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Open or Closed: A Project Proposal for Investigating Two Different EHR Platform Approaches

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Abstract. Technical platforms form the fundament on which IT systems and Electronic Health Records (EHRs) are implemented. The use of either open or proprietary standards and technologies for information modelling and interoperability have implications for how clinical and health data is handled and made available for the system users. In Norway, two different EHRs are procured in different health regions of the Specialist healthcare service. The two platforms are characterized as one being open platform-based and the other being closed platform-based. The study aims to identify and describe consequences and implications related to two different platform approaches for EHRs from an end-user perspective. The study will employ three methods of data capturing; scoping study, interviews, and questionnaires. Data will be systematically analyzed through proven methods. Interviews and questionnaire data will be gathered from European hospitals having implemented EHRs in recent years. Results will be compared to the Norwegian context. The technical platform used for health IT systems in general, and the EHR specifically, can have substantial consequences for clinicians and organization of work. Closed platform-based EHRs still constitutes the majority of the market, but open platform approaches are rapidly gaining popularity. An assessment of the consequences related to different platform designs can shed light on the implications the chosen technical approach will have on clinical and organizational practice.

Keywords. Electronic Health Record, Open Platform, Closed Platform, User Satisfaction, Adoption Rate, Implementation, System Evaluation, openEHR

1. Introduction

From the early developments and implementations of Electronic Health Records (EHRs) in clinical practice in the late 70s and 80s, healthcare has undergone an extensive process of digitalization and innovation. Initiatives to improve treatment, care, patient safety and effectiveness with Information Technology (IT) and digital tools are ever-increasing. Concurrently, both the number and complexity of healthcare IT systems that clinicians have to rely on in their day-to-day work increases. Clinicians are dependent on effective, intuitive and adapted IT systems to treat and care for patients; documenting, accessing and evaluating patient information is to a large degree done through digital formats. The

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technical platform used for health IT systems in general, and the EHR specifically, can have substantial consequences for clinicians and organization of work. The architecture of the platform, and in turn also the clinical applications that run on top of the platform, are built using either open standards, proprietary standards or a combination. In this study we will investigate two conceptually different architectural platform approaches.

2. Open platform-based EHRs vs Closed platform-based EHRs

For most healthcare provider organizations, the EHR contains the core functionality for documenting and accessing patient information and health data. The bedrock of any system application ecology is the platform, which provides a set of technical specifications and definitions for the interface and integration of separate applications implemented on the platform [1]. For the sake of argument, we will draw a conceptual line between the two different approaches for EHR platforms; on one side, are platforms based on open standard specifications for architecture and information modelling – from now on termed 'Open Platform EHRs'. For an EHR platform to be truly *open*, it arguably needs to conform to a set of principles. In 2016, Ewan Davis proposed that such principles should include the following; i) the use of freely available open standards; ii) the use of common information models; iii) that applications implemented to run on one instance of the platform easily can be implemented and ran on a different instance of the open platform; iv) the standards used in the platform should be technology and vendor neutral; v) the support for open data in a sharable and computable format; vi) the platform should provide open APIs [2].

On the other side are closed platforms, where the technical standards and information models used in the architecture are developed, maintained and controlled by the vendor using primarily proprietary technologies [1]. Traditionally, EHRs have to a large degree been based on closed platform architectures, often labeled 'megasuits' and 'monolithic systems' – termed 'Closed Platform EHRs'. From a business perspective, the idea behind megasuits have been to offer if not all, then most, needed software functionality in a single solution [3]. While this approach can yield great stability, it inevitably leads to 'vendor lock-in' and a situation where the vendor controls the data, and information interoperability and agility is impeded [4, 5]. On an open platform, it will be substantially easier to either replace applications or add new applications when new needs arise [6]. This dichotomous distinction between the two conceptual approaches is, however, a simplification; on a continuum ranging from open to closed, EHRs can be found on either side of a centre line, rather than on either periphery, depending on its characteristics.

3. Norwegian context

The Norwegian specialist healthcare system is organized in four separate geographic regions. Each Health region operates a number of hospitals and outpatient clinics, and governs their region with a large degree of autonomy in terms of IT decisions and procurements. Today, three of the health regions runs different implementations of the same EHR system from the Norwegian vendor DIPS AS, while the fourth is in the process of procuring a solution from the US vendor EPIC Systems.

The next version of the DIPS EHR (DIPS Arena) is based on the openEHR platform

specifications, and will be implemented in all three health regions currently running DIPS. With the new EHR, DIPS is moving from the proprietary, closed platform-based approach of their current EHR, to an open platform approach with DIPS Arena [7]. There are also cross-regional efforts to consolidate the databases between the three health regions [8]. In addition, through the public organization Nasjonal IKT, the Norwegian healthcare sector has a significant involvement in the development of the openEHR archetypes (ISO 13606) information standard [9]. Although EPIC Systems are, to some degree, starting to use open sourced standards and APIs through the Fast Interoperability Resources (FHIR) specification [10], the EHR is still considered a monolithic and proprietary, closed platform-based systems [4]. This places the fourth health region's EHR in stark contrast to the upcoming EHR in the three other regions, at least in terms of the chosen platform approach. Common for all of the health regions, are the fact that they are procuring EHR systems that architecturally are fundamentally different from what they currently are using.

Nationally, the Norwegian healthcare system operates toward a strategical aim of 'One citizen – one journal' [11]. This implies that a patient's health data should be available regardless of which hospital or health region s/he is admitted to. In practice extending the scope of the EHR from the institution level to a national integrated health and care community. A prerequisite for this, is that data needs to be fully interoperable between IT systems and organizational lines. The platform and information modelling used by their new EHRs will have implications also for how legacy data and systems are migrated and made available for clinicians post-implementation [12]. The consequences of using differing technical platform approaches to achieve this not fully understood. We wish to explore this in the present project.

