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Deriving Facilitators for Electronic Health Record Implementation: A Systematic Literature Review of Opportunities and Challenges

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DERIVING FACILITATORS FOR ELECTRONIC HEALTH RECORD IMPLEMENTATION: A SYSTEMATIC LITERATURE REVIEW OF OPPORTUNITIES AND CHALLENGES

Research Paper

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Abstract

Electronic Health Records aim to remove information asymmetries between healthcare providers and contribute to improved healthcare quality and safety. Nevertheless, the successful and comprehensive implementation remains challenging and complex. Recently, increased interest of patients in their healthcare and enhanced technological opportunities led to new challenges and an emerging amount of research. To achieve an overarching overview of facilitators for EHR implementation, the perspectives of relevant stakeholders were considered. Therefore, we conducted a multidisciplinary systematic literature review involving five databases from public health, information systems, and interdisciplinary research. As a result, we first identified opportunities and challenges according to the stakeholder groups, environmental context, and implementation stages. Second, we derived five facilitators (individual stakeholder readiness, change management, accessibility and ownership, EHR structure, and external factors). Therefore, we lay a state-of-the-art foundation for EHR implementation for scientific studies and development activities in practice with our research.

Keywords: Electronic Health Record Implementation, Systematic Literature Review, Facilitators, Stakeholder Context Model.

1 Introduction

Electronic Health Records (EHRs) promise several beneficial outcomes, such as improved quality and safety of healthcare delivery (Alanazi and Anazi, 2019; Ruhi and Chugh, 2021). To achieve these

outcomes, EHRs provide a platform for information exchange among healthcare providers to decrease information asymmetries and develop a better data foundation for care procedures (Calder-Sprackman et al., 2021). This desired interoperability and exchange of sensible data among healthcare stakeholders is the logical next step after digitizing paper-based patient records (Evans, 2016). While the European Commission published a recommendation on EHR interoperability on an international level, governments that began conceptualizing national EHRs 10 to 20 years ago still struggle to successfully implement comprehensive EHRs (European Commission, 2019; Moncho et al., 2021; Tsai et al., 2020).

Furthermore, advances in data analytics through artificial intelligence, the medical internet of things, and mobile health applications in recent years are leading to new opportunities and challenges for the use of EHRs. Challenges arise regarding the connection of new stakeholders (e.g., companies such as Google and Apple) and subsequent legal and ethical data issues. Therefore, the various stakeholders in the healthcare sector are affected differently by the increasing interoperability, the new opportunities, and the emerging interdisciplinarity (Kohli and Tan, 2016). Within this current context, we address the perspectives of different stakeholders on EHRs and derive overarching facilitators for EHR implementation because a major factor influencing the success or failure of healthcare implementations is how potential user groups perceive the technology (Gagnon et al., 2012). Existing research focuses on individual user groups when examining factors influencing EHR implementation (e.g., Adedeji et al., 2018; Razmak and Bélanger, 2018) or investigating different user groups but not synthesizing the results (e.g., McGinn et al., 2011). Other systematic reviews do not explicitly consider the perspective of different user groups (e.g., Fennelly et al., 2020; Kruse et al., 2016a) or identify challenges or barriers solely without including opportunities (e.g., Gesulga et al., 2017; Kruse et al., 2016b).
Finally, this leads to a fragmented perspective of EHR research, resulting in two limitations. First, the lack of synthesis of challenges and opportunities leads to a skewed perspective that cannot provide an integrated prospect on EHRs. Second, the scarcity of consideration of different stakeholders leads to a one-sided observation that does not allow for an overarching view of facilitators for EHR implementation.

This study overcomes these limitations by deriving overarching facilitators based on the interdependencies of opportunities and challenges from the perspective of relevant stakeholder groups. Therefore, we pose the following research questions:

(1) *What are the challenges and opportunities of EHRs from the perspective of different stakeholders?*

(2) *What are the overarching facilitators for EHR implementation?*

To answer these questions, we conduct a multidisciplinary systematic literature review to explore the challenges and opportunities of each relevant stakeholder group and, subsequently, derive comprehensive facilitators for EHR implementation. The manuscript is structured in six sections. Section two provides the terminology of EHR, sheds light on national implementation efforts, and introduces the stakeholder groups and the environmental context. Section three outlines the systematic literature review process, identifying the challenges and opportunities. Section four presents the literature review results and the derivation of the five facilitators for EHR implementation. Section five discusses the facilitators in regards to technological impact and organizational transformation. Finally, section six presents the conclusion and limitations of this study.

2 Electronic Health Records

2.1 Terminology and national implementation efforts

Digitalization and its associated systems changed the way of accessing and analyzing EHRs. Since the first EHR was used in 1971, various definitions and interpretations of EHR have evolved globally (Evans, 2016). According to ISO/TR 20514:2005, an EHR is defined as follows: “Repository of information regarding the health status of a subject of care, in computer processable form, stored and transmitted securely and accessible by multiple authorized users, having a standardized or commonly agreed logical information model […]”. Therefore, it can be derived that EHRs offer a digital and

interoperable platform for various stakeholders around patient care delivery. Governmental efforts to implement comprehensive EHRs using policies, legislations, and incentives have existed for around 30 years (Moncho et al., 2021). Nations, regardless of having the status of a developing, emerging, or industrialized country, started initiatives to implement e-health strategies (Dornan et al., 2019; Parks et al., 2019; Sinha, 2013).

While most industrialized countries (i.e., the US, UK, Australia, Canada) started developing and implementing EHR strategies between 2000 and 2010 (Sinha, 2013), the pace and effectiveness of implementation vary. As the transferability and accessibility across borders gain importance, the EU started a unique project at the beginning of 2019 that helps transfer healthcare data stored in EHRs within the EU and meets the increasing demand for availability of healthcare data internationally (Hansen et al., 2021). Although nations trying to implement a comprehensive EHR work on similar goals and purposes, it is difficult to compare the success and stage of implementation since EHRs are implemented in non-comparable settings that rely on each system and country (Sinha, 2013). However, it can be observed that the implementation of EHRs can be interpreted as a flow of several implementation stages: starting with the (pre-)implementation and ending with the post-implementation (Bajwa et al., 2019; Bersani et al., 2020; Joukes et al., 2019; Tsai et al., 2020).

