of concern regarding the implementation and use of interoperable systems. Standard adherence in the context of policies is seen to be the concern of suppliers, whereas usability barriers in the context of EHR interoperability exist between HCPs and suppliers. Patients mainly have issues with trusting the technical systems.

Discussion

With this study we set out to answer what the dimensions of accessibility and interoperability to EHRs for relevant stakeholders in the Nordic countries are. In the previous section, we presented our results – the facilitators and barriers for EHR accessibility and interoperability. We will discuss the implications for research within the stakeholder contexts and implications for developing countries from our dimension findings in more detail next.

First, we found that there is an imbalance in research concerning the EHR stakeholders addressed. While patients, HCPs, the public and marginally suppliers have been addressed in previous research, there is a notable gap in focusing on administrators. Especially in the context of EHRs, it is paramount to also consider this stakeholder group, as pointed out by Singleton, Pagliari, and Detmer (2007). Other research into the potential or the ongoing implementation of interoperability (or the lack thereof) suggest that major healthcare IT vendors are resistant to it, which is in turn reflected as overlooked or understudied in research (Kellermann and Jones 2013) – as shown in this paper. Providing access requires individual companies or organizations to build systems which generate revenue through services rendered. However, interoperability requires the foresight to design a healthcare system or application to communicate or exchange information. Additionally, as illustrated in the results, there is a lack of qualitative knowledge or empirical evidence for such areas as usability in the Nordic countries, especially Iceland. This calls for further research into these areas with the stakeholders specifically oriented around administrators, vendors, suppliers, managers, or private organizations.

Second, we found that there are differences in what stakeholder groups are considered to be affected by or affecting the accessibility and interoperability facilitators and barriers. This is of particular interest for those countries that are currently in the process of planning or implementing EHRs. Based on our findings, we can suggest to countries that interoperability as an afterthought to accessibility may prove

to be a liability. As exemplified in Denmark's tactic, a bottom-up approach was initially instigated for regions to design and develop EHRs, but when it came to connecting, or exchanging information in EHRs boundless complications came to light (Kierkegaard 2015). Now, a reformed Danish healthcare system with a top-down approach (primarily using policy, planning, and prioritizing) has brought together a nationwide EHR (NEHR) system. In this system, applications of regulations and standards are applied as a blanket across various healthcare stakeholders, who in turn adopt them to their context which has proven very effective (Adler-Milstein et al. 2014; Kierkegaard 2015). Since Europe is strategizing towards a future with an interoperable cross-country healthcare system that supports all relevant stakeholders, a discussion amongst all these stakeholders is necessary to develop clear and concise top-down policy and plans for an accessible and interoperable healthcare system (Kautsch et al. 2017). Unifying the European aspiration of country-wide interoperable and accessible EHRs.

Conclusion

In this paper, we used the QES approach to identify 19 suitable papers for thematically analyzing in order to reveal dimensions of accessibility and interoperability of EHRs in the Nordic Countries. These were analyzed in the context of five relevant stakeholder types (Patients, Public, HCPs, Administrators, and Suppliers); the dimensions were concentrated on barriers or facilitators for accessibility and interoperability. Thirteen dimensions in total – eight for accessibility and five for interoperability.

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