4. Objective and research questions

In order to fully understand the consequences of EHR and platform choices, more knowledge is needed. The Norwegian context is unique; the specialist healthcare's IT systems are based on two arguably conceptually different approaches. We propose a study protocol to investigate and examine consequences of implementing either an open platform-based EHR or a closed platform-based EHR in general, and examine consequences for a future Norwegian system landscape.

The proposed subject is one that can be investigated from a number of perspectives; implementation process evaluation, technical implications, clinical outcome, workflow and organizational effects, financial consequences and patient care delivery and safety are all relevant variables when studying health IT innovation. The focus in the present study is on clinicians and their perceptions of usability in their EHR.

The main research question in this study is:

- Does the underlying technical EHR platform affect system adoption rate among clinicians?

Secondary research questions are:

- How does the underlying technical platform affect clinicians perceived system usability?
- How does clinician satisfaction with the EHR compare between the open platform approach and the closed platform approach?

5. Methods

The scope of the present project has to be sufficiently narrow to provide practical analysis for the Norwegian national context, yet wide enough to not miss important evidence from sources outside of traditional academia. For instance, a part of the evidence that are relevant for the subject at hand exists in non-peer reviewed literature, and the study will have to look into this so-called grey literature as well as the traditional research literature. Furthermore, because we aim to include sites that are similar to one of the two EHR systems that are in acquisition or implementation in Norway, a categorization is required in order to select hospital locations of interest. Therefore, the categorisations of different EHR systems in this study is a pragmatic attempt to relate to one of the two systems that are being implemented in Norway, and by no means a proposed global taxonomy. In order to achieve its goal, the project is designed to contain three phases: scoping review, interview with mid-level manager staff in hospitals and finally, a survey from clinical hospital staff.

5.1. Scoping study

The scoping study methodology is in most applications well suited for rapidly mapping key concepts, and flexible enough to include both research literature as well as other evidence that are relevant for a research question [13]. In the present project, the first step is to formulate the research question, then identify relevant studies and other evidence and make a selection. Finally, the evidence will be charted and summarized. The scoping procedure will resemble the stages proposed by Arksey and colleagues [14]. The review is designed to identify recurring themes and trends in the literature.

5.2. Interview with mid-level manager staff in hospitals

Interviews are conducted at minimum two, preferably four, hospitals in Europe. We aim to visit hospitals that adhere to different concepts of EHR-solutions- with respondents at the head of department level. The interview will be conducted in a semi-structured fashion. The questions will be open-ended and similar between hospitals, and the interviewees will be invited to elaborate on themes that they deem important. Qualitative data collected from the interviews will be analysed using the Framework Method [15]. Interviews will be recorded in audio and transcribed verbatim, and the transcripts independently read by each member of the research team. Interesting segments of text are then underlined and assigned to a label, to categorize which part of the research questions they are relevant to. Secondly, the research teams meet and present their suggested labels- and the following discussion results in a set of consensus-based codes. The resulting analytic framework is applied to all interviews, by assigning appropriate codes to each meaningful passage of text. Thirdly, the resulting data is summarized in a framework matrix using spreadsheets. Finally, the qualitative data in the framework matrix is reviewed to identify common themes [16].

5.3. Survey

A short questionnaire will be created to survey the clinical staff's perceptions of the EHR. It will be distributed in a digital format. In order for the questionnaire to have minimal interference with the schedules of the clinicians, the questionnaire will be designed to

take a maximum of five minutes to complete. The questionnaire will be based on the System Usability Scale [17], in addition to approximately three items based on recurring themes that were identified in the interviews, and a free text section. The quantitative data from the survey will be summarized and presented descriptively, while the qualitative data from the free-text sections is analysed with a framework theory-based procedure, similar to the interview data.

6. Discussion

6.1. Limitations of the chosen methodological approach.

The methodology of the present project does not control for the effects of differences in implementation timelines of the EHR systems in the studied hospitals. The length of time from implementation is likely to affect the variables of interest in the present study, such as user satisfaction and adoption. Any attempt to make comparisons between hospitals should consider this limitation.

6.2. Risk of bias in respondents and study population

The interview respondents in the present study are not randomly selected, but are volunteers suggested by hospital administration or EHR vendors. There is a risk that the respondents have attitudes that are more positive towards their EHR systems than the hospital staff population in general.

7. Preliminary suppositions and implications

One of the most fundamental tools available for healthcare professionals and clinicians are the functionality provided through the IT systems in the hospital. A prerequisite for high quality and efficient treatment and care delivery are IT systems that are context sensitive, scalable, and with a high degree of usability and data interoperability [18, 19].

This study could contribute with new insight and understanding of the implications of fundamental concepts of the health IT portfolio from the end-user perspective. The growing market trends indicate substantial movement from the traditional megasuite scenario, towards an open platform-based ecology consisting of a multi-vendor system portfolio [20, 21]. This implies that the subject of the study has a high degree of topicality, and can be an important contribution for decision makers and hospital CIOs considering IT procurements.

An assessment of the consequences related to different platform designs can shed light on the implications the chosen technical approach will have on clinical and organizational practice. In addition, this study can constitute a basis for further research, possibly by conducting a more focused investigation on one of the themes that emerges in the present study, expand the number of respondents, or study a different aspect of EHR implementation.

Contributors

KMN and AJF conceived and designed the study and performed the initial investigation on the subject. KMN and AJF have been the main contributors to the manuscript. RP

have critically revised the manuscript and contributed insight on the method and discussion. All authors approved the final manuscript before submission.

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