2.2 Stakeholder context model

When examining EHRs, we remark that various stakeholders are involved in implementing and using such systems in different environmental contexts. Since they interact with EHRs differently, we categorized them as primary and secondary stakeholder groups. Primary stakeholders have direct access to EHR data (Kohli and Tan, 2016). In contrast, secondary stakeholders do not directly contribute to creating and managing healthcare data but work with the respective data (Shah and Khan, 2020). They perceive different impacts on the EHR implementation process. First, in terms of their actions in contributing to care, and, second, in terms of their interactions with other stakeholders, for example, a potential change in the traditional patient-physician relationship through such systems (Choudhury et al., 2020; Hayrinen et al., 2008). Both stakeholder groups are determined by the environmental context, consisting of societal structures, habits, and behaviors, and, consequently, the government, including executive, legislative, or regulatory authorities, and the country in which an EHR is implemented. Thus, the successful implementation and application of EHRs depend on the environmental context. To understand the facilitators of EHRs holistically, we merged the two stakeholder groups and the environmental context and, subsequently, developed a stakeholder context model based on the work by Kohli and Tan (2016).

Primary Stakeholder Group (Patients, Providers, Purveyors)

Patients. The most important stakeholders in healthcare delivery are the patients since they directly profit from the EHR purpose and, consequently, from an enhanced quality of care (Kohli and Tan, 2016). As patients are increasingly interested in their health, they start to interact with EHRs by sharing information with providers and receiving information about their health status vice versa. Additionally, they are engaged with providers who create the services patients receive (Ye, 2021).

Providers. Providers are traditionally the second stakeholders involved in creating healthcare services (Choudhury et al., 2020). These stakeholders include all different stages of patient care (e.g., primary and secondary care) (Hayrinen et al., 2008). EHRs are implemented in the providers' daily workflows and take an important source in the habits of healthcare professionals and frontline workers such as physicians or nurses (Boonstra et al., 2021).

Purveyors. Initially, purveyors of EHR did not play a role in providing healthcare services. Nevertheless, as they act as providers of EHRs, they become increasingly important in sustainably delivering healthcare services (Kohli and Tan, 2016). Purveyors can be differentiated according to the technical requirements: first, technical purveyors own the EHRs and can adapt these systems to the needs of providers or patients. Second, infrastructure providers deliver the necessary infrastructure to create interoperability between EHRs.

Secondary Stakeholder Group (Clinical Research, Public Health)

Clinical Research. Clinical research refers to research institutions, researchers, and similar actors in clinical research who use available EHR data for different purposes to support research goals. As both the individual and aggregated levels of EHRs are easily accessible, EHRs are a valuable source for conducting studies (Taksler et al., 2021). Clinical researchers indirectly support the patient-provider relationship as they contribute new evidence that can be used to deliver healthcare services (Esserman, 2020).

Public Health. Public Health includes the stakeholders who use, as clinical research partly does, the aggregated population health level and its secondary data of EHRs to derive information and strategies to improve population-based healthcare in a specific region (Kohli and Tan, 2016). They are closely related to a nation's government which may derive policies from the analyzed data (Bery et al., 2020).

Environmental Context (Society, Policymakers)

The environmental context describes the setting in which EHRs are implemented. It creates an environment for the primary and secondary stakeholder groups and incorporates strong interdependencies with those.

Society. Society consists of influences associated with specific characteristics, such as economic, demographic, and geocentric factors, and the societal culture and behavioral patterns. Although these characteristics may not appear to be directly involved in the adoption and successful usage of EHRs, society plays a vital role in creating the setting for the implementation (Alkureishi et al., 2021; Jung et al., 2020; Parks et al., 2019).

Policymakers. These stakeholders represent the will of a nation's or region's society and shape the framework for EHRs (e.g., from a legal and financial perspective). Therefore, policymakers strongly influence the EHR implementation (Elkefi et al., 2020; Liang et al., 2021; Parks et al., 2019).

With the development of the stakeholder context model, we can describe interrelations and influences around EHRs, which create a complex environment since diverging interests drive different stakeholders. Consequently, implementing an EHR changes these interrelations between stakeholders and creates other opportunities and challenges while being interrelated with its particular environmental context.

3 Methodology

Existing research focuses on directly identifying facilitators (e.g., McGinn et al., 2011) or adoption factors of EHRs (e.g., Kruse et al., 2016a) by conducting systematic literature reviews, but such approaches increase the risk of omitting facilitators since they have to be stated as such explicitly in the included manuscripts and, subsequently, can be lacking further facilitators. In contrast, we conducted a systematic literature review of the opportunities and challenges of EHRs in a first step to derive facilitators as connection means between the identified challenges and opportunities in a second step. Such research design and the combination with the stakeholder context model allow for a holistic identification of facilitators for EHRs implementation by considering primary and secondary stakeholder groups and the environmental context, which is, to the best of our knowledge, not covered by existing studies so far. Since one goal was to provide a multidisciplinary overview of the subject and current research priorities, we considered a systematic literature review suitable to deal with many research activities that have emerged in recent years. Furthermore, such a structured overview helps to identify research approaches and gaps that can be addressed within the topic (vom Brocke et al., 2015). The systematic literature review was conducted following Kitchenham and Charters (2007), Snyder (2019) and Webster and Watson (2002). Since the field of EHRs is an interrelated and multidisciplinary topic, an interdisciplinary approach for conducting such a systematic literature review was necessary. As a result, we included databases from the fields of information systems (n=3), interdisciplinary research (n=1), and public health (n=2) to examine the topic holistically.

The search string was systematically derived from the research questions, and, thus, consisted of two components: challenges/opportunities and electronic health records. We extended the terms with

synonyms and abbreviations, resulting in the following search string: (EHR OR "health record") AND (opportunity OR advantage OR benefit OR potential OR chance OR gain OR challenge OR disadvantage OR barrier OR hurdle OR limit OR impact).

The 1st of January 2019 was chosen as a starting point for our search. The results should provide a synthesis of the previous findings and reflect possible trends of the past years since the introduction of the EU recommendation on EHR adaptation and international transferability of health data was published at the beginning of 2019. Following the described frameworks of the systematic literature review, the databases were searched until the 7th of June 2021, leading to 431 results. We summarized the whole process of the systematic selection of literature in Figure 1.

