

# XML Technology in support of Clinical Protocols for Teleconsultation

C. Chronaki, P. Lelis, M. Tsiknakis, S.C. Orphanoudakis

## Introduction

As medical teleconsultation is gradually taking its place among healthcare procedures, guidelines and protocols for clinical practice are incorporated to improve the efficiency and effectiveness of teleconsultation services. Furthermore, viewing the lifelong EHR as a collection of documents makes XML the natural choice for the exchange of patient information among healthcare organizations. In the context of a web-based collaboration environment, designed at ICS-FORTH, for integrated problem-oriented GP-to-expert teleconsultation, XML technology has been used to support clinical protocols and provide secure, extensible, customizable, and interoperable teleconsultation services.

## Materials and Methods

Since its adoption as a W3C recommendation in 1998, the eXtensible Markup Language (XML) and a number of related W3C recommendations (Namespaces, XPath, XSLT), notes (XML-Data Reduced), and working drafts (XML-Schema, XPointer, XLink) are shaping the future of the web, providing simple, elegant, and scalable interoperability solutions. In the document-centric world of healthcare, XML's separation of document structure (Document Type Definition or XML Schema) from its presentation (Style Sheets) and its contents which typically reside in a database, seems to provide the solution to interoperability of healthcare documents. As a result, committees within standardization organizations in healthcare such as CEN/TC251, HL7, ASTM, etc. are currently working on recommendations for the use of XML in healthcare.

The first clinical protocol supported by the teleconsultation system was screening of patients with suspected acute myocardial infarction and was deployed between primary healthcare centers and a regional hospital in the island of Crete. Following discussions with a working group of physicians and medical experts, the clinical protocol was reflected in a set of customized HTML documents: the request form, diagnostic report, progress note, and discharge reports. Database integration was hardwired and terminology support was virtually non-existent. Thus, the ability to automatically process teleconsultation folders was very limited.

The demand for system extensions, support of additional protocols, reusability, and assessment presented XML technology as an attractive alternative to HTML. In the second version of the system, emphasis is placed on scalability, adaptability, reuse, and automatic processing. XML technology provided solution to all of these problems. XML schemas have been designed to reflect the structure of the various teleconsultation documents. Besides structure, the XML schema includes information that facilitates interoperability of the teleconsultation application with the health record archive. Namespaces have been created to identify and document the elements and attributes used in the various documents and link them to terminology sources when appropriate. In this way, documents associated with different protocols share meaningful elements and attributes, while promoting documentation, and reuse, and automatic processing. Finally, XSL templates have been designed to present the documents in an attractive way.

## Results

The adoption of XML technology for the definition, processing, documentation, and analysis of customized healthcare documents used in teleconsultation demands considerable time in terms of design and development which is gained in extensibility and adaptability. In the context of problem-oriented GP-to-expert tele-consultation services, XML technology has been successfully adopted to support clinical protocols in teleconsultation.

## Conclusions

Electronic healthcare documents may be rendered in many forms such as printed to paper or a computer

screen, stored in the tables of a database or transformed into other software representations such as messages or transactions. XML technology emerging from the convergence of data processing, communication, and publishing technology, addresses these issues and presents new opportunities for the representation and exchange of clinical information.