

HYBRID ELECTRONIC HEALTH RECORDS

Tiago Pedrosa, Rui Pedro Lopes

Polytechnic Institute of Bragança, Bragança, Portugal

João C. Santos

DEE, Coimbra Institute of Engineering, Coimbra, Portugal

Carlos Costa, José Luís Oliveira

IEETA, University of Aveiro, Aveiro, Portugal

Keywords: EHR, PHR, Mobility, Hybrid EHR.

Abstract: The research related with digital health records has been a hot topic since the last two decades, producing diverse results, particularly in two main types – Electronic Health Records and Personal Health Records. With the current wider citizen mobility, the liberalization of health care providing, as well as alternative medicine, elderly care and remote patient monitoring, new challenges had emerged. These brought more actors to the scene that can belong to different healthcare networks, private or public sector even from different countries. For creating a true patient-centric electronic health record, those actors need to collaborate in the creation and maintenance of the record. In this work, the Hybrid Electronic Health Record (HEHR) is presented, describing how information can be created and used, as well as focusing on how the patient defines the access control. Some new services are also discussed.

1 INTRODUCTION

Digital health records has been under development on the last two decades, focusing on two type of records – Electronic Health Records (EHRs) and Personal Health Records (PHRs). The EHRs were defined and deployed mainly to cope with the requirements of the healthcare providers without considering the patient needs on the process. PHRs were created to enable a more active role by the patient in the creation and maintenance of his health record.

The idea of achieving a longitudinal patient-centered record that can enable health professionals to have an integrated view of the patient's clinical history is still an open challenge (Smith and Kalra, 2008). The liberalization brought a wide number of actors into healthcare provisioning, offering new procedures (Chanda, 2002) (enabling the patient to have free choice of the healthcare provider, access to new types of complementary and alternative medicine, among others). Also the citizen's mobility has increased, either for professional, personal or medical

reasons (EESC, 2007), leading to a huge number of different healthcare providers, public, private, federated, isolated, from different countries. Meanwhile the patient requires a more active role, controlling the access to his medical information and contributing to his record without compromising the choice of his healthcare provider (Eysenbach, 2008).

In order to achieve a record where all the actors could collaborate, this paper describes the Hybrid Electronic Health Record (HEHR), and how it is used in the creation of information, access control and new services support.

2 EHR VS. PHR

To clarify the HEHR, we begin by analysing the two main streams of records, EHRs and PHRs. The EHR can be described as a longitudinal storage of patient health information generated by one or more encounters in any care delivery setting (HIMSS, 2010a). This information may include several kinds of data such

as patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. The EHR has the ability to generate a complete record of a clinical patient encounter, as well as supporting other care-related activities directly or indirectly via external interfaces.

The information on EHRs is produced by healthcare professionals and maintained by the healthcare providers, following four types of models: the fully federated, federated, service orientated and integrated (NCRR, 2006). Moreover, each deployment in each country/region or federation uses different approaches under different regulatory frameworks. This, plus the lack of a well defined standard makes interoperability difficult (The Lancet, 2008).

EHRs are mainly devoted to facilitate the work and information flow between different departments of an institution or a federation. They also try to manage administrative information related to the admission, discharge and payments (The Lancet, 2008). This approach excludes any patient intervention, including the requirements analysis. In other words, it is a solution to cope with healthcare professionals needs, inside a well-defined group of actors, supported by agreements between them, to share patient clinical related information.

PHRs can be described as an lifelong tool for managing relevant health information of an individual (HIMSS, 2010b). It promotes personal information maintenance and may be used in a broader scope or in more specific scenarios, such as chronic disease management. The PHR is owned, managed and shared by the individual or a legal proxy(s).

Although different types of PHR have been developed the most relevant are: the standalone, resident in some external store device (Santos et al., 2010), and the web-based. The most prominent web-based PHR are Google Health, Microsoft HealthVault and Dossia. These web-based PHRs are generally based on a central repository and on a set of core features that, in some cases, can be extended by third-party services.