The initial search result of 229 papers was narrowed down by removing duplicates (n=168) and excluding non-research articles (n=34). In the next step, the titles and abstracts of the articles were screened for their fit to the research questions and their quality. First, we excluded articles that were not peer-reviewed (n=25) because of the lack of an objective quality appraisal. Second, we excluded articles that did not fit the research question (n=52) and articles that used EHR data to perform a study (n=31). After applying the exclusion criteria, 121 articles were considered for full-text screening. During the full-text reading, we used the quality criterion "clear and complete conduct of a research design." Hence, 15 articles were excluded since they did not meet that requirement (e.g., they had not elaborated an acceptable research method). At the same time, one more article was included by cross-referencing because it contained necessary information about a conducted study referred to by two articles. After applying all criteria, 107 articles were identified as relevant to answering the research questions.

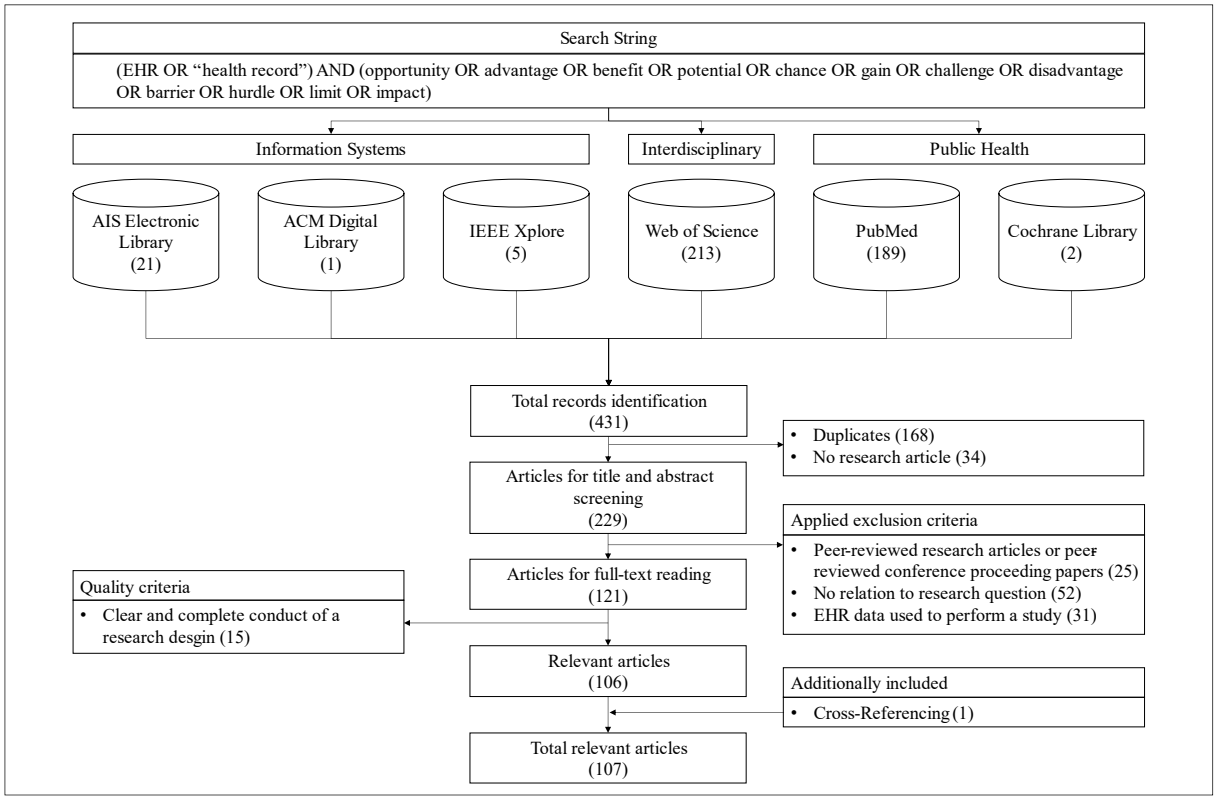

Figure 1. Process of systematic literature review.

Subsequently to the data collection, the results were systematically reviewed, synthesized, and categorized. First, relevant data were compressed, including the objectives, type of study, opportunities, challenges, implications, and limitations of each article. Second, data were collected on the category and source of the studies, year of publication, regional origin in terms of continents and countries, and individual setting. In an iterative process, a concept matrix, according to Webster and Watson (2002),

was created to structure the retrieved data. This concept matrix incorporates the stakeholder context model and the challenges and opportunities of EHR implementation.

4 Findings

From our final article set of 107, 99 articles were published in journals, and 8 were published in conference proceedings. These journals and conference proceedings focused on information systems (n=60) or public health (n=47). Most of the articles were published in 2019 (n=41), followed by the year 2020 (n=38) and the year 2021 until the 7th of June (n=27). Regarding the geographical distribution, most articles were published in North America (n=61), followed by Europe (n=25) and Asia (n=14). From a methodological perspective, the authors mainly conducted literature reviews (n=24). However, also a significant number of articles employed case studies (n=13), interviews (n=13), or surveys (n=10). A closer look at the setting of the articles showed that most articles focused on a specific provider setting, namely hospitals (n=56). If not, many articles targeted healthcare systems (n=29) or disease management (n=19).

4.1 Challenges and opportunities of Electronic Health Records

We found a total of 16 challenges and 11 opportunities for EHRs. In terms of challenges, the majority (n=13) occurred during all stages of implementation, whereas only a few challenges (n=4) got apparent for the secondary stakeholder group in the post-implementation stage. Regarding the stakeholder groups, we could identify the majority of challenges (n=9) and opportunities (n=6) from the perspective of the primary stakeholder group. At first, we present the identified challenges related to the respective stakeholders and then describe the identified opportunities. Hereby, Figure 2 provides a holistic overview of the identified challenges and opportunities in relation to the respective stakeholders and the environmental context, as well as the implementation phases.

