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Web-based applications provide the power of desktop and server applications with the flexibility and accessibility of the web. Using web browsers, users can securely access applications from anywhere within the reach of the company intranet or extranet. The special issue strives to explore the advanced web-based information systems and database applications in healthcare area.

Healthcare organizations are undergoing major reorganizations and adjustments to meet the increasing demands of improved healthcare access and quality, as well as lowered costs. As the use of information technology to process medical data increases, much of the critical information necessary to meet these challenges is being stored in digital format. Web-enabled information technologies can provide the means for greater access and more effective integration of healthcare information from disparate computer applications and other information resources.

This book presents studies from leading researchers and practitioners focusing on the current challenges, directions, trends, and opportunities associated with healthcare organizations and their strategic use of web-enabled technologies. Managing healthcare information systems with web-enabled technologies is an excellent vehicle for understanding current and potential uses of Internet technology in the broad areas of healthcare and medical applications.

The covered topics include semantic web applications, workflow management systems, process management and workflow management systems, content management and portal technology, location-aware systems and mobile technology, prototypes of web-based information systems, data and web mining, access control and security in web-based information systems, web-based information systems and databases, transaction management over the web and tools for the implementation of web-based information systems.

This handbook is an excellent source of comprehensive knowledge and literature on the topic of distributed health and e-health applications.

All of us who worked on the book hope that readers will find it useful.

Athina A. Lazakidou, Ph.D.
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Chapter 1

Development and Evaluation of a Web-Based Personal Electronic Health Record (pEHR)

Vasileios G. Stamatopoulos, George E. Karagiannis, Michael L. Rigby, and Sophia Kossida

Abstract The objective of personal Electronic Health Record (pEHR) project was to investigate the deployment of an advanced web-based electronic health record service, tailored to the needs of the average European citizen while providing to healthcare professionals the means and the IT tools that will help them to be more effective in daily clinical routine. In this study, a web-based service that authenticates users, provides the personal electronic health record application and enables users to access and/or update their own medical information was developed. The system was evaluated across three different patient groups involving a total of 150 patients suffering from congenital heart disease, Parkinson’s disease and diabetes that were recruited from three different European hospitals. The results indicated the pEHR service to be an effective medium for the storage and management of data by different patient groups. Overall, the three patient groups and healthcare professionals considered the service to have comprehensive and valuable content, to be secure and user-friendly and to have a potential for further improvements while they preferred it to be sponsored free.

Keywords: Electronic Health Records · Web-based · Mobile Citizen · Stakeholder Groups

Abbreviations

pEHR personal Electronic Health Record
EHR Electronic Health Record

1.1 Introduction

The personal Electronic Health Record (pEHR) for the Mobile Citizen project aims to showcase the concept of an electronic health record (EHR) Internet-based system...
that empowers users to create and maintain, at their own responsibility, their pEHR in a user-friendly, interactive and secure way, while providing to the healthcare professionals the information technology tools that will help them to be more effective in their daily clinical routine.

In the past years, the efforts carried out towards the establishment of a common EHR for all citizens within Europe are numerous. However, factual implementation of a common structure and real progress on the area have been achieved mainly in the United States.

Medical information gathering is still done in many cases via paper support, but also there are some local implementations of electronic support. However, the mentioned EHR is neither common to all the practitioners and institutions nor standardized in any way. This means that although there is stored information in electronic format, there is not a common way to communicate it in an easy way among different national healthcare systems if necessary.

1.2 Service Description

1.2.1 Service Model

pEHR services will enable users to create and maintain a personal record in an on-going, user-friendly, interactive and secure way. Given its web-based nature, the proposed EHR will be easily accessible regardless temporal or spatial restrictions [1].

This service addresses the needs of the entire European population. The service users will be able to update their own health record with information regarding their current physical state (e.g. weight), diseases suffered from and relevant treatments (medication, operations, etc.), allergies and health-affecting habits (e.g. smoking or physical exercise). In addition, patients suffering from chronic diseases (e.g. diabetes, cardiovascular diseases, hypertension, etc.) will be able to store important indicators/parameters (i.e. blood glucose level, blood pressure, etc.) related with the state of their disease. Furthermore, the EHR may also contain results of diagnostic examinations in digital format, including diagnostic images such as CT, MRI, X-ray and others. To this end, any hospital or other diagnostic centre willing to provide this additional service to its patients should have an appropriate broadband access to the Internet in order to be able to upload the information to a patient’s EHR. Finally, clinicians will be able to record a diagnosis at the patient’s request.

