



**Workshop:
Patient Centered (Health) Care Solutions**

**An Electronic Patient Record Implementation Using Clinical
Document Architecture**

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Abstract

Healthcare is an increasingly collaborative environment involving a wide range of individuals and organizations with diverse perspectives and roles within a healthcare process. During this process, the medical staff of the healthcare organizations involved often need to have access to patient data that may be scattered across the health district's organizations, structured in multiple formats and with different semantics and stored in heterogeneous systems. The ability to readily access and exchange medical information is essential in improving the quality of the healthcare provided while reducing practice variability and patient care costs [.,]. An electronic patient record (EPR) system can provide integrated access to patient information by retrieving the dispersed patient information, transforming it into a common format using same semantics, storing it centrally and presenting it on authorized user request. With the widespread and rapid popularity of the Internet and the web, considerable attention has been paid to implementing EPR systems with the use of new web technologies. In addition, Clinical Document Architecture (CDA) is a document mark up standard that specifies the structure and semantics of clinical documents enabling clinical document exchange across and within organizations, facilitating clinical document management and compilation of an individual patient's clinical document into a lifetime EPR. Thus, recent web technologies and CDA can provide the appropriate technological infrastructure for the development of an EPR system.

In this paper, a prototype web-based EPR system is described that has been developed using recent web-based technologies and standards that supply the technological infrastructure to support interoperability among heterogeneous healthcare systems by defining, structuring and storing clinical documents and by timely, organized and seamless document access and exchange by and among authorized users. This EPR system was implemented on top of the healthcare organization's existing information systems using XML technology for data format, the XML-based Clinical Document Architecture (CDA) for structuring patient information in the form of clinical documents, the XML/SOAP protocol for exchanging clinical documents and web services for providing access to patient's clinical documents. In this system, the CDA release two was used that provides a single CDA XML schema for defining and structuring clinical documents. This prototype system was experimentally implemented in a Greek health district using the 'Gennimatas' District General Hospital of Athens (GDGHA) and two satellite health centres as the cases in point.

In this system, in the District General Hospital (DGH) and in health centres there exist a web server that receives HTTP requests to load web pages and to accept and send XML/SOAP messages, an application server that hosts the web pages, a database server that stores patient data and a local security server that enforces the district-wide security policy. In addition, at the DGH there exists a medical repository where patient clinical documents exist as XML documents and a district-wide security server that enforces the district-wide security policy while protecting the corporate intranet from external attacks by means of a district-wide intranet firewall. In this system, the security policy forced by the local security servers is a subset of the security policy forced by the DGH's security server. During healthcare delivery data accesses and application execution is controlled by the local security servers while web services execution and data accesses to the clinical documents existing at the DGH medical repository during web services execution is controlled by the global security server.

With regard to this architecture, a web service is made available to medical staff of the healthcare organizations that is responsible for retrieving patient clinical documents stored at the DGH medical repository. This web service functionality involves: retrieving from the XML/SOAP message received from the requesting organization the patient's identification data and the requestors criteria for patients medical data of interest, retrieving the patient clinical documents that match to the requestors criteria, unifying the retrieved XML clinical documents into a single XML clinical document and sending as a reply this XML document through XML/SOAP message. In this system architecture, the XML clinical documents existing at the DGH medical repository are created after the patient's exit from a healthcare organization where he/she received medical treatment. In particular, during a patients episode management from a healthcare organization the medical data produced is stored at the organizations database server as SQL data. On patient's exit from the healthcare organization this medical data is

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retrieved from the organizations database server and is transformed into an XML clinical document according to the CDA XML schema. This document is then sent to the DGH site as a SOAP encoded message where is deserialized and the resulting XML document is stored at the DGH medical repository. Then, the health districts Master Patient Index (MPI) is updated adding the XML documents unique identification number to the list of patients documents created during this particular episode management.

In this system implementation the Java programming language was used for writing the programs used in each healthcare organization for retrieving and transforming the patients data to XML clinical documents according to CDA XML schema, the IBM WebSphere environment for developing the web service, Sun's XACML implementation for implementing the security policies, OpenSAML Java implementation of the SAML specification for exchanging security information and Oracle 9i database server that supports the storage of XML documents.