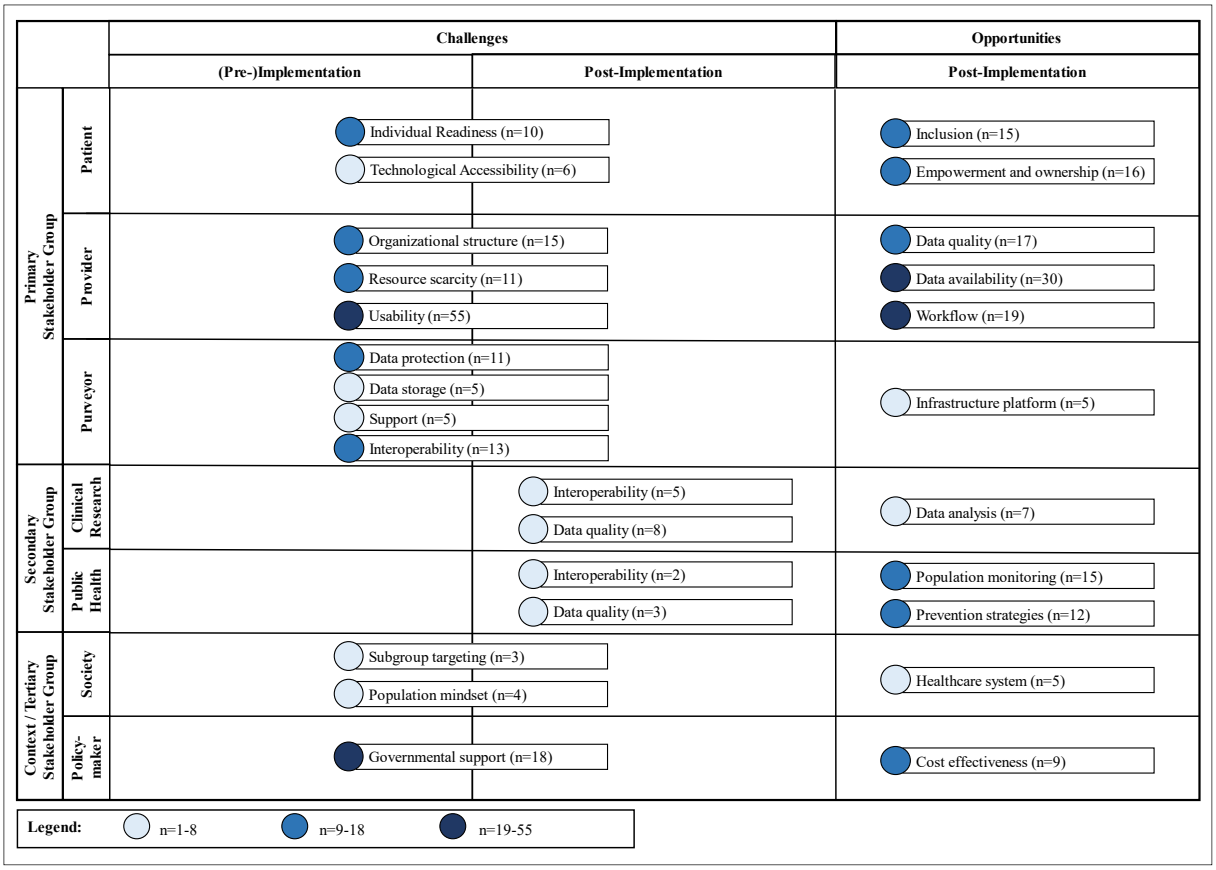

Figure 2. Challenges and opportunities of Electronic Health Records.

For the success of EHR implementation, the commitment of the involved *patients* is a critical challenge (Ploner et al., 2019). Thereby, **individual readiness**, such as patients' barriers to digital solutions or the system accessibility, plays an important role (Alanazi and Anazi, 2019). Besides, this readiness for EHR incorporates patients' psychological barriers, which are lacking trust in the system's security (Alanazi and Anazi, 2019; Ploner et al., 2019) or insecurities regarding the changed patient-provider relationship (Harrison et al., 2019). Lastly, the **technological accessibility** (e.g., computer literacy, barriers in the availability of digital infrastructure, or lacking customization for vulnerable (sub-)groups) further impede the patient's readiness (Eriksson-Backa et al., 2021; Foer et al., 2020; Miklin et al., 2019; Weatherly et al., 2019). One of the most frequently mentioned challenges for *providers* is **usability**. As frontline workers are asked to use EHRs in their daily workflow, usability barriers and workflow disruptions can lead to unmet expectations, rejection, and, consequently, failed system implementation (Joukes et al., 2019; Moerenhout et al., 2020). The negative impact may even go beyond that: an inadequate EHR implementation may result in information and work overload, workarounds, or burnout of the frontline workers in the short and mid-term (Boonstra et al., 2021; Gali et al., 2019; Peccoralo et al., 2021; Shah and Khan, 2020; Wisner et al., 2019), and lower healthcare quality in the long-term (Cohen et al., 2019; Harrison et al., 2019; Nestor et al., 2021). Above all, providers often face **resource scarcity** (Dornan et al., 2019) and challenges due to the **organizational structure,** which can impede the overall organizational readiness towards an EHR implementation due to its specific organizational culture or size, including the style of leadership and change management processes.