Table 1 resumes the main differences between EHRs and PHRs. According to the definitions and the method of deployment of those types of records, the PHR seems to better cope with most of the needs, as it enables the easily sharing between different actors despite of their location, agreements and depends on patient approval. It also solves the problem of the infrastructure cost, as the patient chooses a PHR provider. It also empowers the patient to maintain and control the access to his medical record. One drawback is the trust by the clinical staff on the integrity of the clinical information.

Table 1: EHR vs. PHR.

	EHR	PHR
Guardian	Providers	Patient or a service on his behalf
Creation of data	Medical Staff	Patient or exported by services
Sharing	Institutional agreements	Patient choice
Access Control	Provider	Controlled by the patient
System Provider	Providers	External Service Provider

The EHR has the trust of the medical staff however, record sharing is difficult. It also restricts the patient freedom of choice, since he is dependent on the agreements that providers have in order to access his medical information. In this scenario, the patient is a passive actor, since he cannot contribute to his record, and cannot control the access to his medical information. Mobility and EHR harmonization have been discussed previously (Pedrosa et al., 2010).

3 A NEW PROPOSAL FOR A HYBRID EHR

The Hybrid Electronic Health Record appears as a solution to overcome the problems identified previously, enabling the free collaboration of all the actors, controlled by the patient and with medical data integrity control. The hybrid approach tries to combine the best characteristics of the EHR and PHR, supporting contributions from several actors, and allowing access control by the patient, without dependency on agreements between healthcare providers.

For enabling the HEHR all actors are required to generate a report, considered as a contribution to the EHR. Those contributions can be generated from the already deployed systems, from user input or by specialized services. The aggregation of all contributions results in the patient-centric longitudinal electronic health record.

The HEHR is based in a centralized repository, trusted by the patient, to deposit all the contributions. The collaboration of all the actors is illustrated on Figure 1.

The access control is performed through the patient station, where he can also create contributions. Healthcare providers, such as hospital centers, laboratories and other medical centers, can contribute as well, exporting reports from their systems or using external services. Every contribution must be previously authorized by the patient. New services can manipulate the information as patient centered-services, e.g. prescription alarms or other treatment alarms; scien-

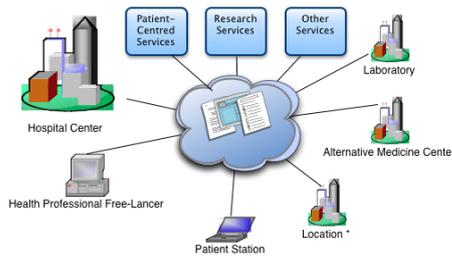


Figure 1: HEHR actors.

tific research, when allowed by the patient; and other new services that can bring added value to the use of patient clinic information.

Each new producer or consumer that wants to gain access to the patient EHR requires patient authorization. The clinical integrity of the contributions can be confirmed, increasing the trust on the system by the healthcare professionals.

3.1 Use Cases

On this type of record, three types of operation should be explained: the deposit of a contribution, the request of the record and how a new service can make use of the HEHR.

The operation of deposit of information can be decomposed in three steps (Figure 2). First a report in a standard format, such as CDA (Dolin et al., 2006), CCR (Ferranti et al., 2006) or OpenEHR archetypes (OpenEHR, 2007) is generated. Then those reports have to be signed by the producers to ensure integrity and traceability. The last step is the deposit of the information on a repository chosen by the patient, if the requester has enough privileges.

Scenarios with already deployed EHR systems should be able to generate the reports, sign and deposit in a seamless way. As an alternative, a local service could perform those steps on the healthcare provider behalf. If the provider doesn't have a deployed system, he can choose a service provider to create the contribution.

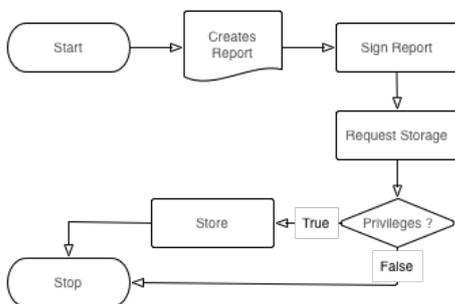


Figure 2: HEHR store procedure.