The personalized information included in the healthcare record can be communicated, in an interactive way, to authorized healthcare professionals using three different authentication methods: (a) secure login using standard SSL and username and password, (b) a Smartcard and (c) an USB token. Nevertheless, the content of the EHR is the citizen’s own responsibility.

This service will be marketed to two different types of customers/patients. On one hand, the service will be available to all European citizens. On the other hand,
the service will also be offered to those organizations that could be interested in sponsoring the pEHR services for a specific group of citizens. These entities can be of a different nature, ranging from private companies to regional public healthcare administration, as well as health insurance companies.

1.2.2 Stakeholder Identification and Benefits

Different stakeholder groups are involved in the operation of the pEHR services. In general, the pEHR services will be paid by stakeholders that either have the role of the direct service recipient (that is the citizen/patient) or the intermediate service provider/beneficiary [2].

While pEHR principally targets the individual citizens/patients, other healthcare professional groups/organizations also belong in the potential pEHR users:

- Patient support organizations and self-help groups
- Doctors
- Healthcare organizations
- Insurance companies
- Pharmacies.

Apparently, pEHR enables the citizen/patient to create and update his/her own web-based medical records. Creating a consolidated electronic record, instead of having several local records of different format (e.g. paper or digital) and at different locations that do not communicate with each other, empowers pEHR users to preserve an integrated file that provides, at once, their clinical status and documents the acts of the professionals in a user-friendly, structured and standardized way.

pEHR systems contribute to the availability of medical information to authorized users and empower the patient to build a complete health record, thus enjoying enhanced mobility and autonomy in selecting the appropriate healthcare provider.

The healthcare professionals and service providers share with the patients the need for immediate access to all relevant clinical data necessary for any given situation, irrespective of time and location, especially in cases of emergency.

For the clinical decision to be accurate, the information must be complete and non-corrupted. pEHR enables good clinical practice in a safe manner since it provides access to a consolidated medical record and supplements the already available, yet in most cases incomplete, professional files.

To this end, clinicians can avoid duplication of activities (i.e. repetition of unnecessary diagnostic tests) and minimize medical errors (e.g. avoid prescription of certain drugs in case of allergies, etc.), while maintaining clinical efficacy and containing costs, especially in the case of the publicly funded healthcare. The above holds true for the insurance companies involved in the care-giving process.

Finally, pharmacists may also benefit from the portable patient records introduced by pEHR. They can review existing clinical information, thus avoiding the
supply of risky combinations of prescribed and over-the-counter products that may have lethal side effects to the patients/customers.

Given the increasing Internet penetration rates in the European population, the rising rate of healthcare professionals with online presence, the current technological advances and the health policy plans, pEHR has a significant potential on a pan-European level as a complete health record service for subscribed customers.

Within the broader healthcare settings that this service will operate, pEHR can be integrated or can communicate with existing, local health platforms and healthcare networks, as well as serve as the means to update current EHR systems in local settings.

pEHR combined with the European Health Insurance Card will facilitate patient mobility and medical travel. Moreover, pEHR can be linked to any e-Reimbursement, e-Prescribing and e-Booking applications utilized by healthcare providers.

1.3 Technical Implementation

1.3.1 Platform Components and Features

The pEHR platform setup was based on two pre-existing components: the Electronic Document Presentment Platform (EDPP – developed by INFORM) and the Virtual Patient Record (VPR – developed by ICCS).

The two modules offer supplementary functionality:

- Creation and management of parameterized EHR by the VPR
- Registration request management, service administration and security capabilities by the EDPP that is integrated and adjusted easily to specific client requirements.

The pEHR services are delivered over the Internet as a web-based interface. The pEHR platform is highly robust and scalable, mainly because it utilizes state-of-the-art XML and messaging technologies. The built-in infrastructure of the application framework includes a collection of XML-encoded resource files for the semantic interoperability of all application tiers and a set of software libraries for the manipulation of the business objects, messaging services and adaptive user interface construction support. Furthermore, this approach natively incorporates the HL7 standard specification, ensuring interoperability between heterogeneous systems, as well as explicit definition of health domain business processes and objects. The ultimate goal of the application framework is to provide a reliable tool for delivering scalable, highly customizable and robust applications for the healthcare sector, which highly benefit the pEHR service.