Depending on the broader environment in which EHRs shall be integrated, *purveyors* are responsible for establishing **interoperability** between existing IT systems of providers (Chen et al., 2020). Moreover, interoperability shall also be assured between EHRs and newly developed systems storing health data, such as wearables (Afrizal et al., 2019; Chipps et al., 2020; Parks et al., 2019). Therefore, creating an integrative system that enables health data transferability is crucial (Dornan et al., 2019). When processing data, **data protection** is important, including developing holistic strategies to establish trust and confidentiality for patients and providers (e.g., through encryption or authorization standards) (Keshta and Odeh, 2021; Koren and Prasad, 2020; Tapuria et al., 2021). Equally important for EHR implementation is to ensure adequate **data storage** options to reduce the actual amount of stored data (García-Berná et al., 2021; Hohemberger et al., 2020). Lastly, the purveyors shall ensure sufficient **support** for the providers during and after implementing EHRs, as ongoing support of providers is required to successfully adapt the implemented EHR designs and workflows to the needs of professionals. Regarding *Clinical Research,* a lack of standardization and, especially, **interoperability** between providers complicates data aggregation (Shah and Khan, 2020). In addition, administrative burdens and bureaucratic challenges, including legal questions about the security of patient data when records are accessed, compound the lack of interoperability (Butame et al., 2021; Taksler et al., 2021). Second, **data quality** must be realistically assessed. This challenge arises since patients' health data are dynamic and often episodic and may contain human errors, which could significantly affect research results (Harding et al., 2020; Taksler et al., 2021). Besides, the quality of data may be hampered by issues of interpretations regarding the analyzed data (Fu et al., 2020; Ni et al. 2019). Consequently, researchers need to develop specific knowledge and skills and learn how to conduct EHR data investigations to obtain results that genuinely help to improve care (Taksler et al., 2021). For *Public Health,* two challenges were most prominent: on the one hand, it is essential to ensure **interoperability** among stakeholders, such as providers and public health agencies, and support standardizations for the data exchange (Feller et al., 2019; Hatef et al., 2019). On the other hand, securing high **data quality** is challenging but essential to support public health strategies and interventions based on the EHR data (Hafer et al., 2019)**.** Data quality also depends on the difficulties of data analysis, as social and behavioral determinants of health, which are particularly important for chronic disease prevention, are fluid and often incomplete. As a result, the analysis and interpretation of EHR data for public health purposes is challenging and usually requires costly tools and algorithms to achieve interpretability (Feller et al., 2019; Zhang et al., 2019). Concerning *Society,* cultural barriers exist which may prevent **the targeting of subgroups** of a population from adopting the new systems due to their unique socio-economic background, ethnicity, or education level. Therefore, the successful adoption of EHRs requires the

acknowledgment of these differences and adopting the EHR provision to the particular setting (Alkureishi et al., 2021; Elkefi et al., 2020). In a broader approach, the **population's mindset** (e.g., the level of confidence in technological advances or security mistrust, the age of the citizens, or the country's economic progress) are essential in the adoption of EHRs (Eriksson-Backa et al., 2021; Parks et al., 2019). A critical challenge for *Policymakers* is **governmental support,** that can mainly be divided into strategy and resource support categories. On the one hand, strategy support consists of a holistic approach for sustainable implementation of interoperable and inclusive EHRs backed by policy and regulatory support (Adler-Milstein and Wang, 2020; Liang et al., 2021). Consequently, agencies need to create reliability for key stakeholders through standardization efforts. However, this goal is challenging to achieve, mainly due to the involvement of many stakeholders and their diverging expectations (Parks et al., 2019). On the other hand, regarding resource support, this would primarily imply the identification of providers who struggle to implement EHRs by allocating scarce resources (Liang et al., 2021; Parks et al., 2019). Thus, governmental support shall focus on accelerating sustainable innovations and protecting and securing sensitive patient health data (Butame et al., 2021). This support for innovation also includes further standardization of EHRs and incentives to connect stakeholders to the EHR infrastructure (e.g., to accelerate the use of secondary data) (Butame et al., 2021; Feller et al., 2019).

After having presented the identified challenges of EHRs, we reflect on the identified opportunities of EHRs for the respective stakeholders and the environmental context. *Patients*, especially vulnerable groups, may benefit from the **inclusion** in EHRs. First, EHRs offer the ability to better identify and address individual needs. In particular, as observed in several studies, customized offerings for subgroups and chronic care settings (e.g., diabetes) can be valuable due to the ability to contribute personal data (Cunningham et al., 2019; Miklin et al., 2019; Ploner et al., 2019). Second, EHRs enable patients to achieve high accessibility and availability to their health data, increasing patient **empowerment and ownership** (Gui et al., 2020; Koren and Prasad, 2020). In particular, patients can monitor and review data on current or past treatments, medications, or test results. As a further result, patients may better understand their healthcare issues and, thus, be better informed, transforming the patient-provider relationship into a more collaborative partnership (Subbe et al., 2020). The increased **data availability** has various positive effects on the *Providers* – on a medical and an administrative level. At first, diagnosis and clinical decision support quality may benefit from better data availability across multiple providers (Koren and Prasad, 2020; Kovács et al., 2019; Ruhi and Chugh, 2021; Subbe et al., 2020; Vivanti et al., 2021). Also, medical treatments may even get more suited to the patient's individual needs and, thereby, be more precise and holistic through the existence of EHRs (Hoffman et al., 2020; Subbe et al., 2020). Furthermore, an EHR implementation might positively impact the **workflow** (e.g., through more standardization, improved communication, and more efficient documentation) (Bajwa et al., 2019; Jung et al., 2020; Liu and Edye, 2020; Nguyen et al., 2021; Suess et al., 2019). Above all, the potential improvements on a medical and an administrative level may contribute to higher **care quality**, as EHRs function as mediators and bring all relevant information together, which ultimately reduces information asymmetries between providers (e.g., regarding medication) (Calder-Sprackman et al., 2021; Neves et al., 2020). For *Purveyors*, EHRs may serve as a foundational **infrastructure platform** for other e-health technologies by interconnecting various stakeholders and containing the necessary data (Parks et al., 2019; Weatherly et al., 2019). Consequently, EHRs can act as a catalyst by providing opportunities to integrate complementary tools such as wearables, smart devices, and documentation facilitators. Furthermore, additional provider services (e.g., telehealth) could be offered through EHRs (Moerenhout et al., 2020; Parks et al., 2019; Weatherly et al., 2019). The major opportunity for *Clinical Research* exists regarding **data analysis**, as EHRs can serve as a tool for identifying and recruiting appropriate study participants (Esserman, 2020; Taksler et al., 2021). Besides, researchers may also conduct remote research studies more easily because data might be directly transferred to research databases (Esserman, 2020). Additionally, researchers can benefit from easier access to aggregated secondary data for future research endeavors (Harding et al., 2020; Shah and Khan, 2020). The opportunities for *Public Health* are twofold: on the one hand, EHRs may facilitate (better) **population monitoring**, as a vast amount of health-related data of the entire

population is available (Yeung, 2019). On the other hand, **prevention strategies** are even more individualized for the at-risk groups based on the data stored in EHRs (Bery et al., 2020; Dornan et al., 2019; Tan et al., 2020). EHRs have the potential to improve and advance the entire **healthcare system** for *Society*. This new level of healthcare in society may be achieved through the improved health services which are already implemented and delivered by providers within an EHR implementation and function as an accelerator for technological advances and a platform for innovation through EHRs (Kataria and Ravindran, 2020; Opipari-Arrigan et al., 2020; Tayefi et al., 2021). *Policymakers* may also have the potential to streamline healthcare systems and improve **cost-effectiveness** by implementing EHRs, which would reduce the burden on society and public spending. In particular, EHRs can contribute to the policymakers' goals by lowering healthcare costs and improving the overall population's health (Liang et al., 2021).