The retrieval process is explained in Figure 3. The actor requests the full record or parts of it. Then, the system checks the requesters' privileges and checks whether the requester wants the contributions individually or assembled as a unique view. Then the previously defined policies, created by the patient, are applied on the contributions set in order to create a filtered view for the requester. The possibility of asking for the contributions before unification allows creating custom views associated with a navigation model. The process of requesting access to the HEHR is de-

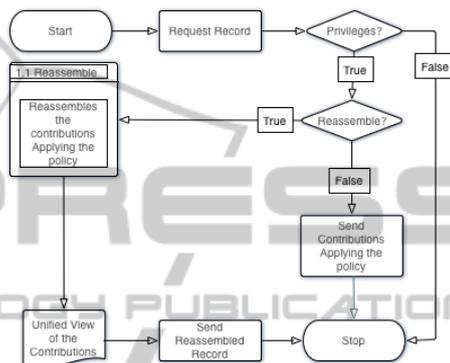


Figure 3: HEHR retrieve procedure.

defined in two main sub processes (Figure 4): the advertisement of a new actor providing a service and the procedure of a patient choosing a new service provider. In the former, the new service should generate a certificate and ask a Certification Authority to sign it. Then, the actor (services or healthcare professionals that want to deposit or access the information) creates a description of the service, sign and register it.

When a patient wants to use a new service, he searches the service, chooses the provider and validates the CA signature. Then, using the public certificate of the chosen service, the patient defines the policy for that actor, controlling what the service/actor can view or store in his record.

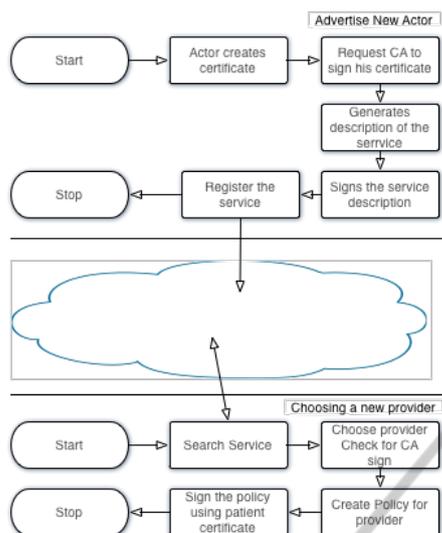


Figure 4: HEHR joining new actor.

4 CONCLUSIONS

The HEHR tries to create a true longitudinal patient-centric electronic health record, based on contributions from all actors that provide healthcare services to the patient. This open collaboration, controlled by the policies specified by the patient, can deal with his mobility and freedom of choice, since all they can easily join as patient collaborators. The bureaucratic sharing problem between actors is solved by the use of the patient consent. The healthcare professionals can trust in the clinical integrity, since it's signature can check all collaborations integrity.

Considering the features of the EHR and PHR (Table 1), the HEHR can be described as a collaborative record, which guardian is a service acting on the user behalf. With such kind of record, it is expected the deposit of more information, combining clinical information with other health related data, e.g. sport activity monitoring, athletic training programs, and other information produced by alternative medicine procedures. Moreover, new paradigms, such as home care, remote patient monitoring, and elderly care, can bring added value to the patient HR.

This paper presented the difficulty that two main streams of digital health records, EHR and PHR, have dealing with the challenges of patient mobility, freedom of healthcare providers choice, and liberalization of market. It also introduces a Hybrid Electronic Health Record, that empowers the patient with access control to his medical information, as enabling the access to new healthcare services. As a result, it establishes a longitudinal patient-centered electronic health record created by the collaboration of all the actors.

We are currently developing a framework to enable hybrid records, taking advantage of existing interfaces between EHR and PHR. Further work includes the implementation of a storage solution and the evaluation of data formats, such as XML serialization of CDA, CCR and OpenEHR archetypes.

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