Management of and Access to Virtual Electronic Health Records

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Introduction

eHealth digital libraries contain electronic artifacts that are generated by different healthcare providers (family doctors, laboratories, hospitals, etc.). An important observation is that this information is not stored at one central instance but rather under the control of the organization where data has been produced. The electronic health record of patients therefore consists of a set of distributed artifacts and cannot be materialized for organizational reasons. Rather, the electronic patient record is a virtual entity and has to be generated by composing the required artifacts each time it is accessed (Figure 1). The virtual integration of an electronic patient record is done by encompassing services provided by specialized application systems (e.g., CIS – clinical information systems, or PACS – picture archiving and communication system) into processes. A process to access a virtual electronic health record encompasses all the services needed to locate the different artifacts, to make data from the different healthcare providers available –given appropriate authorization and authentication–, to perform the format conversions needed, and to present the (possibly anonymized) result to a user (i.e., patient X accesses his virtual health record via web; it contains collected medical documents from different health care institutions. Or doctor W, a specialist for internal medicine, retrieves the automatically integrated information related to the coronary heart disease of his patient Y from several health care institutions). In addition to the patient-centric access to virtual health records, also disease-specific applications can be supported by means of processes. These disease-specific applications allow for epidemiological studies across a set of patients, comparisons, identification of similar diagnoses, etc. (i.e., medical scientist M would like to identify all patients that have similar pathological deviations in the X-ray of their lung than patient Z, for whom SARS has been diagnosed. Or the Ministry of Health needs a statistical overview about diagnoses and treatments during the last three years, in order to control the health system and –for civil protection– to prevent from dangerous sanitary situations).

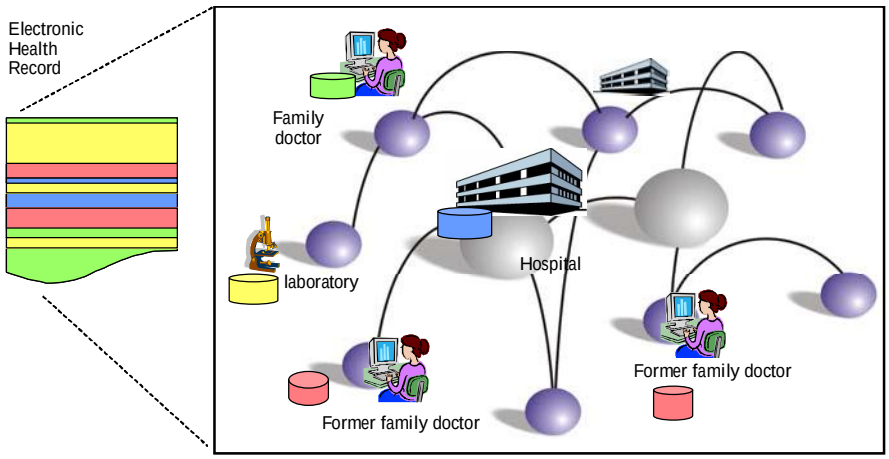

Figure 1: Electronic Health Record

Research Objectives

The realization of these goals first requires the availability of appropriate (web) services in order to access relevant data managed by specialized applications which are hosted by different healthcare organizations. In addition, common standards have to be supported to integrate these legacy applications (e.g., the PACS application where the X-rays of Y and Z are stored) or, alternatively, dedicated services are needed to transform the format of the data retrieved from one application so as to make is available for other, subsequent services. Second, an infrastructure to combine these services into processes is needed that is highly dependable and reliable. Physicians must be given the guarantee that the system and data is always available (i.e., by means of

replication) and that processes come to a well-defined end (e.g., by collecting all pieces of information that are of interest), even in case of failures. Third, the infrastructure has to provide a high degree of scalability, and to efficiently schedule the access to computationally intensive services by applying sophisticated load balancing strategies using grid technology. Physicians need information immediately, especially for patient-centric queries (but also for certain disease-specific queries), in order to make vital decisions. Hence, long response times due to a high system load cannot be tolerated. Consider the first disease-specific scenario above (the lung X-ray of patient Z) where similarity search across a potentially large set of documents is needed. In order to support this search, feature extraction has to take place for all documents/images, nearest neighbors have to be determined, etc. All these steps require significant computing power and should not be limited to the organization where the images are stored. Rather, additional feature extraction services should be installed automatically at hosts which currently feature a low load. Finally, the infrastructure has to allow for the transparent access to distributed data by means of appropriate (peer-to-peer) indexing techniques that avoid single points of failures as well as censorship and that, at the same time, preserve the privacy of data.

Expected Results

The main goal of this DELOS task is to identify, design, and build demonstrators for the basic building blocks needed to access virtual electronic health records, i.e., locate the different artifacts, make data from the different healthcare providers available, perform the format conversations needed, and present the result to a user. In particular, the basic building blocks to access distributed artifacts and to intelligently search within a set of these artifacts will be identified. Moreover, a dependable platform that supports the integration of these building blocks into processes will be provided, thereby realizing a system to manage virtual electronic patient records. Finally, sample building blocks and processes in combination with specialized application systems made available by HITT will be implemented. Examples of these building blocks are algorithms for format conversions (e.g., specialized formats that can be found in healthcare applications like DICOM or HL7), services for similarity search, relevance feedback, or replication.

Project Participants

The authors of this extended abstract are the members of this project. The partner institutions are:

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- Kuratorium OFFIS, Oldenburg, Germany
- National and Kapodistrian University of Athens, Greece
- Swiss Federal Institute of Technology (ETH) Zürich, Switzerland
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