4.2 Facilitators of Electronic Health Record implementation

Through consolidating the challenges and opportunities of EHRs, we identified five facilitators for successfully implementing EHRs. Thereby, Figure 3 provides an overview of the influence of the five facilitators of EHR implementation on the stakeholders and the environmental context.

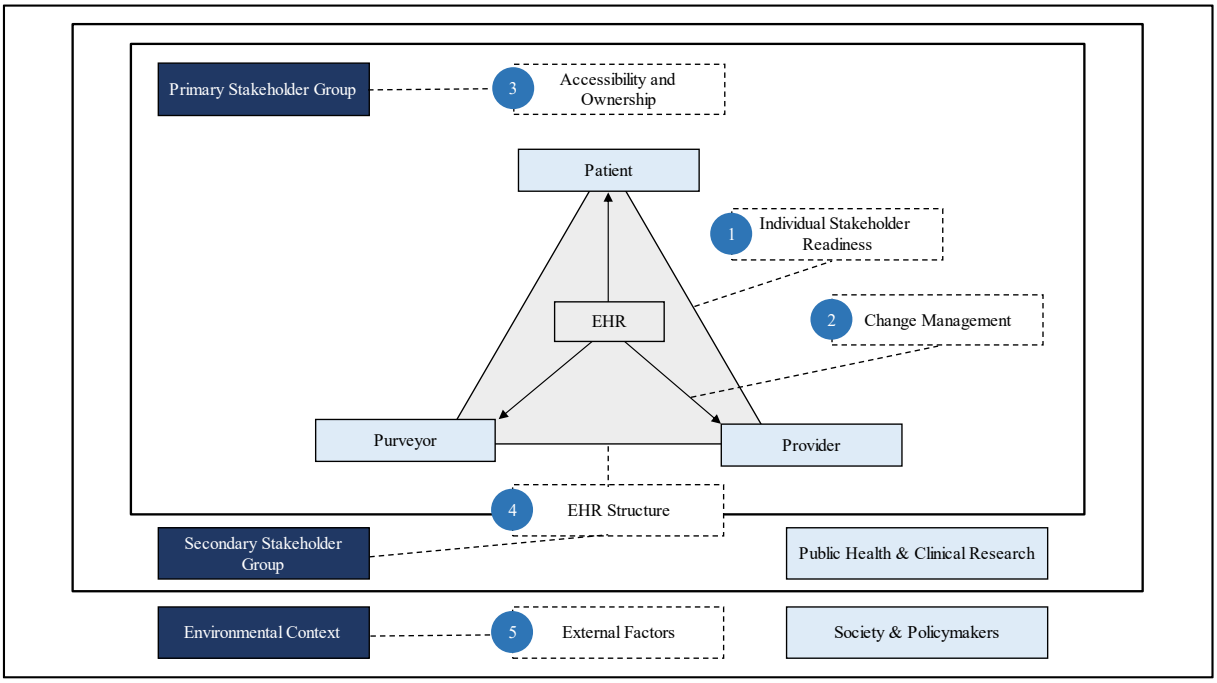

Figure 3. Facilitators of Electronic Health Record implementation.

(1) Individual stakeholder readiness of patients and providers. While the general availability of reliable EHRs from purveyors is given, creating acceptance and readiness among patients and providers is essential for successfully implementing EHRs (Alanazi and Anazi, 2019).

From the patients' perspective, individual readiness mainly depends on technical and psychological barriers (Eriksson-Backa et al., 2021; Miklin et al., 2019; Weatherly et al., 2019). These challenges are often determined not only by the general setting of a population or sub-population in which an individual lives but also by other individual barriers that result from factors such as demographic characteristics, ethnicity, education, or area of living (Alanazi and Anazi, 2019; Eriksson-Backa et al., 2021; Kataria and Ravindran, 2020). Eventually, these challenges may lead to discrimination and exacerbate healthcare disparities due to unequally distributed infrastructure access and IT illiteracy in EHR adoption (Alanazi and Anazi, 2019; Eriksson-Backa et al., 2021; Kataria and Ravindran, 2020). In addition, psychological barriers such as a lack of trust in EHR purveyors, healthcare providers, or institutions, and EHRs themselves could impede measurement effectiveness and willingness to

contribute to EHRs (Ploner et al., 2019). As both patients in general and subgroups at risk in specific could experience benefits through EHRs (i.e., inclusion, empowerment, and ownership regarding their health), interventions such as campaigns, training, nudging, or improved usability appear to be needed to counteract this trend. From the providers' perspective, acceptance can act as both a driver and barrier to EHR adoption and usability (Ploner et al., 2019). Similar to the patients' perspective, the adoption of EHRs among healthcare professionals could be low due to lacking IT literacy, age structure, or reluctance to embrace digitization (Bajwa et al., 2019). Furthermore, the purveyors' support seems to play an essential role in provider acceptance as well. In this context, information asymmetries between purveyors and providers may lead to unmet expectations of and low satisfaction among frontline workers (Bersani et al., 2020; Gui et al., 2020; Liang et al., 2021). To make full use of the EHR in frontline workers' workflow and, consequently, delivered care, the frontline workers' readiness is crucial to the successful implementation of EHRs.

To conclude, the individual needs of patients and providers regarding EHRs must be explored to create engagement and increase the willingness to contribute to the successful implementation of EHRs (Neves et al., 2020).

(2) Change management in provider entities. To engage healthcare professionals in the process of transitioning from a paper-based electronic medical record to an EHR, a holistic implementation process within provider entities is required that includes all stages of implementation (Joukes et al., 2019). Therefore, considering our findings, change management knowledge seems highly useful and needed to provide a sufficient framework for change.

There is the need to solve two challenges to benefit from the opportunities in the provider environment (e.g., an improved workflow and better medical outcomes due to increased data availability). First, regarding the frontline workers, mental preparation seems to be helpful to overcome the challenges of EHR implementation in the process of change (e.g., Bajwa et al., 2019; Bersani et al., 2020; Joukes et al., 2019). This preparation can include organized training programs for frontline workers in the pre-implementation stage when implementing EHRs (e.g., Choi et al., 2021; Miller et al., 2021; Yang et al., 2019). In the post-implementation stage, an evaluation of EHRs should be part of the implementation, as it increases the providers' engagement to involve healthcare professionals in adapting the design, usability, and communication (e.g., Bersani et al., 2020; Murphy et al., 2019; Nguyen et al., 2021). Besides, on an organizational level, challenges concerning the overall provider context influence how change management processes, the change itself, and the implementation of EHRs are carried out. Challenges involving organizational culture, leadership, and provider characteristics can impede or accelerate EHR implementation efforts (Afrizal et al., 2019; Parks et al., 2019).

In summary, to address the challenges, a well-structured change management process is an essential enabler. It helps to leverage the frontline workers' commitment to break down organizational barriers and successfully implement EHRs.

(3) Accessibility and ownership of the primary stakeholder group (patients, providers, purveyors). The introduction of EHRs as a medium empowers the patient's role as a decision-maker. This new empowerment could lead to a greater demand for ownership, not only of the patients' health but also for managing their health data (Tapuria et al., 2021). Based on our findings, we identified three major aspects that need to be addressed to enable the successful use of EHRs.

First, and regarding the issue of ownership in terms of an interoperable EHR, the patient or the provider (e.g., the general practitioner) could be considered a possible responsible entity for managing a patient's medical history. In this context, it is required to discuss to what extent patients' consent to data access should be mandatory from a primary or secondary stakeholder group position (Goldstein, 2020; Shah and Khan, 2020; Taksler et al., 2021). Second, it should be specified which data is stored in EHRs and which stakeholder needs what amount of data when introducing an interoperable infrastructure platform. Such specification is relevant due to the different providers' needs and keeps the flow of information at a manageable level. Consequently, EHRs should make the data available that is genuinely needed for

clinical care procedures to prevent harm to the frontline workers and improve data security and confidentiality (Moerenhout et al., 2020; Tayefi et al., 2021; Tutty et al., 2019). Third, the technical implementation of general accessibility and data storage should be examined. Various options, from centralized data storage to new decentralized methods, exist, which can help to improve data availability, security, and confidentiality (Capece and Lorenzi, 2020; Mehta et al., 2020).

Concerning the elaborated enablers based on accessibility and ownership, it can be concluded that a balance between data accessibility and data scarcity could be helpful to take advantage of the opportunities of EHRs and provide an added value to society (Parks et al., 2019; Tutty et al., 2019).

(4) EHR structure related to purveyors, providers, public health, and clinical research. As the literature review reveals, not all information collected is always relevant to every stakeholder with access to EHR data. Besides, the principle of information scarcity should be ensured. Thus, it is necessary to realize a multidisciplinary approach to EHRs (Moerenhout et al., 2020).

In this regard, frontline workers from provider organizations face the challenges of usability and organizational barriers, as they often require, depending on their profession, a more customized design of EHRs (Moerenhout et al., 2020). At the same time, the secondary stakeholder group (Public Health, Clinical Research) depends on a high ratio of standardized information to derive reliable information from the data (Feller et al., 2019; Hatef et al., 2019; Shah and Khan, 2020). Consequently, diverging challenges arise that need to be overcome. For achieving the opportunities of EHRs, new approaches need to be developed by purveyors and providers in close collaboration to strike a balance between customization and standardization (Bansler, 2021).

In conclusion, an individually balanced approach could not only help to relieve the documentation burden from frontline workers but also to achieve the overall goals of patient-centered EHRs and multidisciplinary accessibility, including the secondary stakeholder group, while avoiding information overload (Hron and Lourie, 2020; Moerenhout et al., 2020; Shah and Khan, 2020; Weir et al., 2021). Therefore, it seems worthwhile to reflect upon the current EHR structures and seek the help of technological progress.

(5) External factors of the environmental context. The environmental context, including society and policymakers, largely influences the successful implementation of EHRs as these stakeholders function either as an accelerator or a decelerator. As primary and secondary stakeholders are embedded in the environmental context, their opportunities cannot be fully exploited without successfully managing the challenges and opportunities of society and policymakers.

The patterns of a society determine cultural barriers and a population's mindset towards technological advances and security concerns (Niazkhani et al., 2020). These cultural aspects affect, for example, the readiness of primary stakeholders such as patients and frontline workers towards change, resulting in an influence on the overall readiness towards EHRs. In addition, the role of policymakers may contribute to or hinder the success of EHRs through the grade of shaping the EHR framework in terms of strategic and financial support (Adler-Milstein and Wang, 2020; Liang et al., 2021). Policymakers shape the legal and ethical roots regarding accessibility, ownership, and data security and, therefore, represent societies' preferences (Goldstein, 2020; Shah and Khan, 2020; Taksler et al., 2021). While, for example, in the US, private companies enjoy a high level of trust in society, it would be unlikely for private companies to achieve the level of patient engagement that is necessary to build trust in the system in Germany (Ploner et al., 2019). Nevertheless, both stakeholders can positively impact the EHR implementation. They may, therefore, act as enablers, while the success of EHRs contributes to a more robust and innovative healthcare system and higher cost-effectiveness (Kataria and Ravindran, 2020; Lewkowicz et al., 2020; Liang et al., 2021; Opipari-Arrigan et al., 2020; Rudy et al., 2019; Tayefi et al., 2021).

To conclude, society and policymakers act as enablers not only for its opportunities but also influence the opportunities of other stakeholders due to the high interdependencies of the context in which an EHR is implemented.

5 Discussion

After identifying challenges and opportunities from the perspective of the two stakeholder groups and the environmental context, we derived five facilitators for EHR implementation. Based on these results, we first discuss the impact of future technological developments on the facilitator's *accessibility and ownership* and *EHR structure*. Second, we outline the effects of future organizational transformations on the facilitators *individual stakeholder readiness*, *change management*, and *external factors*.

Technological impact (accessibility and ownership, EHR structure)

Regarding *accessibility and ownership*, various options, from centralized to new decentralized forms of data storage, exist, which can help to improve data availability, security, and confidentiality (Capece and Lorenzi, 2020; Mehta et al., 2020). First and foremost, blockchain technology can be seen as a promising solution for storing patients' health data in a decentralized manner. Such decentralized information storage provides a higher degree of redundancy and, therefore, increases availability and security. These sensitive data are not stored centrally in one database but on every node instead. Thus, infiltrating and manipulating information becomes more complex than in a central database. Furthermore, emerging identity concepts (i.e., self-sovereign identity) can address the patients' risk of losing control over their health data. Since these data are highly sensitive and should only be visible to as few stakeholders as possible, such identity concepts can give the patients control and authority over their data. Thereby, the patients may provide and deny access to the respective parties without relying on a central institution to manage the access rights. Nevertheless, such patients' autonomy increases the risk of a lower degree of data protection. This risk may occur since patients have to undertake security measures to protect their data from unauthorized access, misusage, or theft, as this would no longer be the responsibility of central providers. A solution to this problem could be a self-sovereign identity concept that does not grant complete data sovereignty to patients but in which specific data flows are already defined and released in advance (e.g., all findings are returned to the general practitioner). Otherwise, patients would have to release all data flows individually, which would increase complexity and control effort. Additionally, such an approach would prevent patients from not giving the required releases due to unreliability and forgetfulness. Subsequently, the attending physicians would not have access to necessary treatment data. Additionally, we identified natural language processing as an exciting opportunity concerning the *EHR structure* (Moerenhout et al., 2020). Natural language processing can standardize unstructured texts (e.g., radiology reports) that can be added to EHRs. This approach would enable better monitoring of disease patterns and extract relevant medical information for clinical research to improve care.

Organizational transformation (individual stakeholder readiness, change management, external factors)

Besides the technological impact, *individual stakeholder readiness* and *change management* are both challenging and important. During our research, we observed that the primary stakeholder group (patients, providers, purveyors) and their challenges play a key role during all stages of EHR implementation. Furthermore, we identified that the secondary stakeholder group (public health, clinical research) especially imposes challenges in the post-implementation stage. Additionally, the *environmental context* determines the expectations and individual needs of the two stakeholder groups towards EHRs. Moreover, inter-organizational collaboration is likely to increase in the future. Stakeholders (e.g., policymakers such as the EU) try to achieve a more significant national or international interoperability level, inevitably leading to increased complexity. Furthermore, private purveyors and companies will try to meet patients' new needs due to the increased engagement in their health (Tayefi et al., 2021). For example, Apple has recently initiated offering interconnectivity between EHRs of healthcare providers and its health application to share patient-generated data with healthcare providers (Apple, 2021). These collaborative and multidisciplinary approaches could help to advance EHRs and demonstrate beneficial opportunities, including improved healthcare quality and safety

(Alanazi and Anazi, 2019; Ruhi and Chugh, 2021). In conclusion, the collaboration between all stakeholders is crucial for EHR implementation since they have potentially diverging interests.

6 Conclusion

In this paper, we conducted a systematic literature review to gain insights into the challenges, opportunities, and facilitators of EHR implementation. First, we derived 16 challenges and 11 opportunities related to EHR implementation through a broad and multidisciplinary approach. Second, we combined these challenges and opportunities to derive five facilitators for EHR implementation, namely *(1) Individual stakeholder readiness of patients and providers*, *(2) Change management in provider entities*, *(3) Accessibility and ownership of the primary stakeholder group (patients, providers, purveyors)*, *(4) EHR structure related to purveyors, providers, public health, and clinical research*, and *(5) External factors of environmental context.*

We found that the primary stakeholder group (patients, providers, purveyors) and their challenges are crucial during all stages of EHR implementation. In this context, especially the organizational and individual readiness towards change is challenging and important. Besides, we observed that the secondary stakeholder group (public health, clinical research) especially imposes challenges in the post-implementation stage. Furthermore, the environmental context determines the expectations and individual needs of the two stakeholder groups towards EHRs that have to be considered when implementing such systems. Overall, we highlighted that the challenges and opportunities of EHRs are determined by a highly complex environment, including various stakeholders and the individual, societal context.

Although we pursued a rigorous research approach, our study is subject to four limitations. First, due to the large amount of literature and the broad approach to conduct the systematic literature review, only a small part of the relevant literature (2.5 years) was reviewed. Due to this time limitation, trends in EHR research could not be derived. Second, since a standardized definition for EHRs according to ISO/TR 20514:2005 exists, we assumed that all analyzed papers share the same understanding. However, we did not check whether this truly applies. Third, it should be noted that the studies were conducted in specific countries. While a strong focus on North America was identified, generalization to other cultural contexts and healthcare systems (e.g., South America or Africa) may be difficult. Thus, when interpreting the results, it should be taken into account that each environmental setting brings its own regulatory, economic, and ethical background. Fourth, a strong focus on hospitals within the provider setting was identified, making it even more challenging to generalize the results of this study to other provider settings.

Nevertheless, it is necessary to identify facilitators serving as a basis for investigating the relations and dependencies between the different stakeholders when implementing EHRs. Therefore, we build a state-of-the-art foundation that further studies in research or development activities in practice can employ. Subsequently, we suggest the following directions for future research: first, our findings could be compared with existing theories about innovation diffusion and adoption to enhance the theoretical body of knowledge. Second, studies could consider expanding the period of 2.5 years to reflect research trends for EHR implementation more closely. Third, since we regarded EHR implementation as independent of country-specific regulatory frameworks and different technical instantiations to achieve the generalizability of our findings, future research could catch up on this point and investigate such implications. Fourth, the opportunities, challenges, and facilitators for EHR implementation, which we derived from conducting a multidisciplinary systematic literature review, might seem intuitive and generic at first glance since they could be applicable for other digital transformation projects as well. However, when taking a closer look, we list the specific characteristics and uniqueness of EHR implementation in the respective text passages. Future research can take up on this and analyze the respective opportunities, challenges, and facilitators of EHR implementation individually regarding their country-specific regulatory frameworks, technical instantiations, and influence on different, stakeholders in detail to, consequently, enhance the foundation, which we laid with our research.

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